Energy Savings Assistance Program℠

CALIFORNIA INSTALLATION STANDARDS

Applicable to:

Pacific Gas & Electric Company
San Diego Gas & Electric Company
Southern California Edison Company
Southern California Gas Company
Southwest Gas Corporation
Liberty Utilities (CalPeco Electric) LLC
Golden State Water Company/Bear Valley Electric
PacifiCorp D/B/A Pacific Power
Alpine Natural Gas Operating Company

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California Installation Standards (IS) Manual

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1.0	May 2022	Update to incorporate modifications to existing measures, addition of new program measures, and code changes.

CALIFORNIA INSTALLATION STANDARDS

Prepared for:

Pacific Gas & Electric Company
San Diego Gas & Electric Company
Southern California Edison Company
Southern California Gas Company
Small Multi-jurisdictional Utilities:
Southwest Gas Corporation
Liberty Utilities (CalPeco Electric) LLC
Golden State Water Company/Bear Valley Electric
PacifiCorp D/B/A Pacific Power
Alpine Natural Gas Operating Company

For use by:

Installation Crews and Inspectors of the Energy Savings Assistance (ESA) Program

Prepared by:

Richard Heath & Associates, Inc.

NOTE: This manual was prepared under a use agreement with four California investor-owned utilities and the SMJUs. The accuracy of the material and the opinions expressed herein are the responsibility of the author and do not necessarily represent the views of PG&E, SDG&E, SCE, SoCalGas, or the SMJUs.

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INTRODUCTION

This manual provides written standards for the installation and inspection of measures and services administered by the California Utilities Energy Savings Assistance Program.

This manual for the installation and inspection of measures provides uniform, objective, clearly written, and illustrated standards. The standards serve as a benchmark for defining quality workmanship and a tool for measuring quality performance. *As such, this manual serves as a program resource when defining performance elements, training workers, and inspecting installations*.

In preparation of the manual, numerous regulations, codes, standards, training manuals, and manufacturers' specifications were reviewed. References to specific codes, laws, and regulations are provided for informational purposes only and are subject to change. The standards are intended to meet or exceed existing codes and regulations and to conform to accepted building practices. When a conflict exists between this manual, utility policy, and local codes, the more stringent requirement shall take precedence.

The research and preparation of this document has been provided by Richard Heath and Associates, Inc. under contract to four California investor-owned utilities and the SMJUs. In order to keep the manual current, we welcome your comments on an ongoing basis.

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ABBREVIATIONS AND ACRONYMS

AAMA	American Architectural Manufacturers Association
ABS	Acrylonitrile butadiene styrene
A/C	Air conditioner, air conditioning
ACCA	Air Conditioning Contractors of America
ACDD	Annual cooling degree days (also see CDD)
ACH	Air changes per hour
AC/HP	Air conditioner/heat pump
AFUE	Annual fuel utilization efficiency
AGA	American Gas Association
AHAM	Association of Home Appliance Manufacturers
AHDD	Annual heating degree days (also see HDD)
AHRI	Air Conditioning, Heating and Refrigeration Institute (formerly ARI)
ANSI	American National Standards Institute
ARI	See AHRI
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWG	American wire gauge
BEAR	Bureau of Electronic and Appliance Repair
BEF	Ballast efficacy factor
BOCA	Building Officials and Code Administrators International
Btu	British thermal unit

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ABBREVIATIONS AND ACRONYMS

Btuh	Btu per hour
°C	Degrees centigrade
CABO	Council of American Building Officials
Cal OSHA	California Occupational Safety and Health Administration
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, California Electrical Code
CFL	Compact fluorescent lamp
CFF	Compact fluorescent fixture
CFM	Cubic feet per minute
CFM_{25}	Cubic feet per minute of airflow at 25 pascals of pressure
CFM_{50}	Cubic feet per minute of airflow at 50 pascals of pressure
CFR	Code of Federal Regulations
CMC	California Mechanical Code
CO	Carbon monoxide
COP	Coefficient of performance
CPC	California Plumbing Code
CPSC	Consumer Products Safety Commission
CPVC	Chlorinated polyvinyl chloride (also see PEX)

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ABBREVIATIONS AND ACRONYMS

CRC	California Residential Code
CSD	California Department of Community Services and Development
CSA	Canadian Standards Association
CVA	Combustion and ventilation air
CZ	Climate zone
DOE	United States Department of Energy
DTSC	Department of Toxic Substances Control
DV	Direct vent
EER	Energy efficiency ratio
EF	Energy factor
EPA	Environmental Protection Agency
°F	Degrees Fahrenheit
FAU	Forced air unit
fpm	Feet per minute
fps	Feet per second
FS	Federal specifications
FSK	Foil/scrim/kraft (paper)
FVIR	Flammable vapor ignition resistance
GAMA	Gas Appliance Manufacturers Association
GFCI	Ground fault circuit interrupter
gpm	Gallons per minutes
HACR	Heating, air conditioning, and refrigeration

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ABBREVIATIONS AND ACRONYMS

HCD	California Department of Housing and Community Development
HDD	Heating degree days (also see AHDD)
HERS	Home Energy Rating System
HP	Heat pump
HP	Horsepower
HPD	Heat-producing device
HSPF	Heating seasonal performance factor
HUD	U.S. Department of Housing and Urban Development
HUD MHCCS	HUD Manufactured Home Construction and Safety Standards ("HUD Code" for mobile homes)
HVAC	Heating, ventilation, and air conditioning
HVACR	Heating, ventilation, air conditioning, and refrigeration
HVI	Home Ventilating Institute
Hz	Hertz (equivalent to cycles per second)
IA	Independent Certification and Inspection Agency
IAPMO	International Association of Plumbing and Mechanical Officials
ICBO	International Conference of Building Officials
ICC	International Code Council
ID	Inside diameter
IGC	IAPMO Guide Criteria
IGU	Insulated glazing unit
IMEF	Integrated modified energy factor
IOU	Investor-owned utility

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ABBREVIATIONS AND ACRONYMS

IS	(California) installation standards
IWC	Inches of water column (the same as IWG)
IWF	Integrated water factor
IWG	Inches of water gauge (the same as IWC)
KBtuh	1,000 Btuh (see Btuh)
KHz	Kilohertz (see hertz)
LED	Light emitting diode
LIHEAP	Low Income Home Energy Assistance Program
MHR	Minor Home Repair
MUD	Multi-unit development (multi-unit dwelling)
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NFRC	National Fenestration Rating Council
NFVA	Net free venting area
NGAT	Natural gas appliance testing
NIM	Non-infiltration measures only (or no infiltration measures)
NOx	Generic term for mono-nitrogen oxides NO and NO_2 (nitric oxide and nitrogen dioxide)
NPT	National pipe thread taper
NSF	NSF International
OC	On center
OD	Outside diameter

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ABBREVIATIONS AND ACRONYMS

OSHA	Occupational Safety and Health Administration
P&P	Policies and procedures
Pa	Pascal
PEX	Cross-linked polyethylene
PG&E	Pacific Gas & Electric
PIR	Passive infrared
ppm	Parts per million
psf	Pounds per square foot
psi	Pounds per square inch
PTAC	Packaged terminal air conditioner
PVC	Polyvinyl chloride (also see CPVC and PEX)
REIK	Retrofit electronic ignition kit
RTV	Room temperature vulcanization (e.g., RTV silicone)
SDG&E	San Diego Gas & Electric
SEER	Seasonal energy efficiency ratio
SHGC	Solar Heat Gain Coefficient
SMJU	Small Multi-Jurisdictional Utility (includes Southwest Gas Corporation, Liberty Utilities (CalPeco Electric) LLC, Golden State Water Company/Bear Valley Electric, PacifiCorp D/B/A Pacific Power, and Alpine Natural Gas Operating Company)
SoCalGas	Southern California Gas Company
SPS	Smart power strip(s)
T&P valve	Temperature and pressure relief valve
TDH	Total dynamic head

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ABBREVIATIONS AND ACRONYMS

TFE	Tetrafluoroethylene
TPE	Thermoplastic elastomer
TXV	Thermal expansion valve
UBC	Uniform Building Code
UL	Underwriters Laboratories
UMC	Uniform Mechanical Code
UPC	Uniform Plumbing Code
US	Ultrasound
UV	Ultraviolet
VA	Volt-amperes
VAC	Volts alternating current
W	Watts
WC	Water column (the same as water gauge)
WG	Water gauge (the same as water column)
WHF	Whole house fan

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DEFINITIONS

Abandoned appliance A natural gas combustion appliance that is no longer used and has been removed from service and (a) the flexible gas connector has been removed and (b) the gas line shutoff valve has been capped or the valve has been removed and the pipe capped.

Air-free (CO) A CO measurement taken with a test instrument that calculates the amount of CO ppm without the presence of excess air. The amount of oxygen in the combustion gas is taken into account by adjusting the as-measured CO ppm value to simulate oxygen-free conditions in the combustion gases.

Air sealing/envelope Includes caulking, outlet cover plate gaskets, evaporative cooler cover, air conditioner cooler cover, attic access weatherstripping, and minor home repairs—which include repairs such as ceiling repair, cover plates, door jams, door patch/plate, door replacement, exhaust fan vents, exterior wall repair, foam wall patch, interior wall repair, glass replacements, glazing compounds, lock sets (exterior door) windowsill repair, thresholds, vent repair and alignment, and window repair.

Appliance line valve (appliance shutoff valve) A manual gas shutoff valve installed between the gas supply line and the flexible gas connector for an appliance. It must be located within six feet of the appliance it serves. The flexible gas connector must be completely in the same room as the appliance to which it is connected.

As-measured (CO) The measured CO ppm from a sample of combustion gases with no regard for the amount of excess air diluting the CO concentration. The test instrument does not perform a calculation to account for oxygen in the combustion gases.

Astragal A vertical strip that spans the gap between the two meeting edges of double doors (e.g., French doors). The astragal attaches to a stile on one of the doors

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and provides a surface against which the other door closes and seals.

Automatic door bottom

An air-sealing device installed at the bottom of a door on the interior. A carrier with a pliable gasket on the bottom slides down to contact the floor or threshold when the door is closed, and it slides up to clear the floor/covering when the door is opened. It may be used when a shoe-and-saddle combination is not feasible. (This is different from a "flip sweep" that pivots to move up and down, which is *not* an approved material.)

Automatic gas shutoff valve

An automatic safety device that is installed on some gas water heaters to protect against overheating by shutting off the gas supply when water in the tank reaches a preset level, typically 210°F. It shuts off gas to the water heater and prevents the burner from lighting. Code requires that a separate pressure relief valve also be installed somewhere in the cold water supply line.

An automatic gas shutoff valve (such as a "Watts-210") may be used on water heaters instead of a temperature and pressure relief valve. This is done in locations where a gravity drain line to the outdoors cannot be installed (e.g., interior locations in multi-family units and in basements).

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:

- duct system return leaks in the vicinity of the appliance, and/or
- the excessive influence of mechanical systems exhausting air from the structure (e.g., bathroom or utility room exhaust fan, range hood fan, clothes dryer, built-in vacuum system, etc.).

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DEFINITIONS

Btuh

The Btuh input rating of a combustion appliance is a measure of the quantity of energy from fuel that is consumed by the burner.

- It is possible to "clock" the gas meter (as described in WIS Appendix F, Step 4.2, "Clocking the Gas Meter"). With that information, determine the volume of gas being consumed by the burner and calculate the Btuh input rating of the appliance.
- For simplicity, large Btu ratings can be referred to as "kBtuh," which is "thousand Btuh" (1,000 Btuh = 1 kBtuh). Thus, the rating of a 90,000 Btuh input furnace can be expressed as "90 kBtuh."

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.

Carbon monoxide (CO)

A gas produced as a byproduct of the combustion process.

Chlorinated polyvinyl chloride

Chlorinated polyvinyl chloride (CPVC) is used to make water pipe. (PVC pipe is similar, but CPVC better reduces scaling. CPVC is usable for both cold and hot water lines, but PVC is only usable for cold water.)

Also see PEX, another type of plastic pipe now commonly in use for water plumbing.

Closure system

See "duct closure system."

CO

See "carbon monoxide (CO)."

Combustion air

The total amount of air provided to the space that contains fuel-burning equipment; it includes air for fuel combustion, for draft hood dilution, and for ventilation of the equipment enclosure.

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DEFINITIONS

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.

Confined space

A room or space having a volume *less than* 50 cu. ft. per 1,000 Btuh of aggregated input rating of all fuel-burning appliances installed in that space. Only space- and water-heating appliances were included until 2008, when the CMC added cooking appliances.

Also see “unconfined space.”

Conventional home

A site-built dwelling unit (in contrast with a factory-built “manufactured” or “mobile” home). It can be a single-family or multi-family dwelling unit.

Cross-linked polyethylene

See “PEX.”

Duct 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, heat-activated tape, or mastic with fiberglass mesh reinforcement). Closure systems for non-metallic flexible ducts also include one or more drawbands.

Drawband

A device that 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.

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DEFINITIONS

Duct system	All ducts, duct fittings, plenums, and fans assembled to form a continuous passageway for the distribution of air.
Envelope sealing	See “air sealing/envelope.”
Excess air	Excess air is the amount of oxygen in the combustion gases that exceeds the exact amount needed for complete combustion.
Factory-built housing	See “modular home.”
Fluorescent torchiere	A torchiere is a tall (five- to six-foot), free-standing floor lamp with a weighted base. The word “torchiere” indicates a “torch-style” lamp with an upward-facing, bowl-shaped reflector on top. A fluorescent torchiere uses a fluorescent lamp of any type or configuration (D-lamp, PL-lamp, etc.).
Forced air unit (FAU)	That portion of a central heating and/or air conditioning (A/C) system that contains the air handler (blower section). In a “split system,” it is the furnace. In a “package unit,” the combination heating and/or A/C unit may be referred to as the FAU.
Gas meter set assembly	The components surrounding the gas meter, which include the service riser, gas meter, and regulator. The required clearance extends outward in accordance with utility policy.
Gas shutoff valve	See “appliance line valve (appliance shutoff valve)” and “automatic gas shutoff valve.”
Halogen (quartz halogen)	A type of incandescent lamp that is very compact and puts out high-intensity light and heat. Quartz halogen torchiere lamps are very hot and can ignite flammable materials that come close to the lamp (bulb). They also consume much more energy than fluorescent lamps, which is why existing quartz halogen torchiere lamps are exchanged for replacement compact fluorescent models.

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DEFINITIONS

Heat-activated tape

Metallic tape with an adhesive coating that is activated and cured by the application of heat and pressure. Heat-activated tape is used only to seal joints in a rigid fiberglass duct system.

HERS Rater

A person trained and certified to perform home energy rating services.

High-efficacy, High-efficacy lighting

Title 24 specifies that new and replacement lights in bathrooms, garages, laundry rooms, and outside on the front porch generally must provide “high-efficacy” lighting. At least half the wattage in kitchens must be from high-efficacy light fixtures.

“High-efficacy” generally means "fluorescent" lighting, because the amount of light produced per watt of electricity is much higher than with incandescent bulbs. To ensure that lighting is “high-efficacy,” fixtures must be “pin-based” rather than “thread-based,” as explained below in “Pin-based CFL.”

Inaccessible appliance

A natural gas combustion appliance that cannot be accessed for NGAT testing due to a locking passage or a physical impediment. Examples include, but are not limited to:

- Water heater in a locked room/enclosure for which a key is not available,
- Attic-mount furnace that requires entry through an inaccessible MUD unit,
- Floor furnace in a crawlspace with inadequate clearance.
- Floor furnace may also be inaccessible because it has been turned off and covered over by plywood or attached floor covering (e.g., wall-to-wall carpet or vinyl).
- Floor or wall furnace may be inaccessible because it has been turned off and blocked by heavy furniture (e.g., a hutch or cabinet).

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Infiltration-reduction measure (infiltration measure)	Any measure that can alter the air infiltration rate in the living space. Infiltration-reduction measures are primarily shell sealing measures, but duct sealing is also included.
Inoperable appliance	A natural gas combustion appliance that cannot be operated without first performing service or repair.
Investor-owned utility (IOU)	Investor-owned utilities in California are Pacific Gas & Electric Co., San Diego Gas & Electric Co., Southern California Edison, and Southern California Gas Co.)
Labeled	Equipment or materials that have been labeled by a nationally recognized testing agency. The agency maintains periodic inspection of the production of labeled equipment or materials, and labeling indicates compliance with nationally recognized standards. Also see “listed, listing” and “UL classified, labeled, listed, recognized.”
Lapped seam	The seam (joint) formed where two pieces of material (usually sheet metal) are overlapped.
Listed, listing	Equipment or materials included in a list published by a nationally recognized testing agency (e.g., UL, Intertek ETL, Warnock Hersey ETL, CSA, etc.) that maintains periodic inspection of the production of listed equipment or materials. Listing indicates compliance with nationally recognized standards. Also see “labeled” and “UL classified, labeled, listed, recognized.”
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.”]
Luminaire	A complete lighting fixture. A luminaire includes the light source/lamp, the reflector for directing the light, an aperture/opening (with or without a lens/diffuser),

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the outer shell/housing, an electrical ballast, if required, and connection to a power source.

Manufactured home See "mobile home."

Mechanical inlet: An intake through which air is being drawn in by a fan, such as an evaporative cooler or window/wall air conditioner air intake.

Also see "nonmechanical inlet."

Mini-split air conditioner or heat pump Mini-split units condition air like a central HVAC system, but they are much smaller and there are no ducts (they are "ductless"). They can be easily installed in almost any room, and their energy consumption is low compared to central systems. They are called "mini splits" because they are very small split systems.

- The outdoor condenser unit is relatively small, and the refrigerant lines and wiring come through the wall in a small-diameter conduit.
- The indoor air-handling unit is mounted on a wall in front of the conduit. The indoor unit looks like a wall-mount air conditioner or a PTAC, but it is surface-mounted rather than extending through the wall, and it does not contain a condensing unit. Some mini-split systems have several indoor units to condition multiple rooms (zones) in the home.

Minor home repairs Those corrections (that are not stand-alone measures) necessary to make possible installation of weatherization measures, reduce infiltration, or mitigate a hazardous condition. See "Minor Home Repair Policies" in the IS.

Mobile home ("manufactured" housing) "Mobile homes" are defined by HCD as having "over 320 square feet of gross floor area, more than 8 feet in width, and more than 40 feet in length." A mobile home is "manufactured housing" regulated by the HUD code (Sec. 3280). A mobile home is built on a trailer chassis and designed for highway delivery to a permanent location, and it can be a single-, double-,

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	or triple-wide home. It is different from a "modular home."
Modular mome ("factory-built" housing)	In California, "modular homes" are called "factory built housing" and are subject to Title 24 and the California Residential Code—not the HUD code. Alteration permits are issued/inspected by the local building department, not HCD. A modular home has framing characteristics similar to a conventional home and is built for permanent installation on a foundation. It is *not* built on a trailer chassis, it does *not* have axels, wheels or license plate, and it is transported in one or more sections on a dolly or trailer.
National pipe thread taper	National pipe thread taper (NPT) is a U.S. standard for tapered threads used on threaded pipes and fittings.
Net free venting area	Net free venting area (NFVA) is 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). NFVA = (total area of the opening) *minus* (the space occupied by the screen and/or louvers present in the vent). NFVA is typically expressed in sq. in.
No infiltration measures (NIM)	NIM means "**N**o **I**nfiltration **M**easures" may be installed. The most common cause for declaring a home NIM is the presence of an NGAT fail due to a combustion appliance hazard. When a home is NIM, only non-infiltration measures are installed.
Nonconforming	Usually used in reference to an appliance or component that does not meet code, such as an unlisted or improperly vented gas appliance or a vent pipe with improper termination or inadequate clearance to combustibles.
Nonmechanical inlet	A passive opening into the home, such as a window, door, or gravity inlet. Air movement is not influenced by a fan.

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Also see “mechanical inlet.”

NSF International

NSF International (NSF) is an organization that provides standards development, product certification, auditing, education, and risk management for public health and the environment. (Originally called National Sanitation Foundation, or NSF.)

Also see UL and CSA.

Occupancy sensor

An occupancy sensor is an electronic device that detects the presence of a person in the room/area where a light fixture is located and operates the fixture circuit. There are two types of occupancy sensors: ultrasonic sensors, which detect sound, and infrared sensors, which detect heat and motion.

To reduce unnecessary, wasteful operation of the fixture, the occupancy sensor does the following:

- Turns on the light when a person enters the area,
- Keeps the light on when occupancy is detected, and
- Turns off the fixture a set length of time after occupancy is no longer detected

Also see “vacancy sensor.”

Overcurrent protection

An electrical protection device (circuit breaker or fuse) designed to break (disconnect) the circuit if the current exceeds the amount for which the wiring and other components are designed.

Tamper-proof overcurrent protection (required when insulating over knob-and-tube wiring) is a circuit breaker or a special “S-type fuse.” An S-type fuse fits into a special threaded adapter permanently installed in the fuse socket. The adapter will accept only a fuse with the correct amperage rating, which prevents a fuse with too high a rating from being installed and possibly causing a fire from overheated wiring.

Package terminal air conditioner (PTAC)

A self-contained, non-ducted air conditioning unit that is normally mounted through an outside wall. It is

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usually larger than a typical wall-mount air conditioner and is most commonly seen in motel rooms and apartments.

Package unit

An air conditioner, or 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). A combination heating and air conditioning unit may also be called a "dual pack."

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 (how well moisture will pass through a vapor barrier).

PEX

PEX, or cross-linked polyethylene, is a material used to make water pipe.

Pin-based CFL

Pin-based CFLs plug in rather than screw in. The Title 24 Building Efficiency Standards require that some new and replacement light fixtures in California homes provide "high-efficacy" lighting. That usually requires installation of ENERGY STAR®-qualified pin-based CFL fixtures, which means thread-based (screw-in) lamps cannot be used.

- The high-efficacy requirement applies primarily to bathrooms, garages, laundry rooms, and outside porch lights. Additionally, at least half the wattage in kitchens must be from high-efficacy light fixtures.
- This requirement prevents thread-based CFLs from being installed and later being replaced with screw-in incandescent bulbs that fit the same size socket (but use four times the energy). Only pin-

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based lamps fit in pin-based fixtures, so installation of ENERGY STAR-qualified pin-based CFLs ensures that new and replacement lighting meets the high-efficacy requirement.

Also see “high-efficacy, high-efficacy lighting.”

Plenum

An air compartment or chamber, including uninhabited crawl spaces, areas above a ceiling, or areas 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.
- FAUs in garages and hallway closets often rest on a “platform” building cavity that constitutes the return plenum, referred to as a “platform return.”

Pressure-sensitive tape

Duct tape with a tacky adhesive coating (butyl, acrylic, etc.) that 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.

Type B or BW gas vent pipe

Double-wall vent pipe. Type B is round; type BW is shaped to fit inside a stud wall cavity and is used to vent wall furnaces.

Polyvinyl chloride

Polyvinyl chloride (PVC) is a material used to make plastic water pipe.

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DEFINITIONS

Qualified person (for combustion appliance service, repair, or replacement)

Qualified persons to work on natural gas combustion appliances include:

- C-20 (HVAC) contractor for furnaces and air conditioners
- C-36 (plumbing) contractor for water heater repair or replacement
- C-10 (electrical) contractor for electrical repairs
- Utility gas service technician for gas appliances

Quartz halogen

See “halogen (quartz halogen).”

Rodent barrier

A thin rigid or flexible material attached to the bottom of the floor supports (joists) of a mobile home to keep rodents out of the insulation and underfloor area (sometimes call the “bellyboard”).

Service/adjustment

Service/adjustment of an appliance entails providing services that are within the scope of the gas service department for customers in general.

Spillage

In a natural draft open combustion appliance, spillage is 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 not adequate to carry combustion gasses up through the vent pipe and outdoors.

- Brief spillage occurs when combustion begins in a cold appliance, because cold air in the vent pipe impedes exhaust flow until the system warms up.
- Occasional spillage may be caused by wind gusts creating pressure at the vent termination.
- Continuous spillage (an NGAT fail) may result when (a) the vent pipe is blocked by an obstruction or is improperly constructed, or (b) when there is excessive negative pressure in the appliance location.

A mirror or the sense of touch (e.g., back of the hand) is used to detect hot moisture, which will be present if

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combustion gases are “spilling” out through the draft hood opening.

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, interior closet, or basement), and the condenser unit (with coil, compressor, and fan) is installed outdoors, usually on a slab next to the house.

Also see “package unit.”

Substandard (construction)

A feature that does not comply with current code or the IS, or is unsafe or creates an unsafe (or hazardous) condition. Examples include the following:

- An unsound ceiling structure that will not support the weight of the installer plus added insulation—such as 2x4 joists 48" OC, bowed and sagging joists, or 1/4" drywall ceiling.
- A roof with improperly sized or spaced rafters that is sagging.
- Wall sheathing that is too thin and is weak or bowed.

Temperature and pressure (T&P) valve

A T&P valve, required on water heaters, which releases water (and thus relieves pressure) if either the temperature or pressure in the tank gets too high. Temperature relief is typically set at 210°F, and pressure relief at 125–150 psi. T&P valves must have a gravity drain line to outdoors.

Also see “automatic gas shutoff valve.”

Thermostatic shower valve

A valve installed in a shower that reduces water flow to a trickle when the water temperature reaches a preset level. Manual activation restores water flow. A thermostatic shower valve reduces energy waste when a person turns on the shower to warm up and leaves it unattended beyond the time required for hot water to reach the showerhead. It can be a separate component or built into the showerhead.

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Torchiere — See “fluorescent torchiere.”

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, or the joint around the perimeter where two rectangular ducts are joined together). (Note: *Transverse* means “across,” in contrast with *longitudinal*, which means “lengthwise.”)

UL Class 0 duct — Air duct materials that have 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, equivalent, labeled, listed, recognized

- UL classified means that UL testing was limited to examination of one potential hazard.
- UL equivalent means a product can be certified and "listed" by another accredited organization (e.g., Intertek ETL, Warnock Hersey ETL, CSA, etc.) who test products and certify conformance with established standards. Such products can thus be "listed and labeled" without reference to UL.
- UL labeled means that a product is either UL listed or UL classified.
- 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. Each UL recognized component is tested to a UL standard applicable to that component and is recognized for use in a UL listed product.

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DEFINITIONS

Unconfined space

A room or space having a volume of *at least* 50 cu. ft. per 1,000 Btuh of aggregated input rating of all fuel-burning appliances installed in that space. Adjacent rooms communicating directly with the space (through proper CVA vents, louvered doors, or openings without doors) are considered part of the unconfined space.

Also see “confined space.”

Unusually tight construction

Homes with a continuous vapor retarder, weatherstripping on operable windows and doors, and caulking in all gaps and openings in the shell.

Vacancy sensor

A vacancy sensor is turned on manually (does not come on automatically when a person enters the room). It keeps the light on when occupancy is detected, and it automatically turns off the circuit after occupancy is no longer detected.

Also see “occupancy sensor.”

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REFERENCED STANDARDS

AAMA 1701.2	Voluntary Standard for Utilization in Manufactured Housing for Primary Windows and Sliding Glass Doors
AAMA 1704	Voluntary Standard Egress Window. Systems for Utilization in Manufactured Housing
AAMA/WDMA/CSA 101/I.S.2/A440-2011 (R2016)	Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors
ANSI Z21.22-2015/CSA 4.4-2015	Relief Valves for Hot Water Supply Systems
ANSI Z21.71-1993 (R2016)	Automatic Intermittent Pilot Ignition Systems for Field Installation
ANSI Z97.1-2015	Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test
ANSI/AHRI 680 (I-P/2015)	Performance Rating of Residential Air Filter Equipment (formerly ARI 680)
ANSI/AHRI 681 (SI)	Performance Rating of Residential Air Filter Equipment
ANSI/ASME A112.18.1M	Plumbing Fixture Fittings
ANSI/ASME B1.20.1 (ASME B1.20.1-2013)	Pipe Threads, General Purpose, Inch
ANSI/BHMA A156.1-2016	Butts and Hinges
ANSI/SMACNA 006-2006	HVAC Duct Construction Standards—Metal and Flexible
ANSI/UL 935 (Class P, Type 1)	Standard for Fluorescent Lamp Ballasts
ANSI/WDMA IS 1	Interior Architectural Wood Flush Doors
ANSI/WDMA I.S.6A-13	Industry Standard for Interior Architectural Wood Stile and Rail Doors

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REFERENCED STANDARDS

ASCE 7-98	Minimum Design Loads for Buildings and Other Structures
ASME B1.20.7	Hose Coupling Screw Threads, Inch
ASME 112.18.1	Plumbing Supply Fittings
ASSE 1062	Temperature Actuated, Flow Reduction Valves for Individual Supply Fittings
ASTM C1311-14	Standard Specification for Solvent Release Sealants
ASTM C516-08 (2013)	Standard Specification for Vermiculite Loose Fill Thermal Insulation
ASTM C534/C534M-16	Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C549-06 (2012)	Standard Specification for Perlite Loose Fill Insulation
ASTM C665-17	Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C669-75 (1989)e1	Standard Specification for Glazing Compounds for Back Bedding and Face Glazing of Metal Sash
ASTM C726-17	Standard Specification for Mineral Wool Roof Insulation Board
ASTM C739-17	Standard Specification for Cellulosic Fiber Loose-Fill Thermal Insulation
ASTM C764-17	Standard Specification for Mineral Fiber Loose-Fill Thermal Insulation
ASTM C834-17	Standard Specification for Latex Sealants
ASTM C920-14a	Standard Specification for Elastomeric Joint Sealants

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REFERENCED STANDARDS

ASTM D870-15	Standard Practice for Testing Water Resistance of Coatings Using Water Immersion
ASTM D1785-15	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D2564-12	Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D2665-14	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM E84-17 (Also known as UL 723 and NFPA 255)	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E814	Standard Test Method for Fire Tests or Penetration Firestop Systems
CPSC 16 CFR Part 1209 (2002)	Interim Safety Standard for Cellulose Insulation
CPSC 16 CFR Part 1404 (2002)	Cellulose Insulation
CSA B1251	Plumbing supply fittings standards
Federal Specification A-A-378 (1979)	Commercial item description: Putty, Linseed Oil Type, for Wood-Sash-Glazing
Federal Specification HH-I-1972/1 (1981)	Insulation Board, Thermal, Polyurethane or Polyisocyanurate, Faced with Aluminum Foil on Both Sides of the Foam
HUD 24 CFR Part 3280	Manufactured Homes Construction and Safety Standards (MHCSS)
IAPMO IGC 244-2015	Tub and Shower Flow-Reduction Systems Standards

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REFERENCED STANDARDS

ISO 9001:2015	The internationally recognized standard for Quality Management Systems (QMS)
NFPA 90A	Standard for Installation of Air Conditioning and Ventilating Systems
NFPA 90B	Standard for the Installation of Warm Air Heating and Air-Conditioning Systems
NFPA 255	See ASTM E84-17
SDI 100	Specifications for Standard Steel Doors and Frames
T8 Section 1532.1 (CCR, Title 8, Section 1532.1)	Title 8, California Code of Regulations, Construction Safety Orders—Lead
T17 Section 36000 (CCR, Title 17, Section 36000)	Title 17, California Code of Regulations, Division 1, Chapter 8. Accreditation, Certification and Work Practices for Lead-Based Paint and Lead Hazards, Article 16. Work Practice Standards (Refs & Annos), §Requirements for Lea Hazard Evaluation for Public and Residential Buildings
Title 24 2019 Energy Standards	Building Energy Efficiency Standards for Residential and Nonresidential Buildings
UL 94	Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 181	Standard for Factory-Made Air Ducts and Air Connectors.
UL 181A	Standard for Closure Systems for Use with Rigid Air Ducts
UL 181A-P	Standard for Safety for Closure Systems for Use with Rigid Air Ducts and Air Connectors

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REFERENCED STANDARDS

UL 181B	Standard for Closure Systems for Use with Flexible Air Ducts and Air Connectors
UL 181B-FX	Standards for Safety for Closure Systems for Use with Flexible Air Ducts and Air Connectors
UL 507	Standard for Electric Fans
UL 723	See ASTM E84-17
UL 746A	Standard for Polymeric Materials—Short Term Property Evaluations
UL 746C	Standard for Polymeric Materials—Used in Electrical Equipment Evaluations
UL 900	Standard for Air Filter Units
UL 935	See ANSI/UL 935
UL 1363	Standard for Relocatable Power Taps
UL 1449	Standard for Surge Protective Devices
UL 1479	Fire Tests of Through-Penetration Fire-stops (Also see ASTM E814)

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MINOR HOME REPAIR POLICIES

Lead Paint Risk Factor
LOW-HIGH

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MINOR HOME REPAIR POLICIES

FOR THE CALIFORNIA INSTALLATION STANDARDS

1. Introduction

1.1. This preface describes the scope of Minor Home Repairs (MHRs) in the ESA Program.

a. MHRs are activities that are not separate measures, but instead make possible the installation of weatherization measures, reduce infiltration, or mitigate a hazardous condition.

b. MHR does not include non-functional appliance repair or replacement but may support the repair or replacement of these appliances.

c. MHR feasibility is determined by individual utility policy.

1.2. The comprehensive category called “envelope/air sealing measures” consists of both stand-alone measures and MHRs.

a. Stand-alone measures include:

- Caulking, cover plate gaskets, evaporative cooler and A/C vent covers, attic access weatherstripping, and door weatherstripping.

b. MHRs include:

- Ceiling repair, cover plates, door jambs, door patch/plate, door replacement, exhaust fan vents, exterior wall repair, foam wall patch, interior wall repair, glass replacement, glazing compound, lock sets on entrance doors, window sill repair, thresholds, vent pipe repair and alignment, and window repair.

1.3. The scope of each category of MHR range from simple envelope repairs to door replacement, the addition of new circuits and catastrophic leaks. These are further defined by the lists in items 2–10.

1.4. Envelope/air sealing measures:

a. Are installed by the utility supplying space heating fuel for the dwelling.

b. Are not installed when the home is NIM.

1.5. Repair work must comply with all local codes.

2. General Envelope Repairs

2.1. Small holes in interior surface of wall between conditioned and unconditioned space:

a. Repair holes 1" in diameter or smaller.

b. Repair holes between 1" and 6".

2.2. Interior holes that completely penetrate the envelope:

a. Holes shall be repaired.

b. Repairs shall be made with appropriate materials (e.g., drywall patch on drywall, wood patch on wood, etc.).

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2.3. Exterior Wall
   a. Patch stucco (up to 36 sq. in.).
   b. Replace missing siding.

2.4. Exterior holes that completely penetrate the envelope into the stud cavity shall be sealed.

2.5. Window repair
   a. Replace glazing compound.
   b. Replace glass.
   c. Replace sash[1].
   d. Repair or replace mullions/muntins[1].
   e. Install casing.

2.6. Patch envelope after appliance replacement
   a. Close-in wall/ceiling spaces created by appliance or vent replacement.
   b. Increase or decrease appliance opening or vent penetration.

2.7. New wood must be treated with a paintable sealer or primed.

3. Repairs to Mitigate Catastrophic Envelope Leaks

3.1. Large holes in interior surface of wall between conditioned and unconditioned space:
   a. Repair large portion of drywall or plaster (up to 12 sq. ft.).
   b. Replace drywall or wood panels (up to 50 sq. ft.).

3.2. Windows and doors
   a. Replace entire window[1]. (See IS Section 12, Window Replacement.)
   b. Replace entire door[1]. (See IS Section 11, Exterior Door Replacement.)

3.3. Abandoned vent/duct holes shall be blocked. A removable cover (e.g., "pie plate") shall be installed when feasible.

3.4. Kitchen ventilation openings shall not be closed off or sealed.

4. Repairs to Support Installation of Attic Insulation

4.1. Attic access/door
   a. Repair or replace access panel.
   b. Replace molding around access.
   c. Cut new access hole/opening (interior only and only between joists).

4.2. Reconnect duct

4.3. Seal return plenum

[1] Replaced only with program manager's approval on a case-by-case basis.

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4.4. Closet vent/ceiling
   a. Cover vent with flexible insulation.
   b. Install solid material to cover opening.

4.5. Retractable ladder
   a. Repair or replace attic access ladder.
   b. Install frame and/or cover.

4.6. Repair holes in ceiling.

4.7. Exhaust vent
   a. Repair/replace bath exhaust duct.
   b. Repair/replace kitchen exhaust duct.

5. Repairs to Support Weatherstripping and Caulking

5.1. Caulking preparation
   a. Install backer rod.

5.2. Door replacement
   a. Install door stops.
   b. Replace door.
   c. Replace door jamb.
   d. Plane bottom of door.
   e. Cut off bottom of door.
   f. Replace interior casing.
   g. Replace exterior casing.
   h. Replace complete pre-hung door unit.
   i. Adjust hinges.
   j. Replace hinges.
   k. Adjust loose screws.
   l. Replace lock.
   m. Replace existing night latch.
   n. Install/adjust strike plate.
   o. Threshold repairs/replacement.
   p. Install shim under threshold.
   q. Repair/replace subseal[2].
   r. Install new threshold.
   s. Seal threshold.
   t. Install riser.
   u. Install pre-hung door unit.

[2] Subseal is directly under the shim, which is directly under the threshold.

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6. Repairs to Install Attic and Crawlspace Ventilation

6.1. Gable vent
   a. Install new vent.
   b. Replace screen.
   c. Repair existing wooden vent.

6.2. Roof jack/dormer/foundation vent
   a. Install new vent.
   b. Repair existing vent.

6.3. Eave/soffit vent
   a. Clean screen.
   b. Replace screen.
   c. Install new vent.

7. Repairs to Support the Installation of Water Heating Measures

7.1. Covered items
   a. Install combustion air vent.
   b. Install faucet or showerhead adapter.
   c. Replace damaged or leaking faucets.

7.2. Condensate and T&P Relief Systems
   a. Replace/Install condensate lines.
   b. Replace/Install T&P valve and or lines.
   c. Replace drain pans.

8. Repairs to Mitigate Non-Appliance Hazards

8.1. Covered items
   a. Replace broken/cracked switch/outlet covers.
   b. Remove combustible and flammable materials from combustion air vent required clearance zone (may be performed as an NGAT function).

9. Repairs to Mitigate Natural Gas Appliance Fails

9.1. All appliances
   a. Repair gas leaks.
   b. Replace soldered gas connector.
   c. Alleviation of NGAT fails that cannot be corrected with service by utility gas service personnel (or designated representative)—including correction of the following conditions:
      - CO above the action level.
      - Inadequate draft and/or presence of spillage.

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- Vent system hazards.
- Flame interference.
- Use of an unvented appliance when a furnace is not present.

9.2. Furnaces
   a. Correct CVA deficiency.
   b. Clear covered CVA vent opening/screen (may be performed as an NGAT function).

9.3. Mobile home gas cooking appliances
   a. Correct kitchen exhaust defect.

9.4. Water heaters
   a. Correct CVA deficiency.
   b. Extend vent pipe if termination is too close to evaporative cooler. (Subject to individual utility policy.)
   c. Clear covered CVA vent opening/screen. (May be performed as an NGAT function.)

9.5. CVA vent/grille
   a. The NFVA of a vent/grille used for CVA shall be determined by one of the following criteria:
      - Requirements of the local jurisdiction.
      - IS Appendix A (Combustion and Ventilation Air Requirements for Natural Gas Appliances).
      - The manufacturer's NFVA label on the vent/grille.

10. Repairs to Support the Installation of Electric Appliances

10.1. All heat pumps and condensing appliances
   a. Replace/Install condensate lines.

10.2. Heat pump water heaters – Additional material
   a. Thermal expansion tank.
   b. Fused disconnect box.
   c. Condensate drain line (20')
   d. Vehicle barriers/bollards in garages.
   e. T&P valve drain line.
   f. Thermostatic mixing valve.
   g. Drain pan.
   h. Pipe insulation.
   i. Earthquake straps.
   j. Louvered doors.
   k. Upper and lower CVA vents.
   l. Intake/Exhaust duct.

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m. Installation of exterior appliance closet.
n. Relocation of water heater.
o. Expansion of existing appliance closet or the addition of a new closet.
p. Repair of deteriorated flooring.

10.3. Ductless mini split heat pumps
a. Removal of existing heating and/or air conditioning appliance.
b. Patching of holes created by the removal of existing appliances and ducts.

10.4. Central heat pumps and AC
a. Install structural supports.
b. Resize plenum and reconnect ducting system.

10.5. Upgrade electrical circuit
a. Install new circuit.
b. Install fused disconnect box.
c. Install subpanel for new circuit.

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CAULKING

Lead Paint Risk Factor
LOW

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SECTION 1 PREFACE
for

CAULKING

1. Nonfeasibility Criteria

1.1. The existing caulk is functioning properly, even if not installed in accordance with current installation standards.

1.2. Crack does not penetrate the building envelope.

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

1.4. In a MUD with heated hallways, gaps/cracks are in the wall separating the living space from the heated hallway.

1.5. Customer refuses.

2. Installation Policies

2.1. For homes with lapped siding:

a. Caulk shall be applied in standard locations such as door thresholds, door stops, and gaps between different materials, etc.

b. Seams between lapped siding must not be caulked.

2.2. When exterior caulking is required above the first story, it shall be applied whenever the area requiring caulking is readily accessible.

2.3. Contractor must comply with Proposition 65 requirements.

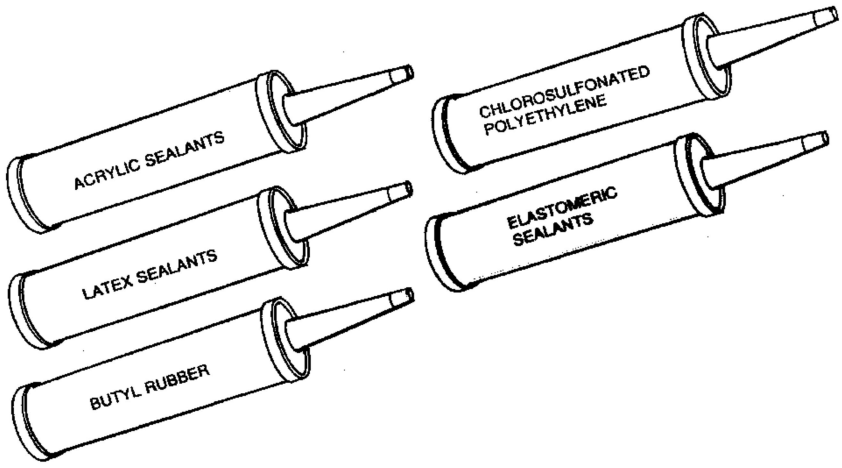
3. Installation Policies Specific to Mobile Homes

3.1. Caulking should be applied to the interior only, with the exception of exterior utility penetration.

CAULKING STANDARDS

1. APPROVED MATERIALS

- **All materials**
  - Sealants applied indoors shall be non-toxic.
- **Solvent release sealants**
  - Includes acrylic, butyl rubber, and chlorosulfonated polyethylene.
  - Conformance to ASTM C1311.
- **Latex sealants**
  - Includes latex, acrylic latex, and siliconized acrylic.
  - Conformance to ASTM C834.
- **Elastomeric joint sealants**
  - Includes polysulfide, polyurethane, and silicone.
  - Conformance to ASTM C920.
  - Neutral cure (oxime or alkoxy) for masonry applications.
- **High-temperature caulk**
  - Sealant rated for constant service up to at least 450°F (e.g., RTV silicone).
- **Foam sealant**
  - UL classified.
  - Class A or Class 1 per ASTM E84, NFPA 255, or UL 723.
  - Minimally expanding.
  - Fire-resistant foam: firestop or firelock foam compliant with ASTM E814 or UL 1479.
- **Bond breaker tape**
  - Polyethylene, polypropylene, PTFE, or closed-cell foam tape.
  - Self-adhesive backing.
- **Warranty**
  - Refer to IS Appendix F (Minimum Warranty Requirements).



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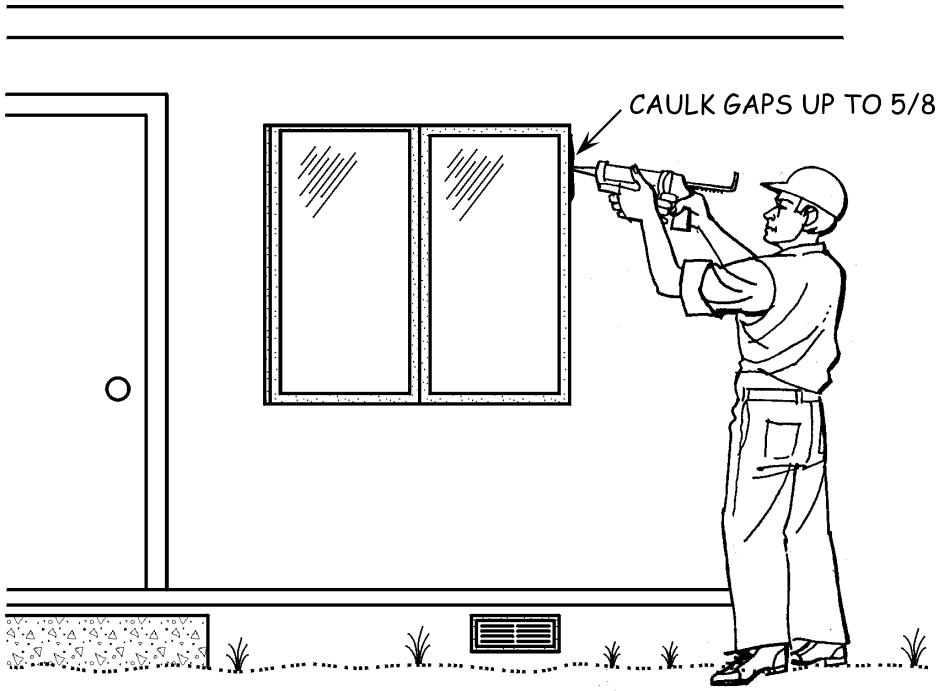
2. MATERIALS FOR EXTERIORS

- **For masonry, metal joints, and joints between two different materials, use:**
  - Elastomeric caulk with an elongation rating of at least 200%, or
  - Masonry caulk that is neutral cure, or
  - Paintable silicone.
- **Attic and crawl space**
  - Foam sealant may be left exposed.
- **Wood joints**
  - Elastomeric caulk or butyl.

3. MATERIALS FOR INTERIORS

- **All unpainted surfaces**
  - Caulk shall be nontoxic, paintable, and clear when dry.
- **All painted surfaces**
  - Caulk shall be nontoxic and paintable.
  - Clear when dry or color coordinated with interior surface.
- **Foam sealant**
  - Foam sealant shall not be left exposed, per UBC, Article 2602.4.



ELASTOMERIC CAULK FOR MASONRY, METAL, AND DISSIMILAR JOINTS

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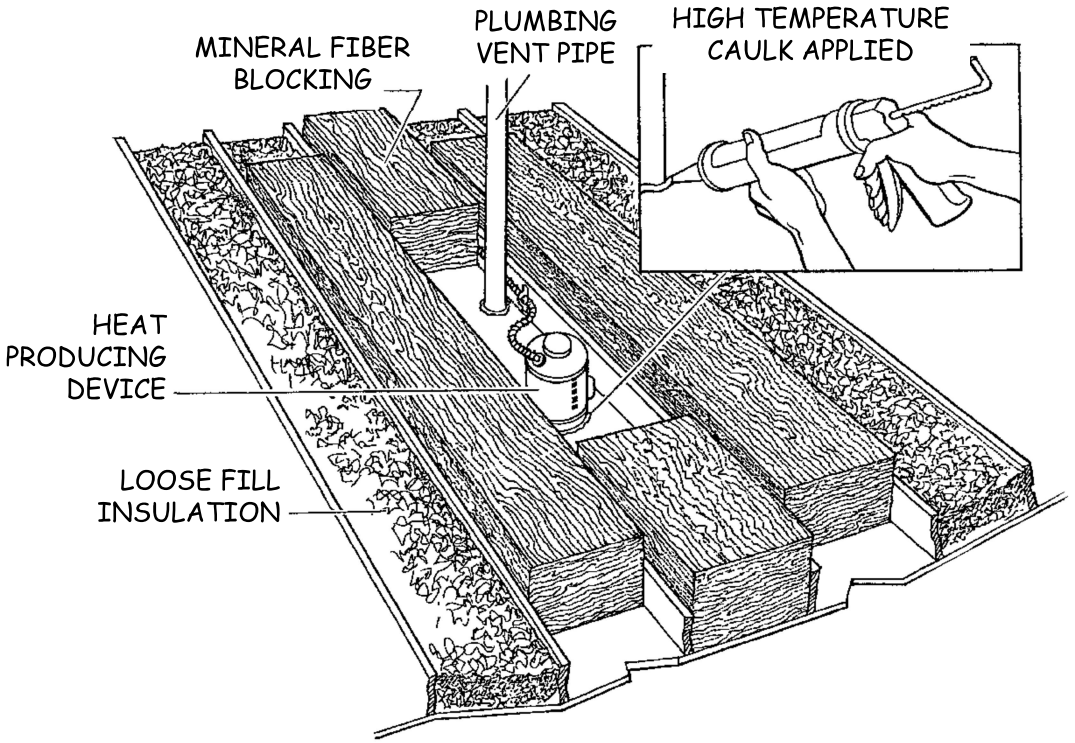
4. MATERIALS FOR VISIBLE LOCATIONS

- **Caulk shall be:**
  - Clear when dry or color coordinated with surrounding material and existing caulk.
  - Silicone may be applied neatly to a joint between dissimilar materials when required by specification.

5. MATERIALS FOR HEAT-PRODUCING DEVICES

- **All heat-producing devices**
  - High-temperature sealant shall be used.
- **Recessed lights**
  - Vent holes in recessed light canister shall not be sealed.
  - Caulk shall not be applied to decorative trim.



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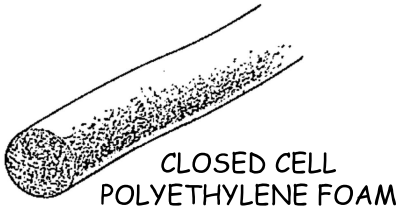
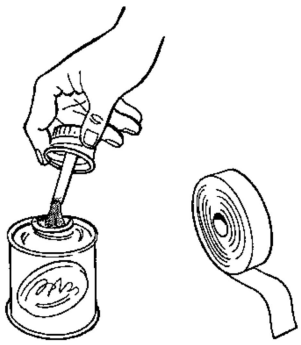
6. FILLER MATERIALS

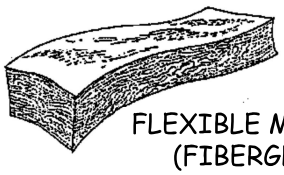
- **Filler material**
  - Acceptable filler materials include:
    - Closed-cell polyethylene backer rod.
    - Flexible fiberglass.
    - Rope caulk.

7. INSTALLATION REQUIREMENTS

- **Surface shall be free of:**
  - Loose or cracked caulking.
  - Dirt, debris, and oily substances.
  - Moisture, unless allowed by manufacturer's specifications.
- **Manufacturer's instructions shall be followed, with careful attention to:**
  - Surface preparation.
  - Application temperature limits.
  - Primer requirements (especially for metal and masonry surfaces).
  - Use of filler material (e.g., backer rod) and/or bond breaker tape.
  - Width and depth of bead.
  - Tooling recommendations.
- **Caulking priority**
  - Largest leaks shall be sealed first.
  - Caulking shall be applied to stop infiltration.







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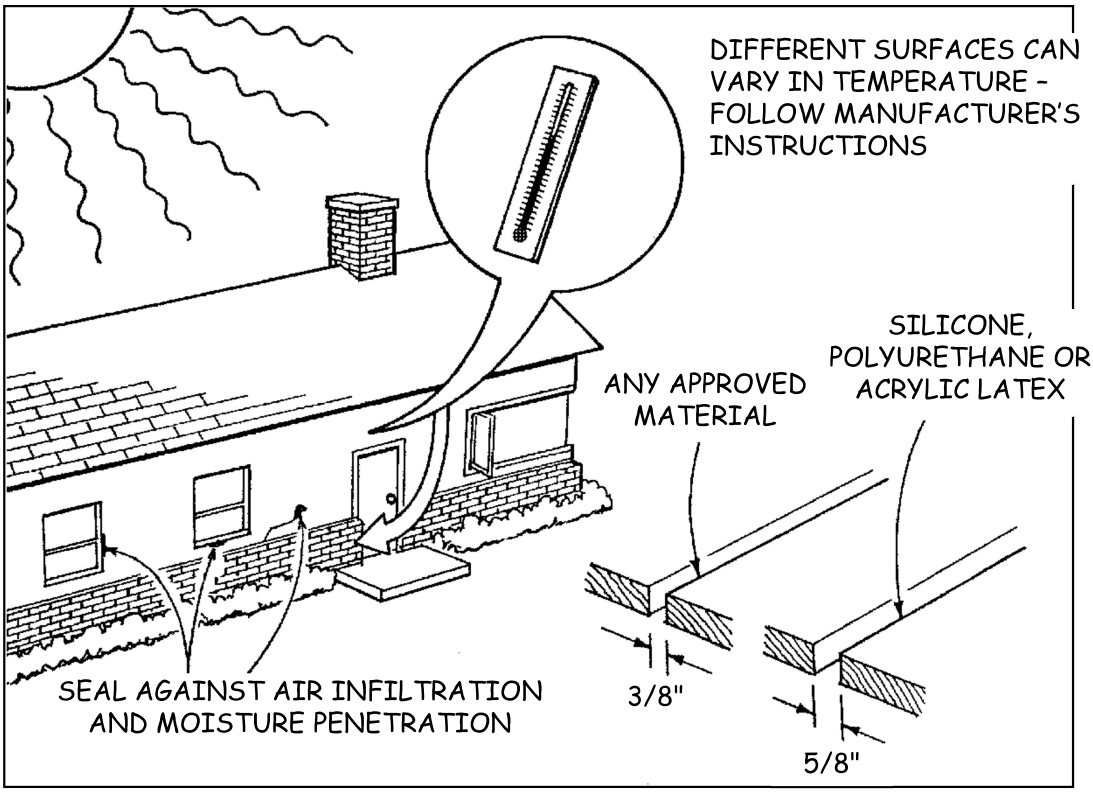
8. WIDTH OF GAP

- **Crack widths to be caulked**
  - Minimum crack width, 1/16".
  - Maximum crack width, 5/8".
- **Gaps up to 3/8"**
  - May be caulked with any material approved for the location and type of joint.
- **Gaps 3/8" to 5/8"**
  - Shall be filled with filler material before caulking.
- **Gaps larger than 5/8"**
  - Shall not be caulked; repair required.



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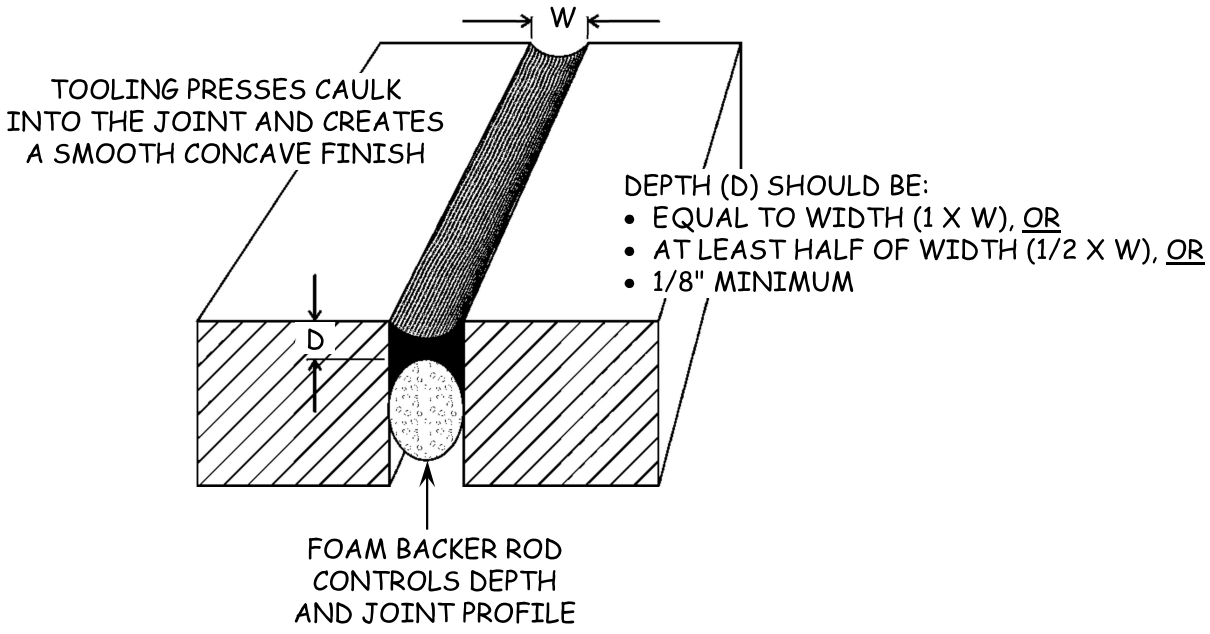
9. FINISHED BEAD

- **All joints**
  - Bead shall be continuous and free of voids and bubbles.
  - All excess caulk shall be removed (e.g., by tooling).
- **Butt joints**
  - Bead shall be at least 1/8" deep—but no deeper than it is wide.
  - Depth may be controlled by filler material (e.g., foam backer rod).
  - Gaps wider than 5/8" shall not be caulked; repair required.
  - Bead shall be tooled.
  - When filler material is not used and a bond breaker is recommended by sealant manufacturer, bond breaker tape shall be installed.



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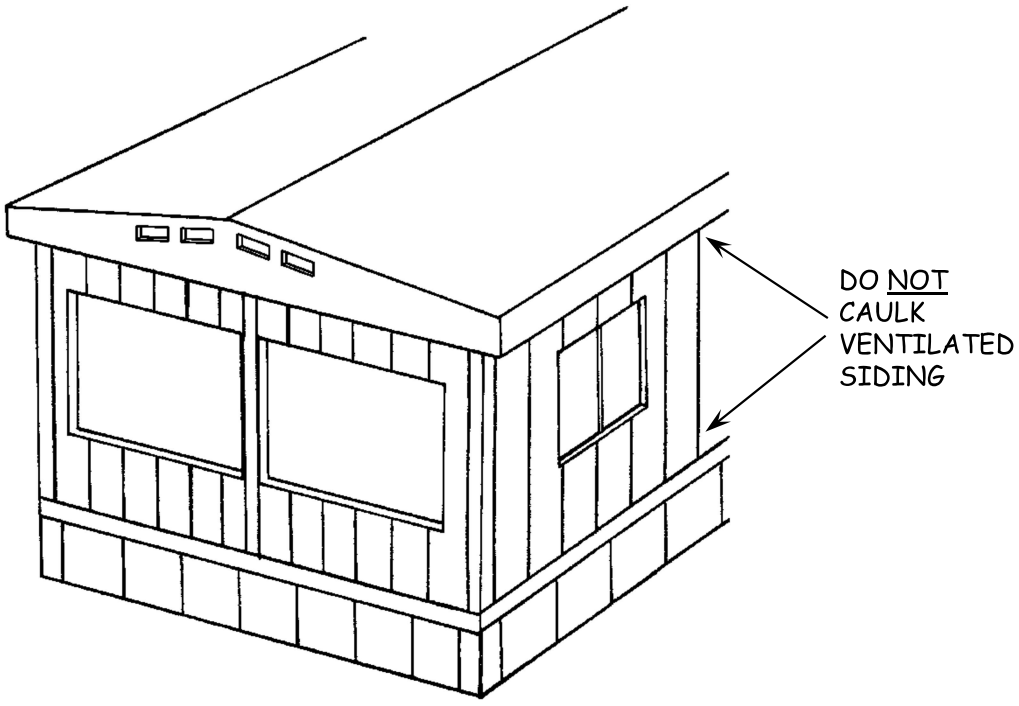
10. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up**
  - Paint dust and chips, scraps, and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Furniture and other household items moved for installation work shall be returned to their original positions.

MOBILE HOME CRITERIA

11. MATERIALS FOR MOBILE HOMES

- **Mobile home marriage line**
  - Elastomeric caulk.
  - Minimally-expanding foam (may be left exposed in the undercarriage area).
- **Location**
  - Caulking shall be applied to interior only.



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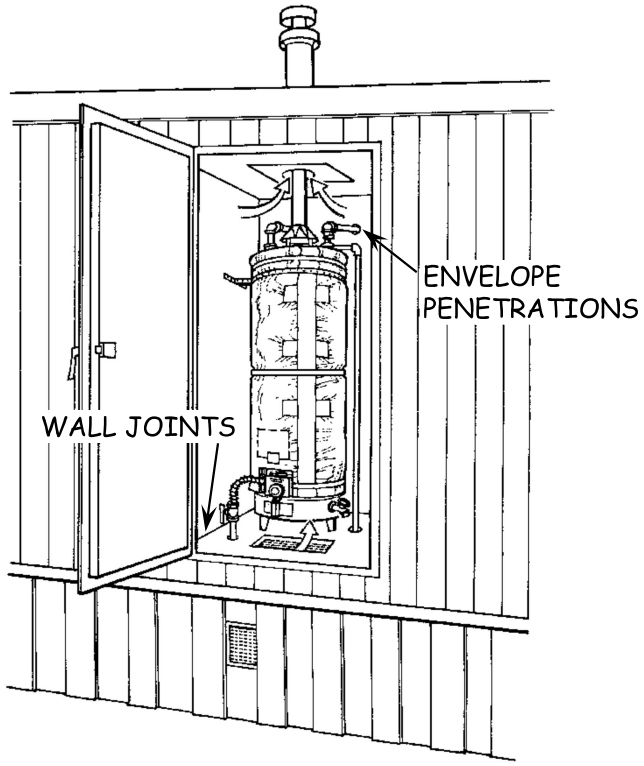
12. APPLIANCE ENCLOSURE WALLS AND EXHAUST DUCT PENETRATIONS

- **Cracks and holes shall be caulked as feasible or shall be repaired/patched:**
  - In furnace and water heater enclosures where products of combustion could leak into the living space.
  - At vent pipe penetrations (e.g., in ceiling above FAU).
  - Around penetration of exhaust fan duct (e.g., range hood duct through the ceiling).



SEAL LEAKS FROM APPLIANCE ENCLOSURE
INTO THE LIVING SPACE

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WEATHERSTRIPPING

Lead Paint Risk Factor
LOW

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SECTION 2 PREFACE
for

WEATHERSTRIPPING

1. Nonfeasibility Criteria

Doors

1.1. The existing weatherstripping is functioning properly even if not installed in accordance with current installation standards.

1.2. Door is located between two conditioned or two unconditioned spaces.

1.3. Door is in a multi-unit dwelling and separates the living space from a heated hallway.

1.4. Door and/or frame is labeled to have a fire rating that requires special weatherstripping, and installation of appropriate fire-rated weatherstripping is not feasible.

1.5. Functional storm door is present.

1.6. Customer refuses.

Appliance Closet Doors

1.7. Combustion appliance receives air from conditioned space (i.e., combustion air grilles present in the enclosure door or wall).

1.8. Combustion air being supplied to the appliance is inadequate (as defined in Appendix A), and adequate CVA cannot be added as MHR.

2. Installation Policies

2.1. Weatherstripping is feasible when there is no existing weatherstripping, or existing weatherstripping does not seal properly and cannot be adjusted to function properly.

2.2. When one or more pieces of the existing jamb weatherstripping do not seal properly, all three pieces shall be replaced (sides and head).

2.3. Existing Weatherstripping

a. Retrofit weatherstripping shall not be installed until existing faulty weather-stripping is removed.

b. On doors with factory-installed weatherstripping, removal of existing weatherstripping is not required if existing weatherstripping does not interfere with proper operation of the door and new weatherstripping.

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

2.5. A threshold shall not be installed if it will create a tripping hazard.

2.6. A retractable automatic door bottom may be used when the installation of a door shoe and threshold combination is not feasible for any of the following reasons:

a. Medical reasons, such as wheelchairs or walkers, require that the floor be as flat as possible.
b. Metal doors cannot be cut to accommodate a shoe.
c. 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.
d. Finished floor is ceramic tile. (A 100% seal at grout lines is not required.)
e. The installation of a proper threshold requires carpet cutting or repair to wooden or concrete sill.
f. The door is unusually expensive and might be aesthetically damaged by cutting.

2.7. Strike Plates

a. A strike plate may be installed when required to properly adjust weather-stripping under the following circumstances:
   - The strike plate is missing.
   - The screw holes in the jamb are stripped and the standard strike plate cannot be properly adjusted. A larger strike plate (e.g., "heavy duty" 4-7/8" x 1-1/4" may be installed.

2.8. Movable Sweeps

a. The only type of movable sweep allowed is a retractable automatic door bottom, which moves up and down vertically when the door opens and closed.
b. Flip sweeps (which rotate up and down) are <u>not</u> allowed.

2.9. Stationary Sweeps: A stationary sweep may be used in lieu of a retractable automatic door bottom only when:

a. A door shoe and threshold combination is not feasible, and
b. An automatic door bottom cannot be installed.

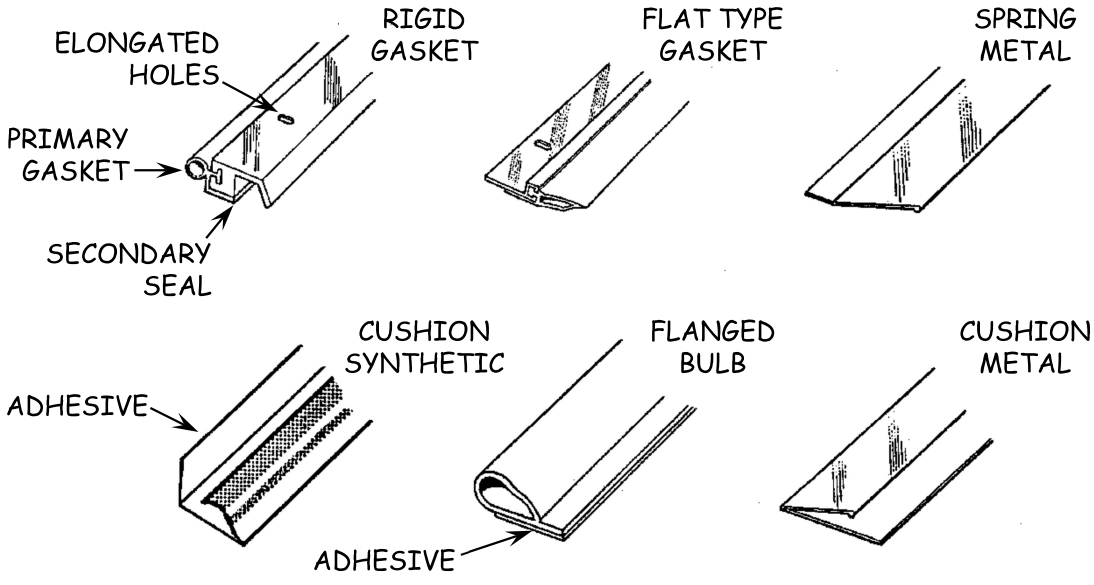
3. Installation Policies Specific to Mobile Homes

None.

WEATHERSTRIPPING STANDARDS

1. APPROVED MATERIALS FOR DOORS

- **Rigid gasket (aluminum carrier)**
  - Solid extruded aluminum carrier 0.05" thick, minimum.
  - Pliable gasket of vinyl, thermoplastic elastomer (TPE), or silicone.
  - Carrier shall have elongated mounting holes, 9" OC maximum.
  - Secondary seal between carrier and mounting surface shall be a minimum of 1/8" wide and extend the full length of the carrier.
- **Spring and cushion metal**
  - Brass, bronze, or stainless steel only; aluminum not allowed.
- **Cushion synthetic pressure-sensitive door gasketing**
  - Polypropylene, TPE, or silicone.
  - L-shaped stabilizer with self-adhesive backing.
- **Flanged bulb (compression bulb)**
  - Pliable gasket of TPE or silicone.
  - Minimum 3/8" wide with self-adhesive stabilizer flange.
- **Round tube**
  - Pliable gasket of TPE or silicone.
  - For use in compression applications only.



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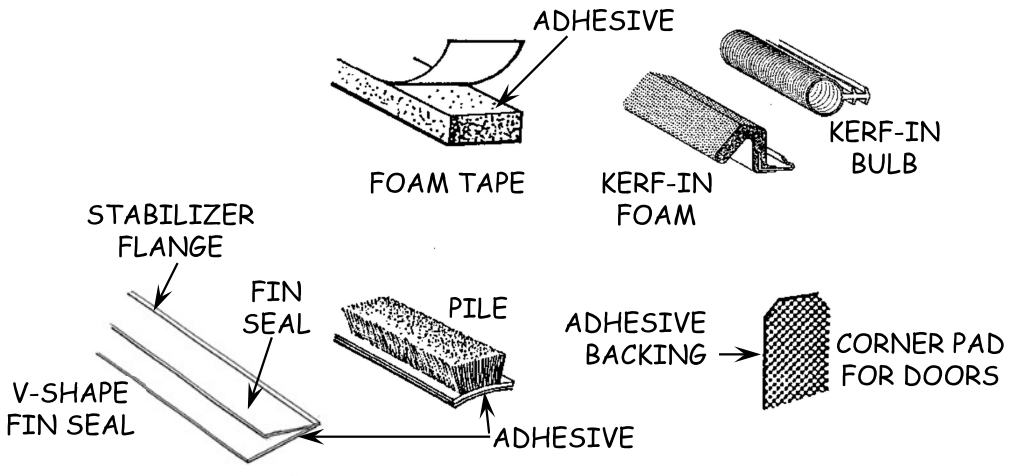
1. APPROVED MATERIALS FOR DOORS (cont.)

- **Foam tape**
  - Shall be used only in compression applications; not allowed where shear/friction movement occurs.
  - Closed-cell foam tape
    - Shall be UV-resistant with self-adhesive backing.
    - Acceptable for sealing entrance doors with metal jambs.
  - Open-cell foam tape
    - Shall have self-adhesive backing.
    - Cooler vent covers and attic access only.
- **V-shaped fin veal**
  - Durable V-seal of silicone or equivalent material, with stabilizer flange and adhesive backing (different from “vinyl V-strip”).
- **Replacement kerf-in bulb and foam**
  - Properly sized for retaining channel.
- **Replacement pile**
  - Fin seal–type when feasible.
  - Properly sized for retaining channel.
- **Corner pads**
  - Pile pad with self-adhesive backing.
- **Mechanical attachments**
  - All screws, nails, staples, and other fasteners shall be metal and noncorrosive.
  - Shall be properly sized for each application.
- **Pressure-sensitive adhesive**
  - Minimum adhesion strength of 65 oz. per inch.
  - Required on all self-adhesive products.



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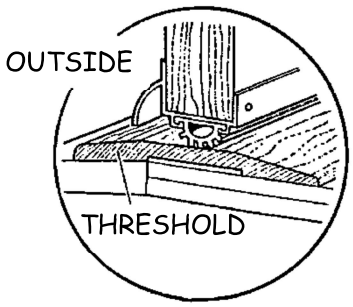
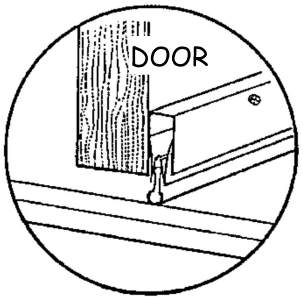
1. APPROVED MATERIALS FOR DOORS (cont.)

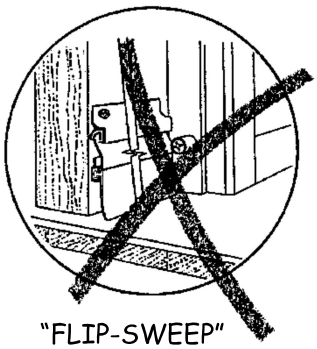
- **Door shoe, automatic door bottom, stationary sweep, metal saddle threshold, and bumper threshold**
  - Solid aluminum extrusions.
  - Gaskets: Pliable vinyl, TPE, silicone, or equivalent.
- **All door shoes, door bottoms, and sweeps**
  - Solid aluminum carrier, 0.05" nominal thickness or greater, with elongated mounting holes 9" OC maximum.
- **Automatic door bottom**
  - Retractable type only; flip sweep not allowed.
- **Stationary sweep**
  - Pliable gasket of vinyl or silicone attached to an extruded aluminum carrier.
  - Shall have elongated mounting holes 9” OC maximum.
- **Metal saddle threshold**
  - All-aluminum only; “gasket saddle” with vinyl top gasket not allowed.
  - Shall have floor-sealer gasket of vinyl, TPE, or silicone.
- **Wooden saddle threshold**
  - Hardwood only; “gasket saddle” with vinyl top gasket not allowed.



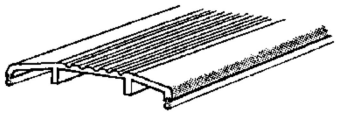
U-TYPE DOOR SHOE
OVER SADDLE THRESHOLD



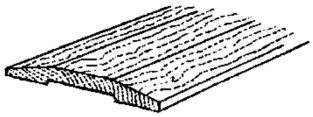
RETRACTABLE
BOTTOM



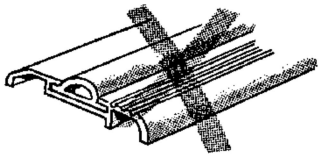
“FLIP-SWEEP”
DOOR BOTTOM



ALUMINUM



HARDWOOD



VINYL GASKET
THRESHOLD

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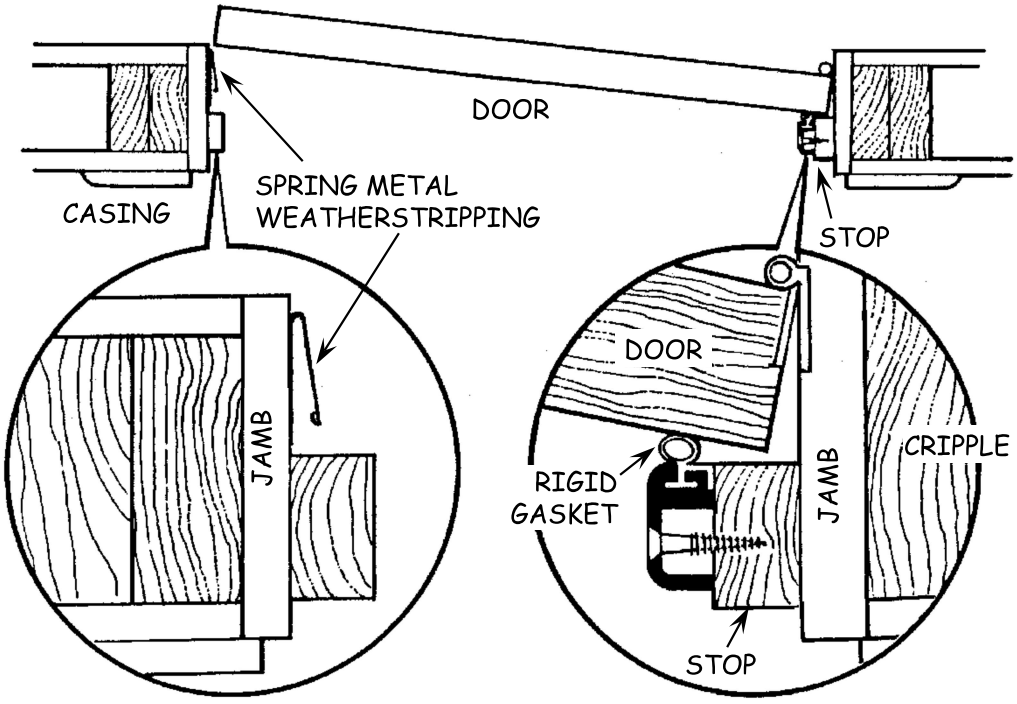
2. WARRANTY

- **Refer to IS Appendix F (Minimum Warranty Requirements).**

3. ENTRANCE DOOR JAMBS

- **Materials for wooden door jambs**
  - Rigid gasket.
  - Spring or cushion metal.
  - Replacement kerf-in bulb and foam.
- **Materials for metal door jambs**
  - Rigid gasket.
  - Cushion synthetic.
  - Flanged bulb.
  - Closed-cell foam.



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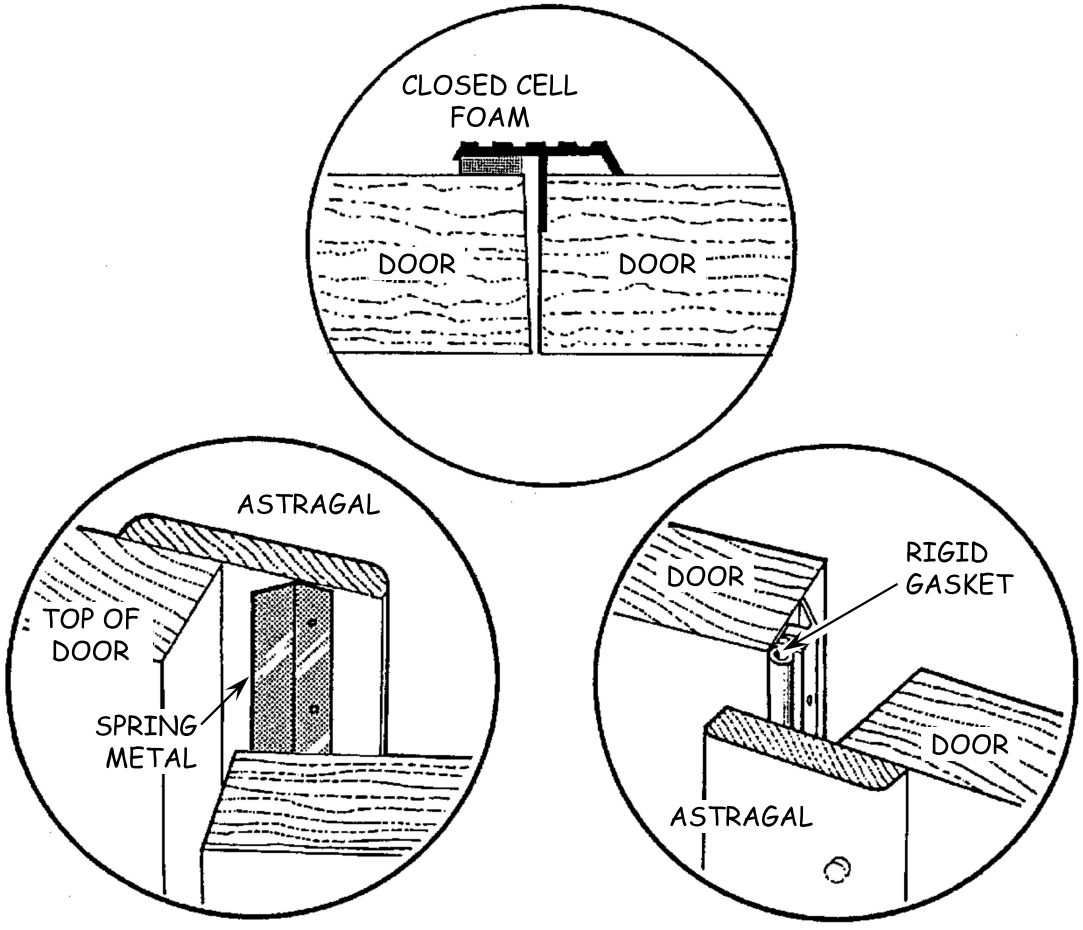
4. ENTRANCE DOOR ASTRAGAL

- **Weatherstripping materials**
  - Rigid gasket.
  - Spring or cushion metal.
  - Cushion synthetic.
  - Flanged bulb.
  - Replacement kerf-in bulb and foam.
  - Closed-cell foam and compression bulb (in compression only).



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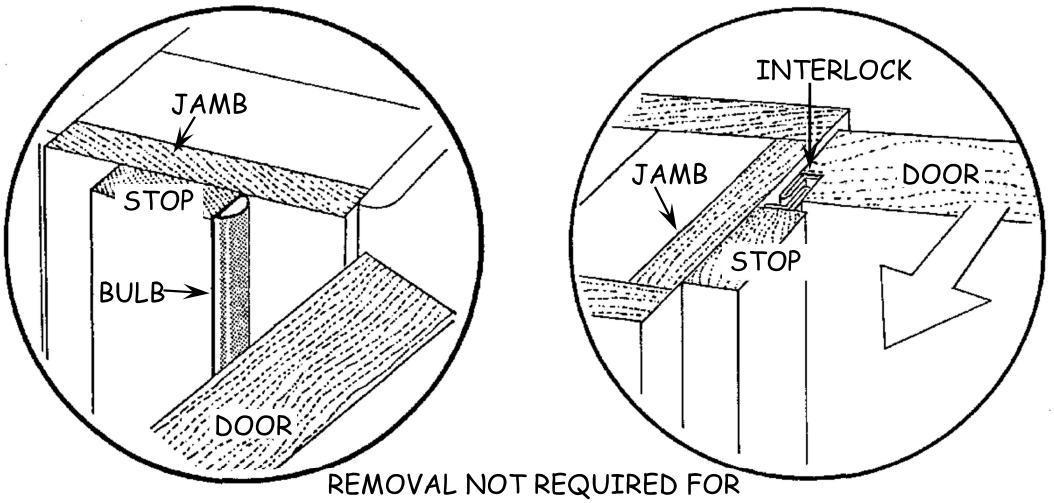
5. SAFETY PRACTICES

- **When metal stock is cut or trimmed:**
  - Burs shall be removed.
  - Sharp edges and ends (e.g., on rain drips) shall be rounded and smoothed.



REMOVAL NOT REQUIRED FOR
FACTORY INSTALLED WEATHERSTRIPPING
SUCH AS INTERLOCK AND BULB TYPES

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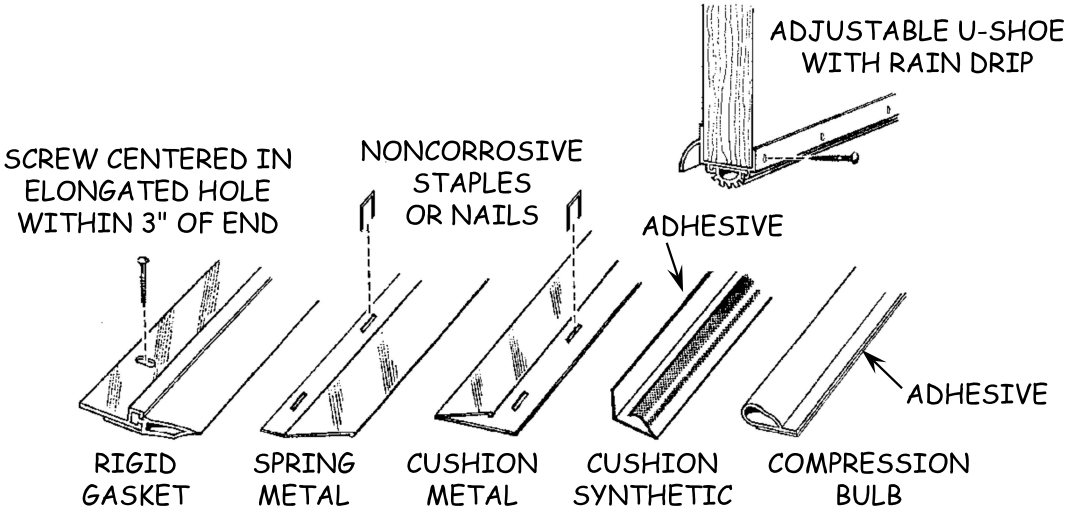
6. ATTACHMENT

- **All types**
  - Manufacturer's instructions shall be followed.
- **Rigid gasket, shoes, and sweeps**
  - Shall be adjustable and attached with screws located within 3" of each end and at intervals not exceeding 9".
- **Spring and cushion metal**
  - Mechanical attachments (e.g., 1/4" x 3/8" staples) shall be placed within 1" of each end and at intervals not exceeding 4".
- **Cushion synthetic, flanged bulb, and foam tape**
  - Mounting surface shall be thoroughly cleaned.
  - Existing adhesive residue shall be removed with solvent.
- **Corner pads**
  - Adhesive backing shall be supplemented with staples, tacks, etc., that penetrate wood 3/8" minimum.
- **Replacement pile**
  - Shall fit snugly into retaining channel.
- **Mechanical attachment**
  - Rigid gaskets, shoes, and sweeps shall be attached with metal pan-head Phillips screws.
    - Head diameter shall be no larger than two times the width of the elongated mounting hole.
    - Manufacturer-supplied Phillips-head screws may be used.



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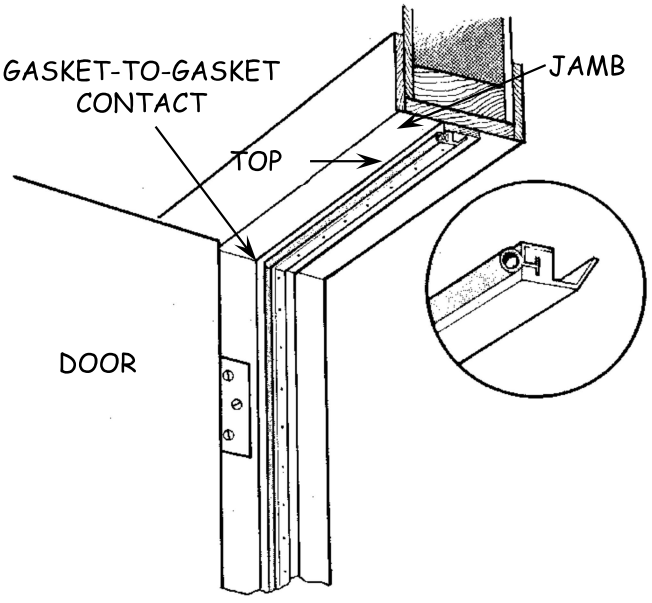
7. FIRE-RATED DOORS AND JAMBS

- **All listed/labeled metal and wooden doors and jambs with a fire rating >20 minutes**
  - Weatherstripping materials and installation shall meet specifications and listing requirements of the door and jamb manufacturer(s), with written documentation placed in job file.
  - Screws shall not be installed in the door or jamb unless allowed by the door and jamb manufacturer(s), with written documentation placed in job file.

8. DOOR JAMB WEATHERSTRIPPING INSTALLATION

- **All materials**
  - Corners and joints shall be trimmed to provide a continuous barrier to infiltration without gaps between adjoining legs.
- **Rigid gasket**
  - Screws shall be positioned to allow for adjustment of carrier.
  - Each leg shall be one continuous strip.
  - Gasket contact
    - Gasket-to-gasket contact required at corners.
    - Gasket-to-threshold contact required at bottom.
    - Contact shall <u>not</u> be achieved by the addition of caulk.
- **Spring and cushion metal and cushion synthetic**
  - Sealing surfaces shall be mitered at the corners.
  - Ends shall be overlapped when possible to provide a seal when compressed.
- **Foam tape and flanged bulb**
  - Material shall be joined at corners and mitered as needed to seal joint.



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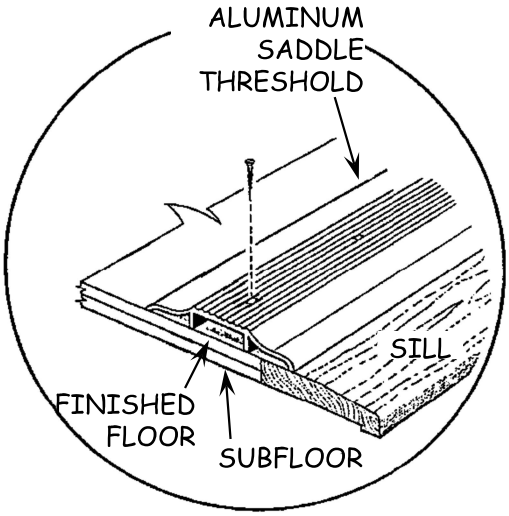
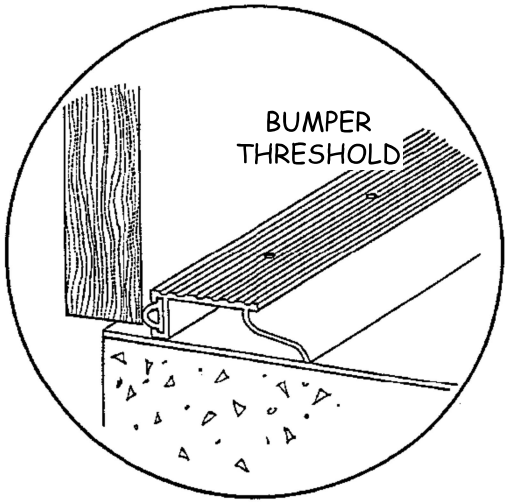
9. THRESHOLD INSTALLATION

- **All thresholds**
  - Shall be installed full length; splicing not allowed.
  - Shall extend above the interior finished floor a maximum of 1", or 1/2" if any occupant is physically handicapped.
  - Ends of threshold shall be cut to match the contour of the jamb (i.e., notched to fit snugly around jamb, stop, trim, etc.).
  - The perimeter shall be sealed (e.g., by caulking the ends and, where applicable, the front and back edges).
  - Saddle threshold shall be installed where possible.
- **Metal thresholds**
  - Saddle threshold shall have floor-sealer gaskets in place.
  - A bumper threshold may be used on out-swinging door for which a threshold-and-shoe combination cannot be feasibly installed (e.g., when closed door does not cover floor surface).
  - Threshold shall be permanently screwed in place.
- **Wooden saddle thresholds**
  - Threshold shall be sealed to the floor with glue or elastomeric caulk or floor-sealer gasketing.
  - Threshold shall be mechanically fastened with nails or screws.
  - Nails shall be countersunk and holes filled with exterior-grade filler/putty.





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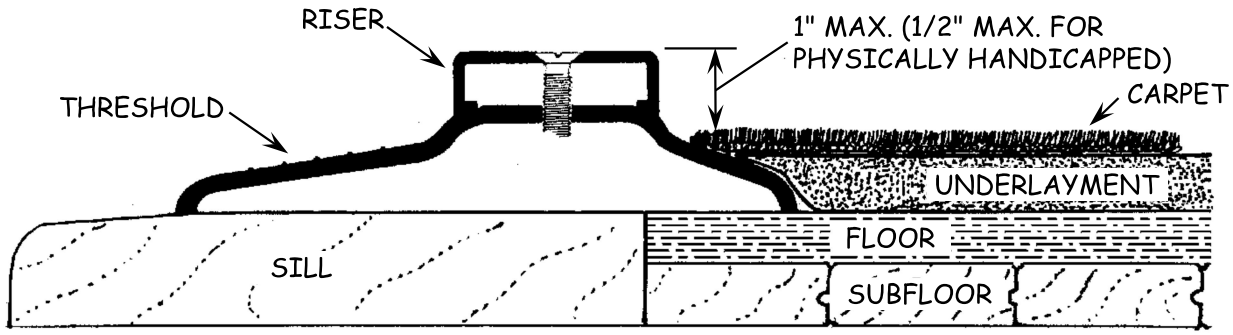
- **Low-profile thresholds (maximum 1/4" height)**
  - May be installed at interior doors without existing threshold, such as:
    - At a step-down from the living space to an unconditioned area (e.g., kitchen to garage).
    - On a floor continuing flat into an unconditioned area (e.g., from kitchen into utility room or, in an apartment complex, from the living area into an unheated common hallway).
  - May be installed to replace an existing defective low-profile threshold.

10. THRESHOLD RISERS AND ELEVATORS/SHIMS

- **All thresholds**
  - When a riser is installed on top of an existing threshold:
    - It shall be installed full-length; splicing not allowed.
    - It must be compatible with the threshold.
    - Field-fabricated, when allowed, shall:
      - Be made of solid stock that:
        a) Equals threshold length,
        b) Is 80–100% of the width of the top surface, and
        c) Has evenly rounded or beveled top edges.
      - Have a minimum of four countersunk holes located within 3" of each end and equally spaced in the field.
  - Top of riser shall extend above the interior finished floor a maximum of 1", or 1/2" if any occupant uses a wheelchair or walker.
  - Riser shall be securely attached with countersunk screws.
- **Riser material shall be compatible with threshold**
  - Metal risers on metal thresholds, and
  - Hardwood risers on wooden thresholds.



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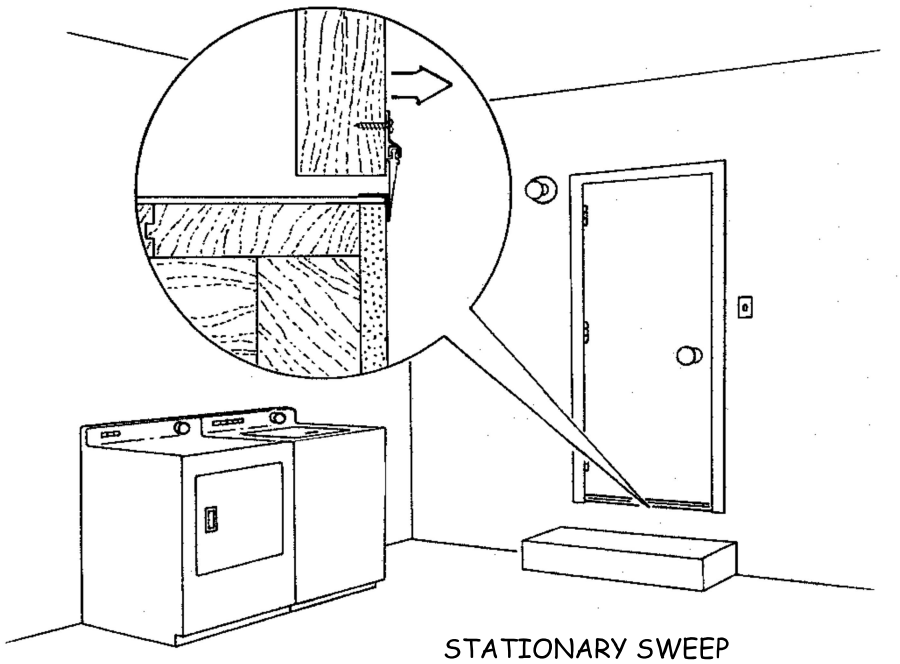
11. ENTRANCE DOOR BOTTOM INSTALLATIONS

- **Shoe-and-saddle threshold combination**
  - Shoe-and-saddle combination shall be used where possible.
  - L-shoe may be installed only where U-shoe cannot be installed (e.g., non-standard door thickness or metal-clad door).
  - Rain drip required on shoes in exposed exterior locations.
- **Stationary sweeps**
  - Allowed only when no other door bottom treatment is feasible.
  - Sweep shall seal along the entire length of the gasket.
  - In-swinging doors
    - Sweeps shall be installed on the interior side of an exposed exterior door.
  - Out-swinging doors in sheltered locations (e.g., inside garage)
    - Sweeps shall seal against a threshold or other vertical surface (e.g., stair nosing).
    - Sweep may be installed on the outward side of the door.



STATIONARY SWEEP
SEALING AGAINST NOSING

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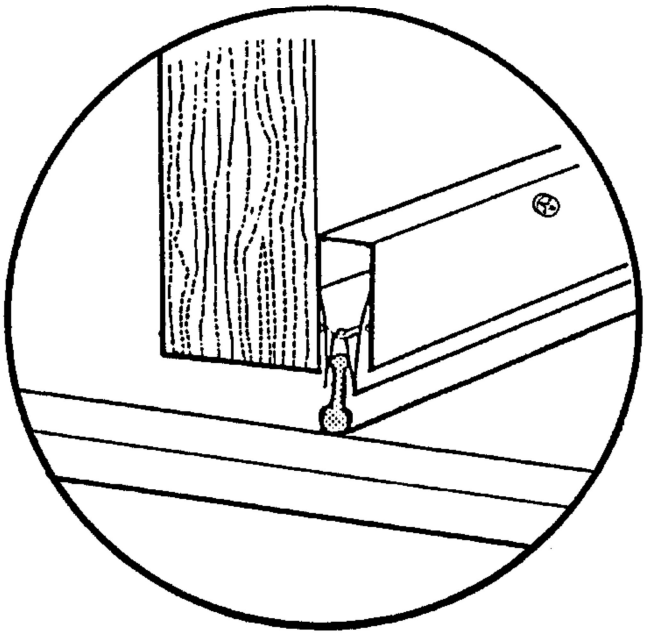
11. ENTRANCE DOOR BOTTOM INSTALLATIONS (cont.)

- **Retractable sweeps (automatic door bottoms)**
  - An automatic door bottom shall be installed only when:
    - There is no threshold over the finished floor, and/or
    - A shoe-and-saddle combination is not feasible.
  - Sweep shall seal against floor or existing threshold along entire length of gasket.
    - *Exception:* A 100% seal is not required at ceramic tile grout lines.
  - Ends of gasket shall be trimmed long enough to extend from jamb to jamb when door is closed.
  - Unit shall be attached securely with screws which penetrate solid wood.
- **All door bottoms**
  - Weatherstripping material shall not drag on the floor covering (wood, tile, carpet, etc.).
  - Unit shall be installed full length; splicing not allowed.

AUTOMATIC DOOR BOTTOM



RETRACTABLE SWEEP GASKETS
MUST SEAL ALONG ENTIRE WIDTH OF DOOR

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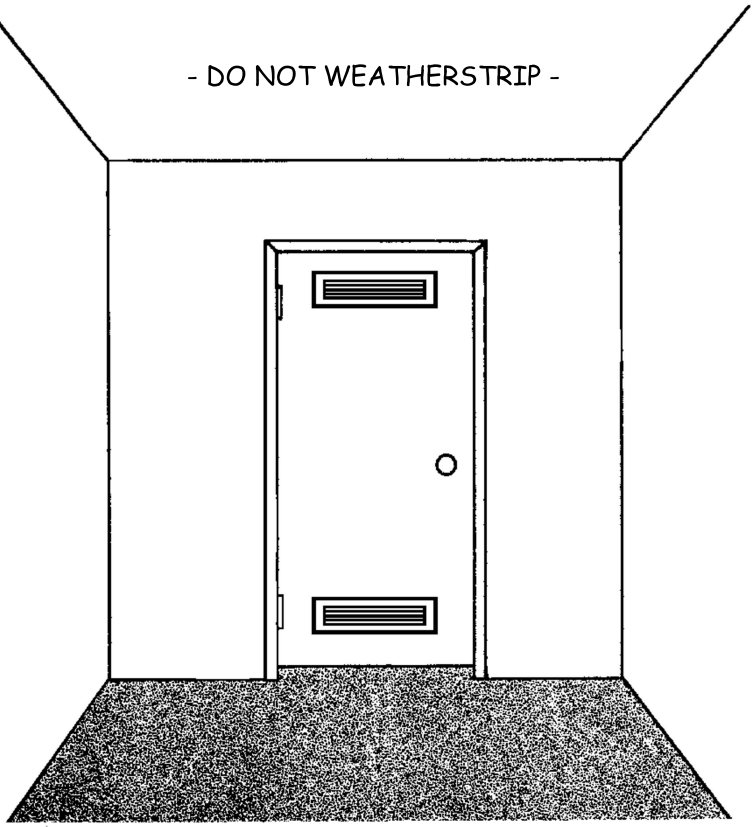
12. APPLIANCE ENCLOSURE DOORS

- **Weatherstripping shall be installed only when:**
  - It is needed to isolate the enclosure from the living space,
  - The enclosure is vented outdoors, and
  - CVA is adequate (per IS Appendix A).
- **Jamb materials**
  - Rigid gasket, spring and cushion metal, cushion synthetic, flanged bulb, or closed-cell foam tape.
- **Door bottom and threshold material**
  - Materials approved for entrance doors shall be used.



APPLIANCE ENCLOSURE DOOR
CONTAINING COMBUSTION AIR VENTS

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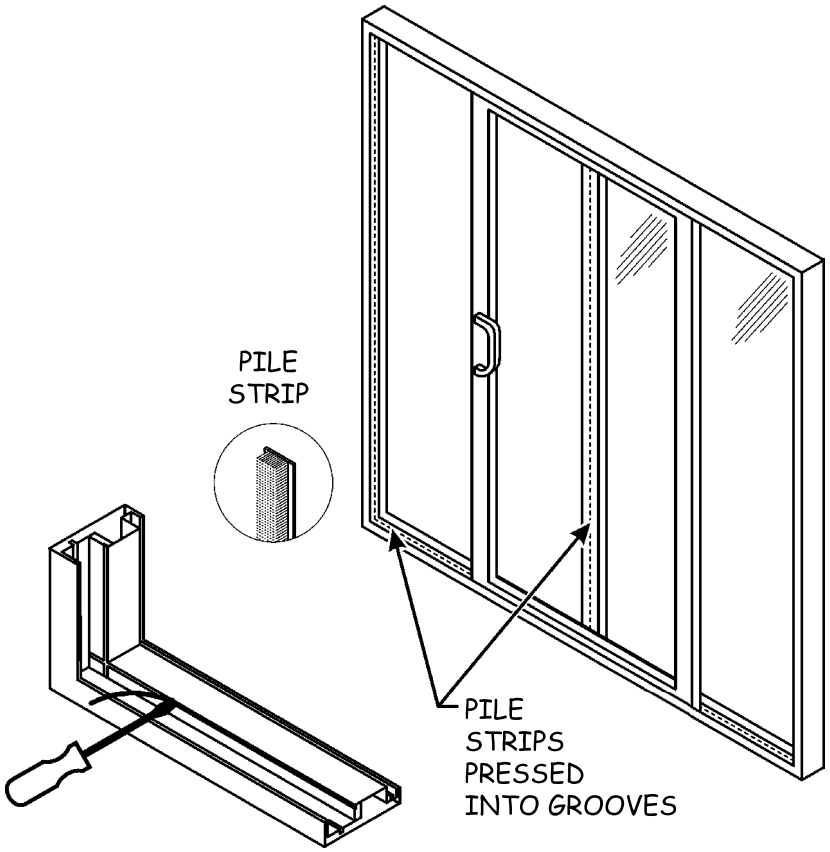
13. SLIDING GLASS DOORS

- **Pile**
  - Worn pile shall be replaced when feasible.
  - Existing pile shall be removed from retaining channels.
  - Replacement pile shall be installed in the retaining channels after existing pile has been removed.
- **Self-adhesive compression material when pile cannot be installed**
  - Cushion synthetic, flanged bulb, or closed-cell foam tape may be installed in compression only (e.g., on the latch side of the jamb).
    - Weatherstripping shall make contact with door and effectively block infiltration.
    - Foam tape shall not be doubled (stacked) to achieve required thickness.
  - Existing material shall be removed and the surface cleaned prior to installing new material.
  - Following installation, the door shall close and latch properly.



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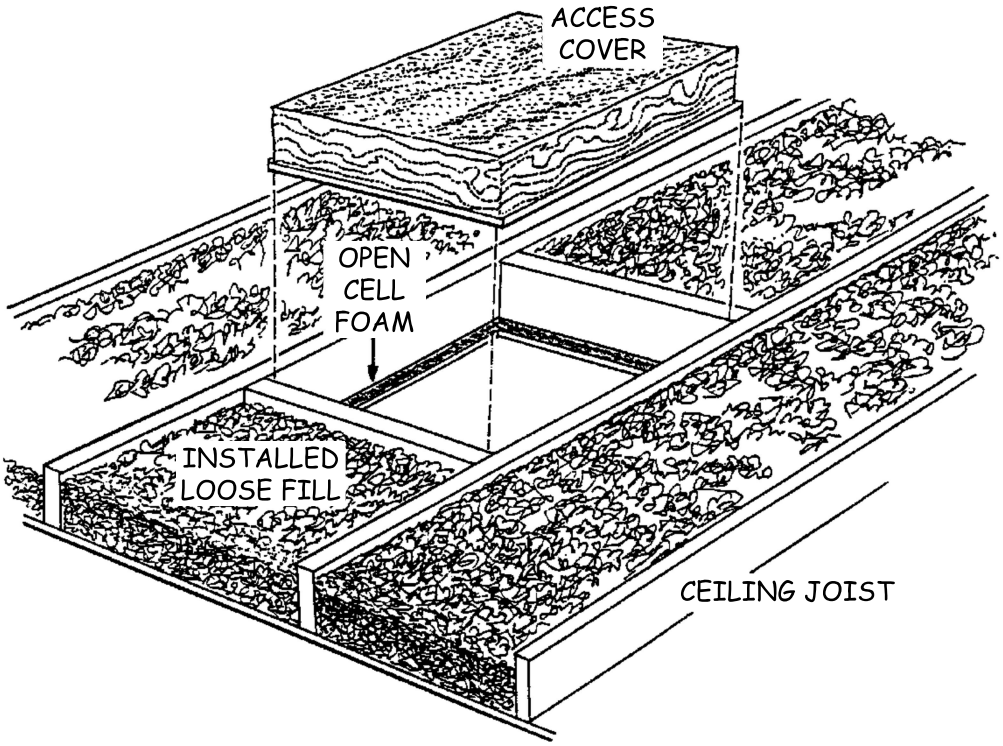
14. ATTIC AND CRAWLSPACE ACCESS DOORS/COVERS

- **Location**
  - Entry doors/covers accessed from conditioned space.
- **Materials**
  - Horizontal access doors/covers
    - Open-cell foam.
    - Closed-cell foam and flanged bulb acceptable if thickness does not create more than 3/16" gap between door and retaining surface.
  - Vertical access doors (i.e., knee wall door)
    - Materials approved for entrance doors shall be used.
- **Mounting surface**
  - Weatherstripping shall be installed on surface providing best adhesion (i.e., smooth wood trim rather than textured drywall lid).
  - Mounting surface shall be free of dust, dirt, and debris.



WEATHERSTRIPPING FOR HORIZONTAL ATTIC ACCESS

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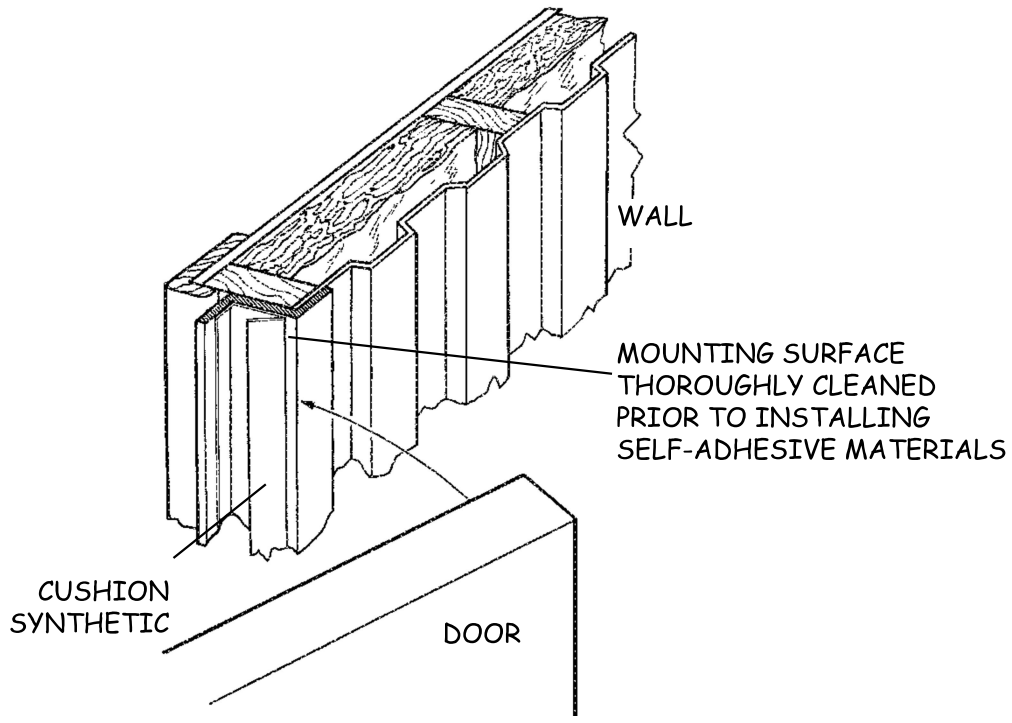
15. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up**
  - Paint dust and chips, scraps, and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Furniture and other household items moved for installation work shall be returned to their original positions.
- **Locks**
  - All functional locks shall latch properly.

MOBILE HOME CRITERIA

16. INSTALLATION AND ATTACHMENT

- **Replacement pile**
  - Shall fit snugly into retaining channel.
- **Materials attached with adhesive**
  - Self-adhesive backing shall have a minimum adhesion strength of 65 oz. per inch.
  - Pre-existing weatherstripping materials and adhesive shall be removed to the extent feasible.
  - Mounting surface shall be thoroughly cleaned.



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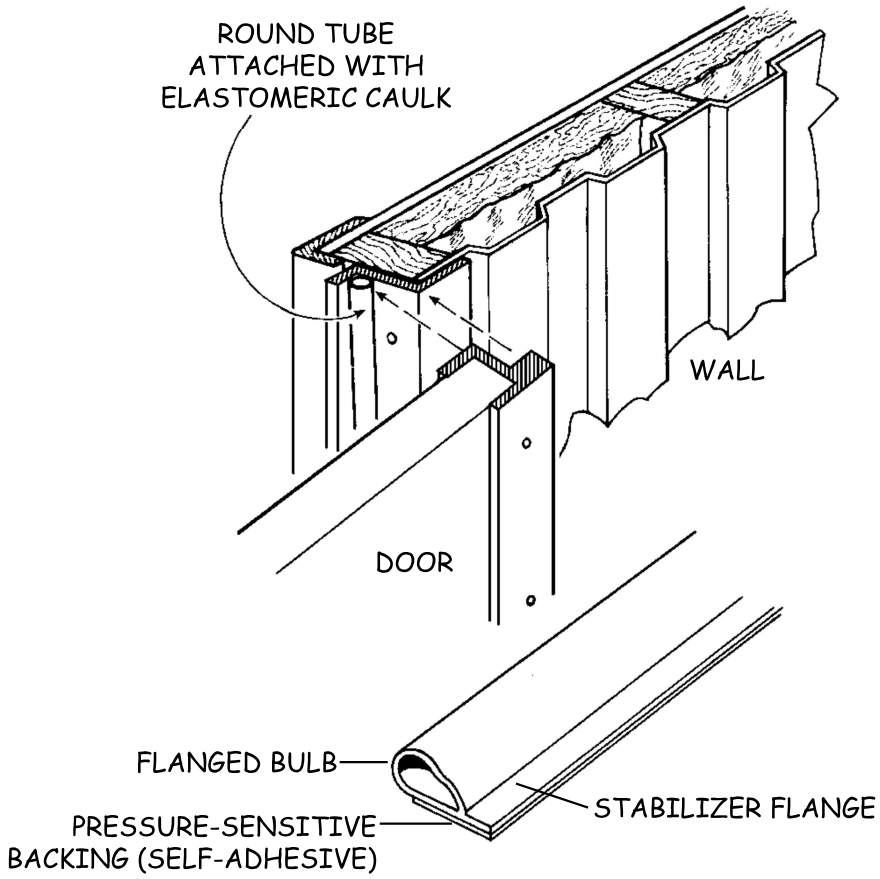
16. INSTALLATION AND ATTACHMENT (cont.)

- **Flanged bulb (i.e., silicone or TPE gasket with stabilizer flange)**
  - Material shall be installed as prescribed by manufacturer.
- **Round tube without flange (e.g. silicone or TPE tube)**
  - Material shall be installed in compression application only.
  - Tube shall be attached with elastomeric sealant (e.g., silicone caulk) or other method specified by manufacturer.
  - Tube shall be placed only in a corner formed by two perpendicular surfaces.



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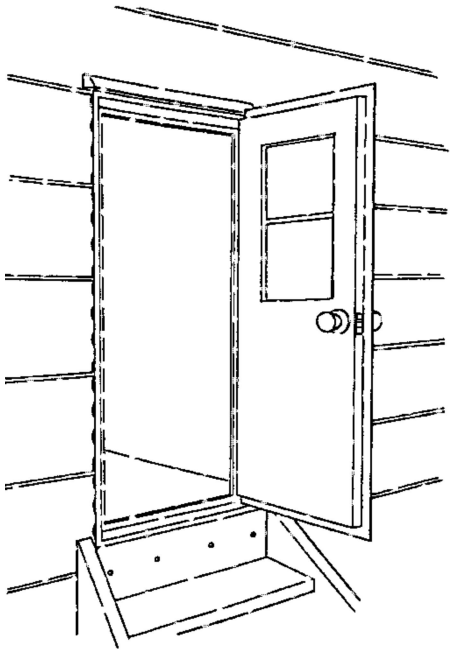
17. FLUSH-MOUNT DOORS

- **Weatherstripping**
  - Shoe-and-threshold combination shall be utilized when feasible.
  - Bumper threshold is allowed when a door shoe or a shoe-and-threshold combination cannot be installed.
  - When mechanically-attached materials are not feasible, the most effective and durable of the following alternatives shall be used:
    - Cushion synthetic.
    - Flanged bulb.
    - Closed-cell foam tape.
    - Round tube.
    - V-shaped fin seal.



FLUSH-MOUNT MOBILE HOME DOOR

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ATTIC INSULATION

Lead Paint Risk Factor
NONE

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SECTION 3 PREFACE
for

ATTIC INSULATION

1. Nonfeasibility Criteria

Attic Insulation Nonfeasibility

1.1. The dwelling is a mobile home.

1.2. The existing insulation level equals or exceeds R-value in the table below.

CEC CZ[1]	Existing Insulation Level[2]
CZ 2–10	R-12 or greater
CZ 1 and 11–16	R-20 or greater

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

1.4. Adequate attic venting is not present and cannot be installed in accordance with current installation standards and IS Appendix B (NFVA charts).

1.5. Required blocking cannot be installed.

1.6. Hazardous electrical wiring or other dangerous conditions are present.

1.7. Enclosed cavity: Insulation of the cavity is not feasible.

1.8. Exhaust vents terminating in the attic cannot be vented to the outside.[3]

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

1.10. Attic accessibility is inadequate[4]:

a. Existing access hatch is smaller than 18” x 22” or gable vent used for access is smaller than 18” x 18”.

b. An inspector cannot gain safe physical access to all treated areas of the attic after insulation is installed, and an on-site inspection is not available.[5]

---

[1] Reference is to the final level of insulation (any pre-existing R-value plus insulation added under the ESA Program). To evaluate pre-existing insulation, see 2.5 “R-value Guidelines for Pre-existing Insulation.”

[2] These levels apply on a forward-looking basis; homes previously receiving lower levels of attic insulation under the ESA Program will not be revisited to bring insulation up to the new higher level.

[3] This comprises two situations that are covered as minor home repair: 1) Reconnecting exhaust vents, and/or 2) addition of exterior venting as covered in the IS.

[4] When added insulation will leave too little clearance for post-inspection, the utility may require an inspector to be on-site during installation.

[5] On-site inspection shall be scheduled in accordance with utility policy.

c. Clearance between top of ceiling joists and bottom of ridge board is less than 24".
d. Structural obstructions, such as cross members of truss systems, provide an opening of less than 18".
e. Access requires crawling over/under HVAC ducts, and clearance is less than 18".
f. Confined Spaces: State and federal regulations regarding confined spaces cannot be met.

1.11. The structure is unsound and will not support the weight of the insulation and installer, such as:
a. 2" x 4" at 24" or greater OC.
b. Bowed and sagging joists.
c. Fiberboard ceiling material.
d. 1/4" gypsum ceiling.

1.12. K&T wiring is present.

1.13. Vermiculite insulation is present in the attic.

1.14. Customer refuses.

Attic Ventilation Nonfeasibility

1.15. The existing venting already meets current installation standards.

1.16. Tiled hip roof without overhang, soffit, or accessible frieze blocks.

1.17. Attic insulation is not feasible.

1.18. Roof-mounted vents are the only option for adding venting and (a) the roofing is tile, metal, or wood shingles/shakes or (b) the roof is in poor condition, for example, because of the following:
a. More than three layers of roofing exist.
b. Roof is structurally unsound and unable to support additional vents.

1.19. Installation is likely to cause damage and/or roof leaks.

1.20. Walking/working on the roofing material will damage it.

1.21. Roof is a flat or built-up roof.

1.22. Customer refuses.

2. Installation policies

Attic Insulation

2.1. Presence of vermiculite insulation: Attic assessment shall not take place and attic insulation shall not be installed in homes where vermiculite is pre-existing.

2.2. Attic insulation feasibility and R-value to be added shall be determined by utilizing the following table. (A climate zone map is available from the CEC website at: http://www.energy.ca.gov/maps/building_climate_zones.html.)

CZ[1]	Existing Insulation Level	Action[2]
CEC CZ 2–10	R-11 or less	Raise R-value to R-30
	R-12 or greater	Do not install additional insulation
CEC CZ 1 and 11–16	R-19 or less	Raise R-value to R-38
	R-20 or greater	Do not install additional insulation

2.3. In accessible locations where height restriction prevents installation of the prescribed R-value, insulation shall be installed to the greatest R-value feasible.

2.4. In cases where local jurisdiction mandates more insulation than required by the table above, contractors may install higher levels only after forwarding documentation of the more stringent requirements to and obtaining written authorization from the ESA Program manager.

2.5. R-value guidelines for pre-existing insulation

a. The R-value of pre-existing insulation shall be determined using the values in the table below.

b. All unidentifiable pre-existing loose fill insulation materials are considered to be R-1 per inch.

c. When there are multiple layers of different insulation types, the R-value of each layer is evaluated separately. The sum of those R-values determines the overall pre-existing R-value for the attic.

INSULATION TYPE AND MATERIAL	PRE-EXISTING INSULATION R-VALUE PER INCH
Loose Fill	
Cellulose	3.5
Fiberglass—Virgin (White)	2.5
Fiberglass—Pink & Yellow	2.5
Rock Wool	2.8
Perlite	2.7
Redwood Bark	1.0
Batts and Blankets	
Fiberglass	2.6

Rock Wool	3.3

2.6. R-value of new insulation
   a. The R-value of newly-installed insulation is based on per-inch R-values in the insulation manufacturer's coverage chart.
   b. Manufacturer's information, and total installed R-value, shall be included in the posted insulation attic card.

2.7. R-value of pre-existing loose fill insulation
   a. Compression by the weight of added new insulation shall be factored in when estimating effective R-value of pre-existing loose fill insulation.

2.8. R-value of pre-existing flexible insulation (batts and blankets)
   a. Properly-installed flexible insulation in excellent condition is assumed to be the R-value marked on the facing. If the insulation is full thickness, but there are no markings on the facing, use the following defaults: 3.5" = R-11, 6" = R-19, 10" = R-30.
   b. If flexible insulation is compressed or damaged:
      - Measure the average thickness, and
      - Use the R-value per inch from the table above to calculate approximate pre-existing R-value.

2.9. Attic access requirements
   a. Existing attic access must be large enough to provide access for the inspector (18" x 22" minimum).
   b. When no attic access exists, contractors will install one prior to installing attic insulation. Minimum dimensions of the new opening shall be 30" x 22" or as required by local code.
   c. If the gable vent is used for attic access, it must be hinged and large enough (18" x 18" minimum) to provide access for the inspector.

2.10. In the event holes are observed in attic fire walls while performing attic insulation, the prime contractor will document and notify the property owner of the existing condition.

2.11. There is no minimum attic square footage required for attic insulation.

2.12. Homes having (a) separate attics or (b) contiguous attics consisting of different sections with various crawl clearances shall have insulation installed only in the sections that have the specified clearances. (See Nonfeasibility Criteria.)

2.13. Before insulation is installed, duct leaks shall be sealed, disconnections shall be reconnected, and needed duct repairs shall be made per IS Section 10 (Duct Testing and Sealing).

2.14. The following precautions shall be taken to protect the home:
   a. Before entry is made into the attic, a drop-cloth must be placed under the access opening.

b. Runners must be used to protect carpeting and linoleum from dirt or damage by the hose.
c. Care shall be taken to prevent damage to the home and furnishings by the insulation hose, ladders, etc.
d. Cutting of fiberglass batts shall not occur inside the living space.
e. All areas between the attic access and the home entrance shall be vacuumed clean after installation is complete.

2.15. *Inaccessible* HPDs/CVA vents covered by existing insulation:
a. *Inaccessible* HPDs and CVA vents located in an inaccessible portion of the attic that is not receiving new insulation will *not* preclude installing insulation in the accessible portion of the attic.
b. To the extent possible, CVA vents in inaccessible areas shall be cleared.

2.16. Blocking is not required for range hood exhaust vents.

3. Installation Policies Specific to Mobile Homes

3.1. Attic insulation (and attic duct reconnections) is not a measure for mobile homes.

ATTIC INSULATION STANDARDS

PART 1: ATTIC INSULATION

1. APPROVED MATERIALS

- **All insulation shall be**
  - Licensed for sale in California.
  - Certified to comply with the CCR, Title 24, Part 12, Chapters 12-13, Article 3, “Standards for Insulating Material”.
- **Mineral fiber**
  - Flexible (batts): Conformance to ASTM C665.
  - Loose fill: Conformance to ASTM C764.
- **Cellulose**
  - Loose fill
    - Listed in the Department of Consumer Affairs “Directory of Certified Insulation Materials.”
- **Rigid**
  - Pre-formed polyisocyanurate board foil-faced on both sides
    - Conformance to FS HH-1-1972/1.
  - High-density fiberglass board
    - Conformance to ASTM C726.

2. R-VALUES

- **Minimum R-values shall be in compliance with Table 3-1.**

Table 3-1: Minimum R-value Requirements

LOCATION	CRITERIA	TOTAL R-VALUE
Attic Floor	CZ 2–10	R-30*
	CZ 1 & 11–16	R-38*
Knee Walls & Skylight Wells	2" x 4" framing	R-13
	2" x 6" framing	R-19
Horizontal Access	Same R-value as attic floor	
Vertical Access	Same R-value as knee walls and skylight wells	

*R-30 and R-38 represent the “minimum final R-value,” which is the R-value of *existing* insulation plus R-value of *installed* insulation. When vertical clearance is inadequate to install full R-value, the maximum R-value that will fit shall be installed.

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3. LOCATION

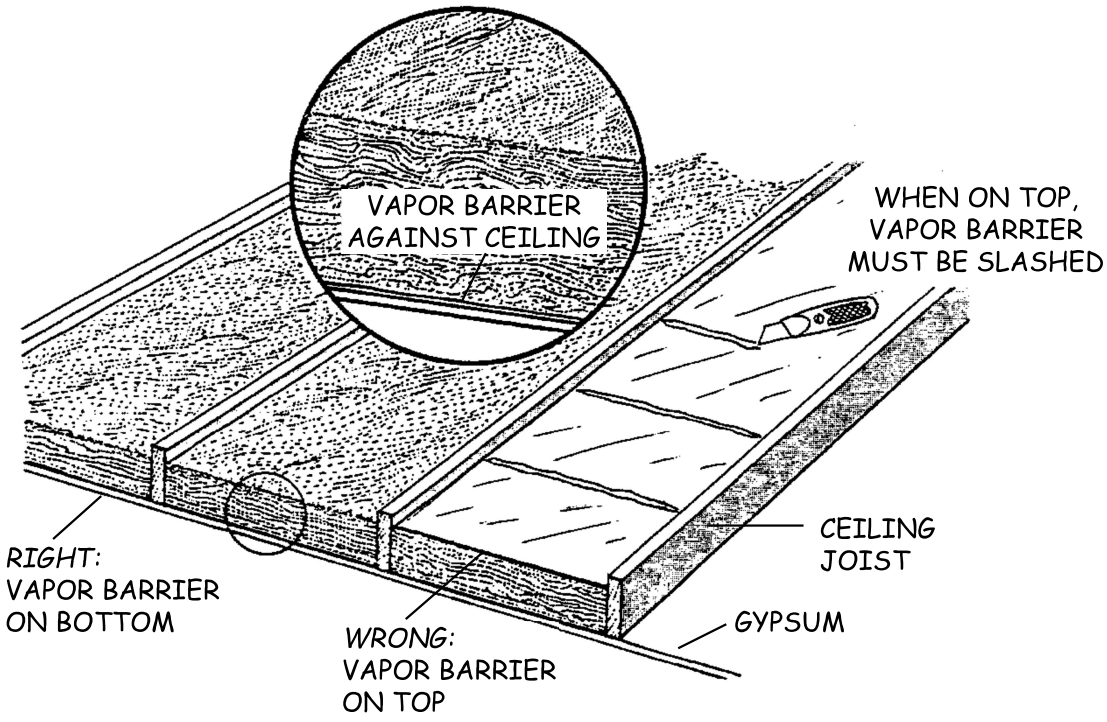
- **All insulation shall be installed only between conditioned and unconditioned areas.**

4. STRUCTURAL REQUIREMENTS

- **All insulation**
  - Ceiling shall be structurally adequate to support weight of installer and installed insulation.
  - Attic insulation shall not be installed when roof leaks are present.

5. VAPOR BARRIER

- **All insulation**
  - Vapor barrier is required only on flexible mineral fiber.
  - Vapor barrier shall not be installed over existing insulation.
  - When installed, vapor barrier shall be:
    - Placed toward winter warm side (e.g., directly on attic floor).
    - Rated no higher than 1 perm.
  - When existing batts are incorrectly installed with vapor barrier on top (upward) and additional insulation is to be installed:
    - Vapor barrier shall be removed from attic, or
    - Batts shall be turned over to place facing against attic floor, or
    - Vapor barrier shall be slashed entire length of batt or across the width of the batt at 12" intervals.



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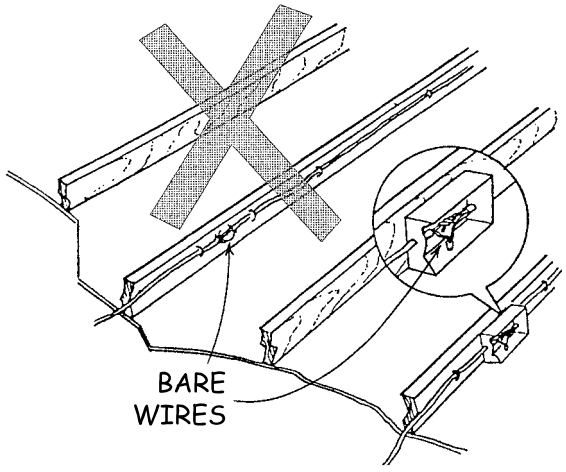
6. ELECTRICAL WIRING

- **All insulating materials**
  - Insulation shall not be installed over energized bare wires or wires with frayed or decayed insulation.
- **Loose fill**
  - Open junction boxes
    - Loose fill material shall not cover open junction boxes.
    - Boxes shall be protected with either of the following:
      - Standard cover plates.
      - A minimum 14-1/2" x 12" piece of unfaced batt that covers the box and equals or exceeds the height of installed loose fill.
  - Wire connections protruding from junction box
    - Loose fill material shall not cover the wires.
    - Connections shall be protected with either of the following:
      - Box extension and standard cover plate.
      - Mineral fiber blocking that exceeds the height of loose fill by 4" and extends away at least 14-1/2" in all directions.
  - Wire connections without junction box (spiderweb)
    - Wire connections shall not be covered by loose fill material.
    - Connections shall be protected with mineral fiber blocking that exceeds the height of loose fill by 4" and extends away at least 14-1/2" in all directions.
  - K&T wiring
    - Insulation shall not be installed when K&T wiring is present.



DO NOT INSULATE

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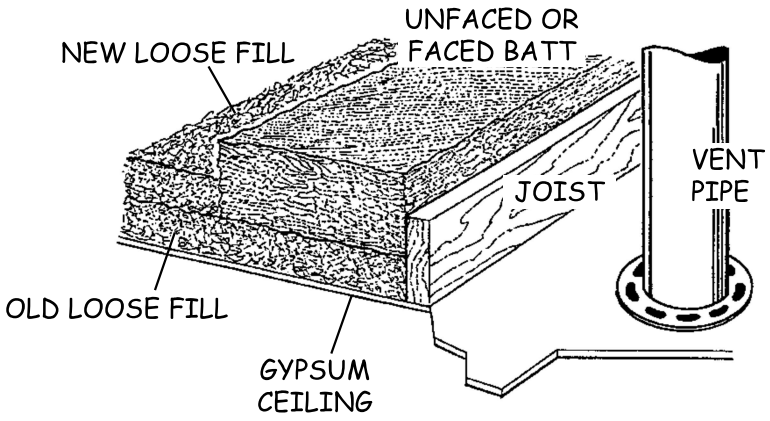
7. PERMANENT BLOCKING

- **Blocking materials may be one of the following:**
  - Flexible mineral fiber–faced or unfaced.
  - Framing members and attached sheathing (e.g., plywood).
  - Corrosion-resistant metal, minimum 0.007" thick.
- Commercially available plastic chutes and cardboard baffles shall not be used to block HPDs.
- **Characteristics**
  - Maximum flame-spread index of 25 and smoke-developed index of 50, per ASTM E84, UL 723, or NFPA 255.
  - Metal blocking shall be mechanically attached to ceiling and/or framing (e.g., with staples, nails, or screws).
- **Blocking for loose fill insulation**
  - Blocking shall extend from the attic floor to the prescribed height above installed loose fill.
  - Blocking height may be achieved with structural wood or a combination of structural wood and permanent blocking material.
  - Unfaced and faced flexible blocking may rest on top of other insulation, with vapor barrier facing either up or down.
- **Flexible insulation**
  - No blocking required.
  - When flexible is being installed over loose fill, blocking/barrier shall prevent loose fill from entering clearance zone.



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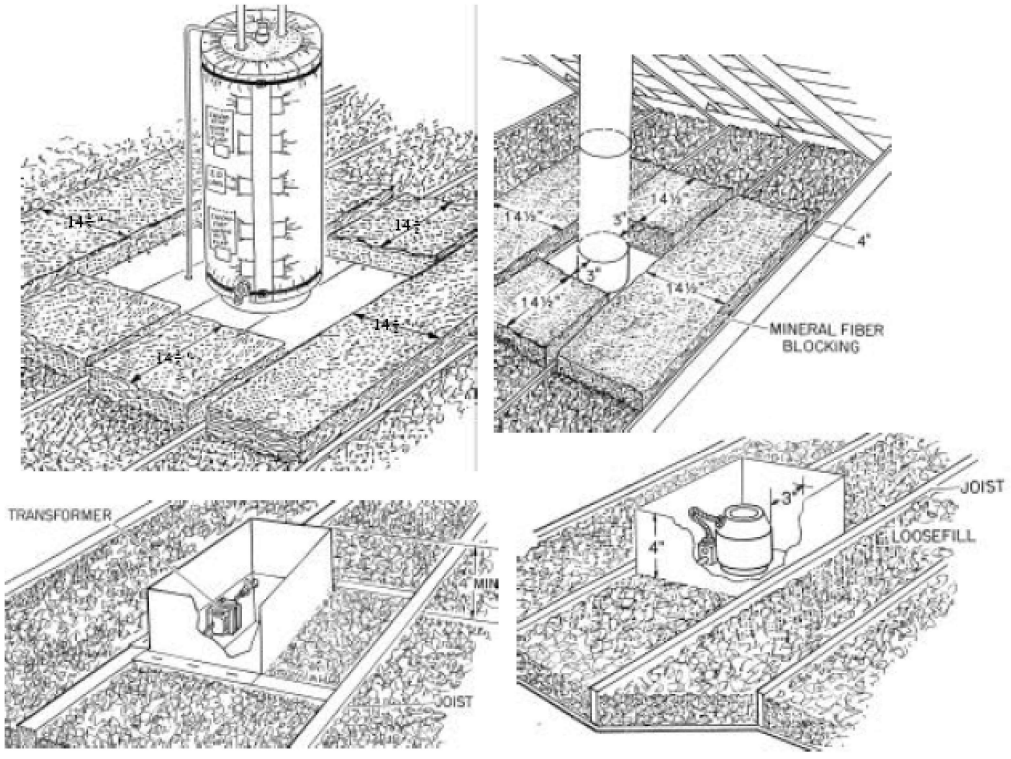
8. TEMPORARY BLOCKING COVER

- **Loose fill**
  - Temporary cover placed over permanent blocking shall be removed after insulating.

9. HPDS

- **HPDs include, but are not limited to, the following:**
  - Recessed light fixtures and doorbell transformers.
  - Exposed fluorescent fixtures.
  - Fan motors.
  - Metal vent pipes and masonry chimneys.
  - Gas and electric appliances (e.g., water heater or furnace).
  - Any other device that produces heat.
- **HPDs shall be blocked in accordance with Item 7.**
  - Flexible batt/blanket insulation and blocking for loose fill insulation shall provide the required clearance on all sides of the HPD (e.g.,3" for most items), as specified for each type of HPD.
  - Blocking shall extend from the attic floor to 4" above the loose fill.
  - Metal blocking shall be permanently attached to the ceiling/framing with staples, nails, or screws.



FOUR EXAMPLES OF HPDs THAT REQUIRE BLOCKING

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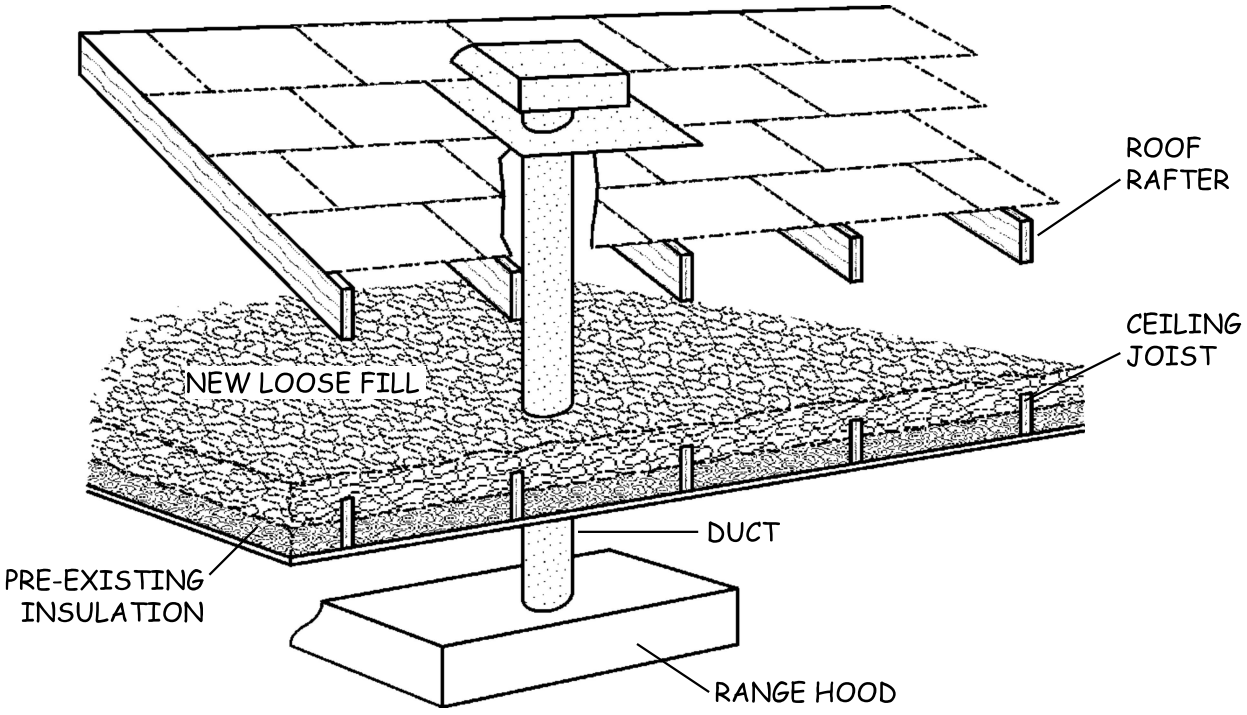
10. KITCHEN AND BATH TYPE EXHAUST SYSTEMS

- **Range hood and bath type exhaust fans shall be blocked per Item 14.**
- **Vent hose/duct**
  - May be covered by loose fill.
  - Shall be unobstructed at its termination (open end).
- **Screened openings shall be blocked per Item 20.**
- **Exhaust termination**
  - Exhaust systems that terminate in the attic shall be extended to the exterior.
  - The vent pipe shall:
    - Be connected to a roof or wall termination.
    - Have an upward slope (flat run not allowed).
    - Conform to local code.
    - Eave vent termination acceptable if allowed by local code.



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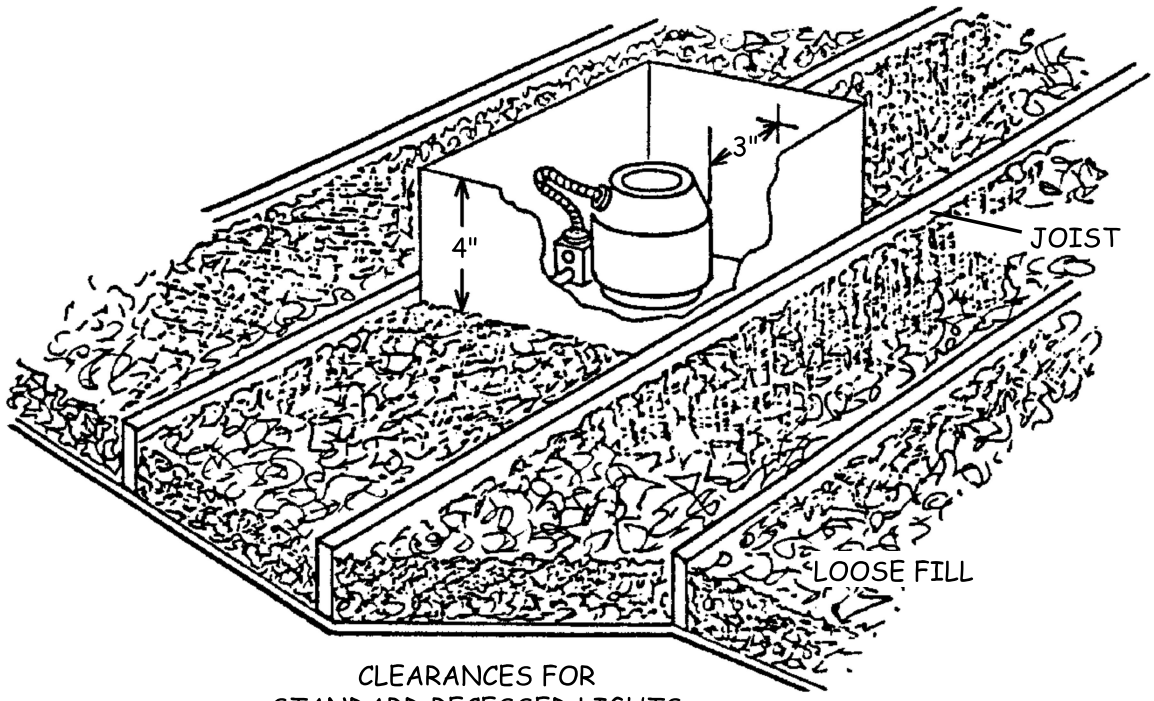
11. RECESSED LIGHTING FIXTURES

- **Standard fixtures**
  - Loose fill
    - 3" clearance zone required around fixture.
    - Noncombustible blocking required.
    - Blocking, in conformance with Item 7, shall exceed height of loose fill by 4".
    - Flexible mineral fiber blocking shall extend at least 14-1/2" away from the clearance zone in all directions.
    - If covered, 24" minimum top clearance required.
    - Gypsum enclosures that house recessed fluorescent light fixtures do not require protection from loose fill.
  - Flexible
    - 3" clearance from fixture required on all sides.
- **Type IC (insulation-covered) recessed lighting fixtures**
  - Blocking is not required for labeled Type IC fixtures.



CLEARANCES FOR
STANDARD RECESSED LIGHTS

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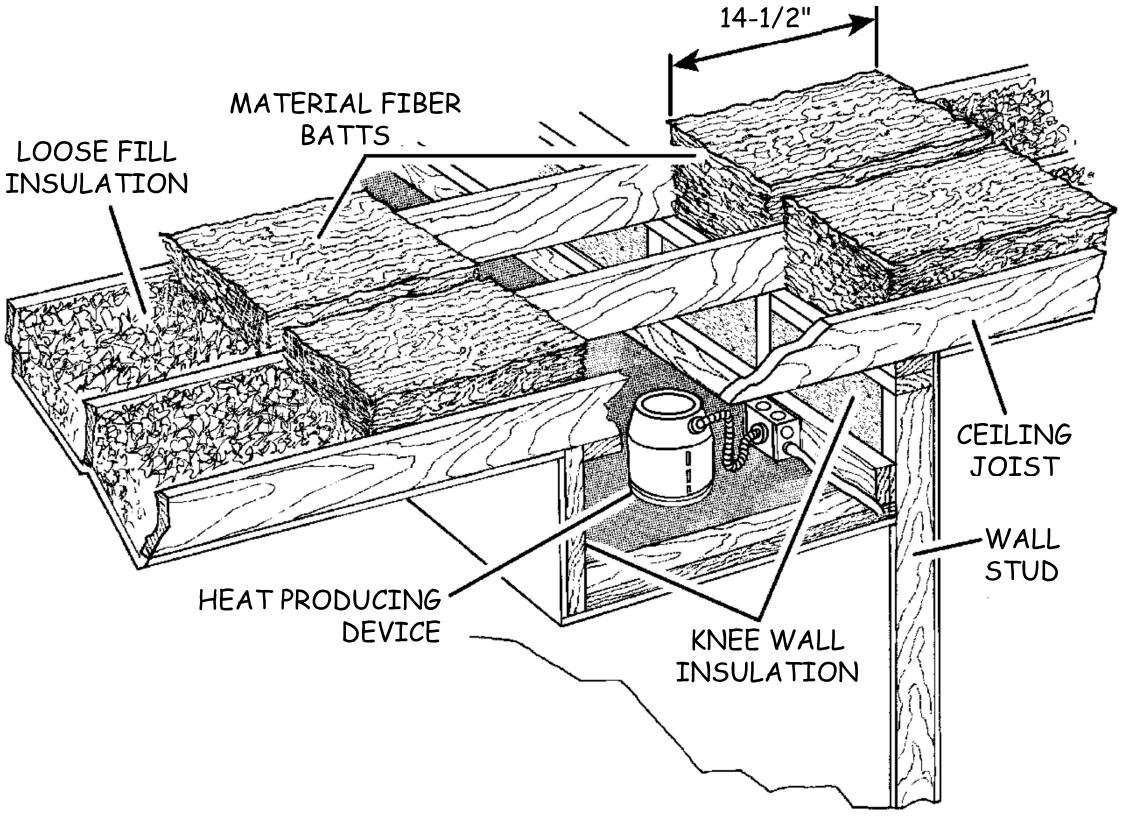
12. RECESSED INTERIOR SOFFITS CONTAINING HPDS

- **Loose fill**
  - Soffits shall be blocked to protect recessed lights and other HPDs.
    - Blocking, in conformance with Item 7, shall:
      - Exceed the height of loose fill by 4″.
      - Extend at least 14-1/2" back from the soffit opening when mineral fiber blocking is used.
    - Blocking inside soffit shall be installed in conformance with Item 9 of this section.
  - Accessible knee walls shall be insulated in conformance with Item 29 of this section.



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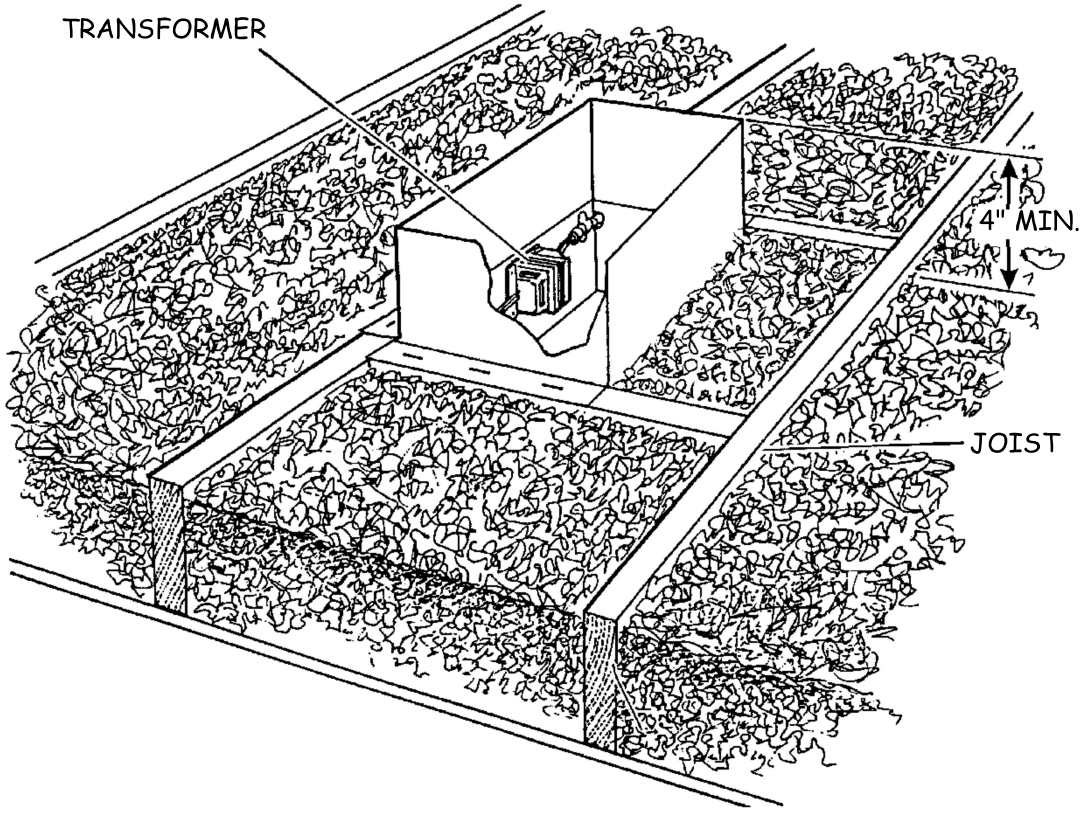
13. DOORBELL TRANSFORMER

- **Loose fill**
  - 3" clearance zone required around transformer.
  - Noncombustible blocking required.
  - Blocking shall conform to Item 7 and exceed height of loose fill by 4".
  - Flexible mineral fiber blocking shall extend at least 14-1/2" away from clearance zone in all directions.
  - If covered, 24" minimum top clearance required.
  - Blocking <u>not</u> required if transformer is mounted above top of insulation.
- **Flexible**
  - 3" clearance from transformer required on all sides.



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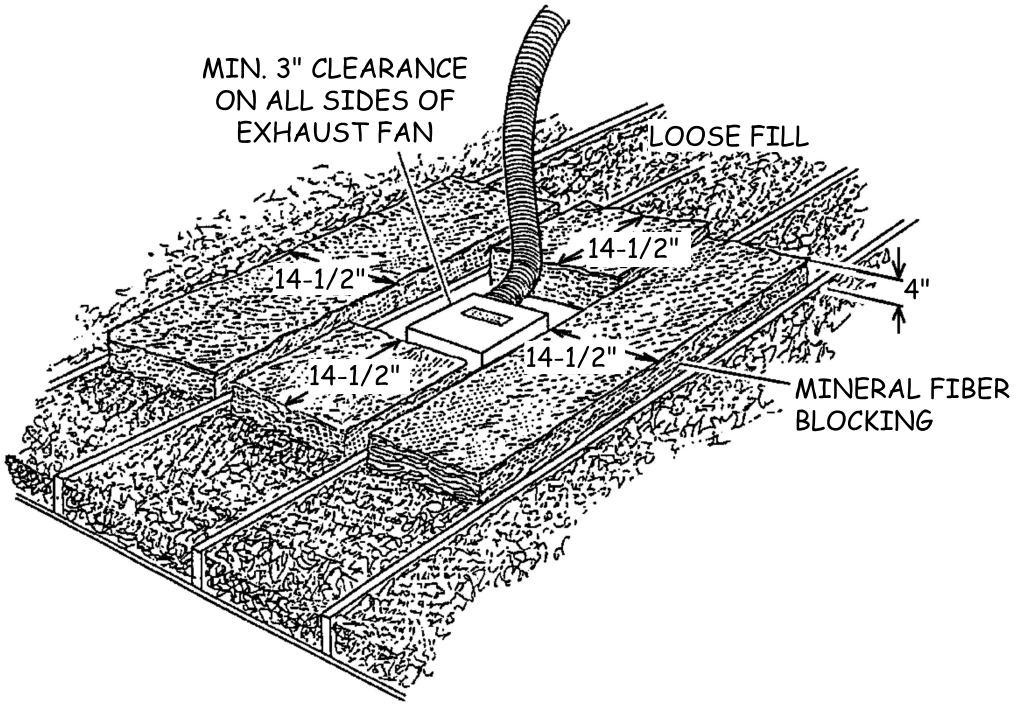
14. FAN MOTORS AND MISCELLANEOUS HPDS, INCLUDING EXPOSED FLUORESCENT FIXTURES

- **HPDs include, but are not limited to, the following:**
  - Recessed light fixtures
  - Doorbell transformers
  - Fan motors
  - Metal vent pipes
  - Masonry chimneys
  - Other heat producing devices
- **Abandoned vent pipes must be blocked or removed.**
- **Loose fill**
  - 3" clearance zone required around HPD.
  - Noncombustible blocking required.
  - Blocking, in conformance with Item 7, shall exceed height of loose fill by 4".
  - Flexible mineral fiber blocking shall extend at least 14-1/2" away from clearance zone in all directions.
  - When cover/insulation is placed above an HPD, cover/insulation shall be at least 24" above the HPD.
- **Flexible**
  - 3" clearance from HPD required on all sides.



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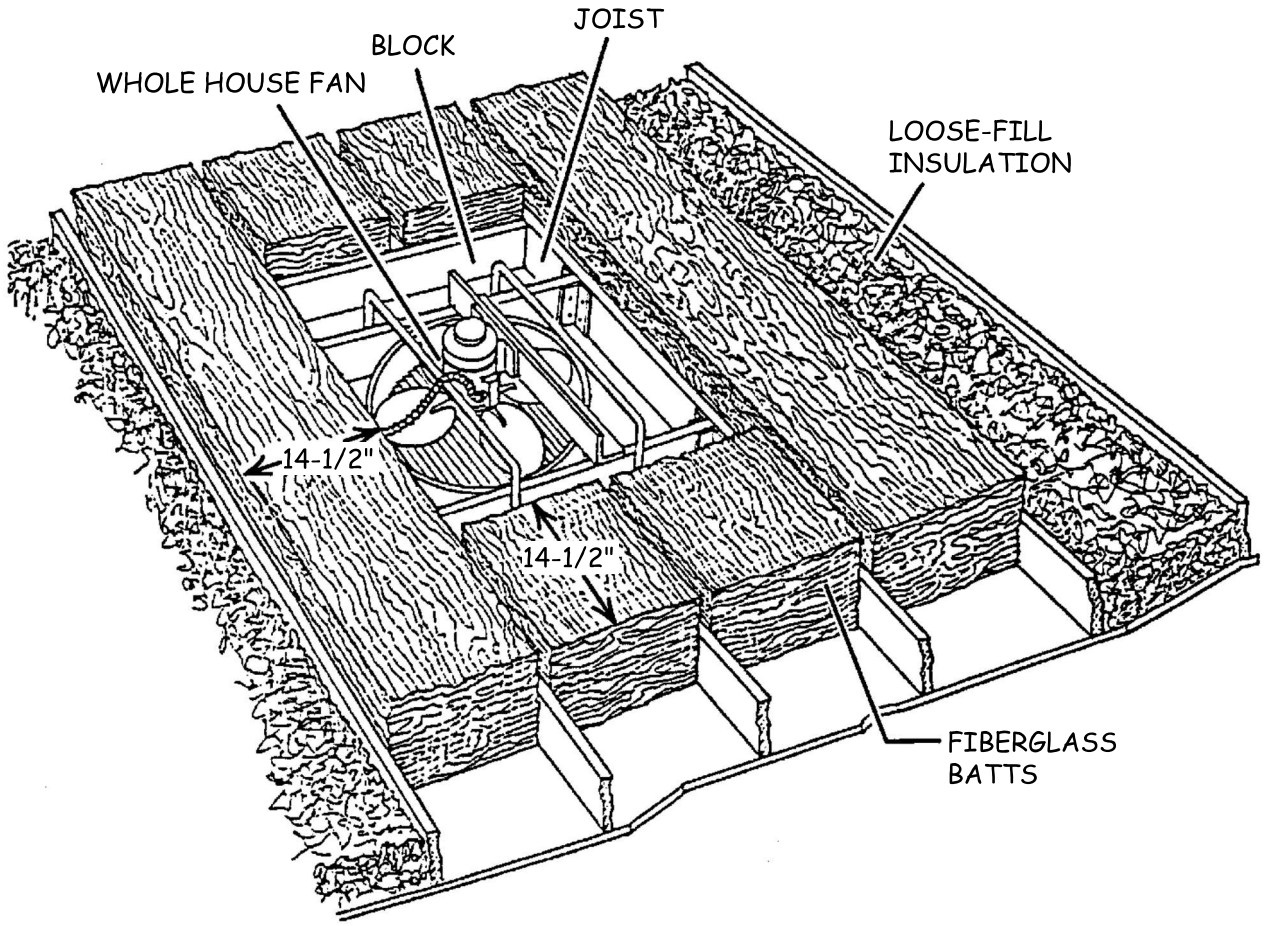
15. WHOLE-HOUSE FANS

- **Loose fill**
  - Blocking required, even when a shroud is present on the fan.
  - 3" clearance zone required for fan motor.
  - Blocking, in conformance with Item 7, shall exceed height of insulation by 4".
  - Flexible mineral fiber blocking shall extend at least 14-1/2" away from clearance zone in all directions.
- **Flexible**
  - 3" clearance required for fan motor.



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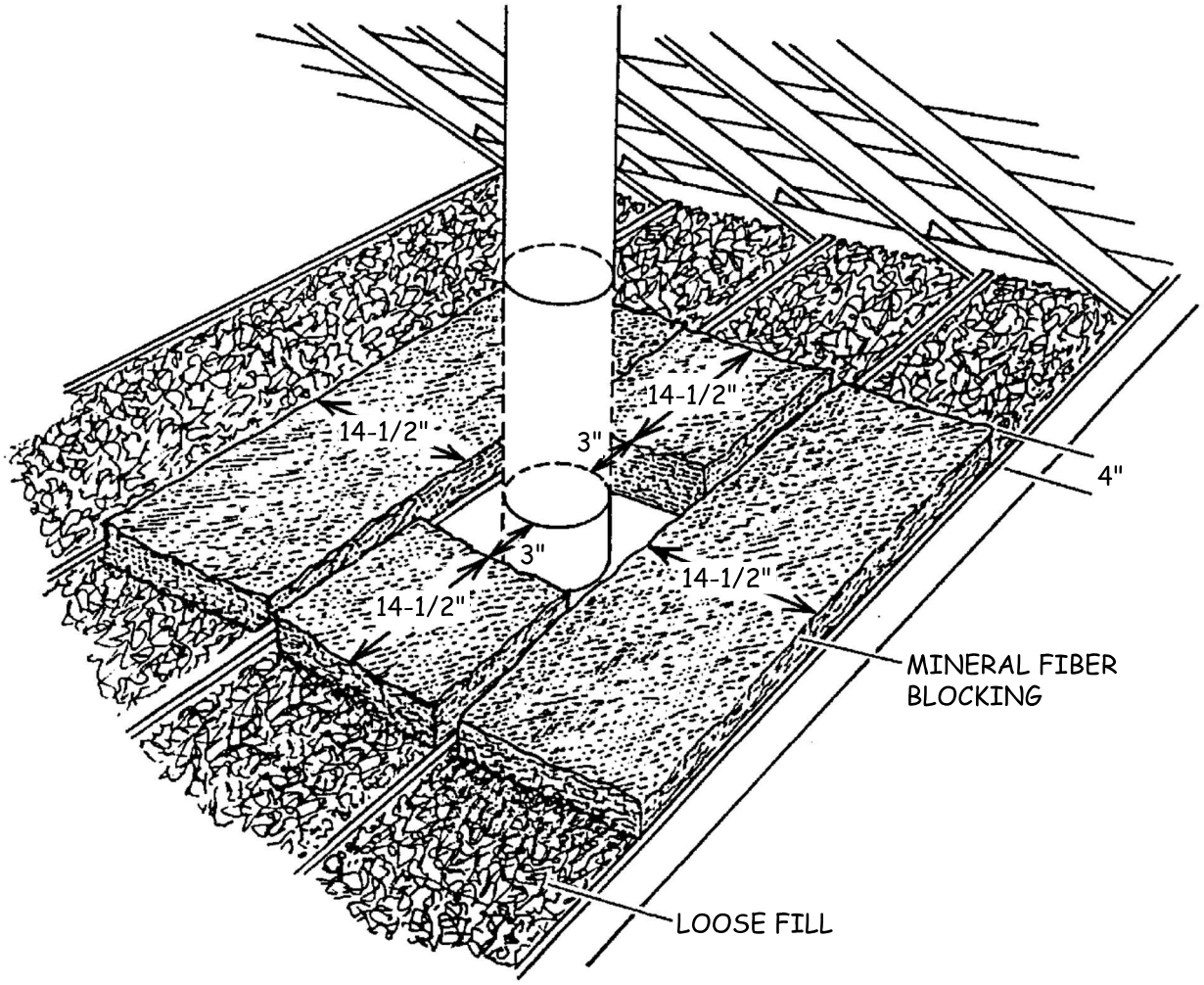
16. GAS VENT PIPES AND SOLID FUEL CHIMNEYS

- **Loose fill**
  - 3" clearance zone required around HPD (6" to combustibles if single-wall).
  - Noncombustible blocking required.
  - Blocking, in conformance with Item 7, shall exceed height of insulation by 4".
  - Flexible mineral fiber blocking shall extend at least 14-1/2" away from clearance zone in all directions.
- **Flexible**
  - 3" clearance from HPD required on all sides (6" to combustibles if single-wall).
- **Abandoned pipes**
  - Shall be blocked or removed.



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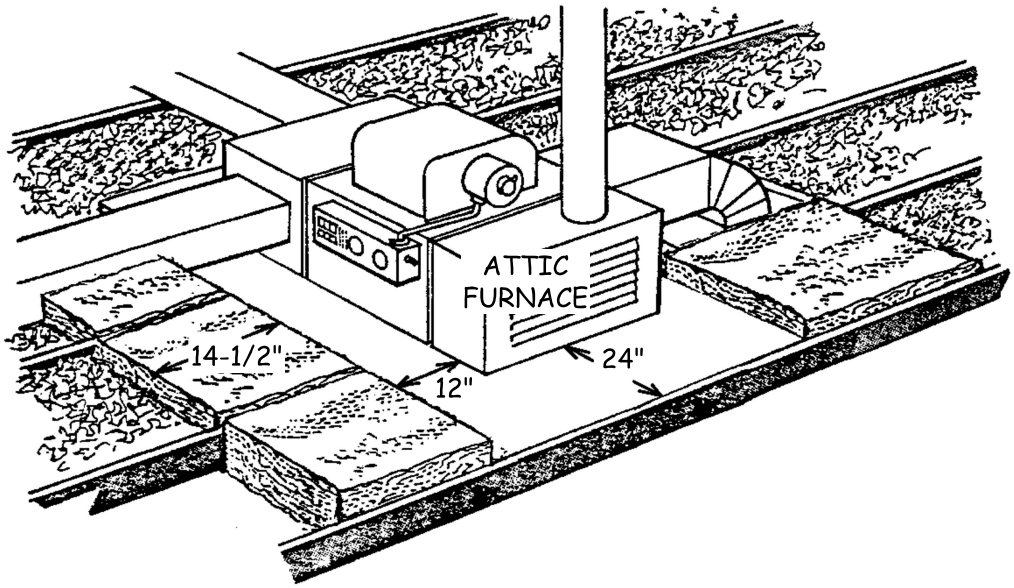
17. FURNACES AND HEAT PUMPS LOCATED IN ATTICS

- **Loose fill**
  - A clearance zone is required around all units.
    - 12" clearance around back, sides, and top.
    - 24" clearance in front.
    - 3" clearance for vent pipes (6" to combustibles if single-wall).
  - Blocking, in conformance with Item 7, required unless bottom of unit is more than 4" above loose fill.
  - Blocking shall extend from the attic floor and exceed height of loose fill by 4".
  - Flexible mineral fiber blocking shall extend at least 14-1/2" away from clearance zone in all directions.
  - Insulation "overblow" shall be cleared from unit and clearance zone.
  - If HVAC unit is suspended or draws combustion air from the bottom:
    - 12" clearance shall be provided below unit, or
    - Flexible insulation shall be installed below and extend 12" beyond unit on all sides. (No exposed loose fill beneath unit.)
- **Flexible**
  - 12" clearance required on all sides.
  - 3" clearance for vent pipes (6" to combustibles if single-wall).
  - 6" clearance below units drawing combustion air from bottom.
- **Platforms and catwalks**
  - Insulation shall be installed underneath both when accessible.
  - Insulation shall <u>not</u> be installed on top of platforms.



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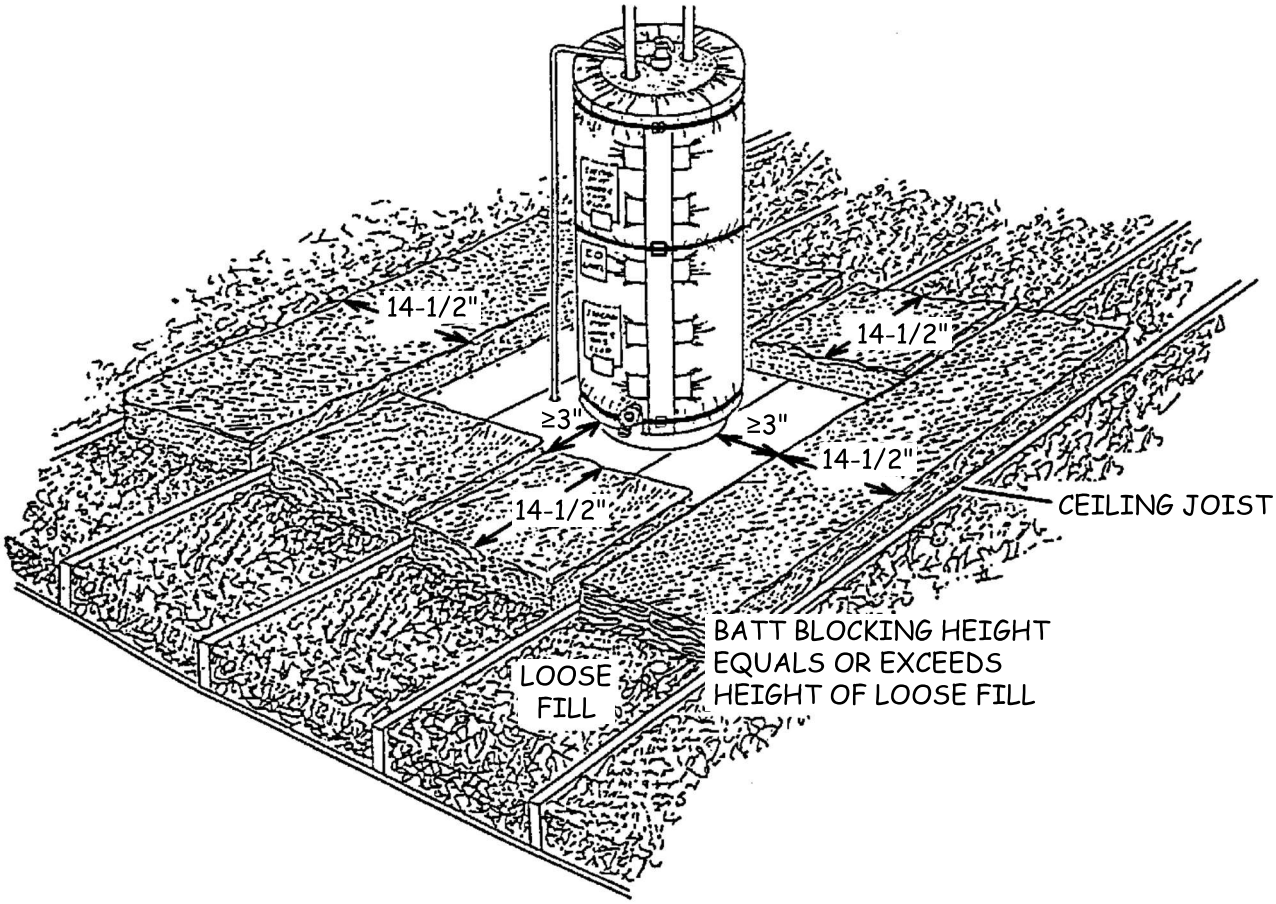
18. WATER HEATER LOCATED IN ATTIC

Electric Units

- **Loose fill**
  - 3" clearance zone required around unit.
  - Blocking, in conformance with Item 7, required if bottom of unit is below top of installed loose fill.
  - Blocking shall be noncombustible, conform to Item 7, and equal or exceed height of insulation.
  - Flexible mineral fiber blocking shall extend at least 14-1/2" away from clearance zone in all directions.
  - Insulation "overblow" shall be cleared from unit, clearance zone, and platform.
- **Flexible**
  - 3" clearance from unit required on all sides.



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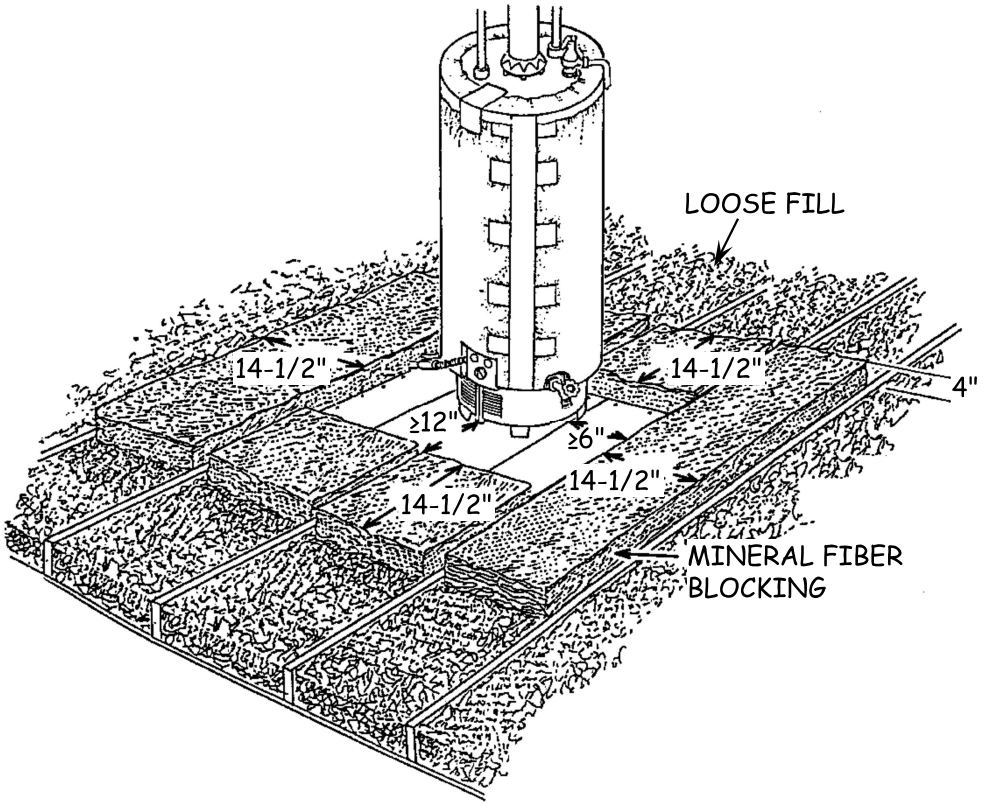
18. WATER HEATER LOCATED IN ATTIC (cont.)

Gas Units

- **Loose fill**
  - A clearance zone is required around the unit.
    - 6" clearance around sides and back.
    - 12" clearance in front.
    - 3" clearance for vent pipes (6" to combustibles if single-wall).
  - Blocking, in conformance with Item 7, required if bottom of unit is not at least 4" above installed loose fill.
  - Blocking material shall be noncombustible and exceed height of loose fill by 4".
  - Flexible mineral fiber blocking shall extend at least 14-1/2" away from clearance zone in all directions.
  - Insulation "overblow" shall be cleared from unit, clearance zone, and platform.
- **Flexible**
  - 6" clearance from unit required on all sides.
  - 3" clearance required for vent pipes (6" to combustibles if single-wall).



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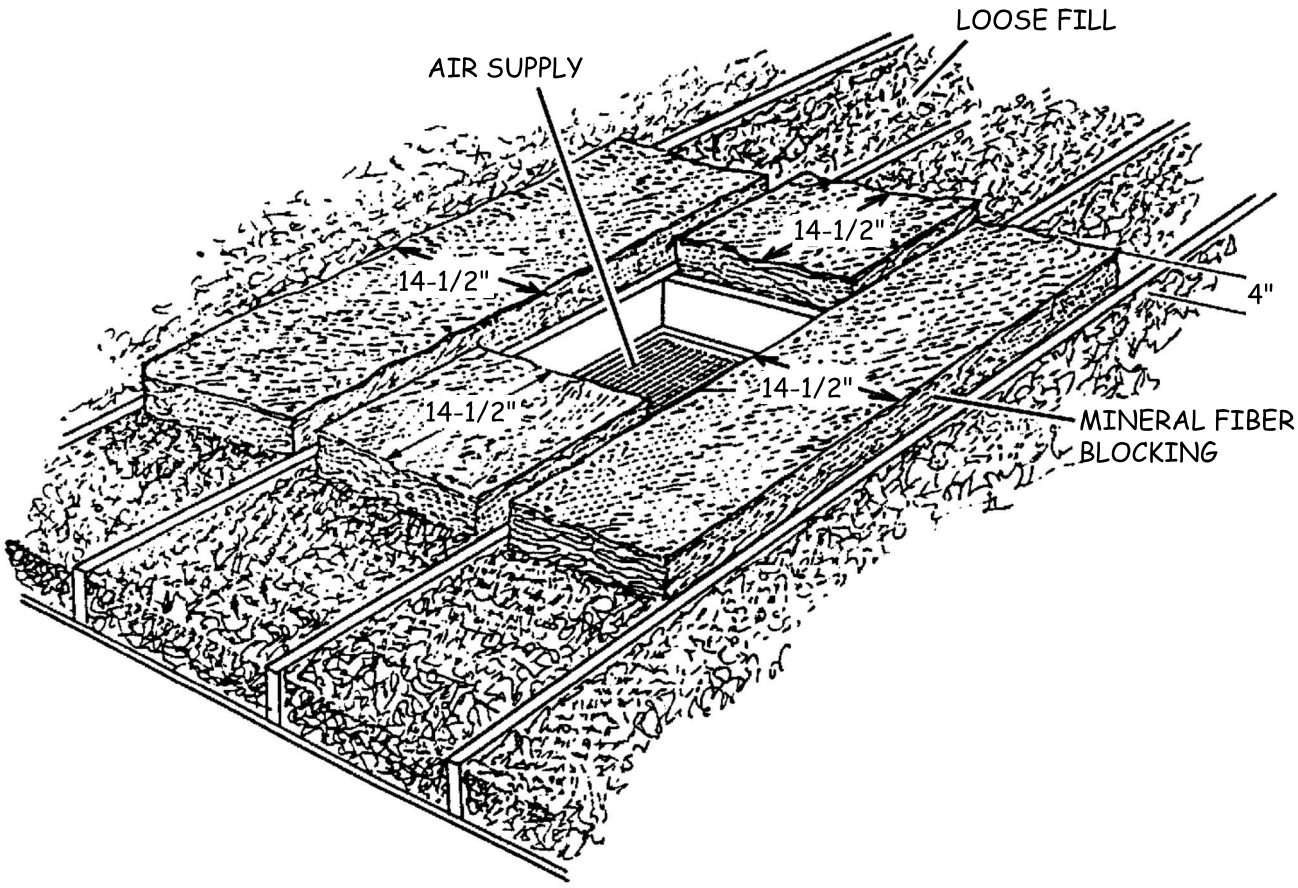
19. COMBUSTION AIR SUPPLY

- **Loose fill**
  - Blocking required.
  - Must not obstruct air supply.
  - Blocking shall conform to Item 7 and exceed height of loose fill by 4".
  - Flexible mineral fiber blocking shall extend at least 14-1/2" away from vent opening in all directions.
  - Any insulation that blocks the screen shall be removed.
  - Blocking may be either flexible fiberglass batts or metal barriers.
- **Flexible**
  - Must not obstruct air supply.



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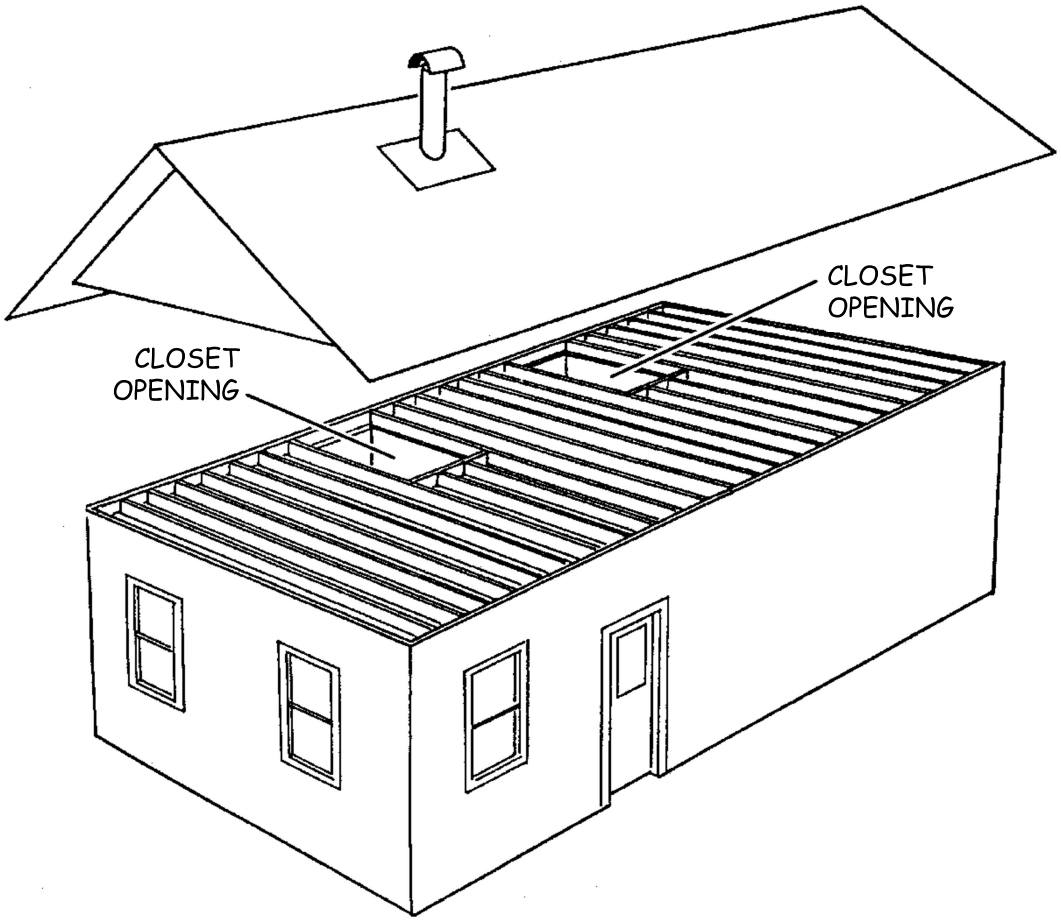
20. CLOSET OPENINGS

- **All insulation**
  - Combustion air supply
    - When closet opening is used for combustion air supply, it shall be blocked per Item 19.
  - Ceiling vents not used for combustion air
    - The opening shall be sealed and covered with insulation.
    - Vents shall be sealed with minimum 1/2" gypsum or plywood or minimum 0.007" metal.
    - Vents shall not be sealed with mineral fiber batts or foam board.



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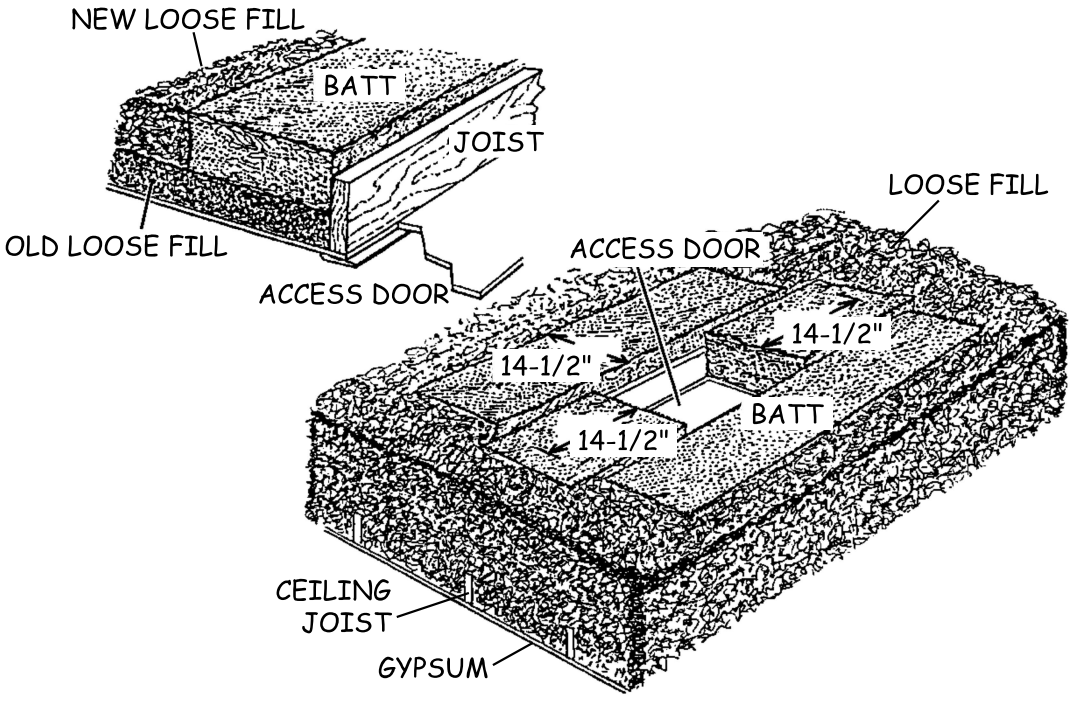
21. ATTIC ACCESS DOOR BLOCKING

- **Loose fill**
  - Each openable access must be blocked.
  - Blocking shall conform to Item 7 and extend from the attic floor to the top of the installed loose fill.
    - Flexible mineral fiber batts shall extend at least 14-1/2" away from access opening in all directions.
    - Metal barrier material shall not be installed.
  - Two-by joists and other wood members:
    - Where wood extends from attic floor to top of installed loose fill, additional blocking is not required.
    - Where wood extends from attic floor but does not equal height of installed loose fill, blocking shall be added.
      - Mineral fiber batt may be used in combination with wood members to achieve required height.
      - Unfaced batt may be placed on top of existing loose fill.
    - Where wood is not present, flexible mineral fiber blocking shall rest on the attic floor.
- **Flexible**
  - Blocking is required only where unblocked loose fill is present at the access opening.



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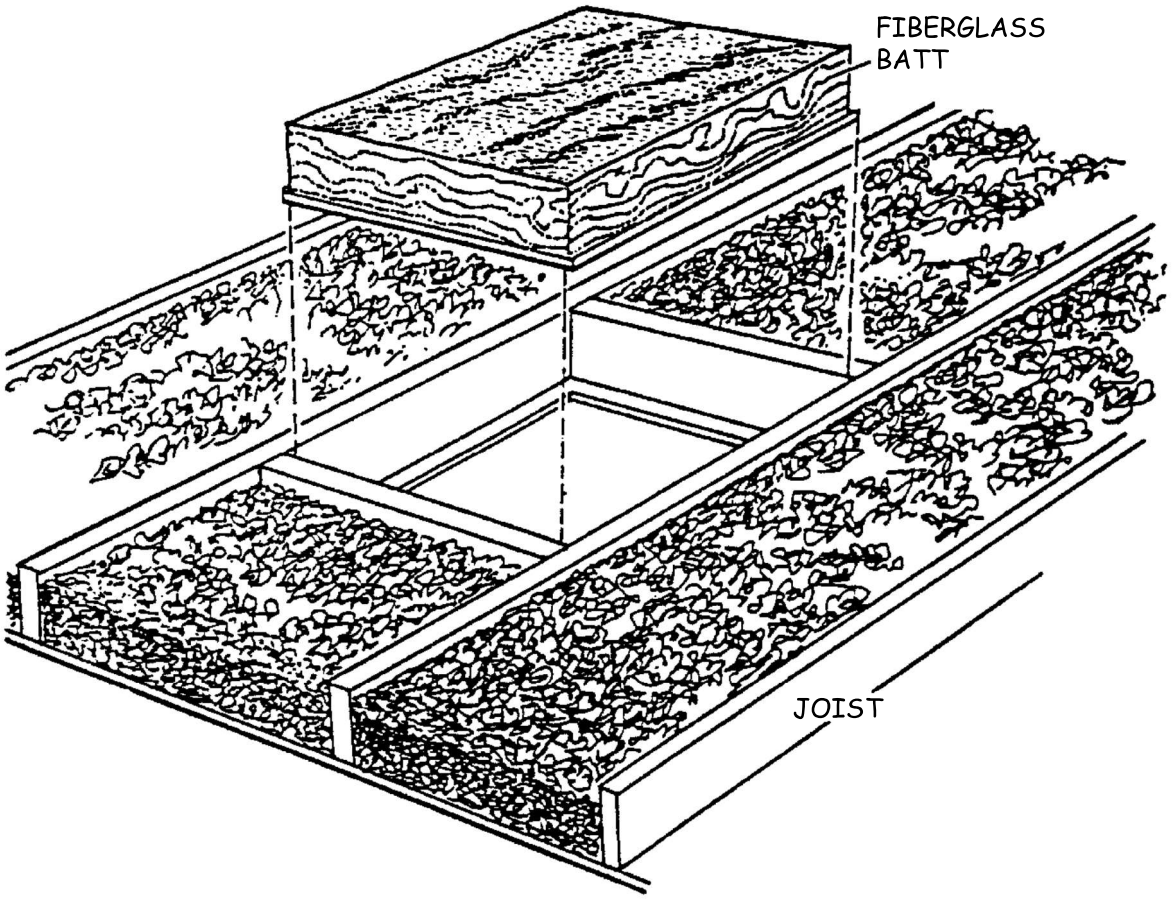
22. ATTIC ACCESS DOOR INSULATION

- **All insulation**
  - All attic entry doors/covers accessed from conditioned space shall be insulated in accordance with Table 3-1:
    - Insulation shall be rigid or flexible and permanently attached.
  - Multiple accesses
    - All attic entry doors/covers adjacent to conditioned space shall be insulated.



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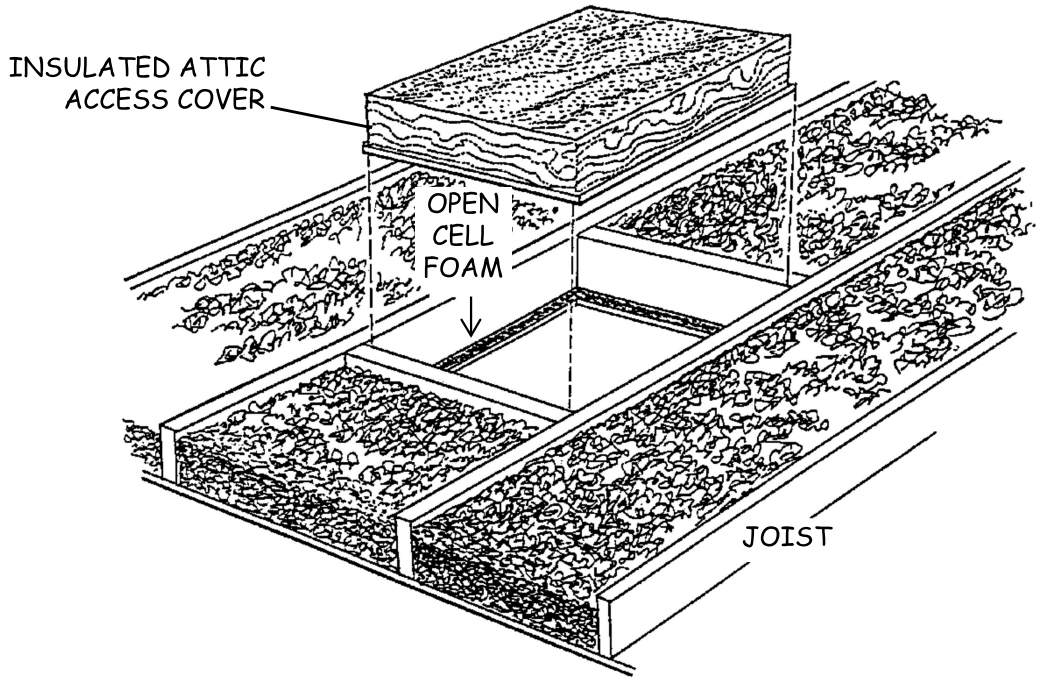
23. ATTIC ACCESS DOOR/COVER WEATHERSTRIPPING

- **Location**
  - Functional/usable attic entry doors/covers accessed from conditioned space shall be weatherstripped.
- **Materials**
  - Horizontal access doors/covers
    - Weatherstripping material shall not create more than a 3/16" gap between door and retaining surface.
    - Visible material, when possible, shall blend with paint color.
  - Vertical access doors
    - Materials approved for entry doors shall be installed in accordance with IS Section 2 (Weatherstripping).
- **Mounting surface**
  - Weatherstripping shall be installed on the surface providing best adhesion (i.e., smooth wood trim rather than textured drywall lid).
  - Mounting surface shall be free of dust, dirt, and debris.



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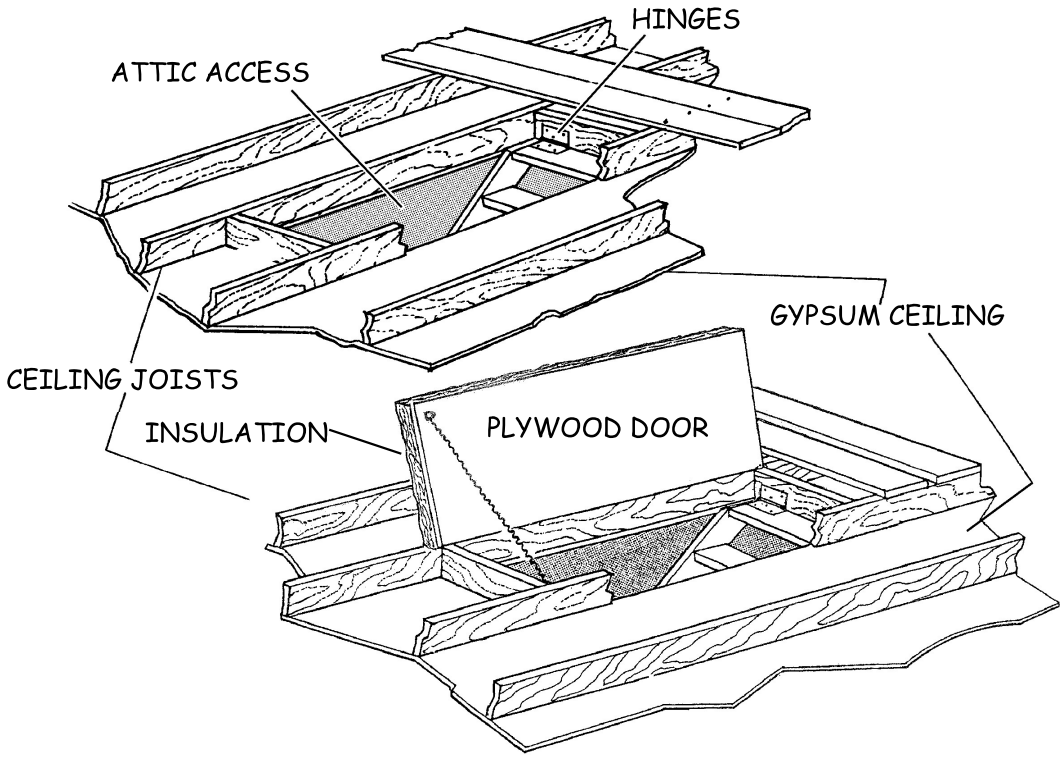
24. DISAPPEARING STAIRS

- **All insulation**
  - When accessed from conditioned space:
    - Hinged lid shall be installed if <u>not</u> already present.
    - Insulation, with R-value equivalent to attic floor insulation, shall be permanently attached to lid.
  - Bottom door (or lid, if no bottom door) shall be weatherstripped as prescribed in Item 23.
- **Loose fill**
  - Blocking shall conform to Item 7 and be installed as prescribed in Item 21.
- **Stairs with top lids**
  - Top lid shall be insulated as prescribed in Item 22.
  - Blocking shall be installed as prescribed in Item 21.
  - Top lid shall be weatherstripped as prescribed in Item 23.



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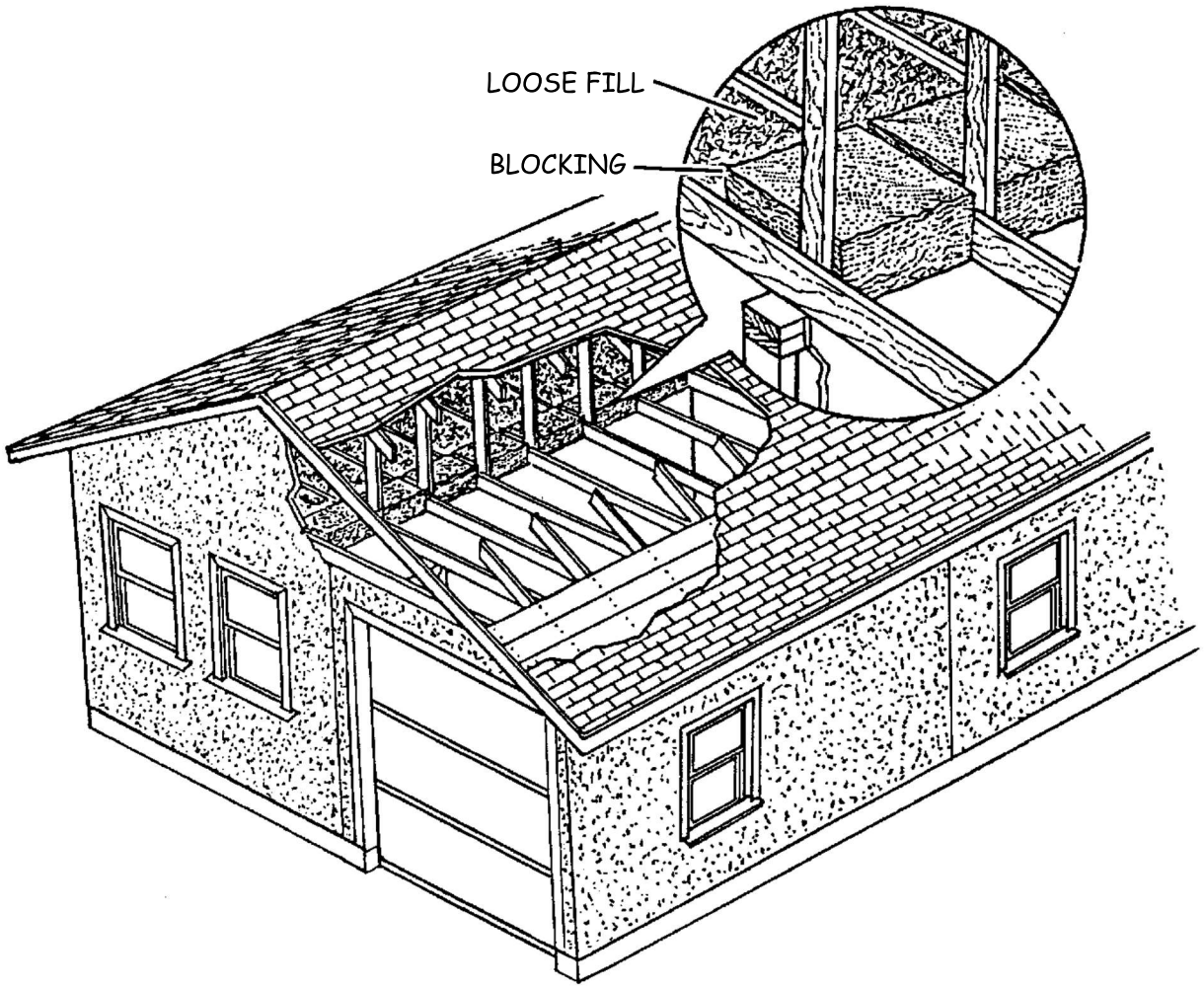
25. OPEN END CAVITIES

- **Loose fill**
  - Blocking shall be installed to prevent loose fill from spilling out the open end of the joist cavity.
  - Blocking shall confirm to Item 7 and rest on the top plate and exceed the height of loose fill by 4".
  - Metal, manufactured pre-cut cardboard chute/barrier material, or flexible insulation may be used.
  - Flexible insulation shall extend at least 14-1/2" back from the open end of the cavity.



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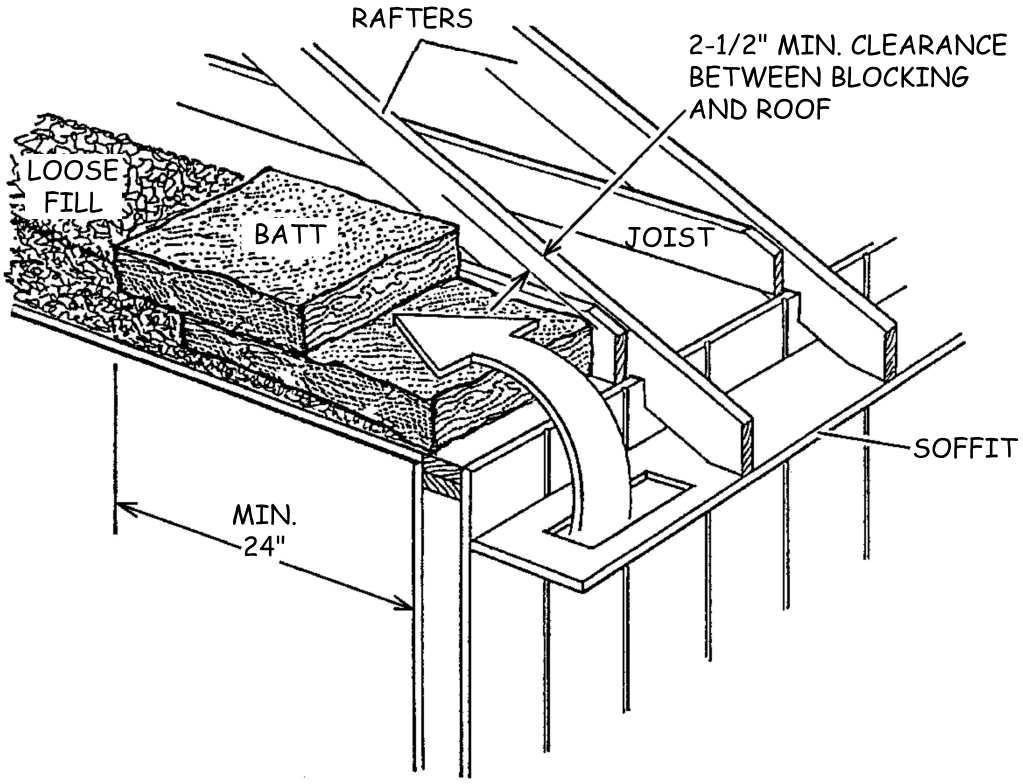
26. EAVE AND SOFFIT VENTS

- **Flexible**
  - Minimum 2-1/2" clearance required between roof sheathing and insulation.
- **Loose fill**
  - Blocking shall be installed which extends to the top plate (i.e., batt, chute, baffle, etc.).
  - Minimum 2-1/2" clearance required between roof sheathing and blocking.
  - Vent screens shall be free of loose fill.
- **Horizontal mineral fiber blocking**
  - May rest on existing loose fill provided no loose fill is exposed at the top plate.
  - Blocking which extends inward 14-1/2" shall exceed height of the loose fill by 4".
  - Blocking which extends inward 24" shall equal or exceed height of the loose fill.



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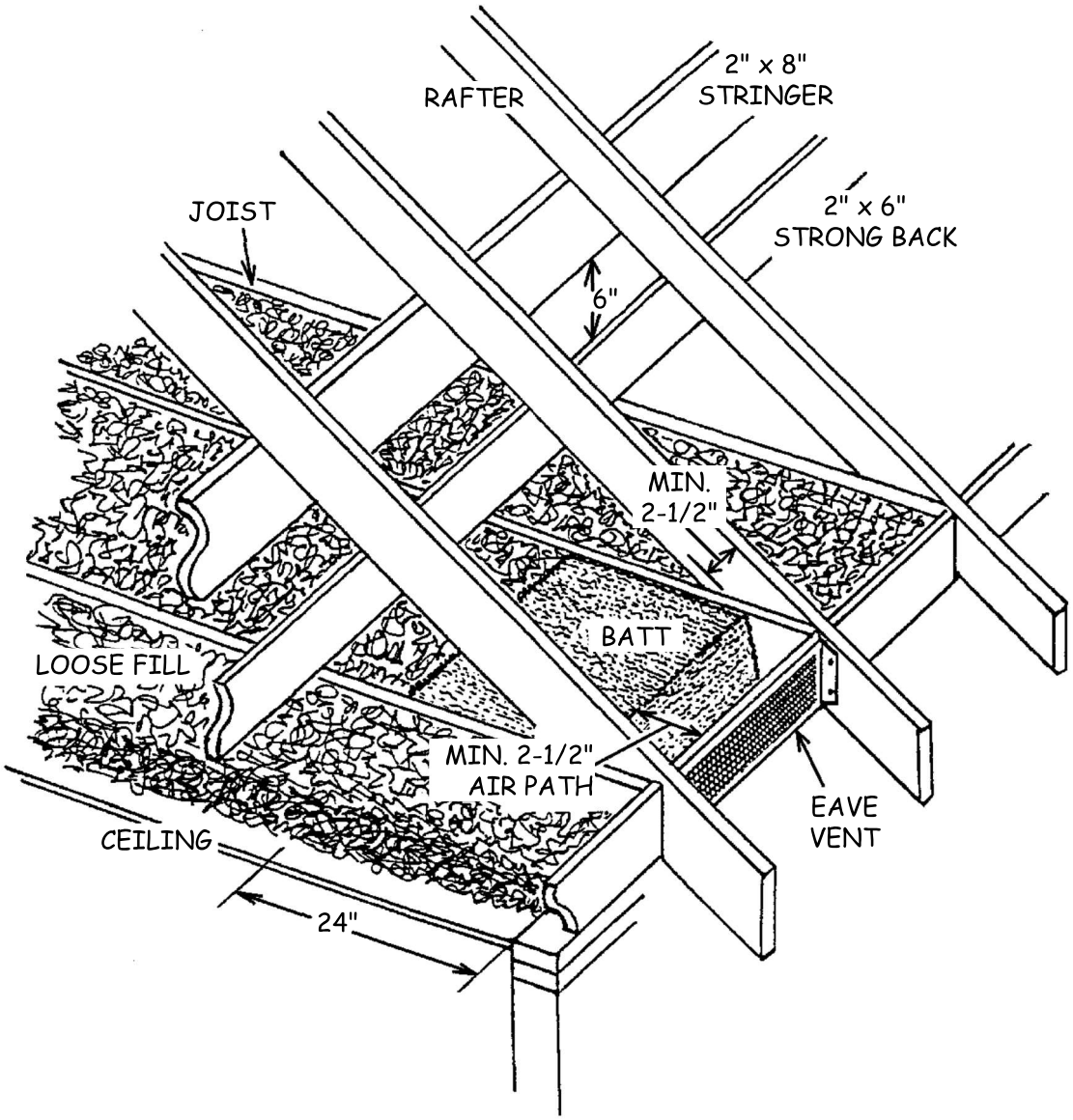
26. EAVE AND SOFFIT VENTS (cont.)

- **Restricted Access**
  - Flexible mineral fiber blocking shall be installed.
  - Minimum 2-1/2" clearance between blocking and roof sheathing.
  - Minimum 2-1/2" air path between vent and blocking.
  - Blocking
    - May be placed over existing loose fill if unfaced batt is used and loose fill is not blocking vent.
    - Shall exceed height of loose fill or extend inward at least 24".



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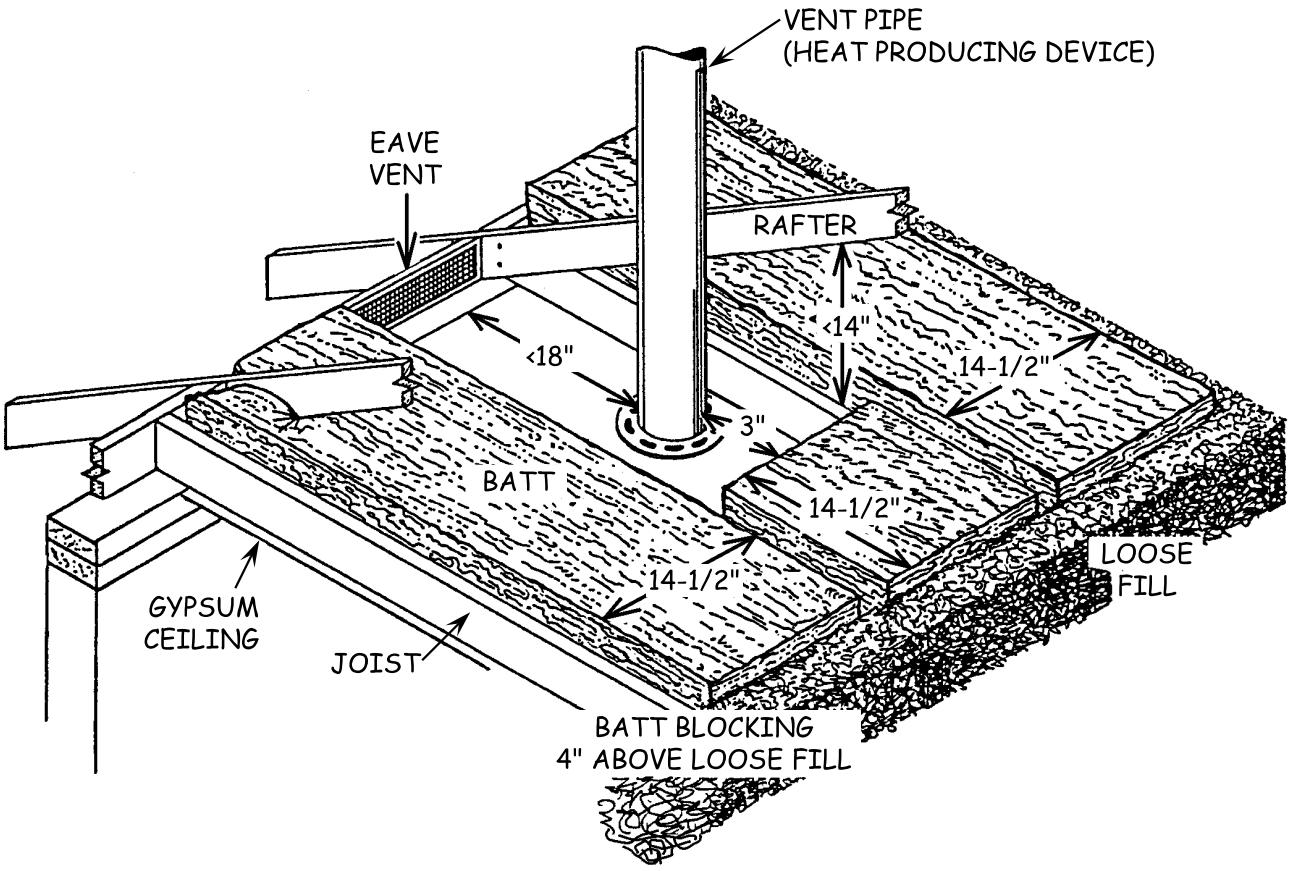
26. EAVE AND SOFFIT VENTS (cont.)

- **Restricted Access (HPD Present)**
  - Applies when HPD is less than 18" from an eave/soffit vent and clearance between floor joists and rafters is less than 14" at edge of clearance zone (as illustrated below).
    - Clearance zone shall be free of loose fill.
    - Minimum 3" clearance required between HPD and blocking.
    - Between joists adjacent to the HPD, flexible mineral fiber blocking shall be installed which rests on the attic floor, extends inward at least 14-1/2", and or exceeds height of the installed loose fill by 4".
    - Along the outside of each joist adjacent to the HPD, flexible mineral fiber blocking shall be installed (may rest on existing loose fill) which extends away from the clearance zone at least 14-1/2" and or exceeds height of installed loose fill by 4".



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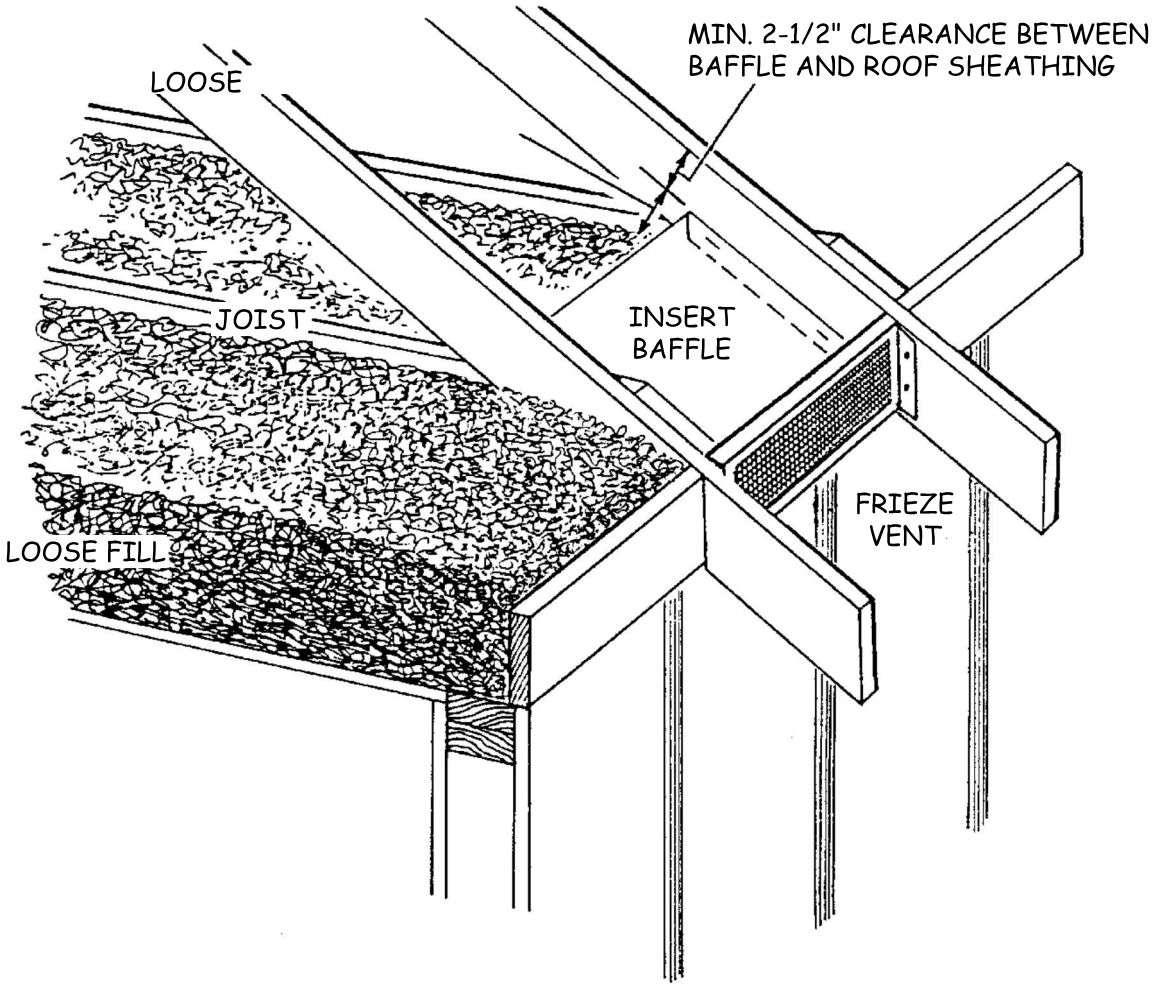
26. EAVE AND SOFFIT VENTS (cont.)

- **Baffles and chutes attached to rafters shall:**
  - Rest on (begin at) the top plate and extend above the loose fill by a minimum of 4" and a maximum of 12".
  - Be permanently attached with a minimum of two mechanical fasteners per rafter.
  - Be kept 3" away from heat producing devices, if non-metal.
- **Baffles and chutes may be made of:**
  - Preformed plastic, commercially available.
  - Precut cardboard, commercially available.
  - Minimum .007" metal.
  - Plywood or gypsum.



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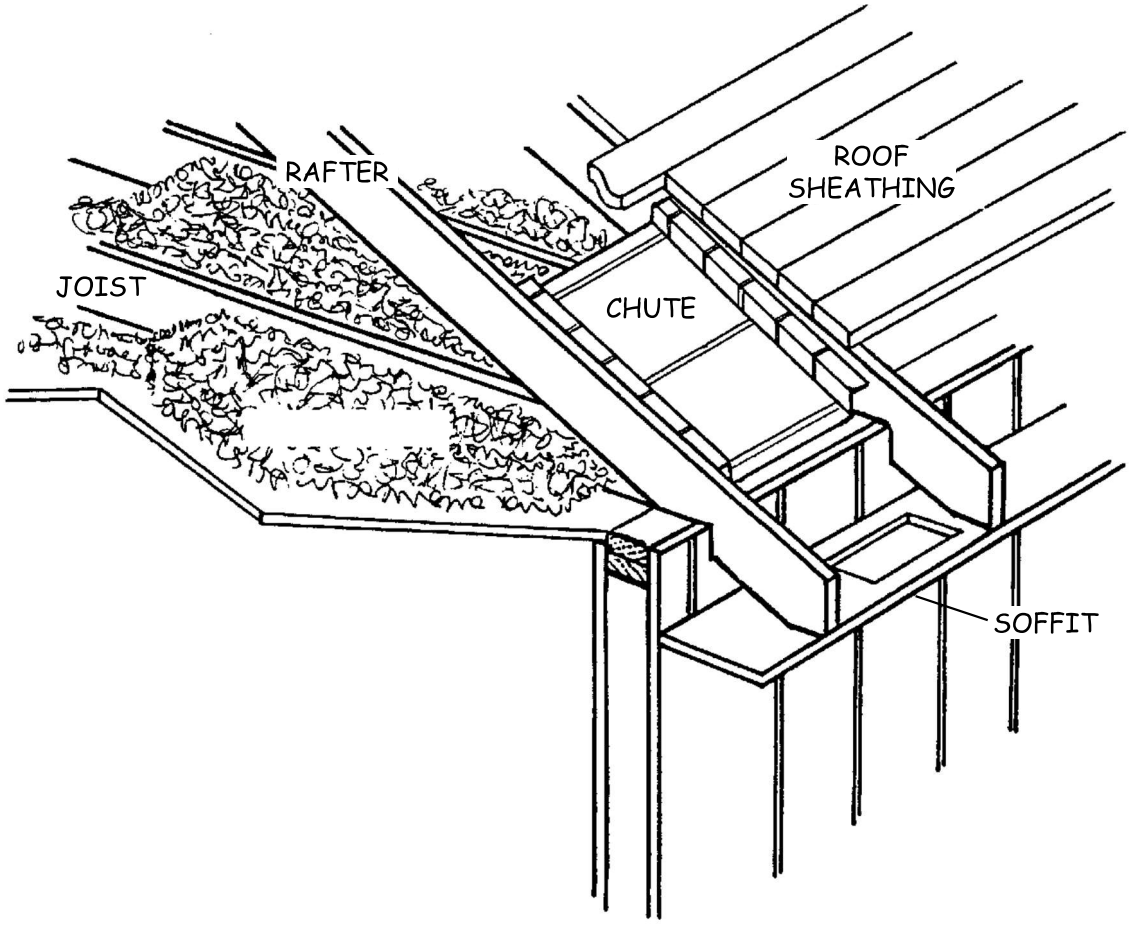
26. EAVE AND SOFFIT VENTS (cont.)

- **Preformed Ventilation Chutes**
  - Molded rigid plastic.
  - Minimum air path:
    - 2" x 12" for 16" OC rafters.
    - 2" X 18" for 24" OC rafters.
- **Chutes shall:**
  - Rest on (begin at) top plate and extend above the loose fill by a minimum of 4" and a maximum of 12".
  - Be permanently attached at the top with at least one mechanical fastener on each side.
  - Be installed in a manner which prevents new loose fill from blowing around the bottom and edges.



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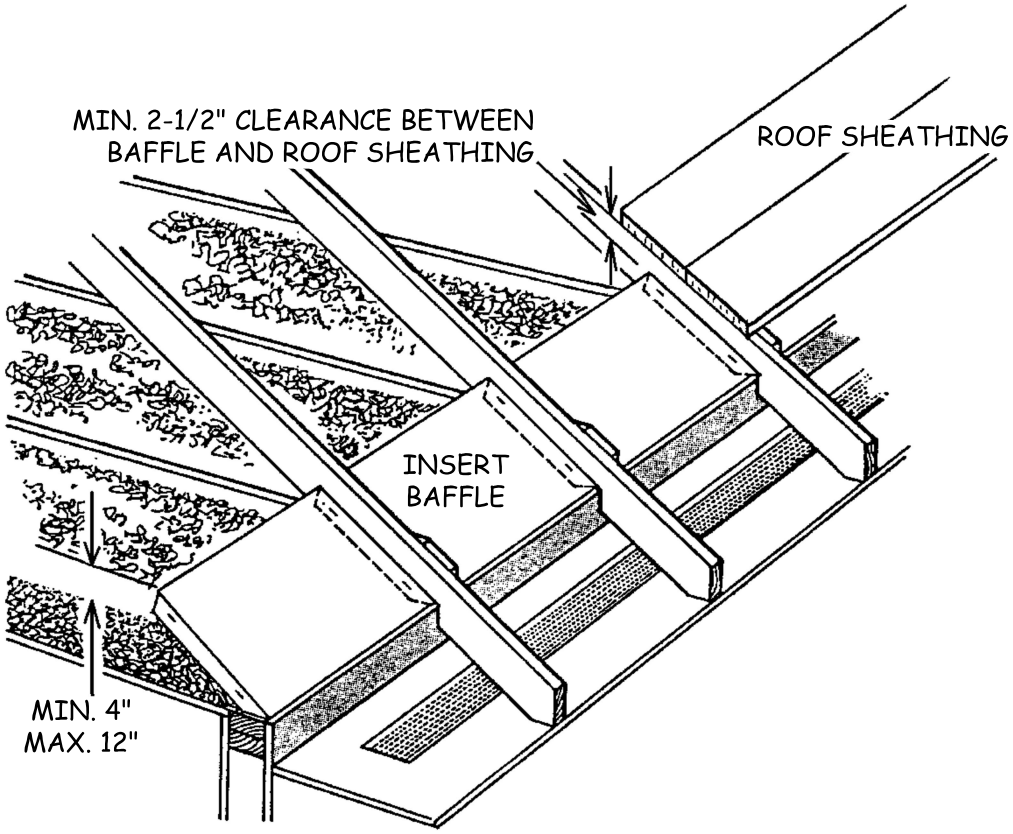
27. CONTINUOUS SOFFIT VENTS

- **All loose fill**
  - Blocking (batts, baffles, or chutes) shall be installed as prescribed in Item 26.
  - All vents, individual or continuous, shall be protected with blocking.
  - Loose fill that falls on the vent screen must be removed.
- **Flexible**
  - Minimum 2-1/2" clearance required between roof sheathing and insulation.
  - Must rest on attic floor.



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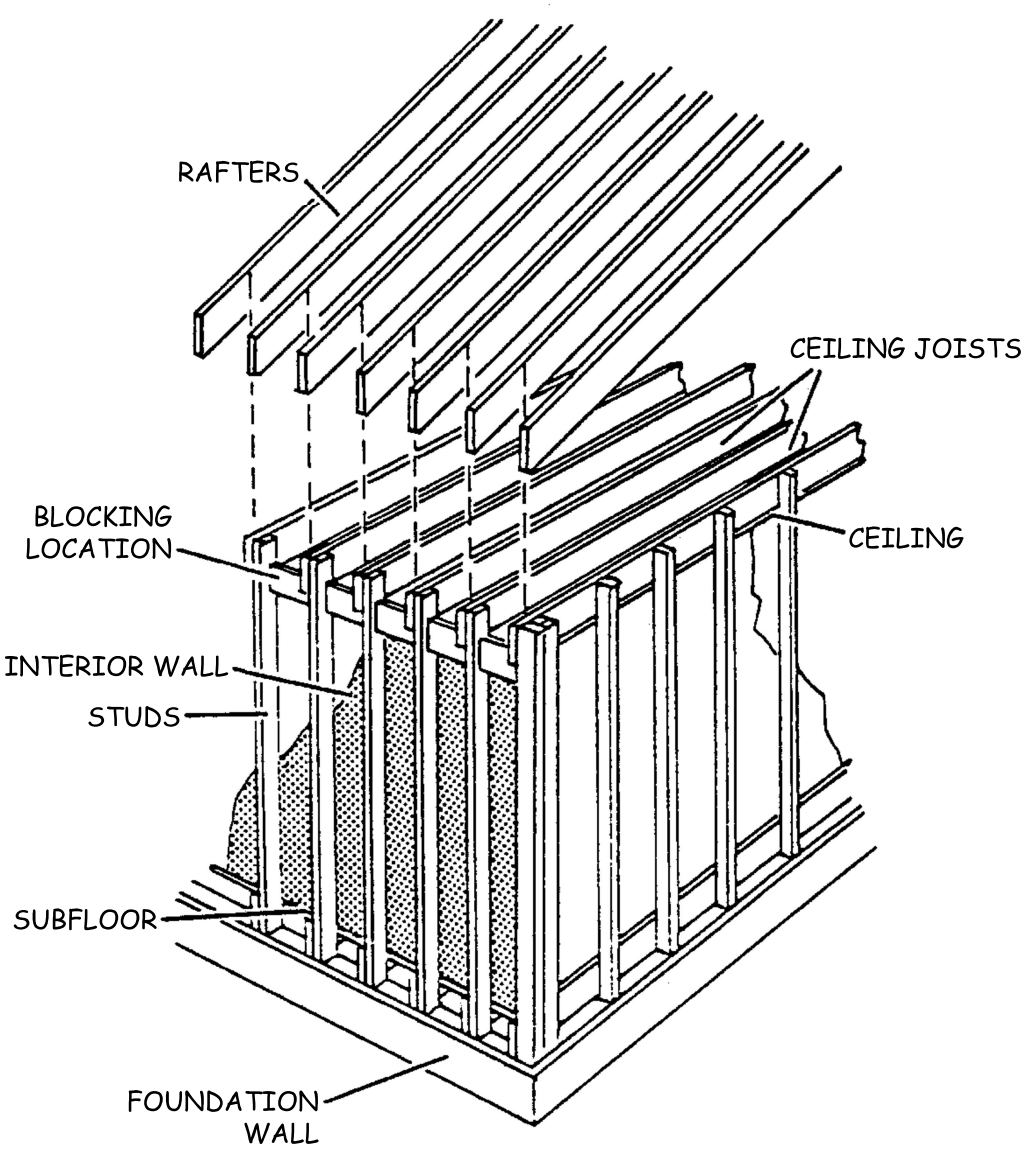
28. BALLOON FRAMING

- **Loose fill**
  - Blocking, in conformance with Item 7, shall be installed to prevent loose fill from falling into open wall cavities and crawl space or basement.



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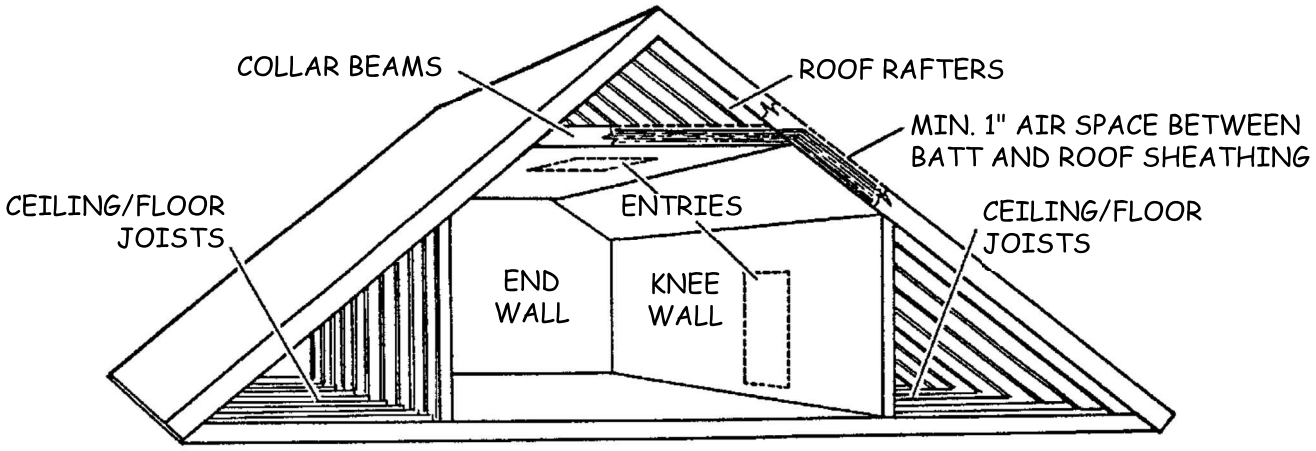
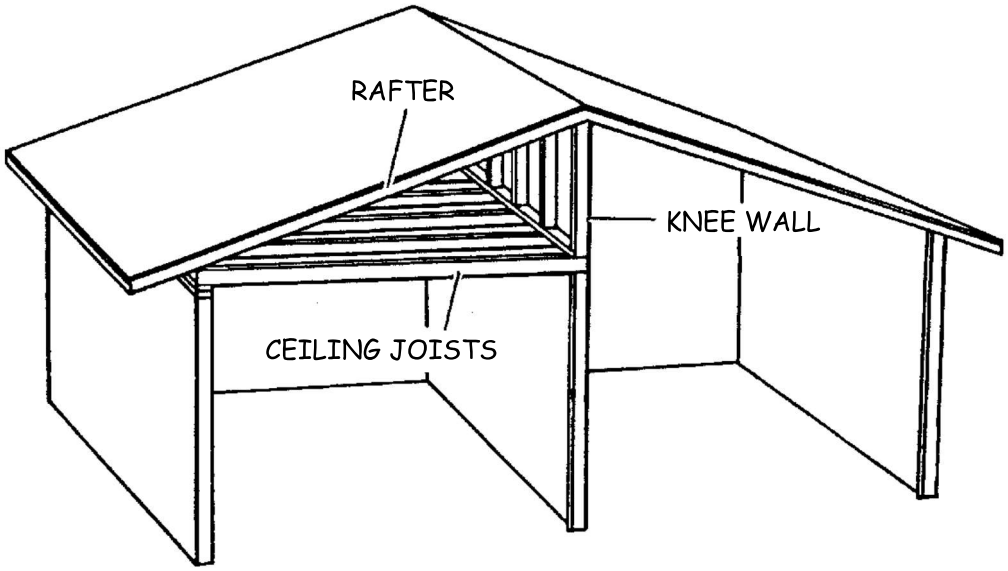
29. KNEE WALLS AND PARTIAL CATHEDRAL CEILING COMBINATIONS

- **Knee walls and skylight wells**
  - Uninsulated knee wall areas and uninsulated skylight wells shall be insulated to the R-value specified in Table 3-1.
- **Sloped ceiling and knee wall combinations**
  - Mineral fiber batt may be installed in partial sloped ceiling cavities.
  - Minimum 1" air space required between batt and roof sheathing.
  - Loose fill not allowed.
- **Sloped ceiling with attic above**
  - Required R-value shall be maintained over the entire sloped ceiling.
  - Loose fill material shall be certified by the manufacturer for slopes greater than 4:12.





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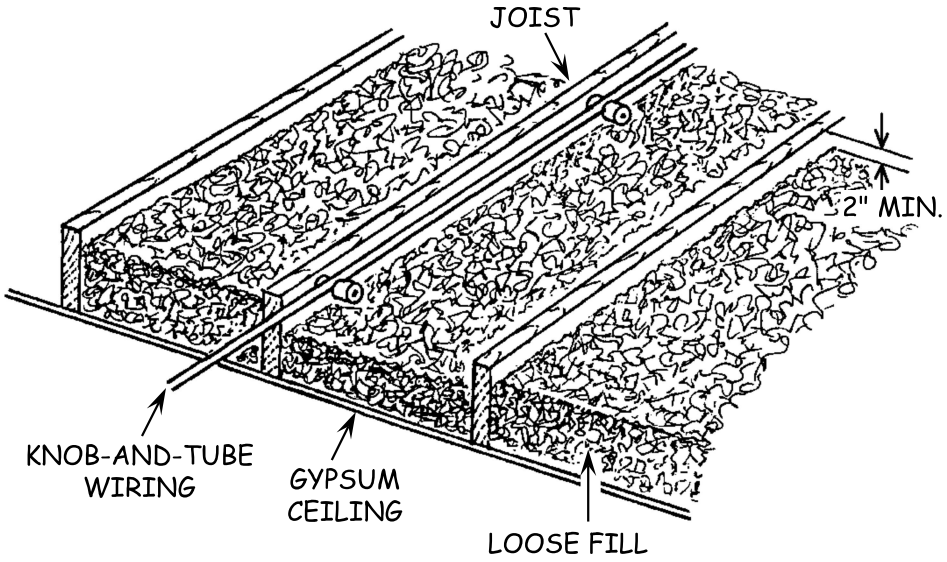
30. K&T WIRING

- **All insulation**
  - Insulation shall <u>not</u> be installed when K&T wiring is present.



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31. DUCT REPAIR AND SEALING

- **Forced air systems**
  - Duct leaks shall be sealed, disconnections shall be reconnected, and needed duct repairs shall be made in accordance with IS Section 10 (Duct Testing and Sealing).

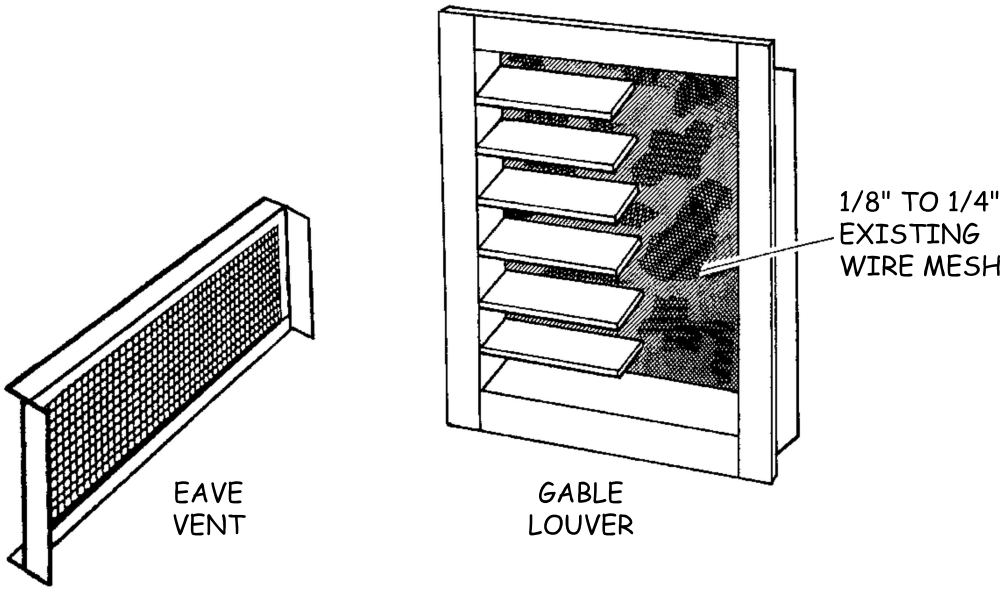
PART 2: ATTIC VENTILATION

32. APPROVED MATERIALS

- **Wood**
  - Shall be constructed of treated stock or redwood.
  - Shall be installed only in gable applications.
- **Metal**
  - Galvanized sheet metal or aluminum.
- **Plastic**
  - Shall be UV-resistant.

33. MESH

- **Required on all vents except turbines.**
- **Shall be made of corrosion-resistant metal only; nonmetallic mesh is not allowed.**
- **The weave on existing vents shall be 1/8"–1/4".**
- **New mesh with 1/4" weave shall be installed when:**
  - Existing mesh has tears or gaps greater than 1".
  - The mesh is missing.



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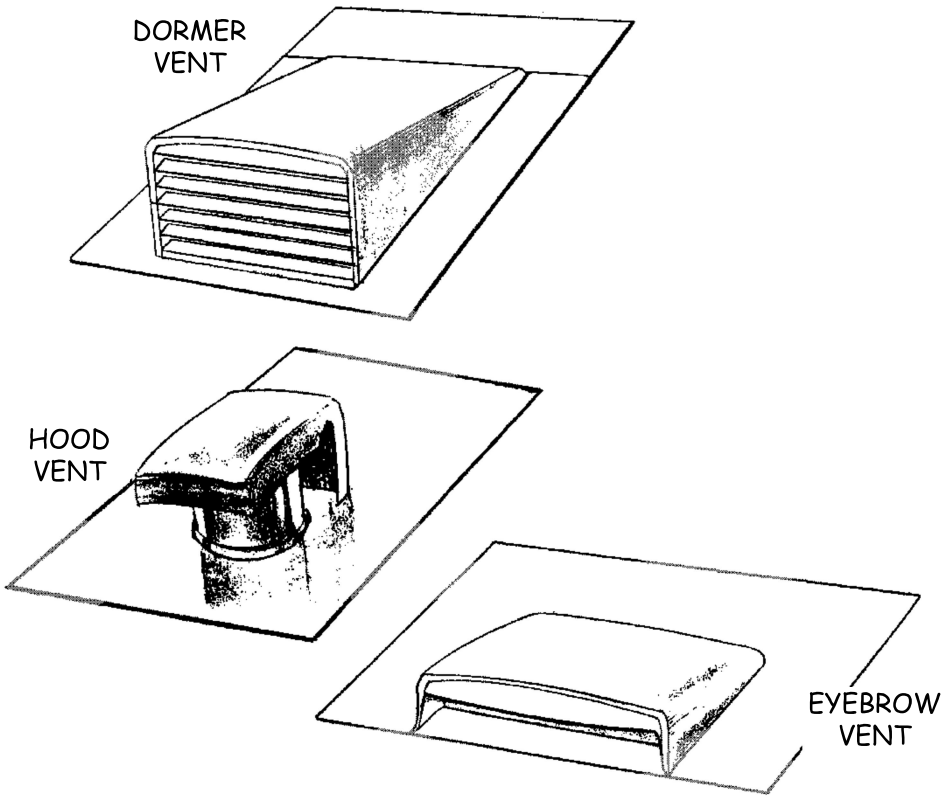
34. ROOF JACKS

- **Vents shall be constructed of galvanized sheet metal or aluminum.**
- **Roof jacks**
  - Includes dormer, eyebrow, mushroom, and hood vents.
  - Not allowed for low vents when eave or soffit vents can be installed.
  - Not allowed when roof slope is less than 2:12.



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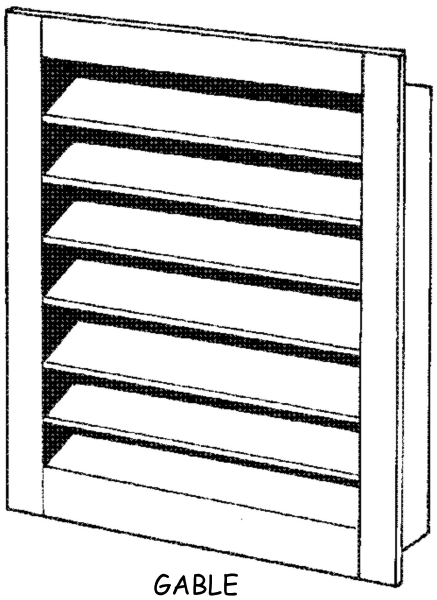
35. LOUVERS

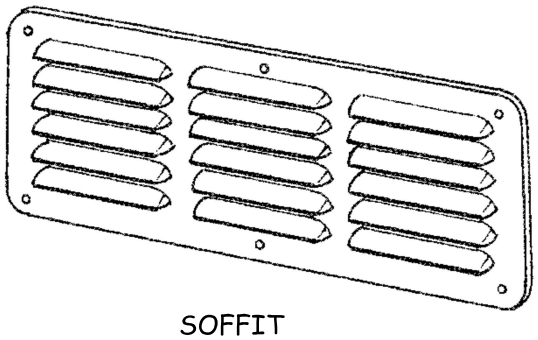
- **Louvers shall be present on vents exposed to precipitation.**
- **Vertical vents**
  - Louvers shall be angled downward.
- **Horizontal vents**
  - Louvers shall be directed toward the wall.

36. INSULATION PRECAUTIONS

- **Vents adjacent to insulation**
  - Applies to eave and soffit vents and to gable vents and roof jacks used for lower venting, etc.
  - Insulation shall not obstruct or hamper proper operation of vents.
- **Loose fill insulation**
  - Blocking shall be installed as prescribed in Part 1: Attic Insulation.
- **Flexible insulation**
  - A 1" clearance (air path) required between insulation and the:
    - Roof sheathing.
    - Vent opening.



GABLE LOUVER



SOFFIT VENT

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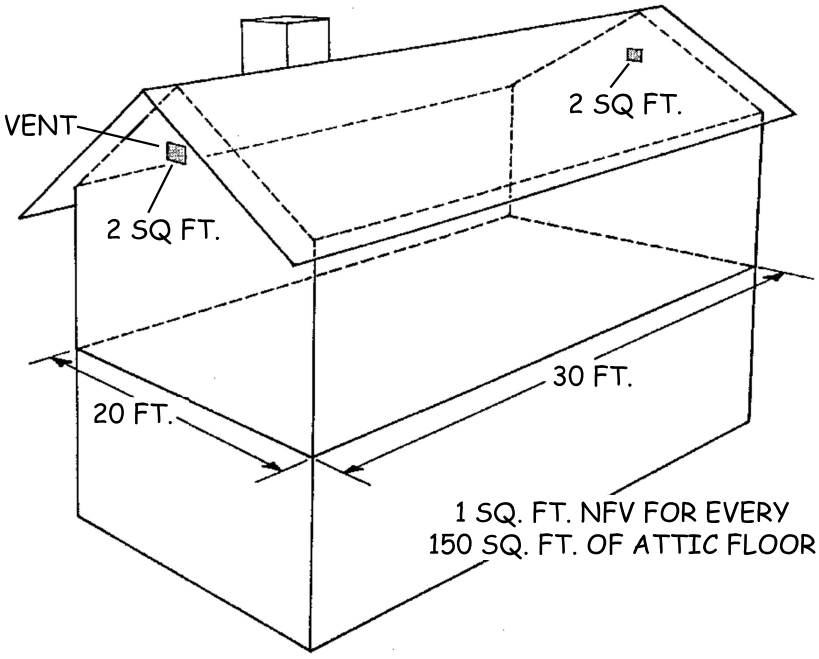
37. VENTILATION

- **All insulation**
  - For attic insulation to be installed, venting shall comply with the following CRC criteria, unless superseded by the program P&P.
  - Cross ventilation for each separate space is required.
- **CRC Venting criteria**
  - One square foot of NFVA required per 150 sq. ft. of ceiling area.
  - A ratio of 1 sq. ft. to 300 sq. ft. is acceptable if either or both of the following conditions are met:
    - Class I or II vapor retarder placed toward the winter warm side is present, in CZ 14 and CZ 16.
    - Forty to fifty percent of the venting is upper venting, with upper vents located within 3' of the ridge or highest point of the space, with the balance of required ventilation provided by lower venting.



38. HIGH AND LOW VENTS

- **The following may be used as high vents:**
  - Gable vents.
  - Roof jacks (e.g., eyebrow, dormer, mushroom and hood).
  - Ridge vents.
- **The following may be used as low vents:**
  - Eave and soffit vents, when possible.
  - When eave or soffit vents cannot be installed:
    - Eyebrow or dormer vents may be mounted low on the roof.
    - Gable vents may be mounted low on unvented gable walls.

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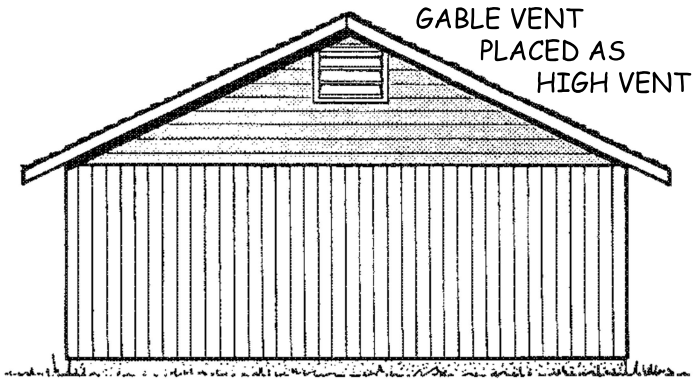
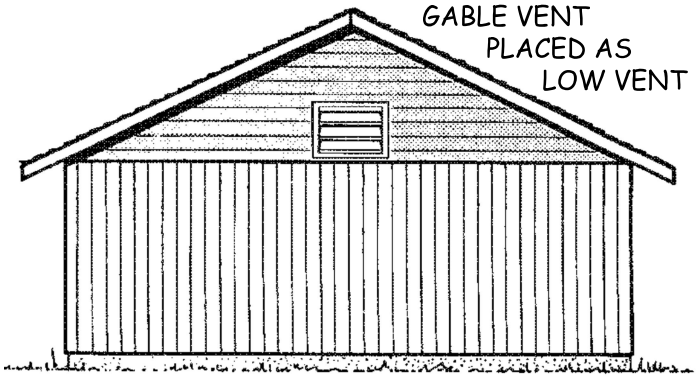
39. PLACEMENT AND INSTALLATION

- **All vents**
  - Placement and installation shall be in conformance with manufacturer's instructions and applicable codes.
  - High and low vent combination shall be installed when possible.
- **Eave and soffit vents**
  - Unless replacing an existing vent, eave and soffit vents shall not be installed above an operable window when prohibited by local jurisdiction.





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- **Roof jacks (static vents with flanged base)**
  - At least 2/3 of the upper base flange shall be secured underneath roofing material.
  - Shall not be installed on roofs with a slope of less than 2:12.
- **Ridge vents**
  - Base flanges shall be secured underneath roofing material.
  - Shall not be installed on metal, shake, or wood shingle roofs.

40. EXISTING MESH

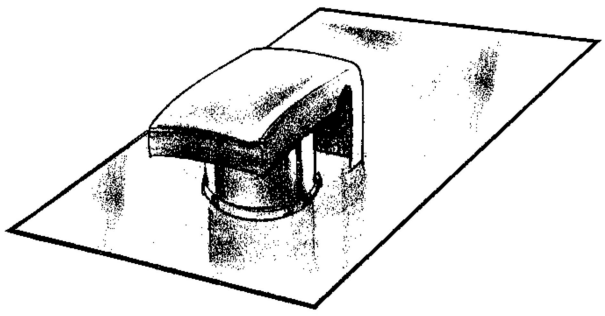
- **All vents**
  - Existing mesh shall be cleaned or replaced if openings are clogged.
  - Removal of 1/16" insect screen and replacement in accordance with Item 33 is required.

41. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

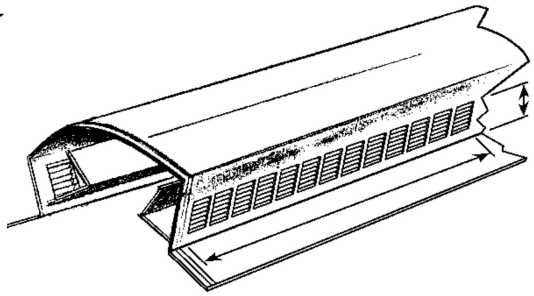
- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up**
  - Paint dust and chips, scraps, and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Furniture and other household items moved for installation work shall be returned to their original positions.

MOBILE HOME CRITERIA

None—This section does not apply to mobile homes.



ROOF JACK



RIDGE VENT

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CENTRAL AIR CONDITIONER TUNE-UP STANDARDS

Lead Paint Risk Factor
NONE

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SECTION 4 PREFACE
for

CENTRAL AIR CONDITIONER TUNE-UP

1. Nonfeasibility Criteria

1.1. The existing A/C needs repair or is non-operational.

1.2. The existing A/C is not a central split system or package unit.

1.3. The home is in a climate zone not approved for A/C tune-ups.

1.4. The A/C system has been tuned up within the last five years (or the interval specified by utility-specific policy).

1.5. The A/C is combined with a furnace (package unit or split system), and the furnace fails NGAT and correction is not feasible.

1.6. The duct system contains asbestos, disconnections, and/or excessive damage or deterioration and cannot be brought into compliance with IS Section 10 (Duct Testing and Sealing).

1.7. Airflow is below manufacturer's minimum specifications (e.g., determined by Subcooling Airflow Range Calculator or measured at less than 300 cfm/ton), and airflow cannot feasibly be brought into conformance.

1.8. The A/C system has a refrigerant leak.

1.9. The condition or location of the A/C unit and/or condenser makes it unsafe to perform one or more of the tune-up procedures.

1.10. Customer refuses.

2. Installation Policies

2.1. Central A/C tune-up may be performed on existing package units and split systems in all housing types, but only in approved climate zones.

2.2. Procedures shall not be performed that will violate the equipment manufacturer's warranty.

2.3. In accordance with individual utility policy, airflow assessment and refrigerant charge adjustment may be performed using in-house or third-party verification.

2.4. When in-house verification is performed, the proper refrigerant charge diagnostic procedure shall be performed in accordance with T-24 requirements in RA3.2 and A/C manufacturer's recommendations.

2.5. When third-party verification is utilized, airflow assessment and refrigerant charge adjustment shall be performed in accordance with and verified by a third-party tune-up monitoring/verification service.

3. Installation Policies Specific to Mobile Homes

None.

CENTRAL A/C TUNE-UP STANDARDS

A/C TUNE-UP OVERVIEW

1. APPROVED METHODS

- **All tune-ups**
  - Performed on central air-cooled A/C and air source heat pumps (HP).
  - Shall be performed using either:
    - CEC-approved diagnostic methods, per the current Title 24 Residential Compliance Manual, or
    - An approved third-party verification method.
  - Shall address the following treatments:
    - Verification of system operation.
    - Air filter cleaning/replacement.
    - Air handler service.
    - Evaporator coil service.
    - Condenser unit service.
    - Verification of proper airflow across the evaporator coil.
    - Verification of proper refrigerant charge and correction, if needed.
  - When a third-party method addresses a required treatment, third-party method–specified procedures apply.
  - When a third-party method does not address a required treatment, treatments must be implemented per this standard.

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Section 4

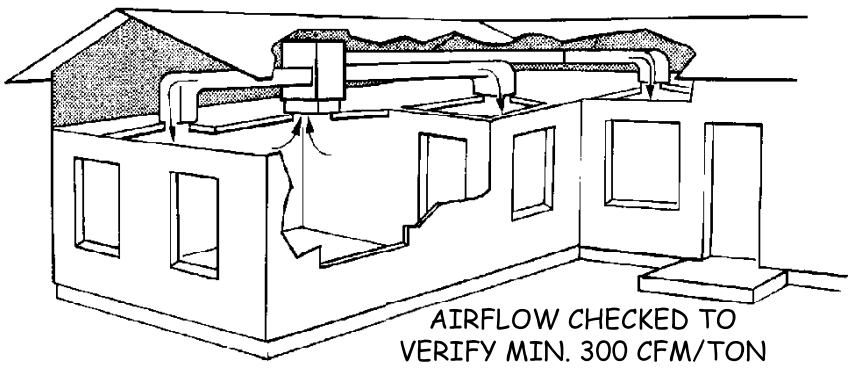
PART 1: A/C TUNE-UP USING CEC-APPROVED DIAGNOSTIC METHODS

2. GENERAL REQUIREMENTS

- **Order of procedure**
  - CEC-approved diagnostic methods shall be used in the following order:
    - Step 1: AC/HP system evaluation, cleaning, and correction.
    - Step 2: Airflow assessment.
    - Step 3: Refrigerant charge verification and correction.
- **Minimum airflow**
  - Refrigerant charge shall only be performed if system airflow across evaporator coil is verified to be 300 CFM/ton or greater.
- **CEC Standards**
  - The appropriate diagnostic procedures specified in Title 24 RA3.2 shall be used.
  - When outdoor temperature is <55°F, weigh-in method shall be used.
- **Refrigerant theft protection**
  - When an A/C is repaired or replaced, locking caps shall be installed on accessible refrigerant service valves.
    - Exception: Locations requiring keyed access.
  - Locking caps shall be brass with integral O-ring and covering/plating that is color-coded or labeled for refrigerant type.

3. STEP 1: AC/HP SYSTEM EVALUATION, CLEANING, AND ADJUSTMENT

- **Verification of system operation and setting up system for maintenance**
  - Verify complete system operation, including:
    - Temperature of supply air (unit must be cooling), and
    - Temperature of suction line (must be cold).
  - Open all register dampers, duct dampers, and zone dampers.
  - Check that thermostat functions properly.



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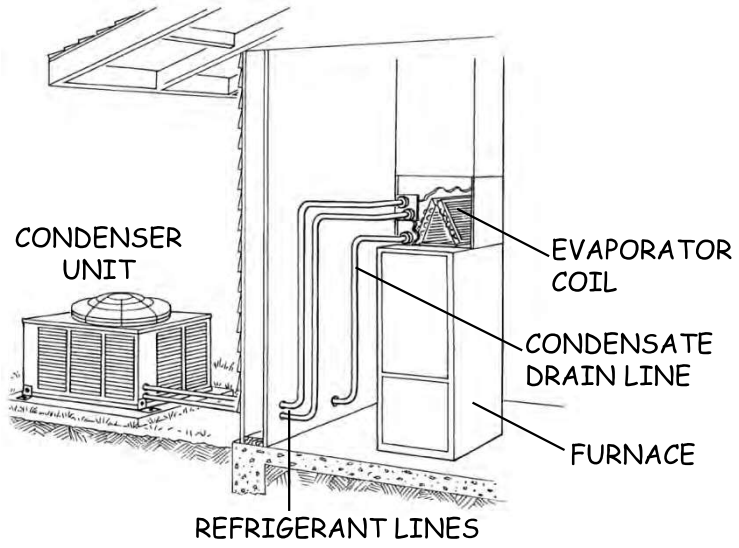
3. STEP 1: AC/HP SYSTEM EVALUATION, CLEANING, AND ADJUSTMENT (cont.)

- **Air handler service**
  - Air handle blower wheel shall be cleaned.
- **Air filter cleaning/replacement**
  - Replaceable filters shall be replaced.
  - Washable filters shall be cleaned or replaced per IS Section 18 (Natural Gas Central Forced Air Heating System R&R), Part 5.
  - Electrostatic filters shall be clean but not replaced.
- **Evaporator coil service**
  - Evaporator coil shall be checked and cleaned when it can be accessed through removable panels.[1]
    - Coil shall be cleaned using a brush, vacuum, and/or air pressure.
    - Components shall be allowed to dry before proceeding if water or chemicals are used.
    - Condensate drain system (including pump, when present) shall be checked and cleaned as needed.
    - Accessible coil fins shall be checked for damage and combed as needed.
    - Access panels shall be closed and sealed with UL 181A/B or B-FX metallic tape with non-butyl adhesive.



[1] Coil removal for cleaning when removable access panels are not present is beyond the scope of this measure.

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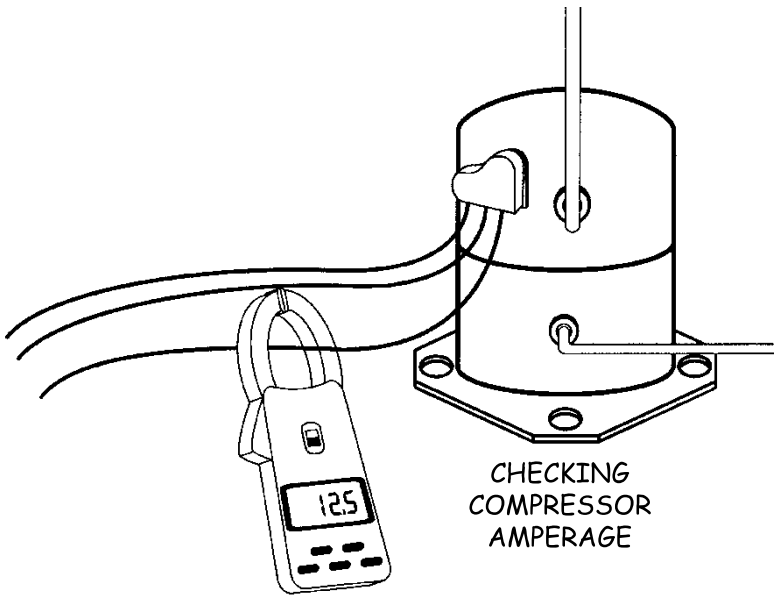
3. STEP 1: AC/HP SYSTEM EVALUATION, CLEANING, AND ADJUSTMENT (cont.)

- **Evaporator motor service**
  - Visually inspect capacitors and wiring.
  - Check blower components.
    - Check motor bearings for wear and oil them as needed.
    - Check blower wheel and clean as needed.
  - Check blower motor amperage for compliance with manufacturer's specified range, with:
    - Blower operating at high speed, and
    - Access panel in place.
- **Condenser unit service**
  - Check and clean condenser unit.
    - Unit shall be cleaned using:
      - Vacuum and/or air pressure, and/or
      - Chemicals (sprayed and hosed down).
    - Components shall be allowed to dry before proceeding when water or chemicals are used.
- **Condenser motor service**
  - Visually inspect capacitors and wiring.
  - Check compressor contact points and compressor terminal block to ensure all connections are proper and tight.
  - With unit operating in AC mode, check the following for compliance with manufacturer's specifications:
    - Condenser fan amperage, and
    - Compressor amperage.
  - Check fan motor bearings for wear and oil them as needed.



CHECKING COMPRESSOR AMPERAGE

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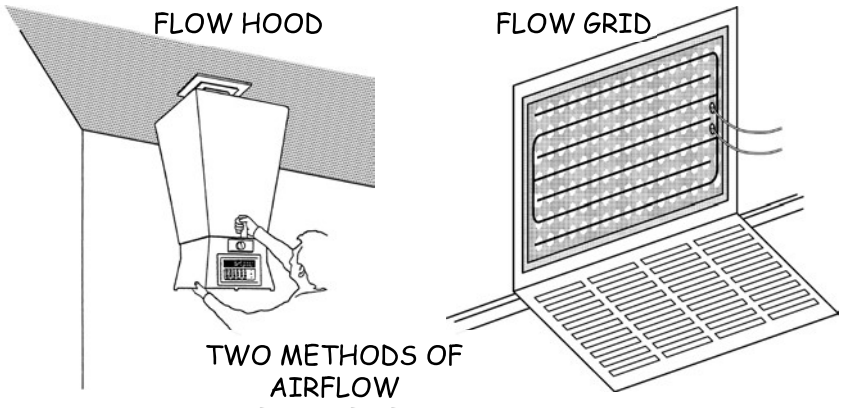
4. STEP 2: AIRFLOW ASSESSMENT

- **Minimum airflow**
  - A CEC-approved method shall be utilized to determine whether airflow across the evaporator coil is 300 CFM/ton or greater, which is required to allow a valid refrigerant charge test.
- **Acceptable methods of checking airflow include:**
  - Direct measurement methods per Title 24 Residential Appendix RA3.
    - Plenum pressure matching and fan flowmeter
    - Flow grid
    - Powered flow capture hood
    - Traditional flow capture hood

5. STEP 3: REFRIGERANT CHARGE VERIFICATION AND CORRECTION

- **Feasibility**
  - Verification shall only be conducted on A/C systems that have been evaluated, cleaned and adjusted and system airflow verified to be 300 CFM/ton or greater.
- **Procedure**
  - Proper refrigerant charge and correction shall be verified using a CEC-approved method appropriate for ambient conditions and equipment type, as defined in Residential Appendix RA3.2.
  - Approved methods include:
    - Superheat method for fixed-orifice metering devices.
    - Subcooling method for TXV metering devices.
    - Weigh-in method (use when outdoor temperature is <55°F and no applicable alternative noted in RA1 is available).
  - When RA3.2 specifies different pass/fail criteria for installer and HERS rater:
    - Pass/fail criteria for the installer shall be used.
    - If the system fails the verification test, the refrigerant charge shall be corrected and re-verified.



TWO METHODS OF AIRFLOW

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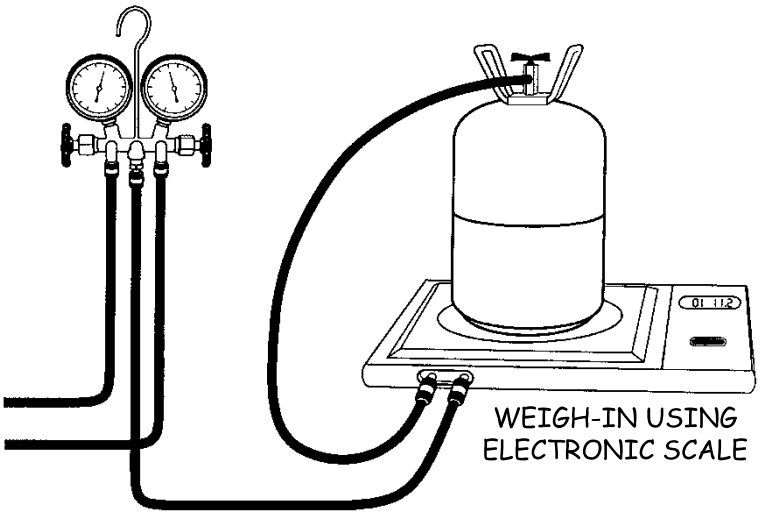
PART 2: A/C TUNE-UP USING THIRD-PARTY VERIFICATION METHOD

6. PROCEDURE FOR THIRD-PARTY VERIFICATION METHOD

- **Method shall:**
  - At a minimum, address system airflow and refrigerant air charge, and
  - Be executed per third-party verification method specifications to address the following treatments:
    - Verification of system operation.
    - Air filter cleaning/replacement.
    - Air handler service.
    - Evaporator coil service.
    - Condenser unit service.
    - Verification of proper airflow across the evaporator coil.
    - Verification of proper refrigerant charge and correction, if needed.
- **Other requirements**
  - If third-party protocol does not address one or more required treatments, the specifications contained in Part 1 shall apply.
  - For superheat and subcooling methods, outdoor temperature shall be in compliance with the third-party protocol used.
  - When ambient temperature is below the required minimum, an approved “weigh-in” procedure shall be utilized as specified by the third party.



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POST-INSTALLATION

7. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Operation check**
  - The system shall be tested for proper operation.
  - Proper operation shall be explained and demonstrated to the customer, including:
    - Filter replacement.
    - Routine maintenance recommended by the manufacturer.
- **Refrigerant handling**
  - Refrigerant recovery, handling, and disposal shall be performed in accordance with federal law by a technician with EPA-approved certification as a Type II or Universal technician.
- **Clean-up**
  - Any debris resulting from tune-up work shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Furniture and other household items moved for tune-up work shall be returned to their original positions.
  - All hazardous waste materials shall be disposed of in conformance with federal, state, and local codes.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

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WATER HEATER TANK INSULATION

Lead Paint Risk Factor
NONE

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Section 5

20. Exterior Compartment Wall and Door Insulation 14

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SECTION 5 PREFACE
for

WATER HEATER TANK INSULATION

1. Nonfeasibility Criteria

All Water Heaters

1.1. The existing blanket is functioning properly, even if it is not installed in accordance with current installation standards.

1.2. External insulation is specifically prohibited by the manufacturer.

1.3. A T&P relief valve or automatic gas shutoff valve is not present or is not located within 6" of the tank.

1.4. The T&P valve discharge faces the front of the tank and has no drain line directed away from the front of the tank.

1.5. The T&P valve outlet is plugged or capped.

1.6. The tank/location is unsafe, such as:

a. Weak or unstable flooring does not hold tank in stable position.

b. The tank is leaning abnormally.

c. Safe access is not available and/or state and federal regulations regarding confined spaces cannot be met.

1.7. The tank is exposed to weather.

1.8. A leak is present in the tank or water pipes.

1.9. Plastic piping (e.g., CPVC) is present in the cold or hot water line to/from the tank.

1.10. Three blanket straps physically cannot be installed.

1.11. The tank is located within 12" of a stove, range, or cooktop.

1.12. The tank capacity is greater than 100 gallons.

1.13. The water heater is a tankless type.

1.14. Customer refuses.

Gas Water Heaters

1.15. Front clearance prior to blanket installation is less than 4" between the tank and the door.

1.16. A gas leak is present.*

1.17. The vent pipe and/or draft hood is not properly installed, including*:

---

* When this condition exists, contact designated utility personnel.

a. No draft hood is present.
b. Two draft hoods are present.
c. The vent pipe is defective or missing.

1.18. Evidence of improper combustion and/or venting exists as characterized by*:
a. A large accumulation of soot near the draft hood or on the floor underneath.
b. Scorching at the draft hood or combustion chamber.

1.19. No appliance line valve (gas shutoff valve) is present.

1.20. Both the burner access door and rollout shield are missing.*

1.21. The internal insulation is R-12 or greater.

1.22. A non-FVIR water heater located in a garage is not 18″ off the floor.

Electric Water Heaters

1.23. Hazardous electrical wiring/conditions are present.

1.24. Thermostat cover plate is missing.

1.25. Internal insulation is R-16 or greater.

2. Installation Policies

2.1. Only water heaters supplying hot water to residential units receiving other ESA Program measures are eligible to receive water heater insulation blankets.

3. Installation Policies Specific to Mobile Homes

None.

* When this condition exists, contact designated utility personnel.

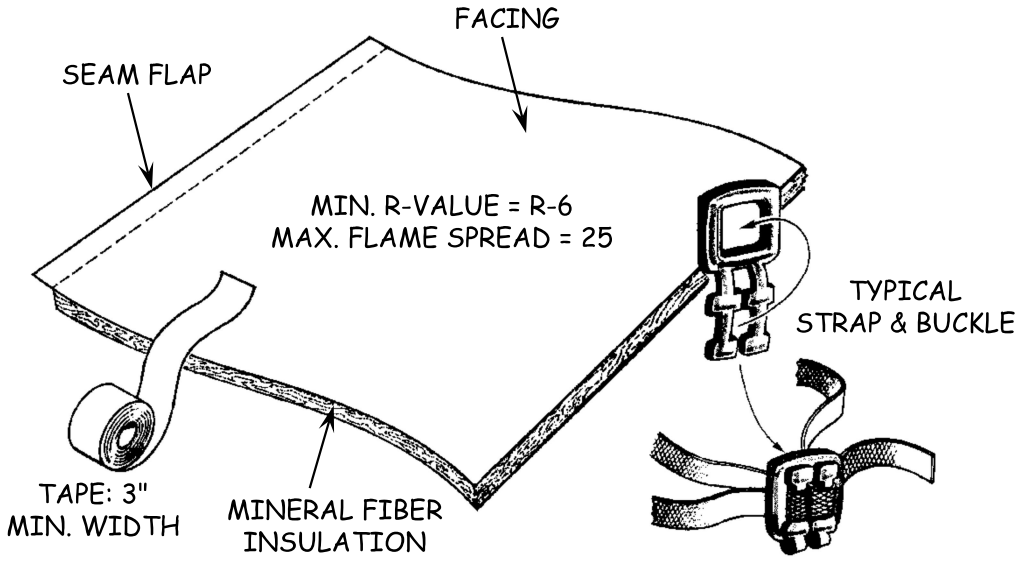
WATER HEATER TANK INSULATION STANDARDS[1]

1. APPROVED MATERIALS

- **All materials**
  - Maximum flame-spread index of 25 and maximum smoke-developed index of 50, per ASTM E84, UL 723, or NFPA 255.
- **Water heater blanket**
  - Mineral fiber only, with vinyl or fiber-reinforced foil facing.
- **Tape**
  - Vinyl or fiber-reinforced foil compatible with facing.
  - Minimum width 3".
  - Duct tape not allowed.
- **Straps and buckles**
  - Polypropylene blanket straps and compatible buckles or other mechanical strap locks; tying of straps not allowed.

2. R-VALUE

- **R-6 minimum**



[1] Storage water heaters only; tankless units are not insulated.

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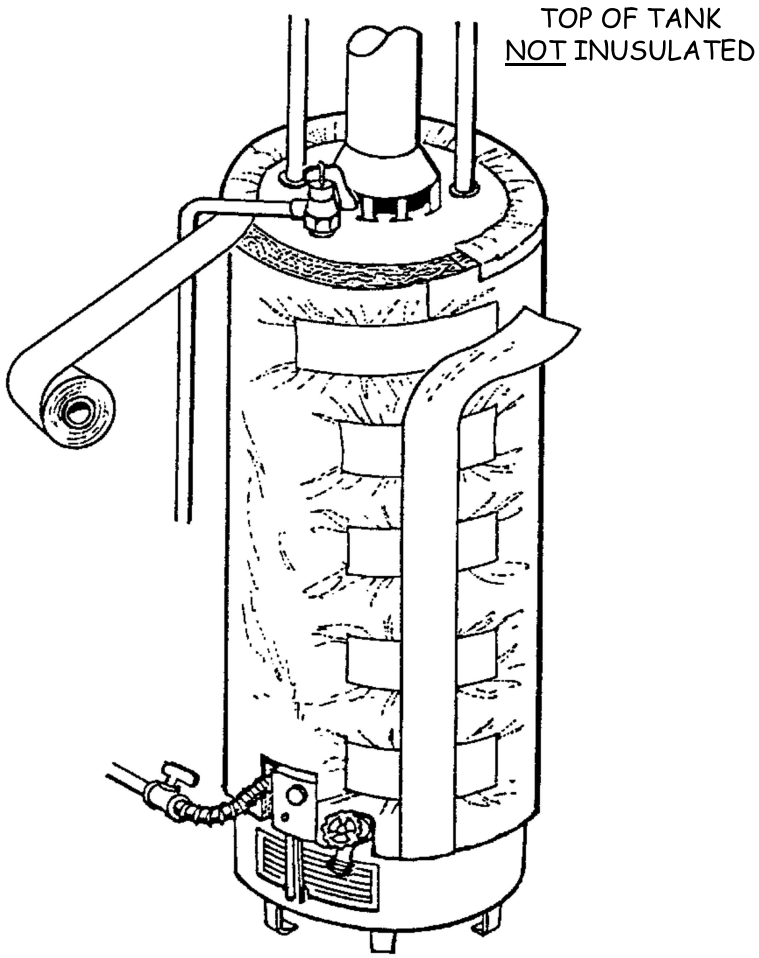
3. COVERAGE

- **Open combustion gas water heaters**
  - Top of tank shall not be insulated.
  - Side insulation shall:
    - Completely surround tank to provide 100% coverage.
    - Extend from top of tank to bottom of drain valve neck.
  - Side insulation shall not extend beyond bottom of tank nor in any way restrict combustion air access.
- **Closed combustion gas water heaters**
  - A top cover shall be installed on closed combustion and induced draft/power vented units with 3" clearance from flue system and inducer fan.



NOTE: APPLIES TO GAS UNITS ONLY

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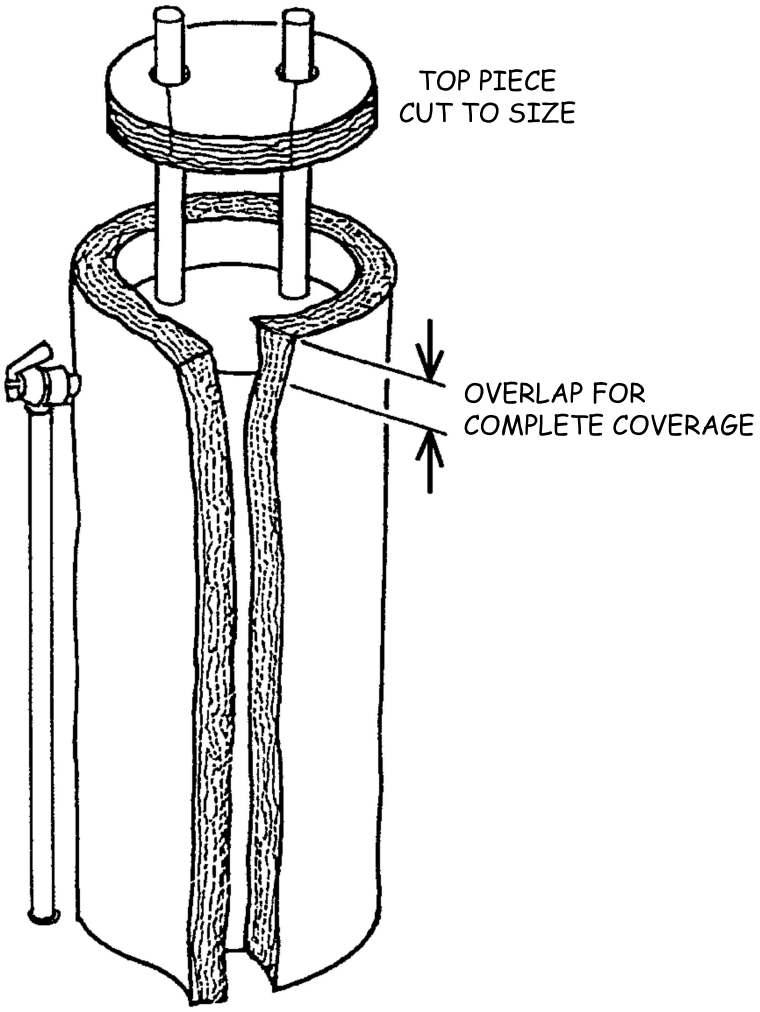
3. COVERAGE (cont.)

- **Electric water heaters**
  - Top of tank shall be completely covered with insulation.
  - Side insulation shall:
    - Completely surround tank to provide 100% coverage.
    - Extend down to bottom of drain valve neck.



TOP COVER INSTALLED
ON ELECTRIC UNITS ONLY

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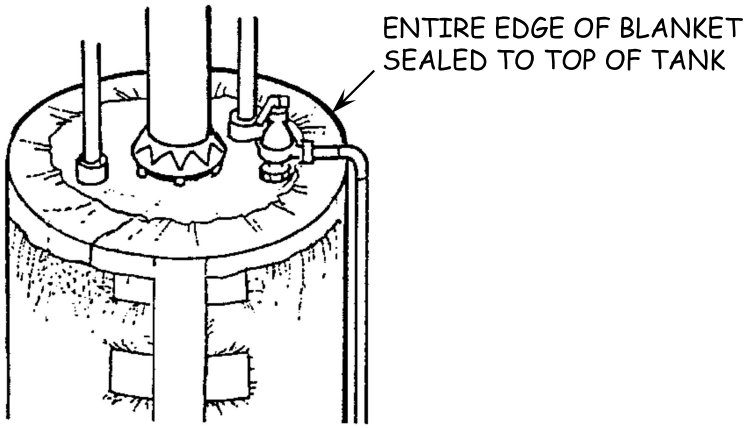
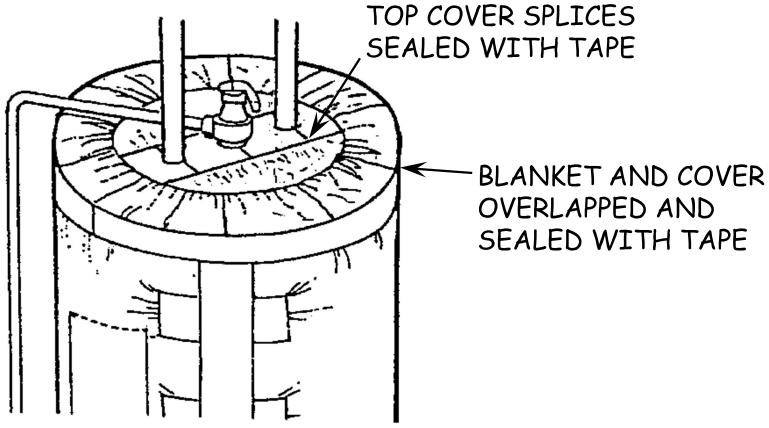
4. TOP SEAMS AND EDGES

- **Gas water heaters**
  - Top edge of blanket shall be sealed to top of tank with tape around the entire perimeter of tank.
- **Electric water heaters**
  - Top seams
    - Perimeter of top cover shall be sealed to top edge of blanket with tape.
    - All seams and slits in cover shall be sealed with tape.



GAS UNIT – NO TOP COVER



ELECTRIC UNIT – TOP COVER INSTALLED

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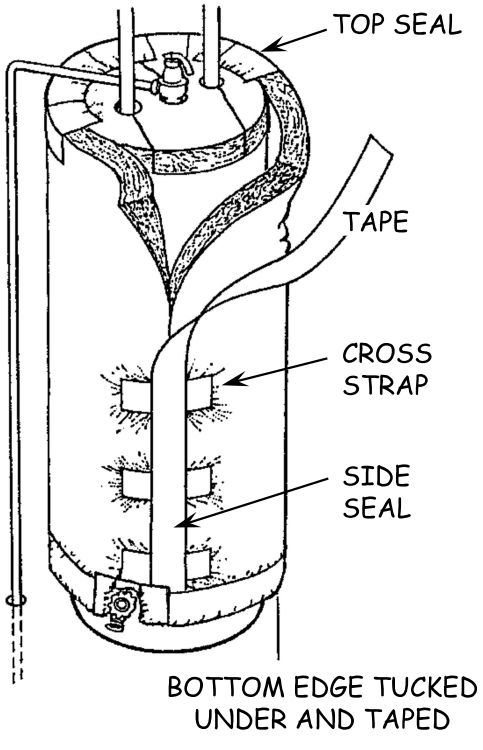
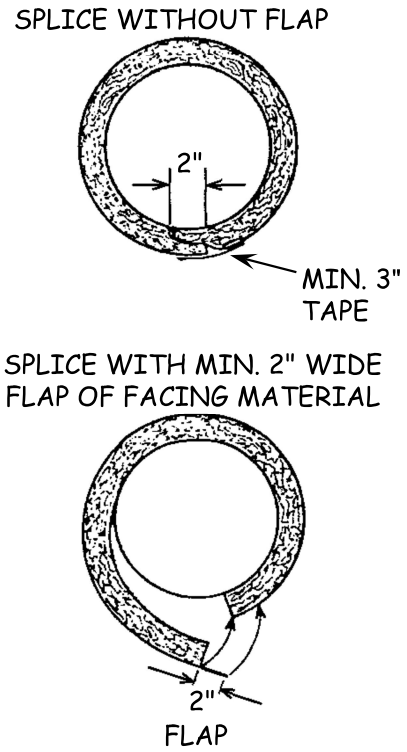
5. SIDE SEAMS AND BOTTOM EDGE

- **Side seams on all water heaters**
  - Cross straps
    - All splices shall be reinforced with minimum 10" long cross straps of tape.
    - Cross tapes shall be located a maximum of 18" apart.
  - Splices with minimum 2"-wide flap of facing material
    - Pieces shall be joined securely and sealed with tape the full length of the flap.
  - Splices without flap
    - Blanket shall be overlapped at least 2".
    - Seams shall be sealed with tape the full length of the splice.
- **Bottom edge on water heaters within the living space (<u>not</u> in an enclosure)**
  - Bottom edge fiberglass shall <u>not</u> be left exposed.
    - The bottom edge shall be sealed to the tank with tape, <u>or</u>
    - The facing shall be tucked under and taped permanently in place.





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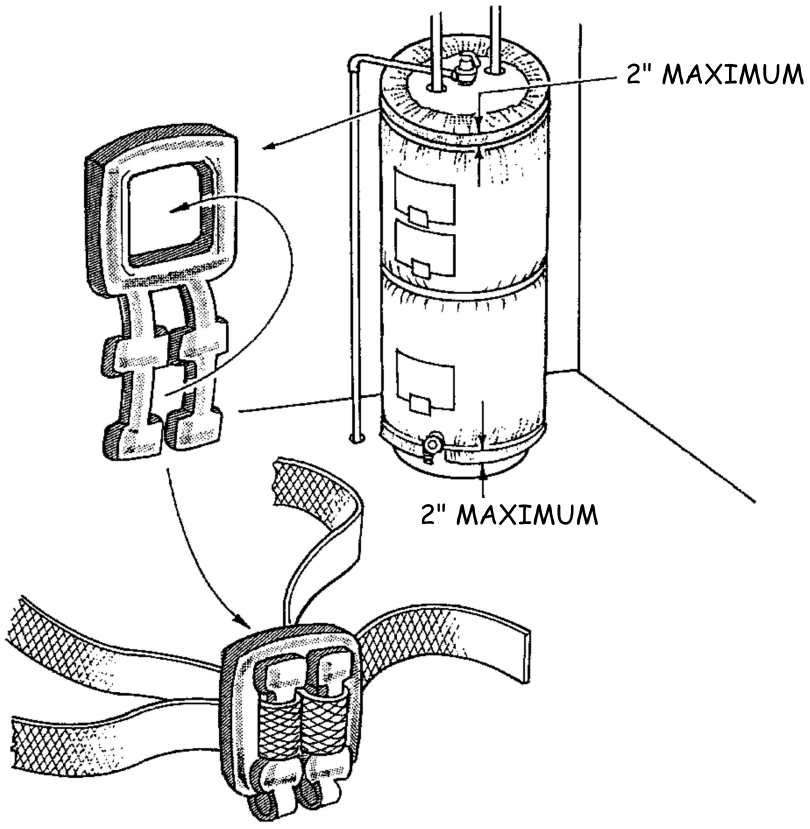
6. BLANKET STRAPS AND BUCKLES

- **All water heaters**
  - A minimum of three blanket straps shall be installed in addition to tape.
  - Straps shall be secured with buckles or other mechanical strap locks; tying of straps is <u>not</u> allowed.
  - Straps shall be installed:
    - One strap within 1-2" of the top of water heater.
    - One strap within 1-2" of the bottom (or as close to this as feasible) of blanket.
      - *<u>Exception</u>:* For gas unit, the strap may be located above the control if it cannot be located within 1-2" of the bottom of blanket.
    - One strap midway on the blanket.
  - Straps shall <u>not</u> be placed over thermostat cover plates, controls, valves or burner access door.
  - Straps shall provide a snug fit, with minimal compression of blanket under straps only.



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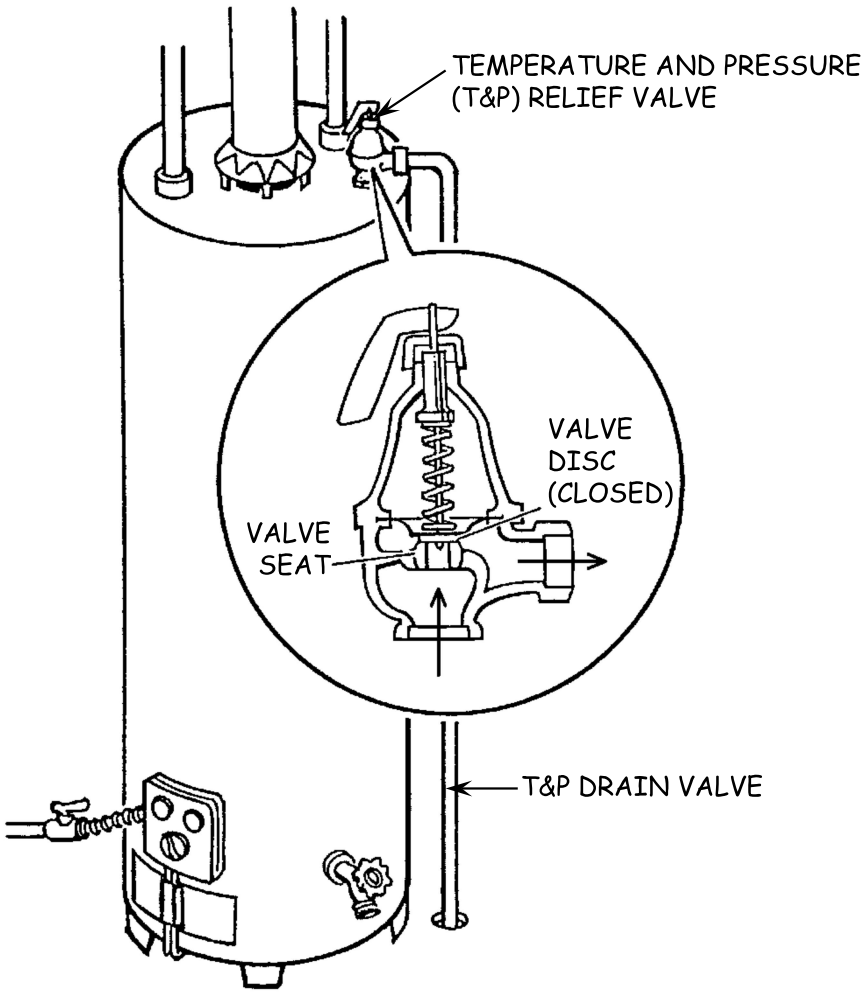
7. T&P PROTECTION

- **All water heaters**
  - T&P relief valve, or automatic gas shutoff valve, shall be:
    - Present and located within 6" of the tank.
    - In conformance with local code.
  - Valves shall not be covered by the blanket.
  - T&P drain line:
    - End shall be open and unobstructed (not capped or plugged).
    - End shall not be covered or obstructed by the blanket.



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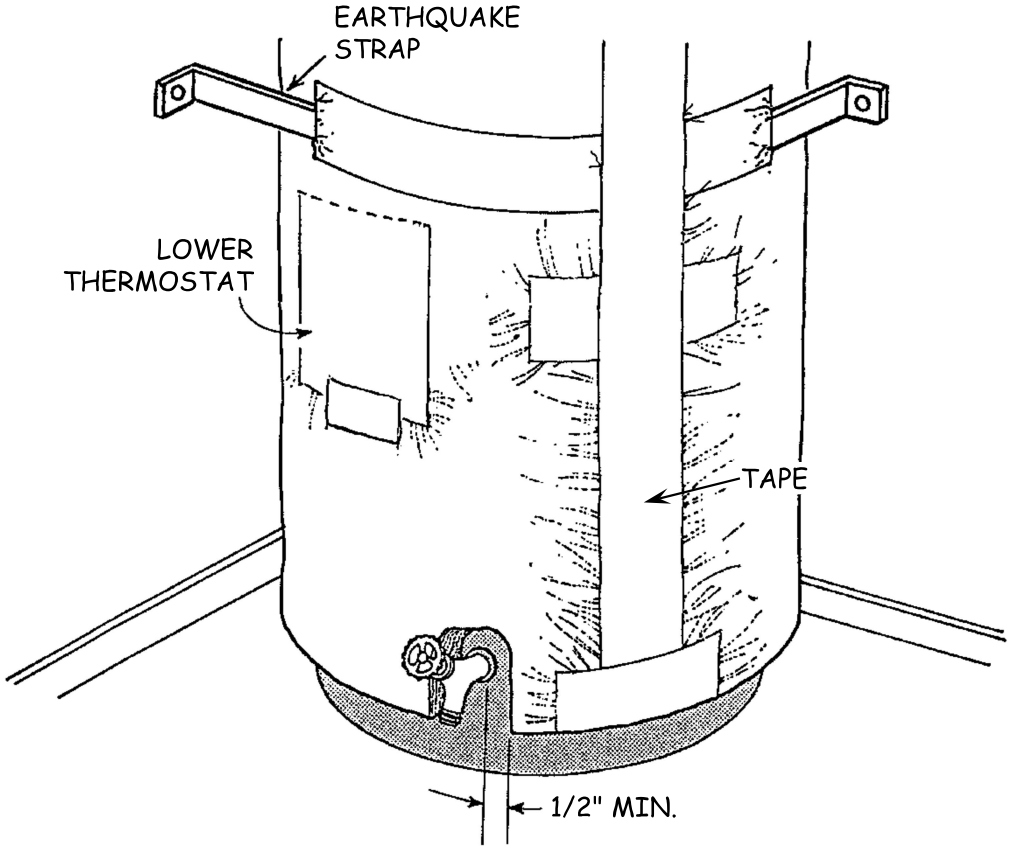
8. DRAIN VALVE

- **All water heaters**
  - The drain valve shall not be covered by the blanket.
  - Minimum 1/2" clearance required between the blanket and the valve.

9. EARTHQUAKE STRAPS

- **All tanks**
  - Existing straps shall not be removed and reinstalled over the insulation blanket.
  - The blanket shall be slit to fit around straps.
  - All slits shall be securely taped.



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GAS WATER HEATERS

10. GAS CONTROL VALVE

- **Clearance**
  - Valve shall not be covered by blanket or tape.
  - Blanket strap shall not be placed over front of control valve.

11. BURNER ACCESS AND DRAFT HOOD

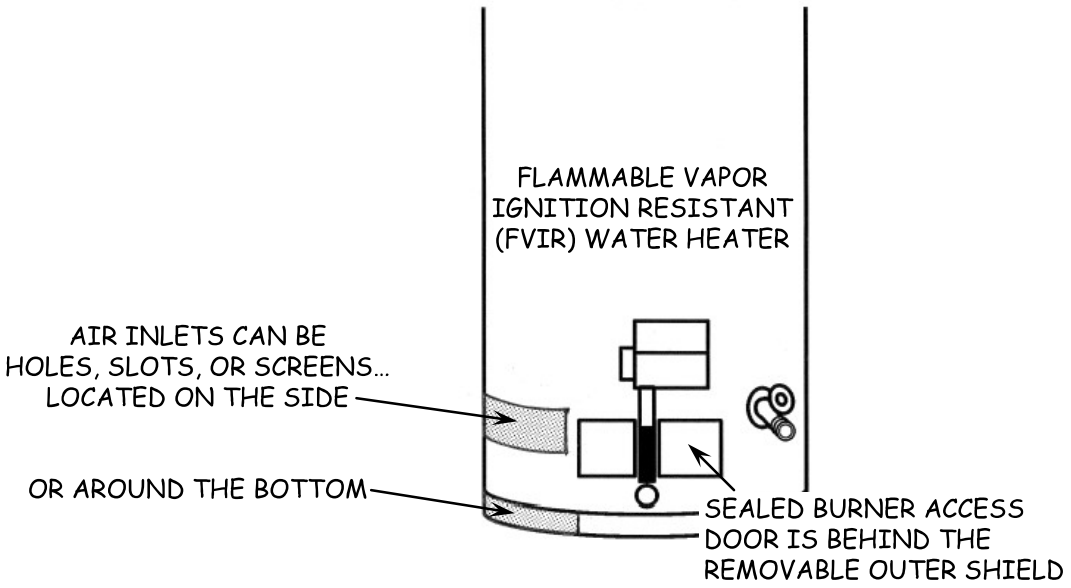
- **Minimum 3" clearance required from blanket and tape to edge of:**
  - Burner access opening.
  - Draft hood opening.

12. AUTOMATIC GAS SHUTOFF VALVE

- **Clearance**
  - Valve and gas pipe/flex to/from the valve shall not be covered.

13. COMBUSTION AIR SUPPLY

- **Clearance**
  - Air path shall not be obstructed.
  - When unit is located in attic with loose fill insulation present, blocking shall be installed in accordance with IS Section 3 (Attic Insulation).



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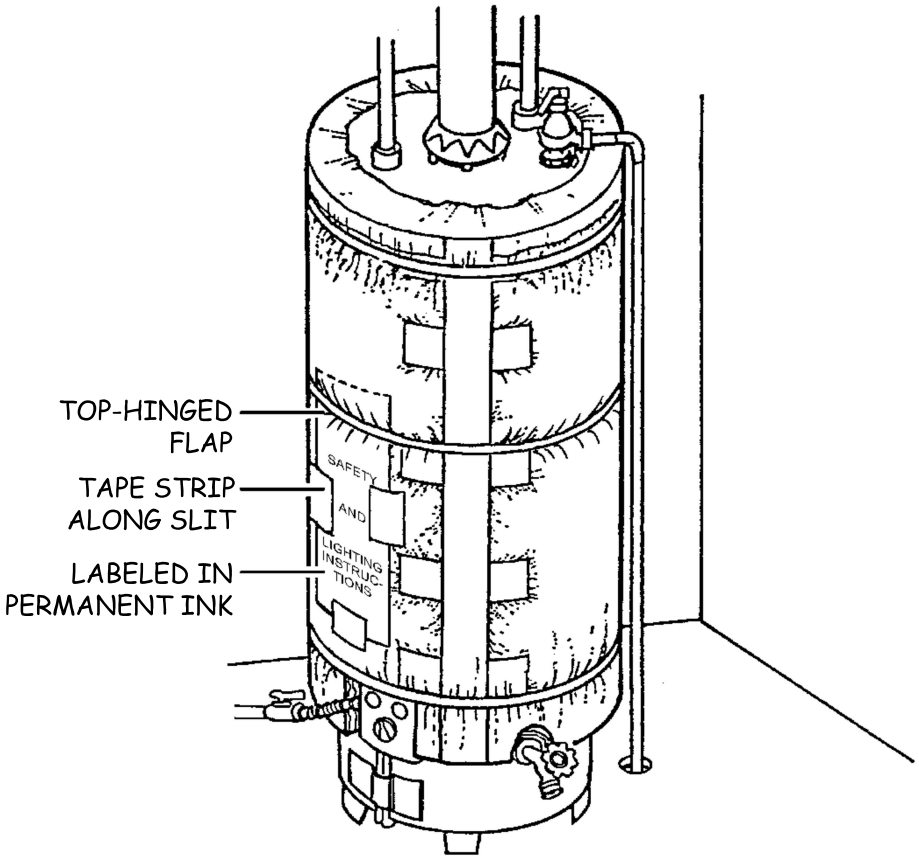
14. OPERATION AND SAFETY INSTRUCTIONS

- **Access**
  - Identification label, safety information, and lighting instructions shall be identified and made easily accessible.
  - A flap (top-hinged when possible) shall be cut in blanket to provide access.
  - 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 (e.g., “Safety Instructions”).



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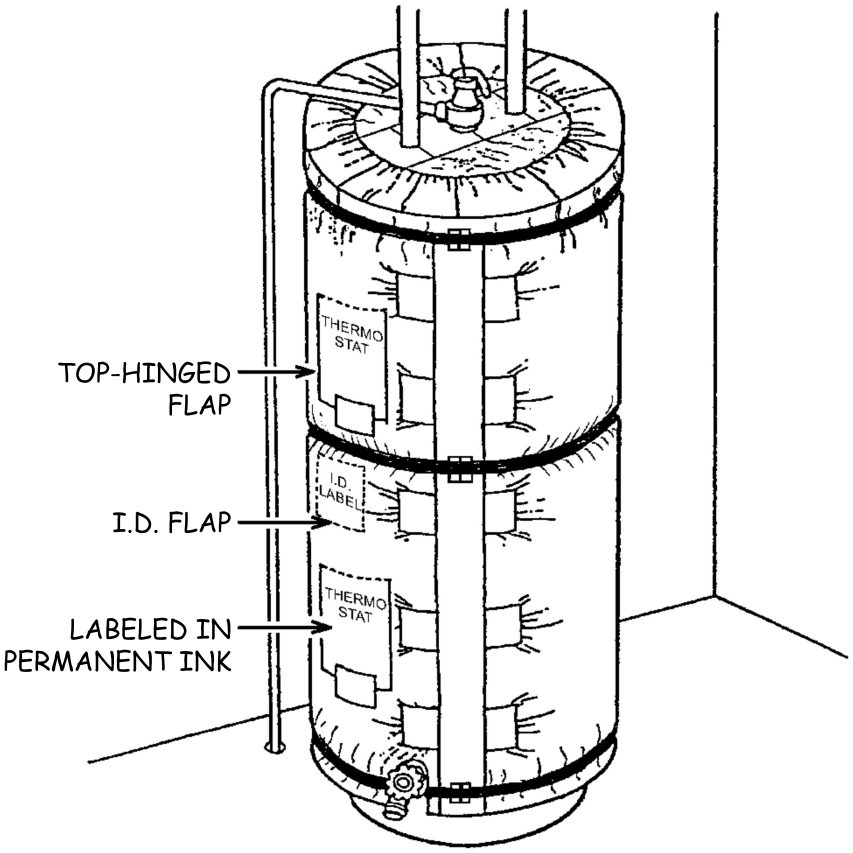
ELECTRIC WATER HEATERS

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.



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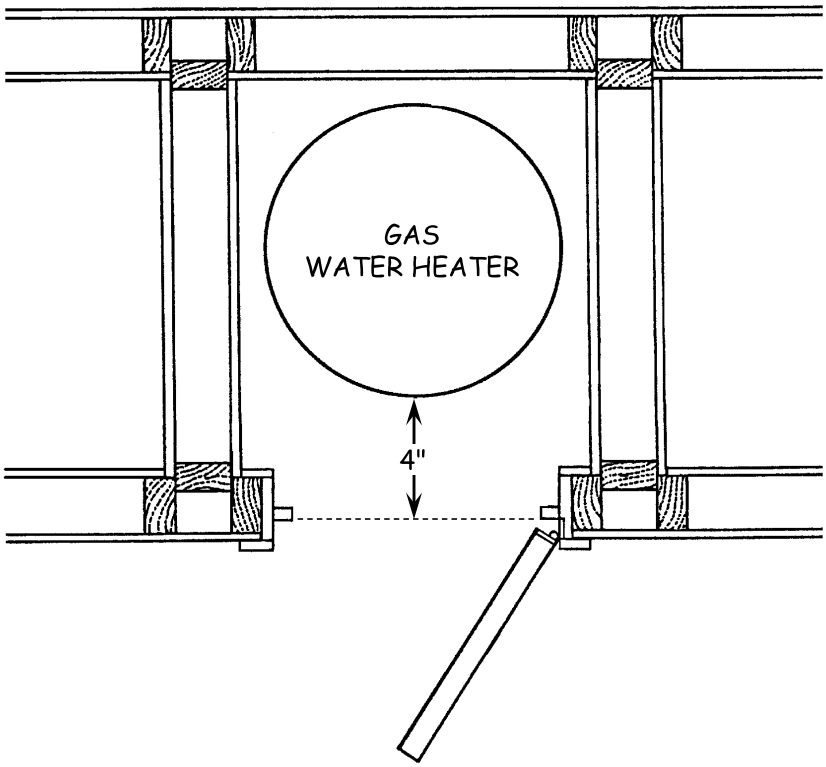
16. UNIT LOCATION AND CLEARANCES

- **Water heater location**
  - Unit must be in a protected area that is not exposed to the weather.
  - Units in either conditioned or unconditioned space shall be insulated.
  - Unit shall not be insulated if less than 12" from a gas cook stove.
- **Gas water heater clearances**
  - Clearance requirements prior to blanket installation:
    - Open combustion natural draft
      - Minimum 4" clearance in front.
    - Induced draft and sealed combustion chamber (including FVIR).
      - Less than 4" clearance in front acceptable, when allowed by appliance manufacturer instructions.
- **Electric water heater clearances**
  - Clearance requirements prior to blanket installation:
    - Front clearance shall be sufficient to allow the enclosure door to close freely with blanket installed.



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17. COMBUSTION SAFETY REQUIREMENT—GAS UNITS

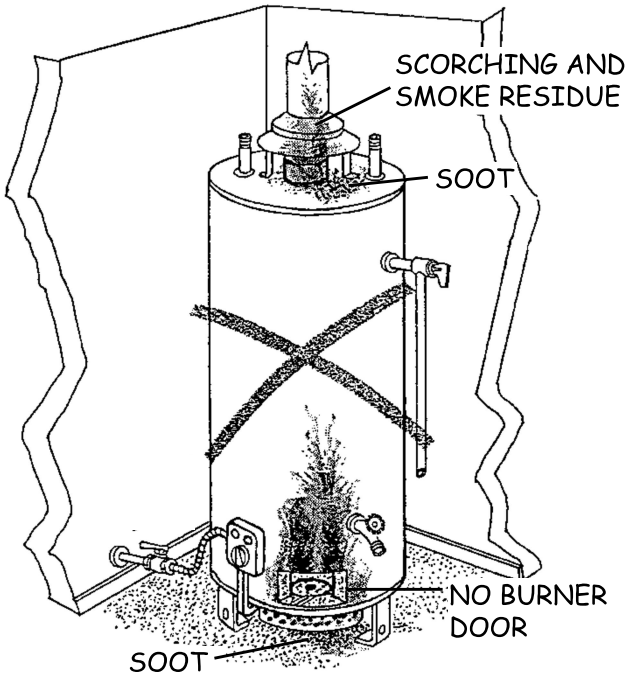
- **Improper combustion**
  - Insulation shall not be installed when there is evidence of improper combustion, such as:
    - Soot accumulation near draft hood or on floor underneath tank.
    - Scorching or smoke residue at the draft hood or combustion chamber access.
- **Combustion chamber access cover**
  - At least one access cover shall be present.
  - There shall be no signs of scorching or incomplete combustion.

18. WATER HEATER COMPARTMENT FLOOR

- **All units**
  - 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 not be installed.

19. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up**
  - All packing materials and installation debris shall be cleaned up and removed from the premises.
  - Household items moved for water heater tank insulation shall be returned to their original positions.



TANK WITH EVIDENCE OF IMPROPER COMBUSTION IS NOT INSULATED

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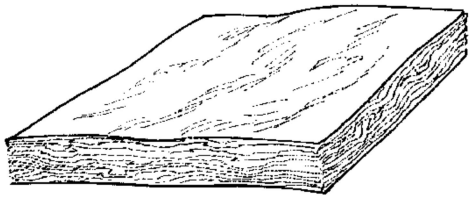
MOBILE HOME CRITERIA

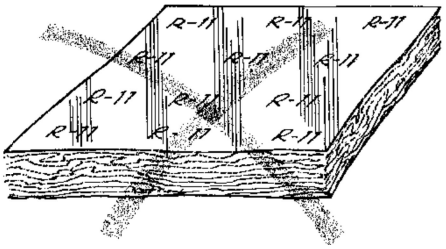
20. EXTERIOR COMPARTMENT WALL AND DOOR INSULATION

- **Closet wall insulation is feasible only if:**
  - Closet walls are not internally insulated, and
  - Space/clearance is adequate.
- **Electric water heater closets with exterior access**
  - Cracks and holes in the envelope (especially floor) shall be sealed.
  - Door weatherstripping shall be installed, in conformance with IS Section 2 (Weatherstripping).
- **Gas water heater closets with exterior doors**
  - The closet door, and adjacent portions of the exterior wall within 6" of the combustion chamber access, shall not be insulated.
- **Allowed insulation material**
  - Minimum R-11 flexible fiberglass
  - Faced or unfaced with maximum flame spread rating of 25.
  - Gas water heaters: Flame-resistant foil-faced or unfaced only.
  - Electric water heaters: Kraft-faced allowed.



UNFACED OR FOIL-FACED FIBERGLASS ALLOWED

KRAFT-FACED FIBERGLASS NOT ALLOWED WITH GAS UNITS



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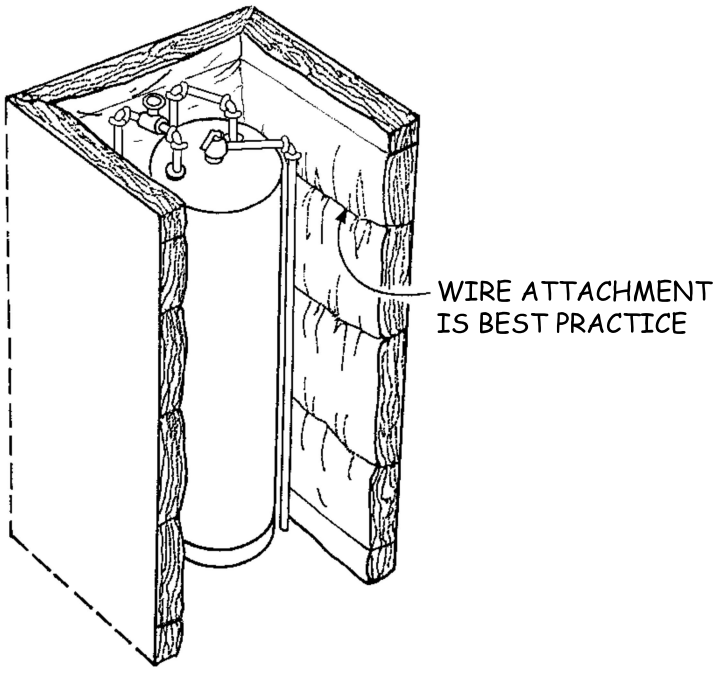
20. EXTERIOR COMPARTMENT WALL AND DOOR INSULATION (cont.)

- **Attachment**
  - Faced batts shall be installed with facing placed against the wall.
  - Batts shall be permanently attached.
    - Wire attachment shall be corrosion-resistant, minimum 20-gauge.
    - Staple attachment allowed when faced batts are installed.
  - Maximum 10% compression of insulation by attachments.
- **Material clearances for gas water heaters**
  - No air space is required between blanket and wall insulation on sides and back.
  - Minimum 4" clearance is required between front of blanket and closet door.
  - Where space is not adequate for both wall insulation and blanket, blanket installation takes precedence.
- **Material clearances for electric water heaters**
  - No air space is required between wall/door insulation and blanket.
  - Where space is inadequate for both wall/door insulation and blanket, blanket installation takes precedence.
  - Closet door shall close freely following installation of insulating measures.



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WATER HEATER PIPE INSULATION

Lead Paint Risk Factor
NONE

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8. Attachment 6
9. Ties and Tape for Attachment 7
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MOBILE HOME CRITERIA 8

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SECTION 6 PREFACE
for

WATER HEATER PIPE INSULATION

1. Nonfeasibility Criteria

1.1. The existing pipe insulation is functioning properly, even if not installed in accordance with current installation standards.

1.2. An unsafe condition is present that causes tank insulation to be unfeasible.

1.3. Leak present in tank or water pipes.

1.4. T&P relief valve, or automatic gas shutoff valve, is not present, or is not located within 6" of the tank.

1.5. T&P valve discharge faces front of tank and has no drain line directed away from the front of the tank.

1.6. T&P valve outlet is plugged or capped.

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

1.8. Less than 1 foot of continuous insulation can be installed.

1.9. Plastic piping (e.g. CPVC) is present in the cold or hot water tank lines to/from the tank.

1.10. Pipes are inaccessible, or the configuration prevents proper installation.

1.11. Customer refuses.

2. Installation Policies

2.1. For tankless water heaters, insulation is installed only on the first 5 feet of the hot water pipe.

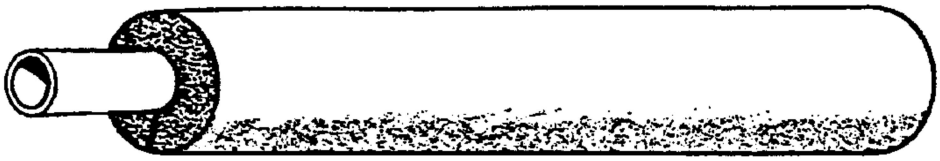
3. Installation Policies Specific to Mobile Homes

None.

WATER HEATER PIPE INSULATION STANDARDS

1. APPROVED MATERIALS

- **All materials**
  - Maximum flame-spread index of 25 and maximum smoke-developed index of 450 per ASTM E84 or UBC Standard 8-1.
- **Insulation**
  - Preformed foam (e.g. closed-cell polyethylene) conforming to ASTM C534.
  - Inside diameter of preformed material shall be appropriate for the size pipe being insulated.
  - Rated for temperatures up to 180°F.
- **Tape**
  - Tape specified by insulation manufacturer, or
  - Minimum 2"-wide, pressure-sensitive, metallic tape labeled UL 181A-P or UL 181B-FX.
  - Cloth duct tape and electrical tape are not allowed.
- **Ties**
  - Plastic cable ties.
  - Corrosion-resistant wire and metal sleeves.
- **Glue**
  - Compatible with insulation material and manufacturer's instructions.



PREFORMED FOAM PIPE INSULATION

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2. R-VALUE OF PIPE INSULATION

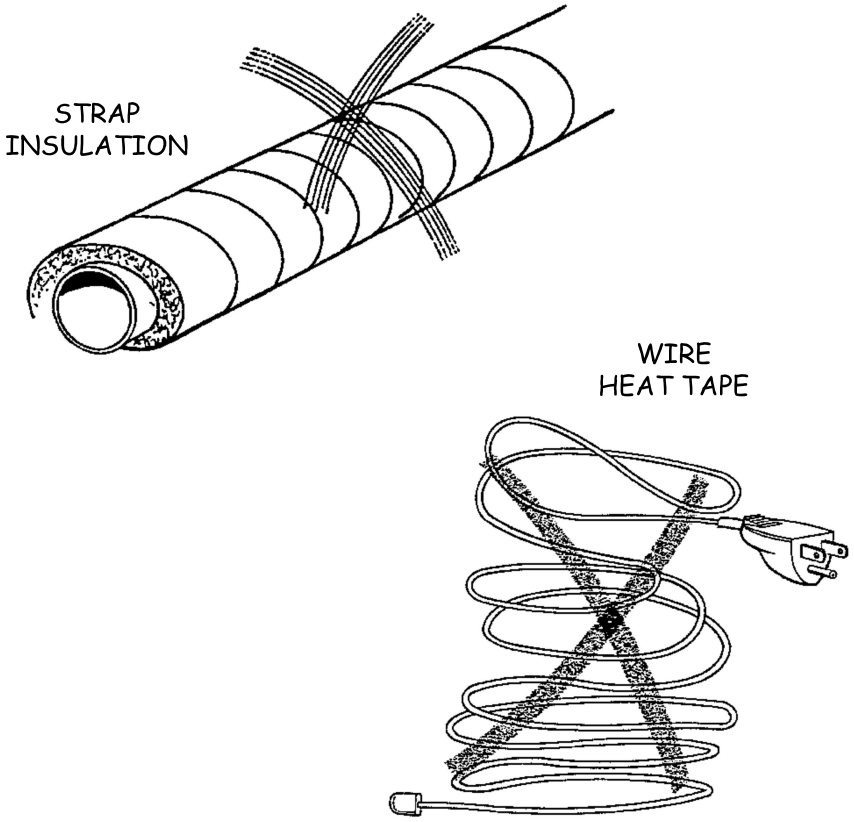
- **R-value shall be in conformance with Table 6-1.**

Table 6-1: Pipe Insulation Requirements

Condition (Pipe <1" OD)	**Water Temp.**	**Min. R-value**
New tank or water pipes not installed	Any	R-4
New tank or water pipes installed	105 to 140 °F	R-7.7
	141 to 200 °F	R-11.5

3. MATERIALS NOT ALLOWED

- **All units**
  - Sheet or semi-molded insulation.
  - Heat tape or strap insulation.



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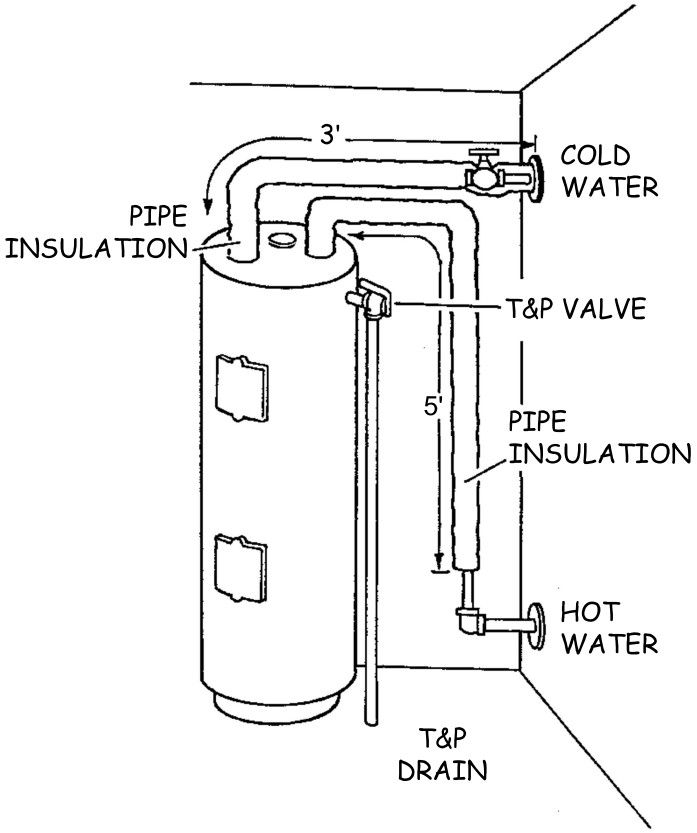
4. COVERAGE REQUIREMENTS

- **Pipes to be insulated**
  - For storage water heaters, insulation shall be installed on hot and cold water pipes that are:
    - Connected to the water heater.
    - Under continuous water pressure.
    - Free of leaks.
  - For tankless water heaters, insulation shall be installed only on the hot water pipes.
  - Insulation shall be installed on both rigid and flexible lines as feasible.
- **Coverage**
  - Insulation shall cover all accessible portions of the first five feet of each pipe (hot and cold) on storage water heaters.
  - Insulation shall begin at the tank unless prevented by clearance requirement.
  - Valves shall be covered, but handles shall be left clear and unobstructed.



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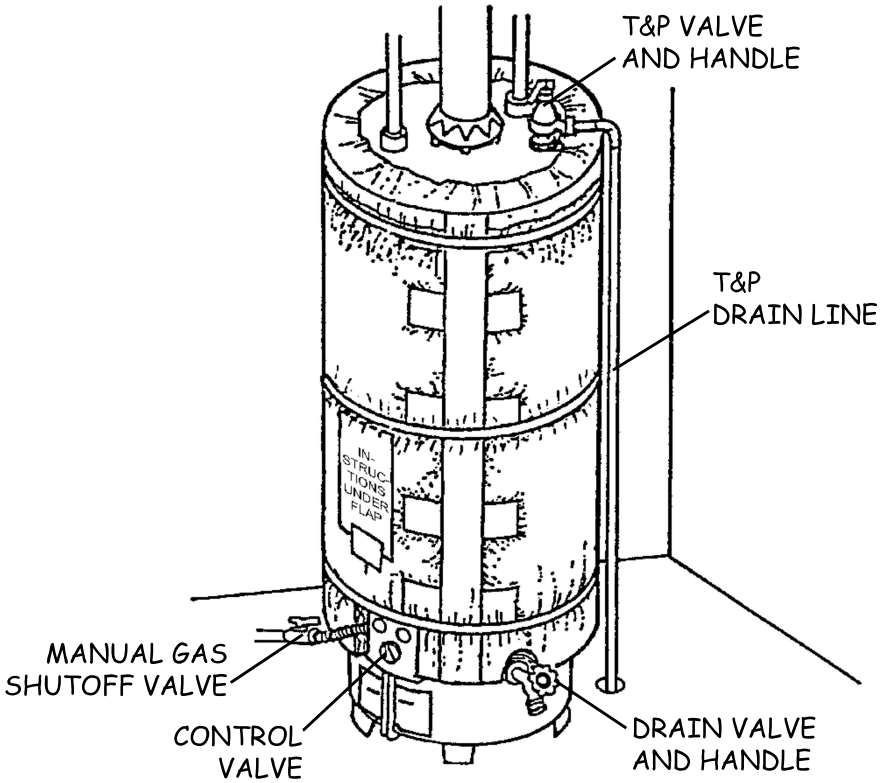
5. COVERAGE RESTRICTIONS

- **All units**
  - Insulation shall not cover:
    - T&P relief valve or automatic gas shutoff valve.
    - Valve handles.
    - Control and safety devices.
    - T&P drain line.
    - Leaking pipes.
- **Gas units**
  - Clearances shall be in conformance with Table 6-2 or as specified by pipe listing.

Table 6-2: Clearance Between Insulation and Pipe/Component

Pipe/Component	Clearance from Insulation
Single-wall pipe	6"
Type B double-wall pipe	1"
Type L double-wall pipe	3"
Draft hood opening	Shall not be obstructed



ITEMS NOT TO BE COVERED

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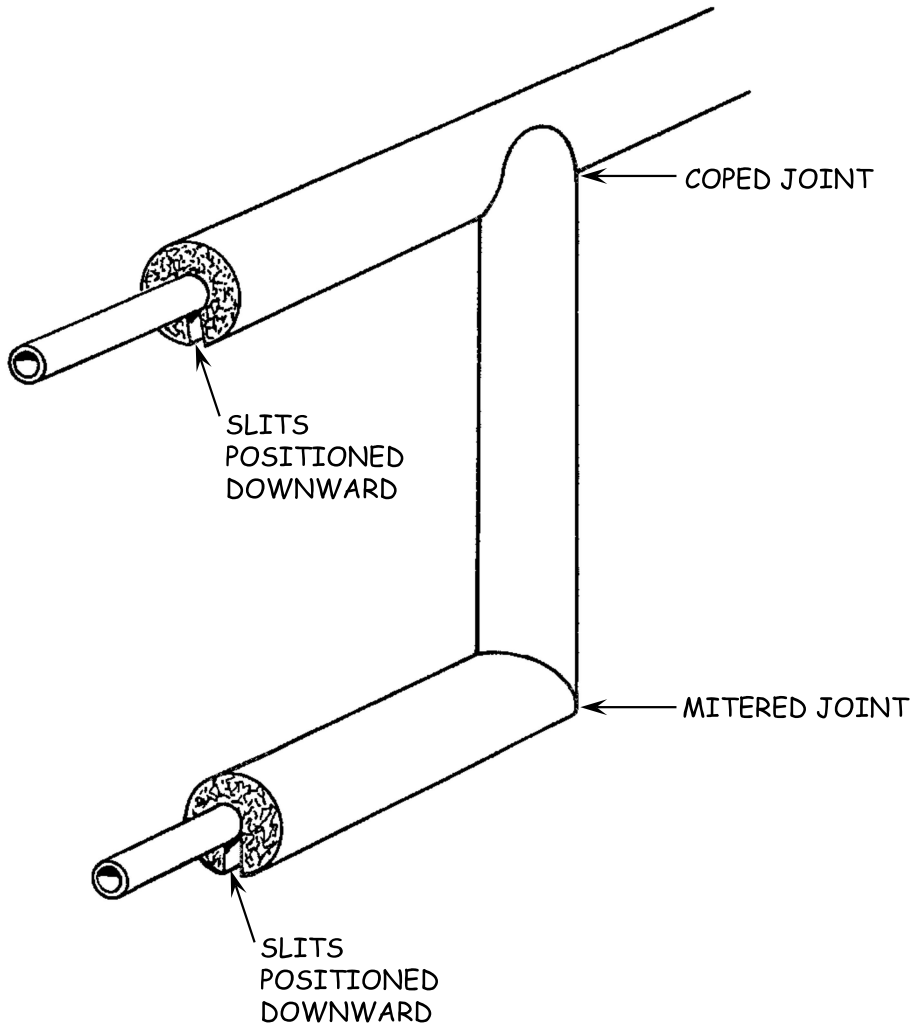
PREFORMED PIPE INSULATION

6. POSITION OF SLITS

- **Slits shall be positioned downward on horizontal pipe.**

7. CORNERS, BENDS, AND JOINTS

- **Insulation shall be mitered and/or notched on bends, corners, and joints to provide complete closure without gaps.**



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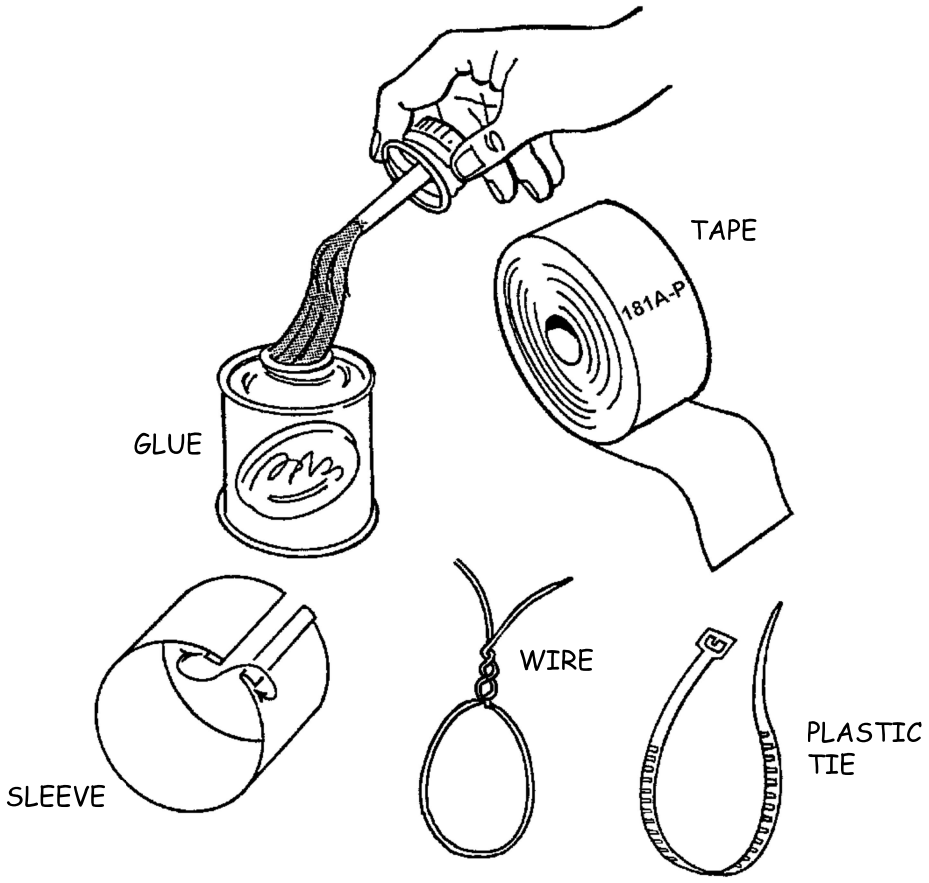
8. ATTACHMENT

- **General requirements**
  - Insulation shall be firmly secured with plastic ties, tape, wire, or sleeves.
  - All slits and joints shall be glued or taped to achieve complete closure.
  - Tape shall be used on bends, 90º elbows, and joints.



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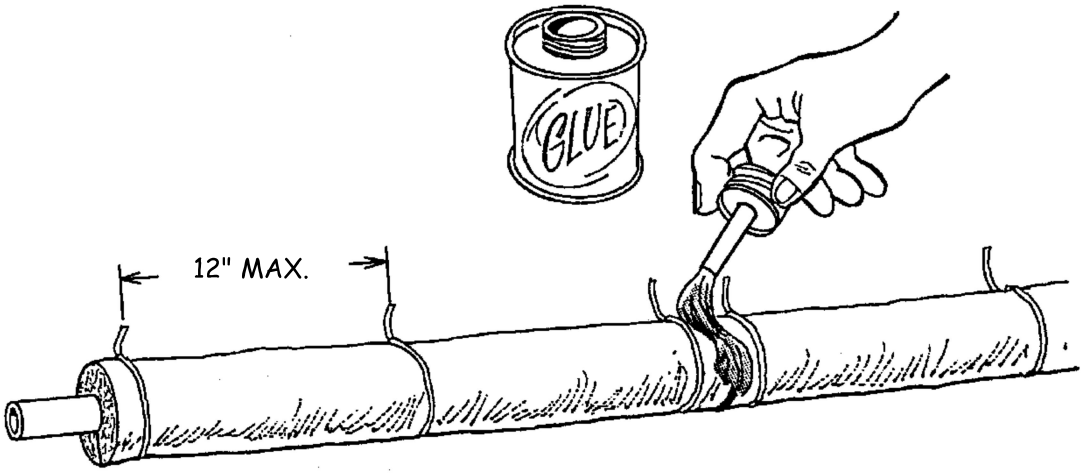
9. TIES AND TAPE FOR ATTACHMENT

- **Attachments shall be installed:**
  - A maximum of 12" apart and
  - Within 1" of each end.
- **1/4" total compression at ends only.**

10. SLEEVES FOR ATTACHMENT

- **Compression**
  - Sleeve shall not compress insulation, except for 1/4" total compression at ends.



MIN. 1" FROM EACH END

CORROSION-RESISTANT SLEEVE

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11. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up**
  - Paint dust and chips, scraps, and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Furniture and other household items moved for installation work shall be returned to their original positions.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

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COVER PLATE GASKETS

Lead Paint Risk Factor
NONE

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2. Location 1

3. Installation 2

4. Lead-Safe Weatherization and Post-Installation Requirements 2

MOBILE HOME CRITERIA 2

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SECTION 7 PREFACE
for
COVER PLATE GASKETS

1. Nonfeasibility Criteria

1.1. Evidence of electrical malfunction or hazard, such as:
   a. Electrical box not permanently attached, or
   b. Loose electrical connection, or
   c. Signs of burning or charring or other evidence of hazardous wiring condition.

1.2. Gaskets are already present and functioning properly, even if not installed in accordance with current installation standards.

1.3. Cover plate is located on a wall between two conditioned or two unconditioned areas.

1.4. Cover plate is located behind furniture or major appliances that are too fragile or too heavy to move.

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

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

1.7. Customer refuses.

2. Installation Policies

2.1. All broken, cracked, or missing cover plates shall be replaced.

2.2. All gaskets must be contractor-installed. No gaskets are to be left behind for customer installation.

3. Installation Policies Specific to Mobile Homes

None.

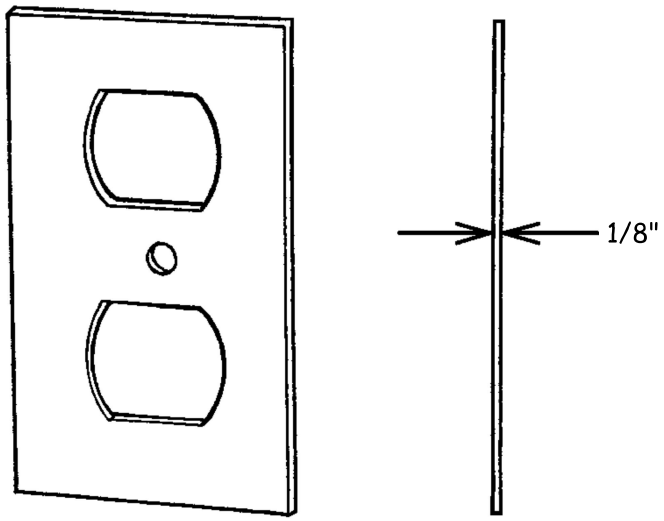
COVER PLATE GASKET STANDARDS

1. APPROVED MATERIALS

- **All gaskets shall be:**
  - Fire-resistant.
  - Pre-cut to fit.
  - Closed-cell foam.
  - Minimum 1/8" thick.

2. LOCATION

- **Gaskets shall be installed:**
  - On inside of walls between conditioned and unconditioned space.
  - Under cover plates for electrical switches and receptacles, telephone jacks, and television cables/lines.



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3. INSTALLATION

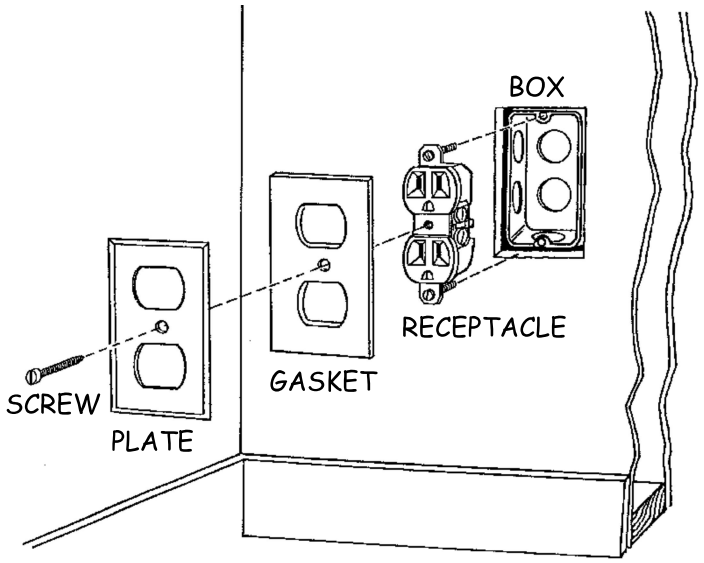
- **All locations**
  - Gasket shall match switch/receptacle style.
  - Gasket shall cover the gap between the utility box and the surrounding wall material.
  - When utility box is an odd size and standard gaskets will not work, gap between box and wall shall be caulked when feasible.
  - Plate shall cover gasket completely.
  - Broken or missing cover plates shall be replaced.

4. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up**
  - Paint dust and chips, scraps, and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Furniture and other household items moved for installation work shall be returned to their original positions.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.



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ENERGY-SAVER SHOWERHEADS AND FAUCET AERATORS

Lead Paint Risk Factor
NONE

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MOBILE HOME CRITERIA 4

SECTION 8 PREFACE
for

ENERGY-SAVER SHOWERHEADS AND FAUCET AERATORS

1. Nonfeasibility Criteria

Energy-Saver Showerheads

1.1. Existing showerhead:
   a. Has a flow rate less than or equal to the maximum flow rate specified in IS item 2.
   b. Is functioning properly, even if not installed in accordance with current installation standards.
   c. Is required for medical reasons.

1.2. Existing shower arm:
   a. Is made of plastic.
   b. Is missing or defective (e.g., cracked, broken).
   c. Requires removal.

1.3. Shower is not mechanically functional.

1.4. Standard metal adapters will not work.

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

1.6. Water pressure exceeds maximum specified by showerhead manufacturer.

1.7. Customer refuses.

Faucet Aerators

1.8. The aerator is functioning properly, even if not installed in accordance with current installation standards.

1.9. The existing aerator has a flow rate less than or equal to the maximum flow rate specified in item 2.

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

1.11. Faucet does not provide hot water.

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

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

1.14. Standard aerators will not fit.

1.15. Customer refuses.

2. Installation Policies

2.1. All existing showerheads with a flow rate greater than 1.8 gpm and not required for medical reasons shall be replaced with low-flow showerheads.

2.2. Replaced showerheads and aerators must be left with the customer or the property manager.

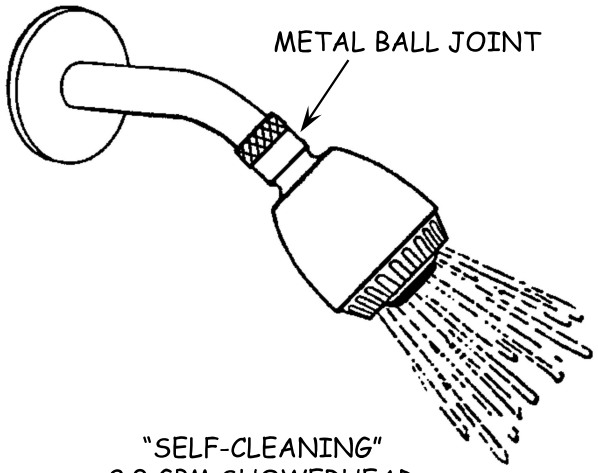
3. Installation Policies Specific to Mobile Homes

None.

ENERGY-SAVER SHOWERHEAD AND FAUCET AERATOR STANDARDS

1. APPROVED MATERIALS

- **Showerheads and aerators**
  - Conformance to ASME A112.18.1.
  - May include integral thermostatic shower valve.
- **All showerheads**
  - WaterSense-labeled “self-cleaning” type or cleanable without being unscrewed from the shower arm.
  - Non-aerating type.
  - Ball joint shall be metal (e.g., chrome-plated brass).
- **Handheld showerheads**
  - Backflow prevention: Handheld showerheads shall include an integral or add-on backflow prevention device that complies with ASME A112.18.3.
  - Hose: Minimum 48" length, flexible vinyl or PVC, metal-clad or reinforced (e.g., with nylon), capable of swiveling at both ends.
  - Mounting bracket:
    - Heavy-duty thermoplastic (e.g., ABS) or equivalent
    - Designed to attach to shower arm (not the wall).
    - Swivel ball shall be all-metal (e.g., chrome-plated brass).
  - Attachment: must fit standard-thread shower arms and standard adapters.



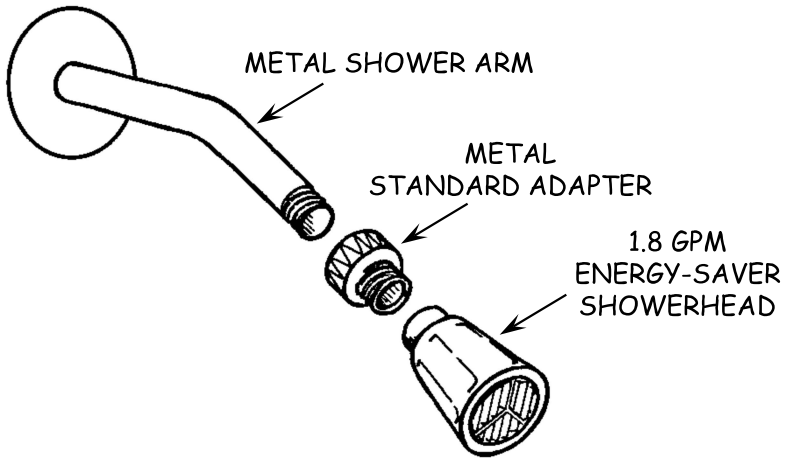
- **Shower arm adapters**
  - Adapter shall be metal (e.g. chrome-plated brass).
  - Minimum 5/8” long male pipe threads with a minimum taper of 3% on showerhead end.
- **Aerators**
  - Shall be metal (e.g., chrome-plated brass).
- **Shower control valve (“trickle valve”)**
  - Chrome-plated brass.
  - Designed to fit standard 1/2" showerheads and arms.
  - Flow rate from 2.0 gpm to a trickle.
  - May be separate or built into the showerhead.
- **Thermostatic shower valve**
  - Selected and installed in accordance with IS Section 27 (Thermostatic Shower Valves).

2. FLOW RATE

- **Showerheads**
  - Maximum flow rate: 1.8 gpm at 80 psi.
- **Bathroom faucet aerators**
  - Maximum flow rate: 1.2 gpm at 60 psi.
- **Kitchen faucet aerators**
  - Maximum flow rate: 1.8 gpm at 60 psi.
  - May have the capability to momentarily increase to 2.2 gpm for filling pots and pans.

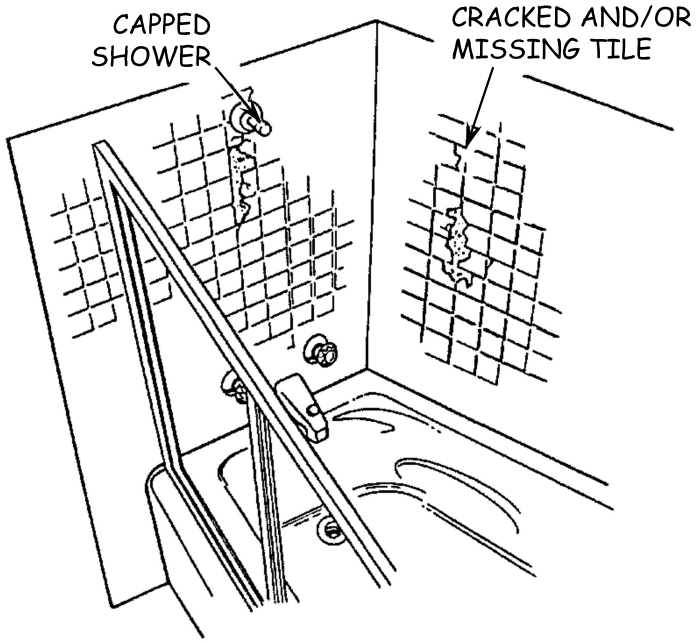
3. WARRANTY

- **Refer to IS Appendix F (Warranty Requirements).**



4. INSTALLATION

- **Functional showers**
  - Energy-saver showerheads shall be installed on all functional showers that have flow rates greater than 1.8 gpm.
- **Nonfunctional showers**
  - Energy-saver showerheads shall not be installed on showers that are not functional.
- **Handheld showerheads**
  - Showerhead shall attach to the shower arm, not the wall.
  - May be installed only when:
    - Required due to customer's physical limitations, or
    - Pre-existing showerhead is handheld and is defective.
- **House line pressure**
  - Shall be within manufacturer's specification for minimum and maximum water pressures to achieve listed flow rate.



NONFUNCTIONAL SHOWER

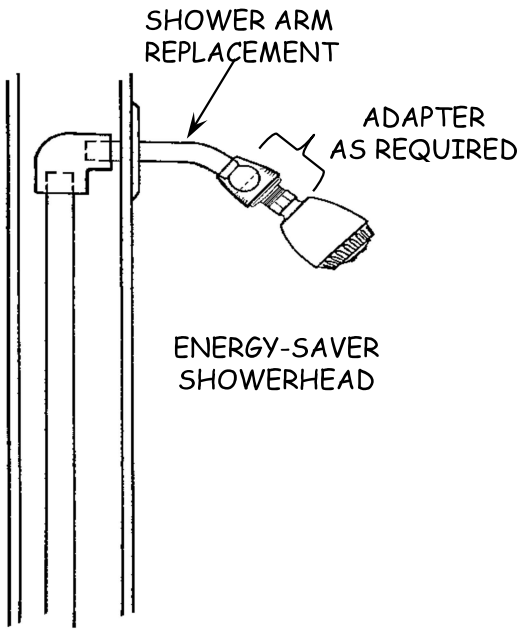
- **Shower arms**
  - Shower arms shall not be removed or replaced.
  - Showerheads shall not be installed on plastic shower arms.
- **Shower arm adapters**
  - Adapters shall be installed when required for installation of energy-saver showerheads.
- **Faucet aerator**
  - Aerators shall be installed only on faucets that provide hot water.

5. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **All units**
  - All installed components shall function properly.
  - Threaded connections shall not leak.
  - Scraps and debris shall be cleaned up and removed from the premises.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.



EVAPORATIVE COOLER AND AIR CONDITIONER VENT COVERS

Lead Paint Risk Factor
NONE

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MOBILE HOME CRITERIA 7

SECTION 9 PREFACE
for

EVAPORATIVE COOLER AND AIR CONDITIONER VENT COVERS

1. Nonfeasibility Criteria

Evaporative Cooler Covers

1.1. An existing evaporative cooler vent cover is functioning properly, even if not installed in accordance with current installation standards.

1.2. The vent(s) serving the evaporative cooler is (are) shared with a heating system.

1.3. Vent/register opening is so close to the wall or ceiling that proper installation of the cover is impossible.

1.4. Water damage to the ceiling or wall area around the vent/register is evident, prevents proper cover installation, and cannot be repaired.

1.5. Electrical wiring/plug/receptacle interferes with proper installation, and furring is not a feasible option.

1.6. Customer refuses installation of evaporative cooler vent covers.

Window/Wall A/C Vent Covers

1.7. An existing A/C vent cover is functioning properly, even if not installed in accordance with current installation standards.

1.8. Window/wall A/C unit has an operable fresh air intake which can be closed to stop infiltration.

1.9. Water damage to the window or wall area around the unit/vent is evident, prevents proper cover installation, and cannot be repaired.

1.10. The vent/unit is so close to the wall that proper installation of the cover is impossible.

1.11. An external cover is already present.

1.12. Customer refuses.

2. Installation Policies

2.1. Shop-built wooden vent covers can only be used when a commercially manufactured cover is not available.

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

2.3. In the cooling season, when the cooler or window/wall A/C is in use, contractor can leave the cooler cover uninstalled after the initial installation and customer instruction.

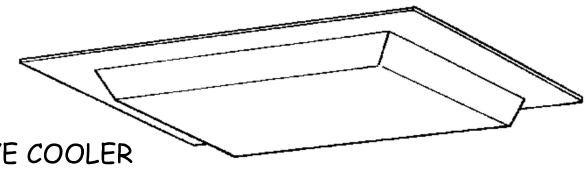
3. Installation Policies Specific to Mobile Homes

None.

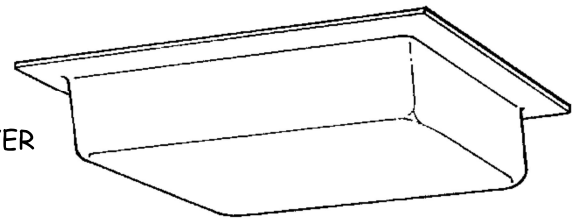
EVAPORATIVE COOLER AND AIR CONDITIONER VENT COVER STANDARDS

1. APPROVED MATERIALS

- **All covers**
  - Maximum perm rating shall be 1.0.
- **Plastic covers**
  - Rigid plastic covers
    - May be one-piece or multi-piece adjustable.
    - Adjustable cover must consist of pieces that bond together to form the equivalent of a one-piece cover.
  - Plastic film
    - 12-mil minimum.
    - Framed with aluminum, rigid plastic, or finished hardwood.
- **Metal covers**
  - Aluminum, galvanized, or painted metal.
- **Window/wall A/C outdoor covers**
  - Heavy duty, commercially-made product with secure attachment.
  - Must create a complete seal.
- **Wood covers**
  - Finished wood only.
  - Bare wood shall be sealed/finished with paint, urethane, varnish, or stain.
  - May be installed only when other types are not feasible.
- **Magnetic sheeting**
  - Minimum 30-mil flexible magnetic sheeting with vinyl face.



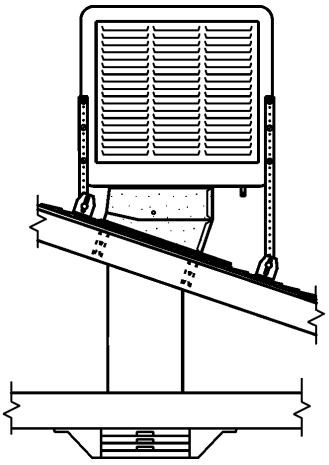
EVAPORATIVE COOLER VENT COVER



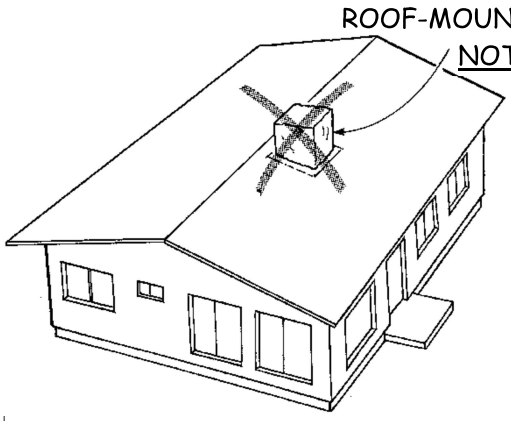
WINDOW-MOUNT AIR CONDITIONER VENT COVER

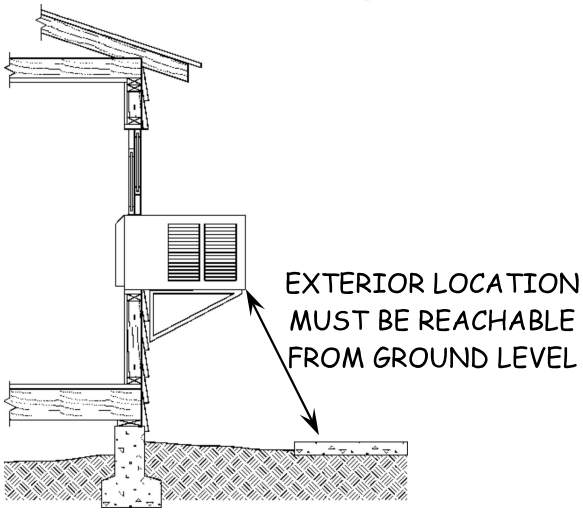
2. LOCATION

- **Placement**
  - Cover shall be placed to block infiltration.
  - All wall and ceiling vents must be covered.
  - Exterior covers for wall/window units are allowed only in easily-accessible locations. The unit must be in a location that:
    - Is free of obstructions and reachable from ground level.
    - Allows easy removal and reinstallation of the cover.
- **Shared ducts**
  - Cover shall <u>not</u> be installed when the cooler and a heating unit use a common duct system.
- **Dedicated cooler ducts with metal supply registers**
  - Applies to ducts serving only the cooler (not an FAU) with HVAC-style supply registers.
  - Registers may be blocked with magnetic sheeting trimmed to cover the register surface.



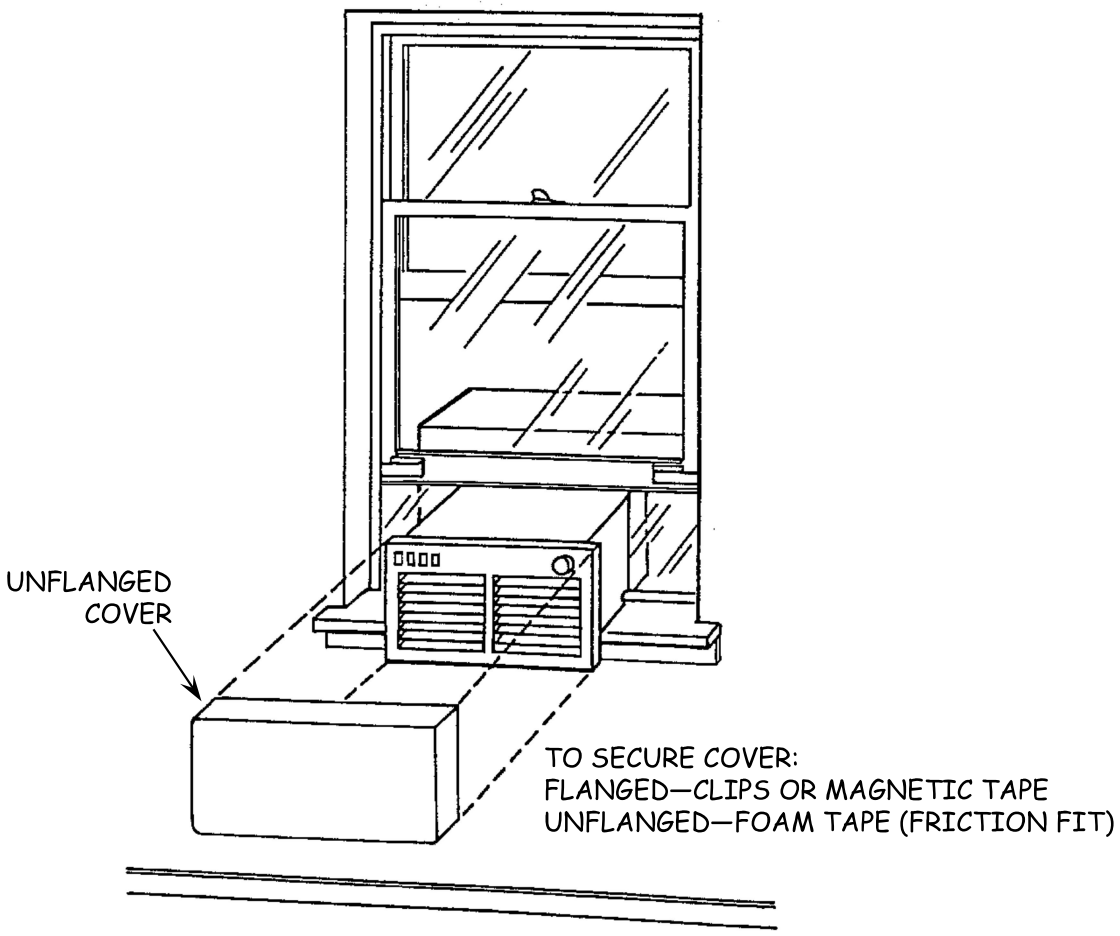
INTERIOR COOLER VENT COVER





3. EASY REMOVAL

- **Cover shall be:**
  - Held securely in place.
  - Easy to install and remove.
- **Flanged covers**
  - Cover shall be secured with rotating clips or magnetic strips.
- **Covers without mounting flange**
  - Cover may be held in place with weatherstripping (e.g., foam weatherstripping tape installed on interior for a friction fit).

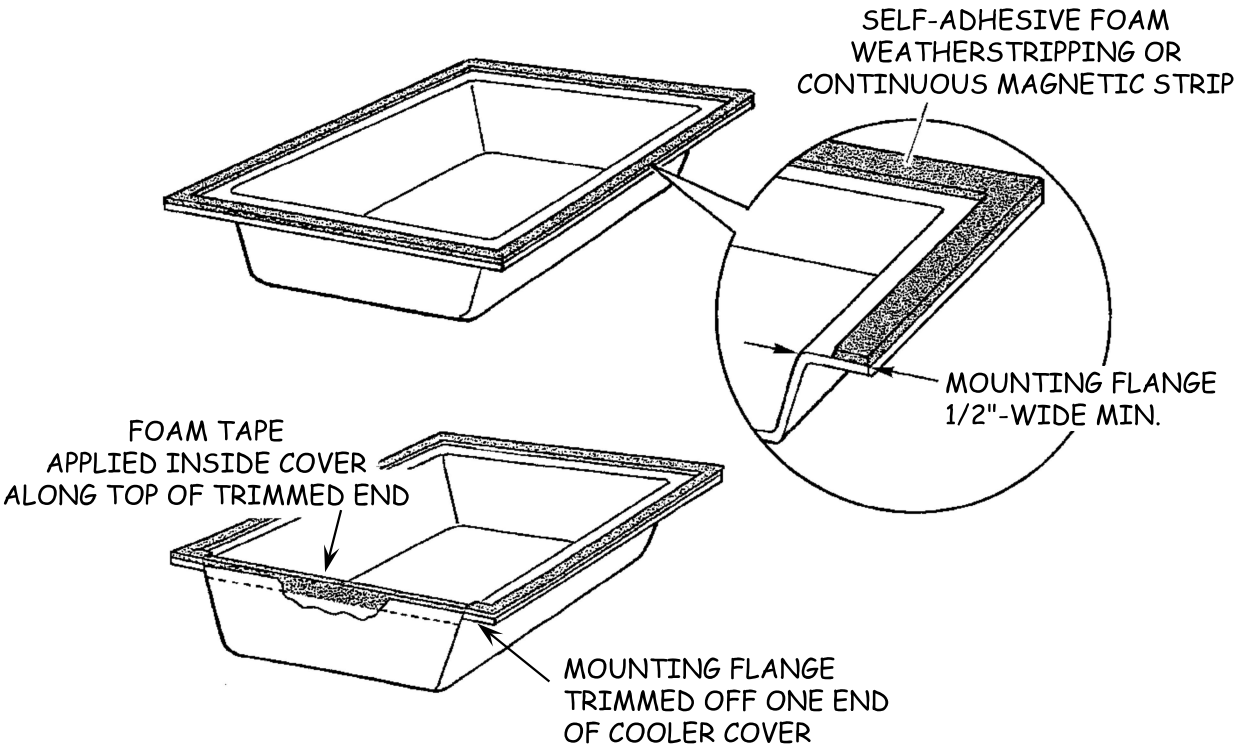


4. MOUNTING FLANGE

- **Unobstructed locations**
  - Each edge of the cover shall be a minimum of 1/2" wide to accommodate attachment and weatherstripping.
- **Obstructed locations**
  - Flange may be trimmed on one side to facilitate installation if cut side can be sealed against air leakage.

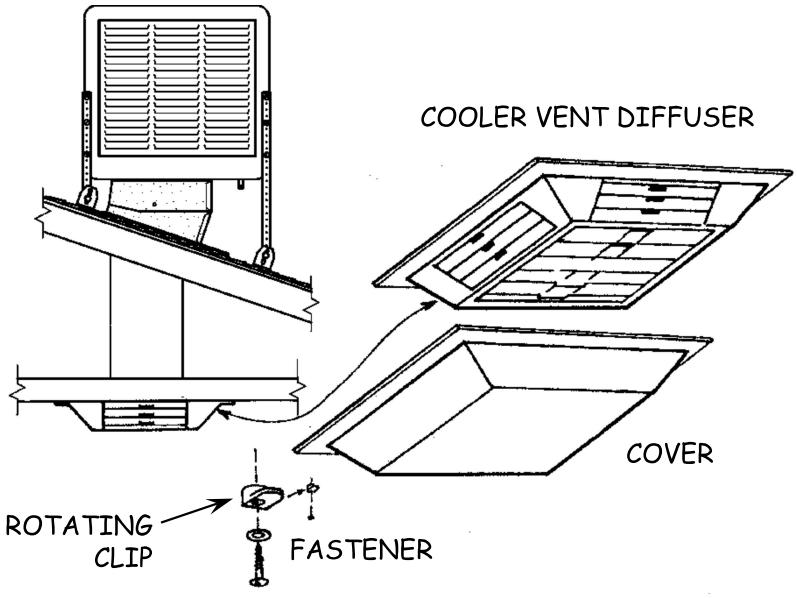
5. WEATHERSTRIPPING

- **All covers**
  - Perimeter of cover shall be sealed against air leakage.
- **Weatherstripping materials**
  - Open-cell foam or hollow-gasket weatherstripping.
  - Magnetic strip may be used in lieu of weatherstripping if an airtight seal is achieved (i.e., installed without gaps).



6. ATTACHMENT

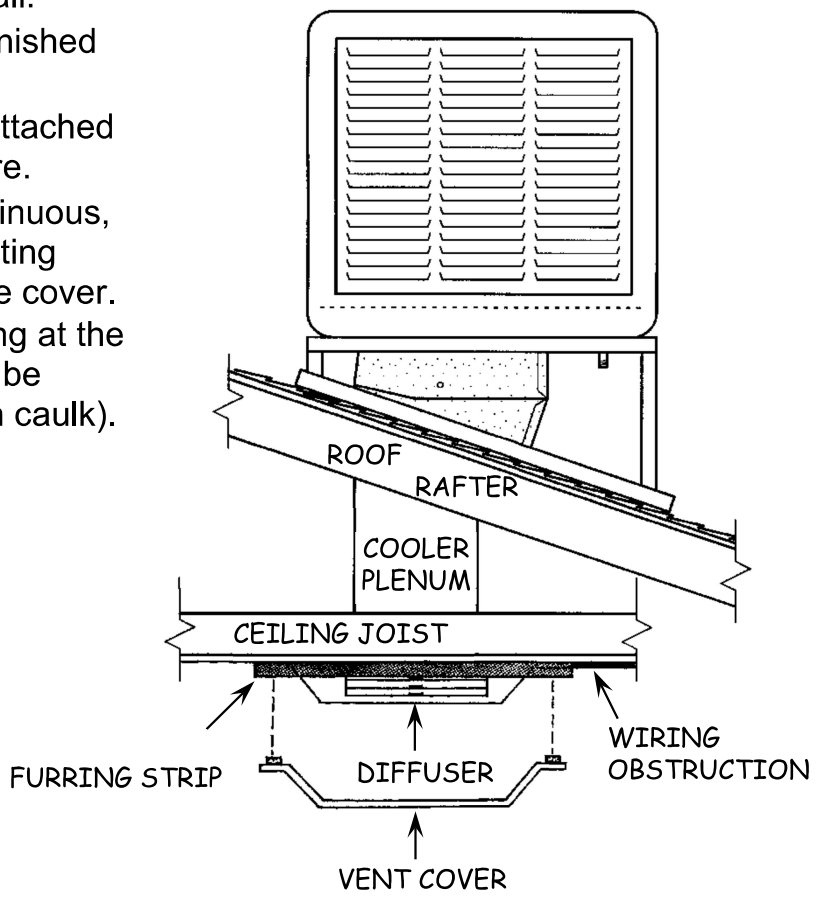
- **All types**
  - Attachment shall be secure and permanent.
- **Screws**
  - Screws shall penetrate:
    - Solid wood at least 1/2", or
    - Sheet metal, or
    - An anchoring device (e.g., drive- or expansion-type anchor).
- **Anchors (drive anchors, expansion anchors, molly bolts, etc.)**
  - Mounting surface shall be appropriate and conform to manufacturer's installation specifications.
- **Rotating clips**
  - Barrel of clip shall rest on mounting surface.
  - Sides exceeding 26": Clips shall be placed within 4" of each corner, minimum of two clips per side.
  - Sides up to 26": Minimum one clip per side, centered.
  - Clip and cover shall be made of compatible materials.
    - Metal clips shall be used with metal and wood frames.
- **Magnetic tape**
  - Tape shall be:
    - Permanently attached to mounting surface and cover.
    - Adequate to hold cover securely in place.
    - Continuous around the entire perimeter if weatherstripping is <u>not</u> used.



- **Magnetic sheeting**
  - Magnetic strength shall be adequate to tightly secure the sheet to metal registers.
  - Sheet must be neatly, squarely cut to cover the flat surface of the register.
  - A small slot shall be cut for the damper control arm, with a slit cut from end of cover to arm slot to enable installation of cover around the arm.
- **Multipiece covers**
  - Pieces shall be bonded together per manufacturer's instructions and installed/secured as a one-piece rigid cover.

7. FURRING STRIPS

- **Obstructed locations**
  - Furring strips may be installed as spacers that allow the cover to clear the obstruction (such as an electric wire).
  - Furring strips shall:
    - Be made of finished wood.
    - Be securely attached to the structure.
    - Create a continuous, smooth mounting surface for the cover.
  - Gap/hole in furring at the obstruction shall be sealed (e.g., with caulk).



8. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up**
  - Paint dust and chips, scraps, and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Furniture and other household items moved for installation work shall be returned to their original positions.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

DUCT TESTING AND SEALING

Lead Paint Risk Factor
NONE

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SECTION 10 PREFACE
for

DUCT TESTING AND SEALING

1. Nonfeasibility Criteria

Duct Testing and Sealing

1.1. Ductwork contains excessive damage or deterioration that precludes proper testing, or duct system is damaged and deteriorated beyond repair.

1.2. Total length of ducts located in unconditioned space is less than 40 linear feet, unless there is an obvious leak that is accessible.

1.3. Ductwork contains or is made of asbestos.

1.4. Metal ductwork is insulated or sealed with asbestos.

1.5. Ductwork is inaccessible or an unsafe condition exists, causing duct testing or duct repair and sealing to be unfeasible (e.g., as delineated for crawl clearance and unsafe conditions in Preface item 4).

1.6. A natural gas appliance hazard exists requiring repair or replacement per NGAT policy, and repair/replacement is not feasible.

1.7. Forced air unit is inoperative and cannot be repaired.

1.8. Forced air unit is abandoned or inaccessible, or duct system has been abandoned.

1.9. Mobile homes:

a. Proper isolation of return air at the FAU cannot be achieved, per IS Section 24 (Natural Gas Appliance Testing).

b. A leaky belly cavity or roof cavity return exists, and installation of a central return system is not feasible.

1.10. Gas dryer moisture exhaust passes through the FAU plenum.

1.11. Customer refuses.

Duct Sealing

1.12. Duct testing is not feasible.

1.13. Duct leakage is below the threshold leakage.

2. Installation Policies for Duct Testing and Sealing

2.1. Duct testing and sealing as a measure will be offered and performed only in accordance with individual utility policy.

2.2. The utility or its designee will verify initial and final duct leakage rates, in accordance with the procedures in this section and IS Appendix D (Methods for Determining Airflow).

3. Installation Policies Specific to Mobile Homes

3.1. Attic duct reconnection is not a measure for mobile homes.

4. Nonfeasibility Criteria for Repair/Replacement Requiring Attic or Crawl Space Access

4.1. Crawl clearance is inadequate:

a. Attic Clearance
   - Clearance is less than 24" between top of ceiling joists and bottom of ridge board.
   - Obstruction(s) in the attic, such as truss cross members, provide an opening with a minimum dimension of less than 18".

b. Under-Floor Clearance
   - Clearance is less than 18" from the ground to bottom of floor joist system (girders under a mobile home).
   - Crawling under or over an obstruction in the crawl area is required, and the crawl clearance is less than 12".

c. Confined spaces: state and federal regulations regarding confined spaces cannot be met.

4.2. Unsafe condition exists, which prevents safe access to the duct system:

a. Attic and Crawlspace
   - Hazardous insect or pest infestation is present.
   - Hazardous electrical wiring.
   - Structural hazard.

b. Crawlspace
   - Excessive ground moisture (standing water or mud) is present.
   - Sewage waste is on the ground or other unsanitary condition is present which poses a health and safety hazard.

DUCT TESTING AND SEALING STANDARDS

PART 1: DUCT TESTING

1. EQUIPMENT

- **Leakage measurement equipment**
  - Test equipment shall be in compliance with current Title 24 Residential Appendix RA3.

2. HVAC SYSTEM AIRFLOW (FAN FLOW)

- **HVAC system airflow shall be determined in accordance with:**
  - Current Title 24 Residential Appendix RA3.
  - Guidelines in IS Appendix D, utilizing one of the following methods:
    - Nominal system airflow (fan flow) estimate
    - Flow grid measurement
    - Plenum pressure matching measurement
    - Flow capture hood (traditional or powered)
- **Nominal system airflow estimate**
  - Airflow may be estimated as shown in Table 10-1, utilizing Title 24 protocol.

Table 10-1: System Airflow Defaults

HVAC System Type	System Airflow Defaults
A/C only	• 400 CFM/ton
Gas heating only	• 21.7 CFM per kBtuh heating output
Combination heating and A/C	• Fan flow CFM shall be the *greater* of cooling capacity CFM or heating capacity CFM.
Electric heating only	• Per IS Appendix D

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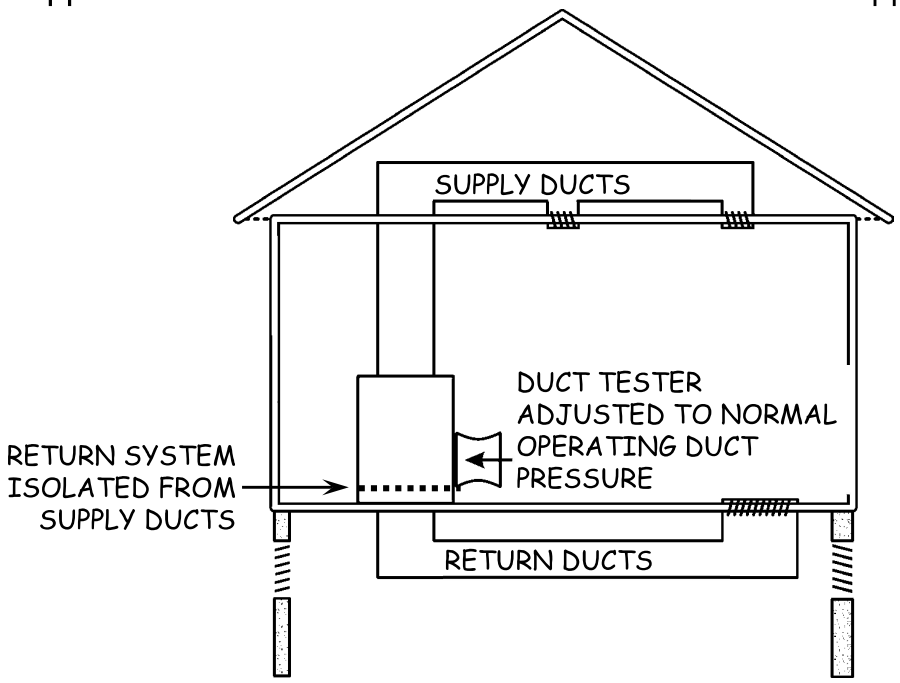
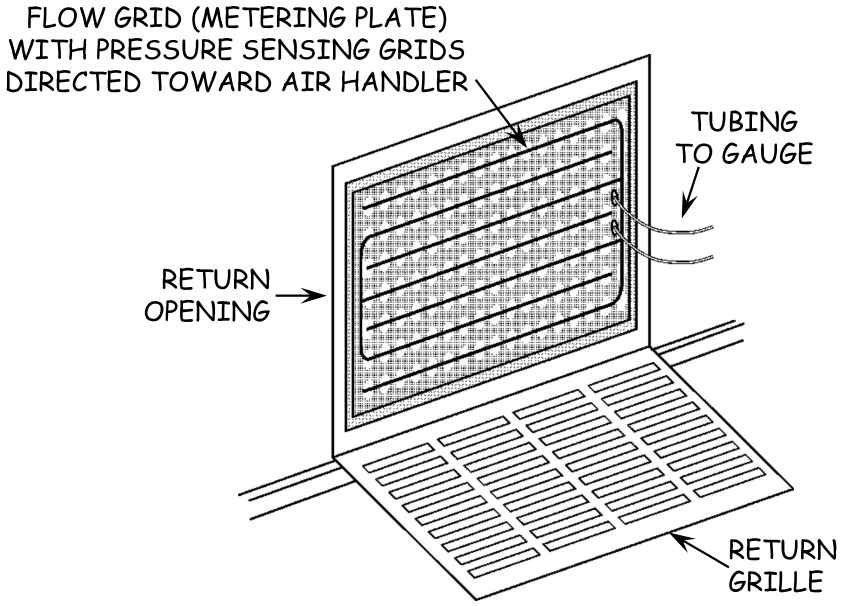
2. HVAC SYSTEM AIRFLOW (FAN FLOW) (cont.)

- **Measurement Equipment**
  - Equipment used for airflow measurements shall be in compliance with applicable subsections of current Title 24 Residential Appendix RA3.



SET-UP FOR PLENUM PRESSURE MATCHING AIRFLOW MEASUREMENT



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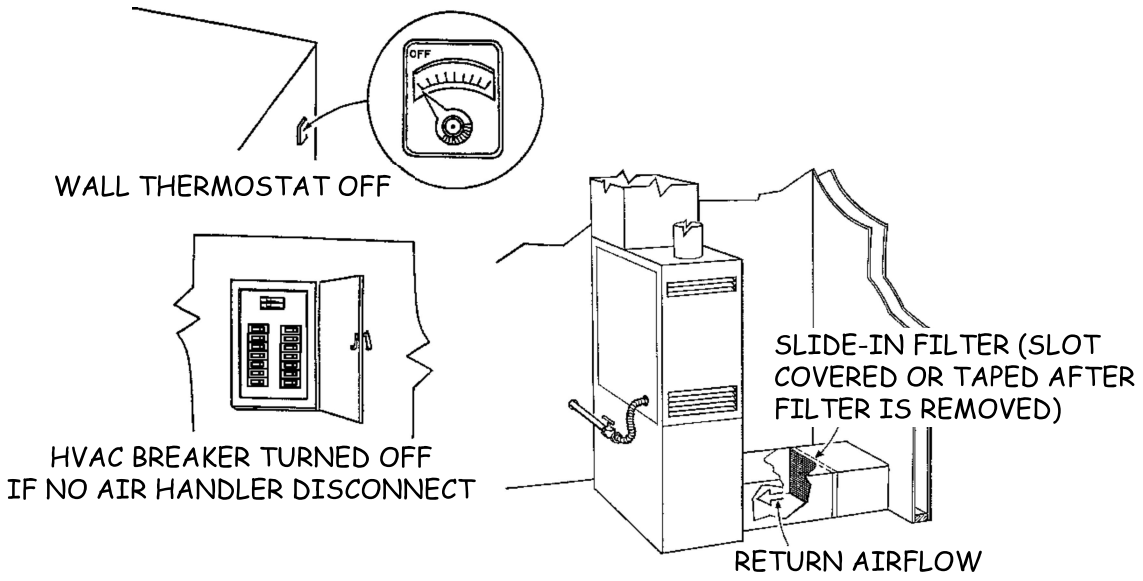
3. TEST CONDITIONS FOR ALL DUCT LEAKAGE TESTS

- **Equipment operation**
  - HVAC system must be functioning properly.
- **Air filters**
  - Filter(s) shall be removed from the duct system.
  - Opening (slot) for slide-in filters in the plenum shall be temporarily sealed.
- **Ventilation air intakes (make-up air)**
  - Intakes connected to the duct system shall be temporarily sealed.
- **All fan-equipped appliances shall be in the off position.**
  - HVAC equipment: FAU and room air conditioners.
  - Exhaust devices: Fans and clothes dryer vented outdoors.

4. BLOCKING SUPPLY AND RETURN DUCT TERMINATIONS

- **All blocking methods**
  - Terminations must be temporarily blocked/sealed during duct pressurization testing.
  - The same blocking/sealing method shall be used for all tests.



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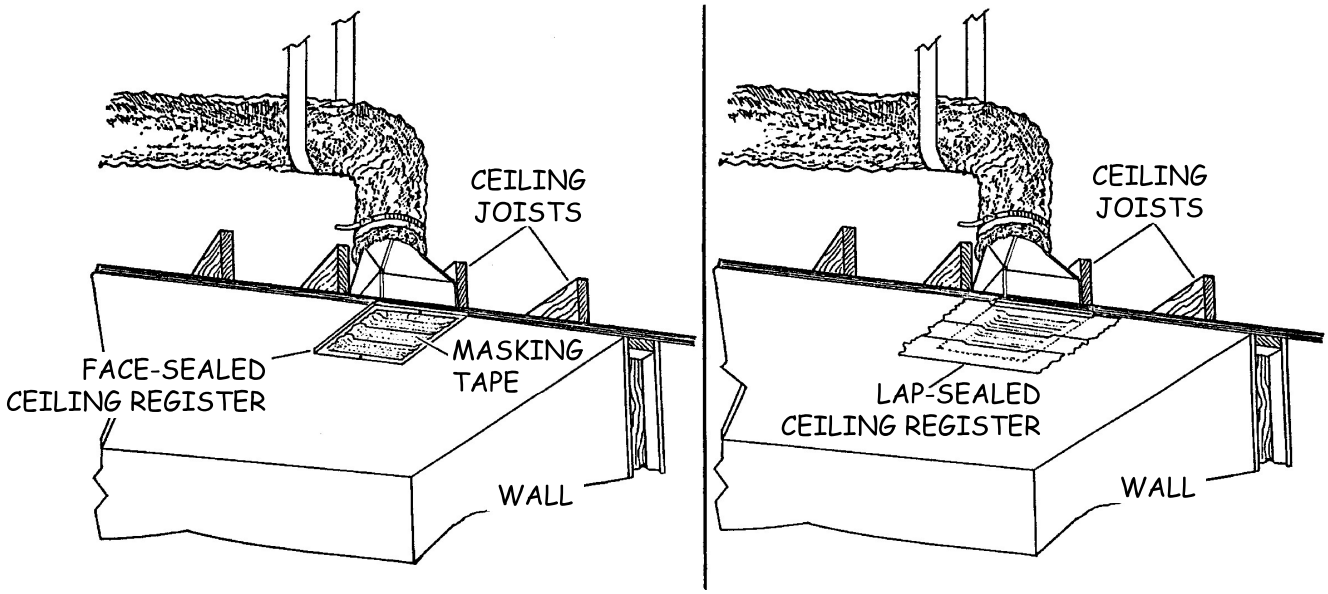
4. BLOCKING SUPPLY AND RETURN DUCT TERMINATIONS (cont.)

- **External blocking method**
  - Face-seal register/grille
    - The face of the supply register or return grille shall be covered with a temporary barrier material that does *not* lap onto the surrounding surface.
  - Lap-seal register/grille
    - The register/grille shall be covered with temporary barrier material that laps onto the surrounding surface.
    - Not applicable where surface damage may occur (e.g., ceiling with acoustical texturing).
- **Cover pan method**
  - The supply/return opening shall be covered/sealed with a gasketed cover pan.
  - Gaps between the boot and the structure shall be sealed/caulked if the cover pan method is used.
  - This method shall not be used where acoustical texturing is present.
- **Internal blocking method**
  - The boot shall be internally blocked and sealed with a temporary plug or dam (e.g., a tight-fitting block of dense foam or duct board).
  - Plug must seal the boot completely.
  - Gaps between the boot and the structure shall be sealed/caulked if the internal blocking method is used.



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5. DUCT TESTER INSTALLATION

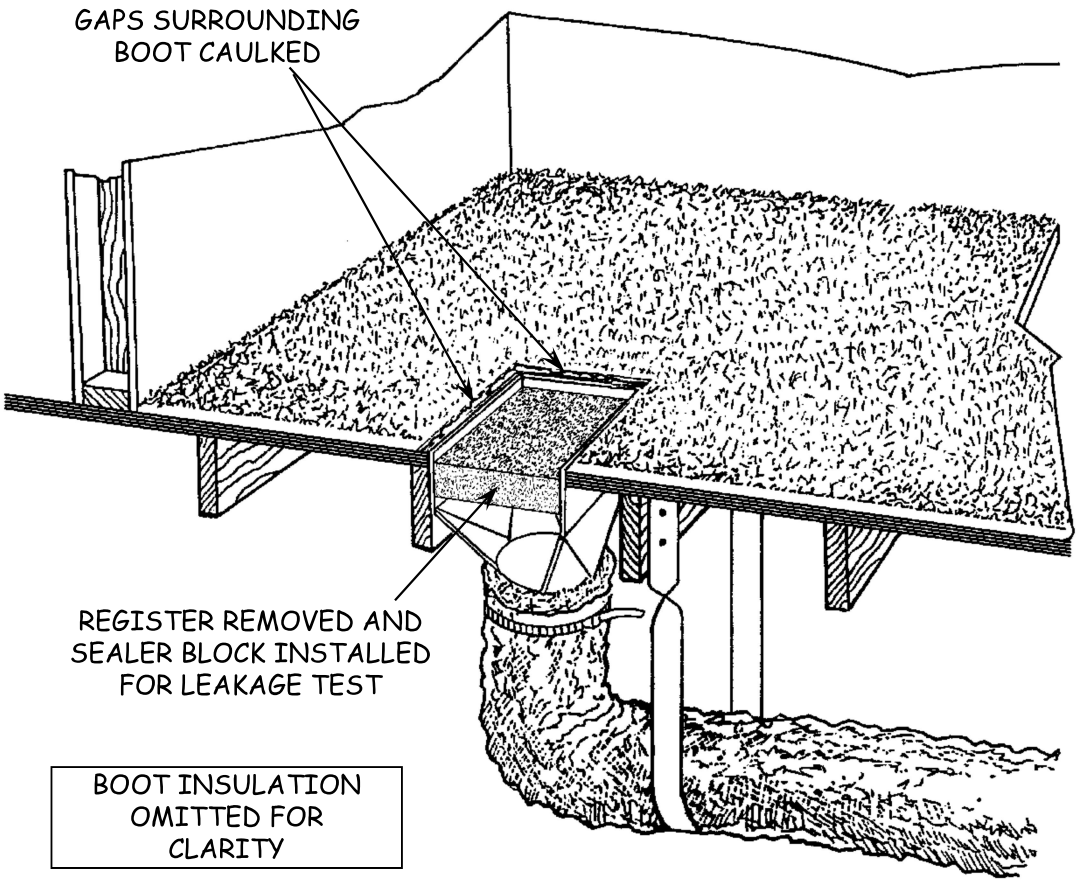
- **Test equipment shall be set up, calibrated, and operated in accordance with manufacturer's instructions.**

6. LEAKAGE TO OUTSIDE

- **Not a feasible test method in this program.**

7. TOTAL DUCT LEAKAGE TEST

- **Procedure**
  - Tests shall be performed in accordance with test equipment manufacturer's instructions.
  - Ducts shall be pressurized to 25 Pa.
  - Target total duct leakage is ≤15% of system airflow or as specified in the program P&P.
- **Very leaky systems**
  - When a duct pressure of 25 Pa cannot be achieved and the digital gauge does not automatically estimate CFM at 25 Pa, manufacturer's instructions shall be followed.



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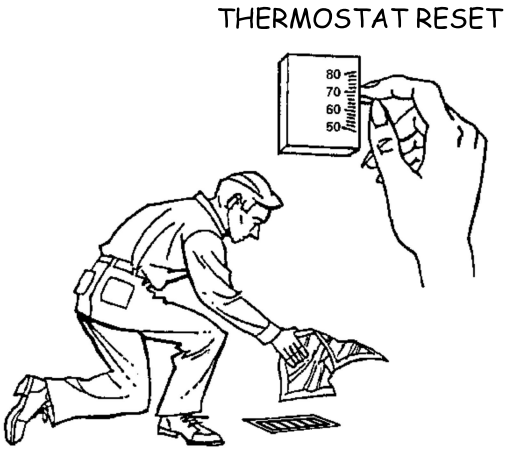
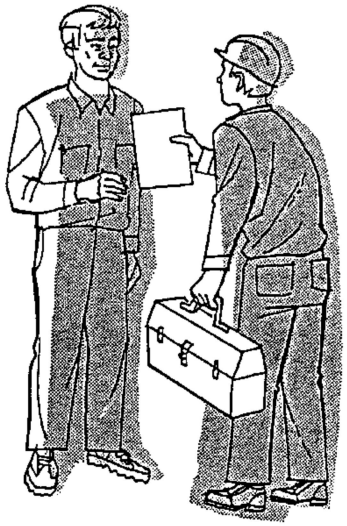
8. WRAP-UP PROCEDURE

- **Following completion of duct testing, the HVAC system, appliances, and home shall be returned to their original condition.**
- **Temporary sealing removed:**
  - All temporary sealing and blocking materials (register sealing film, temporary tape, foam plugs, etc.) shall be removed.
  - Ventilation air intakes shall be restored to normal.
- **Air filter(s) reinstalled:**
  - Filters removed for testing shall be reinstalled.
  - Dirty filters shall be cleaned before reinstallation.
- **Appliances and furnishings restored:**
  - Wall thermostat, water heater control, HVAC/air handler power, windows, doors, fans, room air conditioners, etc. shall be returned to pre-test settings.
  - Home furnishings shall be returned to their original locations.
  - All test equipment, tools, supplies, and trash shall be removed from the home.



REGISTER SEALS REMOVED



COMMUNICATION WITH CUSTOMER

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PART 2: DUCT SEALING

APPROVED MATERIALS

9. ALL INSTALLATIONS AND REPAIRS

- **Duct installation and sealing shall be in conformance with guidelines in this section and the following standards:**
  - Current Title 24 Residential Compliance Manual, Chapter 4.
  - Current California Mechanical Code, Chapter 6.
- **Only exterior-rated products shall be used outdoors.**
- **UL 181A- and 181B-listed sealants shall be used and shall be labeled per Table 10-2.**

Table 10-2: Approved Sealing Materials

Duct Type	Sealing Material	UL Identification
Rigid metal ducts and components	Pressure-sensitive tape	Marked "181A-P" or "181A-P/181B-FX"
	Heat-activated tape	Marked "181A-H"
	Mastic	Labeled "181A-M" or "181A-M/181B-M"
Flexible ducts	Pressure-sensitive tape	Marked "181B-FX" or "181A-P/181B-FX"
	Mastic	Labeled "181B-M" or "181A-M/181B-M"

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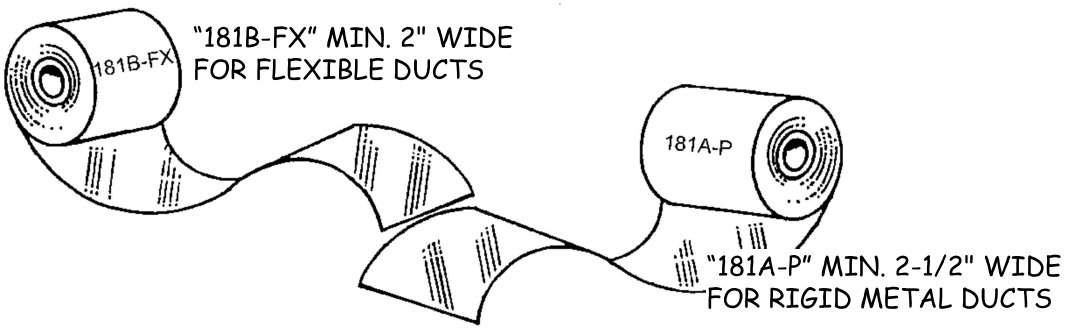
10. PRESSURE-SENSITIVE TAPE

- **Approved tapes**
  - Listed and marked in accordance with Table 10-2.
  - Flexible nonmetallic and flexible metallic ducts
  - UL listed cloth-back rubber-adhesive tapes (including those with “CA” in the product number):
    - May be used for flexible duct connections only when applied in combination with duct mastic and drawbands.
    - Shall not be used to seal start collars to plenums and junction boxes.
  - Rigid metal ducts and components
    - “Butyl tape” without “181A-P” or “181B-FX” markings may be used to seal rigid metal-to-metal connections.
  - Access panels
    - UL listed metallic tapes with non-butyl (e.g., acrylic) adhesive.
  - High-temperature applications
    - Metallic tapes with non-butyl (e.g., acrylic) adhesive and service temperature rating of at least 265°F.



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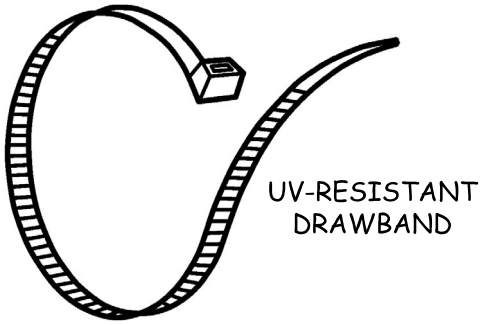
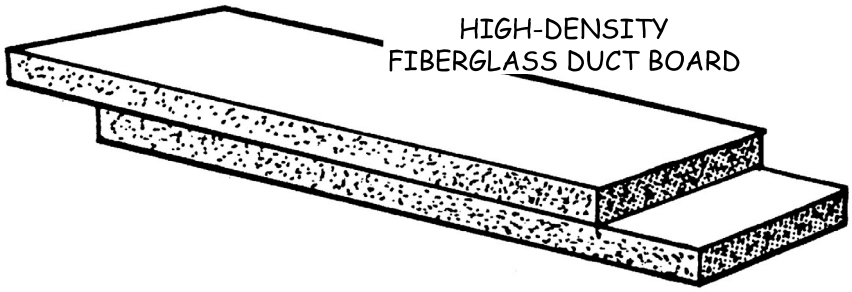
11. DRAWBANDS AND CLAMPS

- **Materials**
  - Drawbands and clamps used to secure flexible nonmetallic ducts shall comply with the duct manufacturer's installation instructions.
  - Drawbands shall be weather- and UV-resistant nylon duct straps/ties rated for outdoor use and marked "181B-C."
  - Clamps shall be stainless steel worm-drive clamps.
- **Drawband installation**
  - Drawbands shall be tightened with an adjustable tensioning tool in accordance with the duct manufacturer's instructions.

12. DUCT BOARD

- **High-density fiberglass duct board**
  - Conformance to ASTM C726, NFPA 90B, or UL Class 1.
  - Minimum R-value: R-4.2
- **Foam board and foam sealant**
  - Not allowed as a barrier material or sealant in the repair of building cavities used as ducts, platforms, or other duct system components.





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13. CAULKING MATERIALS

- **All materials**
  - Shall be non-toxic and selected and applied in accordance with IS Section 1 (Caulking).
- **Sealant for refrigerant lines**
  - Cord tape shall be used for sealing gaps where refrigerant lines penetrate the coil box/plenum.

14. ALL FLEXIBLE DUCTS

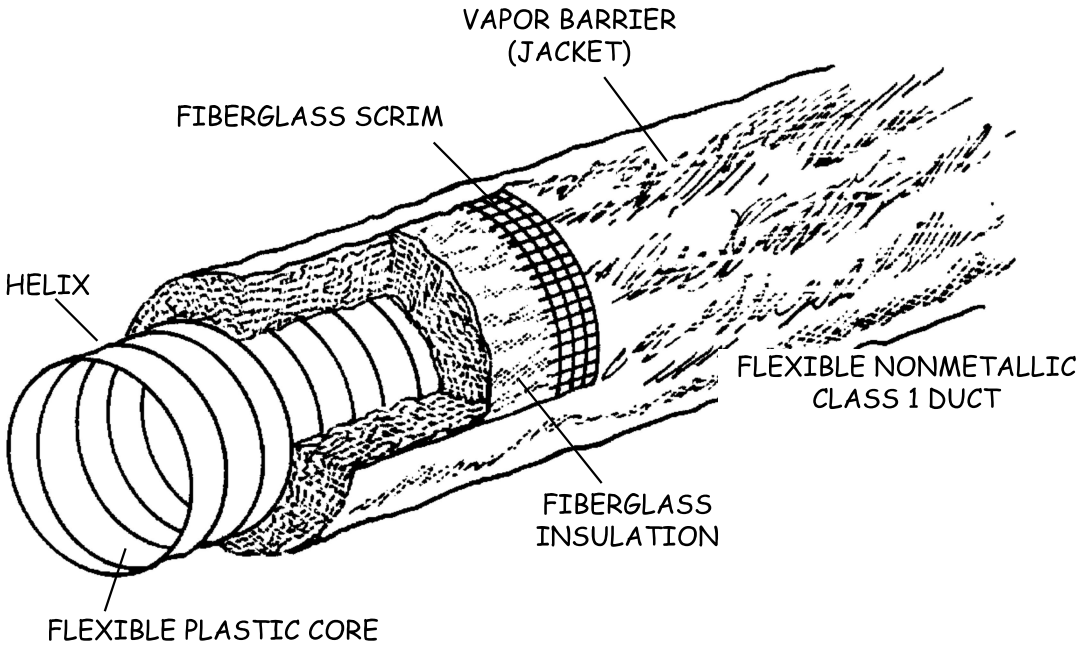
- **Duct material**
  - Ducts shall conform to NFPA 90B and UL 181 Class 1.
  - Nonmetallic insulated ducts with air-permeable core not allowed.
- **Vapor barrier (jacket):**
  - UV-resistant material (e.g., silver metalized polyester jacket).

15. DUCT INSULATION

- **R-value**
  - As shown in Table 10-3, or greater if required by local code.

Table 10-3: Duct Insulation Minimum R-values

CZ	Minimum R-value
1–10, 12, 13	R-6
11, 14–16	R-8



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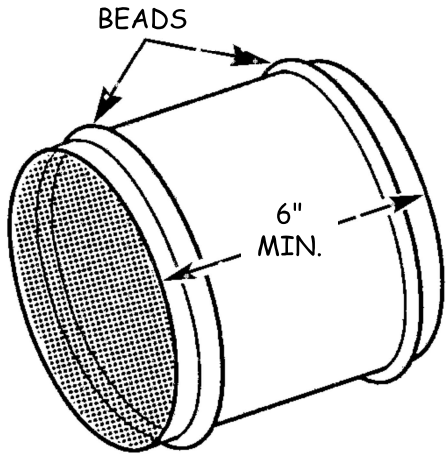
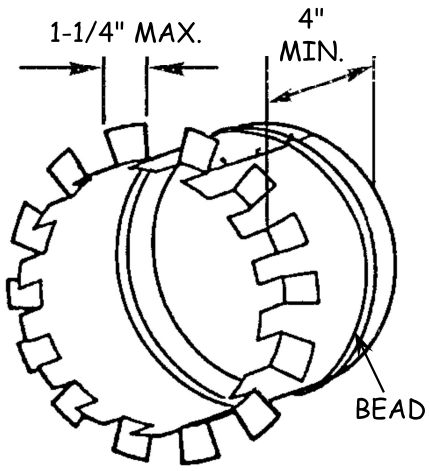
16. SHEET METAL

- **All rigid components**
  - Components shall be constructed of noncorrosive materials.
- **New fittings used with flexible <u>nonmetallic ducts</u>**
  - Starting collars
    - 4" installed length.
    - 26-gauge galvanized steel up to 14" diameter.
  - Splicing sleeves
    - 6" length.
    - 26-gauge galvanized steel up to 14" diameter.
  - All fittings
    - Fittings shall be beaded at each core connection (e.g., both ends of a sleeve) when flexible nonmetallic ducts are attached. *<u>Exception</u>:* When a preexisting fitting is <u>not</u> beaded, the core's wire coil shall be secured to the fitting as prescribed in Item 23.



BEADED SLEEVE MINIMUM 6" LONG FOR FLEXIBLE NONMETALLIC DUCTS



SHEET METAL COLLAR (DOVETAIL) MIN. 4" LONG AND BEADED FOR FLEXIBLE NONMETALLIC DUCTS

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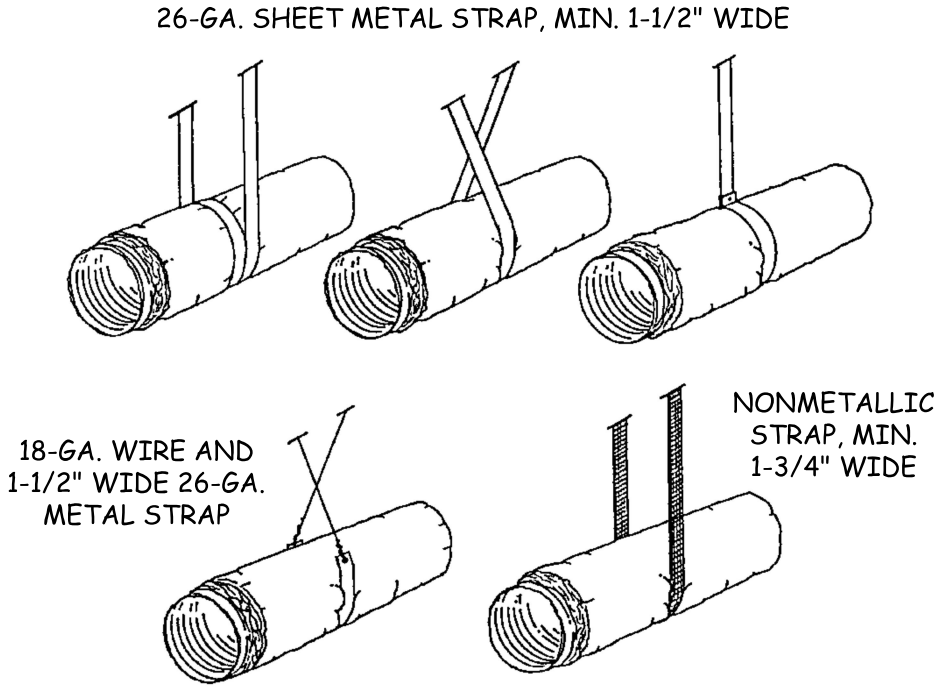
17. DUCT SUPPORTS

- **All ducts**
  - Support materials shall be corrosion-resistant and shall:
    - Conform to the duct manufacturer's installation instructions, Title 24 Standards, and CMC Chapter 6.
    - Be installed in compliance with Item 20.
- **Flexible ducts (horizontal and vertical)**
  - Nonmetallic support straps
    - May be used only if allowed by the local jurisdiction.
    - Polypropylene monofilament, woven polyester, polyester scrim reinforced vinyl laminate, or equivalent.
      - Minimum width: 1-3/4".
      - Minimum tensile strength: 70 lbs./inch of width.
  - Sheet metal support straps and saddles
    - Width: 1-1/2" minimum.
    - Thickness: 26-gauge minimum.



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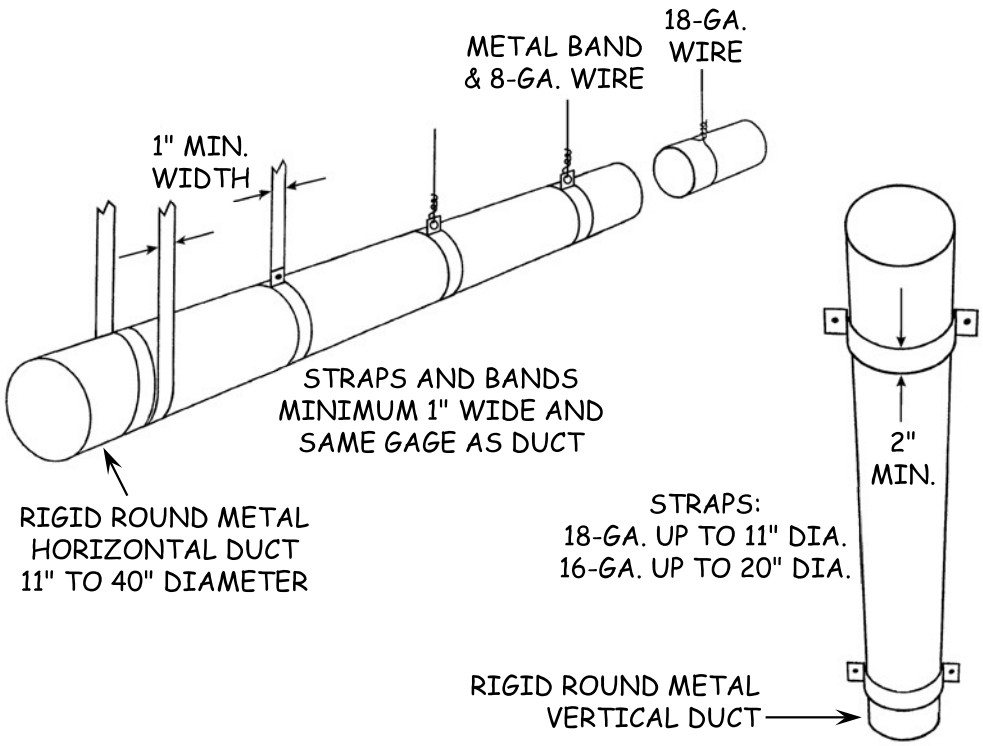
17. DUCT SUPPORTS (cont.)

- **Horizontal rigid round metal ducts**
  - Up to 10" diameter
    - Galvanized steel straps, same gauge as duct, 1" minimum width, or
    - 18-gauge galvanized steel wire.
  - 11" to 40" Diameter
    - Galvanized steel straps, same gauge as duct, 1" minimum width, or
    - 8-gauge galvanized steel wire tied to a galvanized steel band, 1" minimum width, surrounding the duct.
- **Vertical rigid round metal ducts**
  - Up to 10" diameter
    - 18-gauge galvanized steel straps, 2" minimum width.
  - 11" to 20" diameter
    - 16-gauge galvanized steel straps, 2" minimum width.



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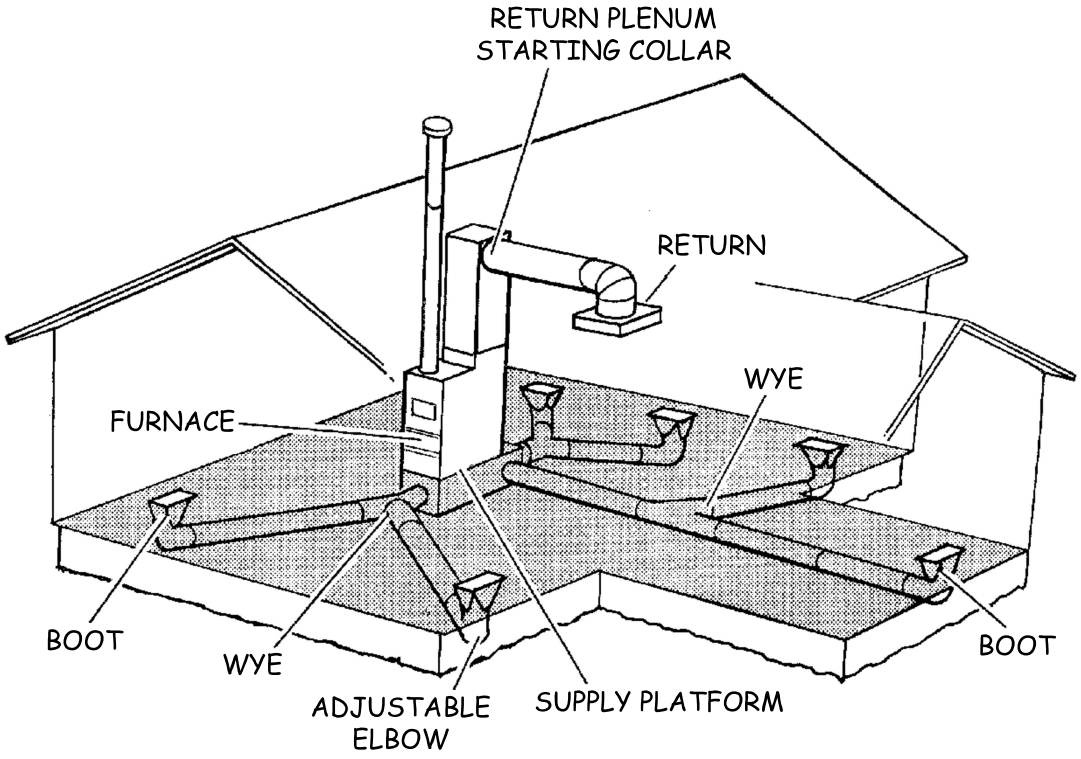
EVALUATION

18. DUCT SYSTEM EVALUATION

- **Inspection of duct system**
  - The duct system shall be inspected for disconnections and other leaks and evidence of damage and deterioration.
  - All accessible portions of the duct system shall be accessed.
  - Registers and grilles shall be removed as needed for access.



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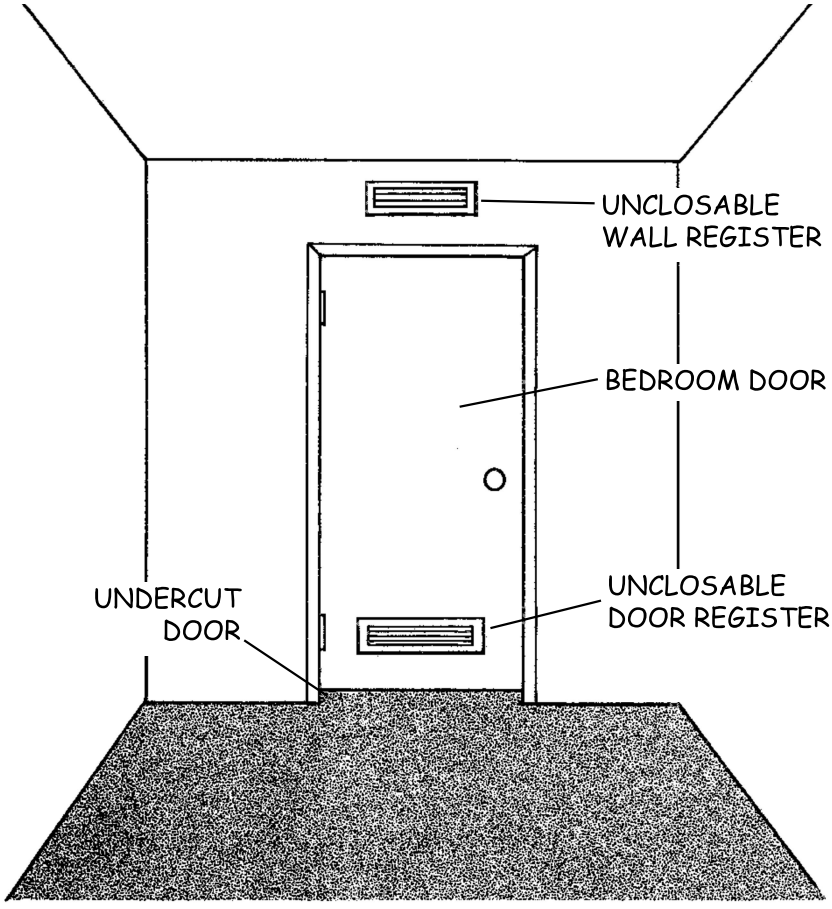
18. DUCT SYSTEM EVALUATION (cont.)

- **Duct system balance**
  - Duct systems shall be balanced to provide adequate air movement throughout the living space with interior doors closed.
  - The required return air path for each room shall be provided by a permanent means, such as one of the following:
    - A transfer or jump duct from the room to the hallway.
    - Unclosable grilled or louvered venting in the door or wall.
    - An undercut door leading to the hallway.



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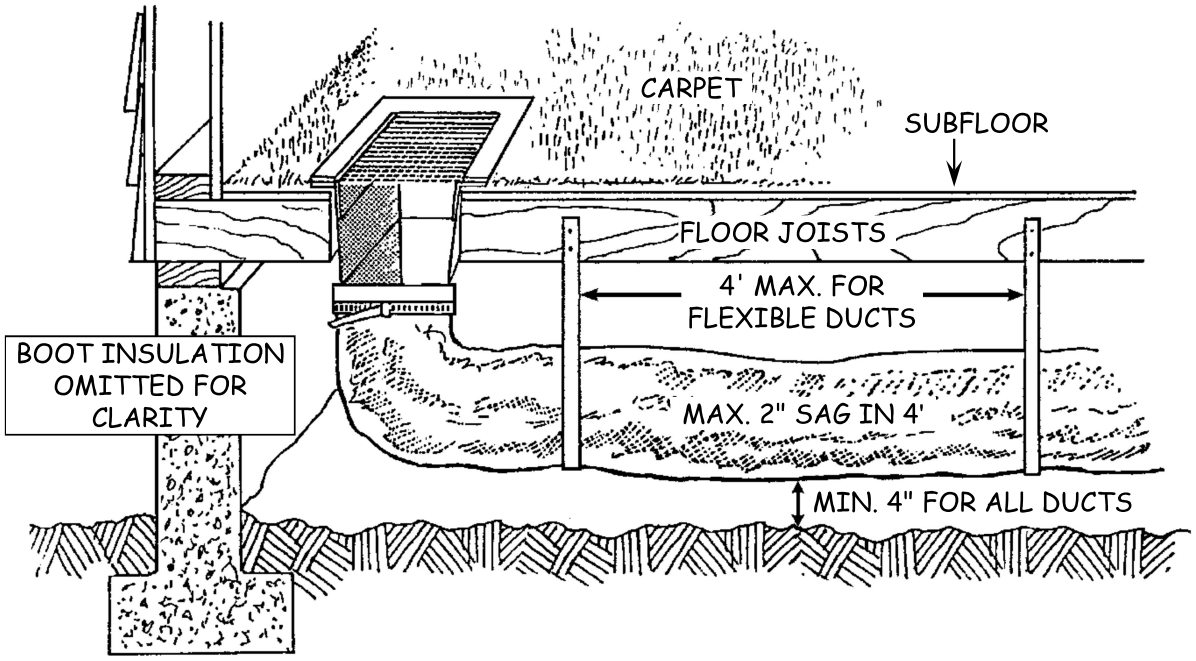
DUCT INSTALLATION

19. GENERAL INSTALLATION CRITERIA

- **All duct installations**
  - Installation and support shall comply with these standards, manufacturer's instructions, and local code, with the more stringent requirements taking precedence.
  - Ducts shall be:
    - Installed with at least 4" of separation from earth.
    - Protected from physical damage.
    - Installed in locations not exposed to the weather unless designed for exterior use.
    - Supported as prescribed in Item 20.
  - Ducts installed within a closet or room shall be enclosed within a cavity constructed of materials equivalent to those used in construction of the closet/room.
  - A building cavity shall not be used as a duct without a sealed duct board or metal liner.
  - Existing platform returns shall be sealed per Item 29.



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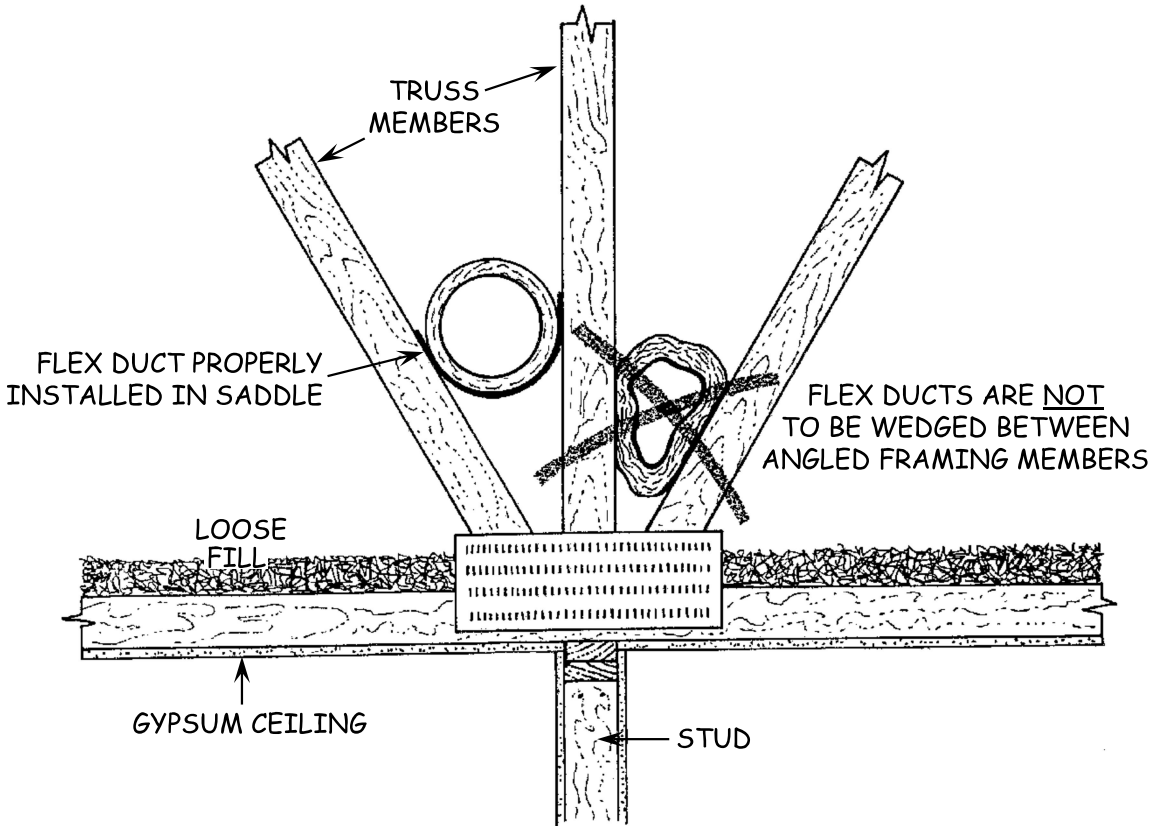
- **Air handler operation**
  - Air handler shall:
    - Be off during the application of all tapes and sealants.
    - Remain off for the drying time specified by the sealant manufacturer.

20. DUCT SUPPORT INSTALLATION

- **Flexible ducts**
  - All installations
    - Straps and other means of support shall not constrict the duct below its rated internal diameter nor cut the jacket.
    - Support saddles
      - Shall fit neatly around and cover the lower half (180°) of duct.
    - The duct may rest on ceiling joists or truss members if:
      - Support spacing and sag limitations are met.
      - The duct is not wedged between truss members.
    - Termination devices (e.g., register boots) shall be properly secured and shall not rely upon the duct for support.



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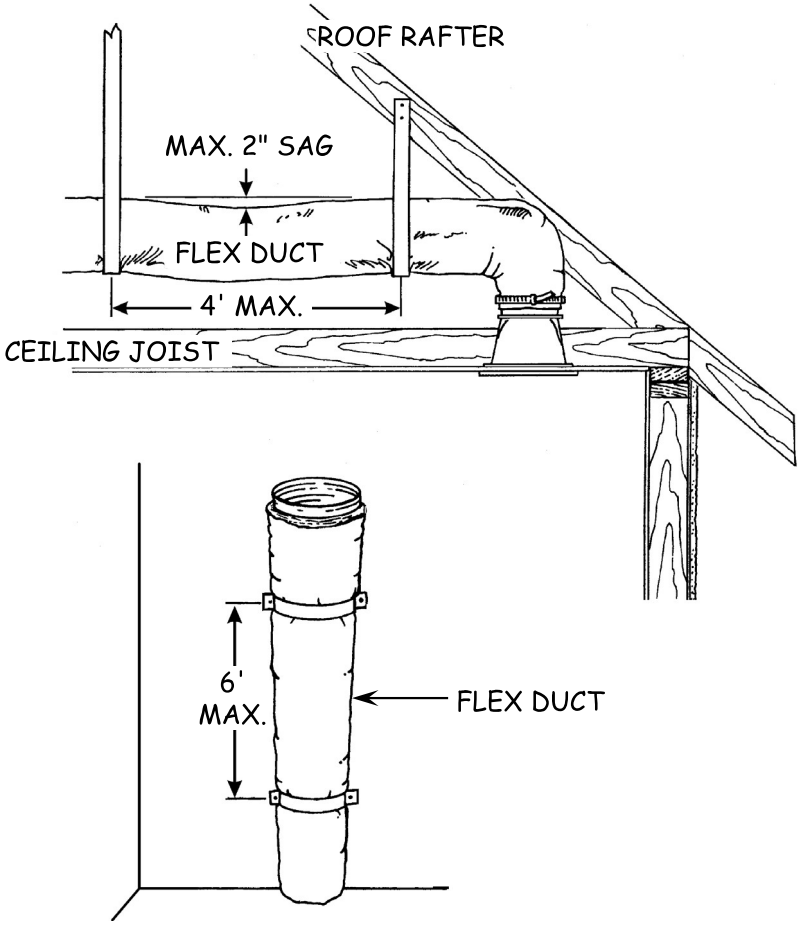
20. DUCT SUPPORT INSTALLATION (cont.)

- **Flexible ducts (cont.)**
  - Nonmetallic support straps
    - Acceptable when allowed by the local jurisdiction.
    - At each end, at least 2" shall be folded over and secured by two or more anchors that penetrate both layers of strap material.
  - Horizontal flexible ducts
    - Spacing between supports shall be 4' maximum.
    - Sag shall be no more than:
      - 1/2" per foot of distance between supports.
      - 2" total between supports.
  - Vertical flexible ducts
    - Spacing between supports shall be 6' maximum.



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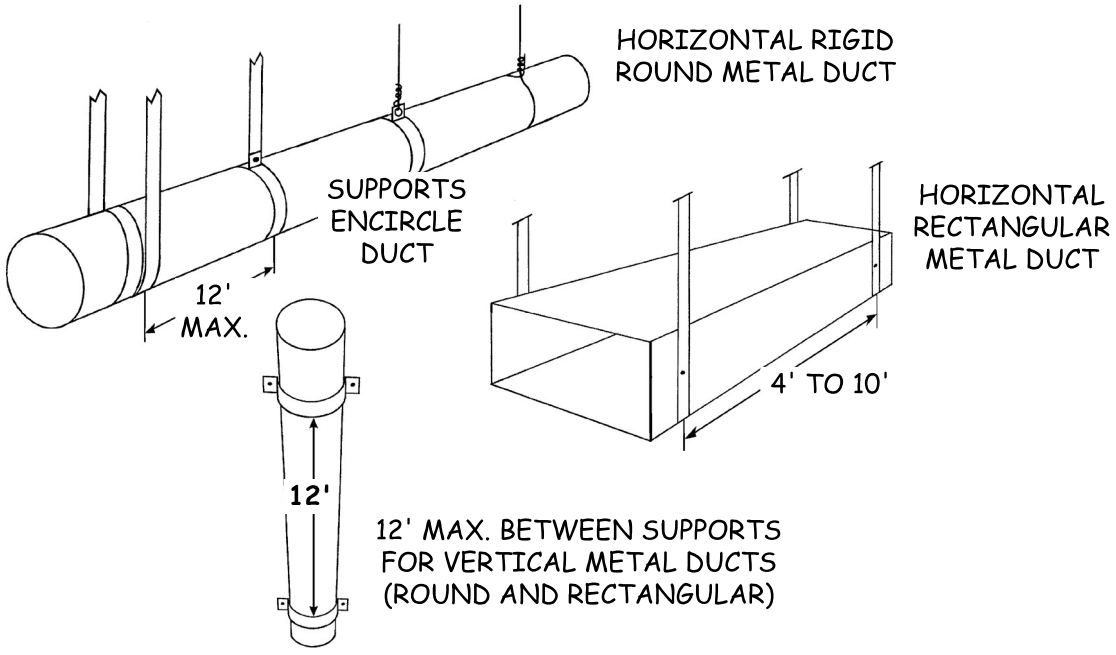
20. DUCT SUPPORT INSTALLATION (cont.)

- **Rigid round metal ducts**
  - Horizontal installations
    - Spacing between supports shall be 12' maximum.
    - Support shall tightly encircle the duct.
  - Vertical installations
    - Spacing between supports shall be 12' maximum.
- **Rigid rectangular metal ducts**
  - Horizontal installations
    - Spacing between supports shall be 4’ minimum to 10' maximum, based on duct size, per ANSI/SMACNA 006-2006.
    - Support straps shall be secured to sides of duct with sheet metal screws, rivets, or bolts.
  - Vertical installations
    - Spacing between supports shall be 12' maximum.
- **Rigid fiberglass ducts**
  - Ducts shall be supported and reinforced in conformance with the CMC and local code.
- **Horizontal plenums (metal and fiberglass duct board)**
  - Shall not rely on furnace for support.
  - Shall be independently supported at each end, and shall be intermediately supported if over 10 feet in length.



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DUCT REPAIR AND SEALING

21. DUCT SEALING PROTOCOL

- **Start criteria**
  - Duct repair and sealing work may begin only if the *initial* total duct leakage satisfies the individual utility's start criteria.
- **Stop criteria**
  - Target leakage must be met as shown in Table 10-4.
  - Measurement method (B) shall be used only when target leakage cannot be met using method (A).
- **Required data shall be recorded as required by individual utility, including:**
  - Duct leakage CFM_{25} from the *initial* test, performed before starting duct repair and sealing work.
  - Duct leakage CFM_{25} from the *final* test performed after completing duct repair and sealing work.

Table 10-4: Title 24 Duct Sealing Target Leakage[1]

Measurement Method	Target Leakage
(A) Total duct leakage	≤15% of system fan flow
(B) Prescriptive default	Target not met but all accessible ducts are sealed[2]

[1] Procedures specified in current Title 24 Residential Appendix RA3.

[2] When leakage target cannot be met, all accessible leaks must be sealed, as confirmed by a smoke test.

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22. DUCT CLOSURE SYSTEMS

- **Gap size and dealing materials**
  - Sealing materials shall be selected in conformance with Table 10-5.
  - Flexible duct connections with gaps wider than 1/4" shall be replaced with properly sized duct and/or fitting.
  - For rigid metal ducts, gaps 1" or wider shall be repaired with a sheet metal patch (Item 27) or sleeve.
  - For rigid fiberglass ducts, repairs shall be:
    - Made with duct board or sheet metal and screws, and
    - Sealed with mastic or metallic tape.
- **Duct mastic and pressure-sensitive tape shall be applied per manufacturer's instructions and Title 24 standards.**

Table 10-5: Gap Size and Approved Sealing Materials

Gap Size	Flexible Metallic & Nonmetallic Ducts		Rigid Metal & Fiberglass Ducts	
	Sealing with MASTIC	Sealing with TAPE	Sealing with MASTIC	Sealing with TAPE
≤1/4"	Mastic	Tape	Mastic	Tape
>1/4"–<1"	Repair required*	Repair required*	Mastic and mesh	Mastic over tape
1" or wider	Repair required*	Repair required*	Metal patch or sleeve and mastic	Metal patch or sleeve and tape

*Duct and/or fitting must be replaced with proper size.

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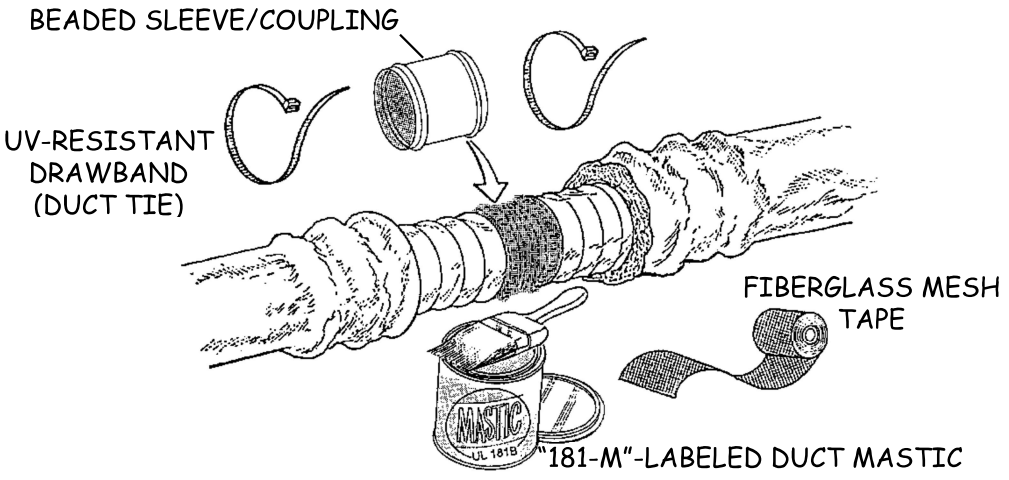
23. REPAIRING AND SEALING FLEXIBLE NONMETALLIC DUCTS

- **Beaded fittings—mastic sealants**
  - A uniform coat of mastic is applied to the outside of the fitting.
  - At least 2" of duct core is pulled onto the fitting extending past the bead.
  - A drawband (or metal clamp) is installed behind the bead.
  - Mastic is applied externally as needed to ensure a complete seal.
- **Beaded fittings—pressure-sensitive tapes**
  - At least 1" of duct core is pulled onto the fitting extending past the bead. (Fitting must provide additional 1" surface beyond duct core for application of tape.)
  - A drawband (or metal clamp) is installed behind the bead.
  - Connection is sealed with at least two staggered wraps of tape applied uniformly over both the core and the fitting.
- **Non-beaded pre-existing fittings—all sealants**
  - The duct core is secured to the fitting with internally-placed mastic and a drawband, or
  - The duct core's wire coil is secured to the fitting with at least three evenly spaced #8 sheet metal screws that capture the wire.
    - Screws must penetrate "181B-FX" pressure-sensitive tape, which is first applied over the duct core to protect it from tearing.
  - The connection is sealed with duct mastic or two staggered wraps of pressure-sensitive tape.
- **Core repairs**
  - Holes/damage in the duct core shall be repaired by removal of the damaged section and insertion of a sleeve/coupling.



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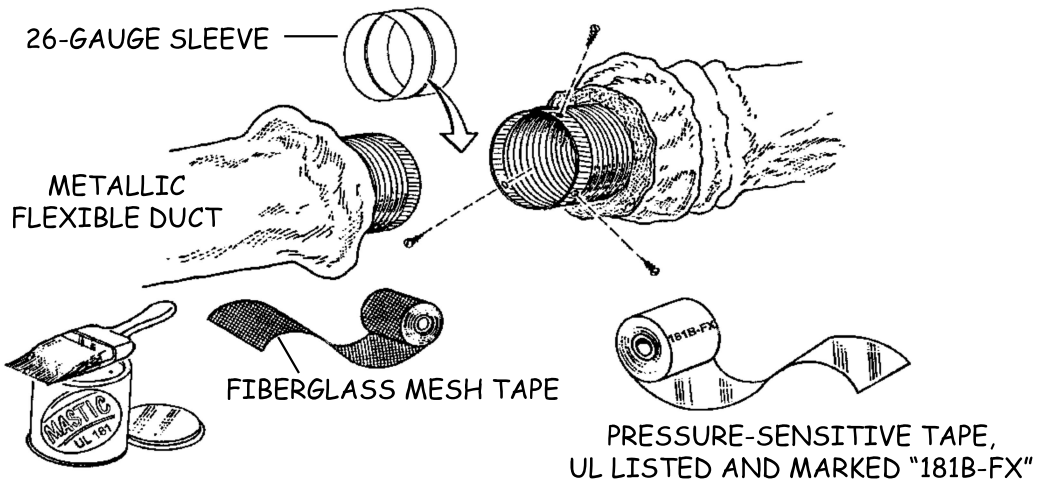
24. REPAIRING AND SEALING FLEXIBLE METALLIC DUCTS

- **Factory-installed sleeve present**
  - Connection shall be secured and sealed, like rigid metal ducts, per Item 26.
- **Factory-installed sleeve not present**
  - The end of the core shall be trimmed squarely, pulled over a metal sleeve or fitting at least one inch, secured with at least three evenly spaced #8 sheet metal screws, and sealed with mastic or tape.
  - Mastic Sealant
    - A uniform coat of mastic is applied to the outside of the sleeve/fitting before the duct core is pulled on, and externally as needed to ensure a complete seal.
  - Pressure-sensitive tape
    - Connection is sealed with at least two staggered wraps of tape applied uniformly over both the core and the fitting.
- **Core repairs**
  - Holes/damage in the duct core shall be repaired by removal of the damaged section and insertion of a sleeve/coupling.



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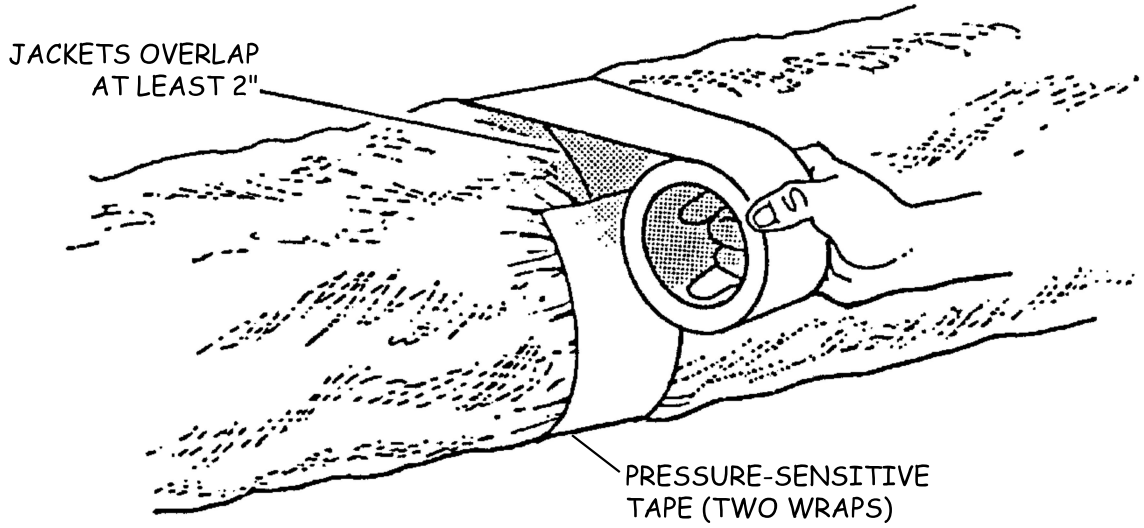
25. FLEXIBLE DUCT INSULATION AND JACKET

- **Insulation shall completely cover the duct core and fitting.**
- **Jacket (vapor barrier)**
  - The jacket shall be pulled back over the insulation.
    - The jackets shall overlap at least 2" at splices.
    - Jackets shall be secured/sealed with a drawband and/or two staggered wraps of pressure-sensitive tape.
- **Jacket Repairs**
  - Rips and holes in the vapor barrier shall be repaired with pressure-sensitive tape or with mastic and mesh tape.



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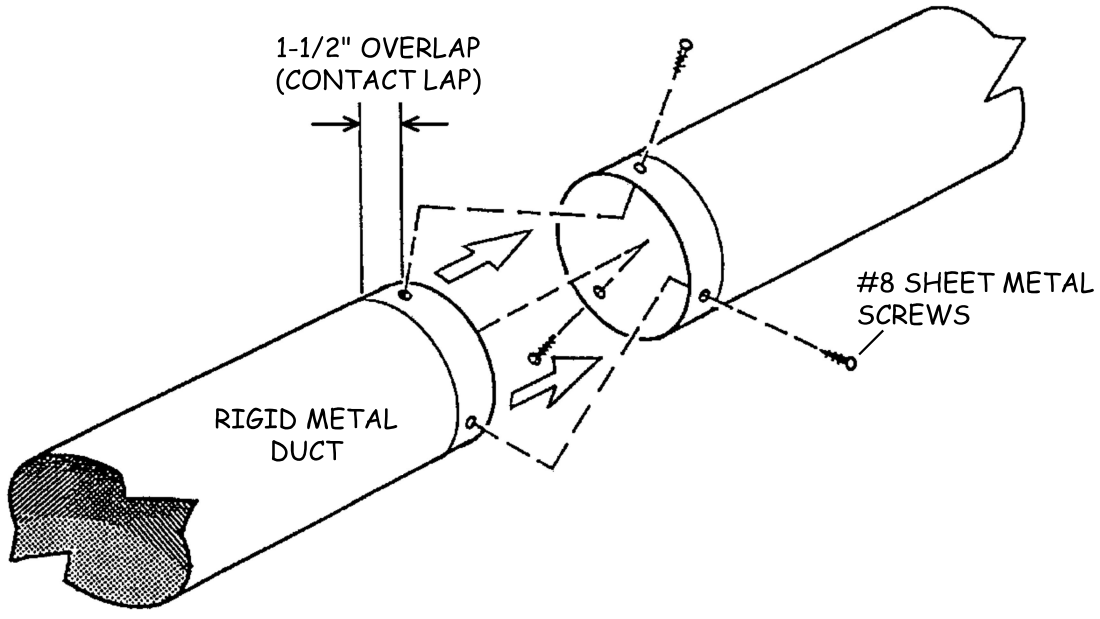
26. REPAIRING AND SEALING RIGID METAL DUCTS

- **Contact lap**
  - Crimp joints shall overlap at least 1-1/2" (e.g., connection of duct to fitting, or two sections of duct).
- **Mechanical fasteners**
  - Rigid metal duct connections shall be secured with equally spaced #8 sheet metal screws.
  - Round ducts
    - Three screws on diameters up to 14".
    - Four screws on diameters 15"–19".
    - Five screws on diameters 20"–24".
  - Rectangular ducts
    - At least one screw per side.
  - Lapped seams (field-fabricated metal plenums, etc.)
    - Overlapped surfaces shall be:
      - In substantial contact with each other along the entire seam.
      - Securely fastened together (e.g., with #8 sheet metal screws at intervals of 12" or less).



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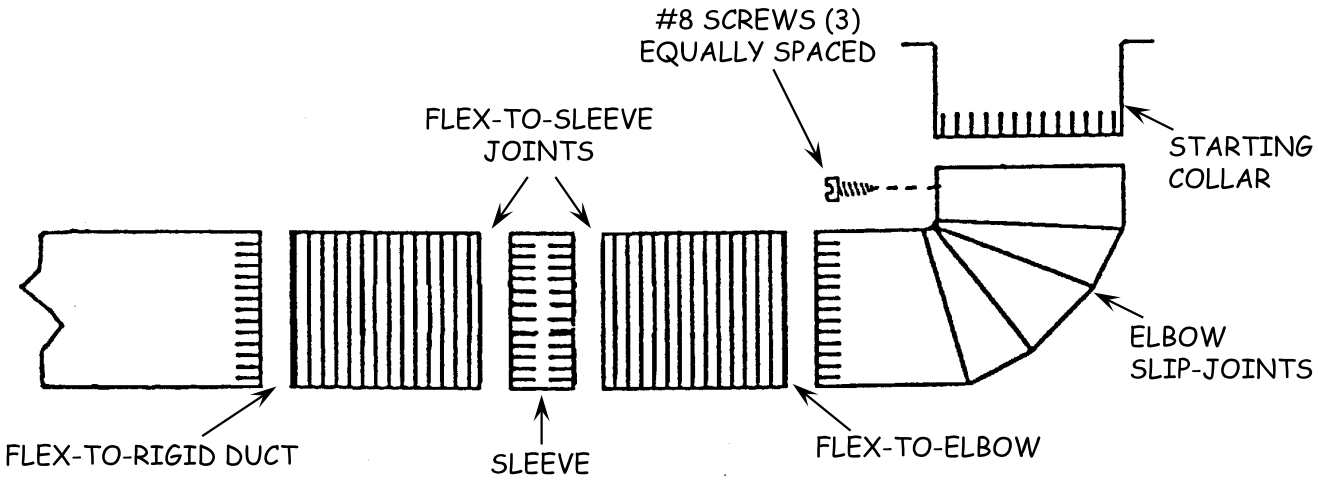
26. REPAIRING AND SEALING RIGID METAL DUCTS (cont.)

- **Gaps 1/4" or smaller may be sealed with:**
  - Duct mastic, or
  - Metallic pressure-sensitive tape.
- **Gaps larger than 1/4" but smaller than 1" wide shall be sealed with:**
  - Duct mastic with embedded fiberglass mesh, or
  - Metallic pressure-sensitive tape covered with mastic.
- **Gaps 1" or wider shall be:**
  - Repaired with a sleeve or a sheet metal patch (per Item 27) and
  - Sealed with mastic or tape.



- TAPE OR MASTIC ON GAPS UP TO 1/4"
- MASTIC & MESH, OR METALLIC TAPE COVERED BY MASTIC, ON GAPS OVER 1/4"

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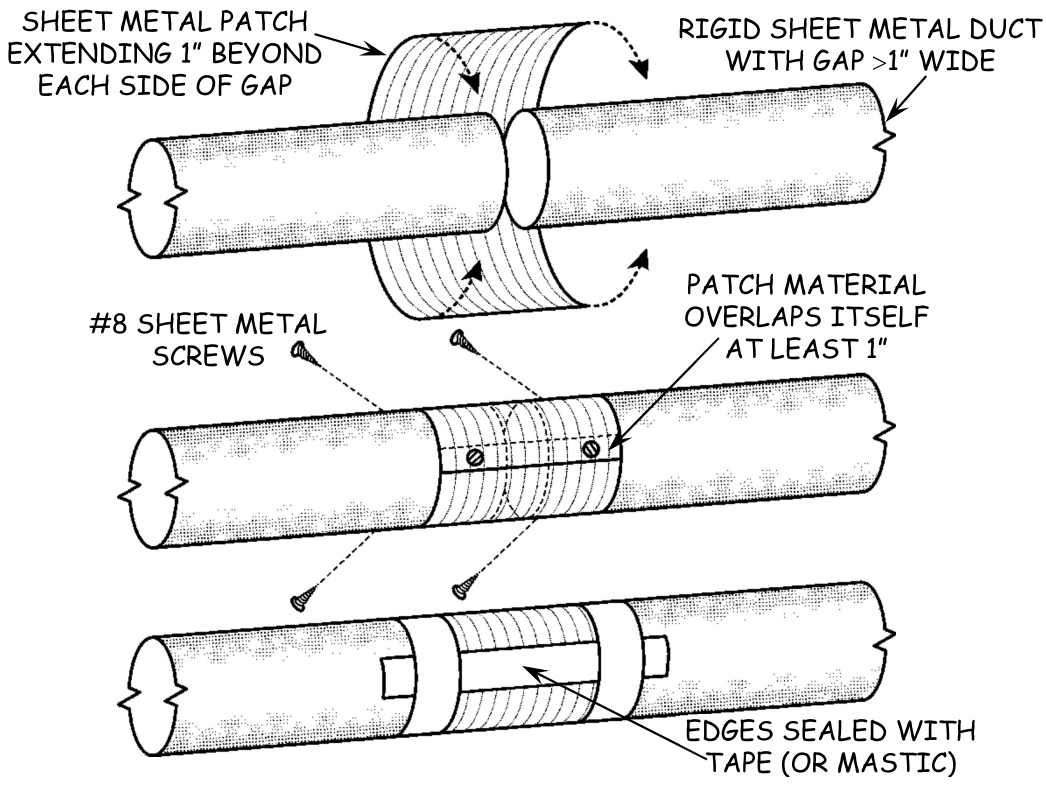
27. SHEET METAL PATCHES FOR RIGID METAL DUCTS

- **Material**
  - Patch material shall match the existing duct material (i.e., galvanized patch for galvanized duct, or aluminum patch for aluminum duct).
  - Gauge of the patch should equal or exceed gauge of the existing duct.
- **Installation**
  - Patch material shall:
    - Extend at least 1" beyond each edge of the gap, and
    - Overlap itself by at least 1".
  - The patch shall be wrapped tightly around the duct and secured with #8 sheet metal screws.
    - Where the patch overlaps itself, at least one screw shall be installed on each side of the gap.
    - At least two more screws shall be evenly spaced around the duct on each side of the gap.
- **Sealing**
  - All patch edges/gaps shall be sealed per Item 26.



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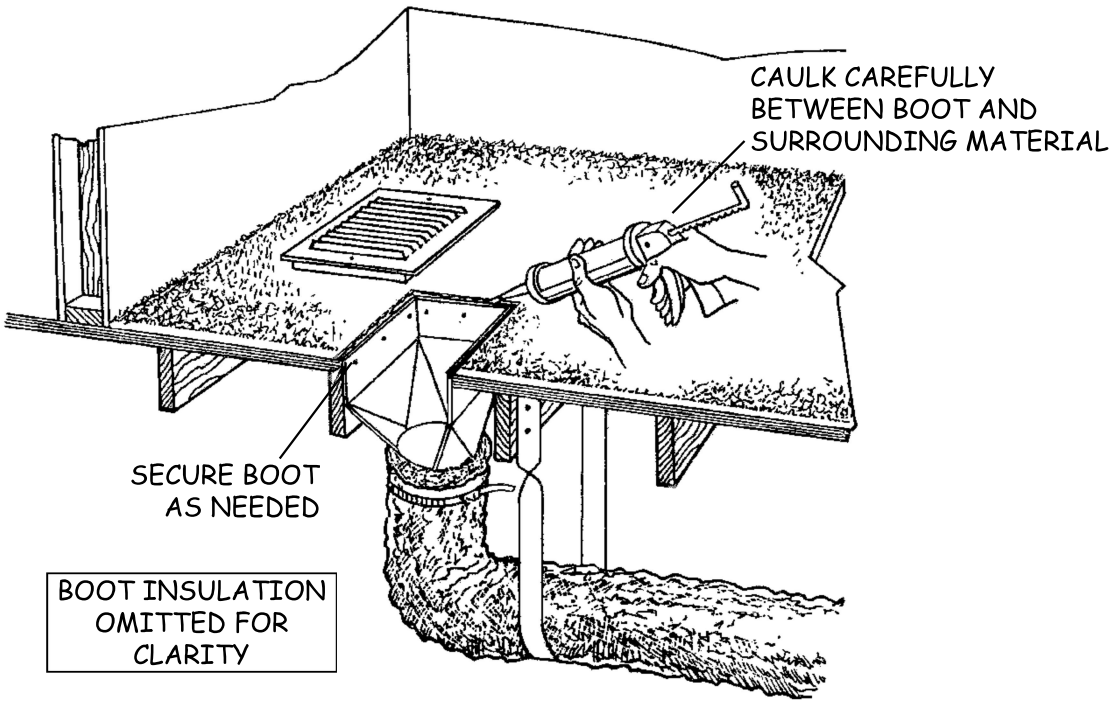
28. SEALING REGISTER BOOTS

- **Boot-to-duct connection**
  - Duct shall be secured and sealed as prescribed above for each duct type.
- **Leaks in the boot**
  - Gaps shall be sealed as prescribed above for repairing and sealing metal ducts.
  - Boot sealing material shall not interfere with removal or reinstallation of register.
- **Boot-to-floor/wall/ceiling connection**
  - Boot shall be mechanically secured to the structure and shall not rely on the duct for support or stability.
  - Sealants for gaps between boot and surrounding material shall be selected based on gap size:
    - Up to 3/8"—Elastomeric caulk.
    - 7/16"–5/8"—Elastomeric caulk supported by backer rod.
    - Up to 1/4"—Duct mastic or metallic pressure-sensitive tape.
    - Over 1/4" up to <1"—Duct mastic reinforced with fiberglass mesh, or metallic tape covered with mastic.
  - Sealants applied to the boot shall not interfere with the removal and replacement of the register.



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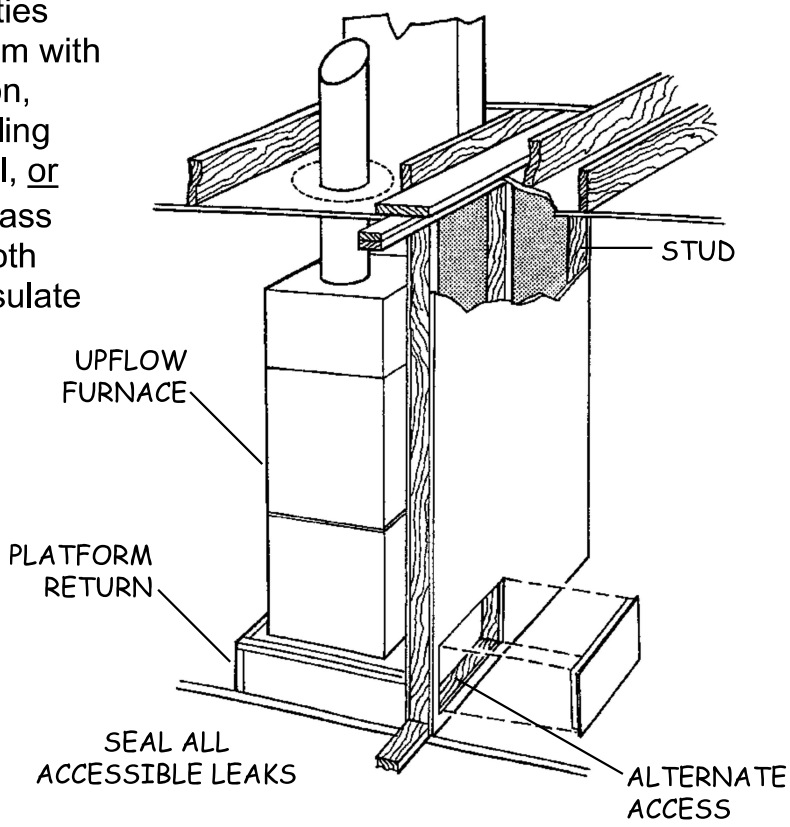
29. SEALING BUILDING CAVITIES

- **Accessible leaks shall be sealed.**
  - Building cavities being used as ducts (e.g., platform return, panned joists, building cavity/chase, cabinet toe-kick supply terminal, etc.) shall be sealed where accessible.
  - Repair/liner materials may include sheet metal and fiberglass duct board.
  - An insulated duct may be installed to connect the return grille to the FAU, in lieu of lining/sealing the platform.
- **Sealants may include:**
  - Duct mastic alone (gaps up to 1/4").
  - Duct mastic plus fiberglass mesh or metallic tape covered with mastic (gaps larger than 1/4" up to <1").
  - Approved caulk (e.g., elastomeric sealants).
  - Metallic pressure-sensitive tape (for metal and foil surfaces).
- **Foam board, foam sealants, and gypsum wallboard shall <u>not</u> be used.**
- **Platform Plenum Insulation**
  - When uninsulated platforms are sealed, they shall also be insulated.
  - Insulation requirement may be met by:
    - Filling stud cavities inside the plenum with flexible insulation, when lining/sealing with sheet metal, <u>or</u>
    - Installing fiberglass duct board to both line/seal and insulate the plenum.



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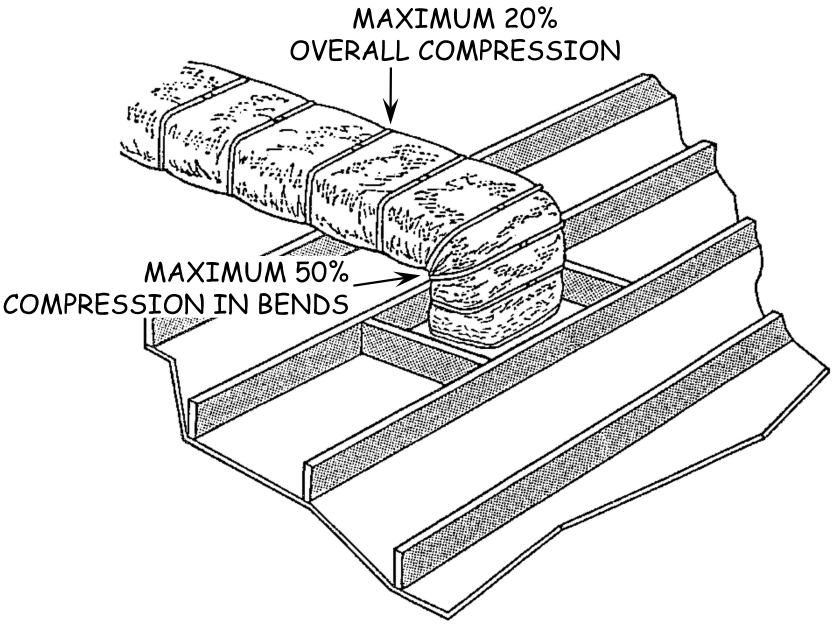
DUCT INSULATION

30. DUCT INSULATION

- **Coverage and R-value**
  - All air ducts, air connectors, plenums, distribution boxes, and system components shall be insulated.
  - One hundred percent coverage required without gaps or openings.
  - R-value shall comply with Item 15.
- **Compression**
  - Maximum 20% overall compression by attachments.
  - Maximum 50% compression in corners/bends.



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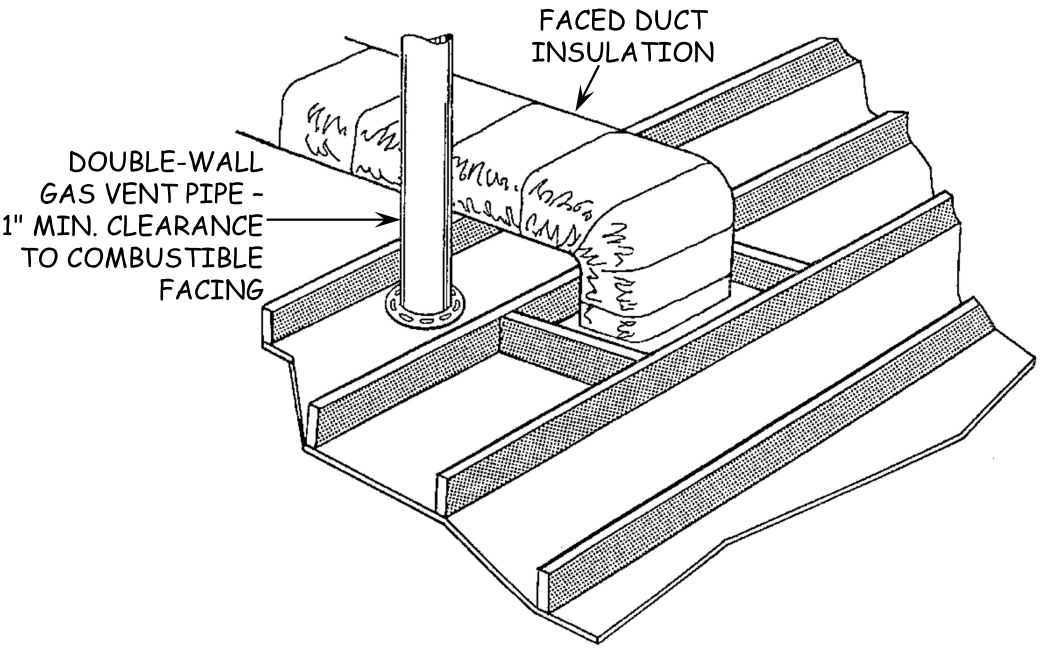
30. DUCT INSULATION (cont.)

- **Clearances**
  - Combustion air vents shall not be obstructed by duct insulation.
  - Combustible facings and attachments
    - 6" clearance from single-wall gas vent pipes.
    - 1" clearance or clearance specified by the listing, whichever is greater, for listed Type B double-wall gas vent pipes.
    - 3" clearance from all other heat-producing devices.
- **Attachment of Rigid Fiberglass Insulation**
  - Insulation shall be securely attached (e.g., with stickpins).
  - Seams shall be sealed with:
    - Metallic pressure-sensitive tape marked “181A-P,” or
    - Duct mastic labeled “181A-M” reinforced with mesh tape.



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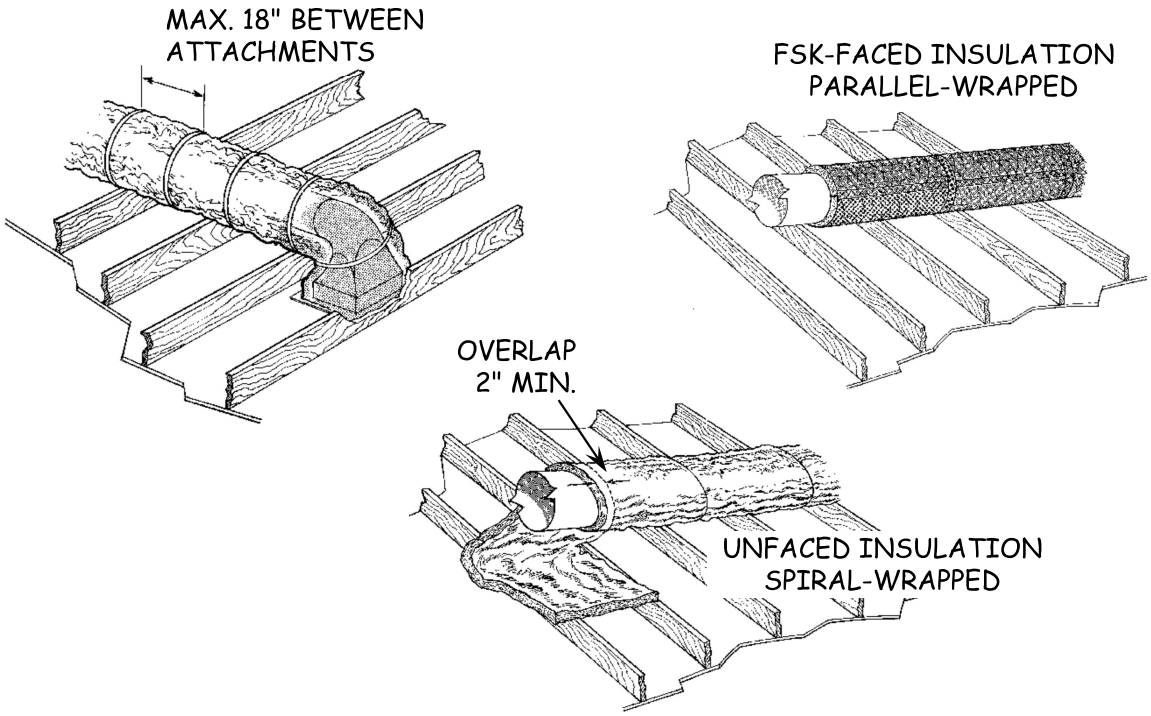
30. DUCT INSULATION (cont.)

- **Installation of Flexible Insulation**
  - Insulation shall be permanently secured with one of the following:
    - Drawbands (duct ties).
    - Noncorrosive wire, 20-gauge minimum.
    - Rust-resistant nails or staples.
    - Pressure-sensitive tape (e.g., metallic or FSK) wrapped a minimum of three times around the circumference.
  - Spiral-wrapped
    - Wraps of unfaced insulation shall overlap each other at least 2".
    - Insulation shall be mechanically secured (e.g., with drawbands, wire, nails, or staples) as needed to prevent gaps or openings.
  - Parallel-wrapped
    - Faced wraps shall be secured and sealed with pressure-sensitive tape or as prescribed by manufacturer.
    - Unfaced wraps shall be mechanically secured with fasteners (drawbands, wire, nails, or staples) installed no more than 18" apart along the lengthwise seam (overlap) of the insulation.



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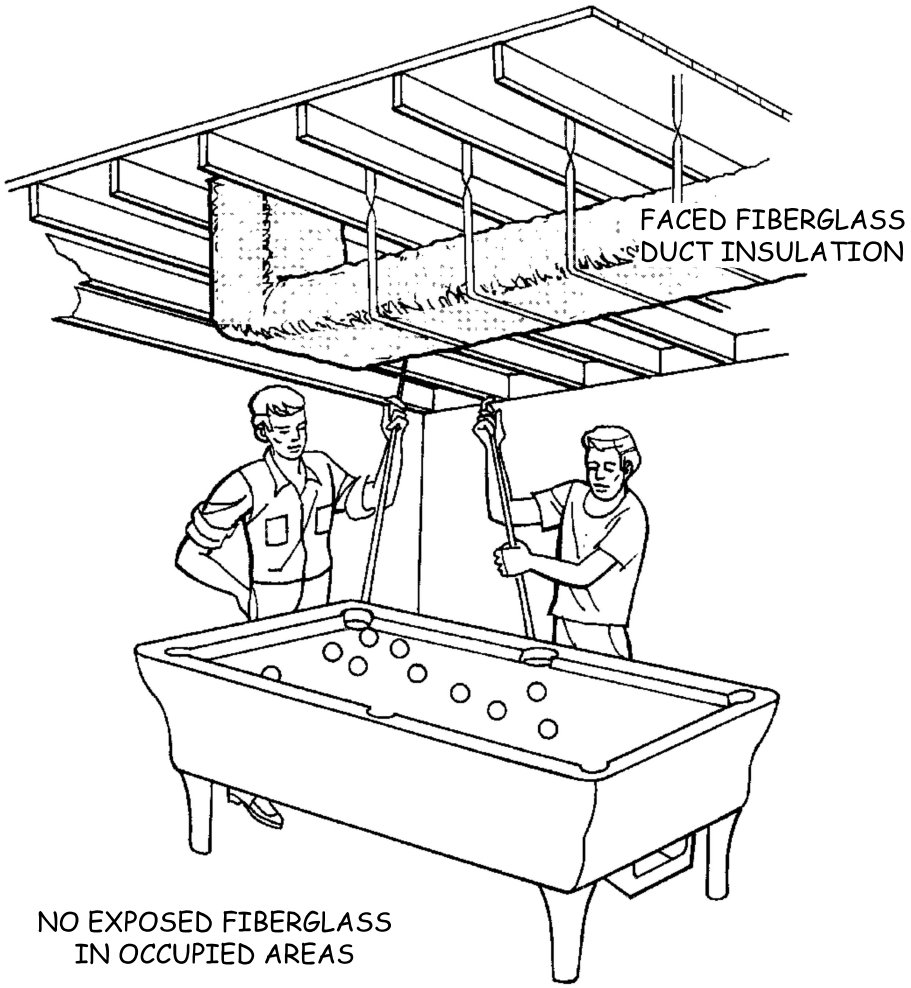
30. DUCT INSULATION (cont.)

- **Exposed Ducts**
  - Ducts located outdoors or not protected from the elements shall be insulated in conformance with manufacturer's instructions and local code.
  - Ducts located in area subject to human contact
    - When fiberglass insulation is installed, it shall be faced.
    - Fiberglass edges shall not be left exposed in the living space.



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31. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

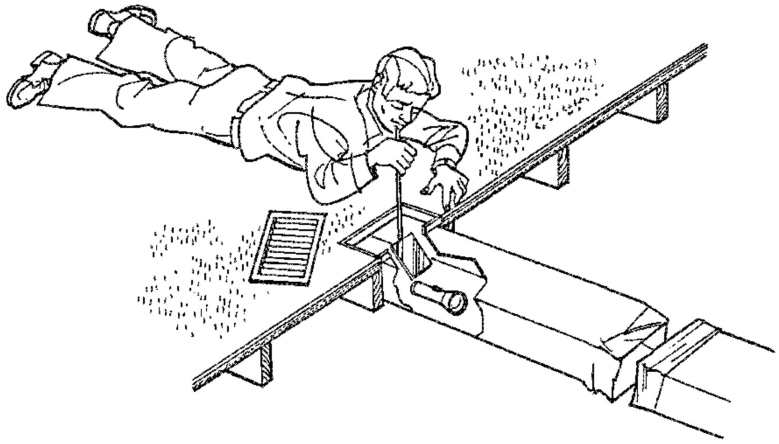
- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up**
  - Paint dust and chips, scraps, and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Furniture and other household items moved for installation work shall be returned to their original positions.

MOBILE HOME CRITERIA

DUCT SEALING

32. DUCT SYSTEM INSPECTION AND ANALYSIS

- **Pre-inspection**
  - Supply registers and return grilles shall be removed to facilitate system inspection and the performance of repair/sealing work.
  - A mirror and light shall be used to perform inspection of:
    - Joints and connections in the boot and riser.
    - Duct termination (dead end) at the register nearest the end of each duct run.
    - Each duct run to locate leaks, disconnections, and other defects.
    - Duct connector under furnace when accessible.
- **Post-inspection**
  - Internal repair and sealing work (e.g., boot/riser-to-trunk connection) shall be inspected with a mirror to ensure that:
    - Sealants have been applied correctly, and
    - All leaks are completely sealed.



METHOD TO INSPECT FOR LEAKS AND DAMAGE AND TO VIEW COMPLETED REPAIRS

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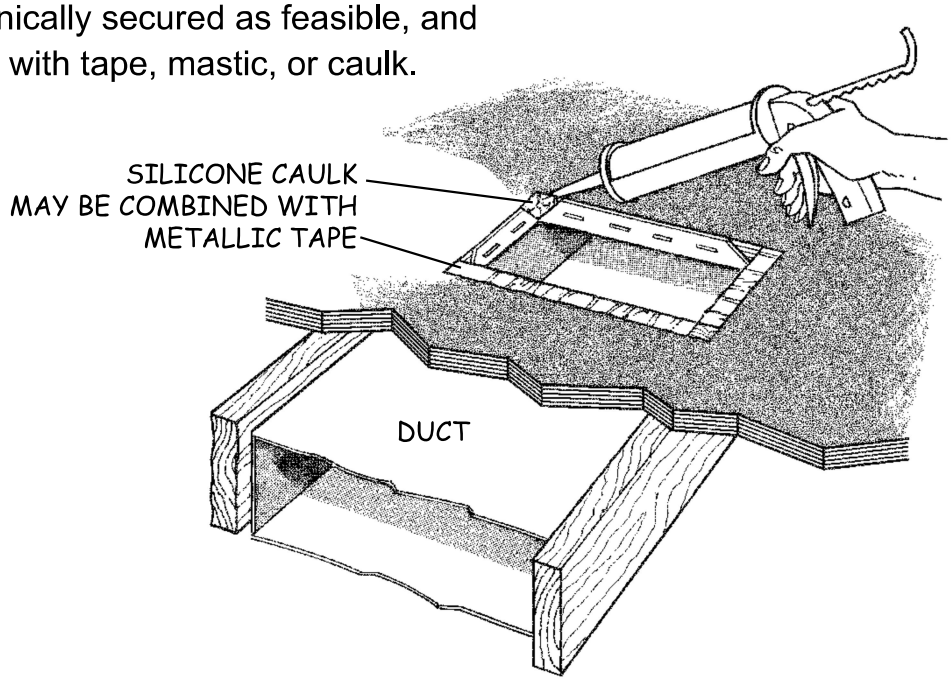
33. GENERAL INSTALLATION CRITERIA

- **New replacement ducts**
  - Ducts shall be sized, installed, and connected as prescribed in this section and HUD MHCSS Part 3280.715.

34. REGISTER BOOT/RISER REPAIR AND SEALING

- **Attachment**
  - Duct boots and risers that are loose or detached from the structure shall be reattached and mechanically secured (e.g., with screws, staples, or nails).
- **Boot/riser termination shall then be sealed to the floor.**
  - Gaps up to 1/4" wide may be sealed with:
    - Elastomeric caulk (e.g., polyurethane or silicone), or
    - Duct mastic applied at least 1/8" thick.
  - Gaps over 1/4" up to <1" wide:
    - Gaps shall be sealed when possible with butyl tape, or with duct mastic reinforced with mesh tape.
    - Elastomeric caulk and pressure-sensitive metallic tape may be used together where a thinner repair is required.
  - Gaps 1" or wider shall be:
    - Patched with sheet metal,
    - Mechanically secured as feasible, and
    - Sealed with tape, mastic, or caulk.



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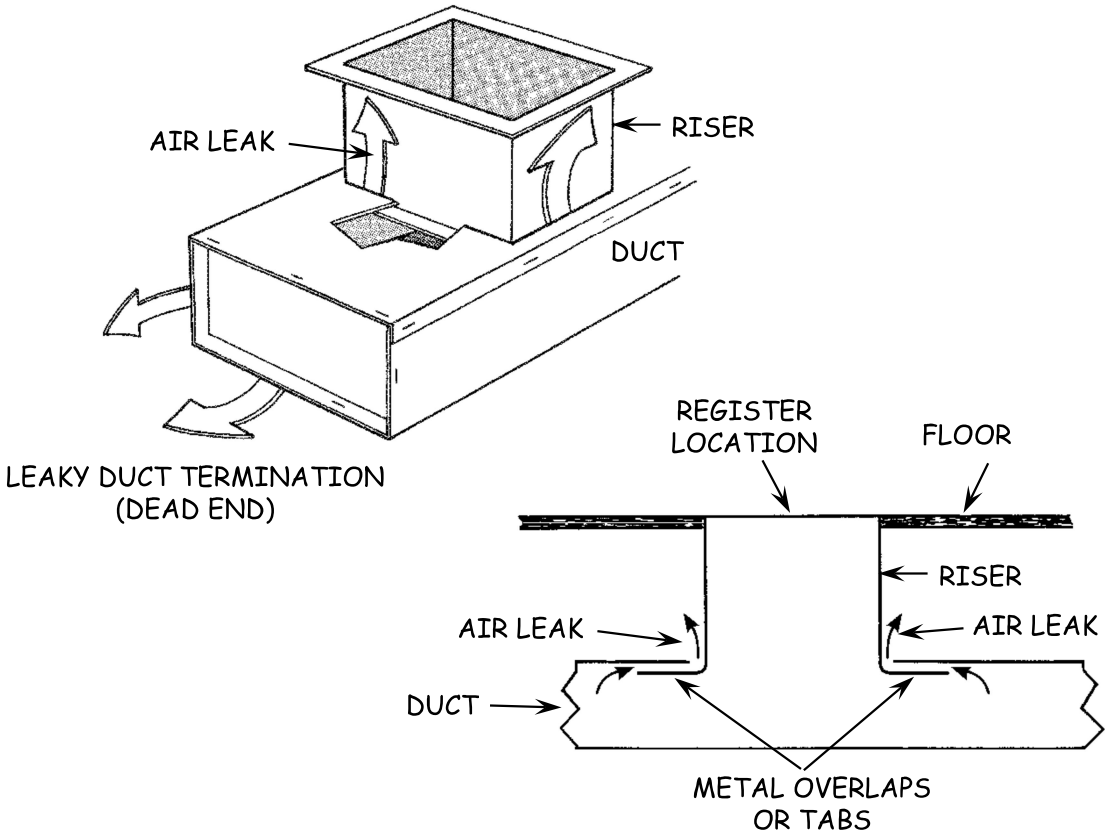
34. REGISTER BOOT/RISER REPAIR AND SEALING (cont.)

- **Risers**
  - Risers that are loose or are disconnected from the trunk shall be reattached, secured, and sealed (e.g., with butyl tape).
- **Metal overlaps/tabs**
  - Metal overlaps/tabs at joint between the riser and trunk duct shall be repaired and permanently sealed (e.g., with butyl tape).
- **Preparation of joint**
  - Metal overlaps/tabs shall be bent as needed to achieve the best possible metal-to-metal contact.
  - Dust and dirt shall be removed to the extent feasible from surfaces to which sealant will be applied (e.g., with vacuum cleaner hose/nozzle, with a brush, or with a damp rag).



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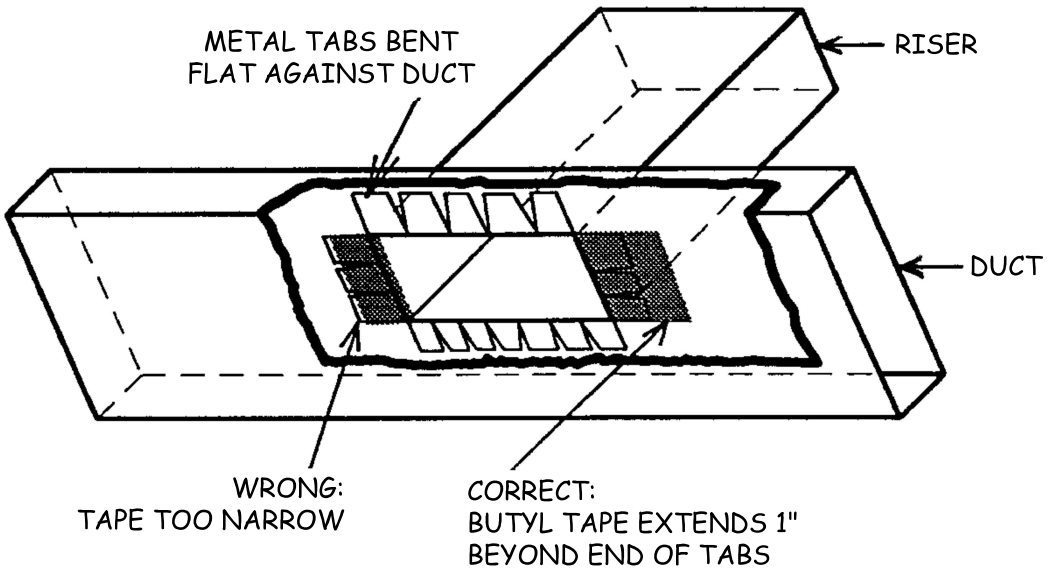
- **Application of sealant**
  - Joint overlaps/tabs shall be sealed with:
    - Butyl tape (e.g., 3" wide), or
    - Duct mastic and embedded fiberglass mesh tape.
  - Sealant shall cover all overlaps/tabs and extend approximately 1" beyond the ends of the overlaps/tabs.
  - Pre-existing metallic tape:
    - If loose, shall be removed to the extent feasible before applying new sealant.
    - If not loose, shall be covered with new sealant to achieve a complete, permanent seal.

35. SEALING OTHER LEAKS WITHIN REACH

- **Reachable leaks**
  - Other obvious leaks that can be reached through the register opening shall be sealed utilizing materials and methods prescribed in Items 26 and 27.
- **Such leaks may include:**
  - Duct joints/splices and other loose metal overlaps.
  - Duct terminations (dead ends).
  - Leaks in the duct connector underneath the furnace (accessed through removable bottom panel on front of unit).



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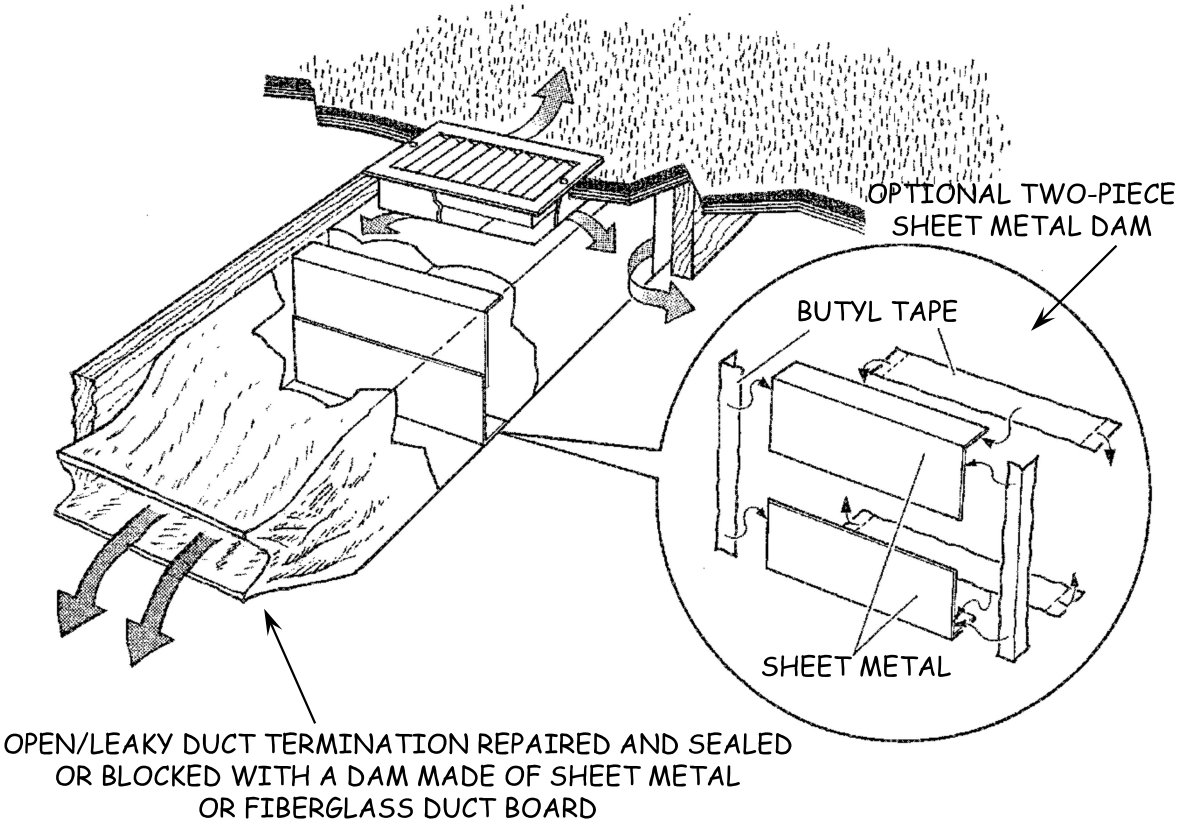
36. REPAIRING LEAKY DUCT TERMINATIONS

- **A duct termination (dead end) shall be:**
  - Repaired and sealed, or
  - Securely blocked (e.g., sheet metal dam, or a fiberglass duct board dam) and permanently sealed.
- **Dam installation**
  - Dams shall be:
    - Placed as far from the register opening as feasible.
    - Attached securely (mechanically when possible).
  - Dams may be attached/sealed with:
    - Butyl tape, or
    - Mastic and mesh tape.



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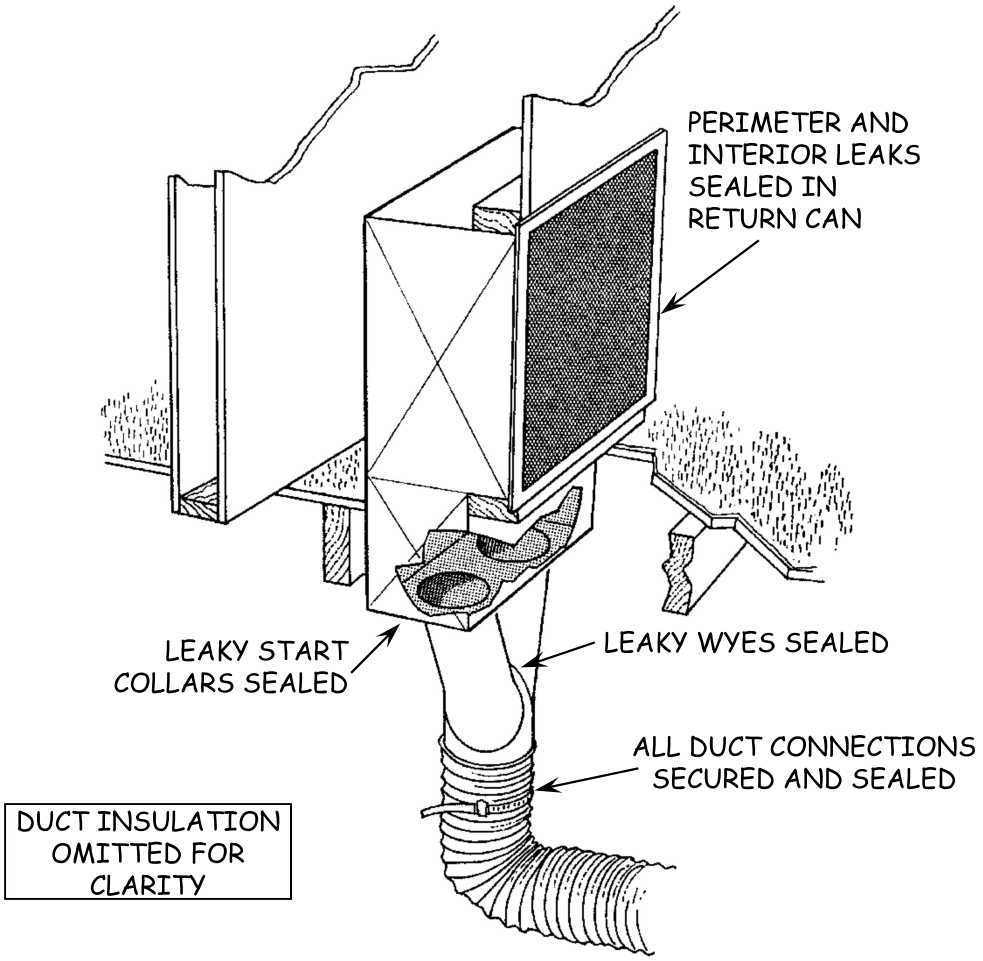
37. DUCTED RETURNS

- **Existing ducted returns**
  - All accessible components shall be inspected for decay, damage, and leaks and shall be repaired as needed.
  - Rodent barrier (bellyboard) sections shall be removed for access as needed.
  - Accessible leaks shall be repaired.
  - Access holes made in the rodent barrier shall be repaired as prescribed in Item 41.



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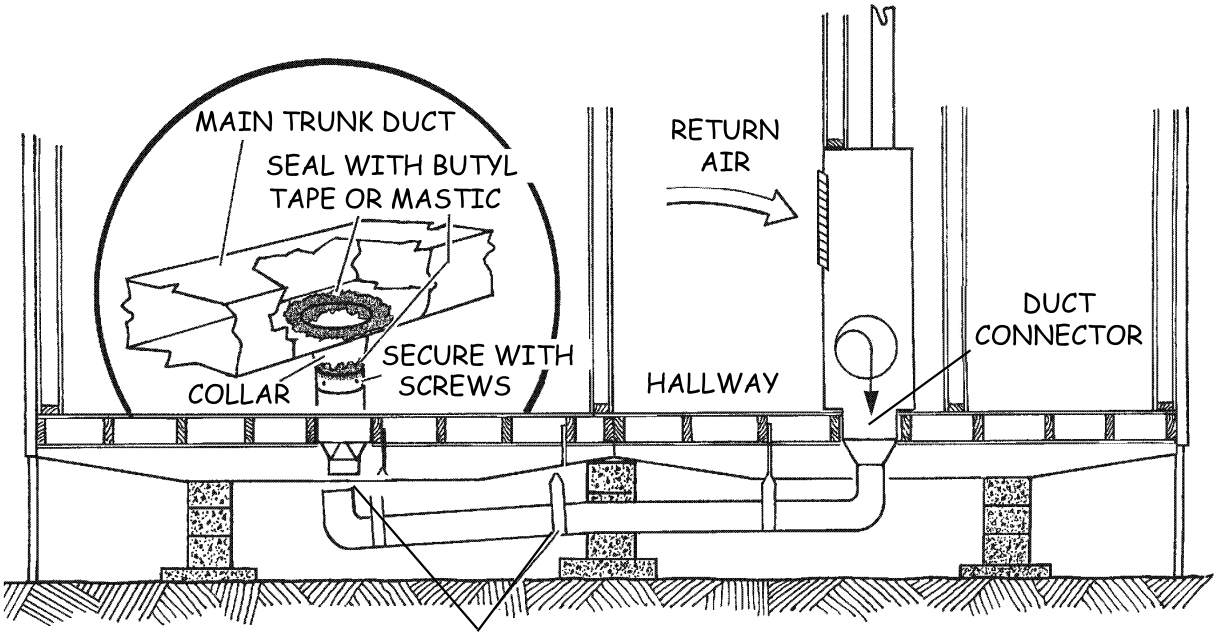
38. CROSSOVER DUCTS

- **Double-wide units**
  - Disconnections shall be reconnected, mechanically secured, and sealed.
  - Other major leaks that are repairable shall be repaired and sealed.
  - Disconnected and damaged duct components that cannot be feasibly repaired shall be replaced.
- **Duct installation**
  - Ducts shall be installed, secured, supported, and sealed as prescribed in this section.
  - Ducts in the undercarriage area shall be protected from damage by animals.



DISCONNECTED/DAMAGED CROSSOVER DUCT REPAIRED/REPLACED,
LOOSE CONNECTION TO TRUNK REPAIRED AND SEALED
(DUCT AND BOOT INSULATION OMITTED FOR CLARITY)

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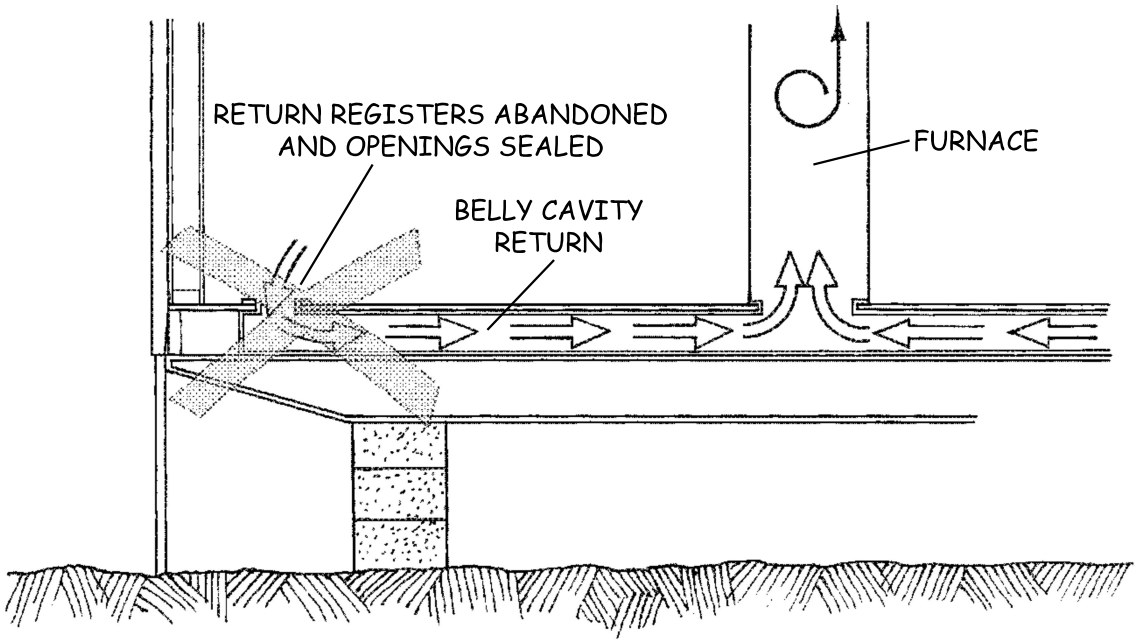
39. NEW CENTRAL RETURN

- **Upflow furnace with belly cavity return**
  - When installation of a new ducted return is feasible, it shall be installed, supported, and sealed as prescribed in this section.
  - The system shall:
    - Be properly sized by a qualified HVAC technician.
    - Provide a balanced airflow throughout the mobile home.
  - When a new central return is installed:
    - The existing belly cavity return shall be abandoned.
    - The abandoned register openings shall be blocked off and permanently sealed.



BELLY-CAVITY RETURN ABANDONED
WHEN A DUCTED CENTRAL RETURN IS INSTALLED

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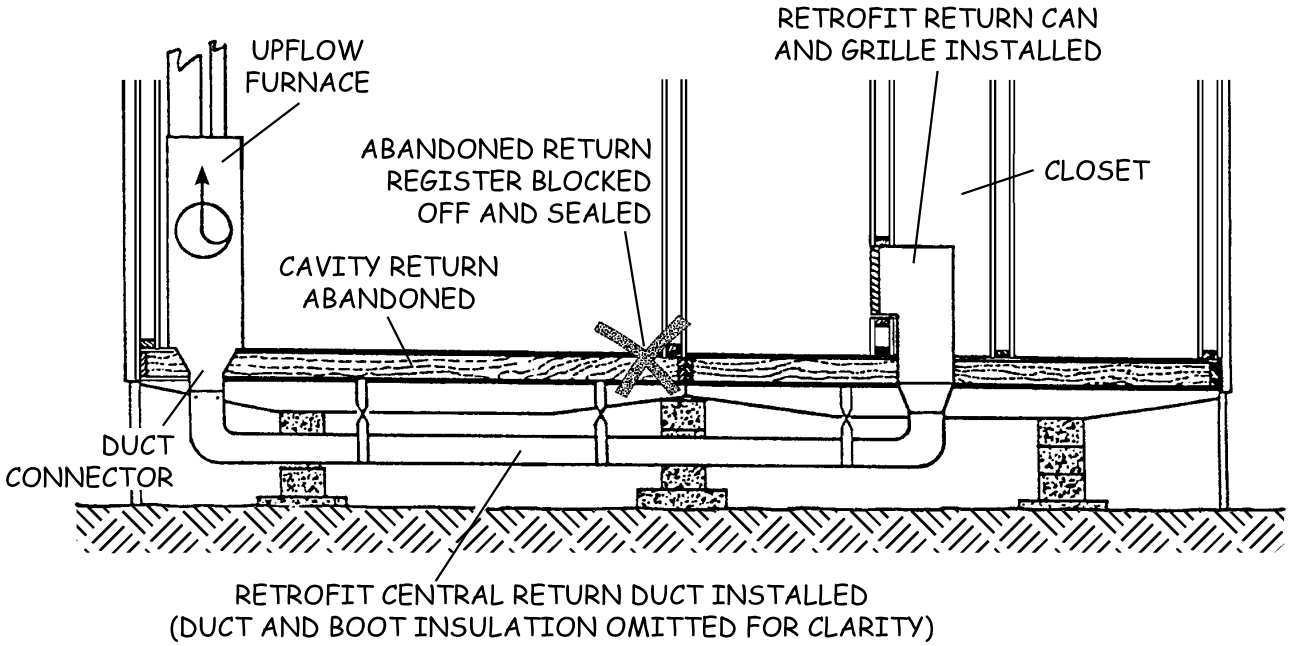
39. NEW CENTRAL RETURN (cont.)

- **Upflow furnace with belly cavity return (cont.)**
  - The return grille shall be:
    - Sized to provide a minimum of 2 sq. in. of NFVA for each 1,000 Btuh furnace capacity.
    - Installed in the outside wall of a closet when possible, or in the floor when necessary.
    - Located in a hallway or other open area.
    - Centrally located within the mobile home.
  - Proper airflow shall be provided for each room containing a supply register utilizing one of the following methods:
    - An unclosable grille that provides a NFVA equal to at least 1 sq. in. for every 5 sq. ft. of total living area in the room may be installed in the door or wall.
    - Two to two and a half inches may be removed from the door bottom; however, no more than half the NFVA so created shall be counted as return air area.
  - System balance shall be checked and modifications shall be made as needed to provide proper airflow and room pressures.



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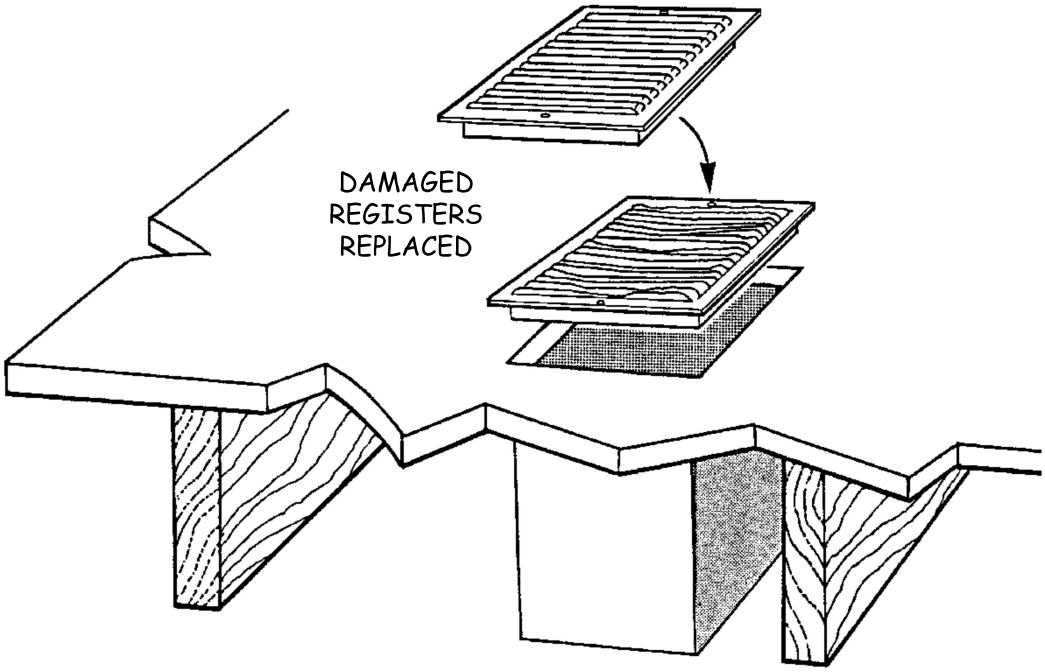
40. REGISTER GRILLES

- **Repair and replacement**
  - Dampers shall function properly.
  - Dampers that will not open or stay open shall be removed if register replacement is not feasible.
  - Damaged registers that do not allow proper airflow shall be repaired or replaced, in accordance with the program P&P.
- **Removal and reinstallation**
  - Boot sealing shall not cause any register to be difficult to remove or reinstall.



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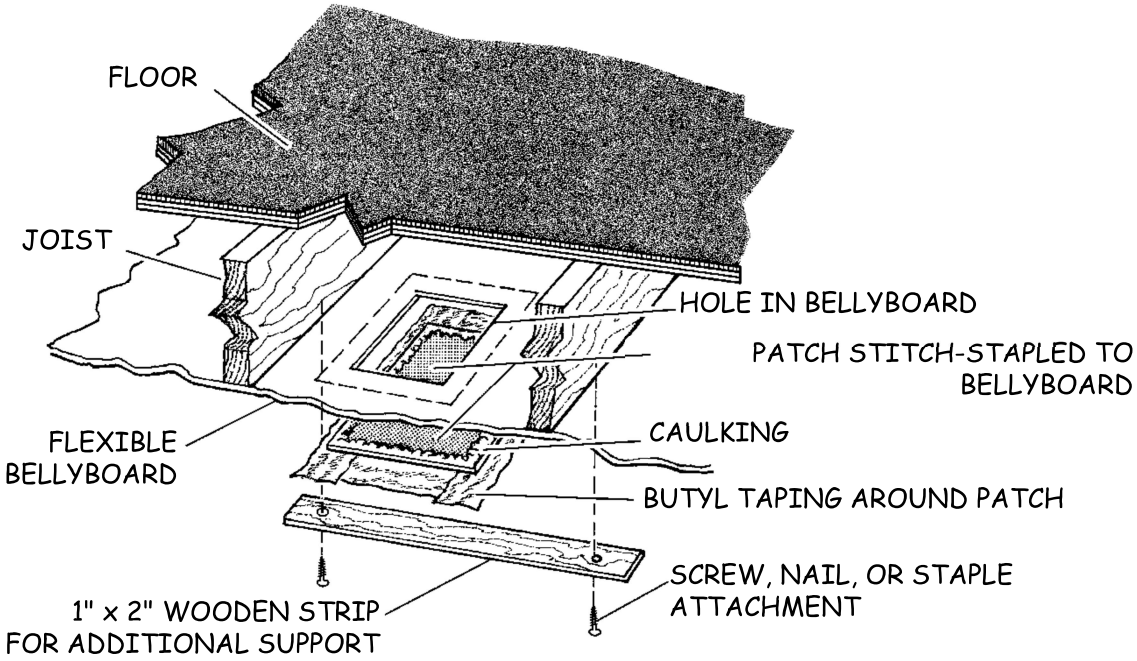
41. RODENT BARRIER (BELLYBOARD) REPAIR

- **Access holes**
  - Holes in the bellyboard created to access ducts from under the mobile home shall be repaired.
- **Rigid or flexible rodent barrier**
  - All holes shall be repaired with material equivalent or superior to the existing bellyboard.
  - All patches shall be securely and permanently attached and create a complete and permanent seal.
- **Patches in *flexible* rodent barrier**
  - All patches shall be secured and sealed by means of self-adhesive backing or caulk/adhesive sealant.
  - Patches shall be mechanically secured as needed to ensure permanence by such means as one or more of the following:
    - Outward clinch (“stitch”) staples, or equivalent, positioned to permanently and securely attach the patch directly to the existing bellyboard.
    - Fasteners penetrating the wooden joists a minimum of 1/2" and spaced a maximum of 4" OC.
    - Wooden strips permanently secured (e.g. with screws into floor joists or wedged above adjacent girders).
  - Tape recommended by barrier manufacturer, butyl tape, or other compatible sealant shall be placed around the perimeter of the flexible patch, as needed, to ensure a complete and permanent seal.



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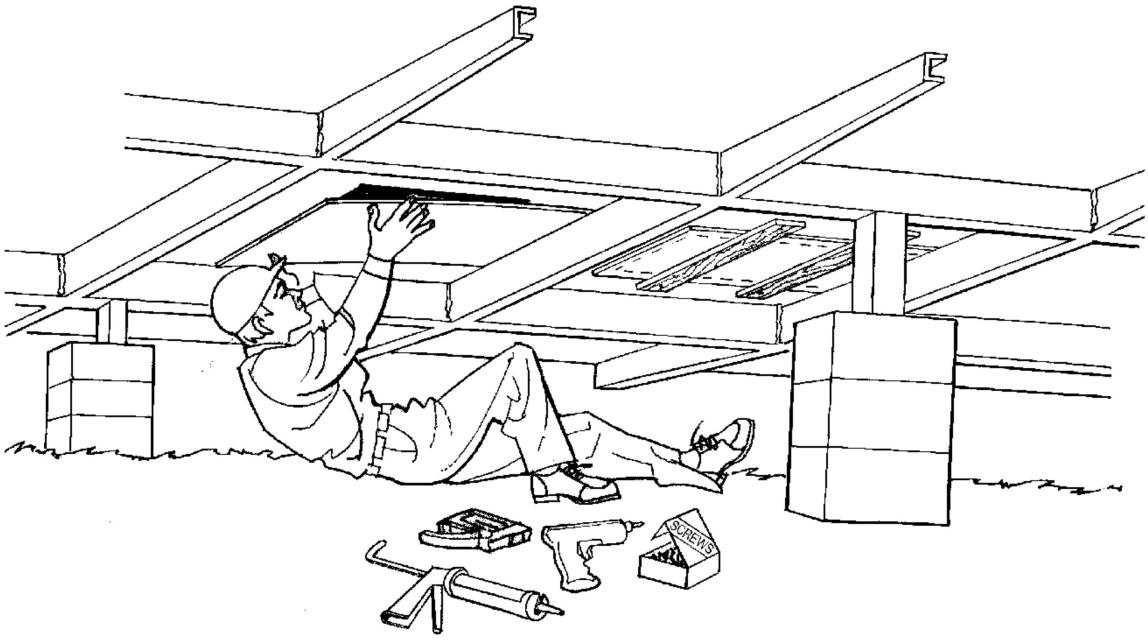
41. RODENT BARRIER (BELLYBOARD) REPAIR (cont.)

- **Patches in *rigid* rodent barrier**
  - Patches shall be sealed with suitable caulk/adhesive sealant and secured mechanically.
  - Approved mechanical attachments include:
    - Fasteners penetrating the wooden joists a minimum of 3/4" and spaced a maximum of 6" OC.
    - Wooden strip supports spanning beyond the patch and secured mechanically into the framework above.
    - Wedging the patching material between the existing bellyboard and the metal framing of the undercarriage.
    - Fasteners that penetrate only the existing bellyboard, for small patches in high-density material.
    - A combination of methods that will provide a stable, permanent repair.



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EXTERIOR DOOR REPLACEMENT

Lead Paint Risk Factor
HIGH

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SECTION 11 PREFACE
for

EXTERIOR DOOR REPLACEMENT

1. Nonfeasibility Criteria

All Doors and Hardware

1.1. Existing door and hardware function properly, even if not installed in accordance with current installation standards.

1.2. Door can be repaired rather than replaced.

1.3. Customer refuses.

Entrance Door Replacement

1.4. Door is structurally sound and provides an adequate barrier to infiltration.

1.5. Door jamb is not structurally sound and cannot be repaired within the scope of the ESA Program, and installation of a pre-hung door is not feasible.

2. Installation Policies

2.1. Exterior door replacement is allowed only when damage and/or deterioration is present, as evidenced by one of the following conditions:

a. There is catastrophic envelope leakage resulting from a hole in the door or diffuse leakage, or

b. The door structurally will not support installation of jamb weatherstripping and/or a door bottom.

3. Installation Policies Specific to Mobile Homes

None.

EXTERIOR DOOR REPLACEMENT STANDARDS

1. APPROVED MATERIALS

- **Wood doors**
  - Conformance to ANSI/NWWDA I.S.1 or I.S.6.
  - Exterior surface or cladding of noncombustible or ignition-resistant material, or
  - Fire resistance rating of at least 20 minutes (per NFPA 252), or
  - Compliant with local code requirements, if more stringent.
- **Metal doors**
  - Conformance to ANSI/SDI 100.
- **Hinged doors**
  - Shall be in compliance with the requirements of local code.
  - Replacement door must match style of existing doors: like-for-like when feasible, subject to local code requirements.
- **Garage door in living space**
  - Minimum 20-minute fire rating.
  - Equipped with self-closing and self-latching device.
- **Glazed doors**
  - Includes doors with glazing that occupies more than 50% of the total area, and sliding glass doors.
  - U-factor and SHGC shall be in compliance with Table 11-1.

Table 11-1: Glazed Door Performance Requirements

Efficiency Factor	CZ	Maximum Value
U-factor	All CZ	0.32
SHGC	1, 3, and 5	No requirement
	2, 4, and 6–16	0.25

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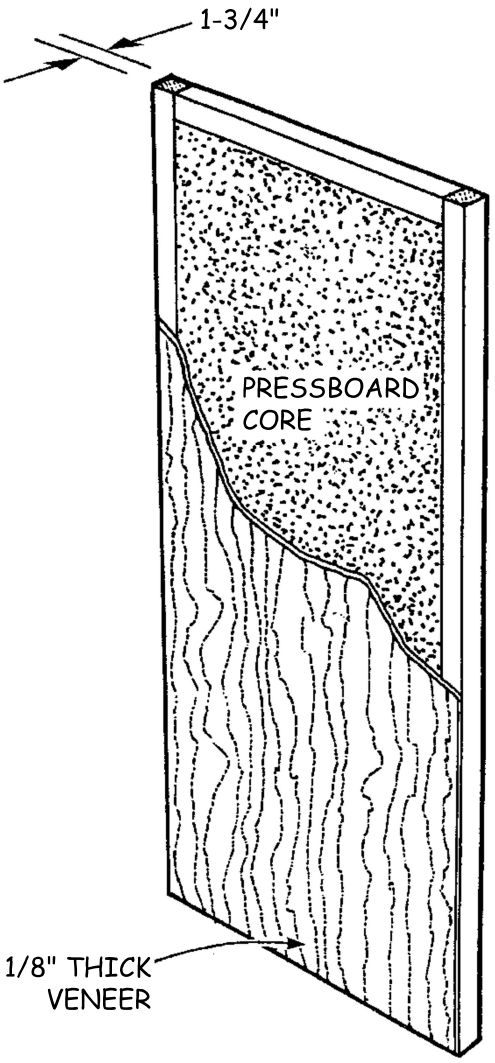
2. DIMENSIONS

- **Door and jamb replacement**
  - 1-3/4" door shall be installed.
- **Door replacement (existing jamb not replaced)**
  - 1-3/4" door shall be installed.
  - *Exception:* 1-3/8" door allowed when 1-3/4" will not fit existing jambs.

3. DOOR COMPOSITION

- **Nonmetallic veneer**
  - Minimum 1/8" thick.
  - Hardboard veneer acceptable.
  - Exterior-grade glue standard.
- **Core**
  - Wood doors shall be solid core.
  - Metal doors shall have a minimum R-6 insulated core.



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4. SAFETY GLASS

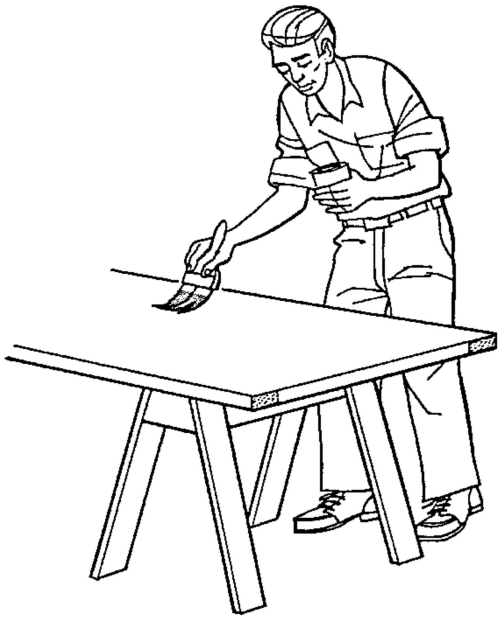
- **Safety glazing shall be permanently labeled and installed in accordance with the CRC.**
- **In doors with glazing, safety glass is required.**
  - *Exceptions*: (a) Jalousie windows; and (b) windows with panes less than 3" in width or height.
  - Polycarbonate may be used if allowed by local code.

5. THRESHOLD SHIMS/ELEVATORS

- **Materials allowed include:**
  - Non-wood: Aluminum and plastic (e.g., vinyl).
  - Solid wood: Redwood, cedar, pressure-treated fir, or solid hardwood (i.e., must be degradation-resistant and exterior-grade).

6. DOOR FINISH/SEALER

- **Wood door**
  - Shall be sealed on both sides and four edges with exterior-grade material.
  - Acceptable sealers are paint, urethane, and varnish.
- **Metal door**
  - Shall be painted or primed.
  - Oil-based or epoxy paint only.
- **Jamb and casing/trim**
  - Acceptable sealers are paint, urethane, and varnish.
  - Exterior-grade material shall be used in exterior locations.



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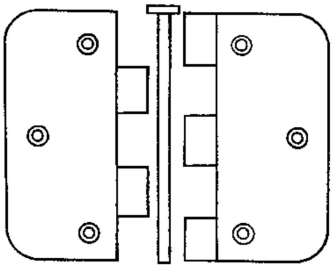
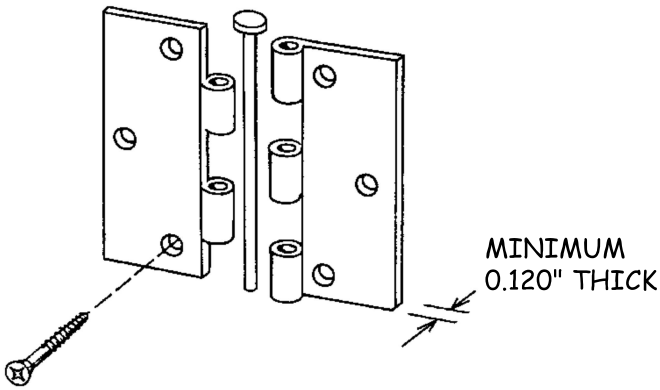
7. HINGE REQUIREMENTS

- **All doors**
  - Minimum three hinges per door.
  - Hinges shall:
    - Conform to ANSI/BHMA A156.1.
    - Be constructed of brass or stainless steel, minimum 0.120" thick.
    - Be loose-pin type unless mounted toward exterior. (Fixed-pin not required on middle hinge.)
- **1-3/8" doors**
  - Minimum hinge size 3-1/2" x 3-1/2".
- **1-3/4" doors**
  - Minimum hinge size 4" x 4".
- **Garage door**
  - Spring-loaded hinge required between attached garage and living area.

8. SCREWS FOR HINGES

- **Wood jamb**
  - Brass or stainless steel flathead screws shall be used.
- **Metal jamb**
  - Flathead screws shall be used.
- **Pre-hung units and replacement jambs**
  - Jamb screws shall be installed.
  - Screws shall penetrate trimmer stud at least 5/8".
- **Use of existing screw holes**
  - Existing screw holes shall be plugged with plugs or wooden golf tees and glued before reuse, unless longer screws are installed.





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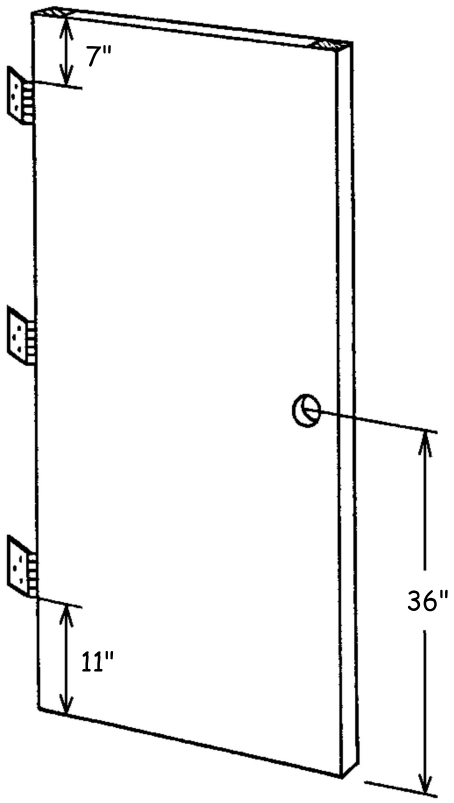
9. HINGE LOCATION

- **Jamb replaced**
  - Three hinges required.
  - Lower hinge located 11" from floor.
  - Upper hinge located 7" from upper jamb.
  - Middle hinge between upper and lower hinges, centered.
- **Jamb not replaced**
  - Existing hinge spacing is acceptable.
  - Mortise holes abandoned due to hinge relocation must be patched.
- **Mortise for hinges**
  - Hinge locations shall be mortised.

10. ENTRANCE LOCKSET AND DEADBOLT

- **Entrance lockset height**
  - Existing height shall be matched if door only is replaced.
  - Lock shall be installed 36" from floor if both door and jamb are replaced.
- **Door replacement**
  - Match existing height if door only is replaced.
- **Door and jamb replacement**
  - Lock shall be installed 36” from floor if both door and jamb are replaced.
- **Deadbolt**
  - Deadbolt shall turn freely.
  - Deadbolt shall engage when door is closed and latch tongue is inside strike plate.
- **Strike plate**
  - Jamb strike plate required.
  - Latch tongue shall engage properly when door is closed without unusual force.
  - Multiple stacked strike plates <u>not</u> allowed: Jamb must be repaired when latch will not function properly with one strike plate.
  - When existing holes will not properly secure a standard strike, the jamb shall be repaired, or a longer heavy-duty strike plate shall be installed.



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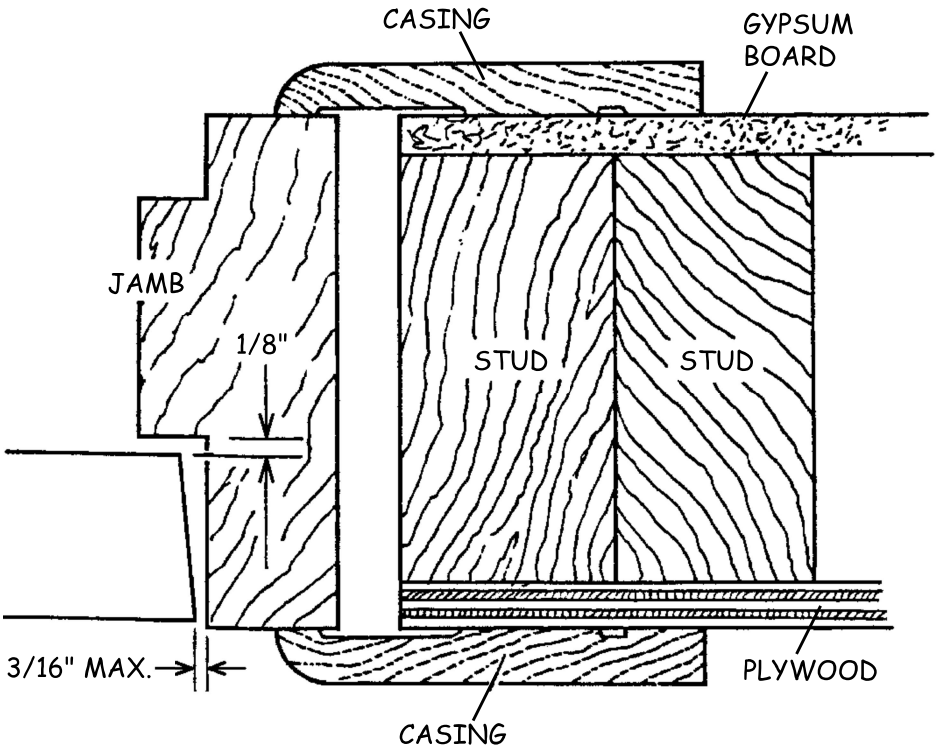
11. DOOR CLEARANCES

- **Stop**
  - 1/8" maximum distance between door face and door stop when latch tongue and strike plate are engaged.
- **Jamb**
  - 3/16" maximum distance between door edge and jamb.
  - 1/8" minimum distance between door edge and jamb.

12. DOOR STOP

- **Wood jambs**
  - Stop shall be made of wood.
  - Paint-grade acceptable unless existing jamb has natural finish.
  - 5/16" x 1-1/4" minimum dimension.
- **Double stops**
  - Stops shall not be doubled (stacked one on top of another) for added thickness.



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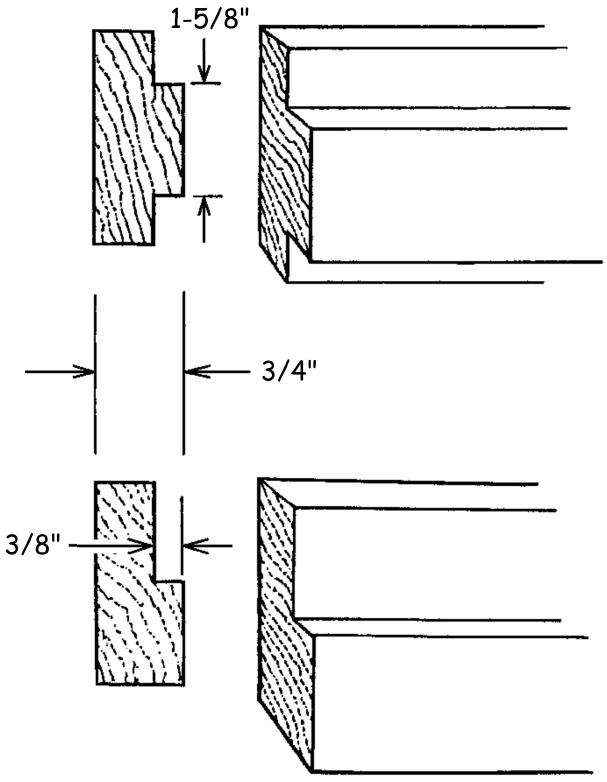
13. CASING

- **Wood**
  - Paint-grade acceptable unless existing jamb has natural finish.
  - Existing casing shall be matched.
  - Existing miters shall be matched.
  - Exterior-grade required in all exterior locations.
- **Perimeter seal**
  - Exterior casing/trim shall be caulked to provide a watertight seal around entire perimeter.
- **Nails**
  - Finishing or casing nails required for interior applications.
  - Galvanized casing nails required for exterior applications.

14. DOOR JAMB

- **Replacement material**
  - Exterior-grade only.
  - Minimum 3/4" thick.
  - 5/4" stock recommended.
  - Top shall be secured to sides with dado or rabbet joints.
  - Width shall be within 1/4" of the finished wall thickness.



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15. DOOR MODIFICATIONS

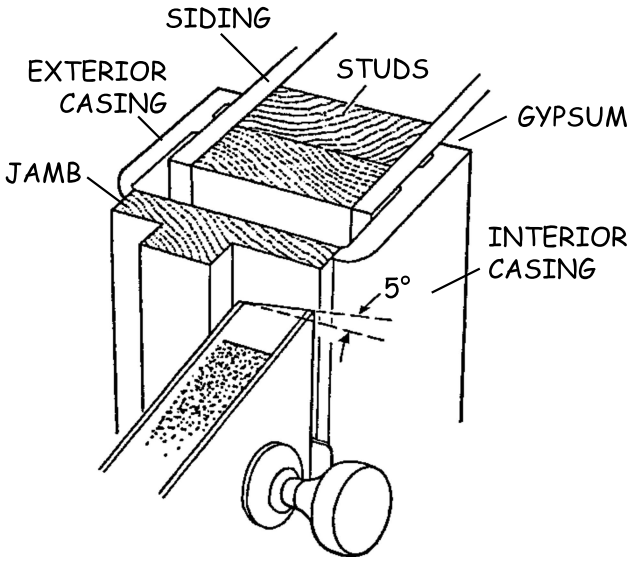
- **Veneer type doors**
  - A maximum of 1" may be cut from sides and top and 2" from bottom if expanded rails and stiles are not used.
- **All types**
  - A 3- to 5-degree bevel is required on lockset edge.

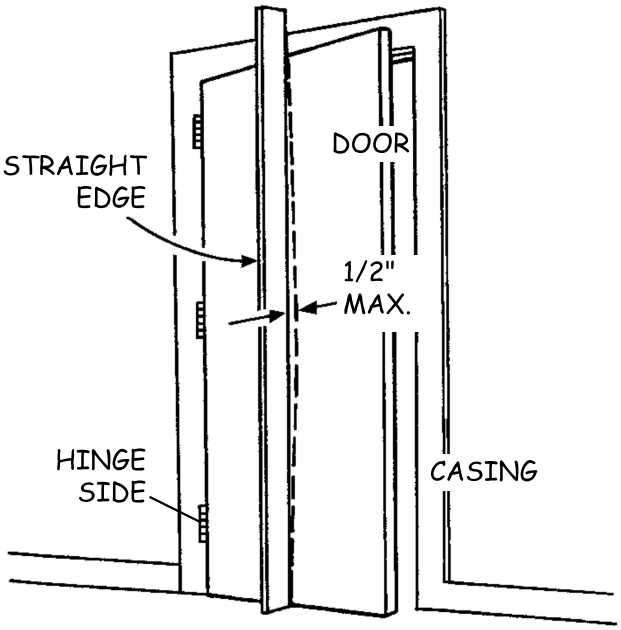
16. WARPAGE

- **All doors**
  - To facilitate proper weatherization, warpage shall not exceed 1/2" from end to end.

17. ATTACHMENTS

- **Replacement doors**
  - Address numbers present on the existing door or trim shall be reinstalled on the replacement door or trim.
  - Address numbers must be positioned so they are clearly visible from the street.
  - Peepholes, mechanical doorbells, mail slots, and other attachments must also be replaced.





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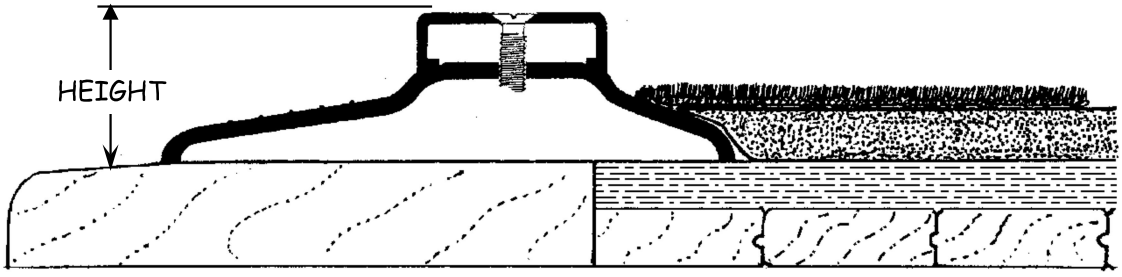
18. SAFETY

- **All doors and modifications**
  - Burs, sharp corners and edges, and other such hazards shall be removed.
  - Threshold height shall extend above the finished floor a maximum of 1", or 1/2" if any occupant uses a wheelchair or walker.

19. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Door operation**
  - Door shall seal properly when closed, with no gaps or openings around the perimeter.
  - Door panel(s), and screened panel on sliding glass door, shall operate smoothly and freely without binding or scraping.
  - Hardware, lock assemblies, and weatherstripping shall function properly.
- **Clean-up**
  - Paint dust and chips, scraps, and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Furniture and other household items moved for installation work shall be returned to their original positions.



MAXIMUM HEIGHT OF THRESHOLD AND RISER IS 1", OR 1/2" FOR HANDICAPPED

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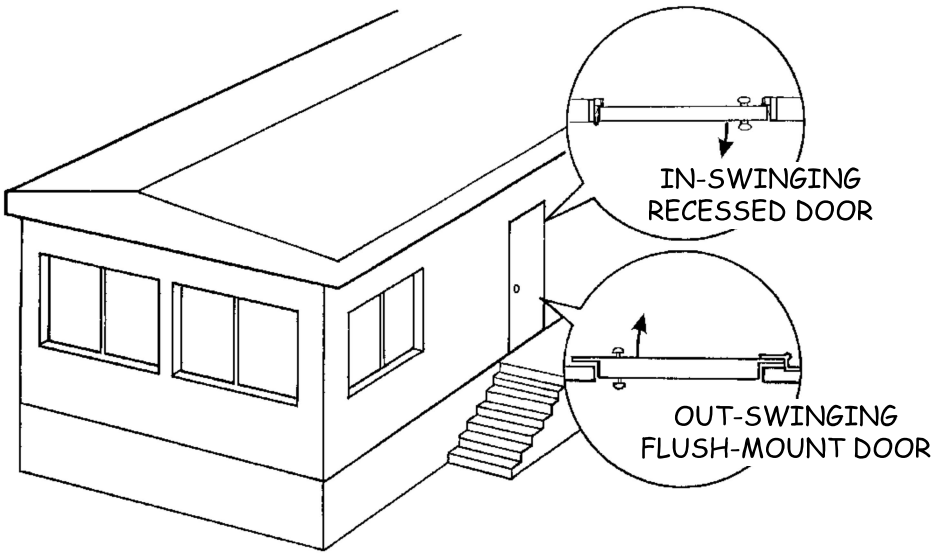
MOBILE HOME CRITERIA

20. REPLACEMENT DOORS

- **Material requirements for all swinging replacement doors**
  - Rigid stiles and rails (e.g., channel steel and/or wood).
  - Permanently-finished skin (e.g., fiberglass or vinyl-clad metal).
- **Material requirements for out-swinging replacement doors**
  - Pre-hung entrance door manufactured for mobile homes.
  - Flanged metal frame (jambs, header and sill) with integral weather seals (e.g., extruded flap vinyl, bulb seal, etc.).
- **Material requirements for in-swinging "house-type" doors**
  - Panel(s) may be replaced independently; pre-hung not required.
  - Weatherstripping (integral or applied) is required.
- **Material requirements for sliding glass replacement doors**
  - NFRC temporary energy performance label.
  - Mechanical interlock at meeting rail.
  - Safety glazing with permanent marking.
  - Sliding panel with insect screen.



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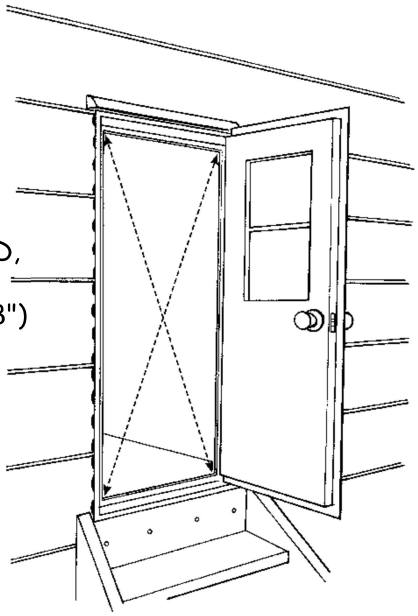
21. REPLACEMENT DOOR INSTALLATION

- **Installation requirements for <u>all</u> mobile home replacement doors**
  - Preparation of opening
    - When diagonal measurements differ by more than 1/8":
      - Chassis should be checked and leveled as feasible, <u>or</u>
      - Rough opening shall be adjusted/shimmed to provide satisfactory mounting surfaces for the replacement frame.
    - Opening shall be structurally sound, square, plumb, and level, in conformance with manufacturer's recommendations.
      - Water penetration points shall be sealed.
      - Sound anchorage shall be provided for replacement unit.
      - Floor shall be structurally adequate to properly support replacement sill in a level condition.
    - Existing door frame, anchors, and sealant shall be removed.
    - All mounting surfaces shall be smooth and clean.
  - Threshold shall extend above the interior finished floor surface a maximum of 1", or 1/2" if any occupant uses a wheelchair or walker.
  - All exterior gaps and cracks exposed to the elements shall be sealed with elastomeric caulk.
  - Interior gaps shall be caulked in conformance with IS Section 1 (Caulking).
  - Finishing requirements for bare wood:
    - Exterior surfaces shall be primed and painted with high-quality exterior products.
    - Interior surfaces shall, at a minimum, be primed or stained.



OPENING STRUCTURALLY SOUND, LEVEL, PLUMB, AND SQUARE (DIAGONALS EQUAL WITHIN 1/8")

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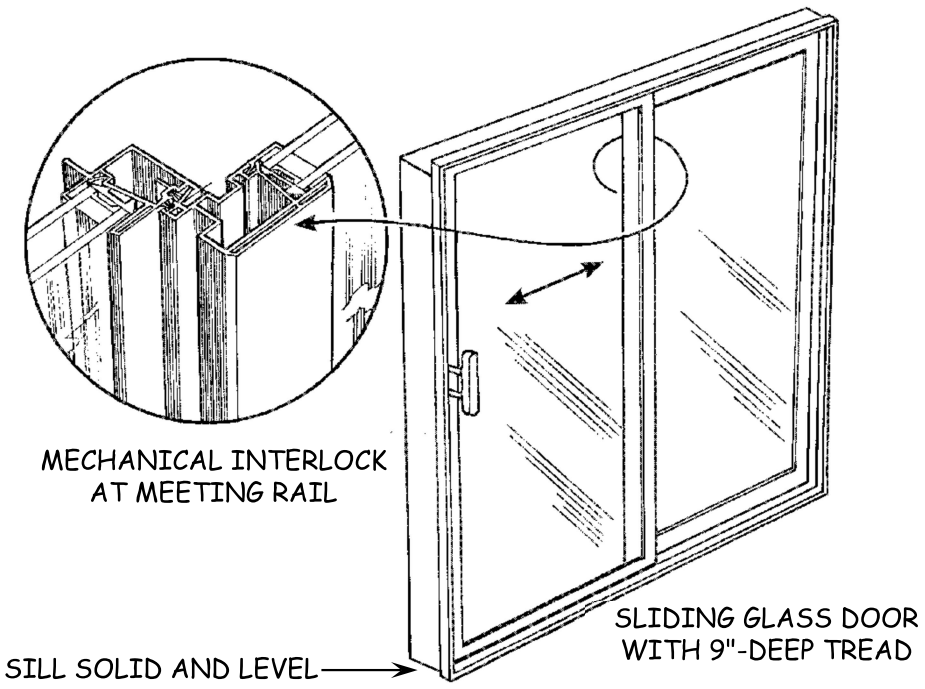
21. REPLACEMENT DOOR INSTALLATION (cont.)

- **Installation requirements for <u>sliding</u> glass doors**
  - Threshold shall have solid, level sill support from inside to outside and end to end.
  - Tread under door or landing surface shall be no less than 9" in depth.
  - Threshold shall extend above the interior finished floor surface a maximum of 1", or 1/2" if any occupant is physically handicapped.
  - Jambs and header shall be flashed and sealed as prescribed for windows in a like installation (e.g., nailing fin, flush fin, box frame).
  - Attachment
    - Door shall be installed square, level, and plumb, and
    - Secured through pre-drilled holes placed 3–10 inches from each corner and 16" OC, or as prescribed by manufacturer.
- **Installation requirements for all <u>swinging</u> replacement doors**
  - Sill shall be installed level over a solid surface/support.
  - Hinge side shall be securely supported and plumb.
- **Installation requirements for <u>in</u>-swinging "house-type" doors**
  - Conventional home standards apply.



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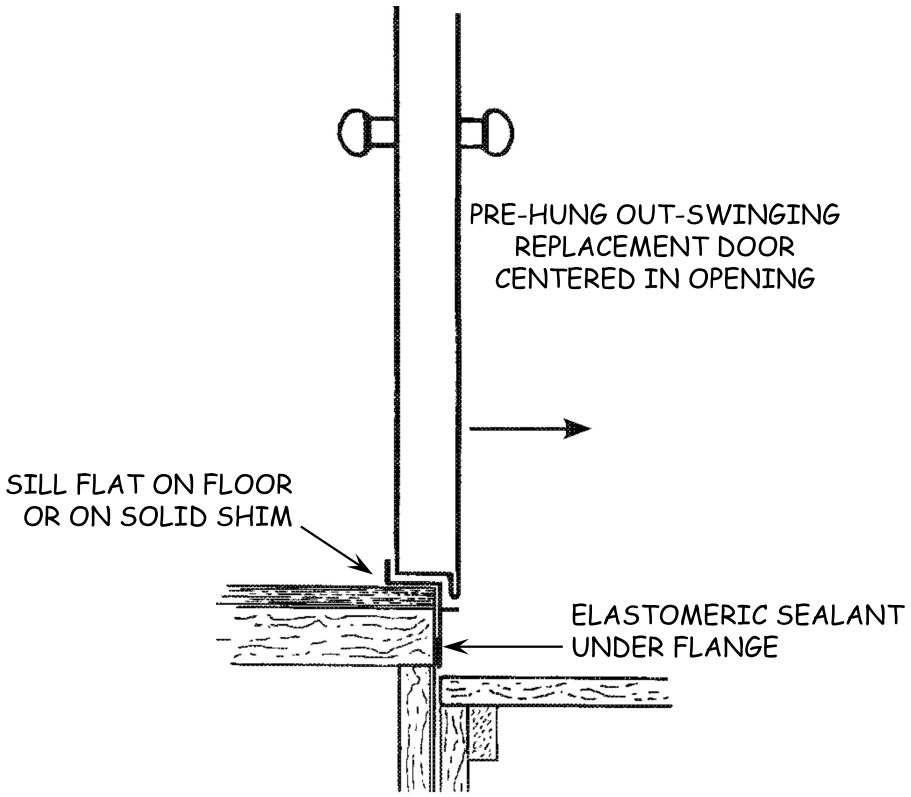
21. REPLACEMENT DOOR INSTALLATION (cont.)

- **Installation requirements for <u>out</u>-swinging replacement doors**
  - Replacement mounting flange shall be positioned to cover holes left by removal of pre-existing door.
  - Elastomeric caulk or non-hardening sealant/putty tape shall be applied to the back of the mounting flange.
  - Sill shall rest on the floor, or it shall have solid support from jamb to jamb.
  - Unit shall be centered side-to-side in the opening, with sides plumb and frame square.
  - The flange shall be securely anchored with screws spaced in accordance with manufacturer's instructions.
  - Hardware (i.e., lockset, door chain, pneumatic closer, etc.) shall be installed per manufacturer's instructions.



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WINDOW REPLACEMENT

Lead Paint Risk Factor
HIGH

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SECTION 12 PREFACE
for

WINDOW REPLACEMENT

1. Nonfeasibility Criteria

All Homes

1.1. Window can be repaired rather than replaced.

1.2. Window is structurally sound and provides an adequate barrier to infiltration.

1.3. Window is located above the first floor of a structure and installation will present unsafe working conditions.

1.4. Customer refuses.

Mobile Homes

1.5. Window replacement will require removal of siding.

2. Installation Policies

2.1. Window replacement is allowed only when required to stop catastrophic envelope leakage.

3. Installation Policies Specific to Mobile Homes

None.

WINDOW REPLACEMENT STANDARDS

1. APPROVED MATERIALS

- **Windows shall:**
  - Comply with local code and Table 12-1.
  - Bear an NFRC temporary label.
- **Permanent label**
  - Each unit shall bear a permanent label that:
    - Lists both the energy performance with rating procedure and minimum design pressure rating, or
    - References the original certification information on file with the IA.
- **Insect screens**
  - All openable windows shall be equipped with insect screens.
- **Caulking materials**
  - Caulking materials shall comply with window manufacturer's instructions and IS Section 1 (Caulking).

Table 12-1: Replacement Window Minimum Requirements[1]

Efficiency Factor	CEC CZ	Maximum Value
Maximum U-factor	All CZ	0.32
Maximum SHGC	1, 3, and 5	No Requirement
	2, 4, and 6–16	0.25

[1] Title 24 energy efficiency requirements from the current Residential Compliance Manual.

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- **Casing**
  - Wood (natural or engineered)
    - Paint-grade acceptable unless existing jamb has natural finish.
    - Exterior-grade required in all exterior locations.
    - Existing casing shall be matched.
    - Existing miters shall be matched.
  - Nails
    - Finishing or casing nails required for interior applications.
    - Galvanized casing nails required for exterior applications.

2. REPLACEMENT TYPE

- **Replacement window type shall be determined in accordance with Table 12-2.**

3. GENERAL WINDOW INSTALLATION REQUIREMENTS

- **All window types shall be installed:**
  - In conformance with manufacturer's instructions and the current CBC.
  - Plumb, level, and square with sash edge parallel to frame edge.

Table 12-2: Replacement Window Type

Existing Window Type	Replacement Window Type
Horizontal slider	Horizontal slider
Vertical slider	Vertical or horizontal slider
Picture window	Picture or sliding window
Jalousie window	Vertical or horizontal slider

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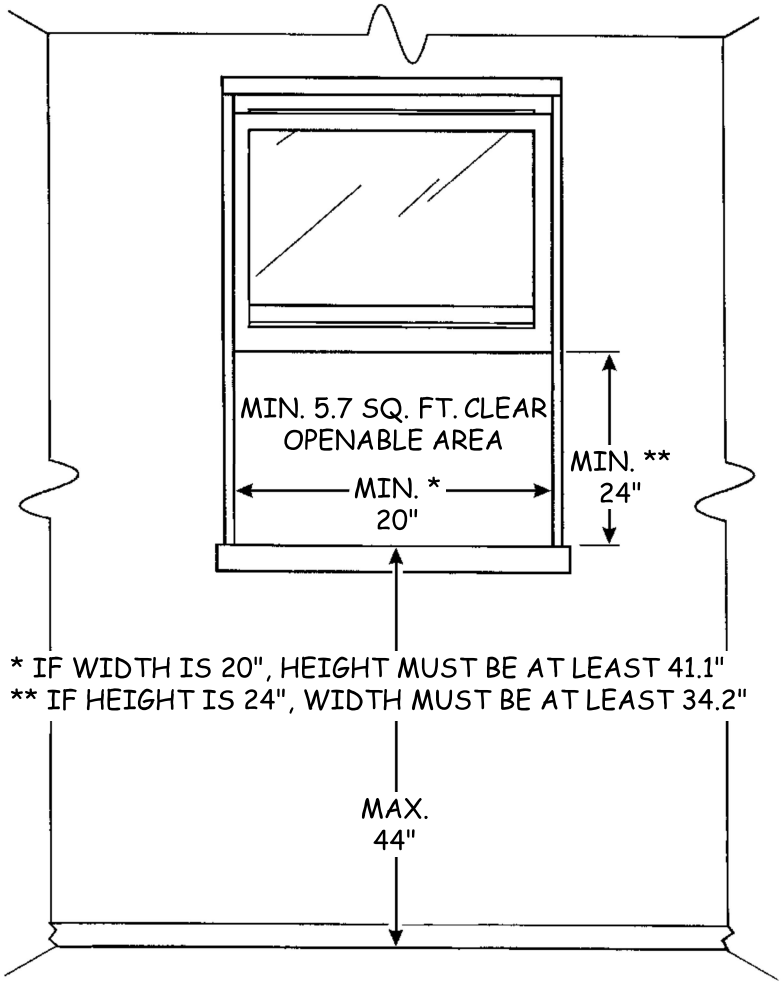
4. EGRESS REQUIREMENTS

- **Windows in bedrooms (sleeping rooms)**
  - Egress requirements apply to <u>all rooms used for sleeping</u>.
  - The egress window in a conventional home shall meet the egress requirements of local code.
    - Minimum net clear openable area and dimensions:
      - Area of 5.7 (or 5.0) sq. ft.[2]
      - Width of 20" and height of 24".
    - Maximum finished sill height of 44" above the floor.



[2] *<u>Exception</u>*: 5.0 sq. ft. minimum on a "grade-floor" opening/window (a window with still height not more than 44" above the finished ground level adjacent to the opening).

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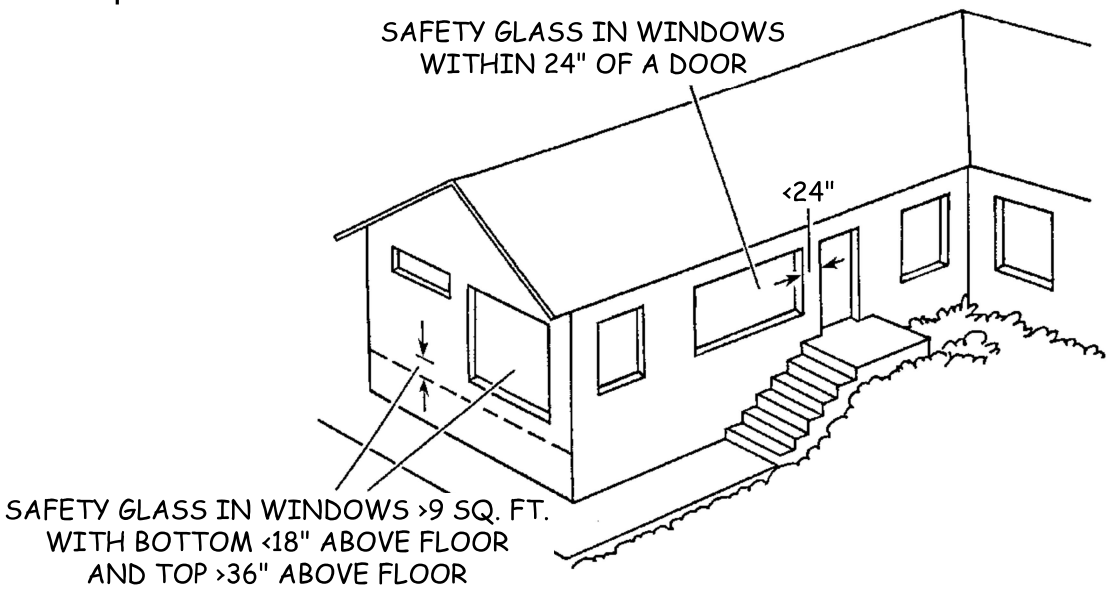
5. SAFETY GLASS

- **Safety glazing shall be permanently labeled and installed per the current CBC, part of which is summarized below.**
- **Windows**
  - Safety glass is required in any window adjacent to a door where:
    - The nearest vertical edge is within 24" of the door, and
    - The bottom edge is less than 60" above the floor.
    - *Exception*: Not required when there is an intervening wall or other permanent barrier between the door and the glazing.
  - Safety glass is required in panes larger than 9 sq. ft. where:
    - The bottom edge is less than 18" above the floor, and
    - The top edge is more than 36" above the floor, and
    - A walking surface is within 36" horizontally of the window.
    - *Exceptions*: As stipulated in the CRC Section 308.
  - Safety glass is required in shower and bathtub enclosures for exterior windows less than 60" above the floor of the enclosure.
- **Doors with glazing**
  - Safety glass is required in doors with glazing *except*: a) jalousie windows and b) windows with panes less than 3" in width or height.

6. SASH

- **Wood**
  - Decayed or deteriorated sashes shall be replaced if complete replacement window is not installed.
  - Springs and sash weight systems shall operate properly after sash replacement.



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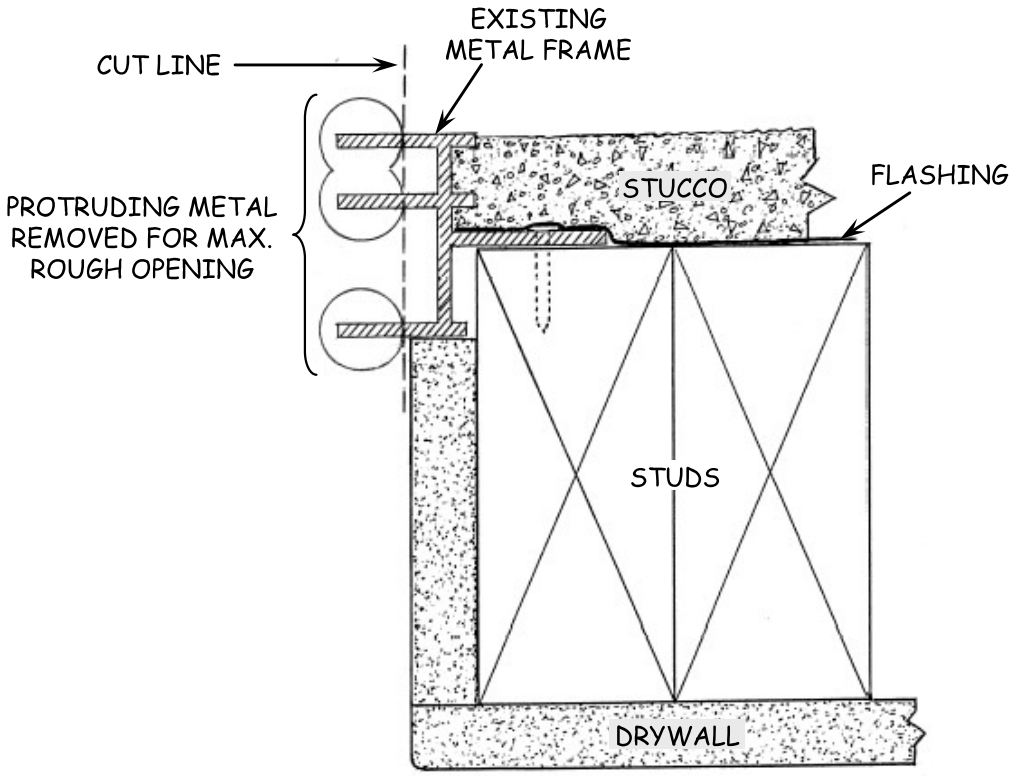
7. PREPARATION OF OPENING

- **When existing frame is removed**
  - The old window frame shall be completely removed from rough opening.
  - Rough opening shall be free of all obstructions, such as nailing fins, nails, and hardware.
  - Rough opening shall be solid and decayed material shall be replaced.
- **When existing frame is not removed**
  - Wood frames
    - The frame shall be free of all obstructions, with the sashes, hardware, stops, and parting strips removed.
    - The existing frame shall be securely attached in the rough opening and any decayed material shall be removed before the new window is installed.
  - Metal frame
    - Sashes, screens, and hardware shall be removed from the frame.
    - The frame shall be free of protruding metal and all other obstructions.
    - Maximum rough opening should be maintained by cutting away metal frame as needed (e.g., on egress windows).



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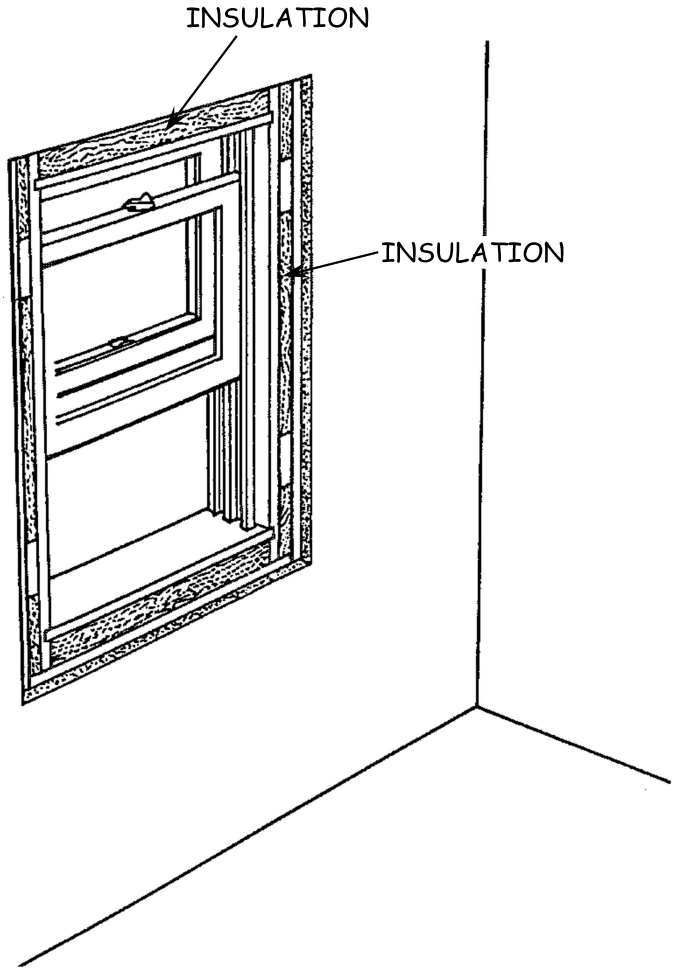
8. SASH

- **Wood**
  - Decayed or deteriorated sashes shall be replaced if complete replacement window is not installed.
  - Springs and sash weight systems shall operate properly after sash replacement.

9. CAVITY INSULATION

- **Wood framing**
  - Open cavities between rough framing and window jamb shall be insulated except where window weights are being utilized.



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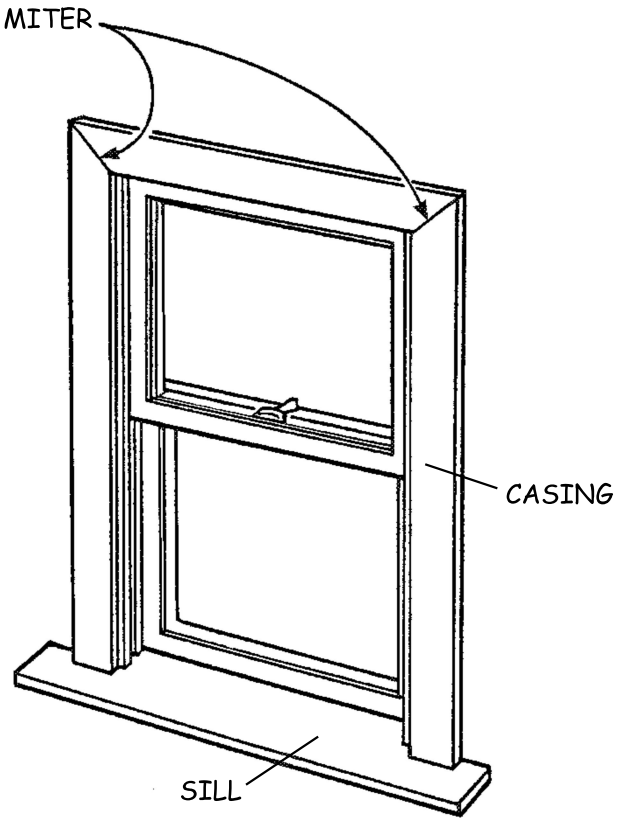
10. EXTERIOR SEAL

- **Flanged windows**
  - Entire window flange shall be caulked prior to installation to ensure watertight seal around perimeter.
- **Block frame windows**
  - Entire exterior perimeter shall be caulked to ensure watertight seal.

11. WOOD FINISH

- **Primer**
  - All window sashes, frames, and trim shall be primed.



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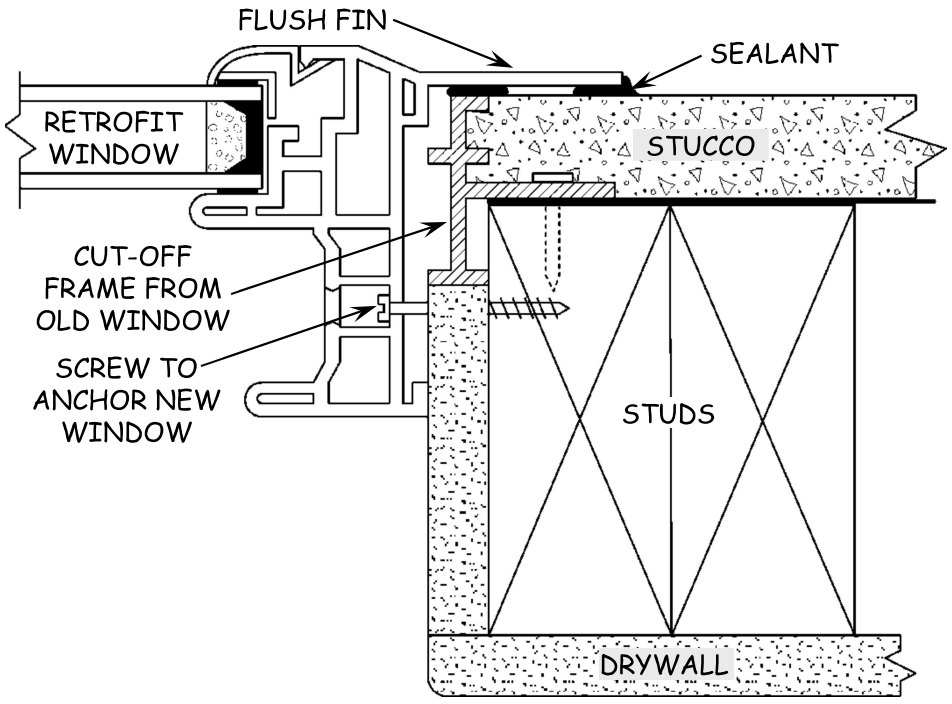
12. INSTALLING FLUSH FIN WINDOWS (RETROFITS)

- **Attachment**
  - Frame shall be anchored to structural framing with screws.
  - Screws shall be minimum #8 non-corrosive.
  - Screws shall not be placed in the fin.
  - Retrofit frame shall not be attached to old window frame.
  - Fin shall not be installed over lap siding.
- **Sealing**
  - Elastomeric caulk shall be installed:
    - Around the perimeter of the existing frame.
    - Between fin and exterior wall surface (e.g., stucco), and
    - Around the perimeter of square-edged fins.
  - The sealant bead shall be continuous except for small gap(s) near center of bottom fin (for drainage).
- **Dissimilar materials**
  - Unlike metals shall be separated from each other with a non-conductive tape, coating, or sealant material.



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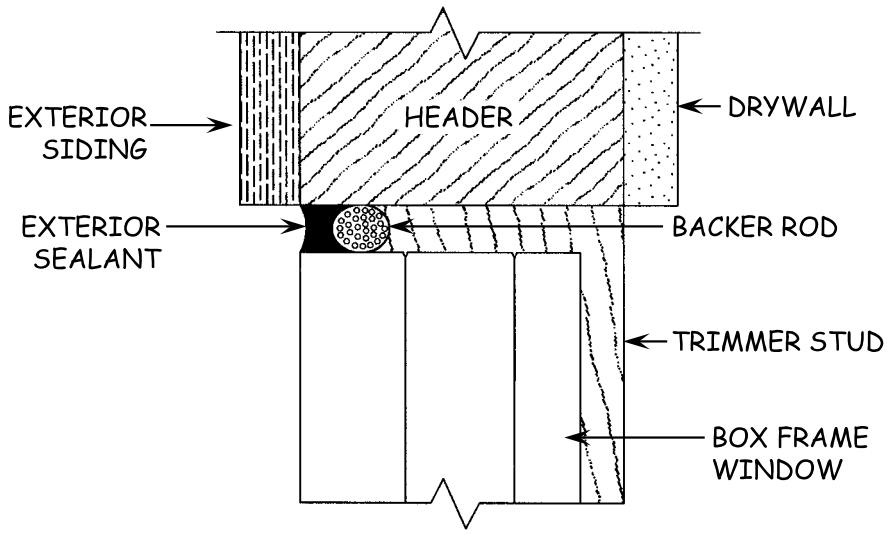
13. INSTALLING BOX FRAME WINDOWS (NO FINS)

- **Installed in existing frames**
  - All sashes, strips, hardware, and other obstructions shall be removed.
  - Existing frames shall be structurally sound and free of damage or deterioration (e.g., dry rot).
- **Installed in rough opening**
  - The existing frame and all other obstructions shall be removed.
- **All openings**
  - Rough framing shall be structurally sound and free of damage or deterioration (e.g., dry rot).
  - New unit shall be sealed in position with elastomeric caulk.
  - Backer rod required when gap exceeds 1/4".



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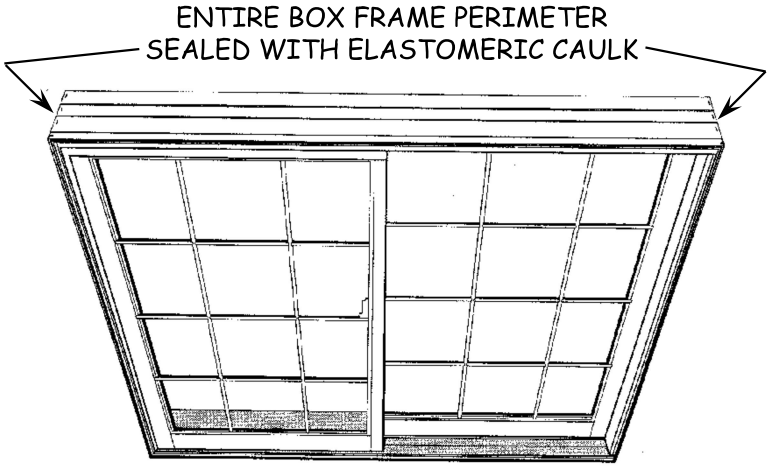
13. INSTALLING BOX FRAME WINDOWS (NO FINS) (cont.)

- **Anchoring**
  - The unit must be anchored per manufacturer's recommendation.
  - Vinyl windows shall not be anchored less than 10" from corners.
- **Stop and casing**
  - Exterior wooden stop and casing materials shall be exterior-grade.
- **Closure at bottom**
  - Step sill, step extender, or equivalent shall be installed when gap between existing sill and new sill jamb exceeds 1/4".
  - Bottom of unit shall be sealed except for small gap(s) near the center (for drainage).
- **Build-out (jamb extension)**
  - The window frame must be extended (built out) when it is narrower than the wall thickness.
  - Build-out material shall be compatible with the frame material.



BOTTOM GAPS EXCEEDING 1/4"
BLOCKED WITH STEP SILL

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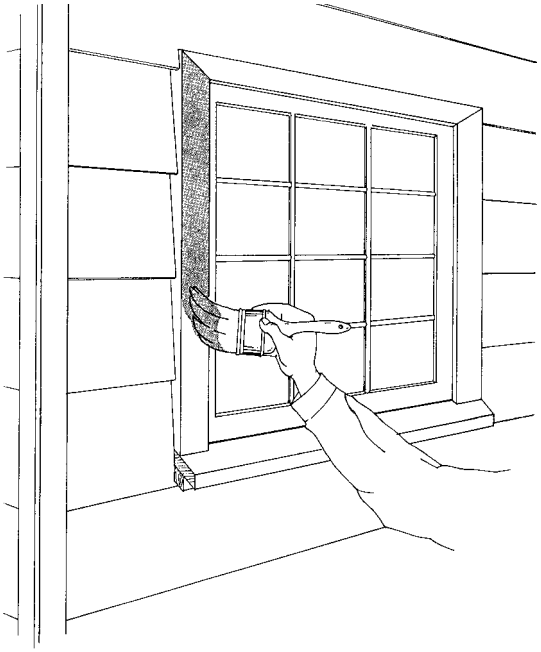
14. PAINTING AND STAINING WOOD MATERIALS

- **General requirements for all window sashes, frames, and trim**
  - All bare wood on the exterior shall be painted and/or primed per manufacturer's instructions and industry standards.
  - Finish coat shall lap 1/16" onto glass for proper moisture seal.
  - *Caution:* Paint shall not be applied to weatherstripping, vinyl, plastic, and other non-wood parts unless specifically allowed by the manufacturer.
  - Frame shall be primed/painted with sashes open or removed.
  - Acceptable sealers are paint, urethane, and varnish.



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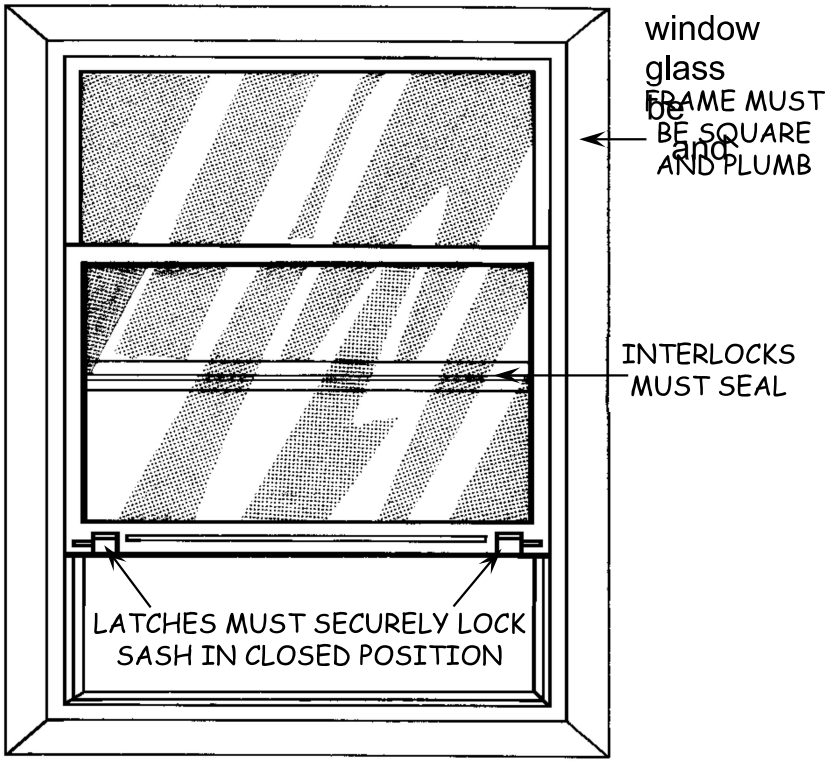
15. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up**
  - Paint dust and chips, scraps, and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Furniture and other household items moved for installation work shall be returned to their original positions.
- **Window operation**
  - Units shall operate smoothly.
  - Frame shall be square so sashes/panels close properly at all corners and edges.
  - Interlocks and latches shall function properly.
- **Safety**
  - Burs, sharp corners and edges, and other such hazards shall be removed.
- **Glass cleaning**
  - All replacement and/or sliding door glass shall cleaned inside out.



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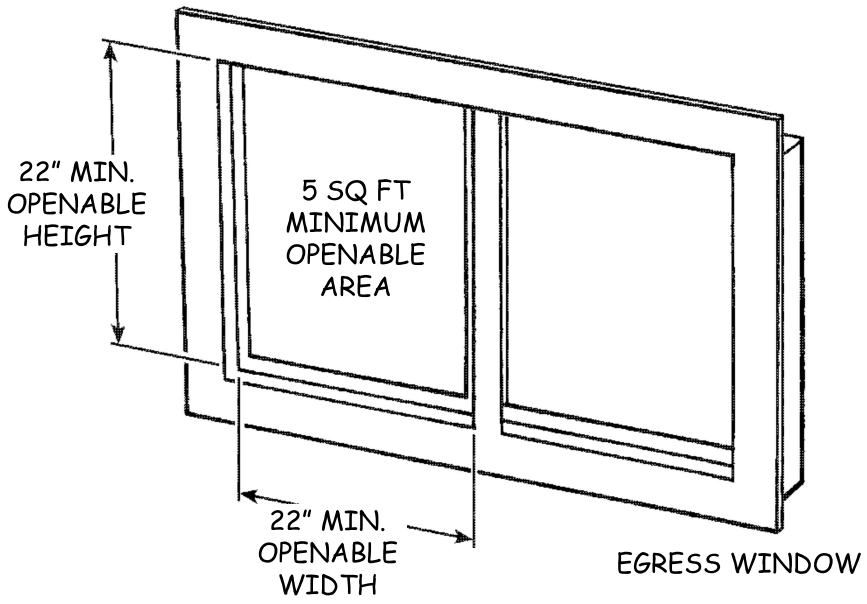
MOBILE HOME CRITERIA

16. REPLACEMENT EGRESS WINDOWS

- **Bedroom windows**
  - Windows placed in emergency egress locations shall meet the requirements of 24 CFR, 3280.404 and AAMA 1704.
  - Egress windows shall meet the following opening requirements:
    - Minimum clear openable area: 5.0 sq. ft.[3]
    - Minimum clear openable horizontal and vertical dimensions: 22".



[3] 5 sq. ft. clear openable area must be achieved. Thus, if height is 24", width must be 30", and so forth.

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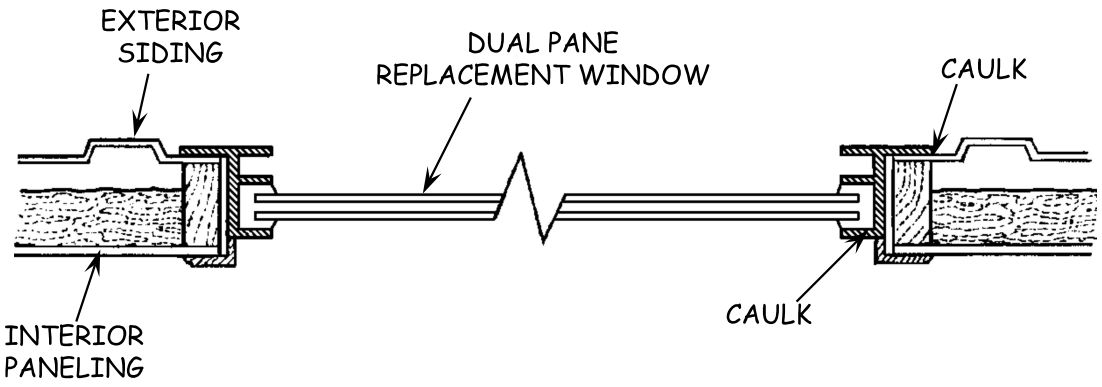
17. REPLACEMENT WINDOW INSTALLATION

- **All windows**
  - Insulation shall be installed in gaps between replacement frame and rough opening:
    - Flexible mineral fiber or non-expanding foam (e.g., backer rod) is acceptable.
    - Expanding foam is not allowed.
  - Clearances between window frame and rough opening shall conform to manufacturer's instructions.
  - The interior edge of the replacement window frame shall be:
    - Sealed around the entire perimeter with caulk.
    - Trimmed with molding as needed for a finished appearance.
  - All installed unfinished wood shall be sealed.
    - Exterior surfaces shall be primed and painted with high-quality exterior products.
    - Interior surfaces shall, at a minimum, be primed or stained.
- **Flanged windows**
  - Existing flanged windows shall be replaced with flanged windows.
  - A continuous bead of caulk, extending completely around the window, shall be placed between flange and mounting surface to achieve a permanent, water-tight seal.
    - Elastomeric sealant shall be used.
    - Finished bead shall be installed to direct water away from the window.



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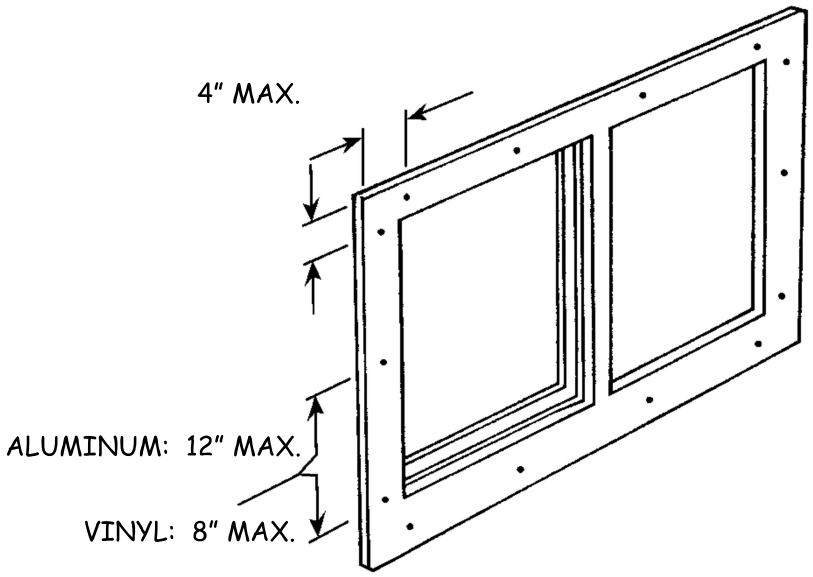
17. REPLACEMENT WINDOW INSTALLATION (cont.)

- **Attachment general requirements**
  - Windows shall be secured in conformance with manufacturer's instructions or the following guidelines.
  - Screws shall be non-corrosive, #8 or larger.
- **Attachment of box frame windows (no flange)**
  - Window shall be held securely in place with screws and/or stops fastened to the rough opening.
  - Screws shall be installed perpendicular to the window frame; angling screws to pull the window into the rough opening is not allowed.
  - Flashing shall be installed at top of window.
  - Drip cap shall be installed in all locations not protected by awning or porch.
- **Attachment of flanged windows**
  - Screws shall be placed within 4" of each corner.
  - For metal frames:
    - Additional screws shall be placed a maximum of 12" apart.
    - Minimum three screws on each side exceeding 18" in length.
  - For vinyl frames:
    - Additional screws shall be placed a maximum of 8" apart.
    - Minimum three screws on each side exceeding 14" in length.



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GLASS REPLACEMENT

Lead Paint Risk Factor
LOW-HIGH

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13. Mobile Home Glass Replacement 9

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SECTION 13 PREFACE
for

GLASS REPLACEMENT

1. Nonfeasibility Criteria

1.1. Small hole, 1/4" or less in diameter, is present and can be patched with clear silicone or clear glass repair tape.

1.2. There is only one crack less than 6" long, extending from edge to edge, that cannot come loose from the frame to pose a safety hazard.

1.3. Window is double-pane, only one pane is cracked, and the cracked pane does not present a health and safety problem/hazard.

1.4. Complete window will be replaced.

1.5. Customer refuses.

2. Installation Policies

IGU Non-Replacement

2.1. The IGU is not replaced when:

a. One pane is intact, and the other pane is only cracked (no holes/gaps).

b. Both panes are cracked, but glass is otherwise intact (no holes/gaps).

c. One pane is intact, and the other pane is broken (holes/gaps present).

- If shards are present, remove them as feasible per individual utility policy.
- If shards are present, but removal is not feasible, notify the customer.

IGU Replacement

2.2. The IGU is replaced when both panes are damaged enough to allow infiltration (hole/gap present in glass that is too large to caulk.)

IGU Repair

2.3. The glass in the IGU is repaired when a small hole/gap (1/4" of less wide) is present that can be caulked with clear silicone or patched with clear glass repair tape.

2.4. Repair can include removal of dangerous glass shards in an IGU that is not replaced, when allowed by individual utility policy.

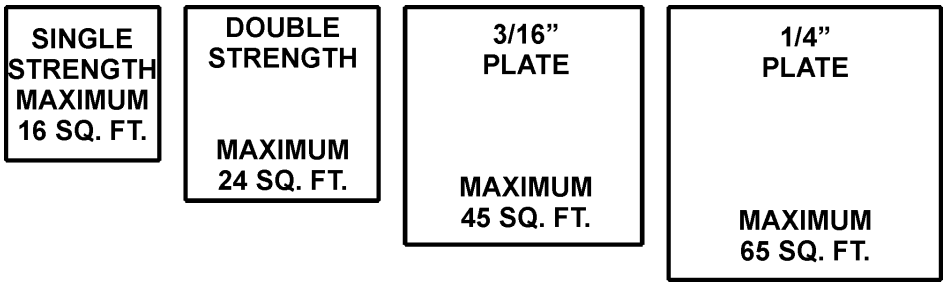
3. Installation Policies Specific to Mobile Homes

None.

GLASS REPLACEMENT STANDARDS

1. APPROVED MATERIALS[1]

- **Single strength (SS)**
  - Allowed when DS is too thick for the frame.
  - Maximum pane size: 16 sq. ft.
- **Double strength (DS)**
  - Allowed to replace SS when frame thickness is adequate.
  - Maximum pane size: 24 sq. ft.
- **3/16" plate glass**
  - Maximum pane size: 45 sq. ft.
- **1/4" plate glass**
  - Maximum pane size: 65 sq. ft.
- **Fully tempered glass**
  - Multiply the above listed sizes by four.
- **Heat-strengthened glass**
  - Multiply the above listed sizes by two.
- **Safety glass**
  - Shall meet the specifications of ANSI Z97.1.
  - Shall be permanently labeled.
- **Plastic materials**
  - UV-treated polycarbonate, minimum of 1/8" thick.
  - All sheeting shall have sufficient rigidity to prevent bowing after installation.
  - Acrylic sheets and plastic film are not allowed.



[1] The listed glass sizing criteria are for installation in conventional home locations with low design pressure. For code requirements applicable to other locations, see Chapter 24 of the current CBC, or consult the local building dept.

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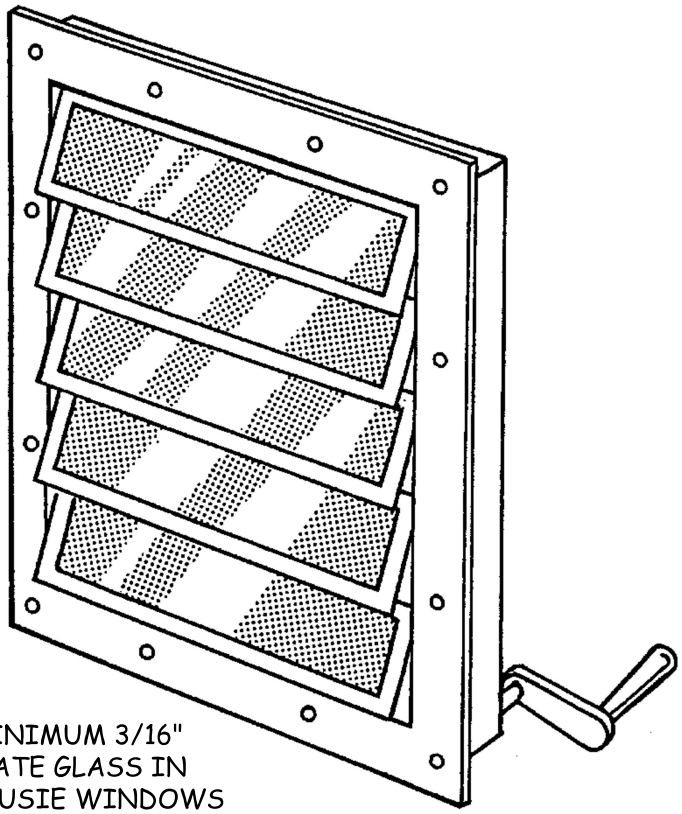
1. APPROVED MATERIALS[1] (cont.)

- **Jalousie windows**
  - Minimum 3/16" glass shall be installed.
  - Maximum pane length shall be 48".
  - All attachment clips must be present.
  - Regular, patterned, frosted, tempered, and heat-strengthened glass allowed.
  - Wired, laminated, and sandblasted glass not allowed.
- **Glass quality**
  - Replacement glass shall equal or exceed that of the existing glass.
- **Glazing compound**
  - Shall be the type that remains pliable.
  - Shall conform to ASTM C669 for metal sashes.



MINIMUM 3/16"
PLATE GLASS IN
JALOUSIE WINDOWS

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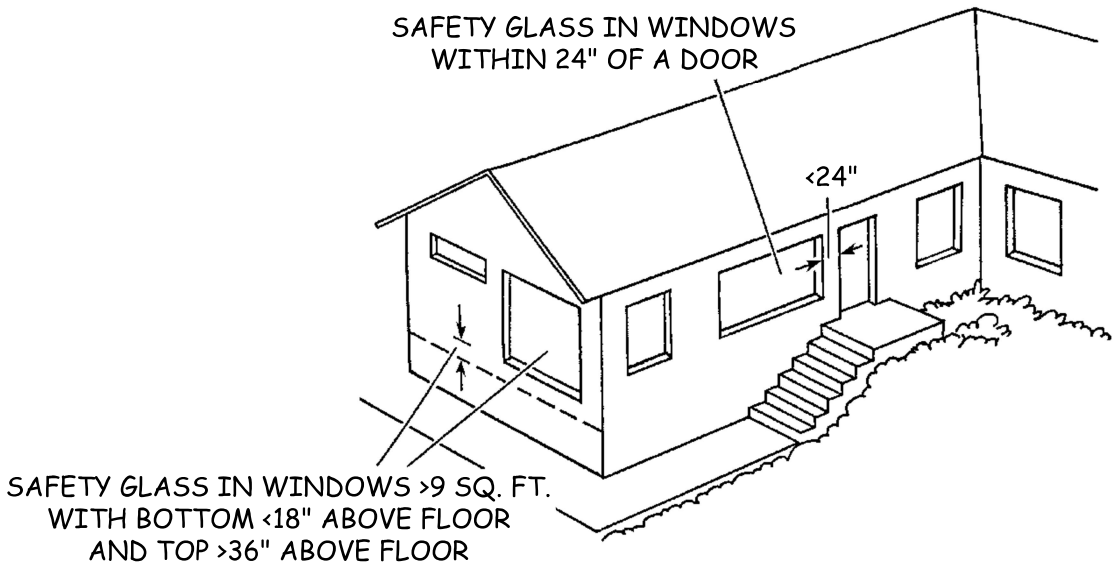
2. SAFETY GLASS

- **Safety glazing shall be permanently labeled and installed per the current CBC, part of which is summarized below.**
- **Windows**
  - Safety glass is required in any window adjacent to a door where:
    - The nearest vertical edge is within 24" of the door, and
    - The bottom edge is less than 60" above the floor.
    - *Exception:* Not required when there is an intervening wall or other permanent barrier between the door and the glazing.
  - Safety glass is required in panes larger than 9 sq. ft. where:
    - The bottom edge is less than 18" above the floor, and
    - The top edge is more than 36" above the floor, and
    - A walking surface is within 36" horizontally of the window.
    - *Exceptions:* As stipulated in the current CBC.
  - Safety glass is required in shower and bathtub enclosures for exterior windows less than 60" above the floor of the enclosure.
- **Entrance doors with glazing**
  - Safety glass is required in doors with glazing except: a) jalousies and b) windows with panes less than 3" in width or height.
- **Plastic glazing**
  - Polycarbonate may be used in lieu of safety glass.



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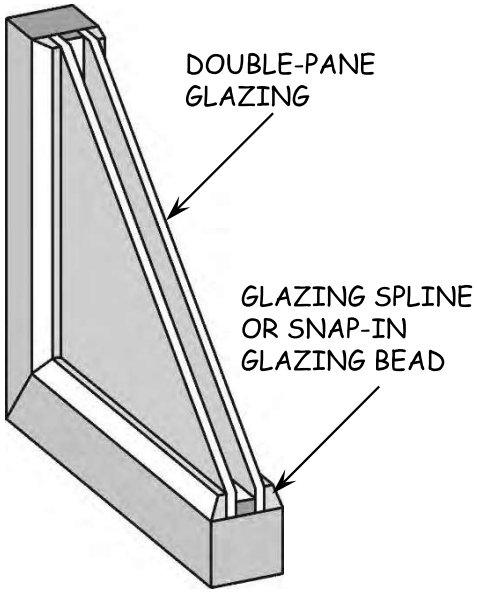
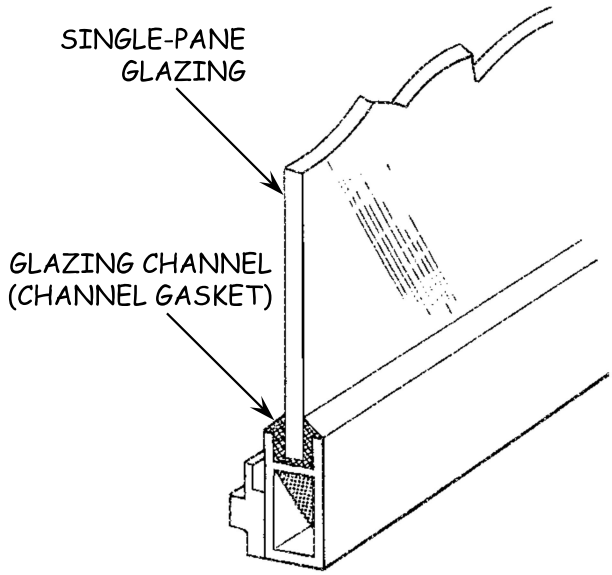
3. GLAZING COMPOUND

- **Application**
  - Required in sashes designed to use glazing compound.
  - Caulk not allowed in lieu of glazing compound.

4. GLAZING CHANNEL

- **Metal and vinyl windows**
  - A watertight seal shall be present all around the sash.
  - Glazing shall be sealed/secured with glazing spline, glazing channel (channel gasket), or snap-in glazing bead.
  - New replacement gasket/spline shall be:
    - Installed when feasible.
    - Properly sized to form a snug fit in the channel.
  - Existing gasket/spline 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/spline cannot be provided, glass shall be stabilized in clear silicone caulk or equivalent.





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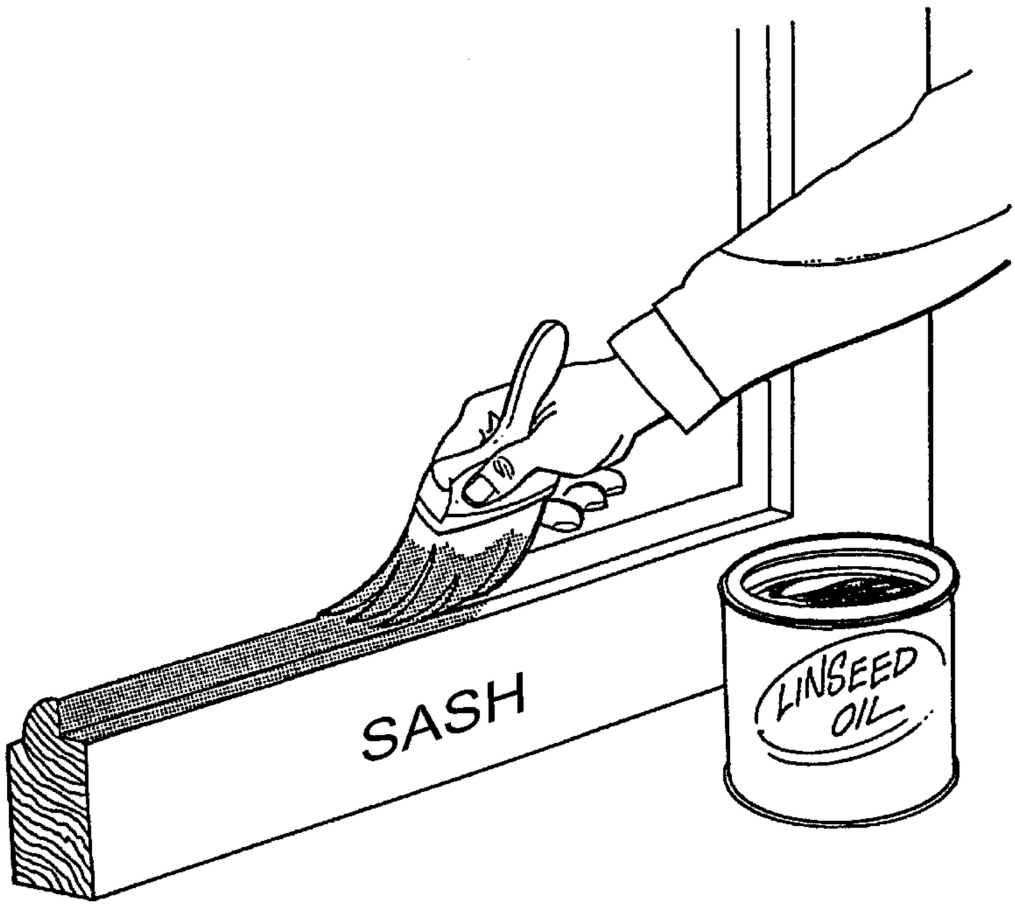
5. TREATMENT OF SASH

- **All sashes**
  - Glass channel shall be clean and free of debris.
- **Wood sashes**
  - Shall be treated with linseed oil before glazing compound is installed.
- **Metal sashes**
  - Shall be painted if rusted or bare.
  - Rust shall be removed before painting.



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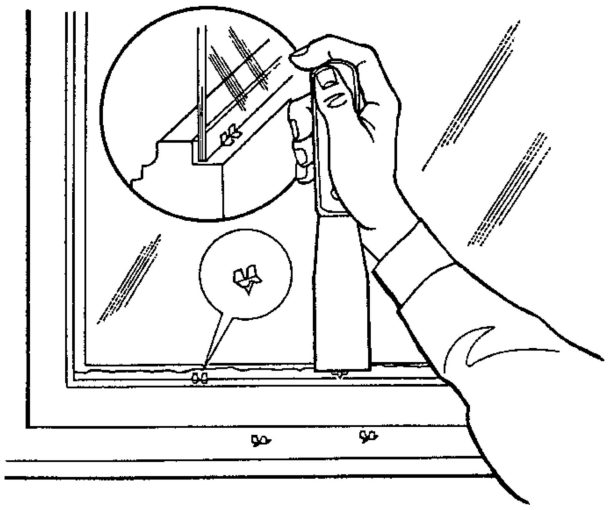
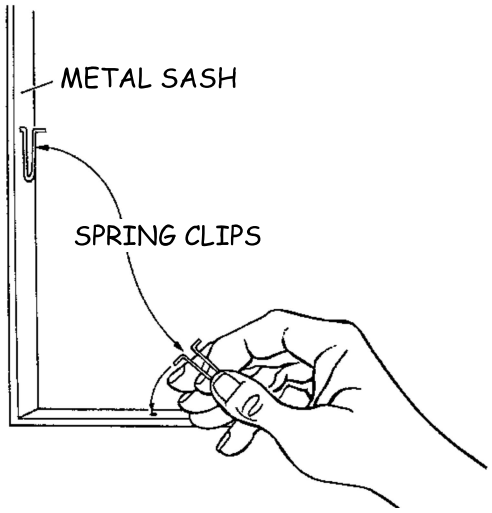
6. WOOD SASH

- **Push points**
  - Push points shall be installed:
    - A maximum of 8" apart.
    - Within 4" of each corner.

7. METAL SASH

- **Spring clips**
  - Spring clips shall be properly installed (i.e., maximum of 12" apart, and within 4" of each corner).
- **Continuous angles or stops**
  - Shall be properly reinstalled (e.g., with screws or snap-in spring retainers) to keep glass securely in place.
- **Glazing splines**
  - Splines shall be properly reinstalled to keep glass securely in place.
  - Replacement glazing splines (e.g., aluminum or vinyl) may be installed when the original glazing splines cannot be reused.





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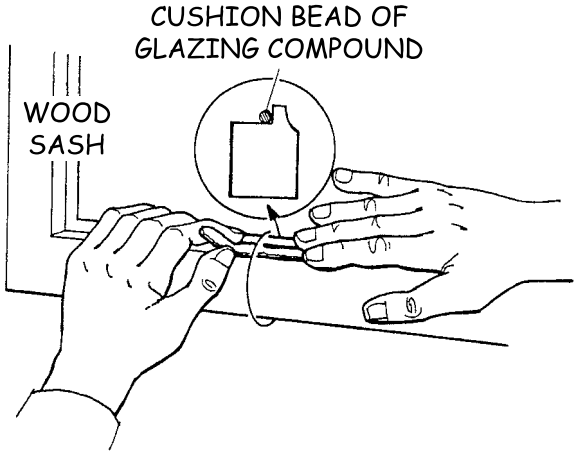
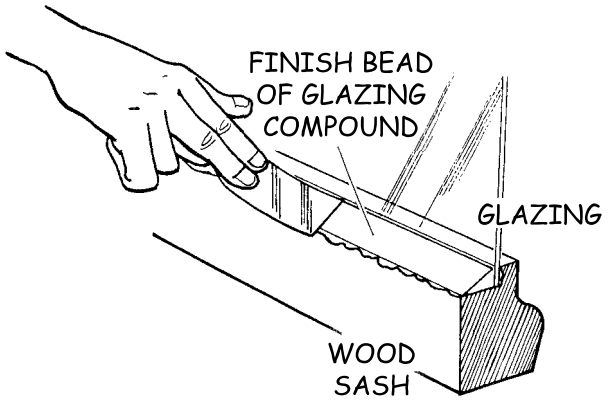
8. CUSHION BEAD

- **Wood and metal sash**
  - Cushion bead shall be continuous and free of voids.
- **Wood sash**
  - Glazing compound shall be used.
  - Caulk shall not be used.

9. FINISH BEAD

- **Wood sash**
  - Finish bead shall:
    - Be free of gaps.
    - Be tooled, as described in IS Section 1 (Caulking), and uniform with existing beads.
    - Not be visible from interior side.





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10. BATHROOM WINDOWS

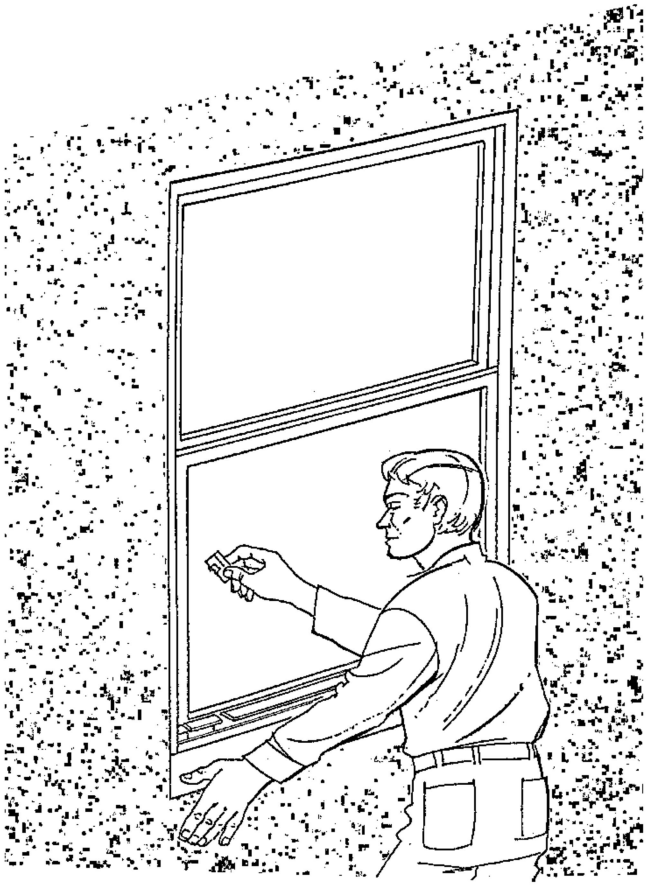
- **Obscure glass on the ground floor shall be replaced with obscure glass if bottom edge of window is less than 60" above finished floor.**

11. OPERABLE WINDOWS

- **Operable windows (movable sashes) shall <u>not</u> be converted to fixed panes.**

12. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up**
  - Replaced glass shall be cleaned inside and out.
  - Paint dust and chips, scraps, and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Furniture and other household items moved for installation work shall be returned to their original positions.
- **Operation**
  - All re-glazed windows shall open, close, and latch properly.



REPLACED GLASS CLEANED INSIDE AND OUT

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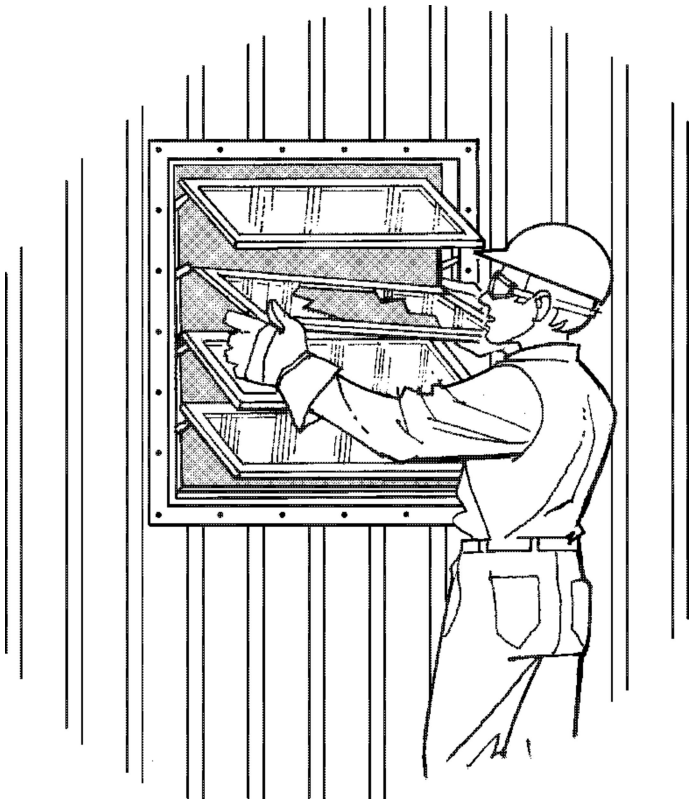
MOBILE HOME CRITERIA

13. MOBILE HOME GLASS REPLACEMENT

- **Glass replacement in awning windows**
  - The sash shall be disassembled as needed to remove broken glass.
    - Care shall be taken to preserve the channel gasket.
    - Damaged gasket shall be replaced or repairs shall be made.
  - Glass thickness shall allow proper installation into the channel with gasket installed.
  - Reassembled sash shall be:
    - Reinstalled and secured properly.
    - Opened and closed and adjusted as needed to operate smoothly and close properly.
- **Glass replacement in sliding windows**
  - Applicable procedures prescribed above for awning windows shall be followed.



SASH HINGE DISCONNECTED AND
AWNING WINDOW PANEL REMOVED

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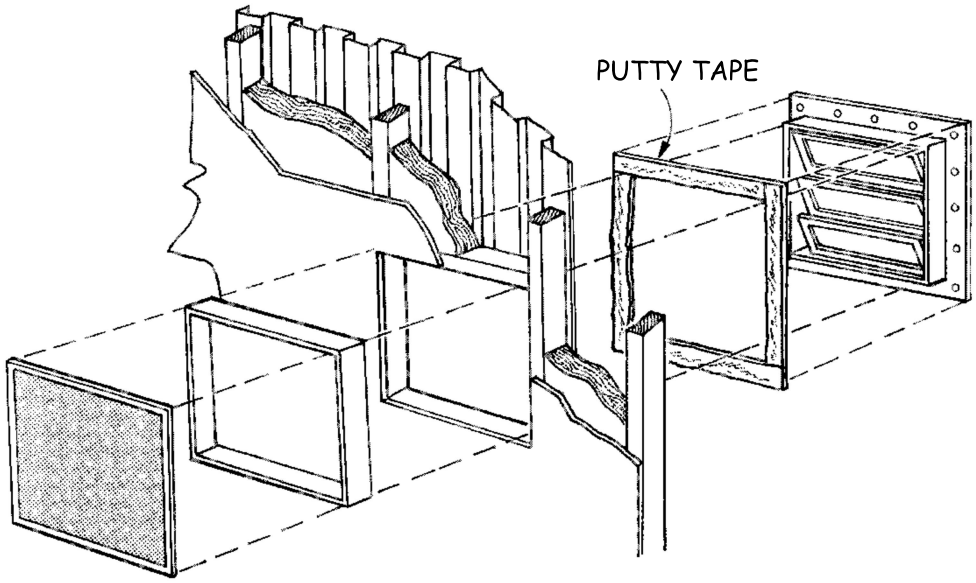
13. MOBILE HOME GLASS REPLACEMENT (cont.)

- **When flanged window frame is removed to facilitate glass replacement:**
  - Integrity of sealant on back side of flange shall be maintained.
  - Elastomeric caulk or non-hardening sealant/putty tape shall be applied as needed to ensure a complete seal.
  - Surfaces to which sealant is applied shall be clean.
- **When flanged frame is re-installed:**
  - Screws shall be reinstalled and fully tightened.
  - Stripped or damaged screws shall be replaced.

EXTERIOR GASKET SEALED WINDOW



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LED SCREW-BASED BULBS

Lead Paint Risk Factor
NONE

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3. Operational Checks **4**

4. Lead-Safe Weatherization and Post-Installation Requirements **4**

MOBILE HOME CRITERIA **4**

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SECTION 14 PREFACE
for

LED SCREW-BASED BULBS

1. Nonfeasibility Criteria

1.1. Socket/fixture is nonfunctional.

1.2. Fixture already has a functional LED or CFL.

1.3. Hazardous conditions exist at the socket/fixture.

1.4. Circuit is controlled by a solid-state timer, or by a dimmer not compatible with available hard-wired LED fixtures, and replacement with a compatible controller or standard switch is not feasible.

1.5. Fixture is in a storage room, closet, or multifamily common area.

1.6. Luminaire is not a permanent fixture or a corded lamp.

1.7. Fixture is not on the customer's electric meter/bill.

1.8. Customer refuses.

2. Installation Policies

2.1. In circuits controlled by a dimmer or vacancy/occupancy sensor:

a. Proper operation of installed LEDs shall be checked.

b. If flickering, noise, or other abnormality occurs, the original bulbs shall be replaced, and LED installation in the circuit is not feasible.

2.2. All lamps, without exception, shall be installed by the contractor.

2.3. Bulbs replaced by LEDs shall be removed from the home, unless the customer asks to keep the old bulbs.

2.4. LED bulbs may only be installed in fixtures that have incandescent or halogen bulbs and are used ≥2.0 hours per day.

2.5. The number of screw-based LEDs to be installed in any single-family residence shall be in accordance with utility program policy.

2.6. The Correlated Color Temperature (CCT) table on the following page may be used to select LED most suitable to customer's preference.

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CORRELATED COLOR TEMPERATURE (CCT)

Installation Location	Color Correlated Temperature (CCT) in Degrees Kelvin (K)	Lighting Characteristic
Indoors	2700K	Soft White
	3000K	Warm White
	3000K	Neutral White
	3500K	Natural White
Outdoors	4000/4100K	Cool White
	5000K	Daylight
	6500K	Daylight

3. Installation Policies Specific to Mobile Homes

None.

LED SCREW-BASED BULB STANDARDS

1. APPROVED MATERIALS

- **LED bulbs**
  - Screw-in (E-26) base.
  - Light source marked with "JA8" ("JA8-E" for enclosed and recessed fixtures) per Title 24 Joint Appendix JA8.
  - ENERGY STAR-certified.
  - Omnidirectional A-lamp, or G-lamp for vanity bar lights.
  - Directional BR or PAR type for recessed fixtures without a lens.
  - Dimmable when controlled by a dimmer.
  - Suitable for damp locations when installed in outdoor damp locations.
- **Warranty**
  - Refer to IS Appendix F (Minimum Warranty Requirements).

2. INSTALLATION REQUIREMENTS

- **All bulbs**
  - Installation shall comply with this section, manufacturer's instructions/recommendations, and local code.
  - LED lumens shall be selected based on the equivalent wattage of the bulb to be replaced, as shown in the table below.
  - Level shall be sufficient to maintain pre-existing light level unless a lower level is acceptable to the customer.

MINIMUM LIGHT OUTPUT (LUMENS)

Minimum Lumens	Light Types		
	LED	Incandescent	Halogen
250+ (Candelabra)	**2W–4W**	25W	18W
450+	**5W–8W**	40W	29W
800+	**8.5W–11.5W**	60W	43W
1,100+	**12W–16W**	75W	53W
1,600+	**17W–22.5W**	100W	72W
2,600+	**N/A**	150W	N/A

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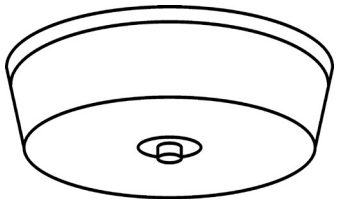
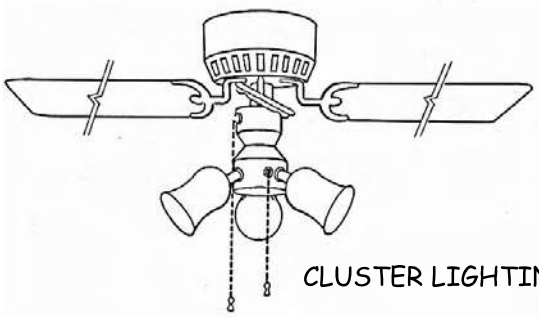
2. INSTALLATION REQUIREMENTS (cont.)

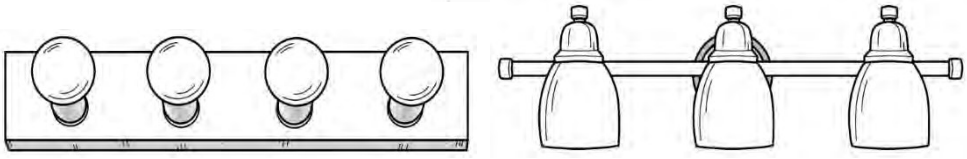
- **Controllers**
  - In a circuit controlled by a dimmer, photosensor, occupancy sensor, or vacancy sensor, an LED bulb may be installed only when the controller is compatible with the bulb.
  - For LED bulbs to be installed in fixtures controlled by a mechanical or solid-state timer, installation must be allowed by the LED manufacturer.
- **Lighting fixture globes**
  - A globe must be present on an exterior fixture receiving an LED.
  - When an LED is installed inside a globe:
    - The LED must be labeled "JA8-E."
    - The globe must be reinstalled after LED installation.
- **Enclosed fixtures**
  - All installed LEDs must be labeled "JA8-E."
- **Cluster lighting**
  - LEDs may be installed in cluster lighting (armed light fixtures), unless prohibited by the LED manufacturer.
  - All installed LEDs in cluster lighting must match.
  - Fixture shall remain level after LEDs are installed.
- **Multi-bulb fixtures (vanity bar and open globe)**
  - All bulbs must match.
  - G-lamps in vanity bars shall be replaced with G-lamps.
  - Exception: Match not required when CFL is non-functional or missing.



ENCLOSED FIXTURE



CLUSTER LIGHTING



VANITY BAR LIGHT FIXTURES

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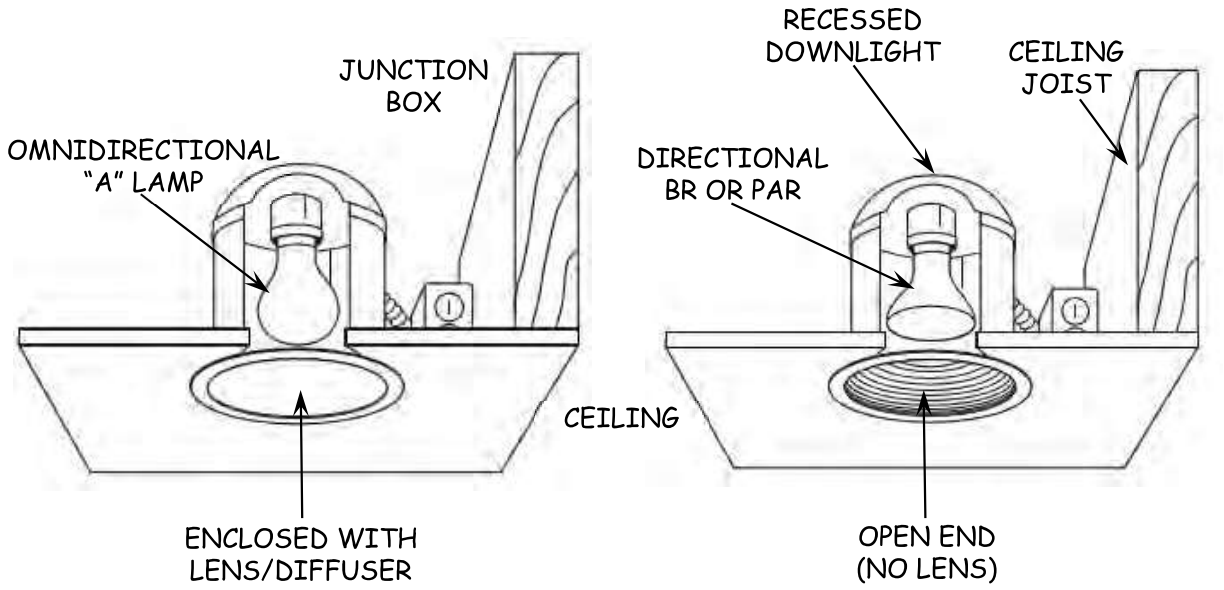
2. INSTALLATION REQUIREMENTS (cont.)

- **Fan lighting**
  - LEDs may be installed in fan lighting fixtures, unless prohibited by the LED manufacturer.
- **Recessed downlight fixtures**
  - Completely enclosed fixture (with trim and lens/diffuser)
    - The LED bulb must be labeled “JA8-E”
    - The fixture trim, lens and/or diffuser must be reinstalled
  - Open End (no lens/diffuser)
    - The LED bulb must be labeled “JA8-E”
    - Only directional lamps may be installed (BR, PAR)



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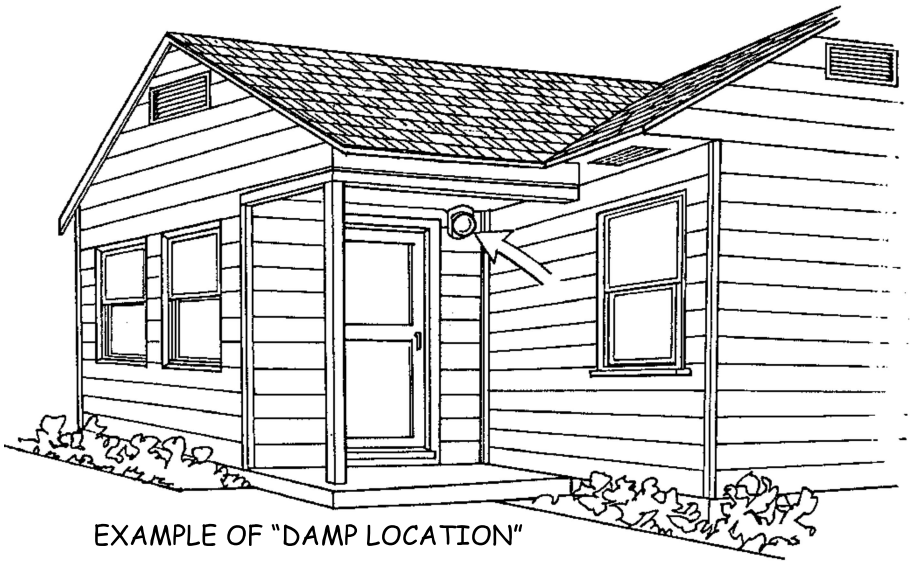
- **Outdoor locations**
  - When LED bulbs are installed in outdoor locations:
    - The fixture shall be rated for Damp or Wet locations.
    - The LED bulb must be rated for the type of location where it is installed.

3. OPERATIONAL CHECKS

- **All bulbs**
  - Installed bulbs shall be checked for proper operation, including compatibility with a controller, when present.
  - Defects shall be corrected.



EXAMPLE OF "DAMP LOCATION"

4. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up**
  - Paint dust and chips, scraps, and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Furniture and other household items moved for installation work shall be returned to their original positions.
- **Measure-specific requirements**
  - Replaced bulbs removed from the home shall be disposed of properly.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

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LED FIXTURES

Lead Paint Risk Factor
LOW

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MOBILE HOME CRITERIA **9**

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SECTION 15 PREFACE
for

LED FIXTURES

1. Nonfeasibility Criteria

1.1. The existing fixture is operable and has functional CFL or LED light source.

1.2. Screw-based LED(s) can be installed in the existing fixture.

1.3. The existing fixture includes an exhaust fan.

1.4. Electrical box is substandard and/or cannot be properly secured.

1.5. Wiring is substandard or deteriorated, and/or rewiring is necessary.

1.6. Circuit does not operate properly (e.g., defective switch) and correction is not feasible.

1.7. Circuit is controlled by a solid-state timer, or by a dimmer not compatible with available hard-wired LED fixtures, and replacement with a compatible controller or standard switch is not feasible.

1.8. Location is ungrounded where grounding is required (e.g., damp or wet location), and alternatives (plastic fixture or GFCI-protected switch) are not feasible or not allowed by local code.

1.9. Location requires a vacancy sensor switch (VSS) or dimmer, but installation of a suitable controller is not feasible.

1.10. Existing fixture is not on the customer's electric meter/bill.

1.11. Customer refuses.

2. Installation Policies

2.1. This measure is for interior and exterior hard-wired LED light fixtures.

2.2. This Correlated Color Temperature (CCT) table may be used to select LED most suitable to customer’s preference.

Installation Location	Color Correlated Temperature (CCT) in Degrees Kelvin (K)	Lighting Characteristic
Indoors	2700K	Soft White
	3000K	Warm White
	3000K	Neutral White
	3500K	Natural White
Outdoors	4000/4100K	Cool White
	5000K	Daylight
	6500K	Daylight

2.3. Light output (lumens) level shall be sufficient to maintain pre-existing light level, unless a lower level is acceptable to the customer.

2.4. Maximum number of fixtures installed shall comply with individual utility policy.

2.5. When a vacancy sensor switch (VSS) is installed, and a neutral and/or equipment ground is not present in the switch box, the lighting load must equal or exceed the minimum wattage required to operate available VSS.

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

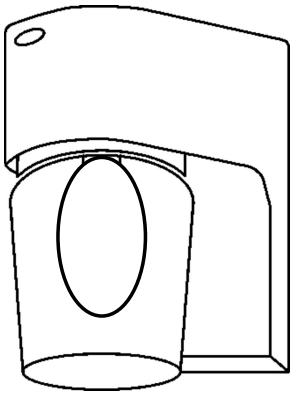
3. Installation Policies Specific to Mobile Homes

3.1. Not approved for exterior installation on mobile homes.

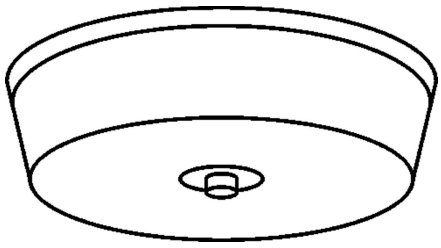
LED FIXTURE STANDARDS

1. APPROVED MATERIALS

- **All fixtures**
  - UL-listed, or equivalent.
  - Light source:
    - ENERGY STAR-certified.
    - Compliant with Voluntary CA Quality LED Lamp Specification 3.0.
    - Marked with "JA8-2016" ("JA8-2016-E" for enclosed and recessed fixtures) per Title 24 Joint Appendix JA8.
    - Dimmable when controlled by a dimmer.
  - Fixtures for outdoor installations must be:
    - Labeled for “damp” or “wet” locations as applicable.
    - Controlled by:
      - Photo-control and motion sensor, or
      - Photo-control and automatic time switch control, or
      - An astronomical time clock or other method that automatically turns the outdoor lighting off during daylight hours.



WALL-MOUNT LED
WITH PHOTO CELL CONTROL



CEILING-MOUNT LED
REPLACEMENT FIXTURE

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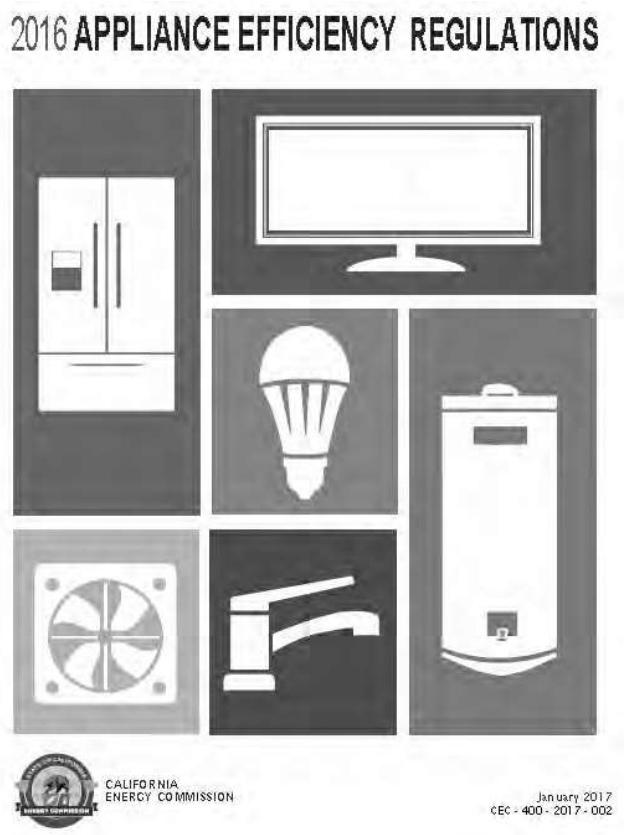
1. APPROVED MATERIALS (cont.)

- **Light controls**
  - Fixtures must have a readily accessible on/off switch.
  - Vacancy sensors, occupancy sensors, motion sensors, and dimmers must be certified to comply with Title 20 Appliance Efficiency Regulations.
  - Forward phase-cut dimmers must comply with NEMA SSL 7A to ensure compatibility with LED lighting.
- **Warranty**
  - Refer to IS Appendix F (Minimum Warranty Requirements).

2. GENERAL REQUIREMENTS

- **All installations**
  - Fixtures shall be installed only to replace existing surface-mount fixtures.
  - All fixtures and lighting controls shall be installed in accordance with manufacturer's instructions, Title 24 requirements, and local code.
  - A permit shall be obtained and finalized when required by local code.



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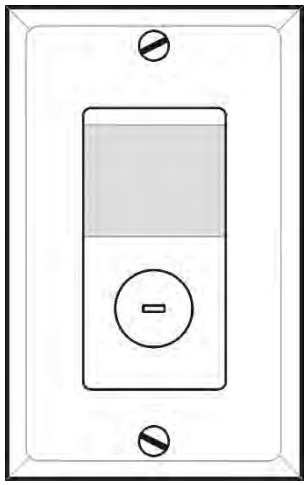
2. GENERAL REQUIREMENTS (cont.)

- **Controls**
  - All lighting controls shall be compatible with the circuits, loads, and fixtures they control.
  - Vacancy sensors
    - Installed in the interior and in the garage when required.
    - Vacancy sensor controlling a switch circuit that does not have a neutral or grounding conductor must be suitable for that use.
    - The appropriate technology (PIR, US, or combination) shall be installed in each location (per IS Section 34, Vacancy Sensor Switches).
  - Occupancy sensors
    - Used only in common areas in multifamily buildings.
    - In corridors and stairwells, occupancy sensors must reduce the light level by at least 50% when unoccupied.

3. INTERIOR INSTALLATIONS

- **All units**
  - All wiring not inside a building cavity shall be housed in a raceway.
- **Permitted jobs**
  - All fixtures with a JA8-certified light source must be controlled by either a dimmer or vacancy sensor (*except* in hallways and closets <70 sq. ft.).
  - In bathrooms, laundry/utility room, and garage, at least one fixture (existing or replaced) must be controlled by a vacancy sensor or an occupancy sensor configured to manual-on operation.

EXAMPLE OF A VACANCY SENSOR



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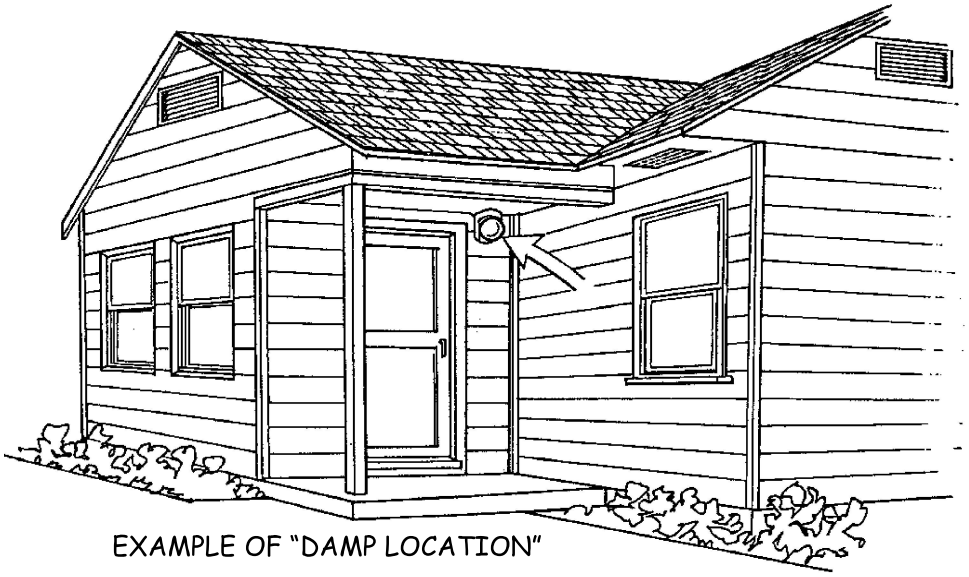
4. EXTERIOR INSTALLATIONS

- **All units**
  - All wiring, conduit, accessories, fasteners, and controls shall be designed for exterior use.
  - All exposed wiring shall be housed in a watertight conduit.
  - Installation must prevent water from entering or accumulating in wiring compartment, lamp holder, or electrical parts.
  - Each installed light fixture must be controlled by an on/off switch and one of the following automatic control options:
    - Photo-control *and* motion sensor, or
    - Photo-control *and* automatic time switch control, or
    - An astronomical time clock or other method that automatically turns the outdoor lighting off during daylight hours.
- **Fixtures marked "Suitable for Damp Locations"**
  - Shall be installed out of direct contact with precipitation, in partially protected locations (e.g., under canopies, in closed porches, and in carports).
- **Fixtures marked "Suitable for Wet Locations"**
  - May be installed in damp locations and in unprotected outdoor locations >4' above the ground.



EXAMPLE OF "DAMP LOCATION"

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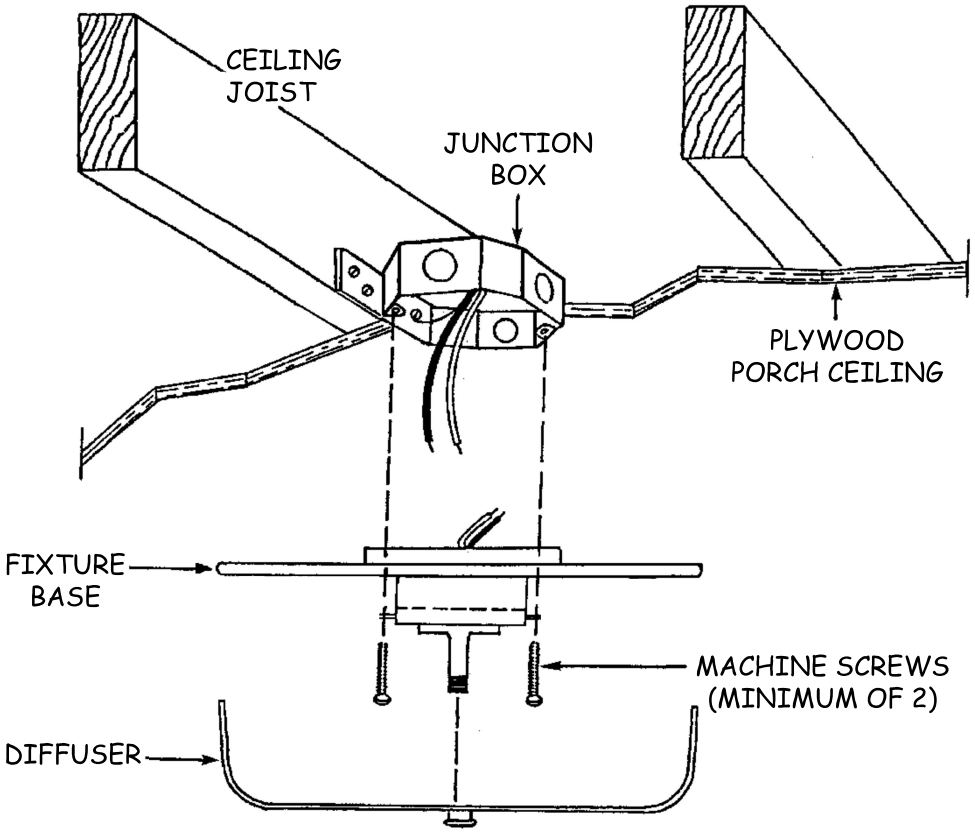
5. ALL INSTALLATIONS

- **Securing fixtures**
  - Fixture shall be secured to a mounting plate, electrical box, or to structural members—not to interior sheathing (plaster, drywall, etc.).
  - Mounting plates and fixtures attached directly to the electrical box:
    - Fixture shall be secured with a minimum of two fasteners.
    - Additional fasteners/screws not required for fixtures attached by a properly installed threaded nipple and nut.
  - Fixtures attached to structural members shall be secured with screws that penetrate solid wood at least 3/4".



CEILING-MOUNT LED REPLACEMENT FIXTURE

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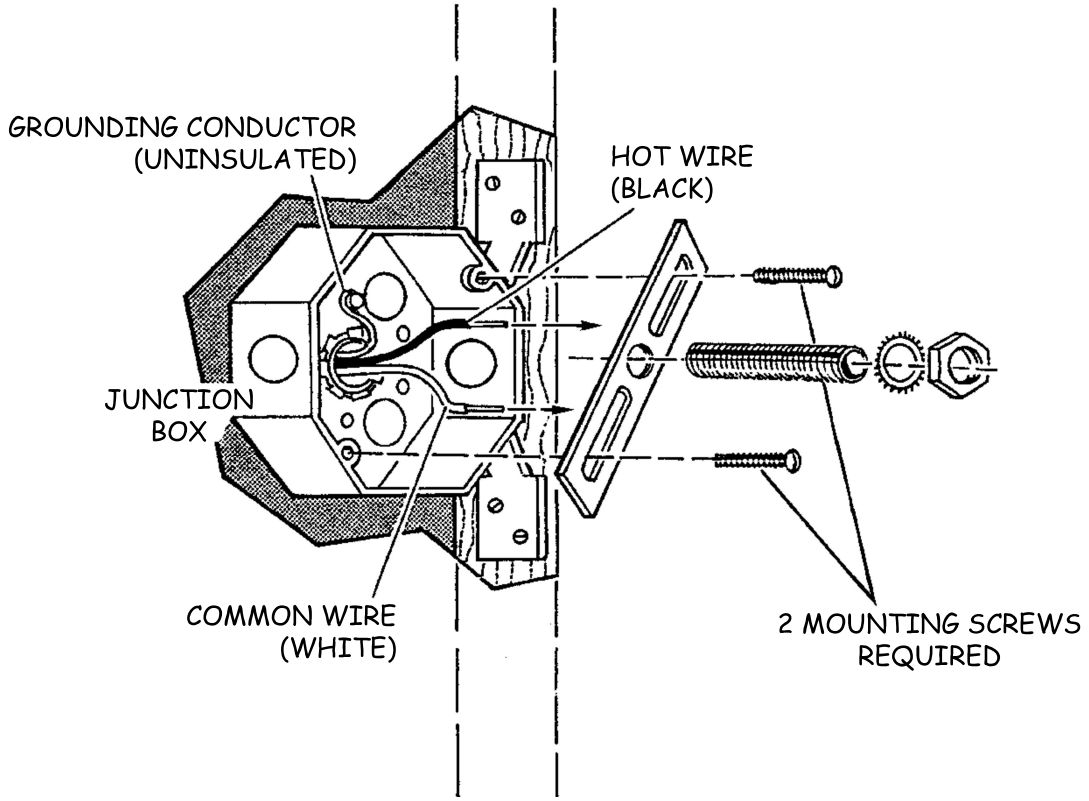
6. ELECTRICAL REQUIREMENTS

- **Circuit**
  - Fixtures shall be installed only in 110–120-volt circuits.
- **Splicing connectors**
  - All connections shall be secured with properly sized pressure splicing connectors (e.g., wire nuts).
  - Electrical tape may be used only as a *supplement* to a properly installed pressure splicing connector, not to secure the connection.
- **Dissimilar wires**
  - Aluminum and copper wires shall not be spliced together unless:
    - Materials used (e.g., pressure terminals, pressure splicing connectors, and oxidation inhibitor) are suitable for the use and
    - They are applied in accordance with manufacturer's instructions and local code.



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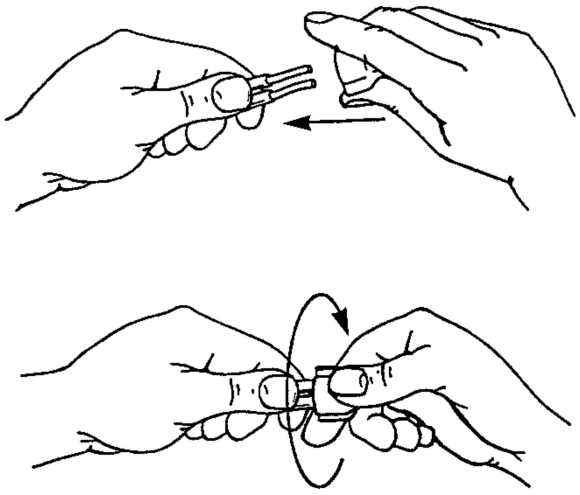
6. ELECTRICAL REQUIREMENTS (cont.)

- **Fixture wiring**
  - Wiring shall not be damaged (e.g., no slices, cuts, nicks, etc.).
  - Splices shall be contained within a fixture, junction box, etc.
  - Twist-type pressure splicing connectors (e.g., wire nuts):
    - Connectors shall be UL-listed, new, and properly sized.
    - Wires shall be:
      - Stripped to length specified by the connector manufacturer and
      - Pre-twisted when instructed or when required by local code.
    - Connectors shall be firmly twisted on to hold them securely in place.
  - "Poke-in" and "stab-in" type electrical connections may be used in lieu of twist-type splicing connectors in accordance with manufacturer's instructions and local code.



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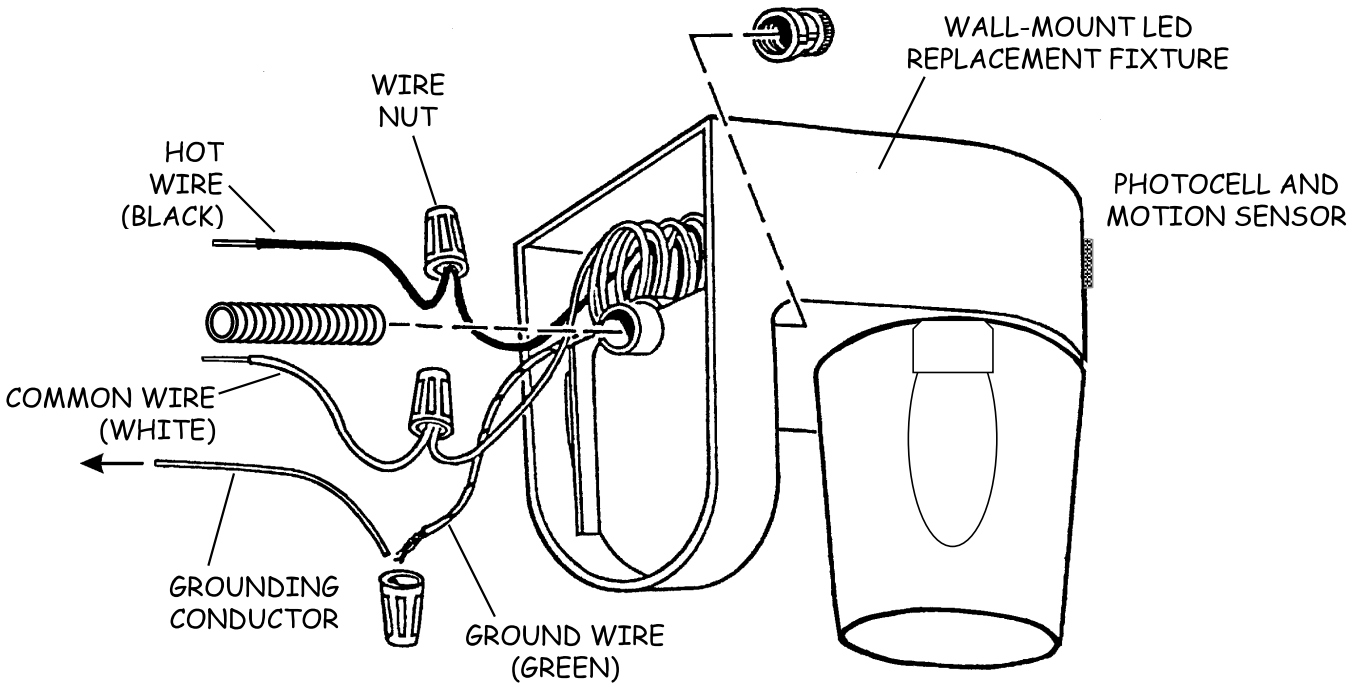
7. GROUNDING

- **Requirement for three-wire systems with grounding conductor**
  - Fixture ground lead/lug shall be properly connected to the system grounding conductor.
    - *Exception:* A plastic fixture may be installed without connection to the grounding conductor when allowed by installation instructions.
- **Options for systems without grounding conductor**
  - When a grounding conductor is not available in the fixture box:
    - A plastic fixture without grounding requirement may be installed or
    - A GFCI-protected switch may be installed in lieu of grounding.

8. OPERATIONAL CHECKS

- **All units**
  - Installed fixtures shall be checked for proper operation of all components, including the on/off switch, LED(s), vacancy sensor, dimmer, timer, photo-control, and motion sensor, as applicable.
  - Defects shall be corrected.



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9. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up**
  - Paint dust and chips, scraps, and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Furniture and other household items moved for installation work shall be returned to their original positions.
- **Disposal**
  - Replaced fixtures shall be disposed of properly.
- **Wet locations**
  - Water shall be sprayed on fixtures installed in wet locations to verify that they are watertight and operate properly.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

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WINDOW/WALL EVAPORATIVE COOLER INSTALLATION

Lead Paint Risk Factor
NONE-HIGH

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SECTION 16 PREFACE
for

WINDOW/WALL EVAPORATIVE COOLER INSTALLATION

1. Nonfeasibility Criteria

1.1. The existing cooler is operational.

1.2. Electrical requirements cannot be met.

1.3. Substandard wiring exists (e.g., ungrounded outlet, decayed insulation, exposed wires), and correction is not feasible.

1.4. Proper exhaust ventilation is not available.

1.5. No feasible window or wall location available.

a. A structurally sound mounting platform and/or suitable mounting location is not available.

b. Wood windows are decayed or deteriorated.

c. Siding is decayed or damaged.

d. Window units: Unit cannot be installed because security bars are present on the window.

1.6. Exterior clearance requirements cannot be met.

1.7. Egress requirements cannot be met.

1.8. Customer refuses.

2. Installation Policies

2.1. Customer must have an operational refrigerated A/C unit.

2.2. For single family homes and mobile homes, evaporative coolers are available only in approved climate zones.

2.3. Evaporative coolers may not be installed in multi-family homes.

3. Installation Policies Specific to Mobile Homes

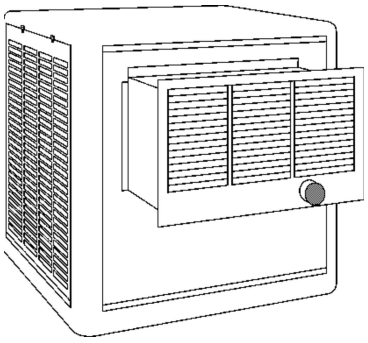
None.

WINDOW/WALL EVAPORATIVE COOLER INSTALLATION STANDARDS

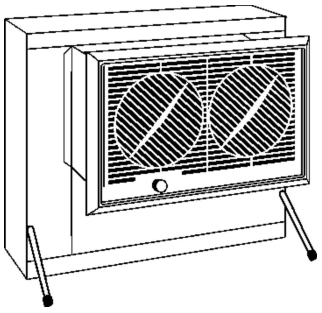
1. EVAPORATIVE COOLERS

- **All units shall be:**
  - Rated for 120 volts.
  - UL-listed and compliant with UL 507.
  - Sealants used in the unit shall be in compliance with ASTM D870.
- **Cabinet and pad frames**
  - Shall be constructed of galvanized steel or polymeric materials.
- **Pump and grille assembly**
  - Polymeric materials shall conform to UL 94, UL 746A, and UL 746C.
- **Warranty**
  - Refer to IS Appendix F (Minimum Warranty Requirements).

EXAMPLES OF WINDOW/WALL EVAPORATIVE COOLERS



STANDARD UNIT



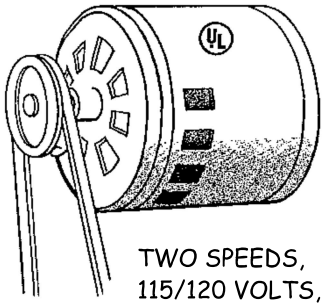
HIGH-EFFICIENCY UNIT

2. MOTOR

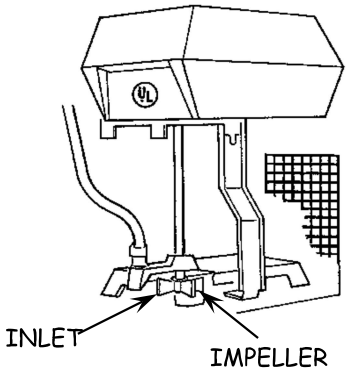
- **All motors shall be:**
  - UL-listed or a UL-recognized component.
  - In compliance with cooler manufacturer's specifications.
  - Wired for at least two speeds or variable speed.
  - Rated at 115/120 volts, 60 Hz, single phase.
- **Mounting brackets/supports**
  - Shall be factory-supplied and adjustable.

3. WATER PUMP

- **All pumps shall:**
  - Be UL-listed or a UL-recognized component.
  - Be protected from water damage to motor winding (e.g., by shaft sleeve, skirting, etc.).
  - Have a protective screen to keep out debris.
- **Motor shall:**
  - Be grounded.
  - Have thermal overload protection.
- **Tubing shall be clear if allowed by manufacturer.**
- **Pump screen**
  - Pump shall have a molded screen or other factory-supplied screening device to keep debris out of the impeller.



TWO SPEEDS,
115/120 VOLTS,
60 HZ, SINGLE PHASE

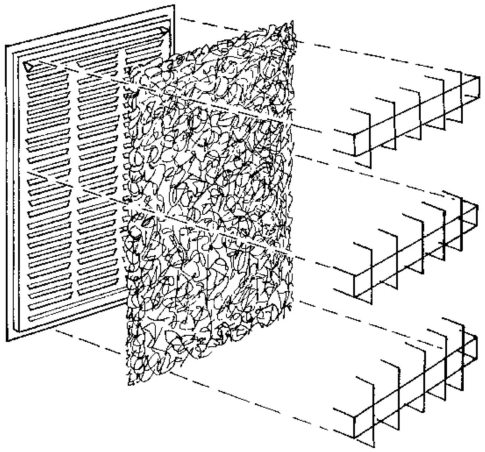


4. WATER SUPPLY

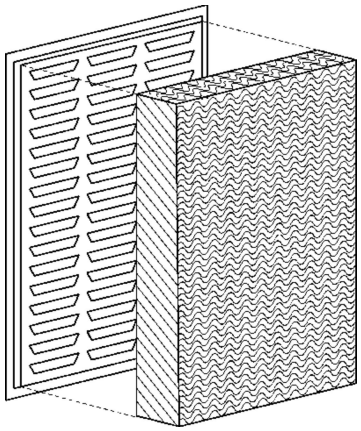
- **New materials**
  - Supply lines shall be minimum 1/4" OD copper tubing.
  - Shut-off valve and fittings shall be brass.
- **Materials <u>not</u> allowed**
  - Plastic tubing, fittings, and valves.
  - Self-tapping needle valve.

5. MEDIA

- **Standard pads**
  - Aspen excelsior bound in netting or type specified by cooler manufacturer.
  - Minimum thickness 1" (± 1/8”).
  - Size shall be as specified by cooler manufacturer.
- **High-efficiency media**
  - Only rigid media shall be used.
  - Size shall be as specified by cooler manufacturer.



STANDARD EXCELSIOR PAD



HIGH-EFFICIENCY RIGID MEDIA

6. SIZING REQUIREMENTS

- **Cooler capacity (airflow in CFM)**
  - Minimum 3.0 CFM per sq. ft. of floor area in average climates:
    - 22.5 ACH with 8' ceilings.
  - Minimum 4.0 CFM per sq. ft. of floor area in hot, dry areas:
    - 30 ACH with 8' ceilings.
  - Table 16-1 may be used as a guide.

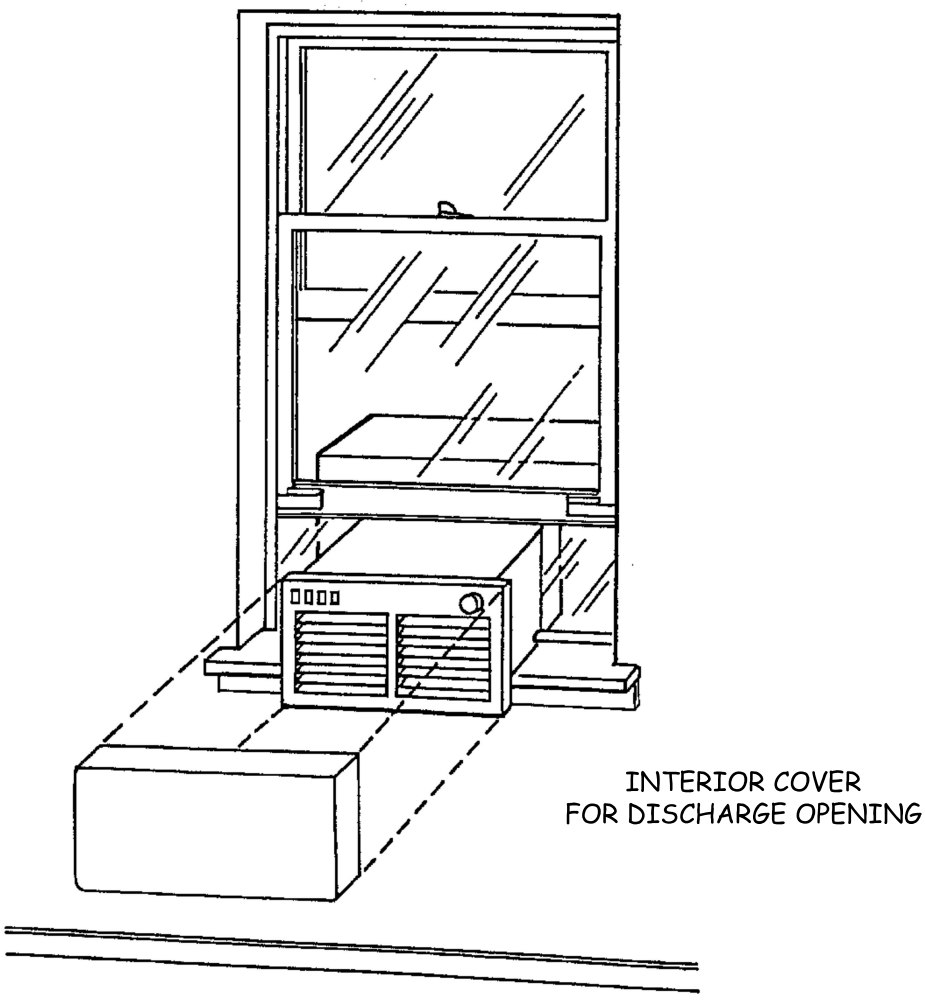
Table 16-1: Cooler Sizing Guidelines

Cooler Capacity (Airflow in CFM) [1]	Maximum Sq. Ft. Floor Area	
	at 3.0 CFM/sq. ft. –22.5 ACH– (average climate) [2]	at 4.0 CFM/sq. ft. –30 ACH– (hot, dry climate) [3]
3,000	1,000	750
3,500	1,165	875
4,000	1,330	1,000
4,500	1,500	1,125
5,000	1,665	1,250
5,500	1,830	1,375
6,000	2,000	1,500
6,500	2,165	1,625

  - For the applicable climate category (column 2 or 3), a cooler capacity (column 1) is selected that is adequate for the living space (floor area) to be cooled.
  - When the floor area is between sizes shown in the table, the next larger cooler capacity is selected.
  - To calculate the cooler capacity required for any size area, the square footage is multiplied by the applicable CFM/sq. ft. figure:
    - (Floor area sq. ft.) x (3.0) for average climates, or
    - (Floor area sq. ft.) x (4.0) for hot, dry climates.

7. WINTER PROTECTION/CLOSURE

- **All units**
  - A means shall be present to close off the cooling system during winter to protect against infiltration of unconditioned air.
  - Cover shall be installed in accordance with IS Section 9 (Evaporative Cooler and A/C Vent Covers).
- **Interior closure**
  - May be created by:
    - Grilles that have positive closed positions, or
    - A damper in the face grille, or
    - Cover/closure for the discharge openings of the cooler unit.
- **Exterior closure**
  - May be created by an exterior cover/closure that seals the intake openings of the cooler unit, when agreed to by the customer.



8. EXHAUST VENTILATION

- **All units**
  - Adequate exhaust ventilation must be provided in accordance with Table 16-2.
  - Exhaust CFM capacity must equal or exceed cooler CFM output.
- **Ceiling-mount exhaust vents**
  - May be installed to be used in lieu of, or in combination with, screened windows and doors.
  - Shall be equipped with a positive closure mechanism and shall close completely to block backdraft/infiltration when the cooler is off.
  - Not allowed when the attic contains an open combustion appliance.

9. INSTALLATION

- **Units shall be installed:**
  - In compliance with manufacturer's instructions and local code.
  - Plumb, level, and securely attached to the structure/wall.
- **Permits**
  - Building permits shall be secured and finalized when required by the authority having jurisdiction.

Table 16-2: Exhaust Openings

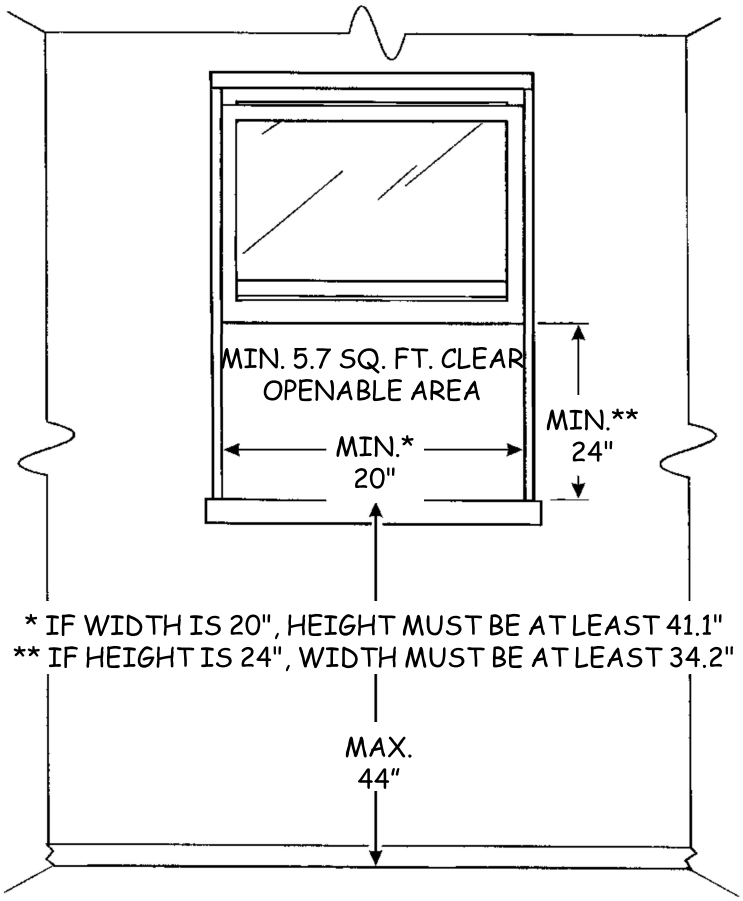
Cooler Capacity (Airflow in CFM)	Minimum Screened Openings (Sq. Ft.) [1]	Minimum Attic Venting NFVA (Sq. Ft.) [2]
1,000	2	1.3
2,000	4	2.7
2,500	5	3.3
3,000	6	4.0
3,500	7	4.7
4,000	8	5.3
4,500	9	6.0
5,000	10	6.7

[1] Values shown (a) assume #16 mesh insect screening, and (b) equal 2 sq. ft. of screened opening per 1,000 CFM cooler capacity.

[2] Column 3 values derived as follows: (Cooler capacity CFM ÷ 750) = Minimum attic venting NFVA. See IS Appendix B for Attic Ventilation NFVA guidelines.

10. EGRESS WINDOWS

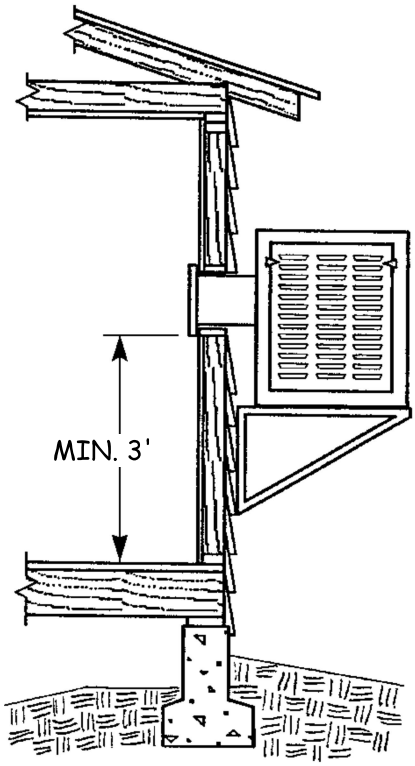
- **Cooler installed in a sleeping room window**
  - Unit shall <u>not</u> violate egress requirements, which apply to <u>all rooms used for sleeping</u>.
  - Installation in a sleeping room window is feasible only when:
    - Allowed by customer, <u>and</u>
    - One of the following is present in the same room:
      - Another operable window that meets egress requirements, <u>or</u>
      - An operable exterior door that meets egress requirements.
  - The egress window in a conventional home shall meet the egress requirements of local code.
    - Minimum net clear openable area and dimensions:
      - Area of 5.7 (or 5.0) sq. ft.[1]
      - Width of 20" and height of 24".
    - Maximum finished sill height of 44" above the floor.



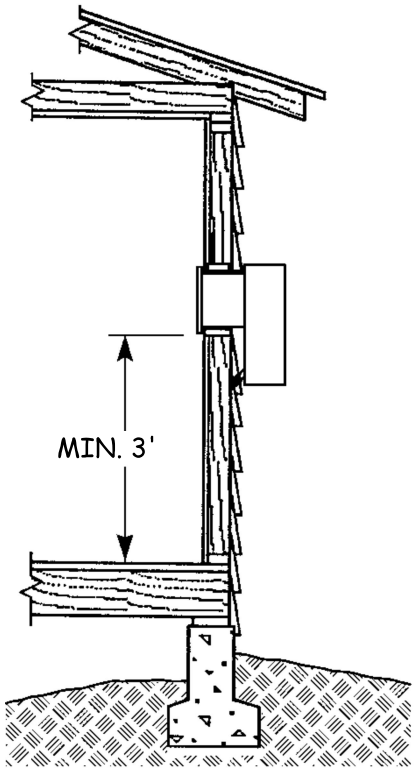
[1] *<u>Exception</u>:* 5.0 sq. ft. minimum on a "grade-floor" opening/window (a window with sill height not more than 44" above the finished ground level adjacent to the opening).

11. LOCATION

- **All units**
  - Clearances and mounting height shall be in compliance with local code and manufacturer's specifications.
  - 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 not 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 in accordance with manufacturer's specifications. If none, location shall be a minimum of:
    - Three feet above the floor unless mounted under window.
    - Eighteen inches above floor if:
      - Discharge grille is equipped with directional louvers, and
      - Location is allowed by manufacturer.
    - *Exception:* Height of an existing location is acceptable if not in conflict with cooler manufacturer's instructions or local code.



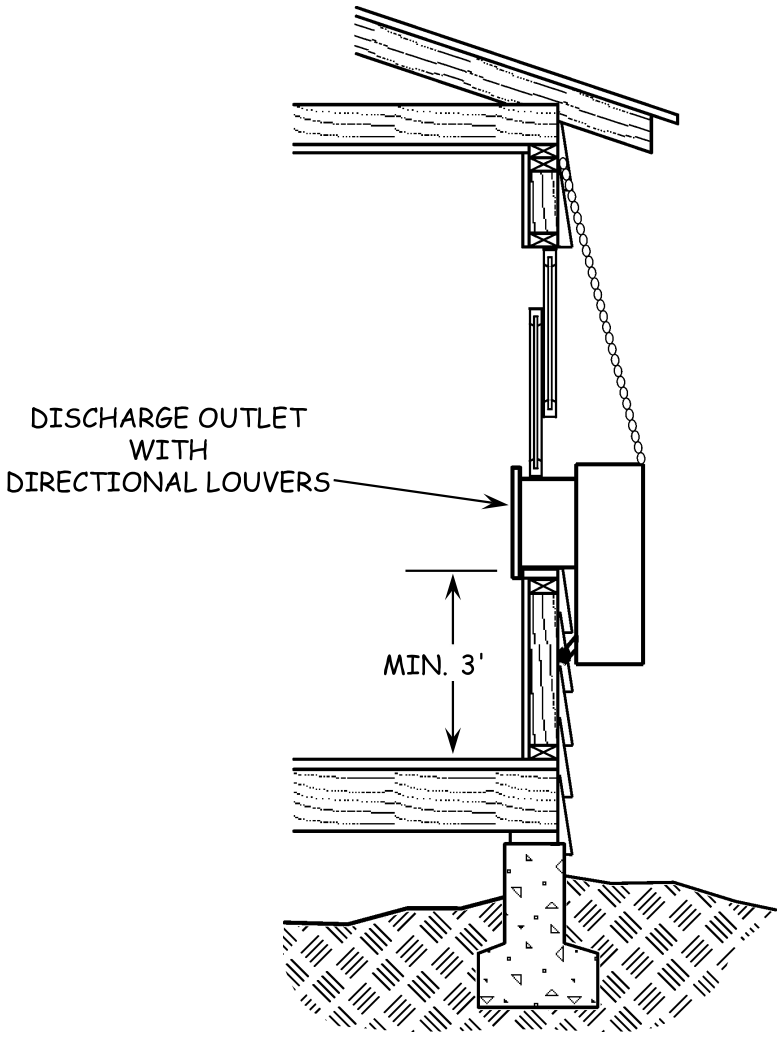
STANDARD
WALL UNIT



HIGH-EFFICIENCY
WALL UNIT

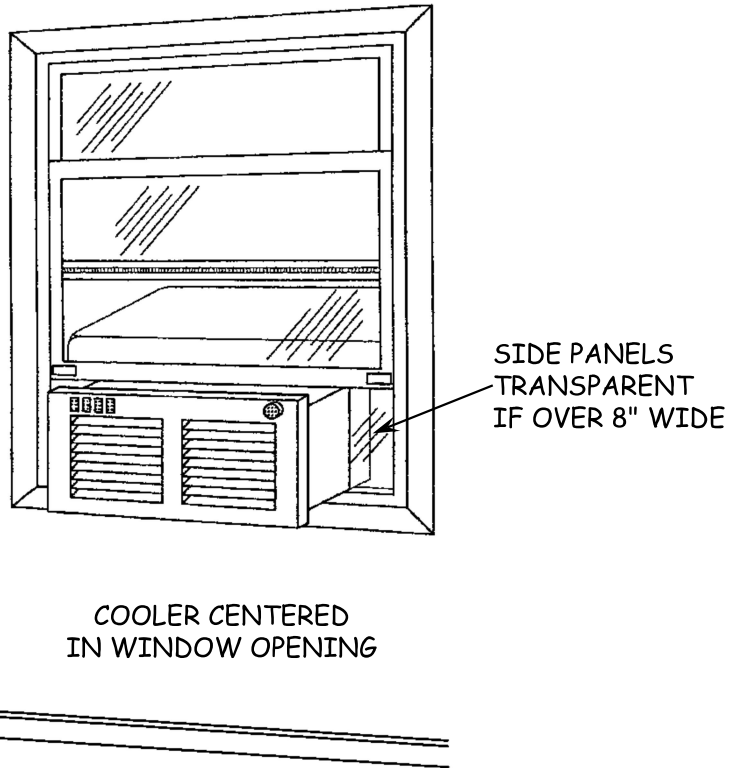
11. LOCATION (cont.)

- **Window-mount units**
  - Air discharge outlet shall be located a minimum of:
    - Three feet above the floor unless mounted under a window.
    - Eighteen inches above floor if:
      - Discharge grille is equipped with directional louvers, and
      - Location is allowed by manufacturer.



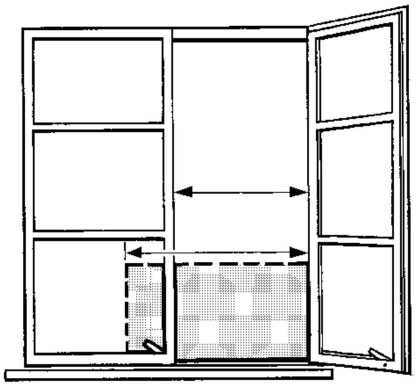
11. LOCATION (cont.)

- **Window-mount units (cont.)**
  - All windows
    - Cooler shall be placed in center of window opening, or as recommended by the manufacturer.
    - Permanent window panels shall be installed to completely fill empty spaces.
    - Side window panels over 8" wide shall be transparent.
    - Window panels shall be sealed in place.
  - Horizontal sliding windows
    - Sliding sash shall seal against unit.
  - Vertical sliding windows
    - Cooler shall be placed in center of window opening.
    - Cooler shall be installed in lower sash opening.
    - Lower sash shall seal against unit and side panels.
  - Awning and jalousie windows
    - Displaced panels/panes shall be removed and left with the customer.
    - Pivots, operators, or other hardware damaged during removal shall be repaired or replaced.

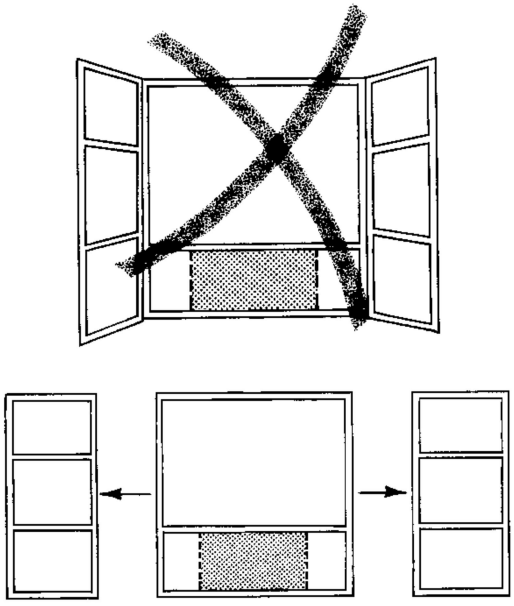


11. LOCATION (cont.)

- **Single-vent casement windows**
  - Sash shall be removed.
  - Cooler shall be permanently installed and sealed.
  - Transparent glazing shall be installed above cooler: glass or polycarbonate.
  - Occupant shall be informed about sash removal and final appearance and shall give consent before installation.
- **Double-vent casement windows**
  - When unit is too large for one sash opening, cooler may be installed only if:
    - Both sashes are removed.
    - Cooler is permanently installed and sealed.
    - Transparent glazing is installed above cooler: Glass or polycarbonate.
  - Occupant shall be informed about sash removal and final appearance and shall give consent before installation.



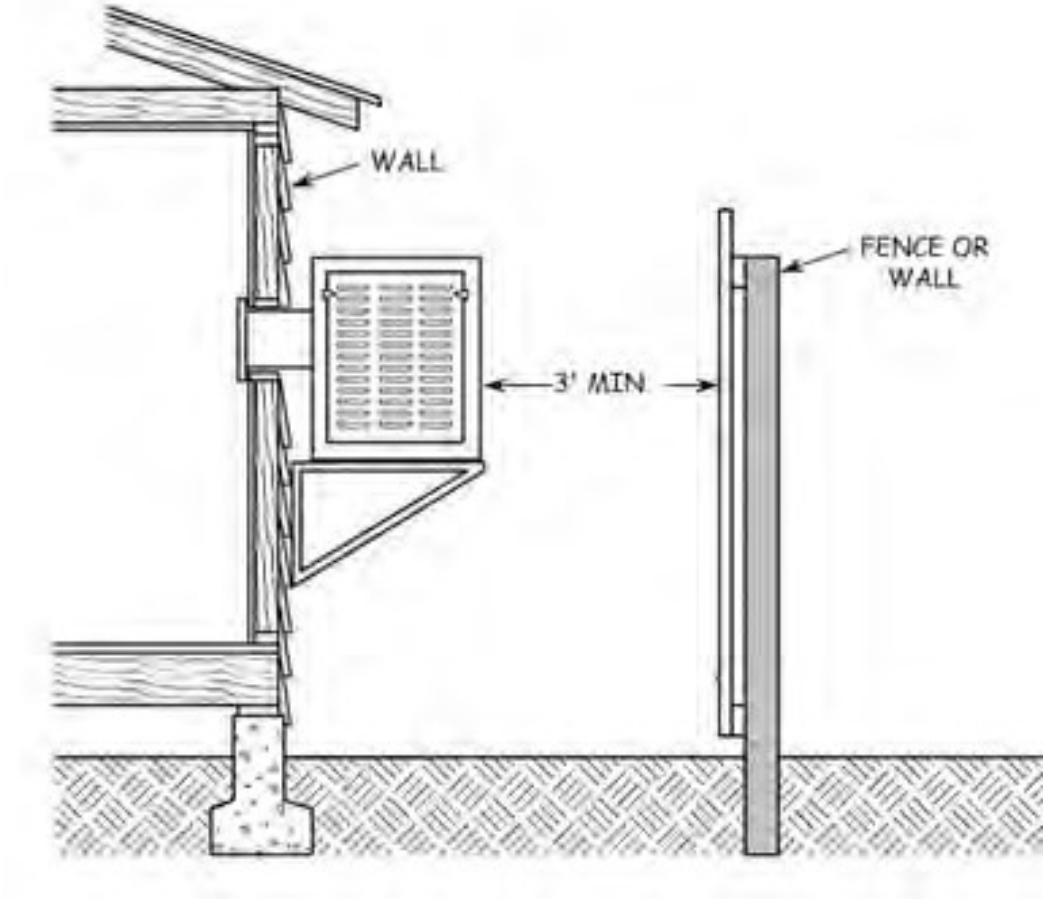
COOLER TOO WIDE
FOR ONE SASH OPENING



BOTH SASHES REMOVED AND
TRANSPARENT GLAZING
INSTALLED ABOVE COOLER

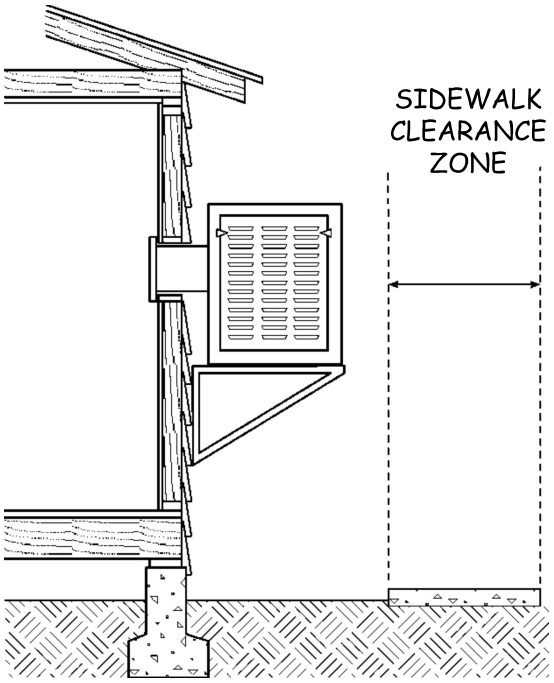
11. LOCATION (cont.)

- **Setbacks**
  - Property setback requirements shall not be violated.
- **Clearance**
  - There shall be at least 3' between the cooler and any adjacent obstruction (e.g., window, wall, fence) or the clearance required by local code or recommended by the cooler manufacturer, if different.

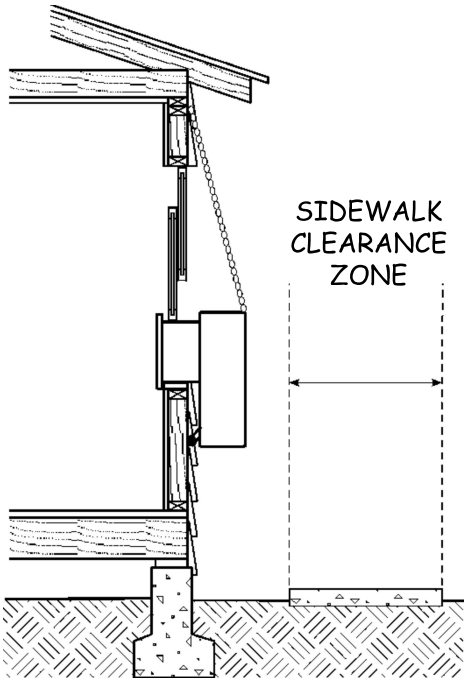


11. LOCATION (cont.)

- **Sidewalk clearance**
  - Unit shall not extend into sidewalk clearance zone (i.e., over sidewalk).
  - Clearance from sidewalk shall be at least 1' or as required by local code.



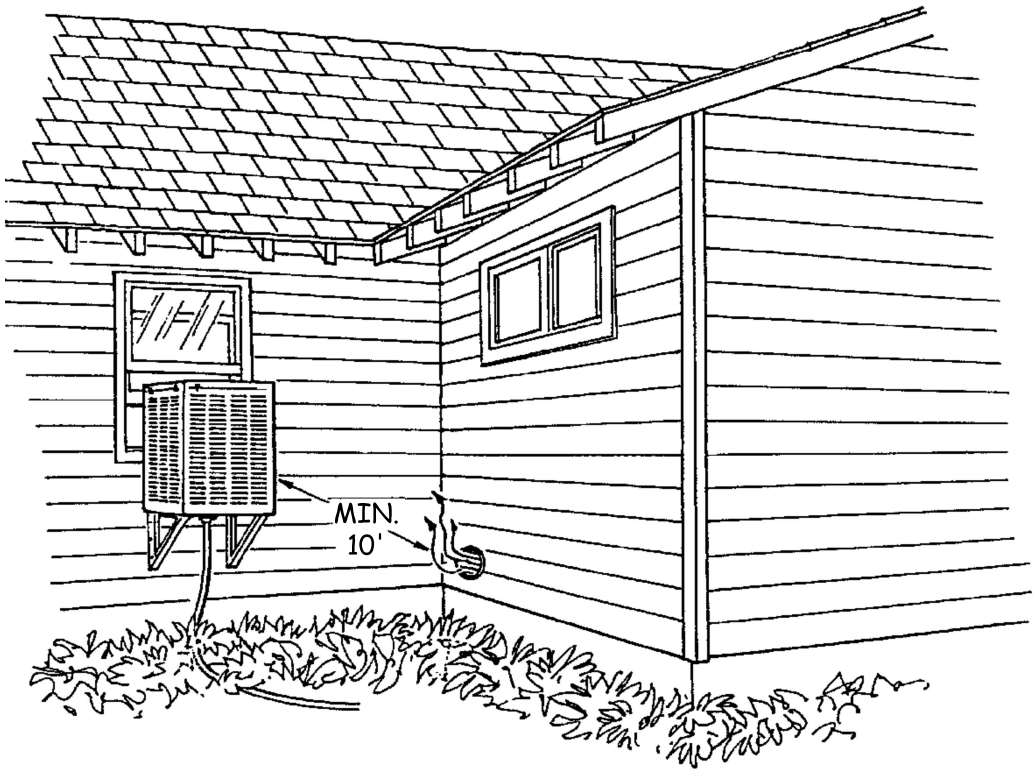
STANDARD
WALL UNIT



HIGH-EFFICIENCY
WINDOW UNIT

11. LOCATION (cont.)

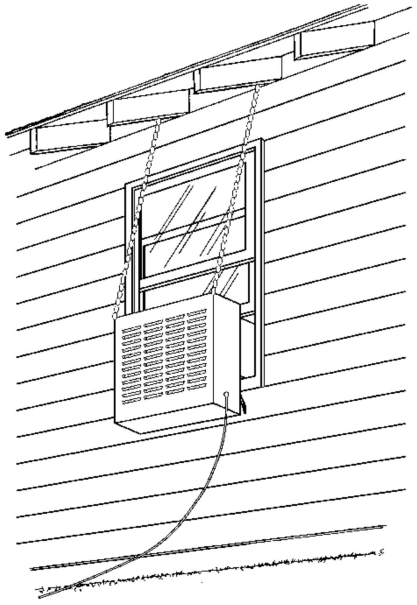
- **Exterior clearance**
  - Clearance shall comply with local code.
  - Cooler air intake shall be located:
    - Minimum of 10' away from or 3' below combustion appliance vent terminations, including direct-vent wall furnaces, with the following *exception*:
      - The vent terminal is for a space heater, and
      - The cooler is equipped with a cooler cover, and
      - The occupants are advised to keep the cover in place when the space heater is operating.
    - At least 10' from the following:
      - Clothes dryer moisture exhaust termination.
      - Plumbing vent terminations.
      - Exhaust fan vent termination.
    - Minimum of 3' from the gas meter set assembly[2].
  - Unit shall not be installed if clearance requirements cannot be met.
- **Interior clearance**
  - Unit shall be free of obstructions such as furniture, curtains, plants, etc.



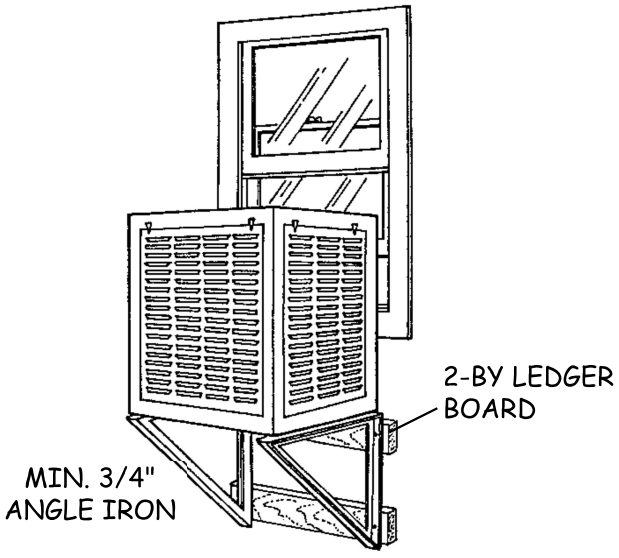
[2] **See revised definition.**

12. COOLER SUPPORTS

- **All installations**
  - Cooler shall be supported by platform, metal brace, or chain kit.
  - All iron or steel shall be primed, anodized, painted, galvanized, or corrosion-resistant.
- **Brace supports**
  - Brace shall be anchored with noncorrosive screws to solid wood such as:
    - Minimum 3/4" siding.
    - Structural framing.
    - Two-by ledger board.
- **Brace support material**
  - All material shall be metal.
  - Minimum 3/4" x 3/4" angle iron or equivalent.
- **Chain brackets**
  - Brackets shall be attached with screws that penetrate solid wood at least 3/4".
  - Brackets shall <u>not</u> be anchored to window sash or trim.



HIGH-EFFICIENCY WINDOW-MOUNT UNIT WITH CHAIN SUPPORT

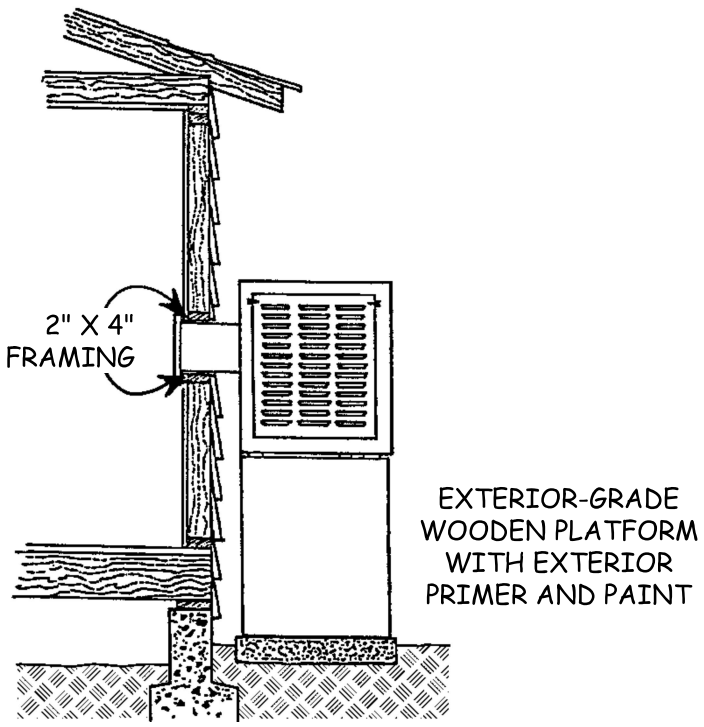


STANDARD WINDOW-MOUNT UNIT WITH BRACE SUPPORTS

- **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).
- **Opening for wall-mount units**
  - Wall opening shall be framed internally with 2-by lumber.
  - Studs cut to create the opening shall be properly secured to adjacent studs with header and sill.
  - Opening shall be flashed/sealed in accordance with local code.
  - Opening shall be trimmed on interior and exterior.
    - New wood shall be primed and painted.
    - Exterior grade materials shall be used outdoors.

13. ATTACHMENTS

- **All units**
  - 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.
  - Anchors shall penetrate framing members a minimum of 3/4" (1" if self-drilling screws).

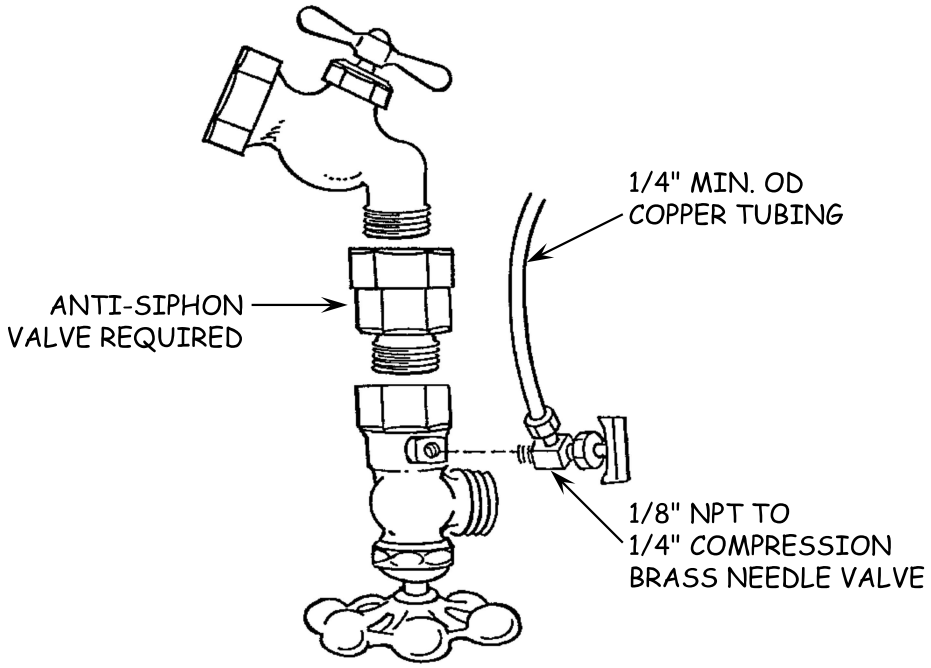


14. LEVELING OF COOLER

- **All units**
  - Cooler shall be level.
  - Water in the troughs and reservoir shall be evenly distributed.

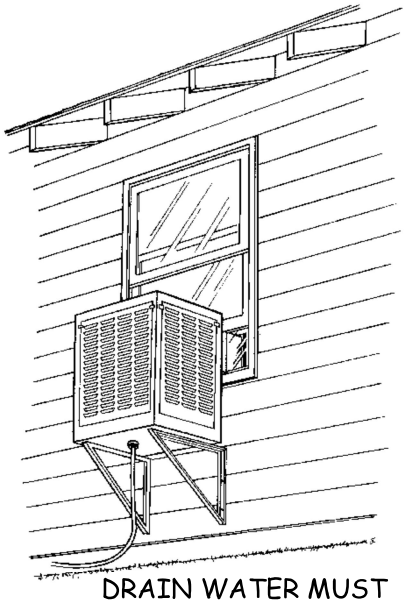
15. WATER SUPPLY

- **Supply lines**
  - Tubing routed along the exterior of the building shall be secured with tube straps/brackets installed a minimum of 28" OC.
- **Shut-off valve**
  - Outdoor water shut-off shall be reachable from ground level.
- **Anti-siphon valve**
  - Anti-siphon valve shall be present.



16. DRAIN OVERFLOW

- **Drain water shall:**
  - Flow away from the house.
  - Not flow or splatter against wall.
  - Not puddle.
- **Drain hose/line**
  - Is required when cooler is located above first floor.
  - Shall be installed to divert water away from the house.
  - Shall not cross walkway.
  - End of hose/line shall be visible.
- **Cleaning device/system**
  - Units must be equipped with an automatic cleaning device, such as:
    - An automatic flushing system (e.g., timed purging) or
    - A bleed-off system, when allowed.
  - Compliance
    - System shall be in compliance with local code.
    - Manufacturer's instructions shall be followed.



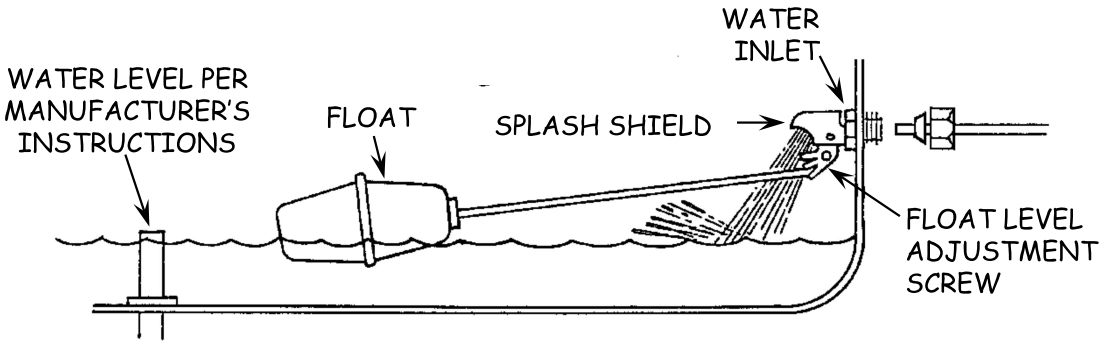
DRAIN WATER MUST
FLOW AWAY FROM THE HOUSE

17. VALVE AND FLOAT

- **Valve shall:**
  - Completely shut off incoming water.
  - Incorporate a downward directional water outlet and/or splash shield that prevents water from spraying away from the reservoir.
- **Water level**
  - All units: As specified by the manufacturer.

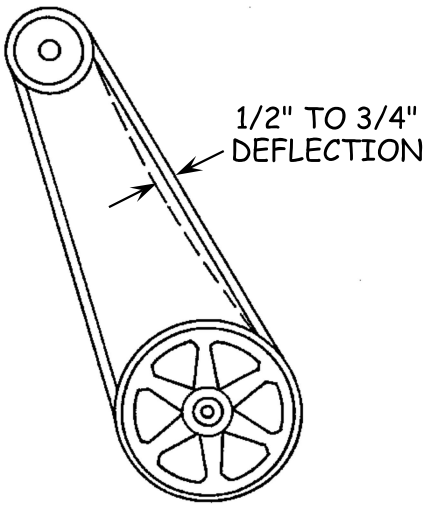
18. WATER DISTRIBUTION

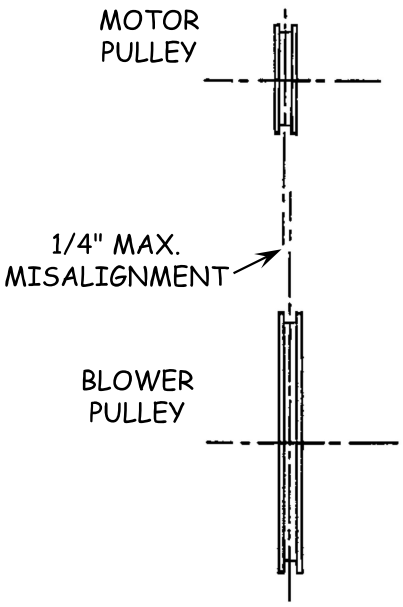
- **Position**
  - Drip trays shall be positioned to provide even distribution of water over pads.
  - Distribution lines shall be positioned directly over drip trays.
- **Drip trays shall:**
  - Be free of all debris.
  - Have clean, open holes.
  - Be level for proper water distribution.



19. BLOWER

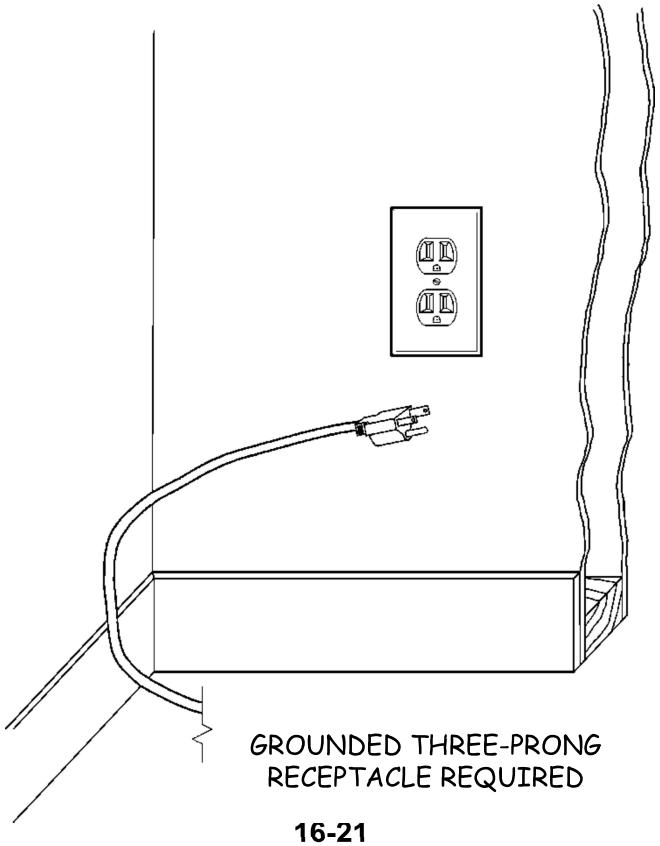
- **Motor**
  - Shall be mounted per manufacturer's instructions with all fasteners tightened securely.
  - Shaft shall spin smoothly and freely.
- **Lubrication**
  - Unsealed motor and fan bearings shall be lubricated:
    - With SAE #20 non-detergent oil placed in the cups, or
    - Per manufacturer's instructions.
- **Adjustments**
  - Belt tension shall be adjusted to a deflection in the middle of 1/2" to 3/4" or per manufacturer's specifications.
  - Motor sheave shall be adjusted to achieve specified motor amperage if not factory adjusted.
- **Pulleys**
  - If not factory adjusted:
    - Pulley rim shall be perpendicular to the shaft.
    - Motor pulley and blower pulley shall be aligned within 1/4" of each other.





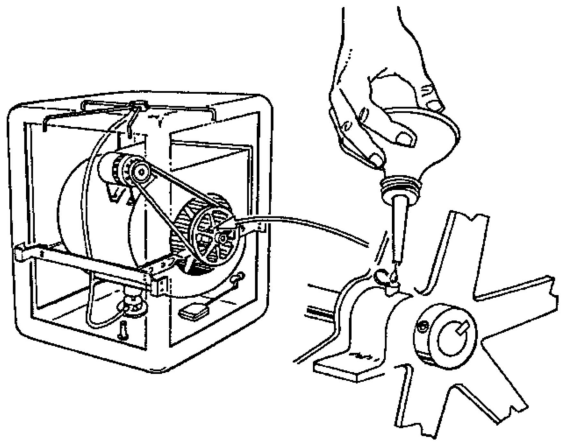
20. ELECTRICAL REQUIREMENTS

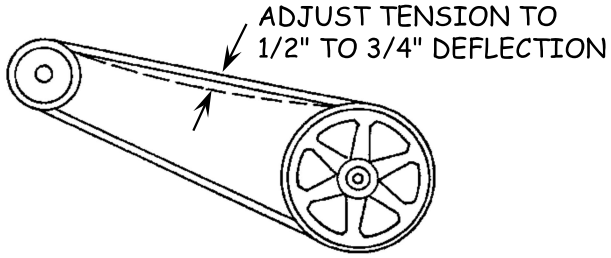
- **Circuit and wiring**
  - Circuit type and capacity shall be in conformance with manufacturer's instructions.
  - Wiring shall be installed in compliance with local code.
  - Splices shall be:
    - Protected with pressure splicing connectors (e.g., wire nuts).
    - Placed inside junction boxes.
  - Junction boxes shall be properly covered.
  - Cooler shall be:
    - Properly grounded.
    - GFCI protected when specified by the manufacturer.
  - Exposed wiring shall be housed in conduit.
- **Circuit Loading**
  - Amp draw shall be checked with a meter.
  - Circuit shall not be overloaded.
- **Plug-in units**
  - Shall be connected to a grounded three-wire receptacle.
- **Extension cord:**
  - May be used if allowed by manufacturer.
  - Shall be rated for cooler load but no lighter than 12 AWG.



21. PRE-OPERATION CHECK

- **Installation shall be checked to ensure that the following requirements are met:**
  - Cooler is securely attached to the mounting assembly.
  - Unit is mounted level in all directions.
  - Mounting anchors are the correct size and properly installed.
  - Unit is installed in a manner that will safely support the operating weight (cooler plus water).
- **Electrical circuitry shall be checked for:**
  - Proper grounding of cabinet, electrical boxes, and conduit.
  - Safe and secure connections.
  - Adequate circuit capacity and overcurrent protection.
- **Pulleys shall be checked for:**
  - Correct alignment.
  - Proper belt tension.
  - Tightly installed set screws and nuts.
- **Blower bearing**
  - Shall be checked for proper lubrication, if applicable.
- **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 ensure:**
  - 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.**

22. START-UP CHECK

- **The following shall be checked for proper operation:**
  - Blower motor and fan.
  - Control/switch in all positions.
  - Even water distribution over pads (and pads correctly installed).
  - Automatic cleaning system (automatic flush or bleed-off).
- **Installed options**
  - Optional items, such as ceiling-mount exhaust vents, shall be checked.

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…

23. INSTRUCTIONS

- **All units**
  - Customer shall be provided with written and verbal instructions for proper cooler operation and maintenance.
    - Manufacturer's written instructions shall be provided.
    - Verbal instructions shall include:
      - Explanation of cooler operation, and
      - Review of the written instructions, including operation and care of cleaning system and/or chemical additives.
  - Customer shall be provided with required warranties.

24. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up**
  - All packing materials and installation debris shall be cleaned up and removed from the premises.
  - All replaced equipment and parts shall be removed from the premises and disposed of properly unless owner requests otherwise.
  - Paint dust and chips, scraps, and other debris resulting from installation shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Furniture and other household items moved for the installation shall be returned to their original positions.

CUSTOMER RECEIVES
VERBAL AND WRITTEN
INSTRUCTIONS
AND WRITTEN WARRANTIES

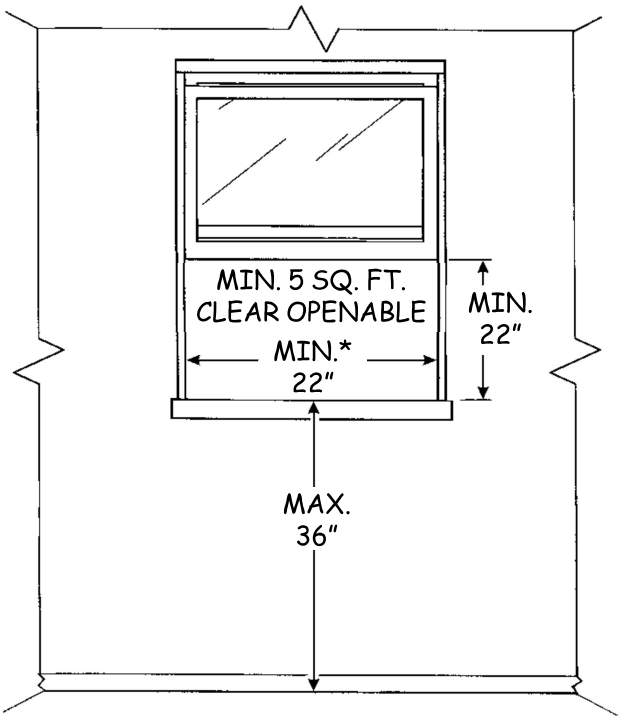
MOBILE HOME CRITERIA

25. LOCATION (MOBILE HOMES)

- **Mobile homes with wooden siding**
  - Location shall be in compliance with Item 11.
- **Mobile homes with metal siding**
  - Cooler shall be installed only in a window opening or an existing wall opening.
  - Cutting new wall openings is not allowed.

26. EGRESS WINDOWS IN MOBILE HOMES

- **Cooler installed in a sleeping room window**
  - Installation shall be in compliance with HCD regulations and HUD MHCSS CFR Chapter XX, Part 3280.
  - A cooler shall not be installed in a sleeping room window, unless another window meets the egress requirements shown below.



.30".

REFRIGERATOR REPLACEMENT

Lead Paint Risk Factor
NONE

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MOBILE HOME CRITERIA 7

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SECTION 17 PREFACE
for

REFRIGERATOR REPLACEMENT

1. Nonfeasibility Criteria

1.1. Refrigerator to be removed is less than 15 years old.

1.2. The electrical outlet used by the existing refrigerator is:

a. not properly grounded and cannot be properly grounded, or

b. unsafe (hazardous electrical condition exists).

c. GFCI-protected.

1.3. The refrigerator is not accessible for removal (e.g., doors from room are too small, refrigerator is encased in tile).

1.4. An appropriate location is not available, due to such factors as the following:

a. The floor is not structurally adequate to safely support the refrigerator.

b. Clearance requirements cannot be met.

c. The refrigerator cannot be installed in a level, plumb, and stable position.

1.5. Customer refuses.

2. Installation Policies

2.1. The minimum size for primary refrigerators replaced under the ESA Program is 10 cu. ft.

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

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

2.4. Second Refrigerator Replacement

a. When a primary refrigerator is replaced in a home with an inefficient second refrigerator, the household must be encouraged to recycle the second refrigerator.

b. If the customer declines to recycle it, a more efficient replacement refrigerator may be offered, using the same guidelines as for the primary refrigerator replacement.

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

2.6. Contractor shall dispose of 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.

3. Installation Policies Specific to Mobile Homes

None.

REFRIGERATOR REPLACEMENT STANDARDS

1. REPLACEMENT REFRIGERATOR

- **All units shall be:**
  - UL-listed.
  - ENERGY STAR-certified.
  - Frost-free.

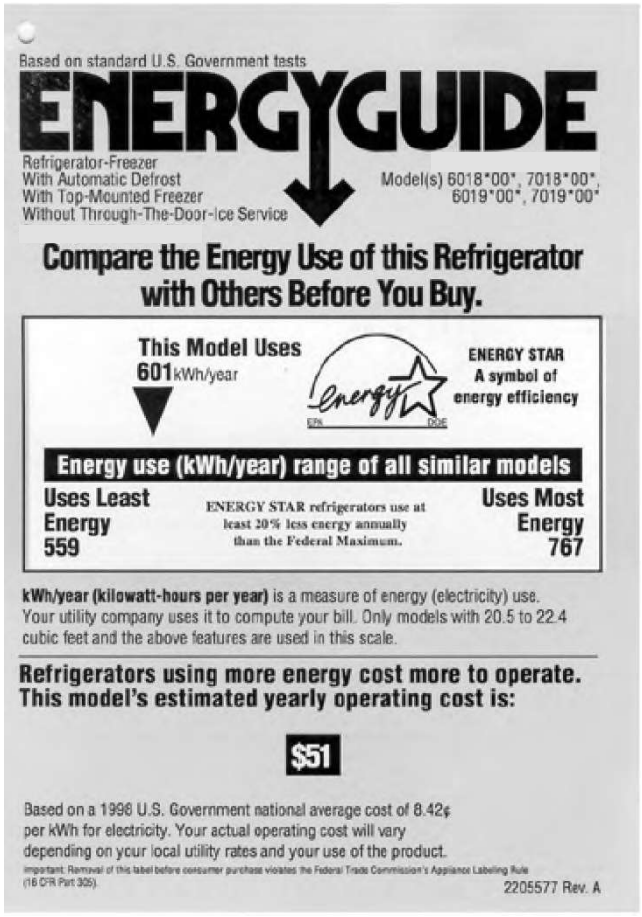
2. WARRANTY

- **Refer to IS Appendix F (Warranty Requirements).**

3. DOOR SWING

- **Direction of door swing shall be in compliance with customer's preference.**

ENERGY GUIDE LABEL
WITH
ENERGY STAR® LOGO


Based on standard U.S. Government tests

ENERGYGUIDE

Refrigerator-Freezer
With Automatic Defrost
With Top-Mounted Freezer
Without Through-The-Door-Ice Service

Model(s) 6018*00*, 7018*00*, 6019*00*, 7019*00*

Compare the Energy Use of this Refrigerator with Others Before You Buy.

This Model Uses 601 kWh/year

ENERGY STAR
A symbol of energy efficiency

Energy use (kWh/year) range of all similar models

Uses Least Energy 559

ENERGY STAR refrigerators use at least 20% less energy annually than the Federal Maximum.

Uses Most Energy 767

kWh/year (kilowatt-hours per year) is a measure of energy (electricity) use. Your utility company uses it to compute your bill. Only models with 20.5 to 22.4 cubic feet and the above features are used in this scale.

Refrigerators using more energy cost more to operate. This model's estimated yearly operating cost is:

$51

Based on a 1996 U.S. Government national average cost of 8.42¢ per kWh for electricity. Your actual operating cost will vary depending on your local utility rates and your use of the product.

Important: Removal of this label before consumer purchase violates the Federal Trade Commission's Appliance Labeling Rule (16 CFR Part 305).

2205577 Rev. A

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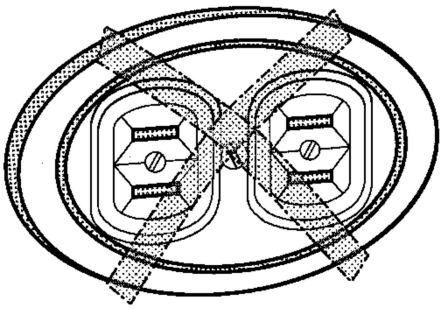
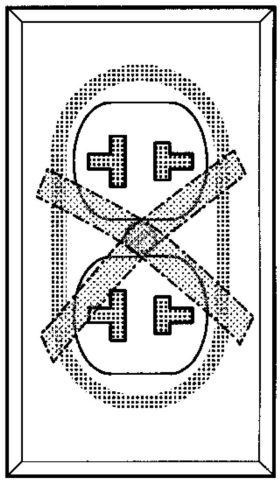
4. TWO-PRONG OUTLETS

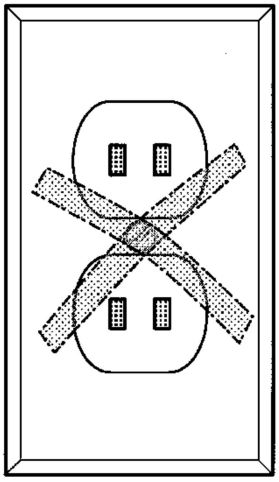
- **Refrigerators shall <u>not</u> be connected to two-prong ungrounded outlets.**
- **An ungrounded two-prong receptacle may be replaced with a new, properly grounded three-prong receptacle in accordance with Item 7.**



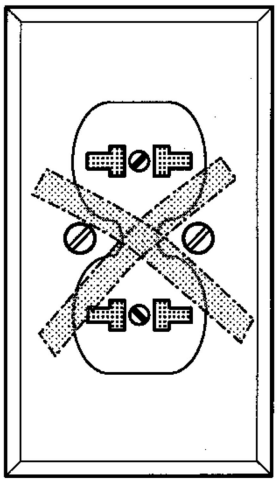
SURFACE-MOUNTED
UNPOLARIZED RECEPTACLE



POLARIZED
RECEPTACLE



CERAMIC DUPLEX
UNPOLARIZED RECEPTACLE



CERAMIC DUPLEX
RECEPTACLE

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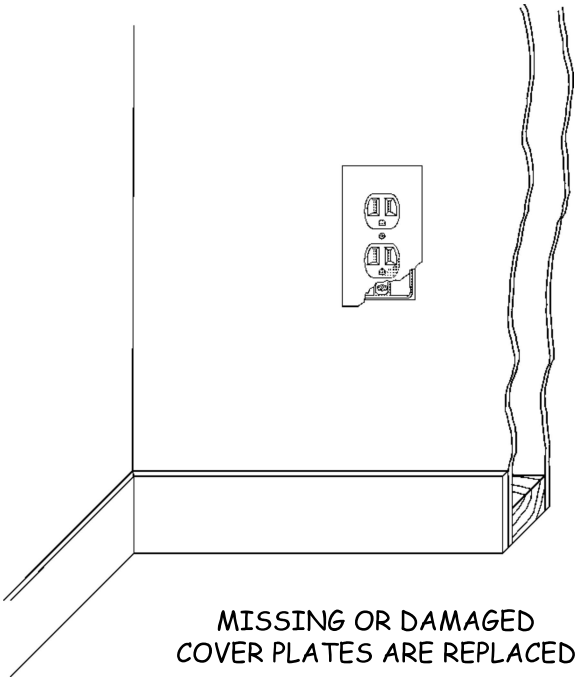
5. ELECTRICAL REQUIREMENTS

- **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 or a switched outlet shall not be used.
- **Electrical outlet**
  - Refrigerator shall be plugged into its own individual electrical outlet (not shared with another appliance).
    - If it is a duplex receptacle that is easily accessible, occupants shall be advised to avoid plugging another appliance into it.
  - The receptacle and cover plate shall be in good condition.
  - The receptacle shall be properly grounded in conformance with 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, three-conductor cord with three-prong plug and receptacle.
    - Minimum 14 AWG.
    - Maximum 6' in length.
  - Appliance cord and extension cord shall not be located where it can create a walking hazard (where people can trip).



MISSING OR DAMAGED
COVER PLATES ARE REPLACED

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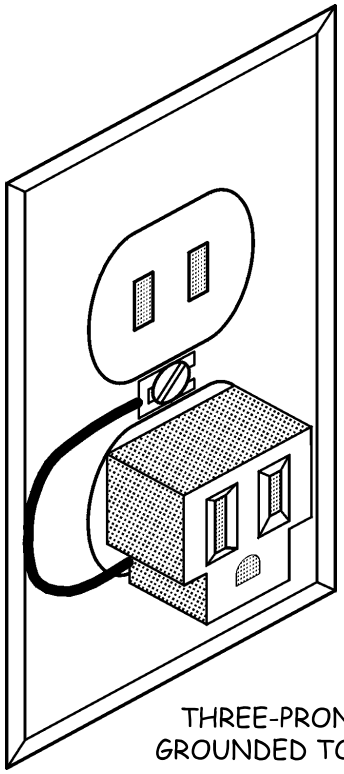
6. USE OF ADAPTERS

- **Three-prong adapters**
  - Shall not be used to *permanently* connect a refrigerator.
  - May be used temporarily for up to two weeks until a properly grounded 3-prong receptacle can be installed.
- **When adapters are used, they shall be:**
  - Aligned to provide proper polarity with the outlet and the power cord.
  - Connected to a ground source (e.g., a properly grounded two-prong receptacle or metal outlet box).



THREE-PRONG ADAPTER
GROUNDED TO RECEPTACLE

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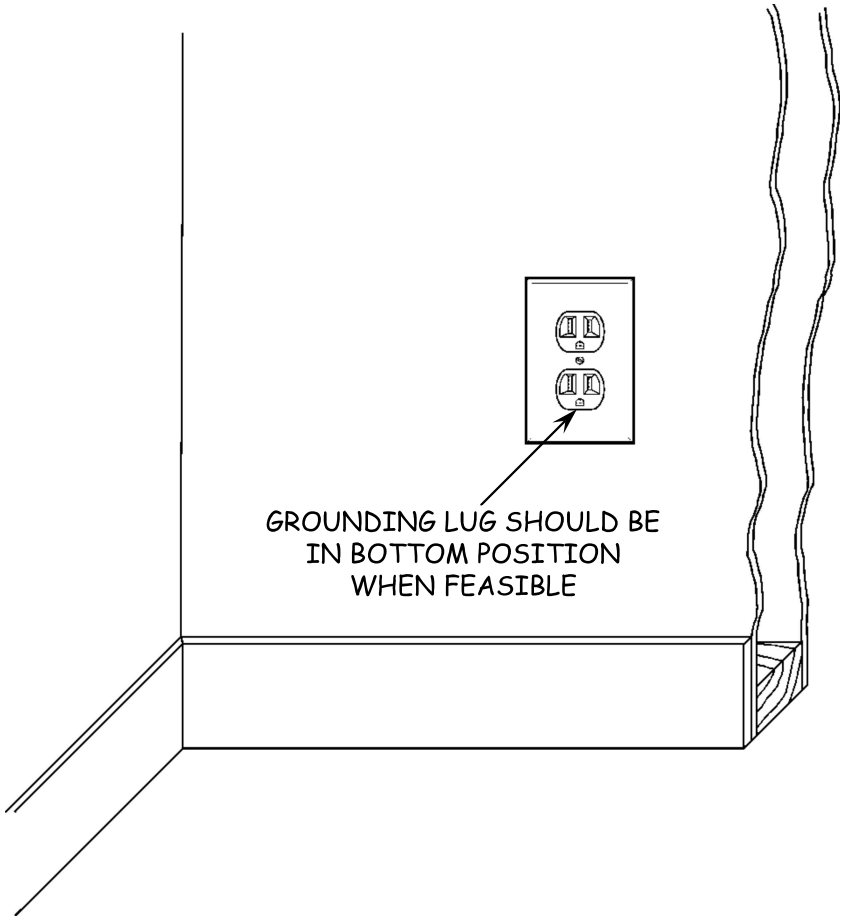
7. INSTALLATION OF A NEW GROUNDED RECEPTACLE

- **Permit**
  - A building permit shall be obtained and finalized when required by the local jurisdiction.
- **New grounded receptacle**
  - A new three-prong receptacle with ground lug shall be installed when the pre-existing receptacle is nonconforming.
  - The new receptacle shall be properly grounded 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.
  - When installation of a grounding conductor is required to provide proper grounding, it shall be installed in conformance with local code and guidelines in IS Appendix C (Grounding Guidelines for Electric Measures).



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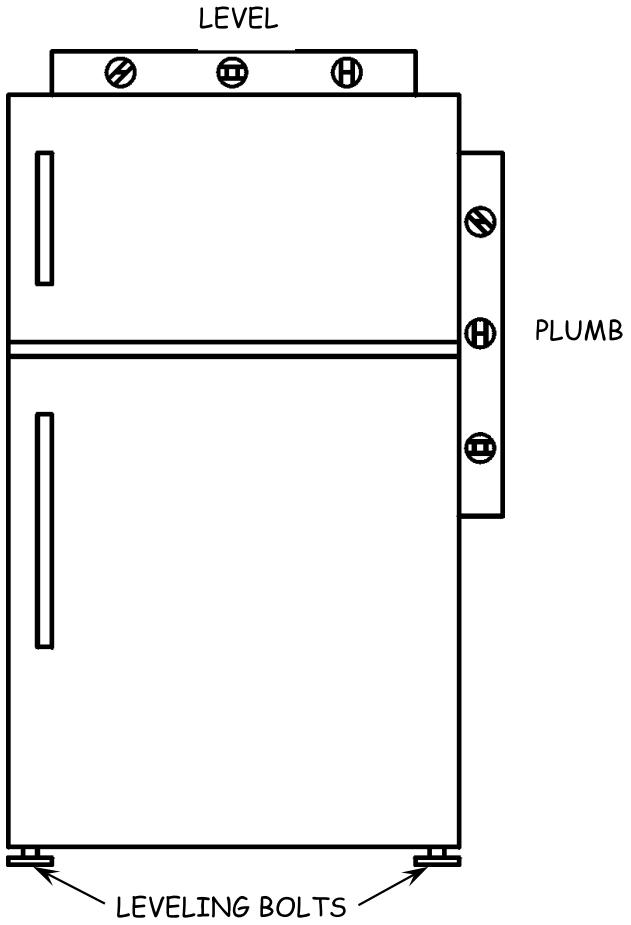
8. INSTALLATION OF A NEW REFRIGERATOR

- **Access**
  - Access route to the refrigerator location shall be adequate to be negotiated without causing damage to the home or furnishings.
- **Location**
  - The floor shall be structurally adequate to safely support the refrigerator.
  - Clearances shall meet manufacturer's specifications.
- **Installation**
  - The refrigerator shall be installed in a level, plumb, and stable position.
    - Leveling devices on the refrigerator shall be adjusted accordingly.
    - Supplementary supports (e.g., shims) shall be used as needed.
  - Installation shall not damage the floor covering or interior finishes.



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9. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Customer shall be provided with the following:**
  - Written instructions for refrigerator operation.
  - Written warranty documents with service phone numbers.
- **Temperature control shall be set appropriately.**

10. REMOVAL AND DISPOSAL OF EXISTING REFRIGERATOR

- **Packing materials**
  - All packing materials and installation debris shall be cleaned up and removed from the premises.
- **Existing refrigerator**
  - The existing refrigerator shall be:
    - Removed from the customer's premises by the installer, and
    - Disposed of properly per 40 CFR 82.155.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

CUSTOMER RECEIVES WRITTEN INSTRUCTIONS AND WARRANTIES

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NATURAL GAS CENTRAL FORCED AIR HEATING SYSTEM REPAIR AND REPLACEMENT

Lead Paint Risk Factor
NONE

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SECTION 18 PREFACE
for

NATURAL GAS CENTRAL FORCED AIR HEATING SYSTEM REPAIR AND REPLACEMENT

1. Nonfeasibility Criteria for Central Forced Air Furnace Repairs and Replacement

All Homes

1.1. Existing furnace is inaccessible.[1]

1.2. Property is renter-occupied.

1.3. Fuel used by the existing unit is not supplied by the utility providing ESA Program services.

1.4. No furnace is present and no natural gas line or electrical outlet is available to accommodate the installation of a furnace.

1.5. Adequate access and/or combustion air cannot be provided.

1.6. Ducts cannot be brought into compliance with IS Section 10 (Duct Testing and Sealing). Includes duct work that contains or is made of asbestos.

1.7. Repair: Repair cost exceeds guidelines of program P&P (e.g., cost to repair is more than 50% of the cost to replace the unit, or the appliance is subject to a CPSC recall).

1.8. Replacement: Existing furnace can feasibly be repaired per the program P&P (e.g., repair cost is 50% of replacement cost or less).

1.9. Replacement of operable furnace with HE Furnace is not feasible when:

a. Existing furnace AFUE is 80% or higher, or

b. Customer's winter season usage is 200% of baseline or less.

c. *Exception:* Replacement is allowed when:

- Existing FAU is inoperable or has a defect that requires appliance replacement, as identified through Natural Gas Appliance Evaluation, or
- "Burnout" has occurred.[2]

1.10. Customer refuses.

Mobile Homes

1.11. A leaky belly cavity or roof cavity return exists and installation of a central return system is not feasible.

---

[1] See Definitions

[2] "Burnout" is defined as failing Natural Gas Appliance Testing (NGAT) and the unit cannot be repaired. In those cases, a high efficiency FAU may replace an inoperable FAU, irrespective of AFUE.

2. Nonfeasibility Criteria for Central Forced Air Furnace Replacement

All Homes

2.1. For roof-mounted unit, roof is not structurally adequate to support the installation.

2.2. Disconnected or damaged space heating ducts are present and cannot be repaired.

Mobile Homes

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

2.4. Proper isolation of return air at FAU cannot be achieved.

2.5. A leaky belly cavity or roof cavity return exists, and installation of a central return system is not feasible.

High Efficiency Furnaces

2.6. Combustion air intake pipe installation, or vent pipe relocation, is not feasible.

2.7. Proper condensate drainage cannot be provided.

2.8. Replacement with HE Furnace is not feasible when:

a. Existing furnace AFUE is 80% or higher, or
b. Customer's winter season usage is 200% of baseline or less.
c. *Exception:* Replacement is allowed when:
   - Existing FAU is inoperable or has a defect that requires appliance replacement, as identified through Natural Gas Appliance Evaluation, or
   - "Burnout" has occurred.[2]

3. Nonfeasibility Criteria for Repair/Replacement Requiring Attic or Crawl Space Access

3.1. Crawl clearance is inadequate:

a. Attic Clearance
   - Clearance is less than 24" between top of ceiling joists and bottom of ridge board.
   - Obstruction(s) in the attic, such as truss cross members, provide an opening with a minimum dimension of less than 18".

b. Under-Floor Clearance
   - Clearance is less than 18" from the ground to bottom of floor joist system (girders under a mobile home).
   - Crawling under or over an obstruction in the crawl area is required, and the crawl clearance is less than 12".

c. Confined Spaces: State and federal regulations regarding confined spaces cannot be met.

3.2. Unsafe condition exists:

a. Attic and Crawlspace
- Hazardous insect or pest infestation is present.
- Hazardous electrical wiring.
- Structural hazard.

b. Crawlspace
- Excessive ground moisture (standing water or mud) is present.
- Sewage waste is on the ground or other unsanitary condition is present which poses a health and safety hazard.

4. Nonfeasibility Criteria for Thermostats

4.1. Furnace is not being replaced or repaired.

4.2. Furnace is being repaired, and a properly functioning thermostat is present.

4.3. A smart or programmable thermostat is already present and operational.

4.4. Customer refuses.

5. Nonfeasibility Criteria for HVAC Air Filter Replacement

5.1. Furnace will not be repaired.

5.2. A serviceable filter is already present.

5.3. The types of filters provided by the ESA Program cannot feasibly be installed or are specifically prohibited by the appliance manufacturer.

5.4. Customer refuses.

6. Furnace Repair/Replacement Policies

6.1. Furnace repair or replacement may be provided only when 1) the appliance fails NGAT, and correction cannot be achieved with service/adjustment[1] by utility gas service personnel (or their designated representative), or 2) per individual utility policy. Note that NGAT fails include the following two scenarios:

a. The furnace is still inoperable after service/adjustment by utility gas service personnel (or their designated representative).

b. No furnace is present and the household uses another gas appliance for space heating.

c. Exception: High efficiency FAUs, as outlined in Items 6.6 and 6.7.

6.2. Furnace replacements and major furnace repairs may be provided only if the residence is owner-occupied. Service/adjustment[1] may also be conducted in renter-occupied homes.

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

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

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

6.6. A high efficiency furnace (AFUE 95% or higher) may be installed when the existing FAU:

a. Is inoperable or has a defect that requires appliance replacement, as identified through Natural Gas Appliance Evaluation, or

b. Has failed Natural Gas Appliance Testing (NGAT) and cannot be repaired.

6.7. A high efficiency furnace may also be installed to replace an existing operational FAU, provided all the following conditions are met:

a. Existing FAU has an AFUE less than 80%.

b. Customer's winter season usage is greater than 200% of baseline.

6.8. An A/C unit may be replaced in conjunction with a furnace replacement under either of the following conditions:

a. The unit being replaced is a combined forced air heating and central A/C package system; or

b. The furnace being replaced is part of a split forced air heating and A/C system, and the A/C evaporative coil and/or the condenser cannot be matched with the new furnace. However, A/C replacement must not require refrigerant line replacement.

6.9. Replaced units must be disposed of and recycled in compliance with all laws and regulations.

6.10. Installer must have C-20 HVAC license.

6.11. A furnace will not be replaced if Title 24 provisions relating to alterations cannot be satisfied (see IS Section 10, Duct Testing and Sealing).

6.12. A furnace that is not abandoned or inaccessible and cannot be made operable through servicing fails NGAT.

7. Thermostat Installation Policies

7.1. A smart or programmable thermostat may be installed only if:

a. A central furnace or central A/C is *replaced*, or

b. A central furnace or central A/C is repaired, and a properly functioning thermostat is not present.

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

7.3. Thermostat may be moved to resolve short-cycling problems in mobile homes.

8. Central System HVAC Filter Installation Policies

8.1. HVAC filters may be replaced only as part of central furnace repair or central A/C replacement.

8.2. Contractors must show customers how to remove, clean, and reinstall the filters.

9. Installation Policies Specific to Mobile Homes

None.

NATURAL GAS CENTRAL FORCED AIR HEATING SYSTEM REPAIR AND REPLACEMENT STANDARDS

PART 1: MATERIALS

1. APPROVED MATERIALS

- **All furnaces**
  - Units shall be in conformance with the current CBC, CMC, DOE, Title 24 Residential Compliance Manual and Title 20 Appliance Efficiency Regulations.
  - All units and components shall be UL-listed (or equivalent) and/or have one of the following certifications: CSA, AGA, AHRI.
  - Shall be low or ultra-low NOx rated, when required by local code.
- **Standard-efficiency furnaces**
  - Conventional home heat-only or split systems
    - Furnace minimum AFUE rating:
      - Outdoor units: 81%
      - Indoor units: 80%
  - Mobile home furnaces
    - Minimum AFUE rating: 80%
- **High-efficiency (condensing) furnaces**
  - ENERGY STAR-certified.
  - Furnace minimum AFUE: 95%

LISTED

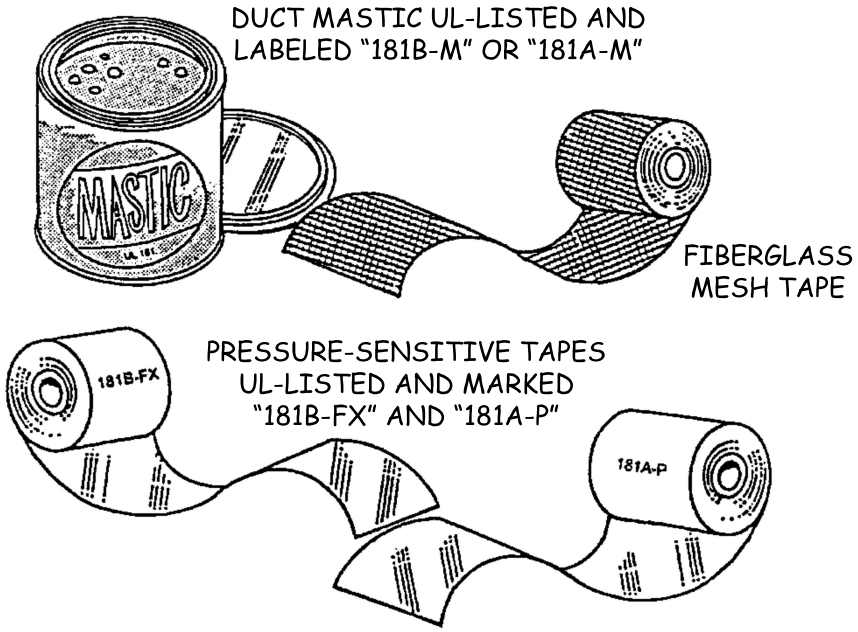
US

CMC

CALIFORNIA TITLE 24 RESIDENTIAL COMPLIANCE MANUAL

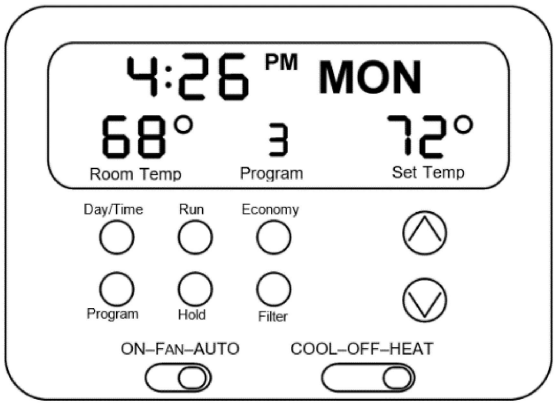
1. APPROVED MATERIALS (cont.)

- **Metal vent pipes**
  - All metal vent pipes, vent connectors, and components shall be UL-listed.
  - Gas vent pipe shall be Type B or Type B-W.
- **Nonmetallic combustion air and vent pipes**
  - Pipes and fittings shall conform to ASTM D 1785 and D 2665.
  - Pipe cement and primer shall conform to ASTM D 2564.
- **Gas pipes and valves**
  - Gas valves: UL listed and AGA or CSA certified.
  - Gas flexible connectors shall be listed epoxy-coated or stainless steel units.
  - Pilot tubing shall be aluminum (copper not allowed).
  - Fuel-gas piping:
    - Shall be selected, sized and installed per the current CMC.
    - Copper gas lines not allowed.
- **Ducts and sealants**
  - Materials shall be in conformance with IS Section 10 (Duct Testing and Sealing).



1. APPROVED MATERIALS (cont.)

- **Wall thermostats**
  - All types
    - Positive on/off switch.
    - Compatible with the HVAC equipment it will control.
    - Digital with anti–short cycle feature.
  - Smart (learning) thermostats
    - ENERGY STAR-certified and in conformance with IS Section 20 (Smart Thermostats).
  - Programmable
    - System powered, not battery powered, on 24-volt systems.
    - Minimum setback capability of 10°F.
    - At least two setback periods per 24-hour day, with change cycle increments no greater than 30 minutes.
    - Programmable for weekdays and weekends.
    - Manual override and standard alkaline battery backup or other program-saving backup system.
  - Standard wall thermostat
    - Alternative when customer refuses smart or programmable thermostat.



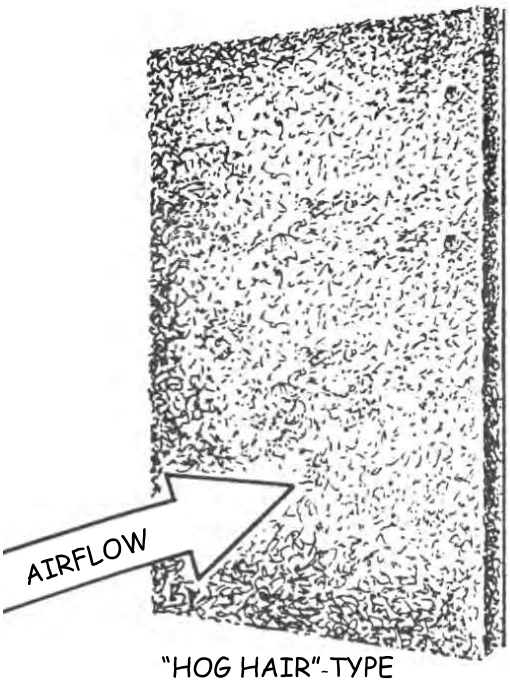
DIGITAL PROGRAMMABLE THERMOSTAT WITH BATTERY BACKUP

SMART THERMOSTAT

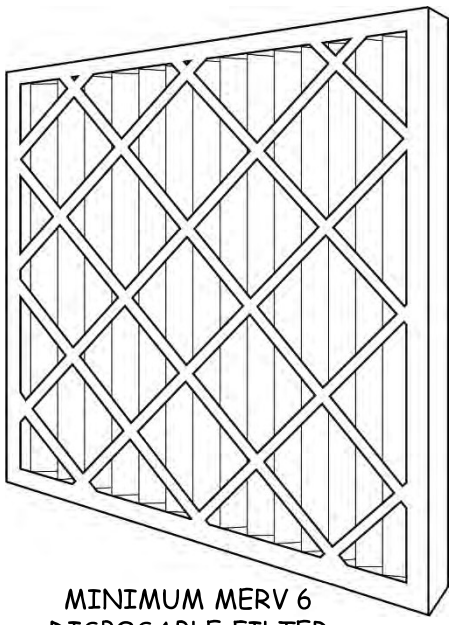
- **Central heating and air filters**
  - Shall conform to manufacturer's specifications and be properly sized, secured, and supported.
  - Shall be rated at MERV 6 or higher for replacement FAUs.
  - Washable filters shall be minimum 1" thick and in conformance with Part 5 of this section.

2. WARRANTY

- **HVAC equipment and thermostats**
  - Refer to IS Appendix F (Minimum Warranty Requirements).



"HOG HAIR"-TYPE
BONDED FIBER
WASHABLE FILTER



MINIMUM MERV 6
DISPOSABLE FILTER

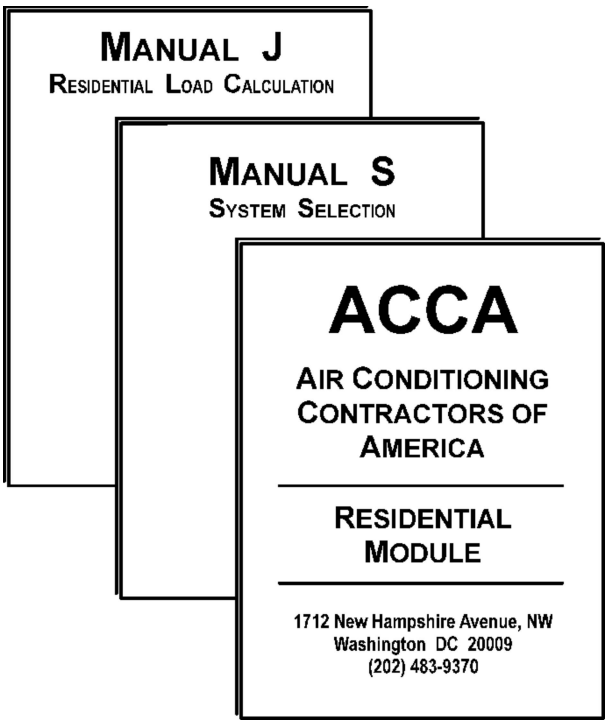
PART 2: NEW FURNACE INSTALLATION

3. GENERAL REQUIREMENTS

- **All installations**
  - A permit for the installation shall be obtained from and finalized by the local jurisdiction.
  - Installation shall be in compliance with:
    - Manufacturer's instructions and specifications.
    - Title 24 Residential Compliance Manual
    - CEC, CMC, and local code.
  - The FAU shall not draw combustion air from a sleeping room.
- **High-efficiency condensing furnaces**
  - Location shall allow for a level installation with slope not exceeding manufacturer's specifications.

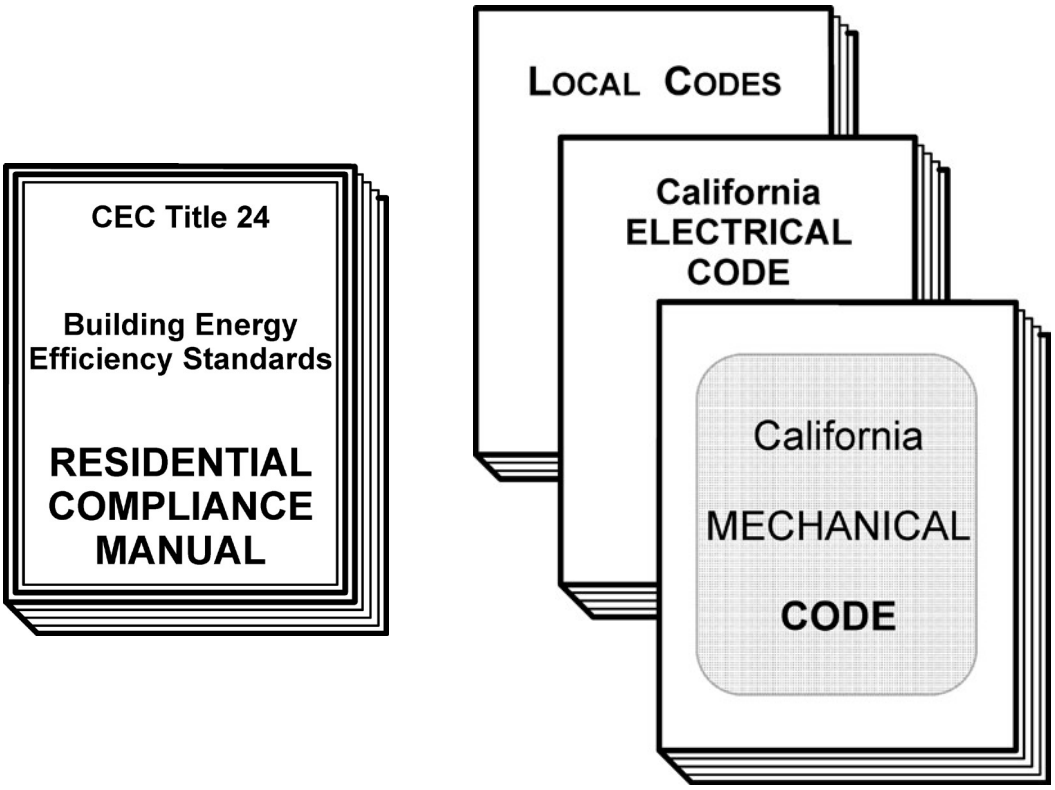
4. SYSTEM DESIGN AND PERFORMANCE

- **All installations**
  - Unit shall be properly sized in accordance with Title 24 Residential Compliance Manual.
- **Installations utilizing existing ducts**
  - New FAU airflow shall be compatible with existing duct system.



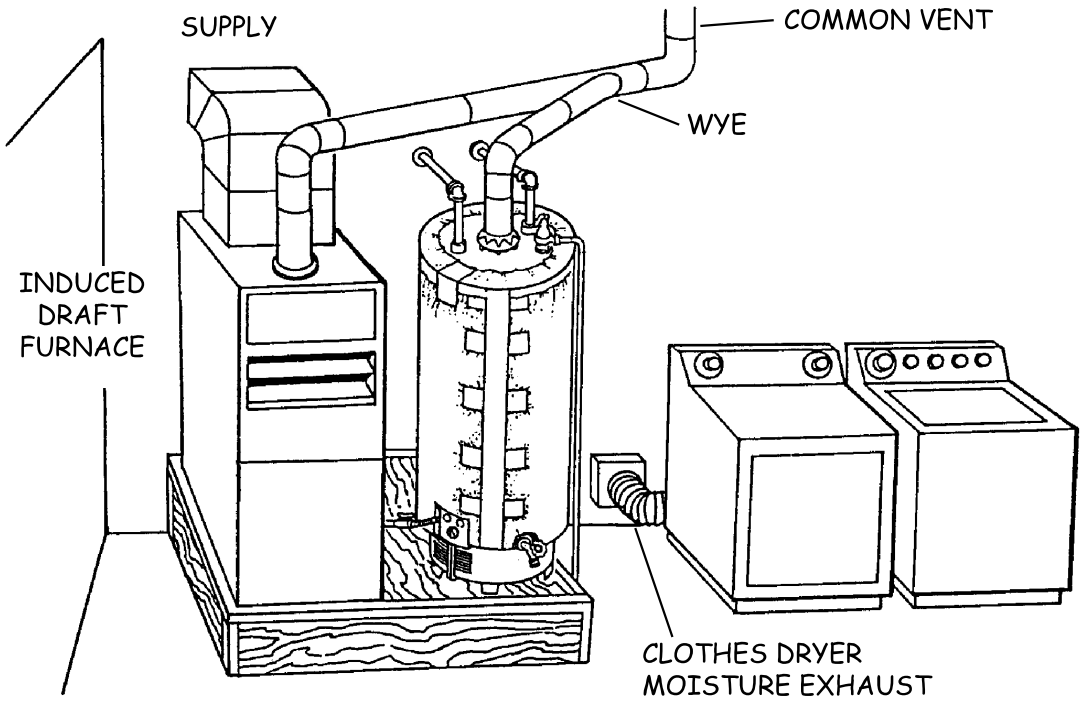
5. AIR DISTRIBUTION SYSTEM

- **All units**
  - Distribution system shall be in conformance with HVAC manufacturer's specifications, Title 24 Residential Compliance Manual, and IS Section 10 (Duct Testing and Sealing).
  - Existing duct system shall:
    - Be examined for leaks and disconnections.
    - Allow the FAU to operate at the static pressure and within the temperature rise specified by the FAU manufacturer.
- **Air filters**
  - All FAUs shall be equipped with a compliant air filter.
  - New HVAC units shall have minimum MERV 6 replaceable filter(s).
  - Repaired units may have washable filter(s) selected and installed in accordance with Part 5 of this section.



6. APPLIANCE VENTING

- **Vent pipe**
  - Appliance vent system and termination shall be in conformance with manufacturer's instructions and local code.
- **Common vent**
  - When an existing furnace that shares a common vent with another appliance is replaced with a new unit, contractor shall ensure that both appliances are properly vented.
  - When the FAU is replaced with a high-efficiency condensing furnace, the existing standard-efficiency vent system shall be modified to isolate it from the new FAU.
- **High-efficiency condensing furnaces**
  - The FAU shall have a new dedicated vent system with the shortest length and fewest elbows feasible.
  - Vent pipe shall:
    - Be insulated if subject to freezing temperatures when specified by FAU manufacturer.
    - Not be connected to any metal pipe or solid fuel chimney.

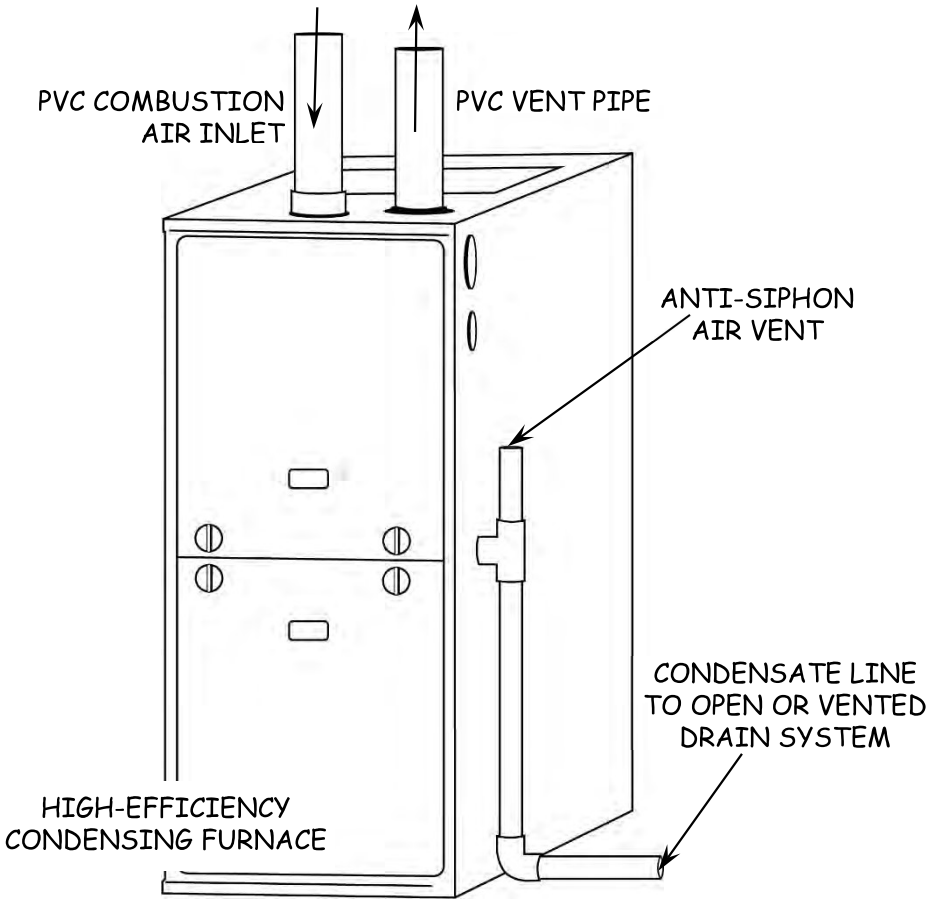


7. CONDENSATE DRAIN

- **High-efficiency condensing furnaces**
  - Condensate drainage, including condensate pump when installed, shall be in conformance with manufacturer's instructions and local code.
  - The drain pipe shall include an anti-siphon air vent at the furnace and shall maintain a minimum 1/4" per foot downward slope.
- **Roof-mount units**
  - Condensate drain line shall also be:
    - Equipped with a trap and terminate per local code.
    - Painted to resist UV degradation if PVC is used.

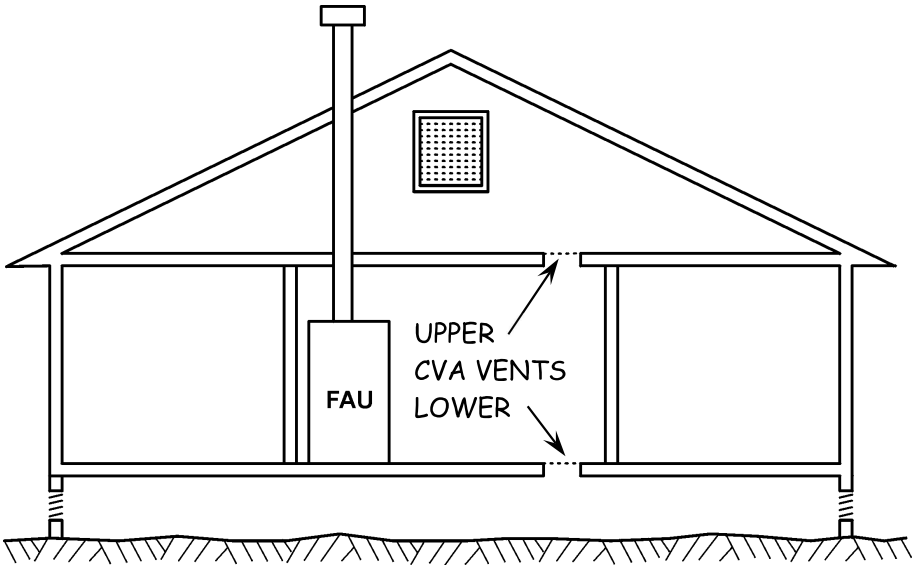
8. WALL AND FLOOR REPAIRS

- **All installations**
  - Surface of repair shall match plane of adjacent material (e.g. subfloor, wall).
  - Patching shall blend with surrounding surfaces.
  - Floor openings shall be closed in a workmanlike manner.
  - All construction debris shall be removed from the work area and the premises.



9. COMBUSTION AIR

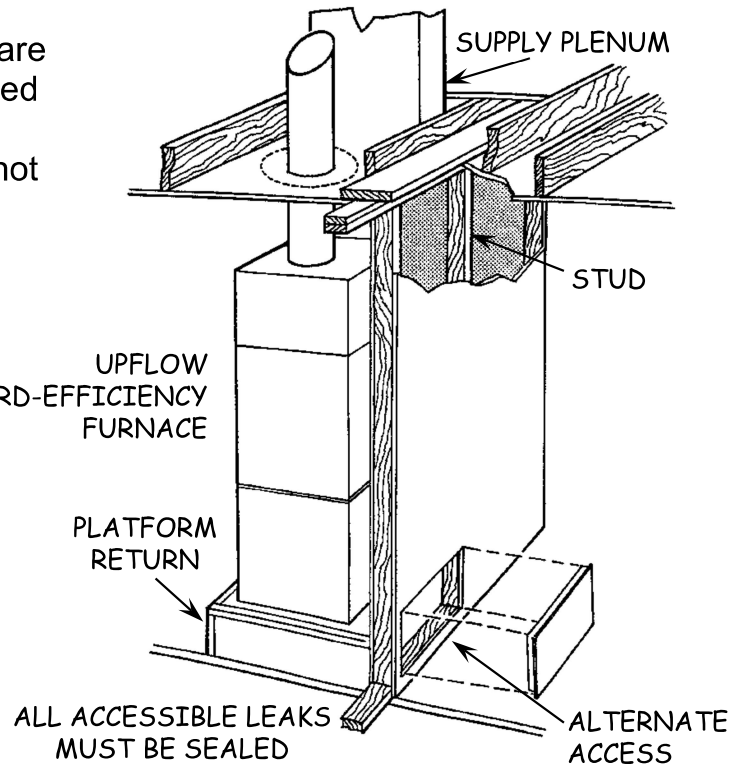
- **All units**
  - Combustion air shall be supplied in conformance with manufacturer's instructions and local code (see IS Section 24, IS Appendix A, and CMC Chapter 7).
  - Existing combustion air vents shall be free of obstructions (such as overblown ceiling insulation, duct insulation, etc.).
  - Return air shall be isolated from combustion air.
- **Open-combustion furnaces inside the living space**
  - Combustion air shall be obtained entirely from either outdoors or inside the living space.
  - When combustion air is obtained from indoors, fans and exhaust devices shall not:
    - Cause a natural draft appliance to draft improperly nor
    - Deprive any appliance of adequate combustion air.
- **Open-combustion furnaces not in the living space**
  - Combustion air may be obtained from indoors, outdoors, or a combination of indoors and outdoors in accordance with CMC Chapter 7.
- **High-efficiency condensing furnaces**
  - Combustion air shall be drawn from outdoors, when feasible.
  - The combustion air intake piping shall:
    - Terminate as prescribed by FAU manufacturer and
    - Have the shortest length and fewest elbows feasible.



OPEN-COMBUSTION FAU WITH UPPER AND LOWER CVA VENTS TO OUTDOORS

10. FAU, ENCLOSURES, PLENUMS, AND DUCTS

- **Supply plenum**
  - Size, minimum length, and attachment/connection to the FAU shall be in compliance with manufacturer's specifications.
- **Return (platform, cabinet, and plenum) shall be free of leaks that:**
  - Affect or draw in combustion air.
  - Are located in unconditioned space.
- **Platform returns**
  - Platform cavity shall be lined/sealed to prevent infiltration from unconditioned space and furnace enclosure.
    - Uninsulated platform plenums shall be insulated.
    - Additional insulation not required when fiberglass duct board is used to line/seal the plenum.
  - Return accessed by full-length swinging appliance enclosure door:
    - Door-mounted grille shall not interfere with proper closure of door.
    - Return shall be isolated from the open-combustion furnace in the enclosure above the return intake (e.g., with weatherstripping).
- **Enclosure isolation**
  - When an open combustion FAU replaces another open combustion FAU, IS Section 2 (Weatherstripping) applies to the enclosure door.
  - When a direct vent FAU replaces an open combustion FAU, enclosure door weatherstripping is required only when there are shell leaks (e.g., abandoned CVA vents) that cannot feasibly be sealed or will not be sealed.
- **Ducts and sealants**
  - Duct repairs and sealing shall be made in accordance with IS Section 10 (Duct Testing and Sealing).



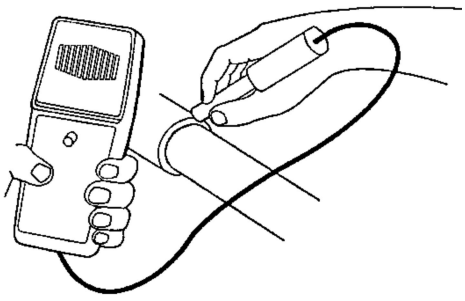
11. WALL THERMOSTAT

- **Replacement**
  - When required, a thermostat shall be installed as prescribed in Part 4 of this section.

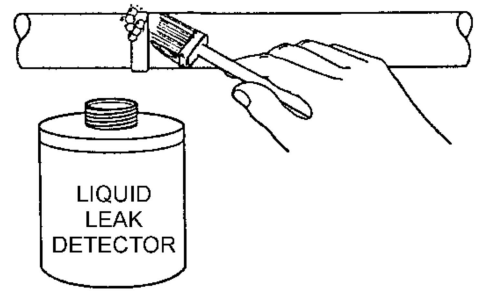
12. GAS PIPING AND VALVES

- **All installations**
  - Installed plumbing/piping parts shall be new; used parts not allowed.
  - All gas piping, fittings, and valves shall be installed in conformance with manufacturer's instructions and local code.
    - Hard pipe shall extend through the FAU housing and
    - A drip leg shall be provided.
  - Existing gas shut-off valve may be used, if it is:
    - In good condition and in conformance with Item 1.
    - Within 3' of the appliance and in the same room or space where the appliance is located.
  - Gas flexible connector shall be new. (Existing connector shall not be reused.)
  - Existing copper components shall be replaced with approved material.
  - All new and affected lines and components shall be checked for gas leaks by a method approved by the local jurisdiction, which may include one of the following:
    - Commercial leak detection liquid.
    - Electronic leak detector.
    - Pressure test of the line.
- **Overpressure protection**
  - Pressure to the gas valve shall not exceed manufacturer's specified maximum.

ELECTRONIC LEAK DETECTOR



LIQUID LEAK DETECTION METHOD

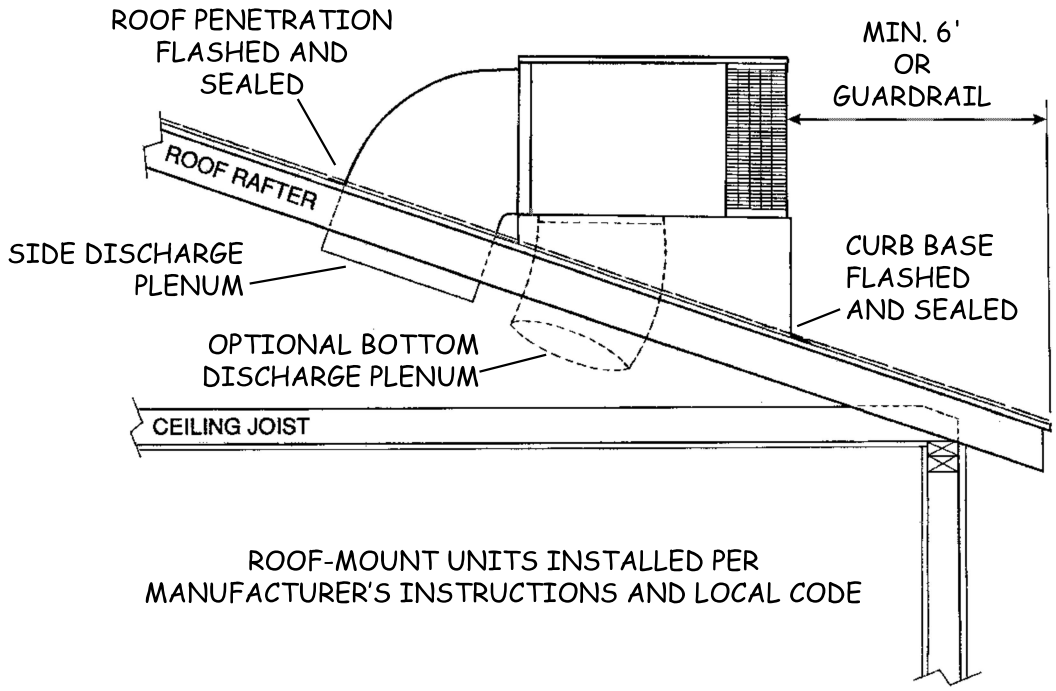


13. ROOF-MOUNT INSTALLATIONS

- **All Units**
  - The roof shall be structurally adequate to properly support the installed equipment.
  - Design and installation of support frame or curb, and installation of system equipment and applicable safety apparatus (e.g., guard rail), shall be in conformance with manufacturer's instructions and local code.
  - Curb base and all exposed roof penetrations shall be properly installed, flashed and sealed watertight.

14. GROUND-MOUNT INSTALLATIONS

- **All Units**
  - The unit shall rest on concrete or other approved base extending at least 3" above the adjoining ground level and protected from damage.
  - For units with air conditioning, locking caps shall be installed on accessible refrigerant service valves in locations that do not require keyed access.



15. ACCESS AND SERVICE SPACE

- **All installations**
  - Access and service space shall be provided in accordance with manufacturer's instructions and local code.
- **Specific locations**
  - Units installed in an enclosure or alcove shall be listed for that type of installation.
  - Appliances in an attic or crawlspace must be accessible by an opening bigger than the largest component and at least 22" x 30".
  - Some other CMC requirements are highlighted in Table 18-1.

Table 18-1: Furnace Location Requirements

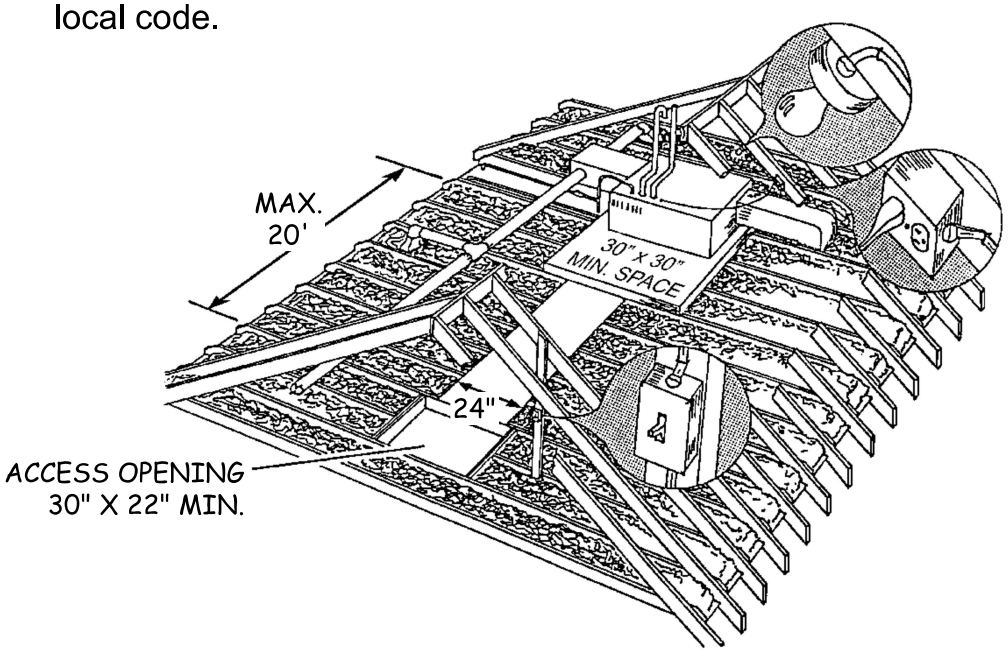
Location	Requirements
Enclosures	- Width and clearances: Manufacturer's specifications - Height: Adequate to accommodate installation and removal
Under-floor and Roof-mount locations	- Compliance with manufacturer's instructions and local code
Attic location	- Unobstructed passageway: • Minimum 24" wide • Maximum 20' long - Service space: • Minimum 30" wide and deep • Level and located in front of unit - Clearance from burner and combustion air openings to insulation shall be at least 12" or as specified by the manufacturer. - Illumination: • Switch located near access/entrance • Sufficient illumination for safe access and service - Convenience receptacle: Permanent 120-volt receptacle near appliance
Garage	- Source of ignition (e.g., pilot and burner) must be located 18" above floor unless FAU is closed combustion, or elevation is not required by code or instructions.

16. AIR CONDITIONERS

- **Central A/C combined with furnace**
  - A/C equipment shall be selected and installed as prescribed in IS Section 21 (Central High-Efficiency A/C and Heat Pump Replacement).
  - Plenum installation shall prevent cooled air and condensate from entering the heat exchanger.
    - The indoor coil shall be installed downstream from the heat exchanger.

17. FURNACE OPERATION

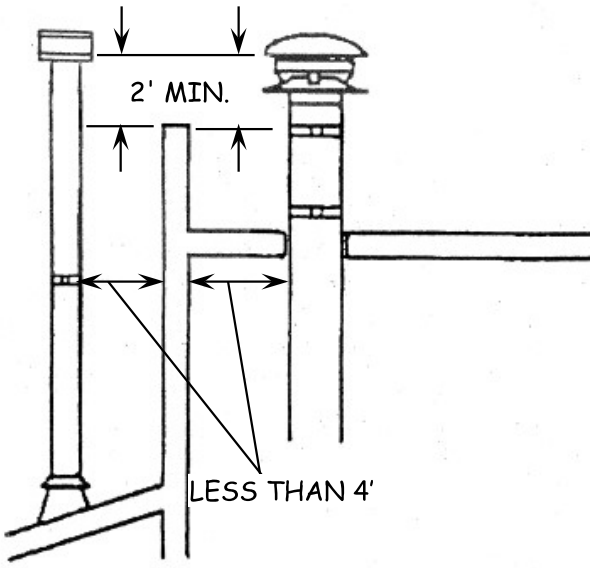
- **Testing**
  - Manufacturer's instructions shall be followed to ensure proper operation of new furnaces, including:
    - Gas pressure.
    - Temperature rise.
    - Supply and return static pressure.
    - Thermostat, cycle controls, and safety controls.
  - CO and draft shall be checked and be in compliance with manufacturer's specifications and the requirements in IS Section 24 (NGAT).
    - For CO measurement in condensing furnaces, PVC pipe may be drilled and plugged when allowed by the FAU manufacturer and local code.



PART 3: FURNACE REPAIRS

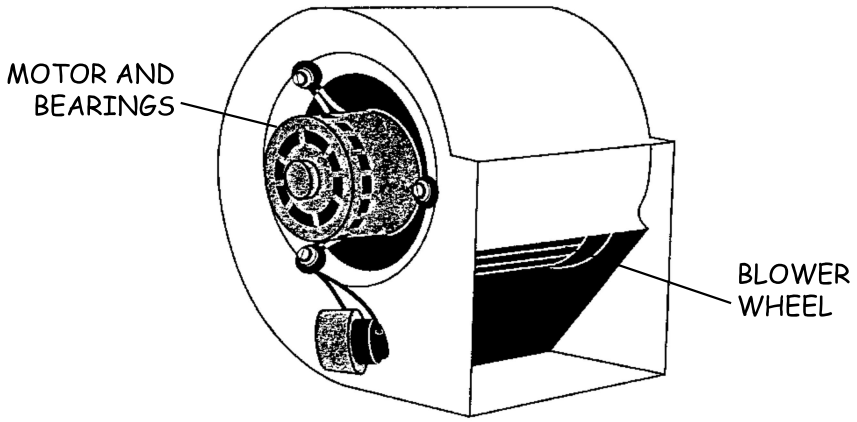
18. PRELIMINARY EXAMINATION

- **NOx rod furnaces subject to CPSC recall shall not be repaired.**
- **The furnace shall be checked for defects, including but not limited to the following:**
  - Gas leaks at valves, fittings, joints, or flexible gas connector.
  - Presence of copper gas line or butt-soldered joints.
  - Inadequate/improper combustion air venting.
  - Excessive rust in the draft hood or heat exchanger.
  - Heat exchanger defects (e.g., cracks, holes, deterioration).
  - Improper position of pilot generator, pilot, or flame.
  - Defective controls or thermostat.
  - Burner defects, such as:
    - Dirty or improperly adjusted.
    - Excessive soot or rust.
    - Flame impingement and/or abnormal flame.
    - Delayed or rollout ignition.
    - Incorrect orifice.
    - Over- or under-fired.
  - Excessive temperature rise.
  - Vent system defects, such as:
    - Disconnections, leaks, obstructions, etc.
    - Defective/missing vent cap.
    - Misaligned, defective, missing, or multiple draft hoods.
    - Inadequate clearance from combustibles.
    - Improper termination.
    - Double-wall pipe not used where required (e.g., past ceiling/wall).



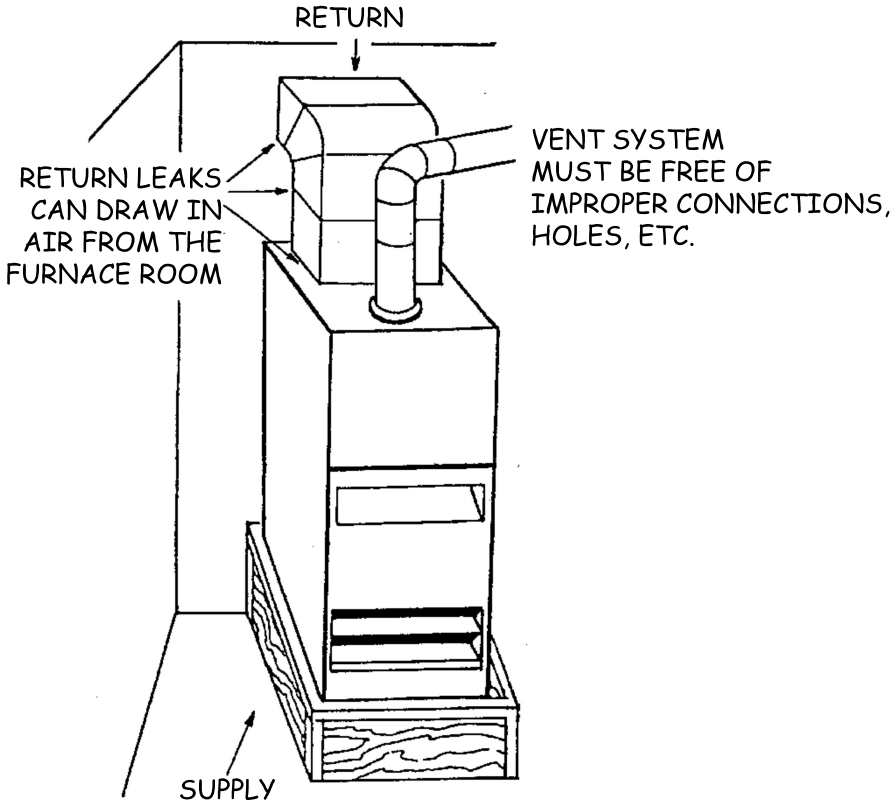
18. PRELIMINARY EXAMINATION (cont.)

- **The furnace shall be checked for defects, including but not limited to the following (cont.):**
  - Controls and thermostats
    - Electrical disconnection or defect.
    - Improper adjustment.
  - Distribution system
    - Duct leaks and defects.
    - Furnace-to-floor/plenum gaps/leaks.
    - Return leaks that draw in combustion air or combustion byproducts.
    - Dirty, defective, or missing furnace filter.
  - Blower chamber
    - Motor or blower bearings in need of lubrication.
    - Dirty blower.
    - Loose or unsafe wiring.
  - Evaporator coil box
    - Dirty or damaged evaporator coil.
    - Air leaks at plumbing or wiring penetrations.
  - Heating unit integrity
    - Loose or hazardous wiring.
    - Loose or missing components.
    - Improper alteration of the heating unit.



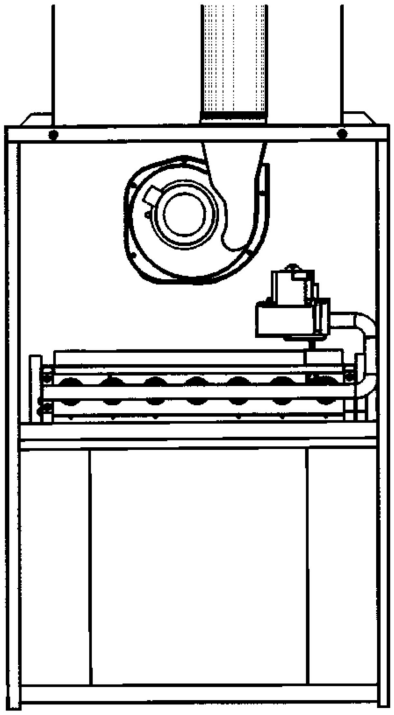
19. AIR DISTRIBUTION SYSTEM

- **Duct testing and sealing**
  - Duct system shall be examined for leaks and disconnections and brought into conformance with ESA Program requirements.
  - Testing and repairs/sealing shall be performed in accordance with IS Section 10 (Duct Testing and Sealing).
- **Return leaks**
  - Leaks in plenum/cabinet/duct that could draw in combustion products or other pollutants shall be repaired.
- **Air filters shall be:**
  - Selected and installed in accordance with Item 1 and furnace manufacturer's specifications.
  - Properly installed and, if reused, clean and in good condition.



20. HEATING UNIT INTEGRITY

- **HVAC unit**
  - Loose items shall be tightened (e.g., screws, bolts, panels, etc.).
  - Missing/damaged components critical to proper operation shall be replaced/repaired (e.g., access doors, roll-out shield, etc.).
  - Improper alterations that adversely affect unit operation shall be corrected.
- **Heat exchanger inspection**
  - Heat exchanger shall be visually inspected for evidence of damage, deterioration, obstruction, etc.
  - Such inspection may require additional steps, which include but are not limited to smoke bomb testing and heat exchanger removal.



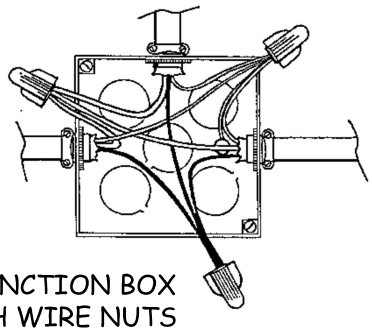
HVAC UNIT CHECKED FOR UNIT INTEGRITY AND SAFE HEAT EXCHANGER

21. GAS PIPING AND VALVES

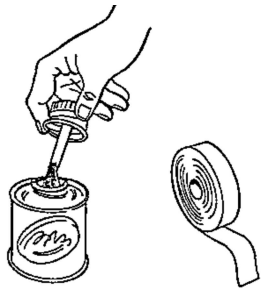
- **All installations**
  - All new and affected lines and components shall be checked for gas leaks by a method approved by the local jurisdiction, which may include one of the following:
    - Commercial leak detection liquid.
    - Electronic leak detector.
    - Pressure test of the line.
  - Nonconforming items, including the following, shall be replaced with materials conforming to applicable code requirements:
    - Defective gas shutoff valve or pipe fittings.
    - Rigid or flexible copper connector.
  - Flexible gas connector
    - Existing connector shall be replaced with a new code-compliant flexible gas connector.
    - Hard pipe shall extend to outside the FAU housing, with the flexible connector beginning there.
  - A code-compliant drip leg shall be present in gas piping to the FAU.

22. WIRING

- **All units**
  - Unit shall be free of wiring defects (e.g., frayed or burned wires, loose or improper connections, etc.).
  - Splices shall be:
    - Located in junction boxes.
    - Secured with pressure splicing connectors (e.g., wire nuts).
  - Aluminum/copper splices shall not be made unless:
    - Splicing connectors used are identified for that purpose.
    - Conditions of use are met (e.g., application of antioxidant).



SPLICES IN JUNCTION BOX SECURED WITH WIRE NUTS



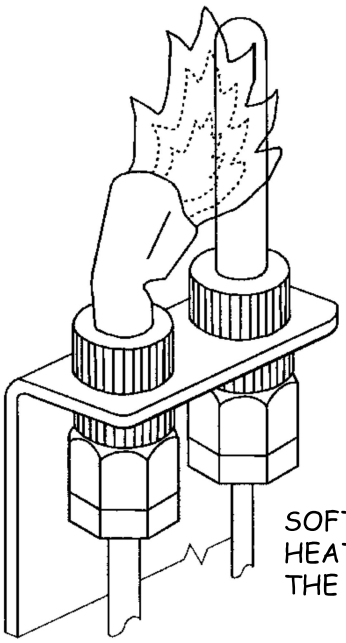
ANTIOXIDANT AND ELECTRICIAN'S TAPE

23. THERMOSTATS AND CONTROLS

- **Wall thermostat**
  - Thermostat shall function properly:
    - Anticipator correctly set to 24-volt heating control circuit amperage, when applicable.
    - Ensure wiring connections are correct and tight.
    - Ensure unit is level and securely installed.
  - New thermostat installation shall be in conformance with Part 4.
- **Controls**
  - Furnace controls, including limit switch and blower fan switch, shall operate in accordance with manufacturer's specifications.
  - Gas control valve
    - Valve shall function properly and be free of leaks and electrical defects (e.g., short or open).
    - Gas pressure adjusted per manufacturer's specifications.
  - Power switches shall function properly, including:
    - Blower access lockout/safety switch.
    - Switch controlling power to the unit (disconnect).
    - Blower speed control switch.

24. PILOT AND THERMOCOUPLE/PILOT GENERATOR

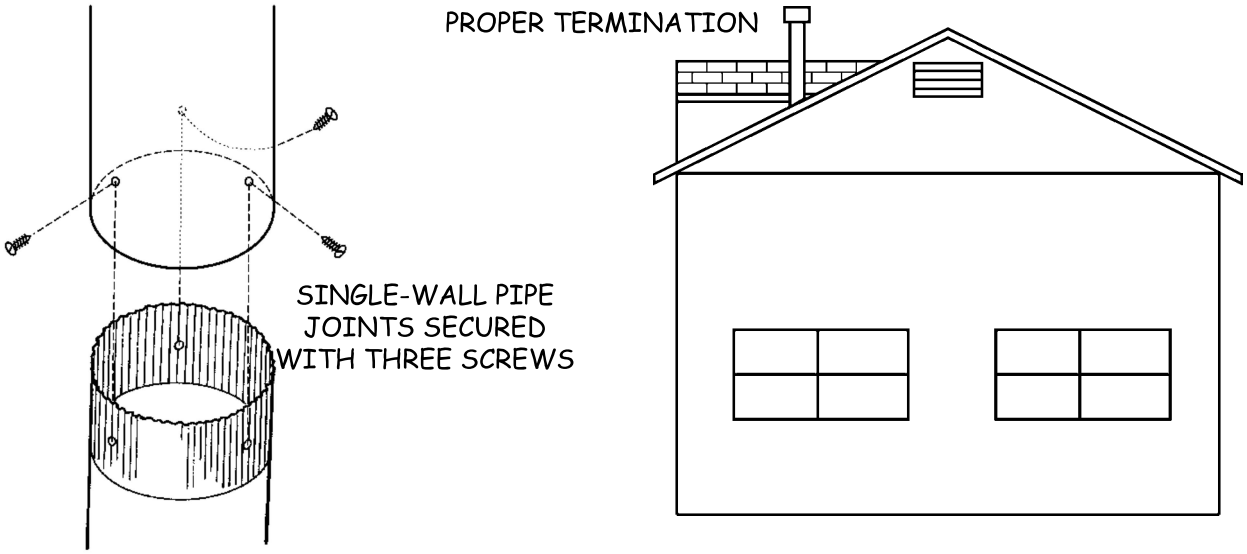
- **Requirements**
  - Thermocouple or pilot generator shall be correctly positioned in pilot flame.
  - Pilot flame shall be properly adjusted.
  - Voltage output shall be within specifications for proper operation of the gas control valve.



SOFT, STEADY PILOT FLAME HEATING TOP HALF-INCH OF THE THERMOCOUPLE

25. VENT SYSTEM

- **All systems**
  - Vent system defects shall be corrected.
  - Vent system shall be checked in accordance with IS Section 24 (NGAT).
- **Single-wall vent pipes**
  - Joints and connections shall be secured with three evenly spaced sheet metal screws when:
    - New components are installed.
    - Existing connections are loose or unsafe.
- **Double-wall Type B vent pipes**
  - Shall be present where required by code (e.g., beyond the ceiling or wall).
  - Shall not be drilled or have screws installed, unless permitted by the manufacturer and local code.
- **Termination**
  - Vent termination shall be in conformance with local code.



26. AIR HANDLER AND EVAPORATOR

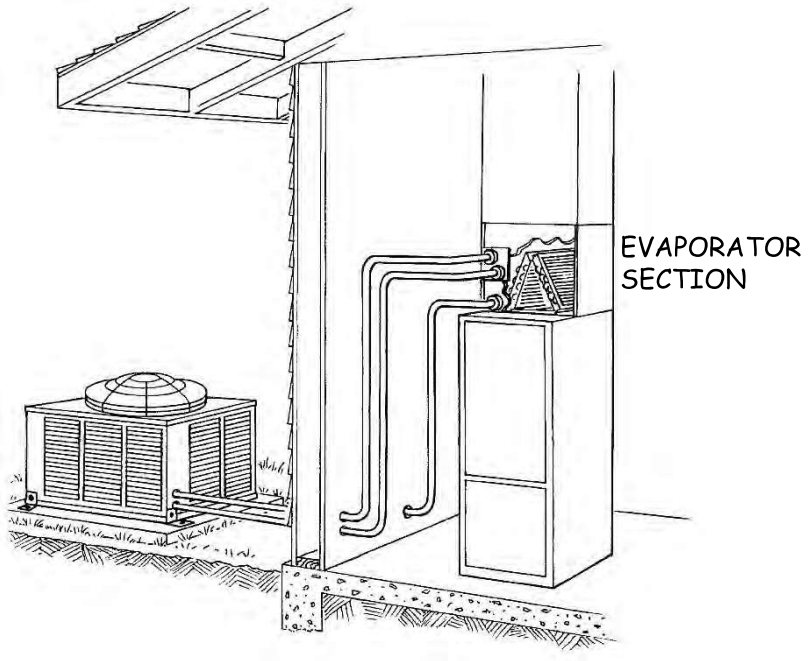
- **Air handler**
  - The following conditions shall be corrected as needed to ensure proper operation of the unit:
    - Dirty blower chamber and/or fan blades.
    - Loose or unsafe wiring.
    - Bearings in need of lubrication.
- **Evaporator section**
  - Evaporator coil shall be clean.
  - Plumbing and wiring penetrations shall be sealed with cork tape.

27. COMBUSTION AIR

- **All units**
  - Adequate combustion air shall be available to the furnace in accordance with Item 9.

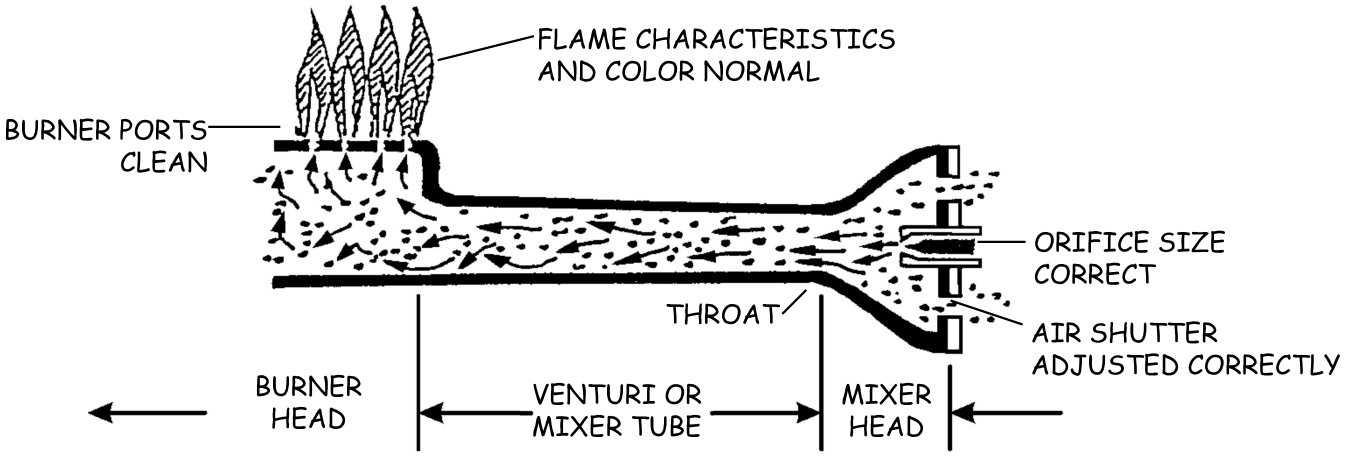
28. APPLIANCE DRAFT

- **Open-combustion natural draft furnaces**
  - Drafting shall be checked and verified to be acceptable in accordance with IS Section 24 (NGAT).



29. BURNERS

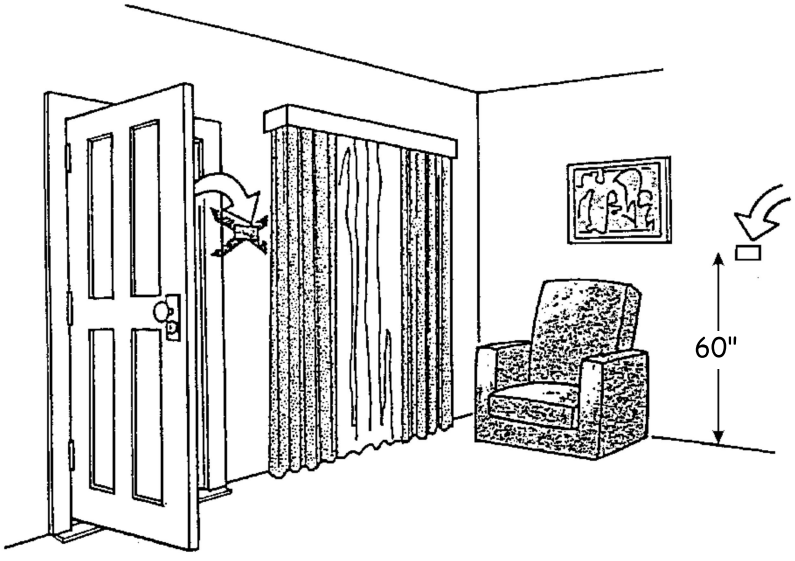
- **Burner performance**
  - Checks shall be made for evidence of combustion problems and corrections shall be made as needed to ensure safe operation.
  - When the burner(s) ignite, checks shall be made for:
    - Delayed ignition.
    - Excessive roll-out.
  - Burner(s) shall be examined for flame abnormalities.
- **Carbon and rust**
  - The top of the burner(s), the heat exchanger, draft hood, and vent pipe shall be examined for excessive amounts of carbon or rust.
- **Burners and venturis**
  - Shall be clean and ports shall be unobstructed.
  - Burners shall be correctly aligned/positioned.
- **Burner operation**
  - Air shutters shall be clean and adjusted for correct air/gas mixture.
  - Gas pressure shall comply with manufacturer's specifications.
  - Burner shall not be under- or over-fired.
- **CO**
  - CO in flue gas shall be within limits specified by:
    - Manufacturer's instructions and
    - IS Section 24 (NGAT).



PART 4: WALL THERMOSTAT INSTALLATION

30. THERMOSTAT INSTALLATION

- **Location and mounting**
  - New thermostat shall be installed at existing location unless affected by drafts, heat from direct sun, or adjacent appliances.
  - Thermostat installed in a new location shall be mounted:
    - 60" above the floor or per manufacturer's instructions, if different, or
    - As low as 48" above the floor when an occupant uses a wheelchair.
  - Thermostat shall be located away from direct sunlight, doors, windows, return/supply air, appliances, and sources of electrical interference.
  - Mounting bracket shall be securely attached to wall.
  - Any holes or damage to wall from installation or removal of thermostat shall be repaired in a workmanlike manner.
- **Wiring**
  - All wiring shall be a minimum of 18-gauge and conform to manufacturer's specifications and local code.
  - All wiring shall be installed inside wall cavities when possible.
  - When not inside a wall, exposed wiring shall be enclosed in a raceway.



30. THERMOSTAT INSTALLATION (cont.)

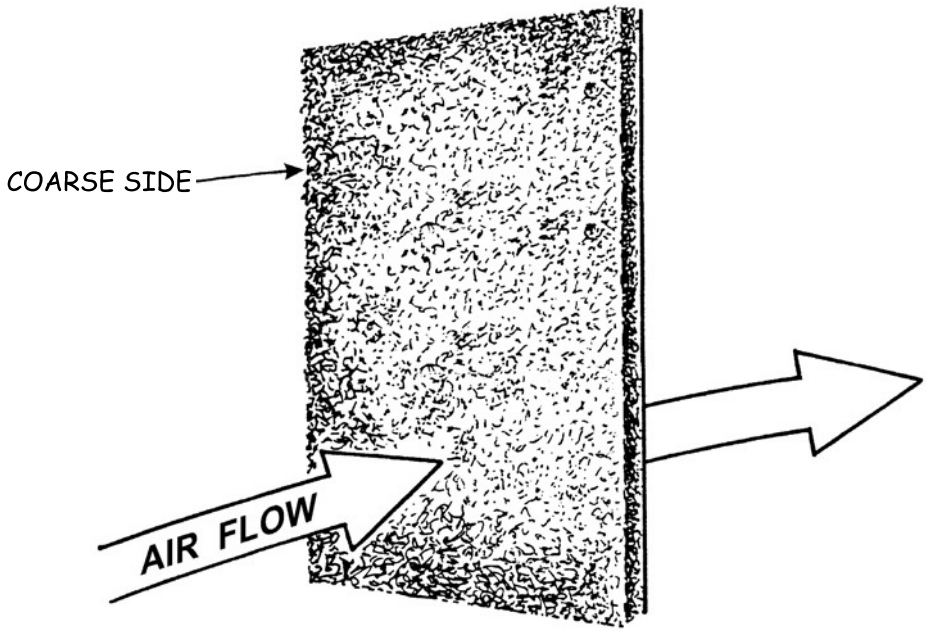
- **Programming and operation**
  - Thermostat shall be cycled to ensure proper operation of all functions.
  - Setbacks shall be programmed in accordance with customer's preference.
- **Instructions and warranty**
  - Customer shall be provided with:
    - A demonstration with verbal instructions for operating the thermostat and installing batteries.
    - The manufacturer's written instructions and warranty.
- **Disposal of replaced thermostats**
  - Old thermostats containing mercury shall be disposed of in accordance with Universal Waste Regulations, as set forth by DTSC at http://www.dtsc.ca.gov/HazardousWaste/Mercury_Therm_Act.cfm.

INSTRUCTIONS AND WARRANTY
PROVIDED TO CUSTOMER

PART 5: WASHABLE FILTER INSTALLATION

31. WASHABLE FILTER SIZE AND INSTALLATION

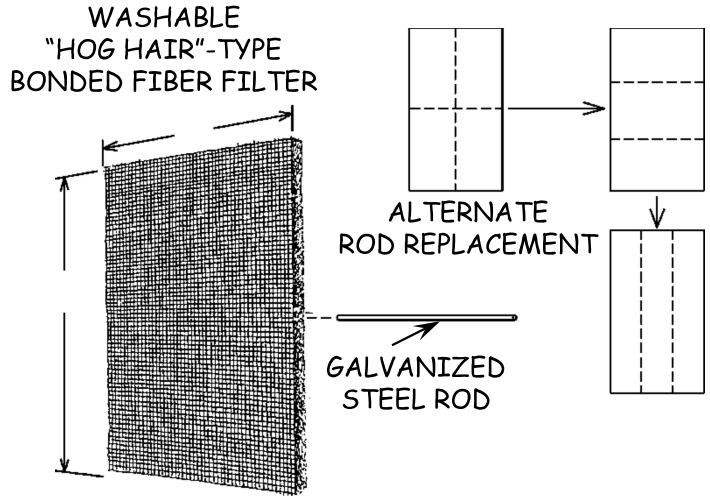
- **Feasibility**
  - Applies to furnace repairs.
  - New furnaces require minimum MERV 6 filter(s).
- **Size**
  - Unframed filters shall be cut for a snug fit with maximum 1/4" tolerance.
  - Framed filters shall fit within the filter housing without crimping or buckling.
- **Installation**
  - All filters shall be installed in conformance with appliance and filter manufacturer's instructions.
  - The coarse (“hairy”) side of “hog hair”–type bonded fiber filters shall always face the incoming air.



"HOG HAIR"-TYPE
BONDED FIBER FILTER

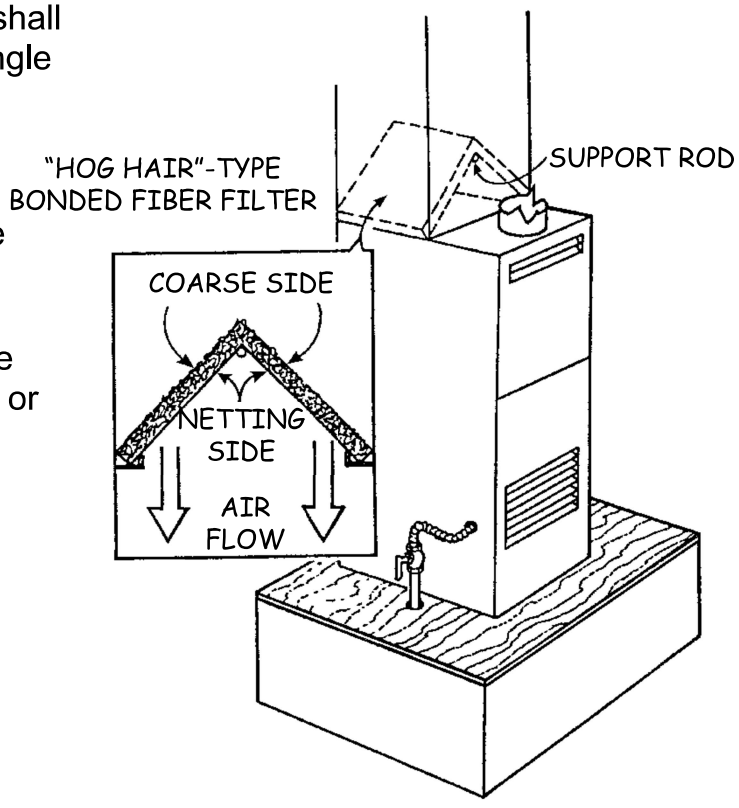
32. UNFRAMED WASHABLE FILTER SUPPORTS

- **All unframed filters**
  - Unframed filters shall be supported as needed to prevent being drawn toward the air handler.
  - Manufacturer's instructions shall be followed.
- **One-inch bonded fiber filters**
  - When not in conflict with appliance or filter manufacturer's instructions, steel rods (galvanized recommended) shall be internally installed as needed to stiffen filters over 20" long in either direction.
    - Support rods shall be:
      - Of adequate gauge to provide the necessary stiffness.
      - Spaced a maximum of 20" OC.
      - Sized to fully extend from one edge of the filter to the other.
      - Inserted into the coarse filter layer near the netting side of “hog hair”–type filter.
      - Inserted in the center of the filter medium or per manufacturer's instructions for other types.
  - At least one rod shall be positioned so that both ends are supported by a solid surface.
- **Other materials**
  - Materials thinner than 1" shall be secured externally.
  - Filters shall not be installed when adequate support cannot be provided.



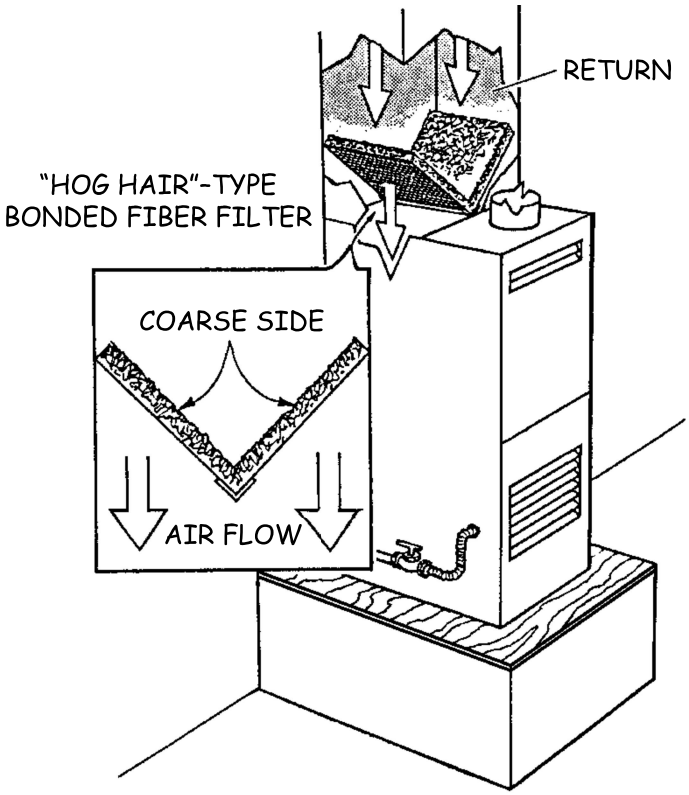
33. "A"-SHAPED 1" BONDED FIBER FILTERS

- **All filters**
  - The HVAC unit shall have:
    - Both upper and lower support devices.
    - Filter access that does not require the removal of any flue, duct, or pipe.
  - A single piece of material shall be used when possible.
- **One-piece unframed**
  - "Hog hair"–type
    - The coarse side shall be slit deep enough to facilitate folding the material in an "A" shape.
    - The netting side shall not be cut.
  - Other bonded fiber filters
    - Shall be cut and installed per manufacturer's instructions.
- **Two-piece unframed**
  - Two pieces of material shall be used only when a single larger piece cannot be installed.
- **Framed**
  - Two framed filters of the correct size shall be installed.
  - Larger filters shall not be modified to fit by cutting or folding.



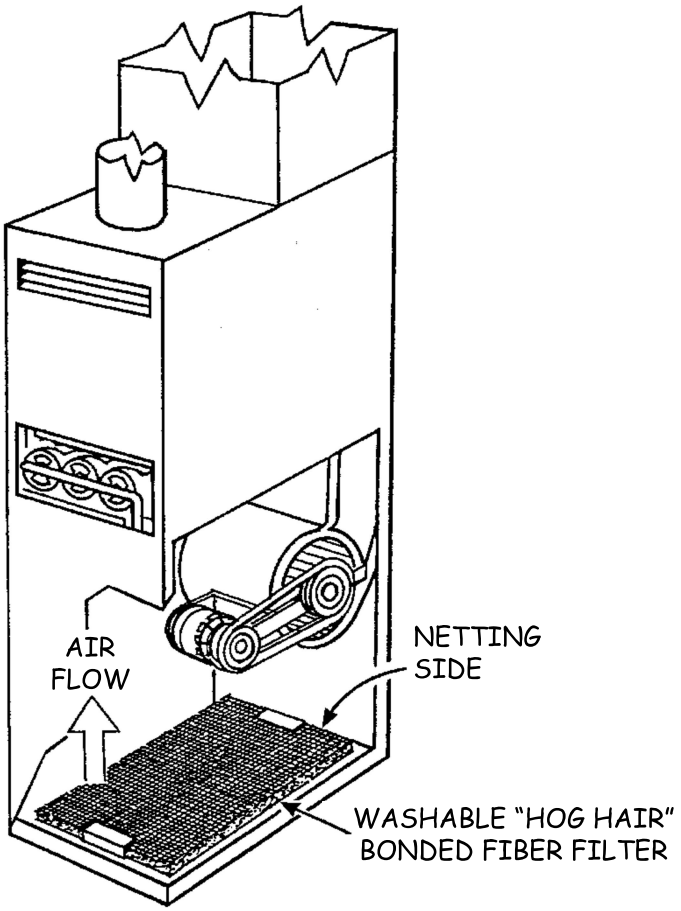
34. "V"-SHAPED 1" BONDED FIBER FILTERS

- **All filters**
  - The HVAC unit shall have:
    - A bottom support for the filter.
    - Filter access that does not require the removal of any flue, duct, or pipe.
  - A single piece of material shall be used when possible.
- **One-piece unframed**
  - "Hog hair"–type
    - A "V" shaped groove shall be cut, as needed, in the coarse side to facilitate folding the material into a "V" shape.
    - The netting side shall not be cut.
  - Other Bonded Fiber Filters
    - Shall be cut and installed per manufacturer's instructions.
- **Two-piece unframed**
  - Two pieces of material shall be used only when a single larger piece cannot be installed.
- **Framed**
  - Two framed filters of the correct size shall be installed.
  - Larger filters shall not be modified to fit by cutting or folding.



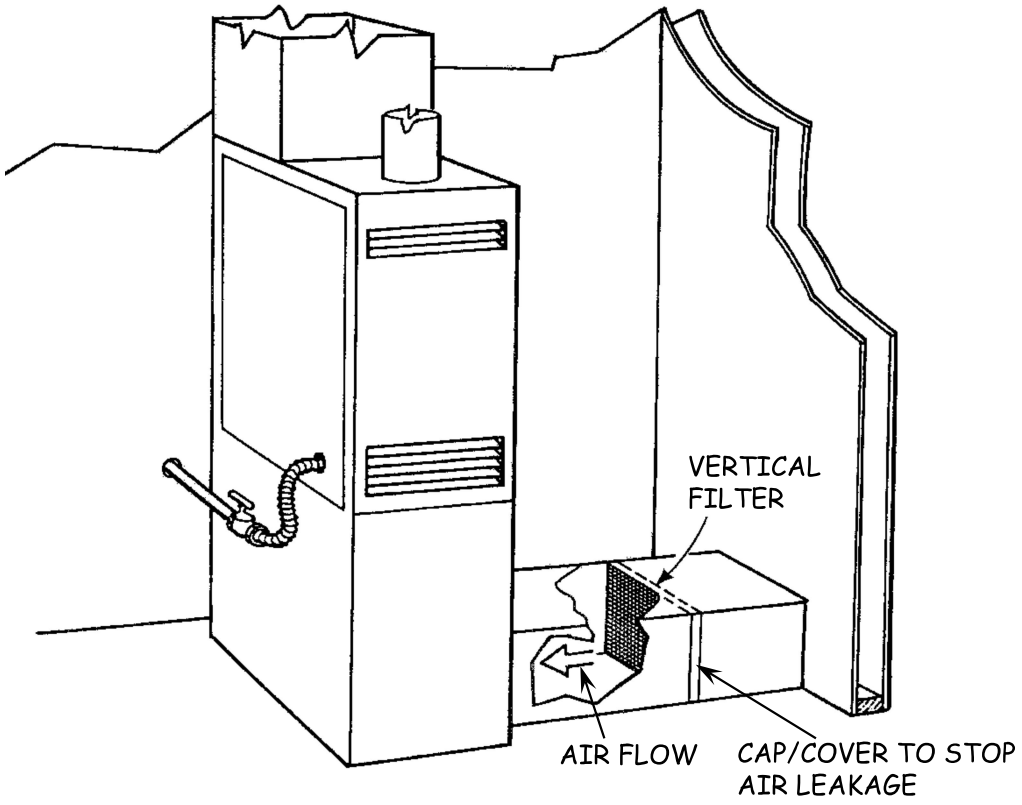
35. HORIZONTAL- AND HAMMOCK-STYLE 1" BONDED FIBER FILTERS

- **Horizontal unframed**
  - Internal support shall be installed as needed.
- **Horizontal framed**
  - Internal support not required.
- **Hammock-style**
  - Unframed filters shall be used.
  - Filter shall be secured with the wire mesh hammock.



36. VERTICAL 1" BONDED FIBER FILTERS

- **Unframed**
  - Internal support shall be installed as needed.
- **Framed**
  - Internal support not required.
- **Vertical-filter cap/cover**
  - Cap/cover must be present.
  - Replacement cap must be formed from 26-gauge galvanized sheet metal.

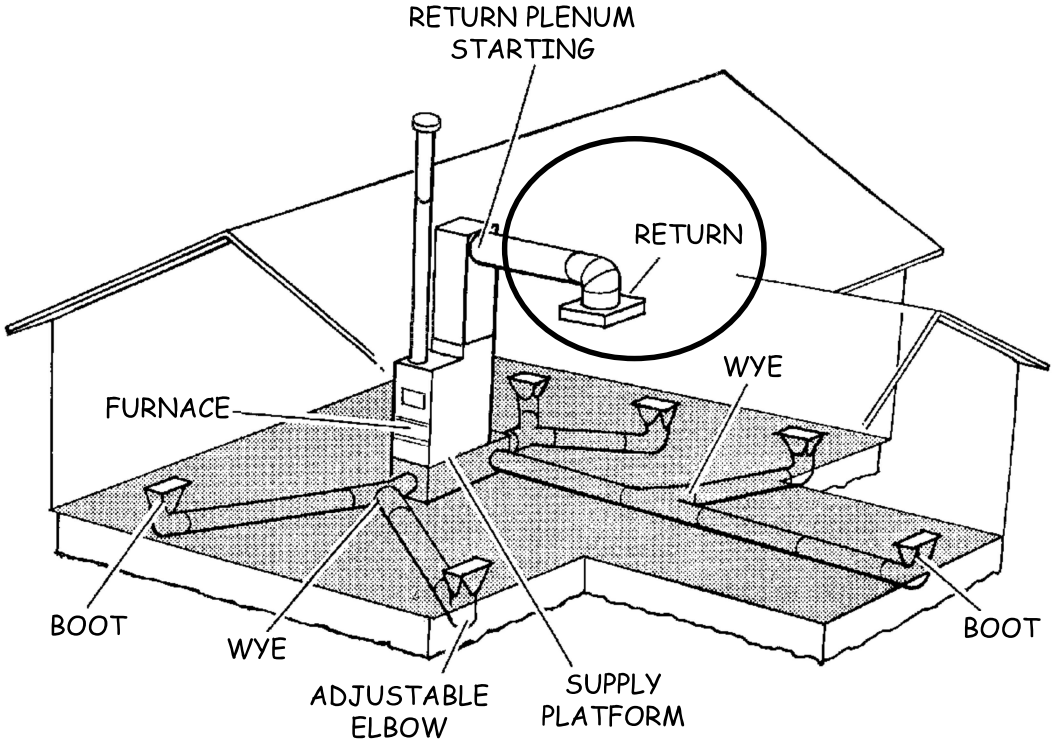


37. RETURN INTAKE GRILLE APPLICATIONS

- **Unframed**
  - Internal support shall be installed as needed.
- **Framed**
  - Internal support not required.

38. TWO FILTERS

- **One return**
  - When two filters exist within the same return path, one shall be eliminated.
  - The most accessible filter shall be replaced with a washable filter.
- **Two returns**
  - Each return shall be treated separately as specified above for one return.



PART 6: POST-INSTALLATION/REPAIR

39. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION/REPAIR REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Appliance operation**
  - The installed unit shall be tested for proper operation.
  - Proper operation shall be explained and demonstrated to the customer, including:
    - Operation of all user-accessible controls.
    - Filter replacement.
    - Routine maintenance recommended by manufacturer.
  - All manufacturer's written instructions and warranty documents shall be supplied to the customer.
- **Clean-up and disposal**
  - Paint dust and chips, scraps, and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - All packing materials and installation debris shall be cleaned up and removed from the premises.
  - All replaced equipment and parts shall be removed from the premises and properly disposed of, unless specified otherwise in the home improvement contract.
  - Refrigerant shall be recovered by a properly licensed and EPA-certified HVAC technician, and all hazardous waste materials shall be disposed of in conformance with federal, state, and local code.

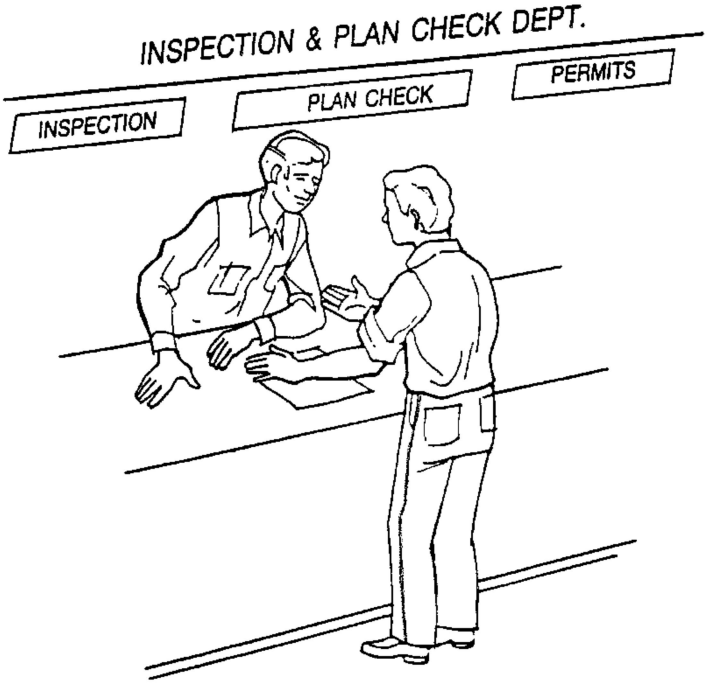
INFORMATION ABOUT HANDLING REFRIGERANT IS AVAILABLE AT THIS EPA WEBSITE:
https://www.epa.gov/section608

EPA United States Environmental Protection Agency

MOBILE HOME CRITERIA FOR NEW FURNACE INSTALLATION

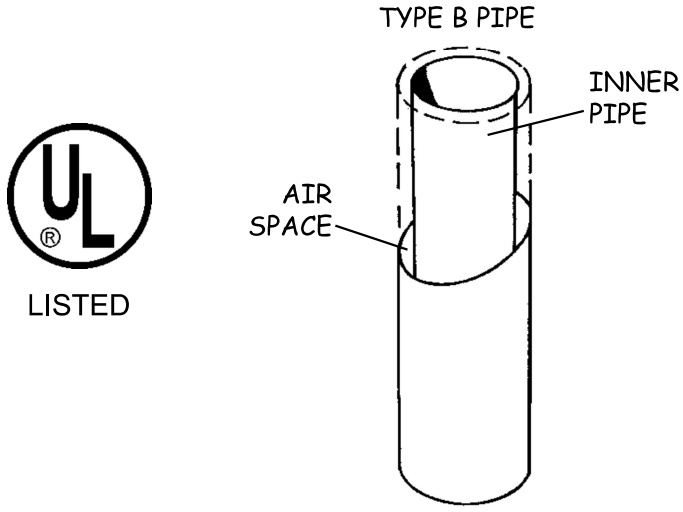
40. GENERAL REQUIREMENTS

- **Permit**
  - A permit shall be obtained from and finalized by HCD or, as applicable, the local building department.
- **Installations within a manufactured home**
  - Materials and installation shall be in compliance with HCD regulations and HUD MHCSS, Part 3280.
- **Installations outside a manufactured home**
  - Materials and installation shall be in compliance with HCD regulations or, as applicable, requirements of the local building department.



41. INSTALLATION COMPONENTS

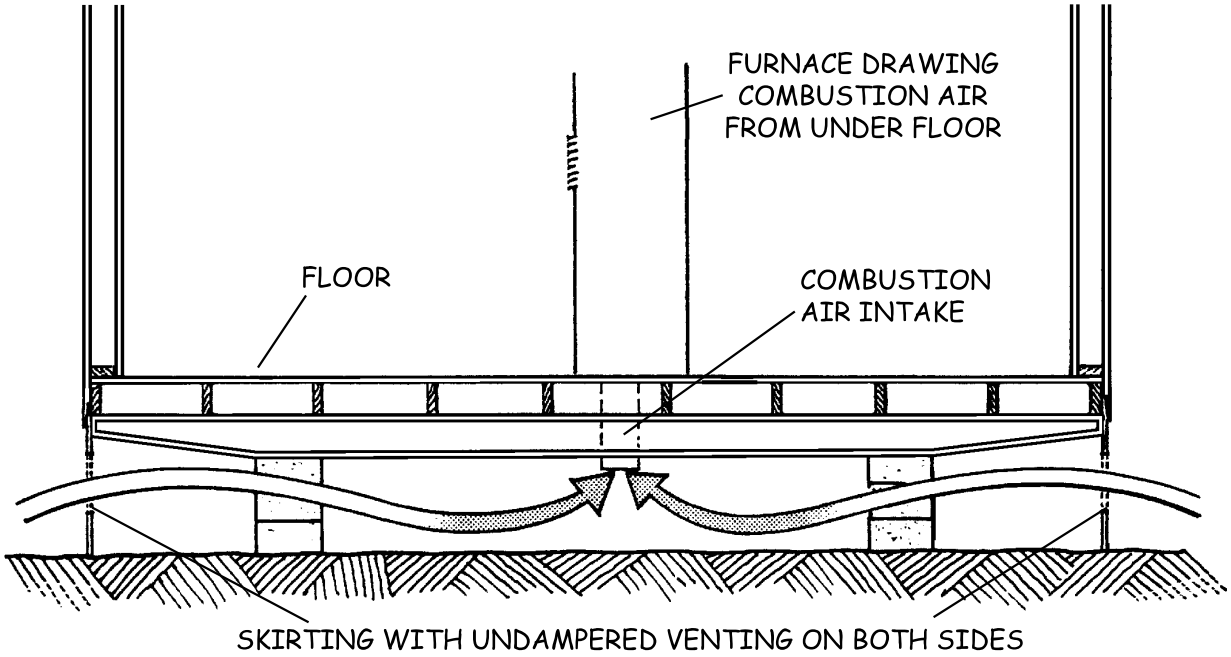
- **Metal vent system shall:**
  - Comply with HUD MHCSS Section 3280.703 and, as applicable, local building department regulations.
  - Be UL-listed and in compliance with furnace listing and manufacturer's specifications and instructions.
- **Gas pipes and valves**
  - Fuel gas piping shall be in conformance with manufacturer's instructions, HUD MHCSS Section 3280.705, and, as applicable, requirements of the local building department.
  - Flexible gas connectors
    - Existing flexible gas connector shall be replaced with a new flexible gas connector.
    - Hard pipe shall extend to outside the FAU housing, with the flexible connector beginning there.
  - A code-compliant drip leg shall be present in gas piping to the FAU.
  - Copper gas lines not allowed.



METAL PIPES AND ASSEMBLIES
UL-LISTED AND MANUFACTURER-COMPLIANT

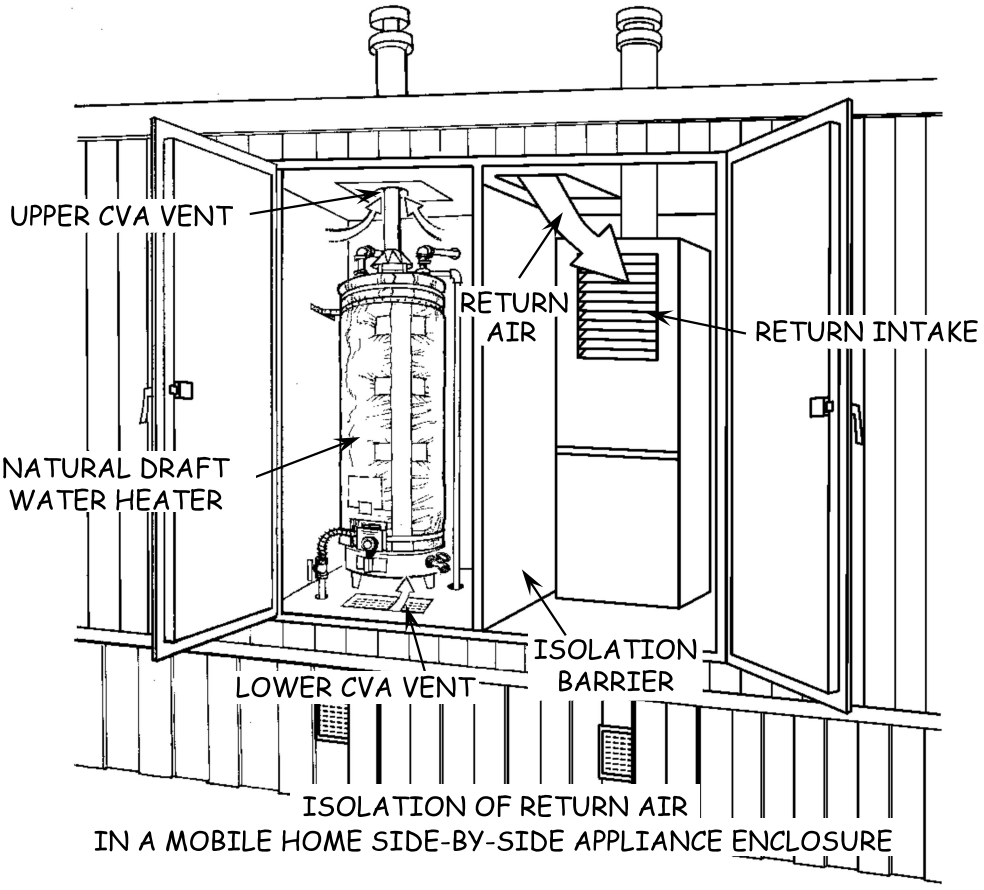
42. COMBUSTION AIR REQUIREMENTS

- **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 cross-ventilation shall be present in the skirting.
  - Skirting vents on each side shall provide at least 1.5 sq. ft. NFVA for each 25 linear feet of mobile home length.



43. ISOLATION OF RETURN AIR

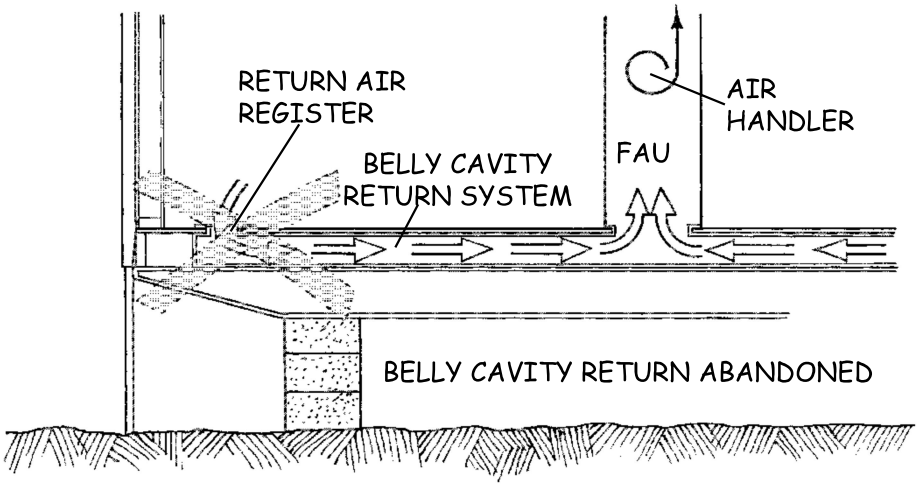
- **Gas water heater and FAU in adjacent enclosures**
  - Water heater enclosure shall not be depressurized by an FAU enclosure that serves as the return plenum.
  - An “isolation barrier” that provides an airtight separation between enclosures must be present when infiltration-reduction measures are installed.



ISOLATION OF RETURN AIR
IN A MOBILE HOME SIDE-BY-SIDE APPLIANCE ENCLOSURE

44. AIR DISTRIBUTION SYSTEM

- **Belly cavity and roof cavity returns**
  - Existing belly cavity return shall be abandoned, and a new ducted central return shall be installed.
  - Existing leaky roof cavity return shall be repaired as applicable and replaced with a new central return when repair is needed but not feasible.
- **New central return**
  - Return shall be designed and installed in conformance with IS Section 10 (Duct Testing and Sealing) and HCD requirements.



NATURAL GAS WALL AND FLOOR FURNACE REPAIR AND REPLACEMENT

Lead Paint Risk Factor
LOW-HIGH

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SECTION 19 PREFACE
for

NATURAL GAS WALL AND FLOOR FURNACE REPAIR AND REPLACEMENT

1. Nonfeasibility Criteria for Wall and Floor Furnace Repair and Replacement

1.1. Existing furnace is inaccessible.

1.2. Property is renter-occupied.

1.3. Fuel used by the existing unit is not supplied by the utility providing ESA Program services.

1.4. No furnace is present, and no natural gas line is available to accommodate the installation of a furnace.

1.5. Adequate access and/or combustion air cannot be provided.

1.6. Existing open combustion appliance is in a location prohibited by the replacement unit instructions or local code, and relocation to an approved location is not feasible.

1.7. Repair: Cost to repair is more than 40% of the cost to replace the unit.

1.8. Replacement: Existing furnace can feasibly be repaired (e.g., repair cost is 40% of replacement cost or less).

1.9. Customer refuses.

2. Nonfeasibility Criteria for Installation or Repairs Requiring Attic or Crawl Space Access

2.1. Crawl clearance is inadequate:

a. Attic Clearance
   - Clearance is less than 24" between top of ceiling joists and bottom of ridge board.
   - Obstruction(s) in the attic, such as truss cross members, provide an opening with a minimum dimension of less than 18".

b. Under-Floor Clearance
   - Clearance is less than 18" from the ground to bottom of floor joist system (girders under a mobile home).
   - Crawling under or over an obstruction in the crawl area is required, and the crawl clearance is less than 12".

c. Confined Spaces: state and federal regulations regarding confined spaces cannot be met.

2.2. Unsafe condition exists:

a. Attic and Crawlspace
   - Hazardous insect or pest infestation is present.
   - Hazardous electrical wiring.
   - Structural hazard.

b. Crawlspace
   - Excessive ground moisture (standing water or mud) is present.
   - Sewage waste is on the ground or other unsanitary condition is present which poses a health and safety hazard.

3. Furnace Repair/Replacement Policies

3.1. Furnace repair or replacement may be provided only under the following conditions:

a. The appliance fails NGAT, and correction cannot be achieved with service/adjustment[1] by utility gas service personnel (or their designated representative).

b. The furnace is non-operable.

c. No furnace is present and the household uses another gas appliance for space heating.

d. When allowed by individual utility policy.

3.2. A furnace fails NGAT if it is not abandoned or inaccessible and cannot be made operable through servicing.

3.3. A furnace may be replaced only if the cost of repairing the unit would be more than 40% of the cost of replacement.

3.4. Furnace repair or replacement may be provided only if the residence is owner-occupied. Service/adjustment[1] may also be conducted in renter-occupied homes.

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

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

3.7. Installer must have a C-20 HVAC license.

4. Installation Policies Specific to Mobile Homes

None.

[1] See definitions.

NATURAL GAS WALL AND FLOOR FURNACE REPAIR AND REPLACEMENT STANDARDS

PART 1: MATERIALS

1. APPROVED MATERIALS

- **All furnaces**
  - Units shall be in conformance with the current CBC, CMC, Title 24 Residential Compliance Manual and Title 20 Appliance Efficiency Regulations.
  - All units and components shall be UL-listed and/or be certified by CSA or AGA.
  - Unit shall be the most efficient model feasible to install, but no lower in efficiency than specified in Table 19-1.
- **Gas pipes and valves**
  - Gas valves shall be UL-listed and CSA- or AGA-certified.
  - Gas flexible connectors shall be listed epoxy-coated or stainless steel.
  - Pilot tubing shall be seamless aluminum (copper not allowed).
  - Fuel gas piping:
    - Shall be selected, sized, and installed per the current CMC.
    - Copper gas lines not allowed.

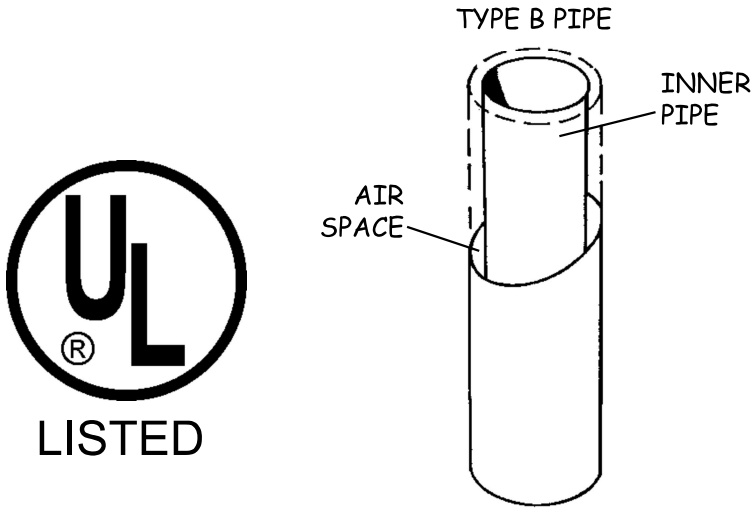
Table 19-1: Minimum Efficiencies of Replacement Furnaces

Furnace Type	Btuh Output Capacity	Minimum AFUE (%)
Wall with Fan	• Up to 42,000 • More than 42,000	• 75% • 76%
Wall without Fan	• 10,001–27,000 • 27,001–46,000 • More than 46,000	• 65% • 66% • 67%
Floor	• Up to 37,000 • More than 37,000	• 57% • 58%

- **Metal vent pipes**
  - All metal vent pipes, vent connectors and components shall be UL-listed and in compliance with furnace manufacturer's specifications.
  - Gas vent pipe shall be Type B. (Type BW for wall furnaces.)
- **Standard wall thermostat**
  - Thermostat shall be/have:
    - In conformance with manufacturer's instructions.
    - Positive on/off switch.
    - Compatible with the furnace it will control.
    - Digital with anti-short cycle feature.
  - Programmable thermostat is not required.

2. WARRANTY

- **Refer to IS Appendix F (Minimum Warranty Requirements).**



METAL PIPES AND ASSEMBLIES
UL-LISTED AND
MANUFACTURER-COMPLIANT

PART 2: FURNACE REPLACEMENT

3. GENERAL REQUIREMENTS

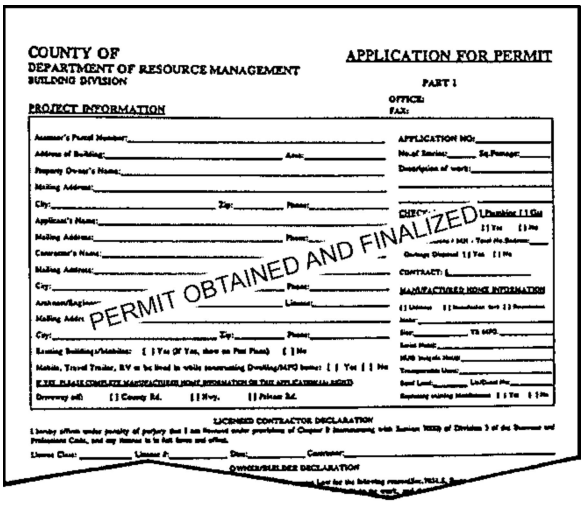
- **All installations**
  - A permit for the installation shall be obtained from and finalized by the local jurisdiction.
  - Installation shall be in compliance with:
    - Manufacturer's instructions and specifications.
    - Title 24 Residential Compliance Manual.
    - CEC, CMC, and local code.

4. DESIGN AND PERFORMANCE

- **System design**
  - Heating capacity and system design shall be in conformance with local code and Title 24 Residential Compliance Manual.
- **Performance**
  - Furnace shall perform as designed.

5. FURNACE INSTALLATION

- **Venting**
  - Appliance venting shall be in conformance with manufacturer's installation instructions and venting tables.
  - Existing vent pipe may be used if it is in good condition and complies with unit listing, manufacturer's instructions, and local code.
- **Plumbing/piping**
  - Only new parts shall be used; used parts not allowed
  - Shutoff valve shall be present in accordance with local code.
- **Electrical wiring**
  - All conductors and connections shall be in accordance with manufacturer's instructions and local code.


COUNTY OF
DEPARTMENT OF RESOURCE MANAGEMENT
BUILDING DIVISION

APPLICATION FOR PERMIT

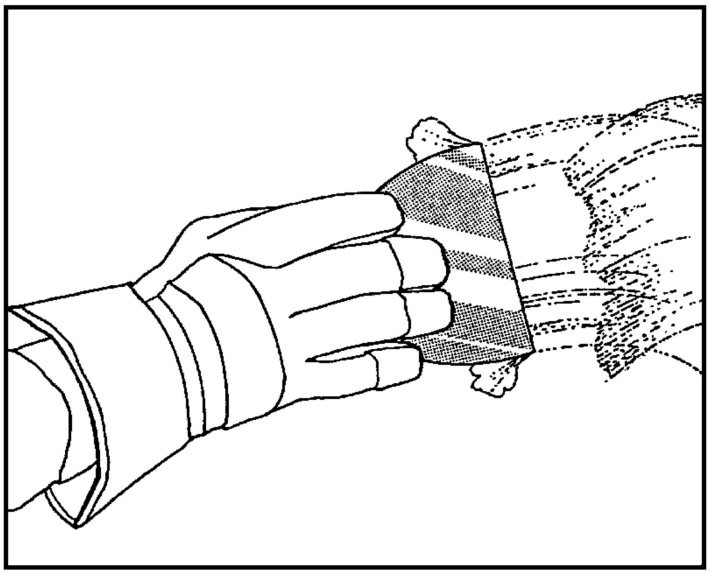
PART 1

PROJECT INFORMATION

PERMIT OBTAINED AND FINALIZED

5. FURNACE INSTALLATION (cont.)

- **Wall and Floor Repairs**
  - Surface of repair shall match plane of adjacent material.
  - Patching shall blend with surrounding surfaces.
  - Floor openings shall be closed in a workmanlike manner.
  - All construction debris shall be removed from the crawlspace and the premises.



FINISH WALL PATCH WITH SPACKLING OR DRYWALL COMPOUND

6. COMBUSTION AIR

- **All installations**
  - Combustion air shall be provided in accordance with manufacturer's instructions and local code. See IS Appendix A (Combustion and Ventilation Air Requirements for Natural Gas Appliances).
- **Open combustion wall furnaces**
  - Volume of the room or space from which combustion air is obtained shall meet code requirements.
- **Floor furnaces**
  - Under-floor spaces shall have free flow of air in accordance with code requirements.

APPENDIX – A

COMBUSTION AIR 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[2,6]
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	[illegible]	25.0
55,000	2,750	100	18.3	[illegible]	27.5
60,000	3,000	100	[illegible]	[illegible]	30.0
65,000	3,250	100	[illegible]	[illegible]	32.5
70,000	3,500	100	[illegible]	[illegible]	35.0
75,000	3,750	100	[illegible]	18.8	37.5
80,000	4,000	100	[illegible]	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	[illegible]	[illegible]	38.8	[illegible]
160,000	8,000	[illegible]	[illegible]	40.0	[illegible]
165,000	8,2[illegible]	[illegible]	[illegible]	41.3	[illegible]

[illegible] one ope[illegible] is allow[illegible]

EXAMPLE

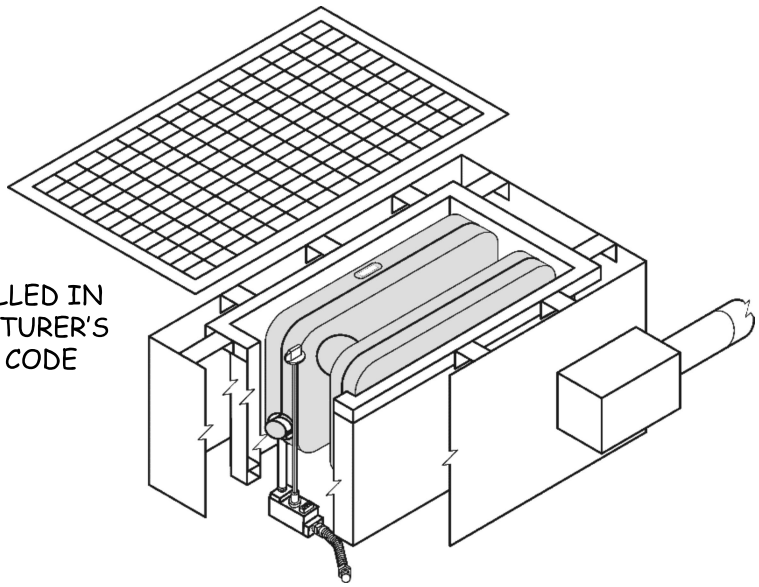
7. WALL FURNACE REPLACEMENT

- **General requirements**
  - A wall furnace shall not be installed in a sleeping room *unless* it is a direct vent unit approved for such installation by the local jurisdiction.
  - Modifications shall not be made to the furnace (e.g., cutting support legs) *unless* allowed by manufacturer.
  - Finished installation shall include blocking of all unnecessary holes in wall studs, floor, and bottom plate.
  - Unit shall be properly aligned and free of metal stress expansion that causes banging and metal ticking.
  - Existing parts (e.g., header plate) shall not be re-used on new installations.
  - Clearances shall be maintained in accordance with the requirements of the listing, manufacturer's installation instructions, and local code.

8. FLOOR FURNACE REPLACEMENT

- **General requirements**
  - Furnace shall not be installed in a bedroom
  - Floor opening shall be framed on all four sides, and furnace cabinet shall be secured to structural framing.
  - Location, access, clearances, and installation shall be in compliance with manufacturer's instructions and local code.
- **Controls**
  - Control valve operation must be accessible from inside the residence.
  - Pilot light must be accessible for lighting from inside the residence.

FLOOR FURNACES ARE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS AND LOCAL CODE

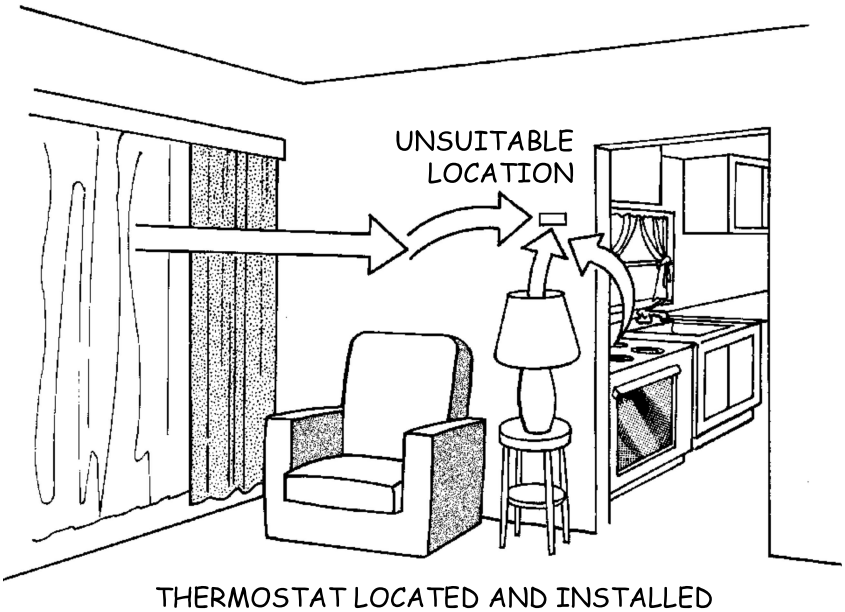


9. THERMOSTAT INSTALLATION

- **Location and mounting**
  - Thermostat installation shall be in compliance with IS Section 18 (Natural Gas Central Forced Air Heating System R&R), Part 4.

10. GAS LINES, FITTINGS, AND VALVES

- **All installations**
  - All gas piping, fittings, and valves shall be installed in conformance with manufacturer's instructions and local code.
    - Gas shutoff valve shall be in good condition and in conformance with Item 1.
    - Gas flexible connector shall be new. (Existing connector shall not be re-used.)
    - Existing copper components shall be replaced with approved material.
  - All new and affected lines and components shall be checked for gas leaks by a method approved by the local jurisdiction, which may include one of the following:
    - Commercial leak detection liquid.
    - Electronic leak detector.
    - Pressure test of the line.



THERMOSTAT LOCATED AND INSTALLED
IN ACCORDANCE WITH IS SECTION 18, PART 4

11. VENT SYSTEMS (FURNACE REPLACEMENT)

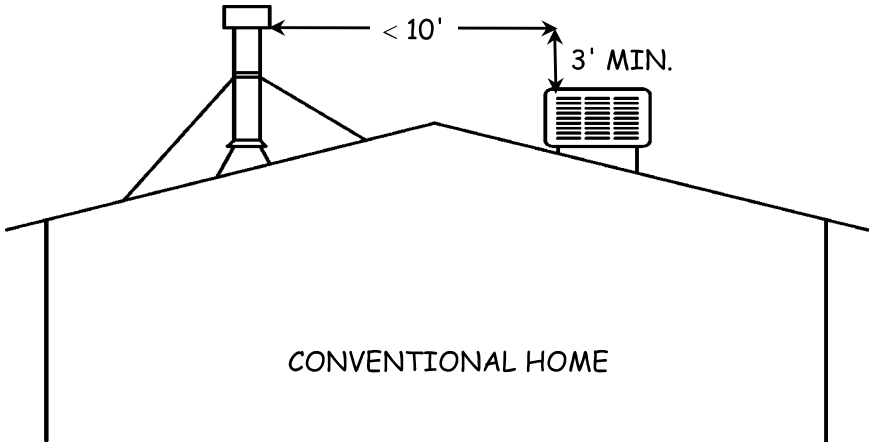
- **Installation**
  - New vent system shall be installed, terminated, and secured in conformance with the manufacturer's instructions and local code.
  - Vent pipe within 10' of an evaporative cooler shall terminate at least 3' above the cooler inlet.
  - Applies to all furnace types including direct vent wall furnaces.

12. ACCESS AND SERVICE SPACE

- **All installations**
  - Access and service space shall be provided in accordance with manufacturer's instructions and local code.
- **Floor furnace**
  - Control valve operation must be accessible from inside the residence.
  - Pilot light must be accessible for lighting from inside the residence.

13. CO AND DRAFT

- **Testing**
  - The appliance shall be tested and be in compliance with manufacturer’s specifications and the requirements in IS Section 24 (NGAT).



14. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS—FURNACE REPLACEMENT

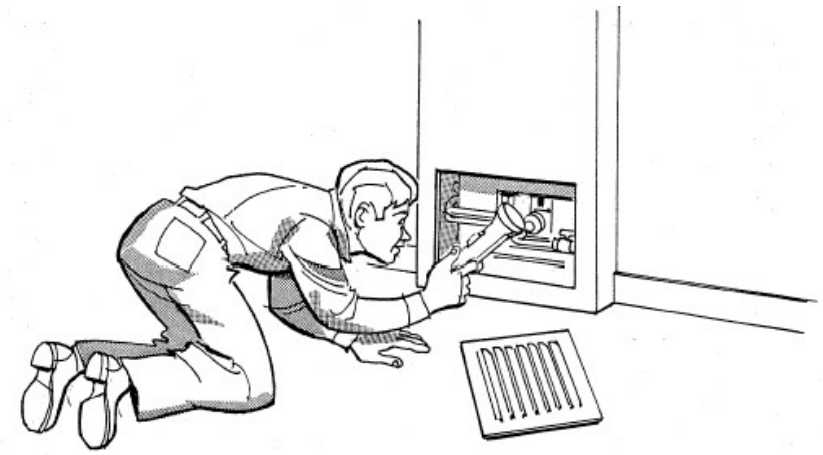
- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Appliance operation**
  - The installed unit shall be tested and shall operate properly.
  - Proper operation shall be explained and demonstrated to the customer, including:
    - Operation of all user-accessible controls, and
    - Routine maintenance recommended by the manufacturer.
  - Manufacturer's written instructions and warranty documents shall be supplied to the customer.
- **Clean-up and disposal**
  - All packing materials and installation debris shall be cleaned up and removed from the premises.
  - All replaced equipment and parts shall be removed from the premises and properly disposed of unless specified otherwise by the customer.

CUSTOMER RECEIVES
VERBAL AND WRITTEN INSTRUCTIONS
AND WRITTEN WARRANTIES

PART 3: FURNACE REPAIRS

15. PRELIMINARY EXAMINATION

- **The furnace shall be checked for defects, including but not limited to the following:**
  - Gas leaks at valves, fittings, joints, or flexible gas connectors.
  - Presence of copper gas line or butt-soldered joints.
  - Inadequate/improper combustion air venting.
  - Controls or thermostats defective or in need of adjustment.
  - Loose or missing components.
  - Improper alteration of the heating unit.
  - Vent system defects, such as:
    - Disconnections, leaks, obstructions, etc.
    - Defective/missing vent cap.
    - Misaligned, defective, missing, or multiple draft hoods.
    - Inadequate clearance from combustibles.
    - Improper termination.
    - Double-wall pipe not used where required (e.g., past ceiling/wall).
  - Excessive rust in the draft hood or heat exchanger.
  - Heat exchanger defects (e.g., cracks, holes, deterioration).
  - Improper position of pilot generator, pilot, or flame.
  - Burner defects, such as:
    - Dirty or improperly adjusted.
    - Excessive soot or rust.
    - Flame impingement and/or abnormal flame.
    - Delayed or rollout ignition.
    - Incorrect orifice.
    - Over- or under-fired.



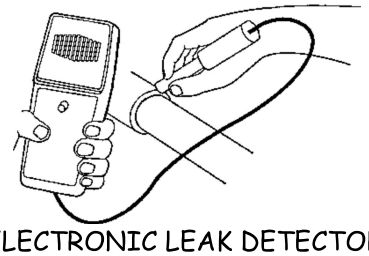
BURNERS & HEAT EXCHANGER CHECKED FOR DEFECTS

16. HEATING UNIT INTEGRITY

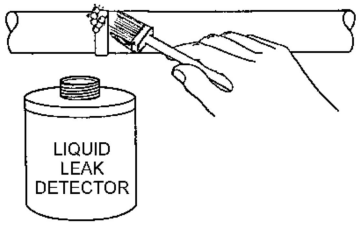
- **Furnace**
  - Loose items (e.g., screws, bolts, panels, etc.) shall be tightened.
  - Missing/damaged components critical to proper operation (e.g., access doors, roll-out shield, etc.) shall be replaced/repaired.
  - Improper alterations that adversely affect unit operation shall be corrected.
- **Heat exchanger inspection**
  - Heat exchanger shall be visually inspected for evidence of damage, deterioration, obstruction, etc.
  - Such inspection may require additional steps, which include but are not limited to smoke bomb testing and heat exchanger removal.

17. GAS PIPING AND VALVES

- **All installations**
  - All new and affected lines and components shall be checked for gas leaks by a method approved by the local jurisdiction, which may include one of the following:
    - Commercial leak detection liquid.
    - Electronic leak detector.
    - Pressure test of the line.
  - Nonconforming items, including the following, shall be replaced with materials conforming to applicable code requirements:
    - Defective gas shutoff valve or pipe fittings.
    - Rigid or flexible copper connector.
    - Old-style flexible gas connectors with butt-soldered joints.



ELECTRONIC LEAK DETECTOR



LIQUID LEAK DETECTION LIQUID

18. WIRING

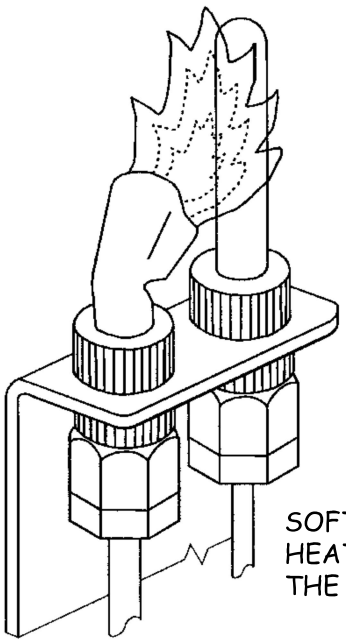
- **All units**
  - Unit shall be free of wiring defects (e.g., frayed or burned wires, loose or improper connections, etc.).

19. THERMOSTATS AND CONTROLS

- **Wall thermostat**
  - Thermostat shall function properly:
    - Anticipator correctly set to 24-volt heating control circuit amperage, when applicable.
    - Wiring connections correct and tight.
    - Unit level and securely installed.
- **Controls**
  - Furnace controls shall operate in accordance with manufacturer's specifications.
  - Gas control valve
    - Valve shall function properly and be free of leaks and electrical defects (e.g., short or open).
    - Gas pressure adjusted per manufacturer's specifications.

20. PILOT AND THERMOCOUPLE/PILOT GENERATOR

- **Requirements**
  - Thermocouple or pilot generator shall be correctly positioned in pilot flame.
  - Pilot flame shall be properly adjusted.
  - Voltage output shall be within specifications for proper operation of the gas control valve.



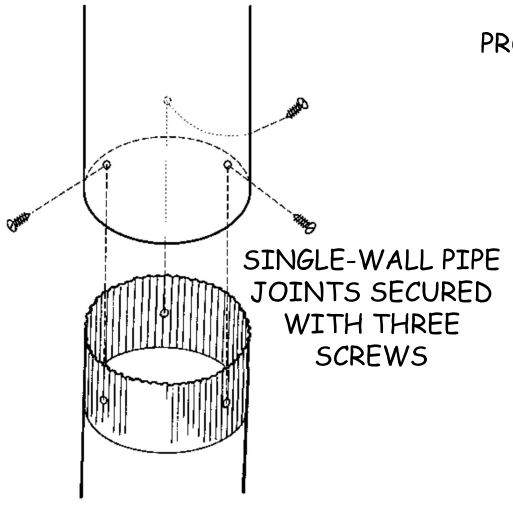
SOFT, STEADY PILOT FLAME HEATING TOP HALF-INCH OF THE THERMOCOUPLE

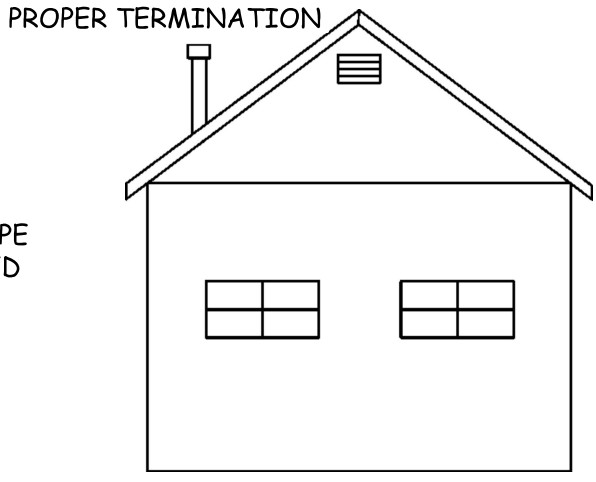
21. VENT SYSTEM (FURNACE REPAIR)

- **All systems**
  - Vent system defects shall be corrected.
- **Single-wall vent pipes**
  - Joints and connections shall be secured with three evenly spaced sheet metal screws when:
    - New components are installed.
    - Existing connections are loose or unsafe.
- **Double-wall Type B or BW vent pipes**
  - Shall not be drilled or have screws installed, unless permitted by the manufacturer and local code.
  - Shall be present where required by code (e.g., beyond the draft hood).
- **Termination**
  - Vent termination shall be in conformance with local code.
  - Vent pipe within 10' of an evaporative cooler shall terminate at least 3' above the cooler inlet, unless an exception listed in IS Section 24 (NGAT) applies.

22. COMBUSTION AIR AND APPLIANCE DRAFT

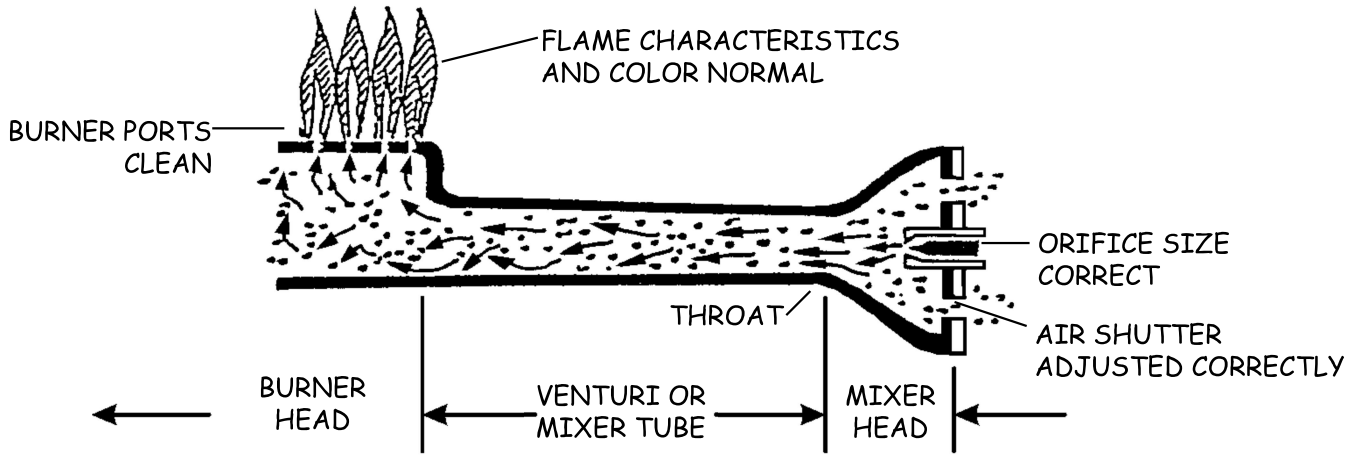
- **Combustion air**
  - Adequate combustion air shall be available to the furnace in accordance with Item 6.
- **Appliance draft**
  - Drafting shall be checked and verified to be acceptable in accordance with IS Section 24 (NGAT).





23. BURNERS

- **The furnace shall be checked for evidence of combustion problems, such as the following, and necessary corrections shall be made.**
- **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.
- **Carbon and rust**
  - The top of the burner(s), the heat exchanger, draft hood, and vent pipe shall be examined for excessive amounts of carbon or rust.
- **Burners and venturis**
  - Shall be clean, and ports shall be unobstructed.
  - Burners shall be correctly aligned/positioned.
- **Burner operation**
  - Air shutters shall be clean and adjusted for correct air/gas mixture.
  - Gas pressure shall comply with manufacturer's specifications.
  - Burner shall not be under- or over-fired.
- **CO**
  - CO in flue gas shall be within limits specified by:
    - Manufacturer's instructions and
    - IS Section 24 (NGAT).



24. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION/REPAIR REQUIREMENTS—FURNACE REPAIR

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Appliance operation**
  - The installed unit shall be tested for proper operation.
  - Proper operation shall be explained and demonstrated to the customer, including:
    - Operation of all user-accessible controls.
    - Routine maintenance recommended by manufacturer.
  - All manufacturer's written instructions and warranty documents shall be supplied to the customer.
- **Clean-up and disposal**
  - Paint dust and chips, scraps, and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - All packing materials and installation debris shall be cleaned up and removed from the premises.
  - All replaced equipment and parts shall be removed from the premises and properly disposed of unless specified otherwise in the home improvement contract.

CUSTOMER RECEIVES
VERBAL AND WRITTEN INSTRUCTIONS
AND WRITTEN WARRANTIES

MOBILE HOME CRITERIA

25. PERMITS

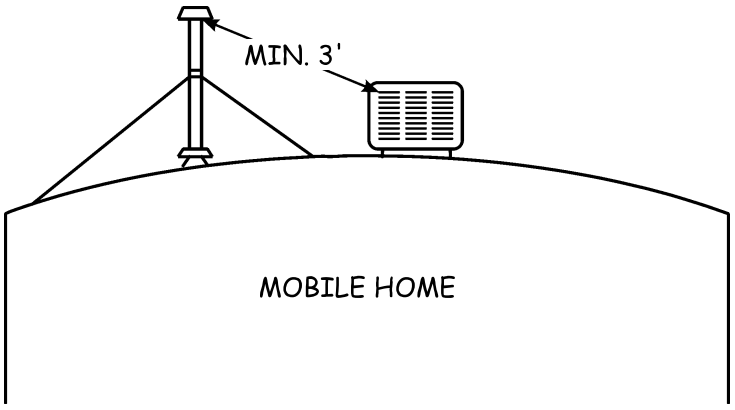
- **All units**
  - A permit shall be obtained for replacements in accordance with HCD regulations and for repairs when required by HCD.

26. MATERIALS AND REPAIRS

- **All furnaces**
  - Furnace installed in a mobile home shall be listed for installation in a mobile home and be in compliance with HCD regulations.
  - Repairs shall be made in compliance with HCD regulations when applicable.

27. MOBILE HOME VENT TERMINALS

- **Furnace vent terminals**
  - A new vent pipe located near an evaporative cooler shall terminate at least 3' from the cooler intake.
  - An existing vent pipe that is not altered or replaced may terminate closer than 3' from the cooler intake under any of the following conditions:
    - The cooler is equipped with a cooler cover or
    - All cooler discharge openings are equipped with a vent cover or
    - The cooler has been removed and the roof opening is sealed.
  - When a cover-related exception applies, the occupants shall be advised to keep the cover(s) in place during the heating season:



SMART THERMOSTATS

Lead Paint Risk Factor
NONE

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MOBILE HOME CRITERIA 4

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SECTION 20 PREFACE
for

SMART THERMOSTATS

1. Nonfeasibility Criteria

1.1. A smart thermostat is already present and operational.

1.2. The dwelling does not have an existing central FAU system nor is one being installed as part of the ESA Program.

1.3. The existing HVAC system is inoperable, and repair/replacement is not feasible.

1.4. The HVAC system uses a thermostat that is a) millivolt type, or b) labeled for 120V or 240V (line voltage wiring is present).

1.5. The HVAC system does not use a 24V wall-mount nonprogrammable or programmable HVAC thermostat.

1.6. Electrical or other safety issues are present that cannot feasibly be repaired.

1.7. Fuel used by the existing heating and/or cooling equipment is not supplied by the utility providing ESA Program services.

1.8. Customer refuses.

2. Installation Policies

2.1. Non-functioning or missing nonprogrammable or programmable thermostats that control an existing central HVAC system may be replaced with a smart thermostat.

2.2. Thermostat must be used to control heating and/or cooling equipment.

2.3. With approval from the customer and when feasible, smart thermostats may be connected to the manufacturer's cloud via Wi-Fi.

2.4. Homes that do not have Wi-Fi are eligible to receive smart thermostats.

3. Installation Policies Specific to Mobile Homes

None.

SMART THERMOSTAT STANDARDS

1. APPROVED MATERIALS

- **Thermostat shall be:**
  - Classified as a “Smart” or “Learning” thermostat (may communicate to, or be controlled by, a “smart phone” i.e. two-way communication).
  - Compatible with the forced air unit it controls.
  - ENERGY STAR-certified and UL-listed.
  - Basic time-of-day usage capable in the absence of connectivity to the thermostat service provider.
  - Capable of responding to Demand Response (DR) events.
  - Equipped with occupancy setback:
    - Occupancy sensor on device, or
    - Geofencing via other device, or
    - Programmable home-away setting.
  - Heat pump auxiliary heat optimization: Thermostat may optimize the use of the refrigerant heating cycle in preference to auxiliary heat, while still enabling the home to achieve a comfortable setpoint.
  - Weather-enabled optimization: Thermostat may use weather predictions and weather data to optimize the HVAC system.
  - Scheduled learning: Learns occupancy patterns with or without interaction from occupant.

SMART THERMOSTATS

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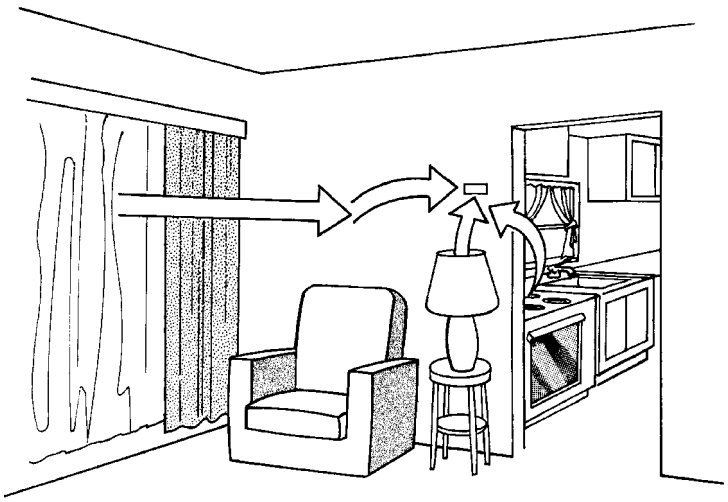
2. WARRANTY

- **Refer to IS Appendix F (Minimum Warranty Requirements).**

3. LOCATION

- **Thermostat shall be installed:**
  - At existing location, unless affected by drafts, heat from direct sunlight, or adjacent appliances.
  - In new locations:
    - Mounted with the top of unit 60” above the floor, or as low as 48” above the floor when the occupant uses a wheelchair.
    - In an area that is free of obstructions that would impede airflow around the thermostat (e.g., shelves, pictures, wall décor, etc.).
    - In the HVAC zone of which it is being used to control.
- **If a new location is required, the thermostat shall be mounted according to manufacturer specifications, or at a minimum it must be:**
  - Installed in or near a common area.
  - On a partitioning interior wall in a location of average temperature, away from:
    - Direct sunlight
    - Windows and entrance doors
    - Corners
    - Area behind interior doors
    - Supply air registers
    - Water pipes
    - Heat-producing appliances
    - Sources of electrical interference



THERMOSTAT MUST NOT BE AFFECTED BY
DIRECT SUNLIGHT, DRAFTS, OR ADJACENT APPLIANCES

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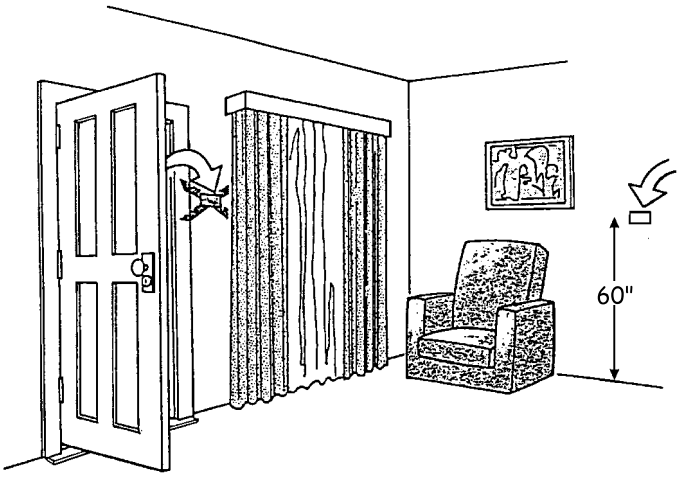
4. INSTALLATION

- **All units**
  - Manufacturer's instructions for installation shall be followed.
  - Power to the heating and/or cooling system shall be shut off prior to thermostat installation, unless otherwise specified by manufacturer instructions.
  - Mounting bracket shall be securely attached to the wall.
  - The hole where the wires come through the wall shall be sealed and shall not create drafts affecting thermostat accuracy.
  - Any holes/damage to wall created during installation shall be covered with the supplied trim plate or patched to match the existing wall finish.
  - When Wi-Fi is present, units shall be commissioned via Wi-Fi/Internet with the latest firmware.

5. ELECTRICAL REQUIREMENTS

- **All units**
  - Wiring continuity shall be verified (e.g. measured with multimeter) and wires shall be labeled prior to thermostat installation to ensure all wires are connected to their proper terminals.
  - All wiring shall be a minimum of 18-gauge, non-stranded wires and conform to manufacturer's specifications and local code.
  - When feasible, all wiring shall be installed in wall cavities.
  - Exposed wiring shall be enclosed in a raceway.
  - When a "C" wire in good condition is not present, install a new "C" wire or an approved thermostat manufacturer's compensating accessory.
- **Determine if existing thermostat wiring is line voltage, as indicated by:**
  - Existing thermostat being labeled 120V or 240V and/or,
  - Presence of line voltage wires and/or,
  - Voltage measurement with test instrument.



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6. OPERATIONAL CHECKS

- **Programming**
  - Smart thermostat shall be set-up and programmed in accordance with manufacturer's specifications and customer's preference.
  - When required, blower speed shall be set for equipment in accordance with manufacturer's instructions.
  - Time delay equipment shall be programmed in accordance with manufacturer's specifications and as appropriate for the climate zone.
- **Testing**
  - Manufacturer's test protocols shall be followed.
  - The thermostat shall be cycled to ensure proper operation of all functions.
  - If the unit does not operate as designed, recommended troubleshooting procedures shall be followed.

7. OPERATION AND INSTRUCTION

- **The following shall be explained to the customer:**
  - Proper operation of unit.
  - Contents of instruction pages.
  - Customer over-ride/control of settings.
  - Ability to override 'smart' settings.
  - Ability to re-program.

8. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up**
  - Thermostats containing mercury shall be disposed of in accordance with Universal Waste Regulations, as set forth by DTSC at: http://www.dtsc.ca.gov/HazardousWaste/Mercury_Therm_Act.cfm
  - Paint dust and chips, scraps, and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
- **Customer shall be provided with:**
  - Education on the proper use of the thermostat.
  - Written warranty documents and instructions.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

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CENTRAL HIGH-EFFICIENCY AIR CONDITIONER AND HEAT PUMP REPLACEMENT

Lead Paint Risk Factor
NONE

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SECTION 21 PREFACE
for

CENTRAL HIGH-EFFICIENCY AIR CONDITIONER AND HEAT PUMP REPLACEMENT

1. Nonfeasibility Criteria for Central A/C and Heat Pump Replacement

1.1. The existing A/C is not operational.

1.2. Individual utility policy does not allow replacement, based on existing A/C SEER or housing type.

1.3. Existing system is a combined furnace and A/C unit and the furnace has not passed NGAT when required by individual utility policy.

1.4. For a roof-mounted unit, the roof is not structurally adequate to support the installation.

1.5. Electrical service requirements cannot be met.

1.6. Ducts cannot be brought into compliance with IS Section 10 (Duct Testing and Sealing). Includes duct work that contains or is made of asbestos.

1.7. Existing system is a combined furnace and A/C unit and:

a. The gas is not provided by one of the IOUs, or

b. A natural gas appliance hazard exists, requiring repair or replacement per NGAT policy, and repair/replacement is not feasible, or

c. A central heat pump is not being installed as part of fuel switching or fuel substitution.

1.8. Duct system airflow is inadequate.

1.9. Split system refrigerant line set is inadequate.

1.10. Mobile Homes:

a. Proper isolation of return air at the FAU cannot be achieved, per IS Section 24 (Natural Gas Appliance Testing).

b. A belly cavity or leaky roof cavity return exists, and installation of a central return system is not feasible.

1.11. Customer refuses.

2. Nonfeasibility Criteria for Systems Requiring Attic or Crawl Space Access

2.1. Crawl clearance is inadequate:

a. Attic clearance

- Clearance is less than 24" between top of ceiling joists and bottom of ridge board.

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- Obstruction(s) in the attic, such as truss cross members, provide an opening with minimum dimensions of less than 18".

b. Under-floor clearance
   - Clearance is less than 18" from the ground to bottom of floor joist system (girders under a mobile home).
   - Crawling under or over an obstruction in the crawl area is required, and the crawl clearance is less than 12".

c. Confined Spaces: state and federal regulations regarding confined spaces cannot be met.

2.2. Unsafe condition exists:

a. Attic and Crawlspace
   - Hazardous insect or pest infestation is present.
   - Hazardous electrical wiring.
   - Structural hazard.

b. Crawlspace
   - Excessive ground moisture (standing water or mud) is present.
   - Sewage waste is on the ground or other unsanitary condition is present which poses a health and safety hazard.

3. Central A/C and Heat Pump Replacement Policies

3.1. Replacements will be offered only in approved climate zones.

3.2. A programmable/setback thermostat may be installed only if a central system is replaced.

3.3. Prior to installation, contractors installing programmable thermostats shall explain their operation and provide the customer an opportunity to refuse the measure.

3.4. HVAC filters may be replaced as part of central system replacement.

3.5. Contractors who replace filters must show customers how to remove, clean and reinstall the filters.

3.6. Replacement of refrigerant line sets is beyond the scope of the ESA Program.

4. Installation Policies Specific to Mobile Homes

None.

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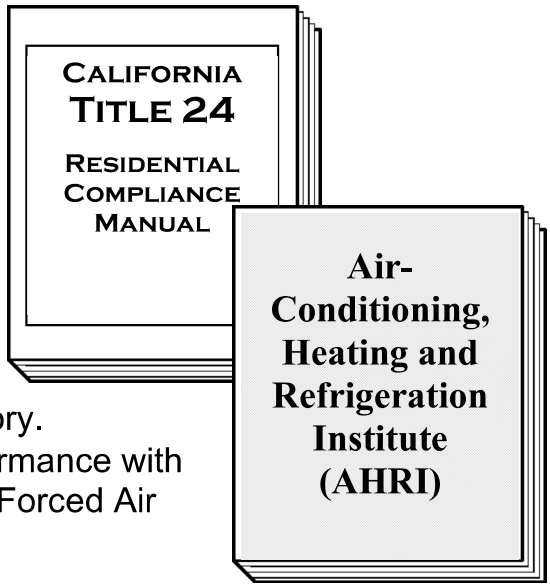
CENTRAL HIGH-EFFICIENCY AIR CONDITIONER AND HEAT PUMP REPLACEMENT STANDARDS

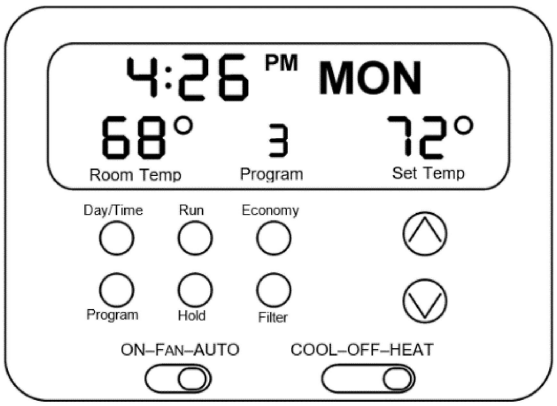
1. APPROVED MATERIALS

- **All units**
  - Shall be in conformance with the current CBC, CMC, DOE and Title 24 Appliance Efficiency Regulations.
  - All units and components shall be UL-listed (or equivalent) and/or have one of the following certifications: CSA or AHRI.
- **A/C**
  - Package units
    - A/C: Minimum SEER of 14 and minimum EER of 11.
    - If dual pack, the furnace shall be in conformance with IS Section 18 (Natural Gas Central Forced Air Heating System R&R).
  - Split systems
    - Minimum SEER of 14 and minimum EER of 12.2 with a TXV.
    - The SEER shall be determined by the coil and condenser combination as listed in the current AHRI Directory.
    - Furnace: Conformance with IS Section 18 (Natural Gas Central Forced Air Heating System R&R).
- **Heat Pumps**
  - Package units
    - Minimum HSPF of 8.
    - Minimum SEER of 14.
  - Split systems
    - Minimum HSPF of 8.2.
    - Minimum SEER of 14.
    - The SEER and HSPF shall be determined by the coil and condenser combination as listed in the current AHRI Directory.
  - Dual fuel: Furnace shall be in conformance with IS Section 18 (Natural Gas Central Forced Air Heating System R&R).



1. APPROVED MATERIALS (cont.)

- **Wall thermostats**
  - All types
    - Positive on/off switch.
    - Compatible with the HVAC equipment.
    - Digital with anti–short cycle feature.
  - Smart (learning) thermostats
    - ENERGY STAR-certified and in conformance with IS Section 20 (Smart Thermostats).
  - Programmable
    - System-powered, not battery-powered, on 24-volt systems.
    - Minimum setback capability of 10°F.
    - At least two setback periods per 24-hour day with change cycle increments no greater than 30 minutes.
    - Programmable for weekdays and weekends.
    - Manual override and standard alkaline battery backup or other program-saving backup system.
  - Standard wall thermostat
    - Alternative when customer refuses smart or programmable thermostat.



DIGITAL PROGRAMMABLE THERMOSTAT WITH BATTERY BACKUP

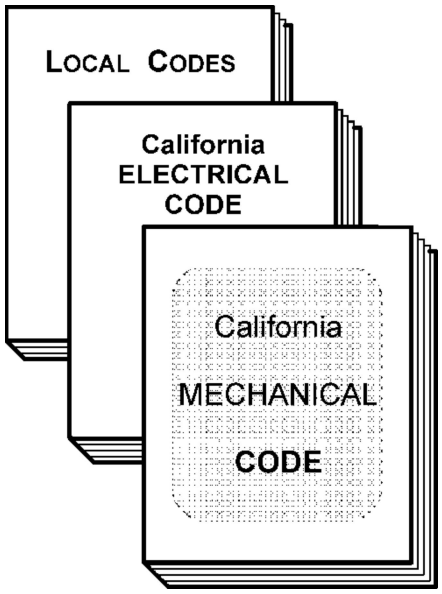
SMART THERMOSTAT

2. WARRANTY

- **HVAC equipment and thermostats**
  - Refer to IS Appendix F (Minimum Warranty Requirements).

3. GENERAL REQUIREMENTS

- **All installations**
  - A permit for the installation shall be obtained from and finalized by the local jurisdiction.
  - Installation shall be in compliance with:
    - Manufacturer's instructions and specifications.
    - Title 24 Residential Compliance Manual.
    - CEC, CMC, and local code.
- **Air filters**
  - Shall conform to manufacturer's specifications and be properly sized, secured, and supported.
  - Shall be rated at MERV 6 or higher for replacement FAUs.
  - Washable filters shall be in conformance with IS Section 18 (Natural Gas Central Forced Air Heating System R&R), Part 5.

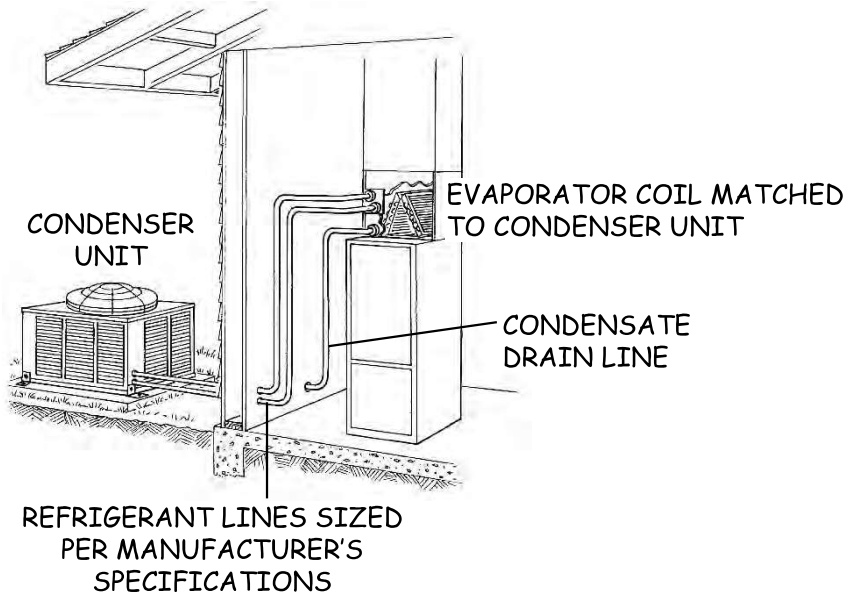


4. SIZING CRITERIA

- **System size**
  - Unit shall be sized in accordance with Title 24 Residential Compliance Manual.
- **Refrigerant lines**
  - Shall be properly sized per manufacturer's specifications.
  - Shall provide the rated SEER for the combination condenser and evaporator coil match.

5. EVAPORATOR COIL AND CONDENSER UNIT

- **Split systems**
  - An evaporator coil shall be installed that is verified to be a rated match with the condenser unit, as listed in current AHRI Directory.
  - The evaporator coil and condenser unit labels shall be visible.
  - Condenser coil and evaporator coil shall be verified to function properly.
  - An access panel shall be provided for cleaning.
- **Evaporator coil replacement**
  - Prior to charging, vacuum shall be drawn on the refrigerant lines to test for leaks and remove water vapor.
  - Depth of vacuum and length of time shall be as specified by the manufacturer.



6. OPERATIONAL REQUIREMENTS

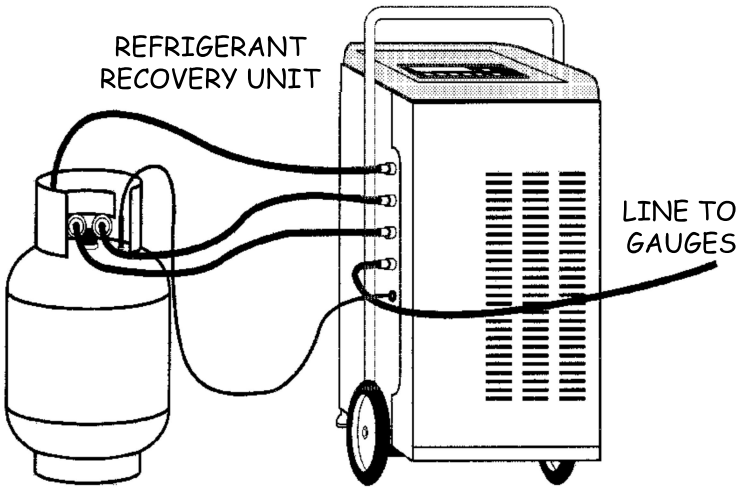
- **Airflow**
  - Airflow through the indoor coil shall be adequate to meet manufacturer's specifications.
- **Refrigerant system charging**
  - Refrigerant system shall be properly charged using methods specified by the manufacturer.
  - Refrigerant recovery, handling, and disposal shall be performed in accordance with federal law by a technician with EPA-approved certification as a type II or universal technician.

7. AIR DISTRIBUTION SYSTEM

- **All units**
  - Distribution system shall be in conformance with HVAC manufacturer's specifications, Title 24 Residential Compliance Manual, and IS Section 10 (Duct Testing and Sealing).
  - Existing duct system shall be examined for leaks and disconnections.

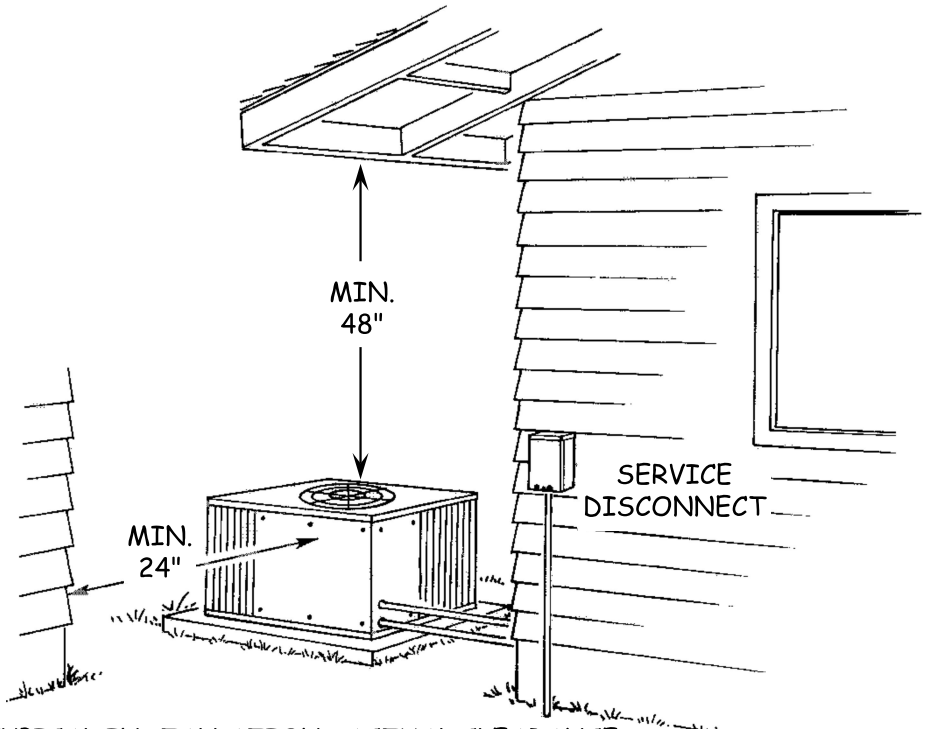
8. WALL AND FLOOR REPAIRS

- **All installations**
  - Surface of repair shall match plane of adjacent material.
  - Patching shall match texture of, and blend with, surrounding surfaces.
  - Floor openings shall be closed in a workmanlike manner.
  - All construction debris shall be removed from the crawl space and the premises.



9. ELECTRICAL ACCESSIBILITY AND GROUNDING

- **All equipment installations**
  - Proper access and working space shall be provided per the CEC.
- **Open space for panels and equipment**
  - An open space shall be provided around electrical panels and equipment requiring servicing and shall be minimum 30" wide by 36" deep or as specified by local jurisdiction.
- **Accessibility for equipment**
  - The equipment shall be accessible for inspection, service, repair, and replacement without removing permanent construction.
  - Minimum clearance between equipment and the adjacent structure/wall/obstruction shall be:
    - Five feet from clothes dryer moisture exhaust (to avoid moisture and lint),
    - Three feet from gas meter set assembly,
    - Forty-eight inches above unit,
    - Twenty-four inches on side(s) containing service access panels, and
    - Twelve inches on all other sides, or
    - As specified by manufacturer and local jurisdiction, if more stringent.



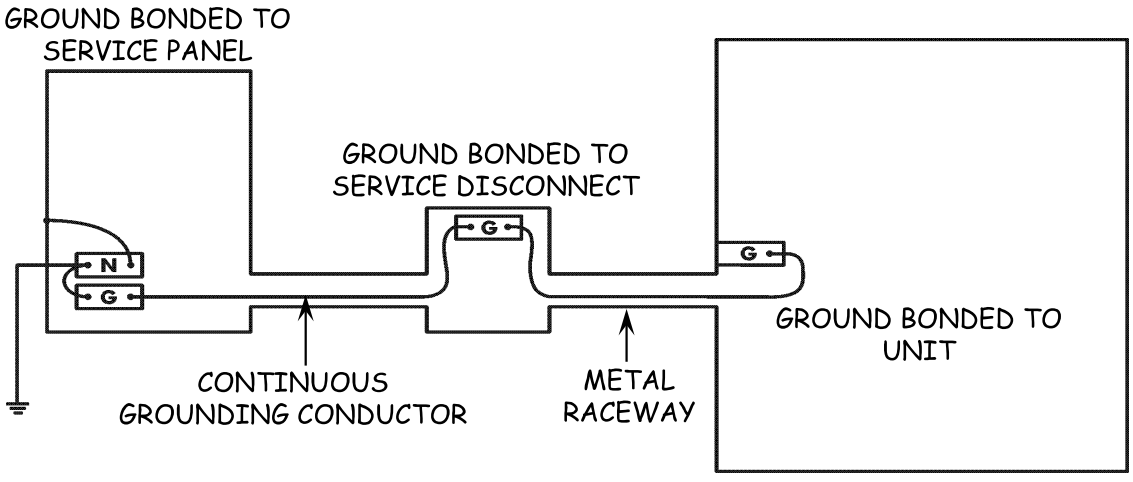
TYPICAL INSTALLATION—ACTUAL CLEARANCES MUST CONFORM TO MANUFACTURER'S INSTRUCTIONS & LOCAL CODE

9. ELECTRICAL ACCESSIBILITY AND GROUNDING (cont.)

- **Service receptacle**
  - A 120-volt grounded exterior service receptacle shall be:
    - Located within sight of the equipment up to 25' (or attached to it).
    - On the supply side of the disconnect switch.
    - On the roof adjacent to the equipment (if unit is roof-mounted).
- **Grounding**
  - Equipment shall be grounded in conformance with manufacturer's instructions and local code.
  - Grounding shall provide a continuous path to the service ground with all disconnects and controllers in the open position.

10. BRANCH-CIRCUIT PROTECTION

- **General requirements**
  - Branch-circuit overcurrent protection, and ground-fault protection, in accordance with manufacturer's instructions, CEC Article 440, and local code.
  - Equipment shall be provided with a disconnecting means.
  - The overcurrent protection device shall be the type and amperage specified on the equipment nameplate.



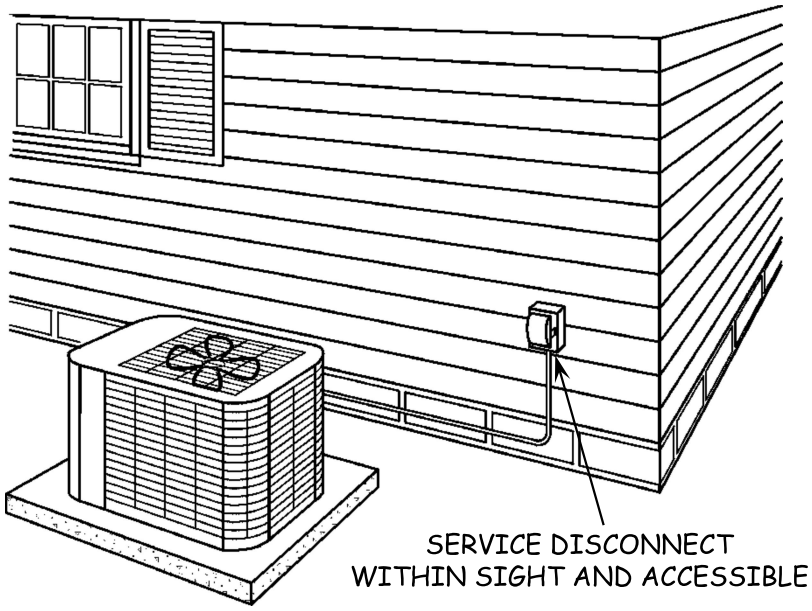
CONTINUOUS GROUNDING PATH FROM SERVICE PANEL TO UNIT PROVIDED BY CONDUCTOR OR RACEWAY

11. BRANCH CIRCUIT CONDUCTORS

- **Branch circuit conductors shall be in conformance with the CEC requirements for:**
  - Ampacity and rating of conductors.
  - Voltage drop and wire length.

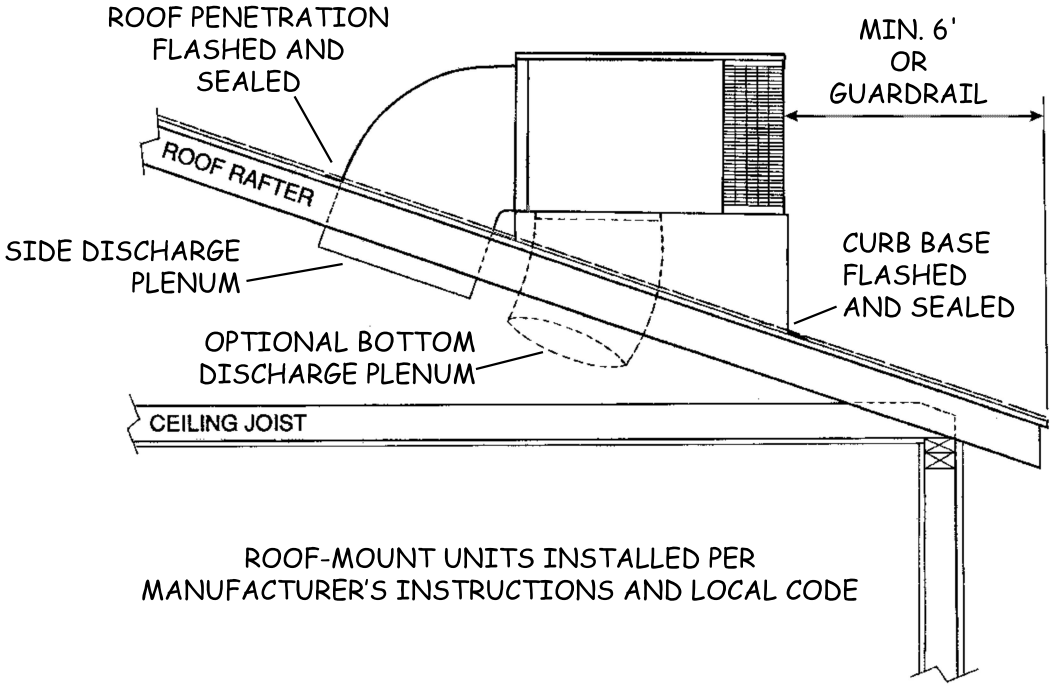
12. UNIT DISCONNECTING MEANS (SERVICE DISCONNECT)

- **The service disconnect:**
  - Shall be located within sight of and be readily accessible from the equipment, or as required by the local jurisdiction.
  - May be installed on or within the equipment.
- **Rating**
  - The rating of the installed fuses or circuit breakers shall not exceed the rating of the installed equipment.



13. MOUNTING OF EQUIPMENT

- **Roof-mount**
  - The roof shall be structurally adequate to properly support the installed equipment in conformance with CBC and local code.
  - Design and installation of support frame or curb and installation of equipment and applicable safety apparatus shall be in conformance with manufacturer's instructions and local code.
  - Curb base and exposed roof penetrations shall be properly installed, flashed, and sealed watertight.
  - The condensate drain line shall be:
    - Equipped with a trap.
    - Painted to resist UV degradation if PVC is used.
  - Roofing materials shall be in good condition and not in need of repair or replacement.

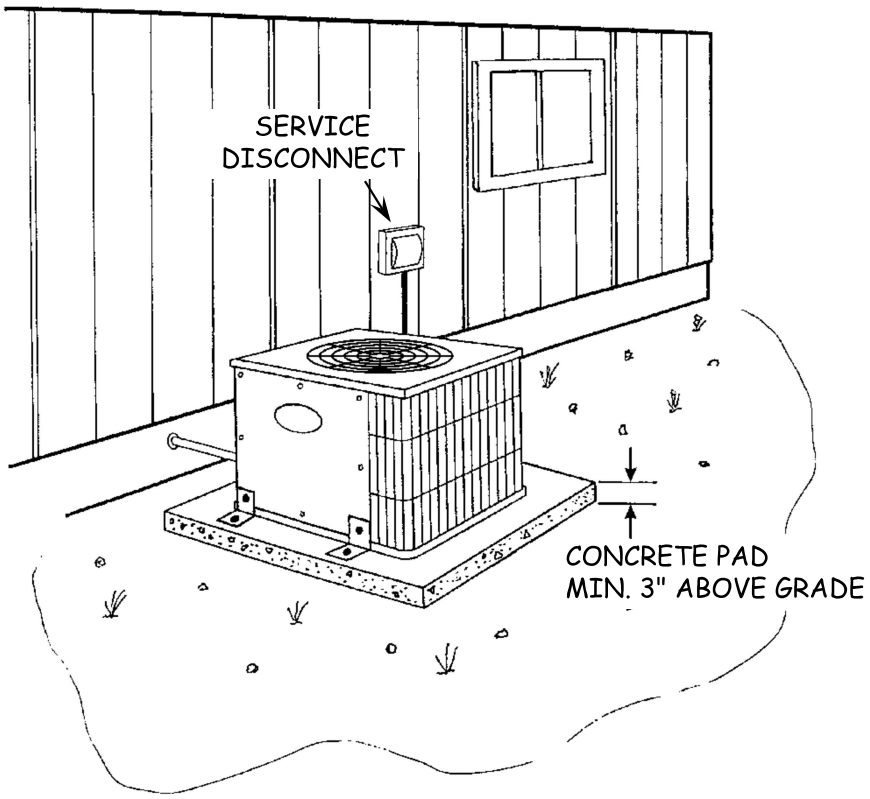


13. MOUNTING OF EQUIPMENT (cont.)

- **Ground-mount**
  - Equipment shall be installed in conformance with CMC and local code.
  - The unit shall rest on concrete or other approved base extending at least 3" above the adjoining ground level.
- **Protection**
  - Units subject to mechanical damage shall be protected in conformance with CMC and local code.
  - Unit shall be attached to base with seismic straps when required by local code.

14. REFRIGERANT THEFT PROTECTION

- **Outdoor units**
  - When a unit is repaired or replaced, locking caps shall be installed on accessible refrigerant service valves.
    - *Exception*: Locations requiring keyed access.
  - Locking caps shall be brass with integral O-ring and covering/plating that is color-coded or labeled for refrigerant type.



15. FUEL SWITCHING AND SUBSTITUTION

- **Pre-installation electrical assessment**
  - The existing circuit shall be checked for proper:
    - Overcurrent protection.
    - Presence and gauge of continuous ground.
    - Number and capacity of conductors.
  - If existing circuit is not adequate, or a circuit is not present, the main distribution panel and subpanel shall be evaluated for the feasibility of adding a new circuit, including:
    - Required amperage.
    - Overcurrent protection.
    - Additional conductors and grounding.
- **Replaced gas appliances**
  - Replaced appliances shall be disconnected and removed from the premises.
- **Remaining gas lines**
  - Disconnected gas lines resulting from fuel switching or fuel substitution shall be capped.

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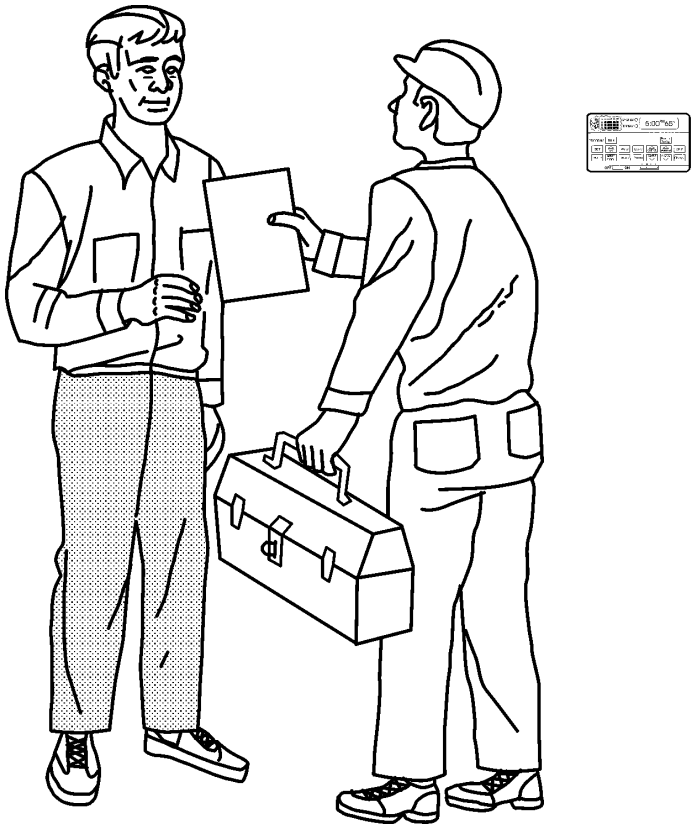
16. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Appliance operation**
  - The installed unit shall be tested for proper operation.
  - Proper operation shall be explained and demonstrated to the customer, including:
    - Operation of all user-accessible controls.
    - Filter replacement.
    - Routine maintenance recommended by manufacturer.
  - Manufacturer's written instructions and warranty documents shall be supplied to the customer.



INSTRUCTIONS AND WARRANTY
PROVIDED TO CUSTOMER

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16. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS (cont.)

- **Clean-up and disposal**
  - Paint dust and chips, scraps, and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Furniture and other household items moved for installation work shall be returned to their original positions.
  - All packing materials and installation debris shall be cleaned up and removed from the premises.
  - All replaced equipment and parts shall be removed from the premises and properly disposed of unless specified otherwise in the home improvement contract.
  - Refrigerant shall be recovered by a properly-licensed EPA-certified technician, and all hazardous waste materials shall be disposed of in conformance with federal, state, and local codes.

INFORMATION ABOUT HANDLING REFRIGERANT IS AVAILABLE AT THIS EPA WEBSITE:
https://www.epa.gov/section608

EPA United States Environmental Protection Agency

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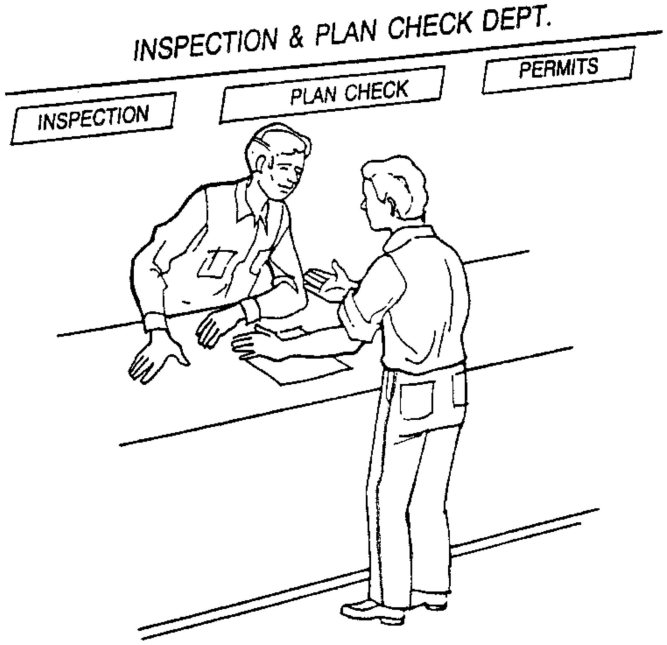
Section 21

MOBILE HOME CRITERIA FOR NEW A/C AND HEAT PUMP INSTALLATION

17. GENERAL REQUIREMENTS

- **Permit**
  - A permit shall be obtained from and finalized by:
    - HCD for installations inside the mobile home.
    - HCD, or as applicable the local building department, for installations outside the mobile home.
- **Standards and specifications**
  - Installation shall be in compliance with manufacturer's instructions and specifications, and, as applicable, with requirements of HCD and/or the local building department.
- **Materials installed within a manufactured home:**
  - Shall be in compliance with HCD regulations and HUD MHCSS (CFR, Chapter XX, Part 3280).
- **Materials installed outside a manufactured home:**
  - Shall be in compliance with HCD regulations or, as applicable, requirements of the local building department.

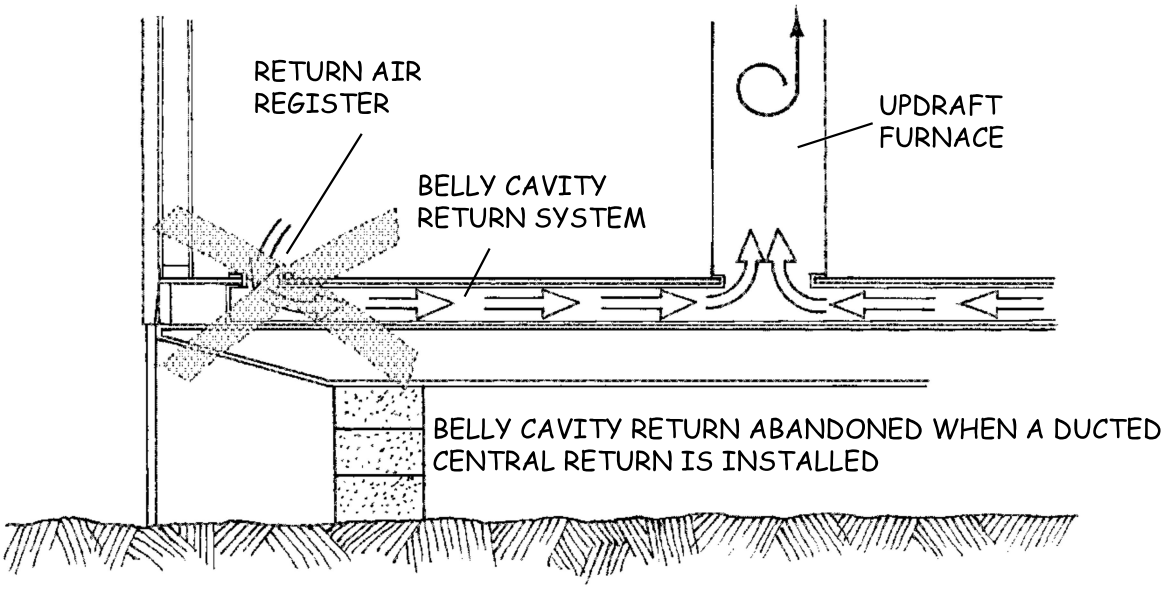


18. MOBILE HOME AIR DISTRIBUTION SYSTEM

- **Belly cavity and roof cavity returns**
  - Existing belly cavity return shall be abandoned, and a new ducted central return shall be installed.
  - Existing leaky roof cavity return shall be repaired, as applicable, and replaced with a new central return when repair is needed but not feasible.
- **New central return**
  - Return shall be designed and installed in conformance with IS Section 10 (Duct Testing and Sealing) and HCD requirements.
- **Cabinet and plenum**
  - Components shall be mechanically attached and sealed around the perimeter (cabinet-to-duct connector, cabinet-to-plenum) using materials and methods prescribed in IS Section 10 (Duct Testing and Sealing).
  - Plumbing and wiring penetrations into the evaporator coil box and return air chamber shall be sealed with cork tape.
  - For a split system, the return shall be isolated from combustion air.

19. ELECTRICAL WIRING, GROUNDING, AND ACCESSIBILITY

- **Unit shall be in conformance with:**
  - Manufacturer's instructions, and
  - HUD MHCSS, Section 3280, Subpart I, and/or, as applicable, requirements of the local building department.



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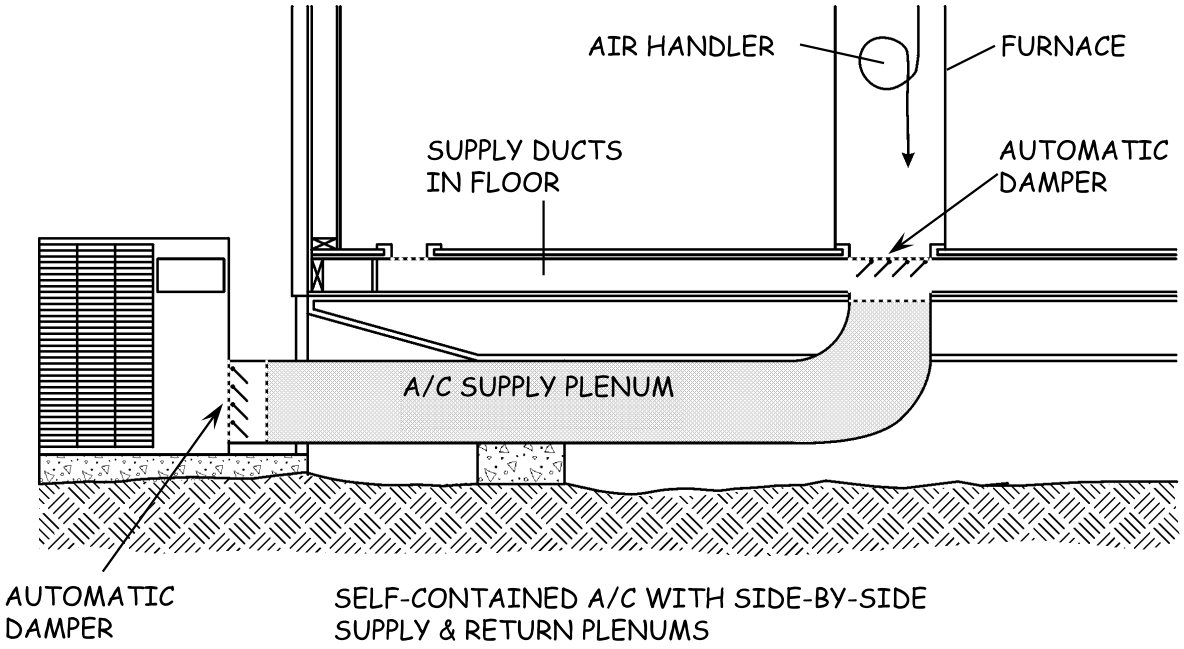
20. MOBILE HOME ADD-ON SELF-CONTAINED A/C

- **An installed self-contained A/C sharing a common supply duct system with the furnace shall comply with the following requirements:**
  - Automatic damper
    - Furnace shall have an automatic damper installed to prevent cold air from entering the furnace when the HVAC system is in cooling mode.
    - A/C shall have an automatic damper installed to prevent hot air from entering the A/C unit when the HVAC system is in heating mode.
  - Function control
    - Controls shall prevent the A/C and furnace from coming on at the same time.



SELF-CONTAINED A/C WITH SIDE-BY-SIDE SUPPLY & RETURN PLENUMS

WINDOW/WALL AIR CONDITIONER AND HEAT PUMP REPLACEMENT

Lead Paint Risk Factor
LOW-HIGH

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SECTION 22 PREFACE
for

WINDOW/WALL AIR CONDITIONER AND HEAT PUMP REPLACEMENT

1. Nonfeasibility Criteria

1.1. Unit is already present and operational, and is less than 15 years old.

1.2. Electrical requirements cannot be met: Wiring is substandard (e.g., ungrounded outlet, decayed insulation, exposed wires), and correction is not feasible.

1.3. Egress requirements cannot be met.

1.4. No feasible window or wall location available.

a. A structurally sound mounting platform and/or suitable mounting location is not available.

b. Exterior clearance requirements cannot be met.

c. Siding is decayed or damaged.

d. Window units:

- Unit cannot be installed because security bars are present on the window.
- Wood windows are decayed or deteriorated.

1.5. Customer refuses.

2. Installation Policies

2.1. High efficiency window/wall A/Cs may be installed only in approved climate zones.

2.2. Replaced units must be disposed of and recycled in compliance with all laws and regulations.

2.3. All units must be adequately supported and braced.

2.4. All replacement units shall be sized for the room area to be cooled.

2.5. When multiple window/wall A/C's are present in the same room:

a. If <u>all</u> units are eligible for replacement:

- All units may be replaced but their combined output must be sized for room area to be cooled, or
- A single unit sized for the room area to be cooled may installed as a replacement.

b. If only <u>one</u> unit is eligible for replacement:

- Only the eligible unit may be replaced, and

- The combined output of the new unit and remaining units shall be sized for the room area to be cooled.

2.6. When an operable evaporative cooler is present in the same room as a window/wall AC that is eligible for replacement, the window/wall AC may be replaced.

3. Installation Policies Specific to Mobile Homes

3.1. In mobile homes with metal siding, cutting new openings is not allowed.

WINDOW/WALL AIR CONDITIONER AND HEAT PUMP REPLACEMENT STANDARDS

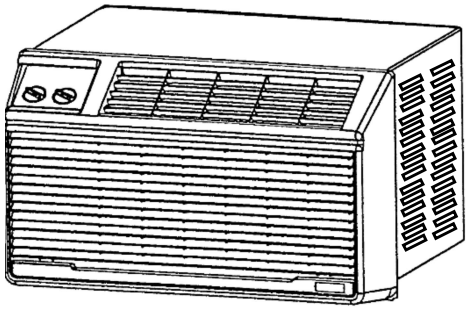
1. APPROVED MATERIALS

- **All units**
  - Shall be UL-listed and equipped with:
    - Minimum two-speed fan.
    - Adjustable thermostat with a minimum of six positions.
    - Removable filter.
    - Air directional control, minimum four-way.
  - Shall be ENERGY STAR-certified with minimum combined EER listed in Table 22-1.
- **Wall units**
  - Shall be equipped with through-the-wall chassis (sleeve).

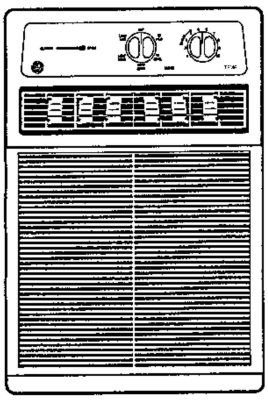
Table 22-1: Minimum Combined EER

Appliance	Cooling Capacity (Btuh) with Louvered Sides	Minimum Combined EER	Cooling Capacity (Btuh) without Louvered Sides*	Minimum Combined EER
Window/Wall A/C	<6,000	11.0	<6,000	10.0
	≥6,000–7,999	11.0	≥6,000–7,999	10.0
	≥8,000–13,999	10.9	≥8,000–10,999	9.6
	≥14,000–19,999	10.7	≥11,000–13,999	9.5
	≥20,000–27,999	9.4	≥14,000–19,999	9.3
	≥28,000	9.0	≥20,000	9.4
Room A/C Heat Pump	<20,000	9.8	<14,000	9.3
	≥20,000	9.3	≥14,000	8.7
Casement-Only Room A/C	Any	9.5	Any	9.5
Casement-Slider Room A/C	Any	10.4	Any	10.4

* Without louvered sides = Through-the-wall units



UNIT WITH LOUVERED SIDES



2. WARRANTY

- **All installations**
  - Refer to IS Appendix F (Minimum Warranty Requirements).

3. MAXIMUM SIZE UNIT

- **Right-sizing replacement units:**
  - The Btuh output of the new unit shall be sized for the room area to be cooled.
  - New unit shall comply with manufacturer's recommendations and the guidelines in Table 22-2.
  - Unit may be down-sized with prior approval of program manager.

Table 22-2: A/C Sizing Guidelines

Area to Be Cooled (Sq. Ft.)	Capacity (Btuh)*
100–150	5,000
151–250	6,000
251–300	7,000
301–350	8,000
351–400	9,000
401–450	10,000
451–550	12,000
551–700	14,000
701–1000	18,000
1,001–1,200	21,000

Adjustments for Special Conditions

Condition	Adjustment
Room is heavily shaded	Reduce capacity by 10%
Room is very sunny	Increase capacity by 10%
More than two people regularly occupy room	Add 600 Btuh per additional person
Unit is for a kitchen	Increase capacity by 4,000 Btuh

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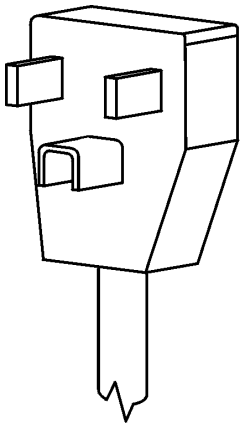
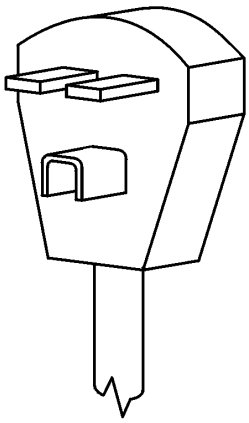
4. INSTALLATION

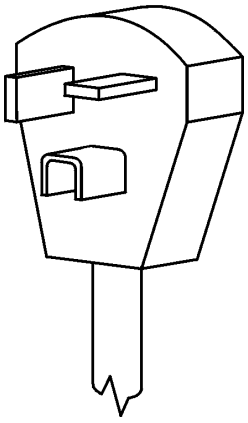
- **Permits**
  - Building permits shall be secured and finalized when required by the authority having local jurisdiction.
  - Units shall be installed in compliance with manufacturer's instructions and local code.

5. ELECTRICAL SUPPLY

- **All units**
  - The receptacle shall:
    - Be in good condition (wiring, receptacle, and cover plate).
    - Be securely installed in an electrical box.
    - Provide grounding to the appliance, when required by manufacturer.
  - The electrical circuit shall have:
    - Proper overcurrent protection.
    - Adequate current capacity available to avoid nuisance tripping of breaker/fuse by the A/C.
    - Constant power (not switched).
- **120 volts and less**
  - Unit shall be plugged into its own separate receptacle when required by the manufacturer.
- **208 volts and greater**
  - Unit shall be plugged into its own separate receptacle.

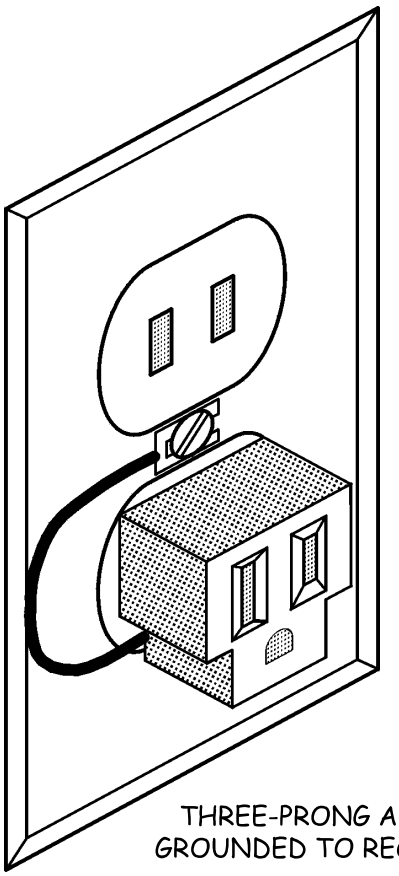






5. ELECTRICAL SUPPLY (cont.)

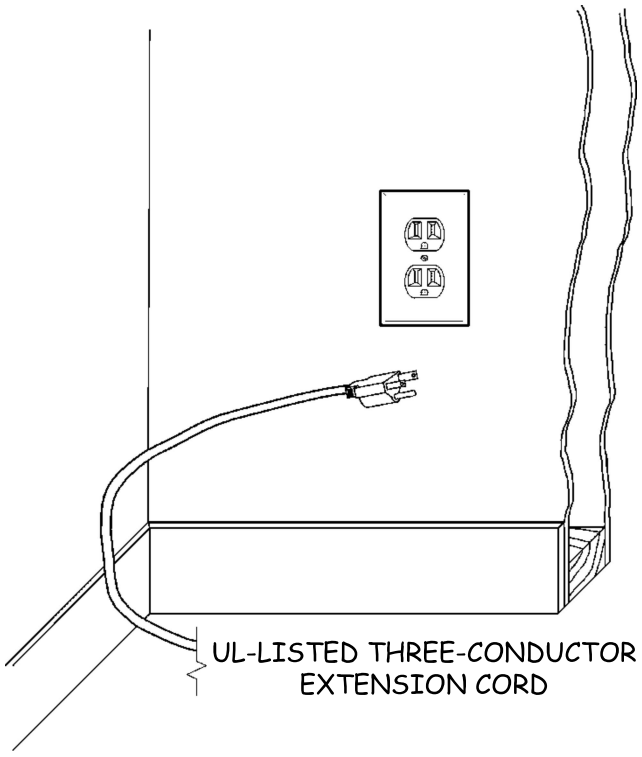
- **Ungrounded receptacles**
  - Units shall be connected to a properly-grounded two- or three-prong receptacle.
- **Three-prong adapters**
  - *Ungrounded* three-prong adapters shall not be used.
  - A *grounded* three-prong adapter may be used only if:
    - Not prohibited by manufacturer's instructions and
    - Adapter provides proper polarity and grounding to the appliance.
  - The ground lug/wire of the three-prong adapter shall be securely attached to a grounding source.



THREE-PRONG ADAPTER
GROUNDED TO RECEPTACLE

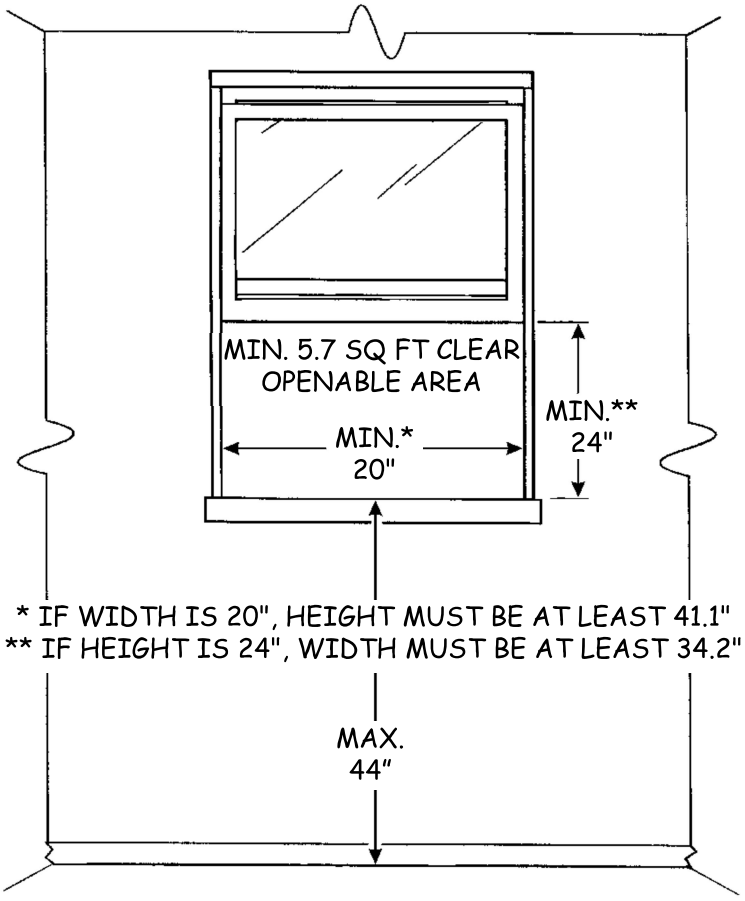
6. EXTENSION CORD

- **Unit voltage**
  - 120 volts or less: One extension cord may be used if allowed by appliance manufacturer's instructions.
  - 208 volts or greater: An extension cord shall not be used.
- **Extension cord shall be:**
  - UL-listed and in conformance with manufacturer's specifications.
  - A three-conductor cord with three-prong grounding plug.
  - AWG-rated appropriately for the appliance.
  - Maximum 6' or maximum length allowed by manufacturer.
  - The shortest feasible length.
- **Cord location**
  - Appliance cord and extension cord shall not be draped over a countertop or furnishings in a manner that:
    - Allows access to children or
    - Creates a walking hazard.



7. EGRESS WINDOWS

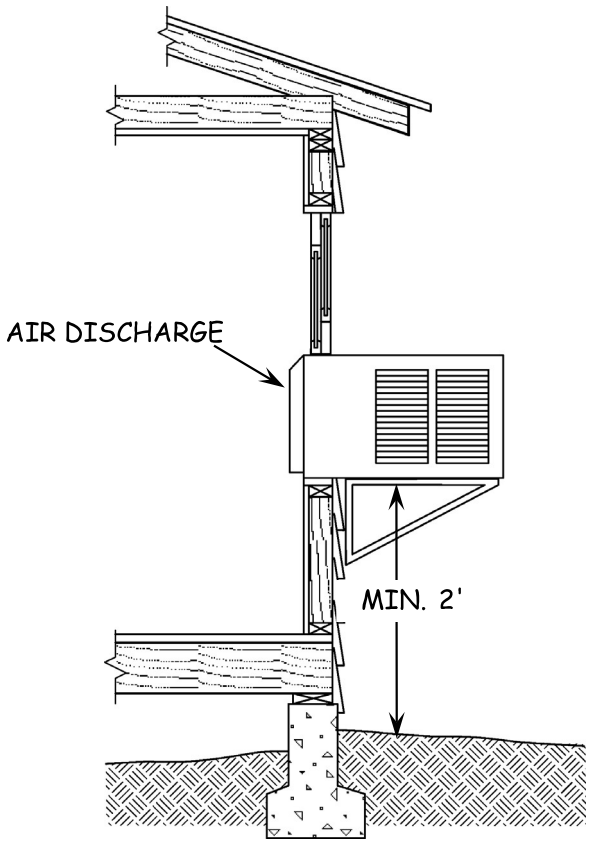
- **A/C installed in a sleeping room window**
  - Unit shall not violate egress requirements, which apply to all rooms used for sleeping.
  - Installation in a sleeping room window is feasible only when:
    - Allowed by customer and
    - One of the following is present in the same room:
      - Another operable window that meets egress requirements or
      - An operable exterior door that meets egress requirements.
  - The egress window in a conventional home shall meet the requirements of local code.
    - Minimum net clear openable area and dimensions:
      - Area of 5.7 (or 5.0) sq. ft.[1]
      - Width of 20" and height of 24".
    - Maximum finished sill height of 44" above the floor.



[1] *Exception:* 5.0 sq. ft. minimum on a "grade-floor" opening/window (a window with sill height not more than 44" above the finished ground level adjacent to the opening).

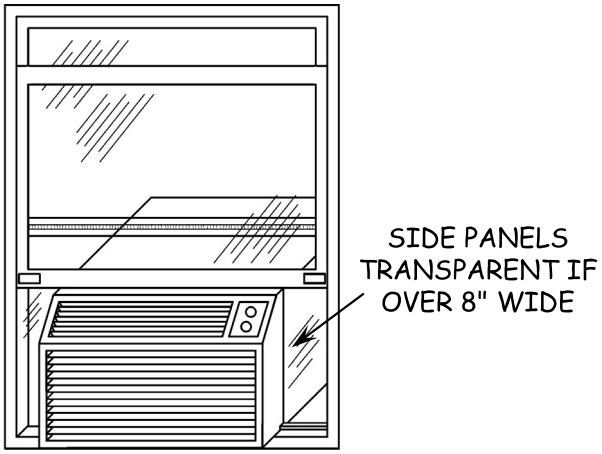
8. MINIMUM HEIGHT

- **All units**
  - Location, clearances, and installation shall be in conformance with manufacturer's instructions and local code.
  - Exterior portion of unit shall be located a minimum of 2' above grade.
- **Window-mount units**
  - Unit shall be installed only in a window.
- **Wall-mount units**
  - Unit shall be installed only in a properly supported wall opening.
  - Installations in existing locations:
    - Location may be used only if compliant with manufacturer's instructions and all structural and clearance requirements.
  - Installations in new locations:
    - Allowed only in conventional homes and mobile homes with wood siding.
    - Location shall be free of electrical wiring, plumbing, and obstructions immediately inside and outside the wall.
  - Air discharge less than18" above floor shall be equipped with adjustable directional louvers.



9. LOCATION

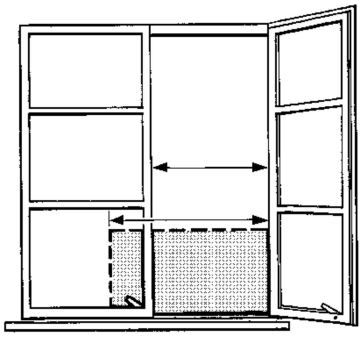
- **Window-mount units**
  - Location
    - North or east side of home, out of direct sun when possible.
    - In the shade of trees and shrubs, when feasible.
  - All windows
    - A/C shall be placed horizontally in center of window opening.
    - Permanent window panels shall be installed to completely fill empty spaces.
    - Side window panels over 8" wide shall be transparent.
    - Window panels shall be sealed in place.
    - A/C shall be permanently installed and sealed per manufacturer's instructions.
  - Vertical sliding windows
    - A/C shall be installed in lower sash opening.
    - Lower sash shall seal against unit and side panels.
  - Awning and jalousie windows
    - Displaced panels/panes shall be removed and left with the customer.
    - Pivots, operators, or other hardware damaged during removal shall be repaired or replaced.



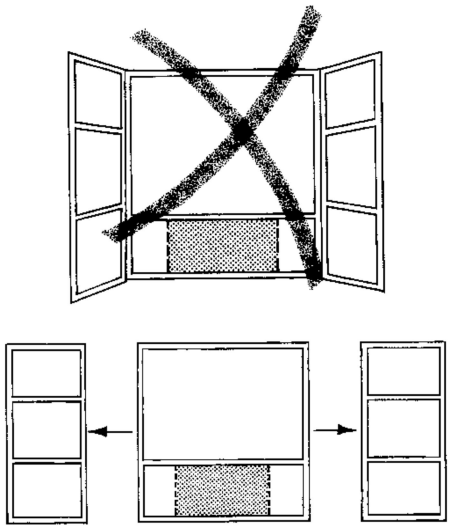
A/C CENTERED
IN WINDOW OPENING

9. LOCATION (cont.)

- **All casement windows**
  - Occupant shall be informed about the final appearance and give consent before installation.
- **Single-vent casement windows**
  - Sash shall be removed.
  - A/C shall be permanently installed and sealed.
  - Glass or polycarbonate transparent glazing shall be installed above A/C.
- **Double-vent casement windows**
  - When unit is too large for one sash opening:
    - Window frame assembly shall be adequate to support the weight of the A/C.
    - Both sashes shall be removed.
  - Glass or polycarbonate transparent glazing shall be installed above A/C, and on side panels (transparent if over 8" wide), as needed.



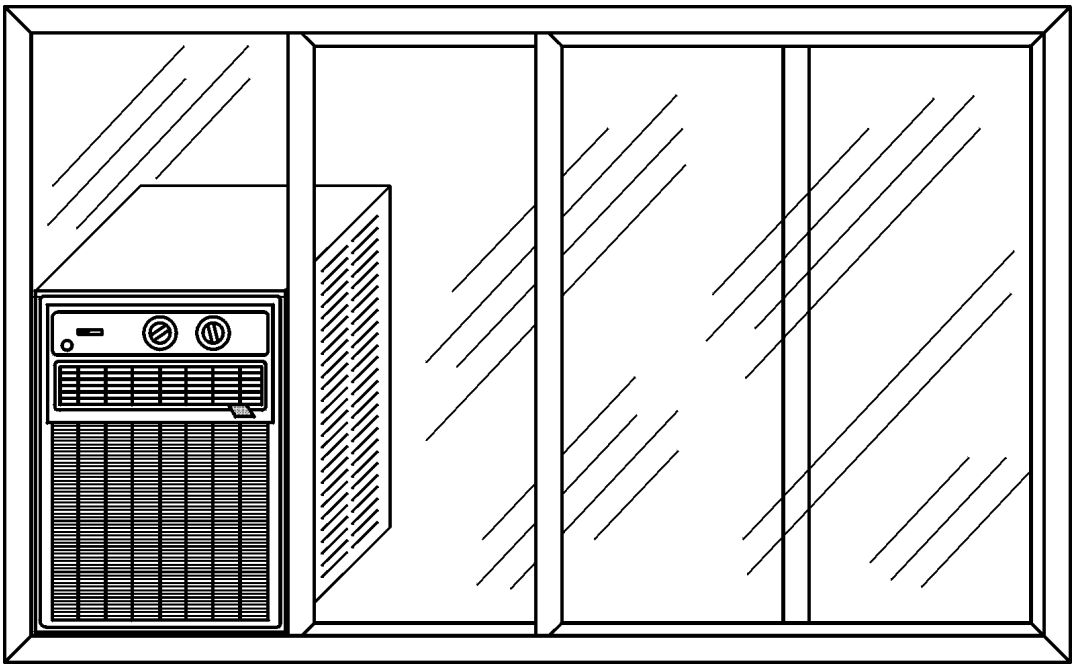
UNIT TOO WIDE
FOR ONE SASH OPENING



BOTH SASHES REMOVED AND
TRANSPARENT GLAZING
INSTALLED ABOVE UNIT

9. LOCATION (cont.)

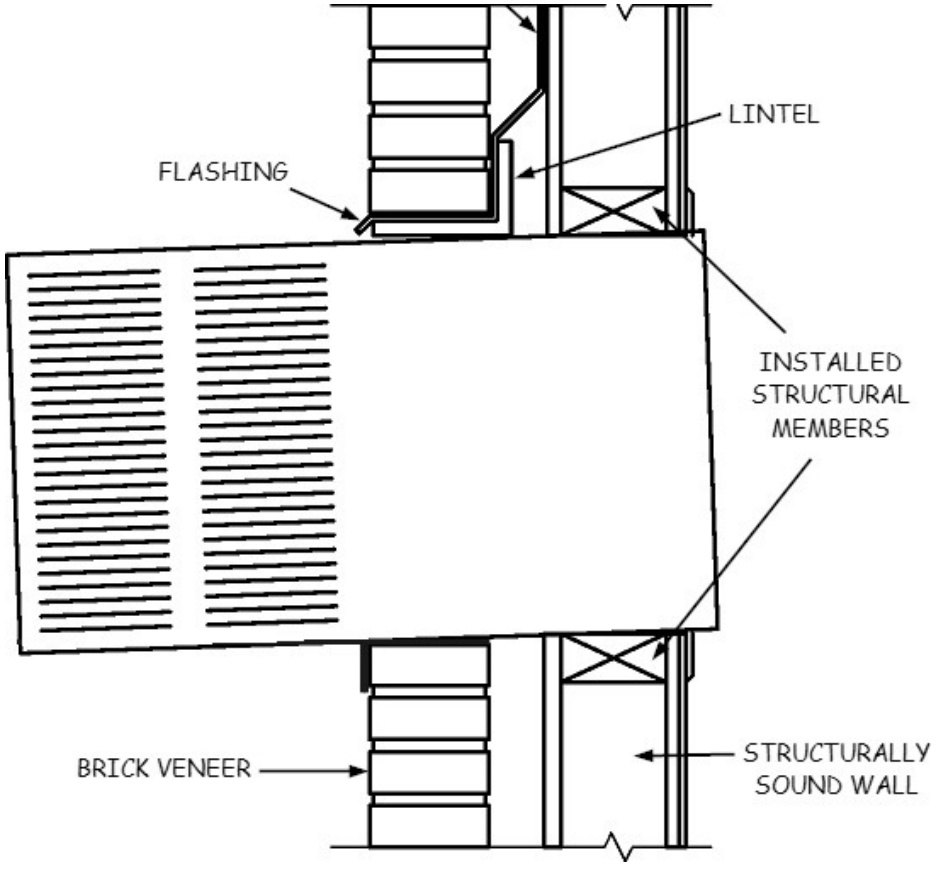
- **Horizontal slider windows**
  - The unit shall fit properly into the opening created by sliding one sash.
  - The window frame may serve as support for the unit.
  - The movable sash shall seal against the A/C and be secured in place.
  - Glass or polycarbonate transparent glazing shall be installed above the unit.



A/C IN HORIZONTAL
SLIDING WINDOW

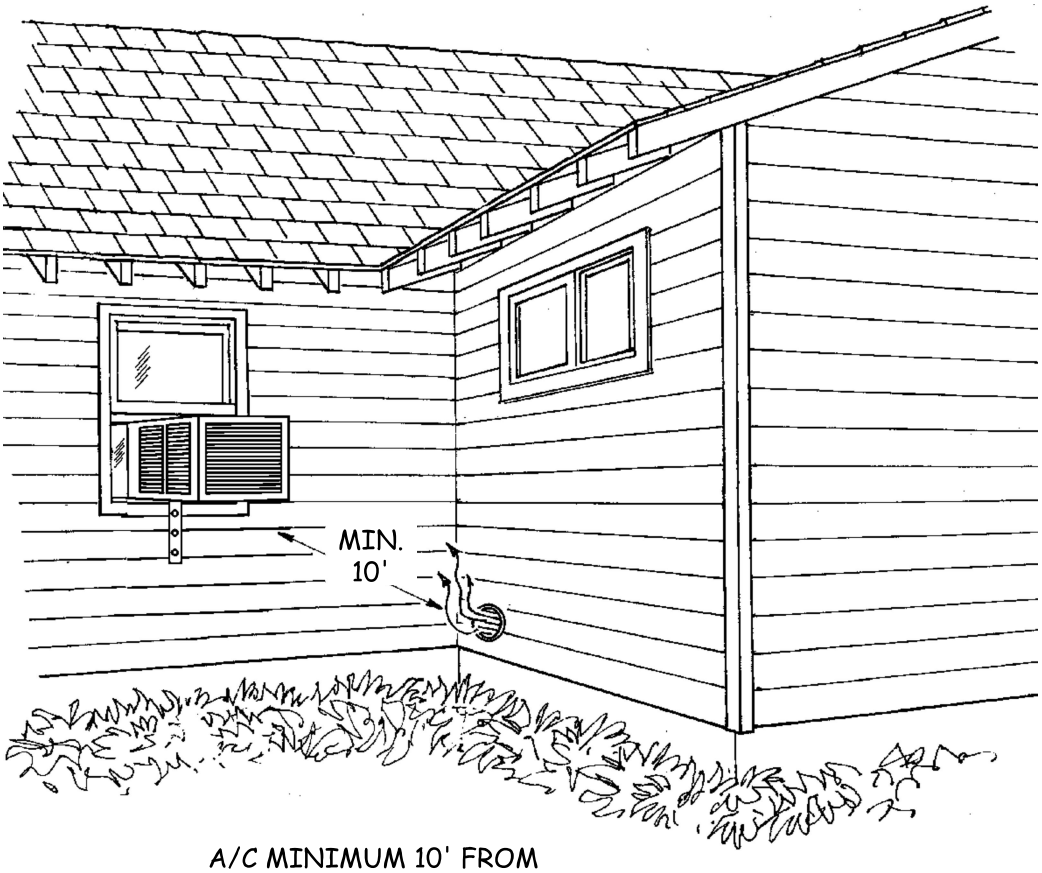
9. LOCATION (cont.)

- **Walls**
  - Wall shall be structurally sound and able to support unit's weight and vibration.
  - The opening shall be framed with structural members.
  - Opening in brick veneer and block walls shall have:
    - Lintels and flashing installed above opening when required.
    - Flashing (drip rail) installed below unit.
  - Unit shall be sealed in place.
- **Wall opening modification**
  - The hole shall be enlarged or reduced to meet manufacturer's hole size and clearance specifications.
  - Opening shall be structurally sound and framed.
  - Interior and exterior sheathing shall be neatly patched and trimmed, with all exposed wood primed and painted to match adjacent trim appearance.



9. LOCATION (cont.)

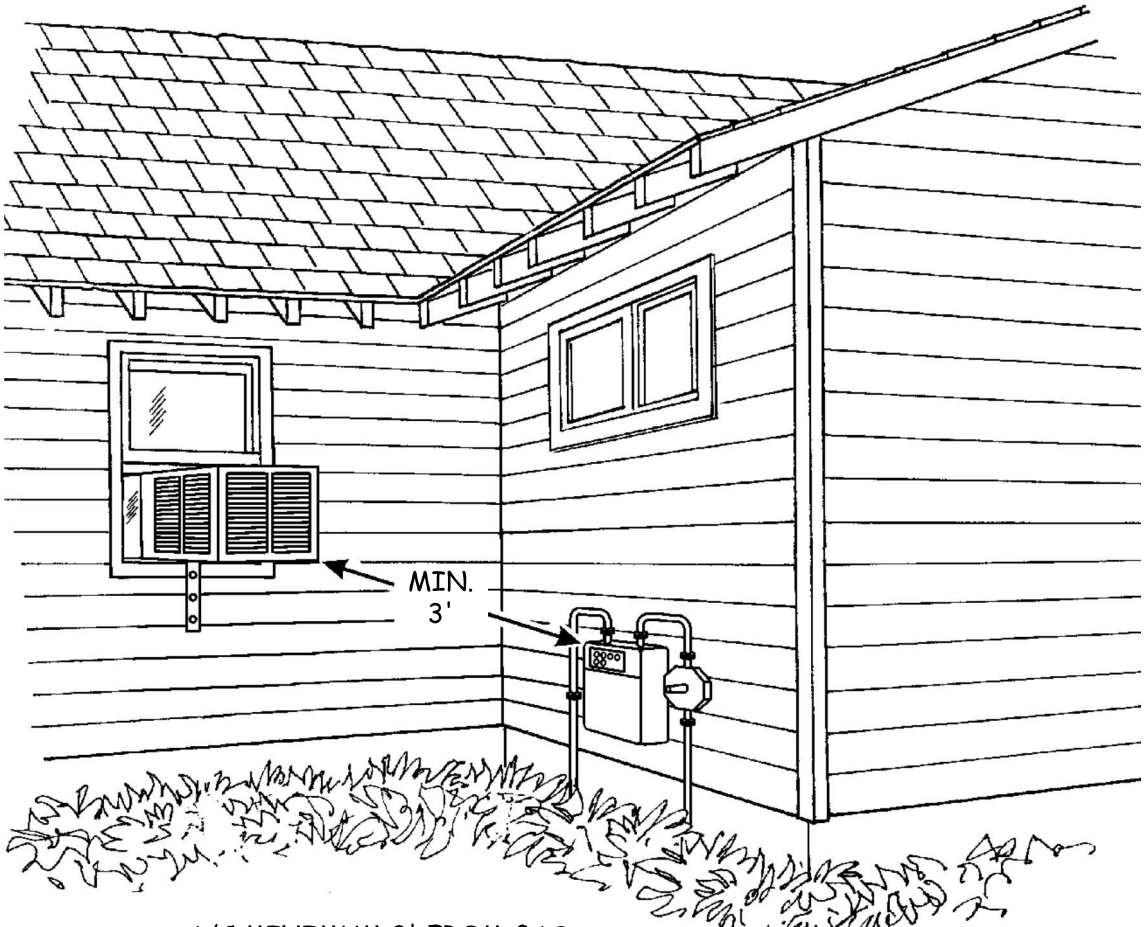
- **Interior clearance**
  - Unit shall be free of obstructions, such as furniture, curtains, plants, etc.
- **Exterior clearance**
  - Unit's air intake shall be located at least 10' away from or 3' below combustion appliance vent terminations, including direct-vent wall furnaces.
  - Unit's air intake shall be located at least 10' away from:
    - Clothes dryer moisture exhaust termination.
    - Plumbing vent terminations.
    - Exhaust fan vent terminations.
  - Unit shall not be installed if clearance requirements cannot be met.



A/C MINIMUM 10' FROM
CLOTHES DRYER MOISTURE EXHAUST

9. LOCATION (cont.)

- **Exterior clearance (cont.)**
  - There shall be at least a 3' clearance from A/C inlet to the gas meter set assembly.
  - Property setback requirements shall not be violated.
  - Unit shall be free of obstructions, such as landscaping, plants, structures, etc.



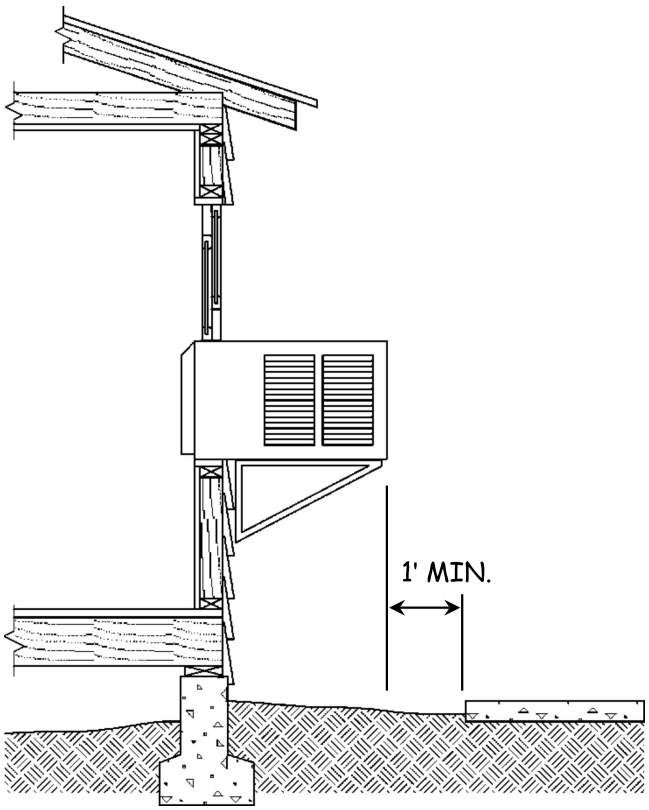
A/C MINIMUM 3' FROM GAS METER SET ASSEMBLY

9. LOCATION (cont.)

- **Exterior clearance (cont.)**
  - There shall be at least 1' between the A/C and adjacent walkway.
  - There shall be at least 30" between the A/C and adjacent wall or solid fence, or per manufacturer's specifications.

10. UNIT SUPPORTS

- **All installations**
  - A/C shall be supported per manufacturer's instructions.

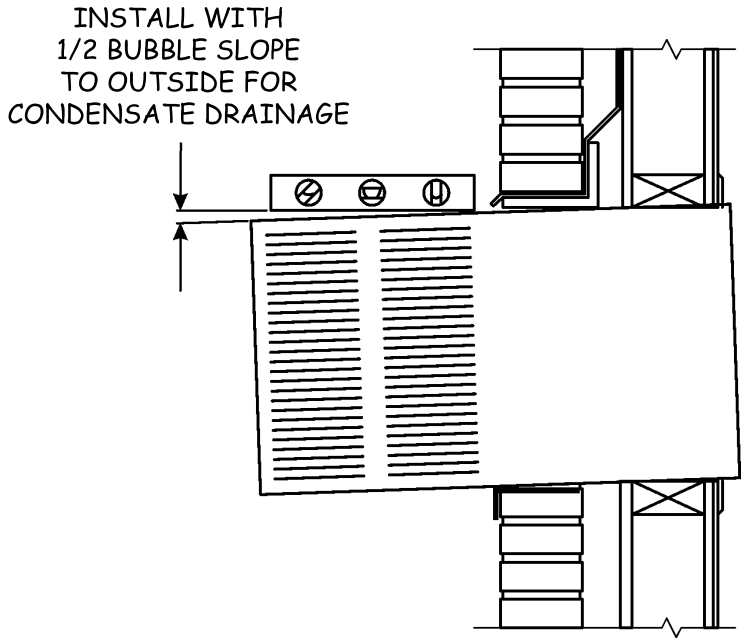


11. LEVEL AND PLUMB

- **A/C shall be installed level side-to-side.**
- **The A/C shall <u>not</u> be installed level front-to-back.**
  - The unit shall be sloped 1/2 bubble downward to the outside for condensate drainage.
  - *<u>Exception</u>:* If manufacturer's instructions specify a level mount or a different slope, manufacturer's instructions take precedence.

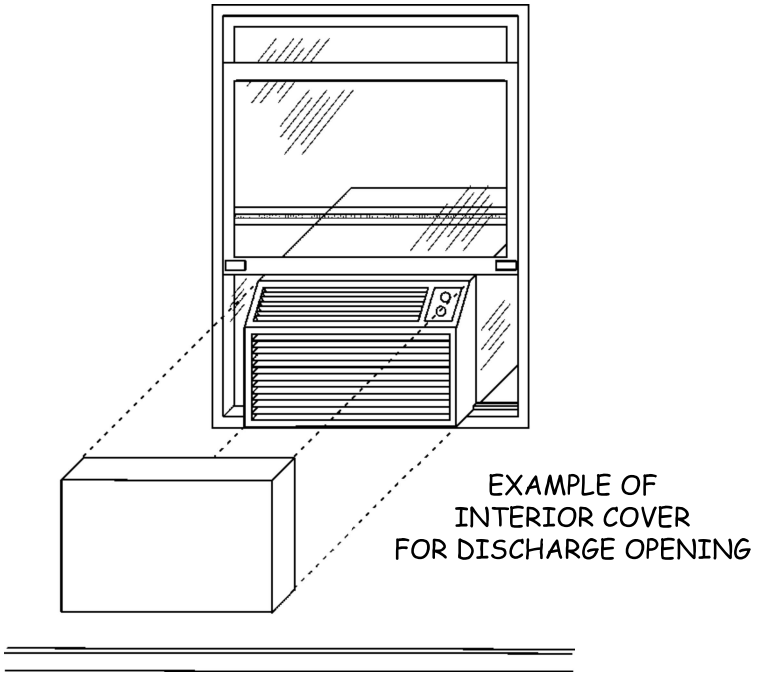
12. CONDENSATE CARE

- **Condensate drain water shall:**
  - Flow away from the house.
  - <u>Not</u> flow or splatter against the wall or puddle.
- **A drain hose/line is required when:**
  - The A/C is located above the first floor.
  - Condensate will otherwise drain onto a patio or walking surface.



13. WINTER PROTECTION/CLOSURE

- **Interior or exterior means:**
  - Shall be present to close off the A/C system during winter to protect against infiltration of unconditioned air.
- **Interior closure may be created by:**
  - Louvered grilles that have positive closed positions, or
  - A damper in the face grille, or
  - Vent cover/closure for the discharge openings of the A/C unit.
- **Exterior closure**
  - Closure may be created by an exterior cover/closure that seals the intake openings of the unit, when agreed to by customer.
- **All vent covers**
  - Cover shall be installed in accordance with IS Section 9 (Evaporative Cooler and A/C Vent Covers).



14. START-UP CHECK

- **Before operation**
  - Installation shall be checked to ensure that the A/C unit is:
    - Mounted level.
    - Sloped downward 1/2 bubble to the outside (or as required by manufacturer).
    - Securely attached and braced.
  - Electrical circuitry shall be checked for:
    - Proper grounding of cabinet, electrical boxes, and conduit.
    - Safe and secure connections.
    - Adequate circuit capacity and overcurrent protection.
- **During operation**
  - Unit shall be operated to determine that it is functioning properly.

Sample Start-Up Checklist

#	✓	Items to Be Verified (Check off as completed)
1.	❑	Unit is mounted level side-to-side.
2.	❑	Unit is sloped downward front-to-back 1/2 bubble to outside.
3.	❑	Unit is securely attached.
4.	❑	Unit, electrical boxes, and conduit are properly grounded.
5.	❑	All electrical connections secure and safe.
6.	❑	Circuit capacity is adequate.
7.	❑	Circuit has proper overcurrent protection.
8.	❑	Unit operates properly in each mode.

15. INSTRUCTIONS AND WARRANTY

- **Instructions**
  - Customer shall be provided with written and verbal instructions for proper A/C operation and maintenance, including.
    - Manufacturer's written instructions,
    - Verbal explanation of A/C operation, and
    - Review of written instructions.
- **Warranty**
  - Customer shall be provided with required warranties (per Item 2).

16. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up and Disposal**
  - All packing materials and installation debris shall be cleaned up and removed from the premises.
  - All replaced equipment and parts shall be removed from the premises and disposed of properly (see 40CFR82, 82.155, 1/2/2019).
  - Paint dust and chips, scraps, and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Furniture and other household items moved for installation work shall be returned to their original positions.

CUSTOMER RECEIVES
VERBAL AND WRITTEN
INSTRUCTIONS
AND WRITTEN WARRANTIES

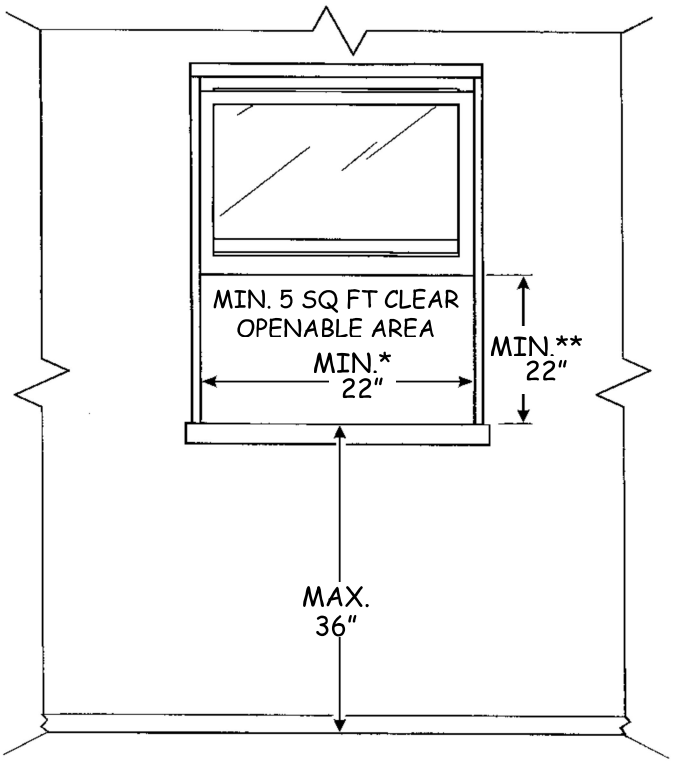
MOBILE HOME CRITERIA

17. LOCATION OF WALL MOUNT UNIT (MOBILE HOMES)

- **Mobile homes with wooden siding**
  - Location and installation shall be in compliance with Items 9-11.
- **Mobile homes with metal siding**
  - A/C shall be installed only in a window opening or an existing wall opening.

18. EGRESS WINDOWS IN MOBILE HOMES

- **A/C installed in a sleeping room window**
  - Installation shall be in compliance with CCR Title 25, S4070.
    - Minimum net clear openable and dimensions:
      - Area of 5 sq. ft.
      - Width and height of 22".
    - Bottom of window maximum 36" above the floor.



*IF WIDTH IS 22", HEIGHT MUST BE AT LEAST 33".
**IF HEIGHT IS 22". WIDTH MUST BE AT LEAST 33".

NATURAL GAS STORAGE WATER HEATER REPLACEMENT

Lead Paint Risk Factor
NONE

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SECTION 23 PREFACE
for

NATURAL GAS STORAGE WATER HEATER REPLACEMENT

1. Nonfeasibility Criteria

1.1. The existing water heater is tankless, and replacement with a storage unit is not feasible or allowed.

1.2. The property is renter-occupied.

1.3. Fuel used by the existing unit is not supplied by the utility providing ESA Program services.

1.4. The existing water heater:

a. Is inaccessible, or

b. Can be feasibly repaired (e.g., repair cost is 50% of replacement cost or less).

1.5. Required drainage cannot be achieved.

a. Drain line for T&P valve or drain pan cannot be properly terminated to outdoors, or to an approved indoor drain, and/or

b. An automatic gas shutoff valve and pressure relief valve cannot be installed in lieu of a T&P valve and drain line.

1.6. Required access, clearance, or combustion air cannot be provided.

1.7. Confined Spaces: state and federal regulations regarding confined spaces cannot be met.

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

1.9. No suitable mounting locations for seismic bracing available.

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

1.11. A required watertight pan cannot be installed under the unit as required.

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

1.13. A whole house fan exhausts into the attic, the existing water heater is in the attic, and relocation or installation of a closed combustion unit is not feasible.

1.14. The unit is a central water heater serving more than one dwelling unit.

1.15. House line water pressure exceeds water heater manufacturer's recommendation, and correction is unfeasible.

1.16. Customer refuses.

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2. Water Heater Replacement Policies

2.1. Water heater replacement may be provided only: (a) when the appliance fails NGAT, and correction cannot be achieved with service/adjustment[1] by utility gas service personnel (or their designated representative), or (b) if the tank leaks, or (c) Natural Gas Appliance Evaluation determines the water heater to be inoperable.

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

2.3. Water heater replacement and major repairs may be provided only if the residence is owner-occupied. Service/adjustment[1] may also be conducted in renter-occupied homes.

2.4. Water heater replacements will be provided only if the fuel used by the appliance is supplied by the utility providing ESA Program services.

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

3. Installation Policies Specific to Mobile Homes

3.1. When the gas water heater compartment floor is not structurally sound, the condition shall be reported to the homeowner.

3.2. When the water heater is leaning in an unsafe position, water heater replacement shall not occur until the floor is repaired or replaced.

[1] See definitions.

NATURAL GAS STORAGE WATER HEATER REPLACEMENT STANDARDS

1. APPROVED MATERIALS

- **Storage water heaters**
  - Natural gas-fueled storage type.
  - Included in the CEC database of certified appliances.
  - Energy Efficiency
    - Minimum Uniform Energy Factor (UEF): as shown in Table 23-1.
    - When UEF is not yet available, minimum Energy Factor (EF): as shown in Table 23-2.
  - FVIR unit or closed combustion.
  - Low or ultra-low NOx rating, when required by local code.
- **Vent systems**
  - UL-listed vent connectors, components, and Type B vent pipes.
  - Nonmetallic systems shall conform to ASTM D 1785 and D 2665.
- **Gas piping and valves**
  - Gas valves: Listed (e.g., by UL) and AGA- or CSA-certified.
  - Flexible connectors: Listed (e.g., by IAPMO) stainless steel or plastic- or epoxy-coated brass connectors.
  - Fuel gas piping: Compliant with CMC, Chapter 13.
  - Copper gas lines and uncoated brass flexible gas connectors and soldered joints: Not allowed.

Table 23-1: Minimum Uniform Energy Factor (UEF) for Gas Storage Water Heaters, Based on First Hour Rating (FHR)

Volume (Gal.)	FHR 18 to <51	FHR 51 to <75	FHR ≥75
30	0.54	0.60	0.65
40	0.52	0.58	0.64
50	0.50	0.56	0.63
55	0.49	0.55	0.62
60	0.74	0.77	0.79

Table 23-2: Minimum Energy Factor (EF) for Gas Storage Water Heaters

Volume (Gallons)	Minimum EF
30	0.63
40	0.62
50	0.60

Equation for calculating minimum EF of other sizes: [0.675 – (0.0015 x V)].
V = rated storage volume in gal.

1. APPROVED MATERIALS (cont.)

- **Pressure relief and backflow prevention**
  - T&P valve and automatic gas shutoff valve shall be listed and manufactured to ANSI Z21.22.
  - Backflow preventer shall be listed by IAPMO or ASSE.
  - Expansion tank shall meet requirements of ASME and shall be sized in accordance with local code.
- **Pipe insulation**
  - Shall conform with IS Manual Section 6 (Water Heater Pipe Insulation).

2. WARRANTY

- **Refer to IS Appendix F (Minimum Warranty Requirements).**

3. GENERAL REQUIREMENTS

- **A permit for the installation shall be obtained from and finalized by the authority having jurisdiction.**
- **Installation shall be in conformance with:**
  - Product listing.
  - Manufacturer's instructions and specifications.
  - The CEC, the CPC, and local code.
- **Orifice shall be verified to be sized for natural gas.**

4. WATER HEATER SIZING

- **Storage replacement water heater capacity, the first hour rating**
  - Unit shall comply with the greater of:
    - Manufacturer's sizing recommendations or
    - Local code requirements.
  - Storage unit's first hour rating shall be no less than the 2007 CPC minimum guidelines, as shown in Table 23-3.

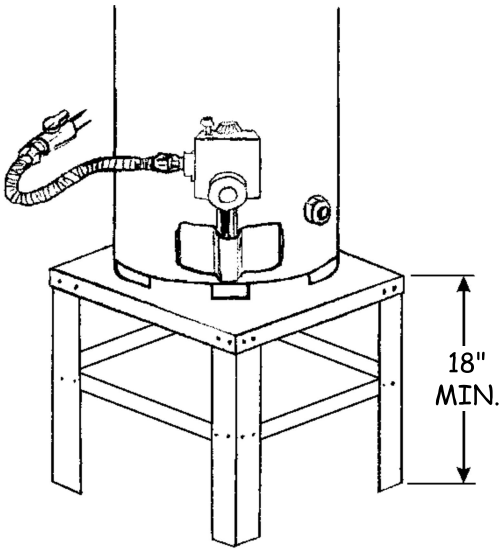
Table 23-3: Minimum First Hour Rating (FHR)

Number of bathrooms	**1–1.5**			**2–2.5**				**3–3.5**			
Number of bedrooms	1	2	3	2	3	4	5	3	4	5	6
First hour rating[1]	38	49	49	49	62	62	74	62	74	74	74

[1] First hour rating, the water heating capacity expressed in gallons, is the amount of hot water the heater can supply per hour (starting with a tank full of hot water). The first hour rating is shown on the yellow EnergyGuide label.

5. LOCATION

- **All units**
  - Clearances shall be in compliance with listing requirements, manufacturer's instructions, and local code.
- **Units in enclosures**
  - Access door shall be at least 24" wide or wide and high enough to accommodate removal of the water heater.
- **Water heaters in attics**
  - Water heater shall not be installed in attic with whole house or attic exhaust fan, unless it has a sealed combustion chamber.
  - Access shall be in compliance with CPC Section 509.4 (i.e., minimum 22" x 30" opening, unobstructed passageway, and minimum 30" x 30" working platform on the front service side of the water heater).
- **Water heaters in bedrooms and bathrooms**
  - An open combustion water heater shall not be installed in a bedroom or bathroom *unless* it is inside a dedicated closet with a weatherstripped, self-closing door and combustion air is drawn from outdoors.
- **Water heaters in garages and hazardous locations**
  - When installed in a garage, unit shall be elevated so that the combustion burner is at least 18" above the finished floor.
    - Exception: For FVIR listed units, 18" height does not apply.
  - Units located outdoors must provide a minimum of 3' of clearance between the source of ignition and the gas meter set assembly[2].
  - Units in locations subject to damage (e.g. by an automobile) shall be elevated or protected with barriers in accordance with code.



COMBUSTION CHAMBER AT LEAST 18" ABOVE GARAGE FLOOR

[2] See revised definition.

6. INSTALLATION

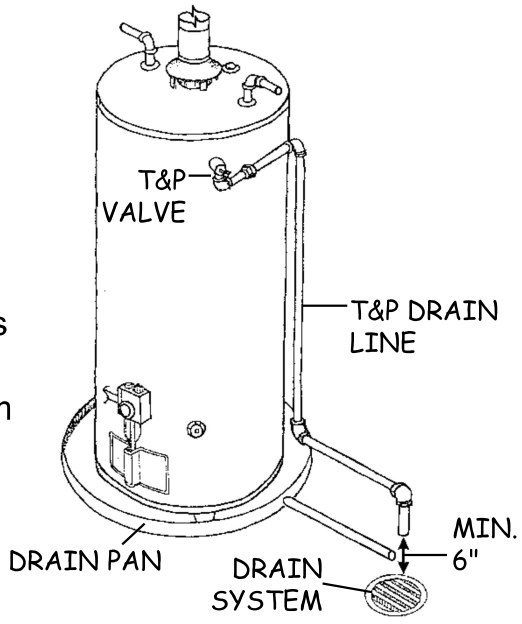
- **The tank shall be installed:**
  - Plumb and level in a stable position.
  - With minimum clearance per manufacturer's instructions.
  - With information labels and controls facing outward.
- **Location**
  - Location shall be structurally sized/constructed to safely support the weight of the tank.
  - Units supported from the ground shall rest on a level concrete pad, which extends at least 3" above grade.
  - Earthquake bracing for storage units shall be installed per Item 10.

7. PLUMBING

- **All units**
  - Only new parts shall be installed.
  - Threaded fittings shall be sealed with Teflon® tape or non-toxic pipe joint compound.
  - A cold water supply shutoff valve shall be installed if not present.
  - Flexible connectors shall be used to connect the tank to the rigid hot and cold water lines.
  - Dielectric insulators shall be installed on water piping connections to the tank when required by local code.

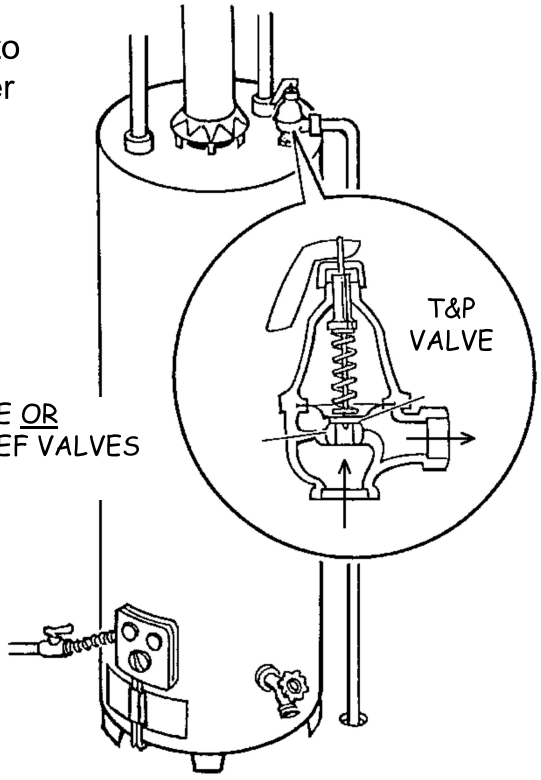
8. DRAIN PAN

- **Storage units**
  - A watertight pan of corrosion-resistant material shall be installed when the water heater is located:
    - In an attic or on a floor-ceiling assembly or
    - In another location for which a pan is required by local code.
  - A minimum 3/4" diameter drain line from the pan shall be installed with a continuous downward slope to the exterior or to a drain system in accordance with local code.
  - Drain pan shall <u>not</u> inhibit proper combustion air flow.



9. T&P REGULATION

- **Safety controls**
  - Either of the following shall be installed in conformance with the water heater manufacturer's instructions and local code:
    - A T&P valve or
    - An automatic gas shutoff valve and pressure relief valve.
  - The T&P valve and automatic gas shutoff valve shall meet the sizing/pressure requirements of the water heater listing.
- **T&P valve drain line**
  - Line shall be galvanized steel, hard drawn copper, or CPVC.
  - Internal diameter of the line and fittings shall equal or exceed the diameter of the relief valve outlet.
  - The line shall drain fully by gravity and shall not be trapped, and it shall not discharge into the drain pan.
  - Drain line shall terminate outside the building, or in an approved drain system with the terminal end:
    - No more than 24", nor less than 6", above the surface and
    - Unthreaded and pointing downward.
- **Backflow preventer and expansion tank**
  - Shall be installed when required by local code or individual utility policy.
- **House line pressure**
  - House line pressure shall be verified to be in compliance with the water heater manufacturer's specifications.
  - A house line pressure regulator shall be installed or replaced when needed to limit water pressure to the tank at the specified maximum.



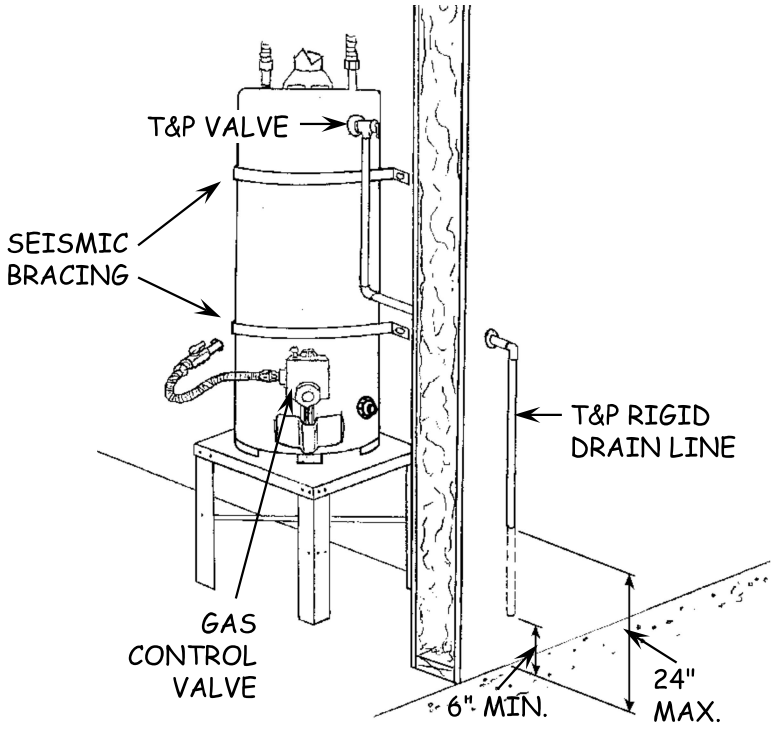
A T&P VALVE AND DRAIN LINE OR
GAS SHUTOFF AND PRESSURE RELIEF VALVES
MUST BE PRESENT

10. SEISMIC BRACING

- **Requirement**
  - The tank shall be braced (strapped or anchored) to resist horizontal movement during an earthquake.
- **Bracing shall be:**
  - Installed per manufacturer's instructions and local code.
  - Securely attached to structural framing or ledger board.
- **Strap locations**
  - Two straps shall be installed: One within the upper third of the tank and one within the lower third of the tank.
  - The lower strap shall be at least 4" above the gas control valve.

11. INSULATION

- **Hot and cold water pipes**
  - Pipe insulation shall be installed in accordance with IS Section 6 (Water Heater Pipe Insulation).
- **Tank**
  - For water heater *replacement*, insulation is unfeasible. (Minimum R-12 internal insulation required.)

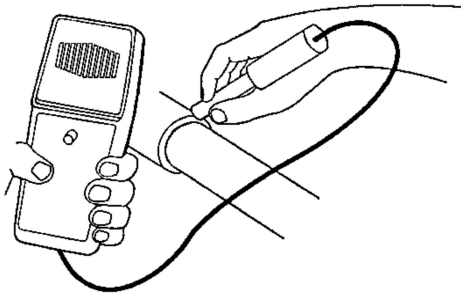


12. CVA

- **All units**
  - Combustion air shall be supplied in conformance with manufacturer's instructions and local code.
    - Refer to IS Section 24 (NGAT) for guidelines.
  - Obstructions in existing combustion air vents (e.g., overblown insulation) shall be cleared as needed to provide required NFVA.
  - FVIR combustion air inlets shall not be subject to obstruction, such as by lint from a clothes dryer moisture exhaust.

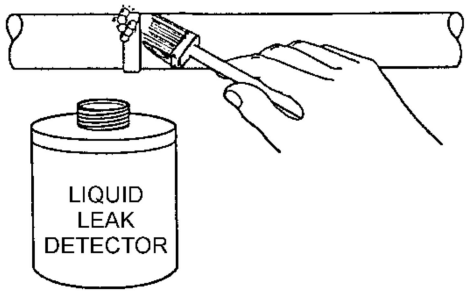
13. GAS LINES, FITTINGS, AND VALVES

- **All units**
  - A new flexible gas connector shall be installed.
  - All gas lines, flexible gas connectors, fittings, and valves shall be installed per manufacturer's instructions and local code.
  - Manual gas shutoff valve shall be within 3' of the appliance and in the same room where the appliance is located.
  - A flexible gas connector shall be located between the gas control valve and shutoff valve.
  - Readily accessible sediment trap (drip leg) shall be located just ahead of flexible gas connector when required by local code.
  - All new and affected gas lines, flexible gas connectors, fittings, and valves shall be checked for gas leaks using a method approved by the local jurisdiction.



ELECTRONIC LEAK DETECTOR

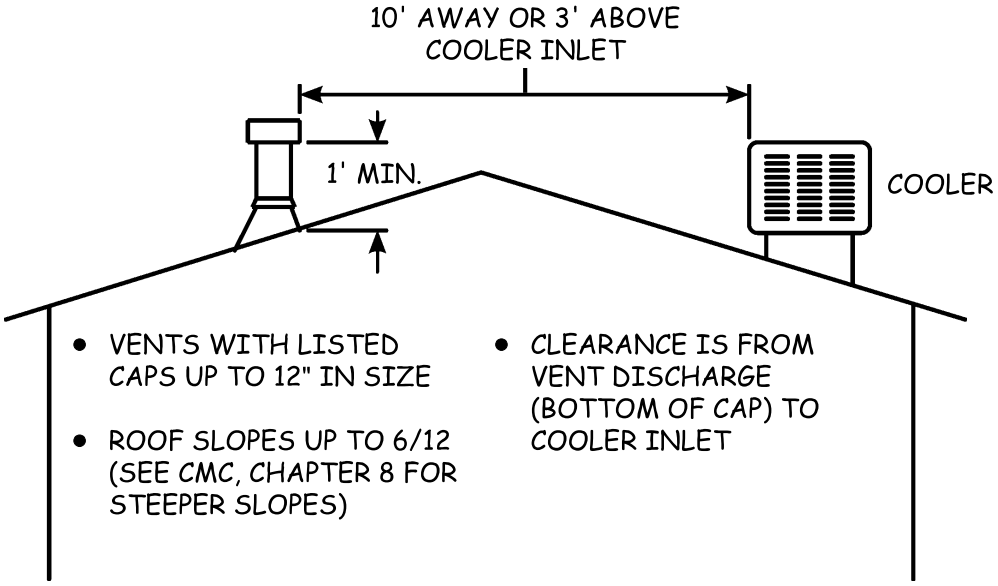
LIQUID LEAK DETECTION METHOD



GAS LINE FITTINGS, VALVES, AND CONNECTORS CHECKED FOR GAS LEAKS

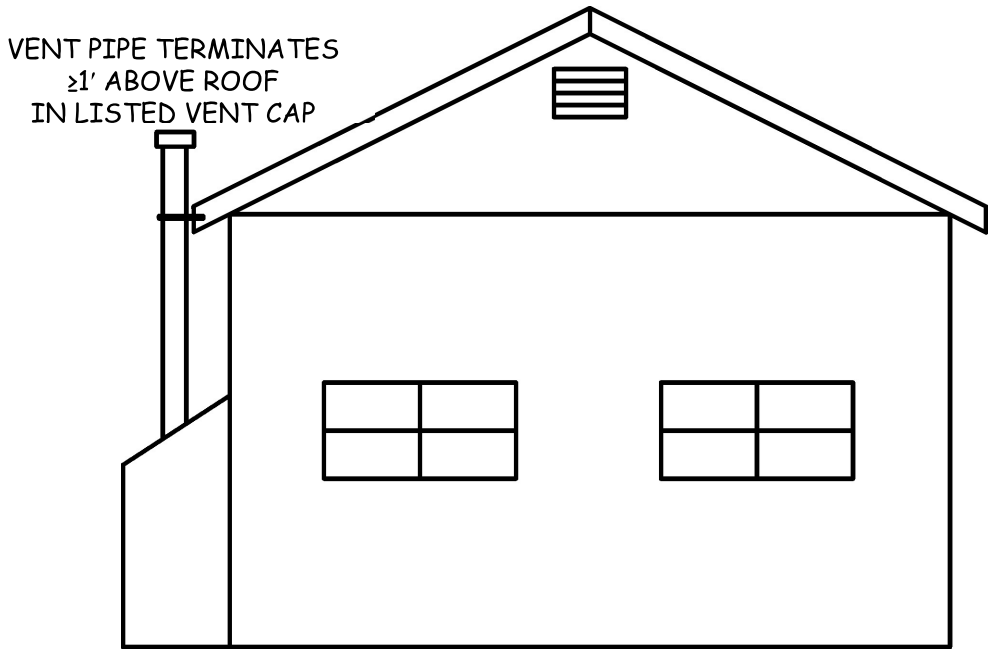
14. VENT SYSTEM

- **All vent systems**
  - Appliance venting shall be in conformance with manufacturer's instructions and local code.
  - Vent dampers shall not be used.
  - Type B gas vent shall terminate at least 5' in vertical height above the draft hood.
  - Horizontal vent connectors shall not dip or sag and shall slope upward a minimum of 1/4" per foot of horizontal length.
- **Type B double wall gas vents**
  - Vents with listed vent caps 12" in size or smaller shall be in compliance with local code and the CMC, Chapter 8.
    - The vent shall terminate above a roof (minimum 1' above for slopes up to 6:12) provided the vent is located at least 8' from a vertical wall or similar obstruction.
    - Vents within 8' of a vertical wall or obstacle must terminate:
      - At least 2' above the highest point where they pass through the roof, and
      - At least 2' higher than any portion of the building within 10'.
  - Vent terminations located within 10' of outside air, makeup air, and forced air inlets shall terminate at least 3' above such inlets.



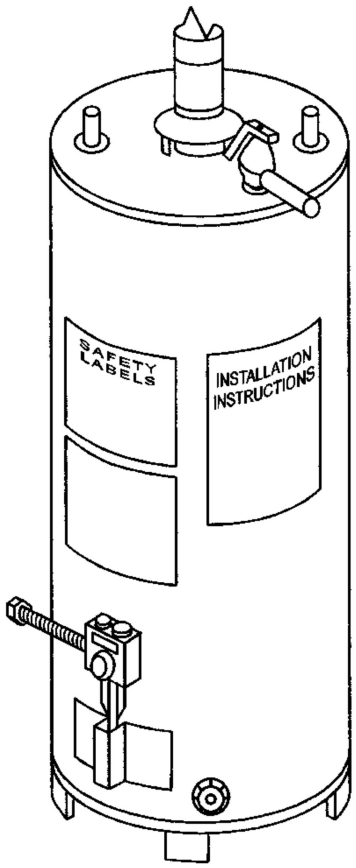
14. VENT SYSTEM (cont.)

- **Type B double wall gas vents (cont.)**
  - A gas vent extending through an exterior wall shall not terminate adjacent to the wall or below the eaves.
  - All gas vents shall extend through the roof flashing, roof jack, or roof thimble and terminate with a listed cap or listed roof assembly.
  - Gas vents extending adjacent to the wall shall be secured and shall terminate at least 1' above the roof in a listed vent cap.
- **Through-wall mechanical draft vent terminals**
  - A mechanical draft venting system shall terminate at least 3' above any forced air inlet (e.g., evaporative cooler) located within 10'.
  - A mechanical draft venting system (other than direct vent) shall terminate the following minimum distances from doors, operable windows, and gravity inlets into a building:
    - 1' above or 4' below or
    - 4' horizontally from the door/window/inlet.
  - A direct vent system shall terminate in conformance with manufacturer's instructions and local code.
- **Common vents**
  - A common vent system serving both the water heater and another appliance shall be sized in accordance with local code.



15. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up**
  - Paint dust and chips, scraps, and other debris resulting from installation of the water heater shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - All packing materials and installation debris shall be cleaned up and removed from the premises.
  - Household items moved for water heater installation shall be returned to their original positions.
  - All replaced equipment and parts shall be removed from the premises and properly disposed of.
- **Water heater operation**
  - The water heater shall be tested and shall perform properly.
  - Operation shall be explained and demonstrated to the customer, including:
    - Operation of all user-accessible controls.
    - Routine maintenance recommended by the manufacturer.
  - Manufacturer's written instructions and warranty documents shall be provided to the customer in plastic jacket attached to the side of the water heater tank.
- **NGAT**
  - NGAT shall be conducted in accordance with the program P&P.



MANUFACTURER'S INSTRUCTIONS AND WARRANTY BOOKLET PLACED IN MANUFACTURER'S PLASTIC JACKET AND ATTACHED TO TANK

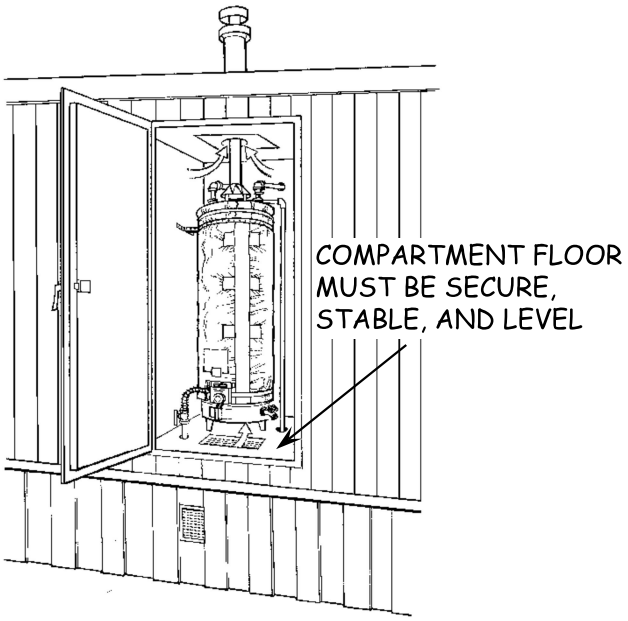
MOBILE HOME CRITERIA

16. MATERIALS AND INSTALLATION

- **Water heater shall be:**
  - In compliance with requirements of the HCD.
- **Installation shall be in conformance with:**
  - Manufacturer's instructions,
  - HCD requirements, and
  - Guidelines in this section.

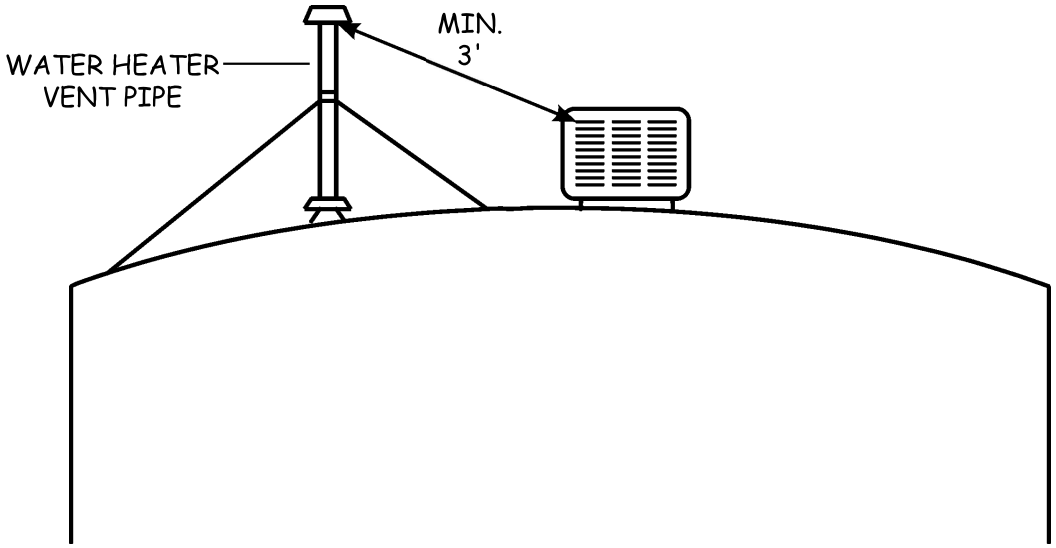
17. WATER HEATER COMPARTMENT

- **Compartment floor**
  - The floor shall be checked for structural integrity and strength adequate to support a storage water heater.
  - The floor must be secure, stable, and level enough to properly and safely support the water heater.
  - If unsafe, it shall be corrected before a new storage water heater is installed.
- **Drip pan and lower CVA vent**
  - A drip pan shall be installed and drained per HCD requirements.
  - If the drip pan covers existing CVA venting in the floor, a new lower CVA vent shall be installed beginning within 12" of the compartment floor.



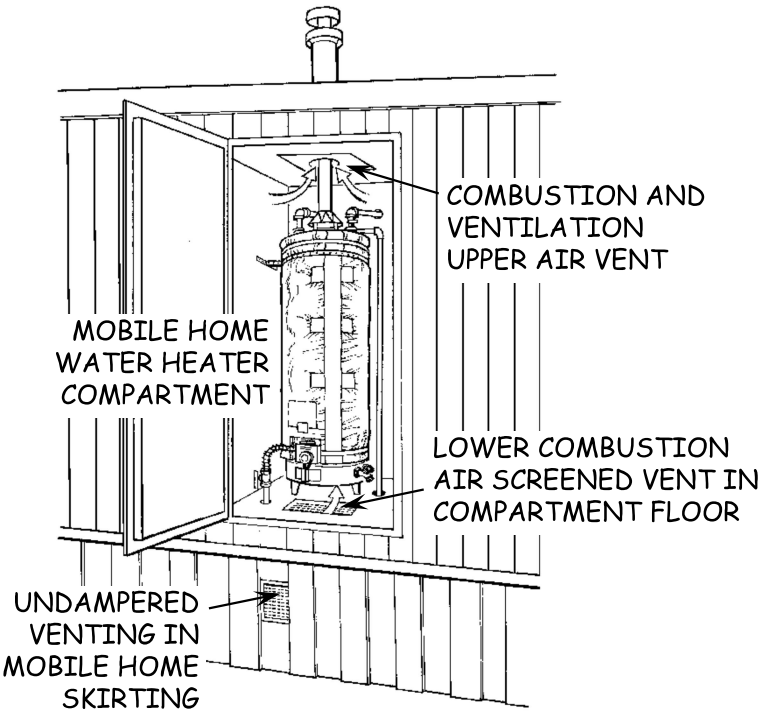
18. VENT SYSTEM (MOBILE HOMES)

- **All units**
  - The appliance vent system shall be in conformance with listing requirements, manufacturer's instructions, and HCD requirements.
  - Vent shall not terminate within 3' of an evaporative cooler air intake.
  - Vent dampers shall not be used.



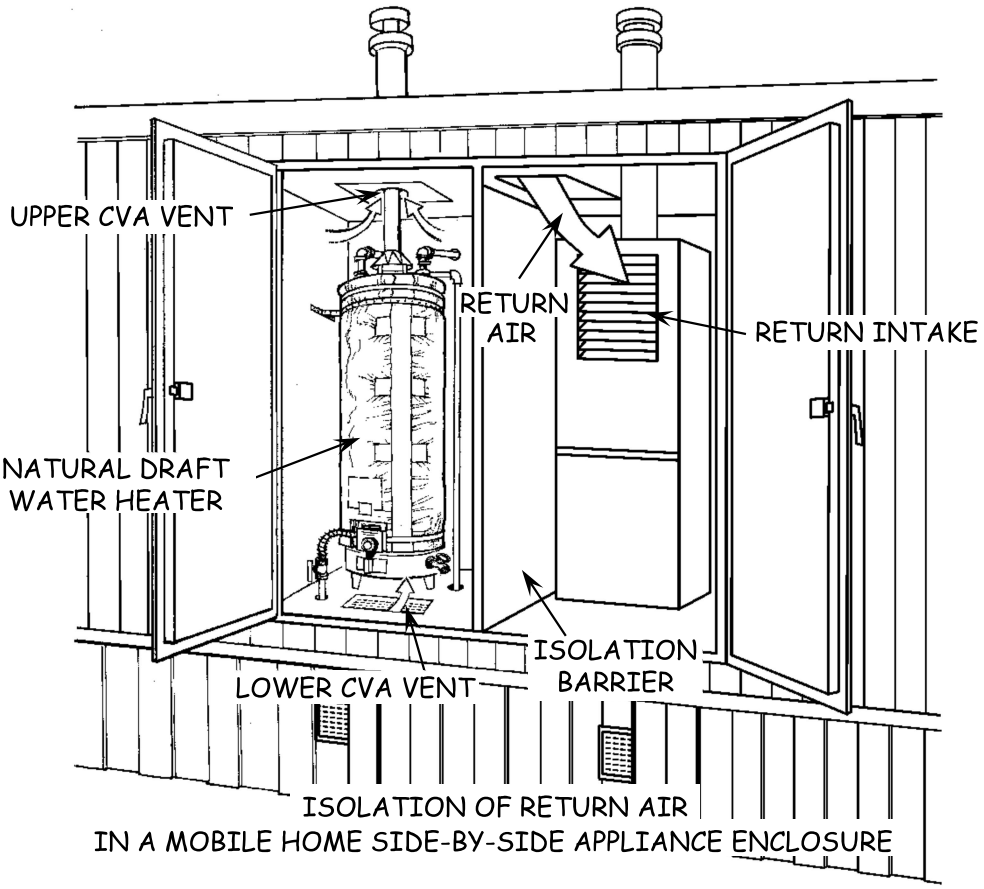
19. COMBUSTION AIR REQUIREMENTS

- **Open combustion water heaters**
  - Both upper and lower CVA vents are required.
  - An upper CVA vent shall be present, such as:
    - 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 (undampered screen or grille to outdoors) shall be present, located in:
    - The enclosure floor or
    - The door or wall beginning 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.
  - CVA vent NFVA shall be in accordance with IS Section 24 (NGAT).



20. ISOLATION OF RETURN AIR

- **Gas water heater and FAU in adjacent enclosures**
  - Water heater enclosure shall not be depressurized by an FAU enclosure that serves as the return plenum.
  - An "isolation barrier" that provides an airtight separation between enclosures must be present when a replacement water heater is installed.



ISOLATION OF RETURN AIR
IN A MOBILE HOME SIDE-BY-SIDE APPLIANCE ENCLOSURE

NATURAL GAS APPLIANCE TESTING (NGAT)

Lead Paint Risk Factor
NONE

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SECTION 24 PREFACE
for

NATURAL GAS APPLIANCE TESTING

1. Nonfeasibility Criteria

Entire Dwelling

1.1. Non-IOU combustion fuel is used in the residence.

1.2. No infiltration-reduction measures are installed.

1.3. No natural gas appliance affecting the living space is present.

Individual Appliance

1.4. Non-IOU combustion fuel is used.

1.5. Appliance is abandoned.[1]

1.6. Appliance is inaccessible.[1]

2. Installation Policies

2.1. NGAT shall be explained to the customer prior to the installation of measures. If customer refuses, infiltration-reduction measures will not be installed (home is NIM).

2.2. Natural gas 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, as defined in this section. In addition, the repair and replacement of a natural gas furnace or water heater involves appliance testing.

2.3. Homes with non-IOU (e.g., propane) fuel:

a. Homes with non-IOU (e.g., propane) space heating fuel are not eligible for natural gas appliance testing nor infiltration-reduction measures.

b. Homes with IOU space heating but which use a non-IOU combustion fuel for another appliance that affects the living space (e.g., water heating) are also ineligible for NGAT due to the inability of the IOUs to service combustion appliances using non-IOU fuels.

2.4. 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 ESA Program, some pre-weatherization evaluations of gas appliances are performed as part of the initial home assessment.

[1] See definitions.

2.5. Pre-weatherization appliance evaluations shall be conducted, as listed in Items 3 and 4 of this section. For mobile homes, additional checks will be made to determine if: (1) gas cooking is present and the kitchen exhaust to outdoors is nonconforming, (2) an exterior-accessed appliance enclosure has unacceptable isolation of furnace return air, and (3) an open combustion space or water heater is present within the living space. Items (1) and (2) may be corrected as a Minor Home Repair only if infiltration reduction measures are feasible, and the work does not involve extensive repairs. Item (3) precludes the installation of infiltration reduction measures.

a. Nonconforming conditions shall be dealt with per Part 3, Item 4 of this section, as outlined in Table 24-1 ("Conditions Requiring Correction" that may render infiltration-reduction measures unfeasible) and Table 24-2 ("Advisory Conditions" that must be reported to the customer).

b. Required corrections will be performed in accordance with individual utility policy. The owner will be informed of conditions that preclude installation of infiltration-reduction measures and cannot be remedied by the ESA Program (e.g., exhausting a clothes dryer outdoors, repair or replacement of appliances and gas vents for which repair or replacement is not available).

2.6. After completion of weatherization that includes infiltration-reduction measures, NGAT is performed for all natural gas appliances affecting the living space, in accordance with Part 4.

2.7. For IOU-fueled gas appliances (appliance using natural gas provided by SDG&E, PG&E, or SoCal Gas), ambient CO testing will be conducted as follows:

a. Space heating appliances, water heaters and cooking appliances: Ambient CO testing per IS Items 10–13.

b. Fireplace gas logs: Exhaust/flue CO test per IS item 15.

c. Clothes dryers: No CO tests are performed.

2.8. For IOU-fueled gas appliances (appliance using natural gas provided by SDG&E, PG&E, or SoCalGas), draft testing will be conducted in accordance with IS item 14.

2.9. 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.

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

a. Homes with Natural Gas Appliances

- For homes with gas appliances using IOU-supplied natural gas, combustion appliance testing post-weatherization NGAT protocol is conducted after weatherization.

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- Post-weatherization NGAT shall be conducted within five working days from the date infiltration-reduction measures are installed.

b. Homes for Which Infiltration-Reduction Is Simulated
   - Temporary sealing/blocking of defective windows and doors 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/blocked (e.g., with plastic sheeting) to simulate infiltration-reduction achieved by the completed window/door repair/replacement.
   - A repeat of NGAT following the completed repair/replacement is not required.

c. Homes for Which Appliance Repair or Replacement Occurred
   - Natural gas appliances that have been repaired or replaced shall be checked for proper operation, as prescribed in part 6 of this section.
   - Problems identified during post-repair/replacement NGAT must be corrected.

2.11. The following actions will be taken when appliances fail NGAT:

a. In owner-occupied homes, natural gas space heaters failing one or more of the tests covered by the NGAT protocol will be referred for service or provided with service/adjustment[2] and, if necessary, will be repaired or replaced in accordance with the program P&P. The absence of a furnace in cases where another fuel-burning appliance (e.g., cooktop, oven, or unvented space heater) is used for space heating will constitute an NGAT fail.

b. In owner-occupied homes, natural gas storage water heaters failing one or more of the tests covered by the NGAT protocol will be referred for service or be provided with service/adjustment[2] and, if necessary, will be repaired or replaced in accordance with the program P&P. Water heater repairs and replacements are provided only to mitigate NGAT fails or to replace water heaters that are leaking from the tank.

c. In owner-occupied homes, non-program appliances (natural gas appliances for which ESA Program repair or replacement is not available) failing one or more of the tests covered under the NGAT protocol will be referred for service or be provided with service/adjustment[2]. If Service/Adjustment does not correct the problem, the appliances in question will be tagged, shut off, and/or capped and reported to the customer.

d. In renter-occupied homes, natural gas appliances failing one or more of the tests covered by the NGAT protocol will be referred for service or be provided with service/adjustment[2]. If service/adjustment does not correct

[2] In this context, Service/Adjustment of an appliance entails providing services that are within the scope of the gas service department for customers in general.

the problem, the appliance be will be tagged, shut off, and/or capped and reported to the customer.

2.12. The cost to repair the furnace should not be more than the cost to replace the furnace, as follows:

a. Central furnaces: 50% (does not include the costs of compliance items).

b. Wall/floor/direct vent furnaces: 40% (does not include the cost of compliance items).

3. Installation Policies Specific to Mobile Homes

3.1. When the gas water heater compartment floor is not structurally sound, the condition shall be reported to the customer.

3.2. When the water heater is leaning in an unsafe position, and NGAT procedures might worsen the unit's condition, NGAT shall not be conducted on the water heater.

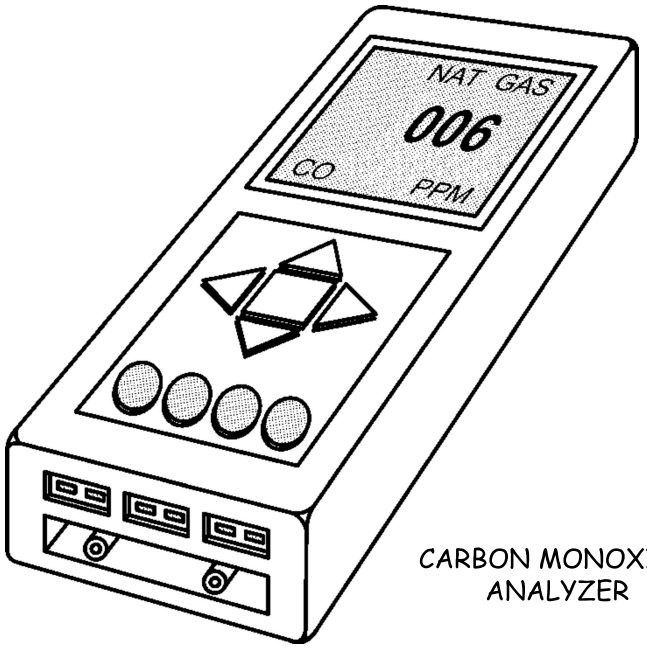
a. If NGAT is not conducted on the water heater, infiltration measures shall not be installed.

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.
  - Must be equipped with a NOx filter when measuring flue gas CO, and a condensate trap.
- **Test equipment calibration**
  - Carbon monoxide analyzers shall be maintained and calibrated in accordance with manufacturer's specifications.



CARBON MONOXIDE ANALYZER

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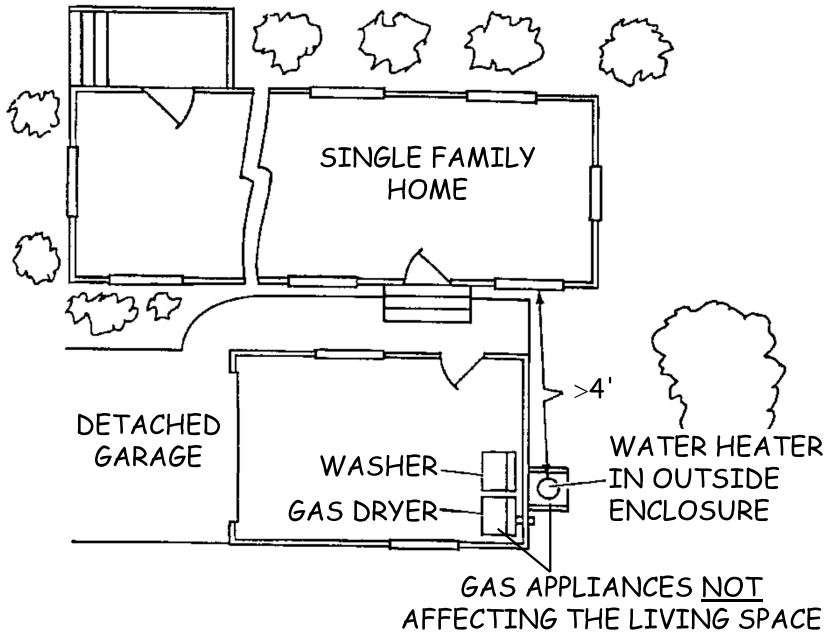
2. NATURAL GAS APPLIANCES AFFECTING THE LIVING SPACE

- **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
- **Appliances affecting the living space are (a) all space heating appliances, and (b) 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 where any part of the appliance is within 4' of an openable door, window, or air inlet 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.**
  - Only checks for gas leaks are required on those appliances; however, hazardous conditions shall be immediately reported to the utility.



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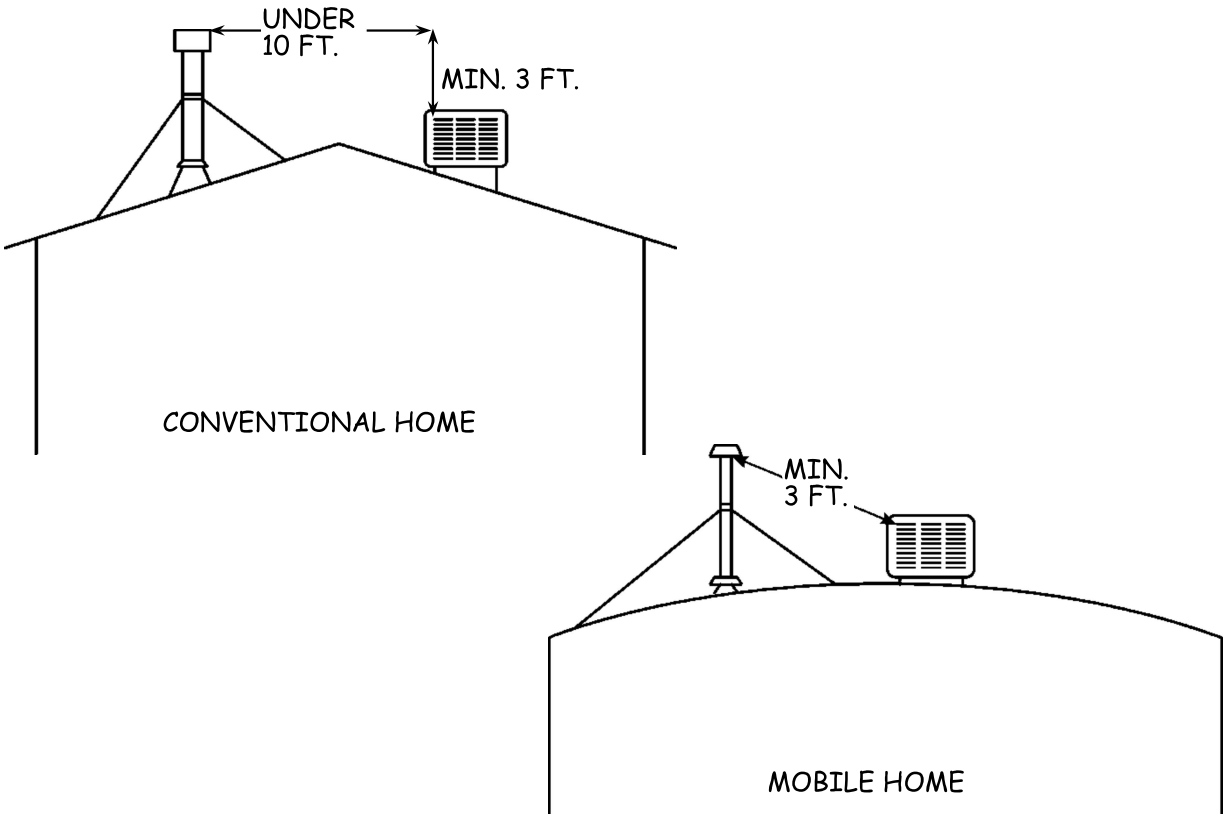
PART 2: PRE-WEATHERIZATION EVALUATIONS

3. PRE-WEATHERIZATION ASSESSMENT

- **The assessment process shall include a check for the following:**
  - Gas leaks (Item 5)
  - Inadequate CVA (Item 6)
  - Inadequate clearance between water heater vent termination and evaporative cooler inlet (Item 7)
  - Other improper vent terminations (Item 7)
  - Inoperable or inaccessible gas appliance (Items 3 and 8)
  - Other conditions listed on the following page.
- **Before weatherization work commences:**
  - Gas leaks shall be repaired.
  - It shall be determined whether:
    - Vent system defects requiring correction can be corrected.
    - Combustion air deficiencies are feasible to correct.



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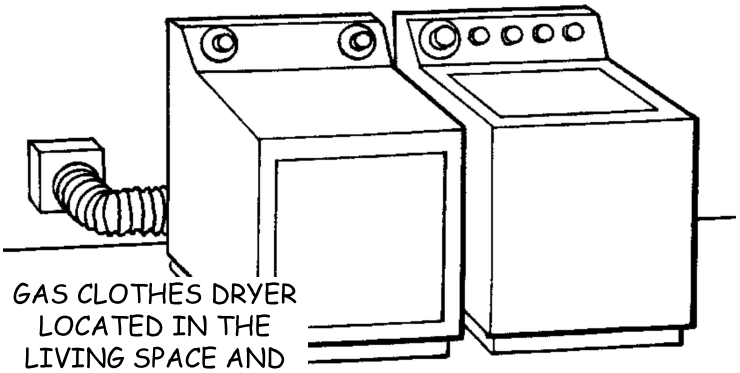
3. PRE-WEATHERIZATION ASSESSMENT (cont.)

- **Assessment shall determine if any of the following conditions are present:**
  - Gas clothes dryer:
    - Located in the living space but not exhausted outdoors.[1]
    - Moisture exhaust (dryer vent) passes through the FAU plenum.
  - Any clothes dryer exhausted into an open combustion appliance enclosure (does not apply to garages).
  - Return leak 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).
  - Whole house fan vented into an attic that contains a gas water heater or an open combustion furnace with standing pilot.
  - Unvented combustion space heater (e.g., gas or kerosene unit) present in the living space.
  - Open combustion water heater or FAU:
    - Present in a sleeping area, or in a bathroom.
    - Located in an unfinished garage used as living space that may be used as a temporary sleeping area.
  - Mobile Home:
    - Open combustion space or water heater in the living space (does not apply to "modular" homes[2])
    - Required kitchen exhaust, or isolation of return air, is not present
  - Gas range present which has a space heater or incinerator that is not properly vented outdoors.
  - Evaporative cooler or room air conditioner located in garage wall in common with the living space.
  - Inoperable gas appliance. [2]
  - Inaccessible gas appliance. [2]



GAS CLOTHES DRYER LOCATED IN THE LIVING SPACE AND VENTED OUTDOORS

[1] Dryer exhaust termination in a crawlspace (conventional or mobile home) or basement is acceptable when the space: (a) has adequate cross-ventilation, (b) does not have a return air intake or combustion air vent in the floor, and (c) does not contain an open combustion appliance.

[2] See Definitions.

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PART 3: WEATHERIZATION CREW VERIFICATIONS

4. PRELIMINARY VISUAL EVALUATIONS

- **A check shall be made for conditions listed in Table 24-1, which preclude installation of infiltration reduction measures, unless repair is feasible in accordance with individual utility policy.**

TABLE 24-1: CONDITIONS REQUIRING CORRECTION

Condition—Natural Gas Appliances
1. Gas leak and/or soldered or other unsatisfactory gas connector
2. Inaccessible gas appliance
3. Appliance is located indoors[3] and has:
a. Improper draft hood (misaligned, missing, or doubled)
b. Vent hazard, such as disconnection or hole/leak indoors
c. Improper vent termination, including natural draft vertical pipe terminating <4' from an outside wall and not extended above roof, horizontal vent pipe outside a wall and not extended above roof, and direct vent wall terminal within 10' of a window/wall A/C or evaporative cooler
d. Inadequate CVA
e. Inadequate clearance to combustibles causing charring.
f. Vent connection to a solid-fuel chimney
4. Open combustion water heater or FAU located in a sleeping room/area (includes converted, finished, or unfinished garage), or in a bathroom
5. Unvented combustion space heater in the living space
6. FVIR water heater manifold door leak/defect present (e.g., damaged/missing grommet, manifold component block, view port window, or door gasket).
7. Gas range with heater/incinerator not vented outdoors
8. Gas clothes dryer: a. Is located in the living space, and is not exhausted outdoors[1] b. Moisture exhaust (dryer vent) passes through the FAU plenum.
9. Return leaks that can draw in combustion products from FAU or other open combustion appliances (includes mobile home FAU/water heater enclosure).
10. Gas log is primary heat source, fireplace damper is not blocked partially open, and installation of partial blocking is not feasible
11. Water heater vent termination too close to evaporative cooler inlet
12. Space heater vent termination too close to evaporative cooler inlet, and cooler vent cover(s) cannot be installed

[3] In living space, attached garage/enclosed porch, basement, crawlspace, or enclosure recessed into the home.

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Condition—Natural Gas Appliances
13. Whole house fan (WHF) vented into attic containing gas water heater or open combustion furnace with standing pilot, and attic ventilation NFVA is less than recommended for the WHF
14. Evaporative cooler or room air conditioner in the garage discharges into the living space.
15. Mobile home: a. Open combustion space or water heater in living space b. Required isolation of return air is not present

4. PRELIMINARY VISUAL EVALUATIONS (cont.)

- **A check shall be made for "Advisory Conditions" in Table 24-2.**
  - When present, infiltration reduction measures may be installed in accordance with individual utility policy; however, the customer shall be advised of the condition.

TABLE 24-2: ADVISORY CONDITIONS

Condition—Natural Gas Appliances
1. Inoperable appliance[4]
2. Appliance is located outdoors[5] and has:
a. Inadequate CVA
b. Misaligned, missing, or doubled draft hood
c. Vent termination (other than DV) that is not 4' below or to side of, or 1' above an openable door/window or gravity air inlet into the home; or is <4' from a wall and does not extend above the wall and roof. (Includes storage water heater in outdoor enclosure and outdoor tankless water heater.)
3. Any clothes dryer exhausting into appliance enclosure or garage, but lint is not affecting open combustion appliances. (Occupants must be advised to watch for accumulation of dryer lint at appliance draft hood and CVA intake.)
4. Clothes dryer moisture exhaust (dryer vent) terminates a. Under a mobile home, into a conventional crawlspace, attic or other concealed space b. Less than 3' from an opening into the building c. Less than 5' from an air conditioner condenser
5. Horizontal FAU is a NOx Rod Furnace subject to recall, and is not replaced.
6. Appliance component(s) missing or damaged, including sight glass, or water heater with combustion chamber inner and outer access cover covers both missing. In a

[4] Appliance may receive Service/Adjustment, which entails providing services within the scope of the gas service department for customers in general. Minor repairs and adjustments may be made to furnaces and water heaters, if these actions would improve the performance of the system at minimal cost.

[5] In a location outside dwelling walls, including outdoor enclosure, detached garage, and open porch.

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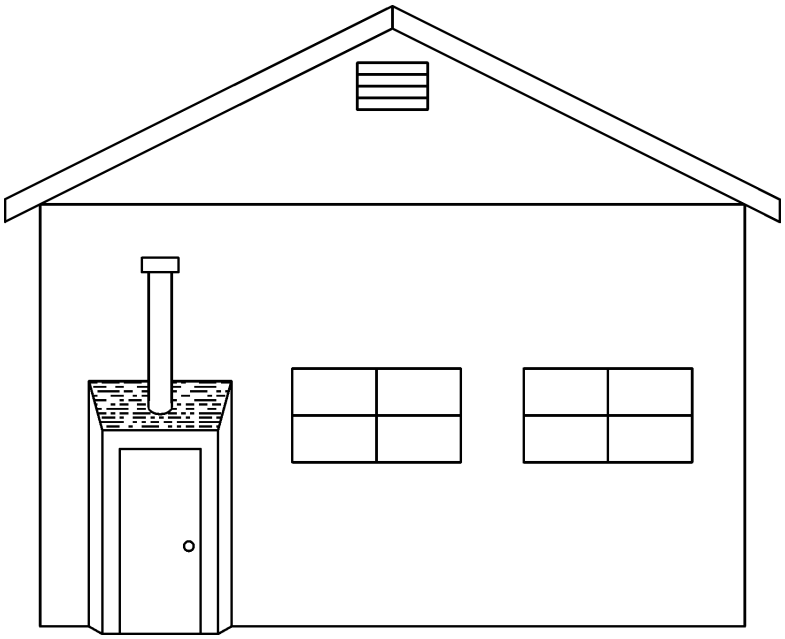
Condition—Natural Gas Appliances
garage, when the combustion chamber is <18" above floor, action shall be taken in accordance with individual utility policy. Exception: Does not apply to FVIR water heaters (see Table 24-1, Item 6).
7. DV termination less than specified distance (6", 9", or 12") from openable door, window, passive air opening into the house.
8. Space heater vent termination too close to evaporative cooler inlet, and cooler vent cover(s) will be installed. (Occupants must be advised to keep cover(s) in place during the heating season.)
9. Gas log is not primary heat source, fireplace damper is not blocked partially open, and installation of partial blocking is not feasible.
10. Vent pipe extending beyond the ceiling or wall is not double wall (Type B).
11. Vent pipe with inadequate clearance from combustibles causing charring.
12. Evaporative cooler, A/C, gas water heater <3' away from gas meter set assembly (see Definitions).
13. Mobile home: a. Gas cooking area ventilation not present/functional b. Gas dryer moisture exhaust (dryer vent) terminates under the home c. Water heater enclosure floor is not structurally sound
14. Missing gas appliance shut-off valve.



OUTDOOR WATER HEATER VENT TERMINATION BELOW THE ROOF AND LESS THAN 4 FT. FROM A WINDOW ("ADVISORY" CONDITION)

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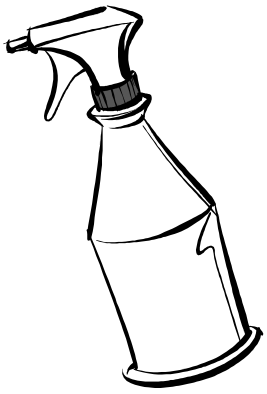
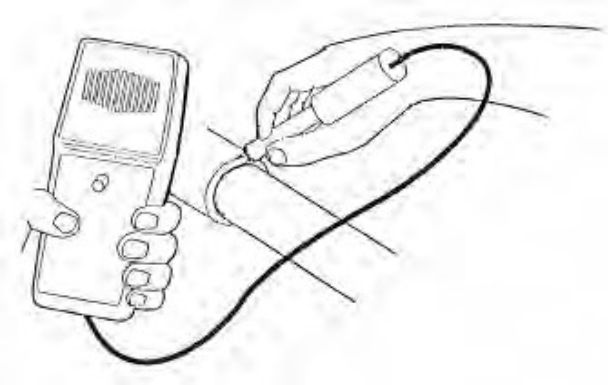
5. GAS LEAKS AND SOLDERED GAS CONNECTORS

- **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, fittings on valves, flexible gas connectors, and pipe connections.
  - Air sampling with electronic leak detection equipment near line valves, fittings on valves, flexible gas connectors, and pipes.
- **When a gas leak is detected:**
  - Inspection shall be conducted, and leaks shall be referred to the utility gas service department (or designee), in accordance with individual utility policy before appliances are operated for natural gas appliance tests.
- **Unsatisfactory gas connectors**
  - Unsatisfactory gas connectors include those which:
    - Have soldered fitting(s),
    - Are leaking,
    - Are kinked, corroded, or have visible signs of damage or deterioration, or
    - Are made of materials considered by the utility to be problematic.
  - Unsatisfactory gas connectors are replaced by the program in accordance with individual utility policy.



SPRAY BOTTLE WITH SPECIAL SOAP OR LEAK DETECTION SPRAY



ELECTRONIC LEAK DETECTOR

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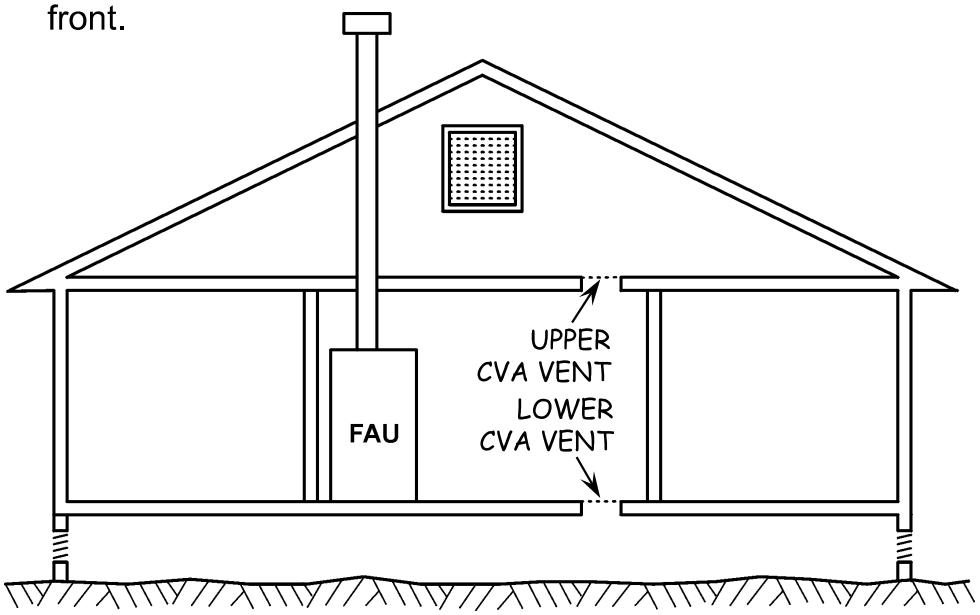
6. COMBUSTION AND VENTILATION AIR (CVA) EVALUATION

- **Open combustion natural gas appliances**
  - In all homes, CVA shall be evaluated for heating systems and water heaters.
  - In homes built in 2008 or later, room volume CVA calculation shall include the sum of Btuh Input ratings for all separate burners in cooking appliances (cooktop burners, griddle, oven, and broiler).
  - CVA shall comply with these guidelines and IS 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 in the ceiling or begin within 12" of the enclosure ceiling, and a *lower* opening or duct shall be in the floor or begin within 12" of the floor.
    - *Exception*: Pre-existing upper openings and ducts with adequate NFVA 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 an upper-only vent or duct to outdoors under the following conditions:
    - Vent/duct 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.



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6. COMBUSTION AND VENTILATION AIR (CVA) EVALUATION (cont.)

- **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.
    - 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 provide at least 1 sq. in. NFVA per 4,000 Btuh total input.
- **Combustion air ducts and sleeves**
  - Duct or sleeve into attic shall extend from appliance enclosure to at least 6" above the top of loose fill 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.**	• **Adequate attic ventilation that is unobstructed.** • **Duct/sleeve extending 6" above top of loose fill insulation.**	• **Free flow of air.** • **Unobstructed openings to outdoors with at least 1 sq. in. NFVA per 4,000 Btuh total input.**

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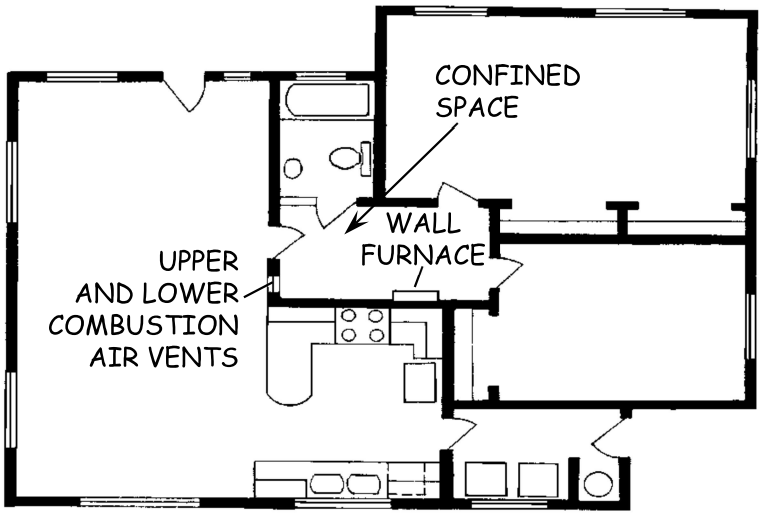
6. COMBUSTION AND VENTILATION AIR (CVA) EVALUATION (cont.)

- **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.[6]
    - 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.
    - 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 in the floor or begin within 12" of the floor, and upper vents shall be in the ceiling or begin within 12" of the ceiling.
    - *Exception*: Pre-existing upper vents are acceptable at any height above the draft hood.



WALL FURNACE LOCATED IN AN INDOOR CONFINED SPACE (VOLUME OF HALLWAY IS LESS THAN 50 CUBIC FEET PER 1,000 BTU/HR INPUT OF THE FURNACE)

[6] For a double-sided wall furnace with burner access from both sides, CVA volume includes spaces on both sides of the wall, so transfer grilles between them are not required.

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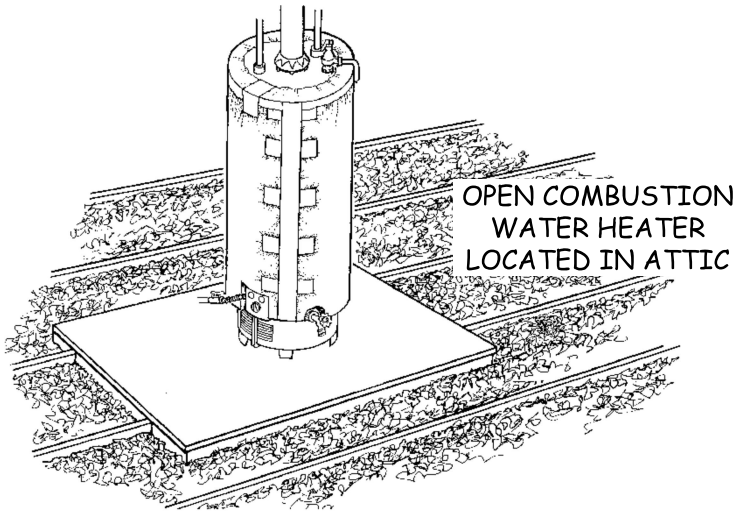
6. COMBUSTION AND VENTILATION AIR (CVA) EVALUATION (cont.)

- **Appliances located in attached garage or enclosed porch**
  - When a garage or enclosed porch is an unconfined space, combustion air is considered adequate.
  - When a converted (finished) garage is a confined space used as conditioned living space, infiltration-reduction measures shall not be installed in the garage, *unless* CVA correction is feasible.
  - When a garage or enclosed porch 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.
  - Lower CVA vents to outdoors shall not be installed within 18" of a gas meter.
- **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 (e.g., foundation vents) shall provide at least 1 sq. in. NFVA per 4,000 Btuh total input.
- **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.



UPPER AND/OR LOWER ATTIC VENTS WITH CROSS VENTILATION REQUIRED WHEN ATTIC IS A CONFINED SPACE

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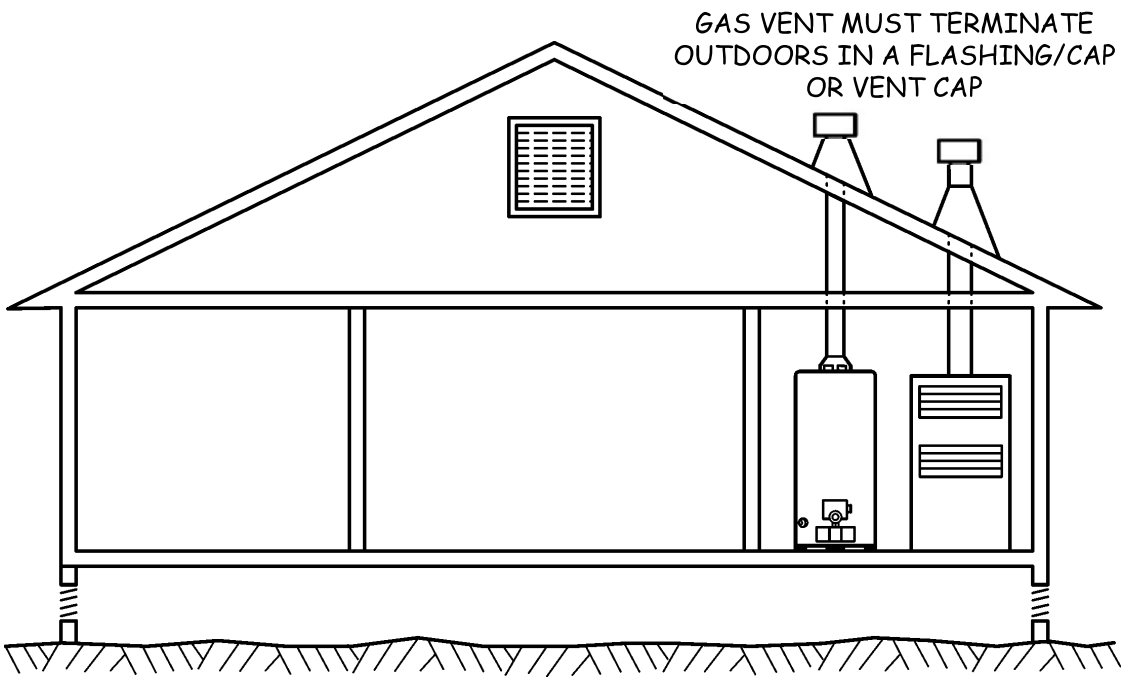
7. EXAMINATION OF EXISTING GAS VENT PIPES[7]

- **Vent system conditions to be checked:**
  - Draft hood defects:
    - Improperly installed or positioned.
    - Multiple (stacked) draft hoods on a single appliance.
    - Missing (no draft hood at all).
  - Inadequate clearances to combustibles causing charring.
  - Disconnections or unsafe joints (e.g., loose, unsecured, etc.).
  - Holes or other hazardous conditions requiring repair.
  - Connection to a solid-fuel appliance chimney.
  - Pipe extending beyond the ceiling or wall is not double-wall (Type B).
- **Vent termination for appliance located indoors**
  - Does not apply to Mechanical Draft and Direct Vent appliances.
  - When infiltration reduction measures are installed:
    - Vertical vent pipe shall extend through the roof and terminate in a flashing/cap or vent cap.
    - Horizontal vent pipe shall extend through the wall, and then vertically above the roof, and terminate in a vent cap.



[7] See Tables 24-1 and 24-2 regarding action to be taken.

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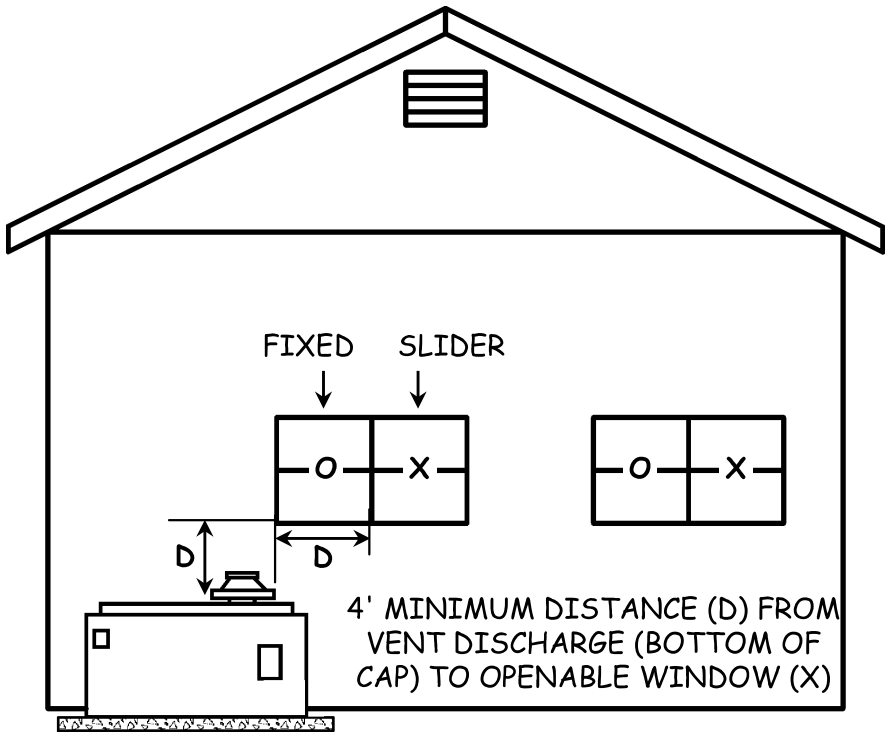
7. EXAMINATION OF EXISTING GAS VENT PIPES (cont.)[7]

- **Vent termination near a door or window—except direct vent appliances[8]**
  - Applies to Package Units, Mechanical Draft Appliances, and Through-the-Wall Terminations
  - Does not apply to the combustion air intake of a Direct Vent appliance.
  - Conditions to be checked:
    - Gas vent terminates closer than the following distances from an openable door or window or a gravity inlet into the house:
      - 4' below, or
      - 4' horizontally from, or
      - 1' above.
    - Terminates less than 10' from any forced air inlet that is not at least 3' below the terminal.



[8] CMC definition of Direct Vent Appliance: "An appliance that is constructed and installed so that all air for combustion is derived directly from the outside atmosphere, and all flue gases are discharged to the outside atmosphere."

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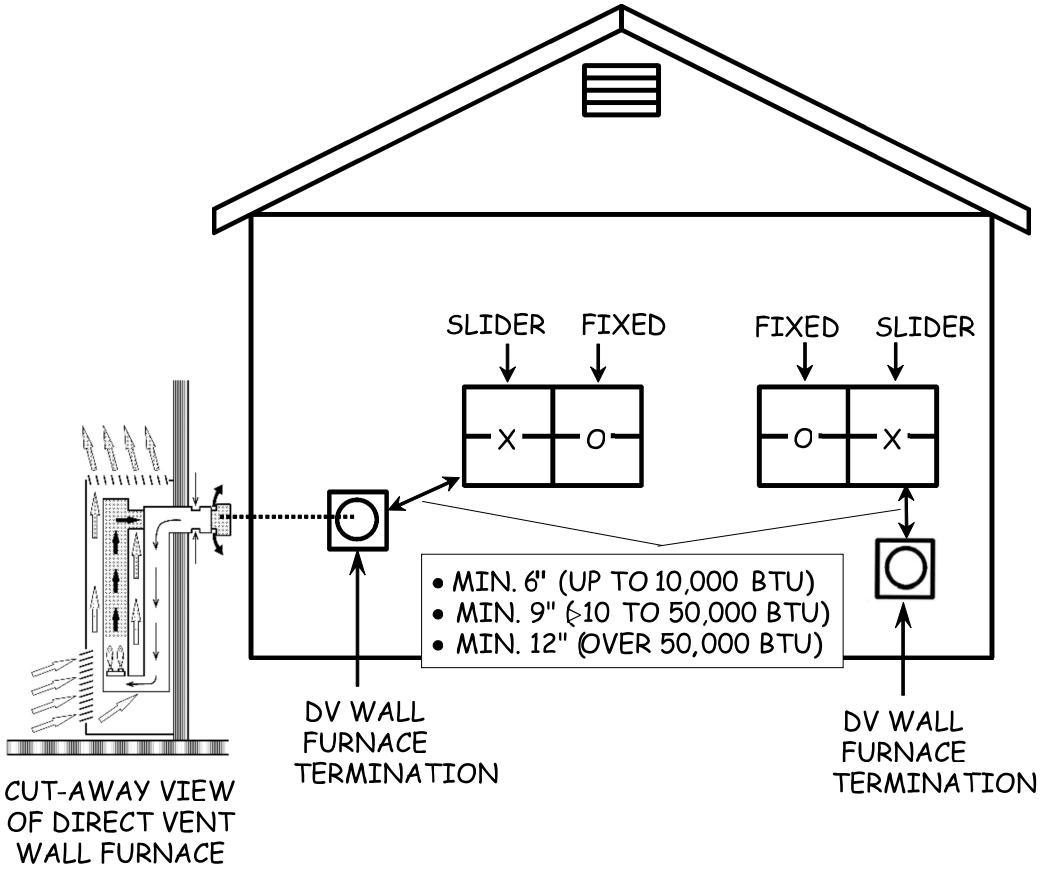
7. EXAMINATION OF EXISTING GAS VENT PIPES (cont.)[7]

- **Vent termination for direct vent appliance**
  - Applies to all appliances meeting the definition of “Direct Vent Appliance” given in footnote 8.
  - Condition to be checked:
    - Vent Termination closer than the following distances from an openable door, window, or gravity (nonmechanical) inlet into the house:
      - 6" away for Inputs up to 10,000 Btu/hr.
      - 9" away for Inputs over 10,000 up to 50,000 Btu/hr.
      - 12" away for Inputs over 50,000 Btu/hr.
    - Vent terminal within 10' of an evaporative cooler, room A/C, or mechanical inlet located less than 3' above the appliance air inlet, except as provided on page 24-17, where a cooler or A/C cover is present.



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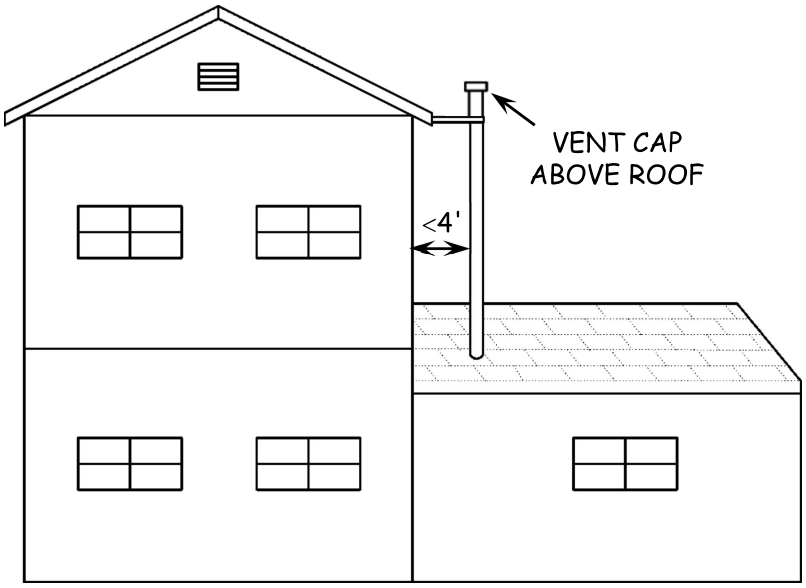
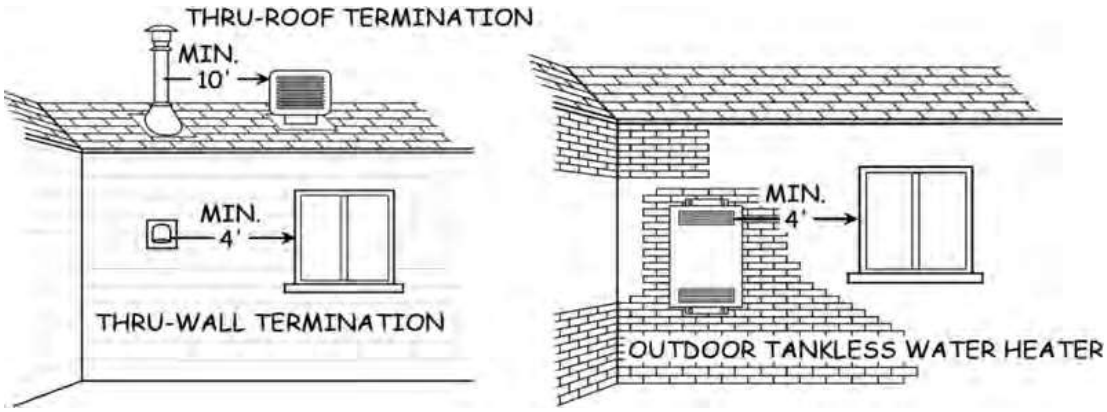
7. EXAMINATION OF EXISTING GAS VENT PIPES (cont.)[7]

- **Vent termination for pipe <4' from a wall**
  - Applies to a natural draft appliance vent pipe that extends above a roof (e.g., the garage roof) and is located within 4' of a wall (e.g., second story wall) or similar obstruction.
  - Condition to be checked: Pipe terminates in a vent cap located above the adjacent (e.g., second story) wall and roof.



- **Tankless water heater exhaust outlet**
  - Through-roof vent pipes:
    - Terminate above roof or per manufacturer if greater.
  - Outdoor wall-mount units and pipe terminals:
    - Minimum 4′ from openable windows and doors.
  - All terminals:
    - Minimum 3′ above any forced air inlet within 10′.



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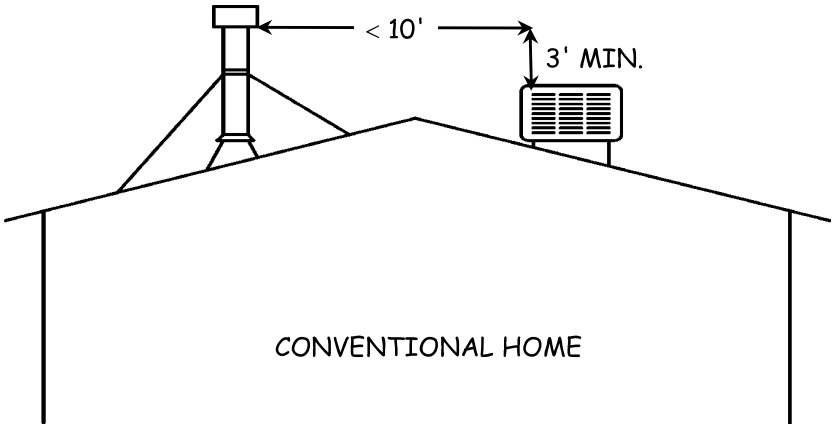
7. EXAMINATION OF EXISTING GAS VENT PIPES (cont.)[7]

- **Vent termination near a cooler or mechanical vent inlet**
  - Any <u>water heater</u> vent termination located within 10' of an inlet shall terminate at least 3' above it.
    - *<u>Exception</u>:* Clearance <u>not</u> required when the cooler has been removed and the roof opening is sealed.
  - Any <u>furnace</u> vent termination, including direct vent wall furnace, located within 10' of an inlet shall terminate at least 3' above the inlet.
    - *<u>Exceptions</u>:* Clearance <u>not</u> required under any of the following conditions:
      - The cooler is equipped with a cooler cover, or
      - All cooler discharge openings are equipped with a vent cover, or
      - The cooler shares the duct system with the FAU, and there is present a functional damper that isolates the cooler from the duct system during the heating season, or
      - The cooler has been removed and the roof opening is sealed.
    - When a cover- or damper-related exception applies, the occupants shall be advised to do the following, as applicable, during the heating season:
      - Keep the cover(s) in place, or
      - Keep the damper completely closed to isolate the cooler from the duct system.



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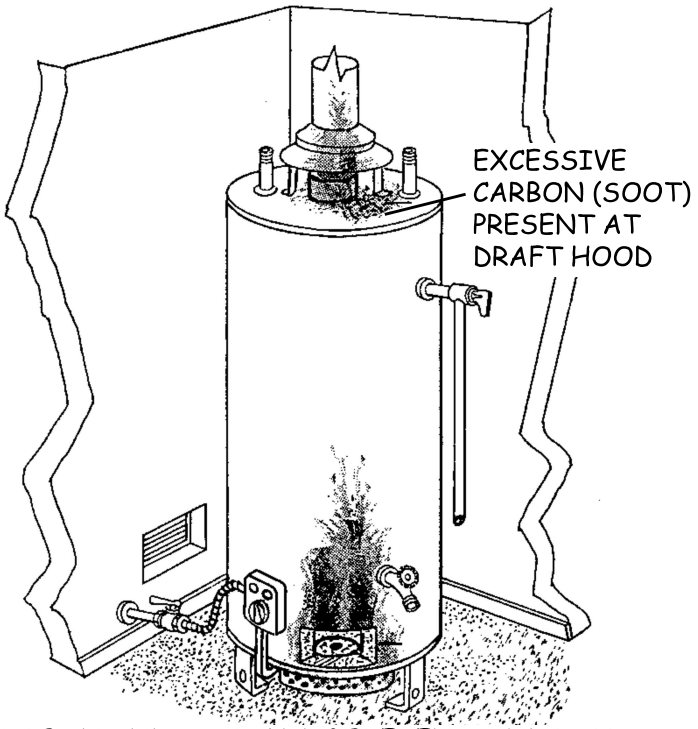
8. OTHER NATURAL GAS APPLIANCE CHECKS

- **All Appliances**
  - Checks shall be made for conditions requiring correction listed in Table 24-1, which are not acceptable when infiltration reduction-measures are installed.
- **Inoperable and inaccessible natural gas appliances**
  - An inoperable appliance must be referred for service, unless it is abandoned or inaccessible[9].
  - An inaccessible appliance precludes NGAT on that appliance and the installation of infiltration-reduction measures.
- **Appliance components**
  - Gas appliances shall be checked for the presence of the following components:
    - Appliance door(s).
    - Combustion chamber access door(s).
    - Water heater access cover and roll-out shield.
    - Roll-out shield on furnace, when unit was manufactured with one.
    - Missing or defective sight glass on closed combustion or FVIR unit.
- **Carbon and rust**
  - The top of the burner(s), the heat exchanger, draft hood, and vent pipe shall be examined for excessive amounts of carbon or rust.
- **Return system leaks**
  - The return system/plenum shall be checked for leaks that can draw in combustion products from the FAU or other combustion appliances.
- **FVIR air inlets**
  - Combustion air inlet(s) checked for free flow of air and absence of lint or other obstructions.



CARBON AND SCORCHING PRESENT, AND ROLLOUT SHIELD AND BURNER ACCESS COVER BOTH MISSING

[9] See Definitions

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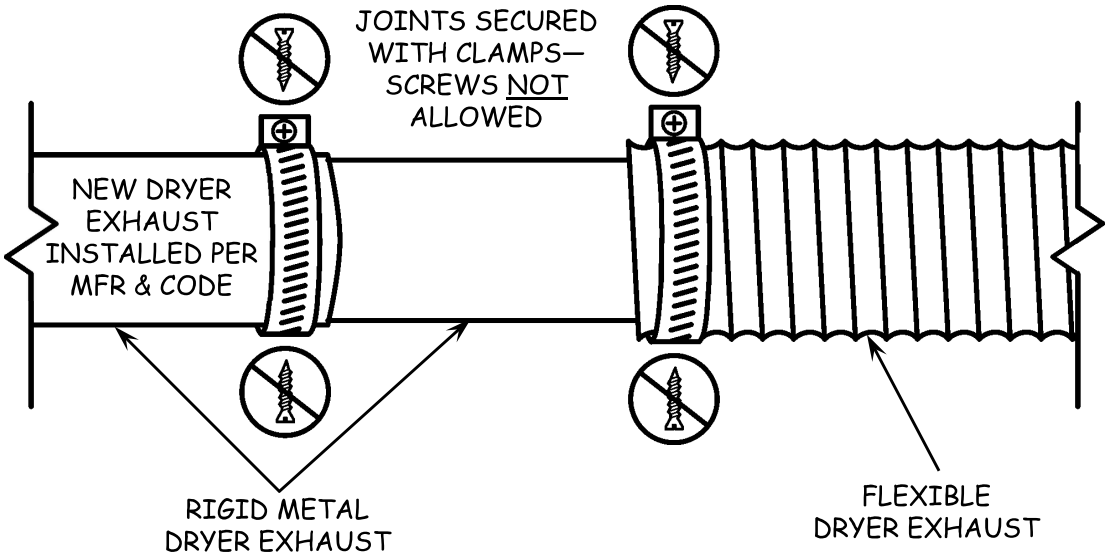
8. OTHER NATURAL GAS APPLIANCE CHECKS (cont.)

- **Heat exchanger examination on open combustion furnace/heater**
  - Each accessible heat exchanger shall be inspected for cracks and other defects with a mirror and strong light.
- **Horizontal furnaces**
  - FAU shall be checked to determine whether it is a NOx rod furnace subject to recall.
- **Clothes dryer moisture exhaust (dryer vent)**
  - Gas Dryer
    - When located in the *living space*, the moisture exhaust (dryer vent) system shall be checked for proper termination outdoors.[10]
    - Moisture exhaust (dryer vent) shall be checked to determine if it passes through the FAU plenum.
  - Gas or Electric Dryer
    - Moisture exhaust (dryer vent) system shall be checked for improper termination in an open combustion appliance enclosure.
    - When moisture exhaust termination is located in an unconditioned garage, the draft hood and CVA intake of open combustion appliance(s) in the garage shall be checked for accumulation of dryer lint.
- **Evaporative cooler or room air conditioner in the garage**
  - It shall be determined if the unit discharges into the living space.



[10] Dryer exhaust termination in a crawlspace (conventional or mobile home) or basement is acceptable when the space: (a) has adequate cross-ventilation, (b) does not have a return air intake or combustion air vent in the floor, and (c) does not contain an open combustion appliance.

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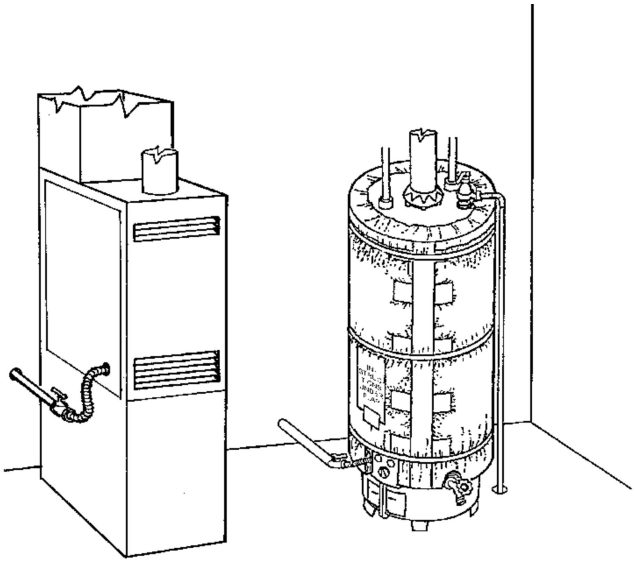
PART 4: POST-WEATHERIZATION NGAT PROCEDURES

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 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**
  - Gas leaks detected during post-weatherization NGAT shall be referred to the utility gas service department (or designee), in accordance with individual utility policy.
  - If a Room Ambient or Appliance Ambient CO measurement equals or exceeds the action level of 10 ppm, unit(s) causing elevated CO reading shall be referred for service or be serviced/adjusted by a utility gas service technician (or designee).
  - An appliance that has inadequate draft or is inoperable shall be referred for service or be serviced/adjusted by a utility gas service technician (or designee).
  - All units repaired or replaced shall undergo post-repair/replacement testing per Part 6.



NATURAL GAS APPLIANCES THAT RECEIVE DRAFT TEST

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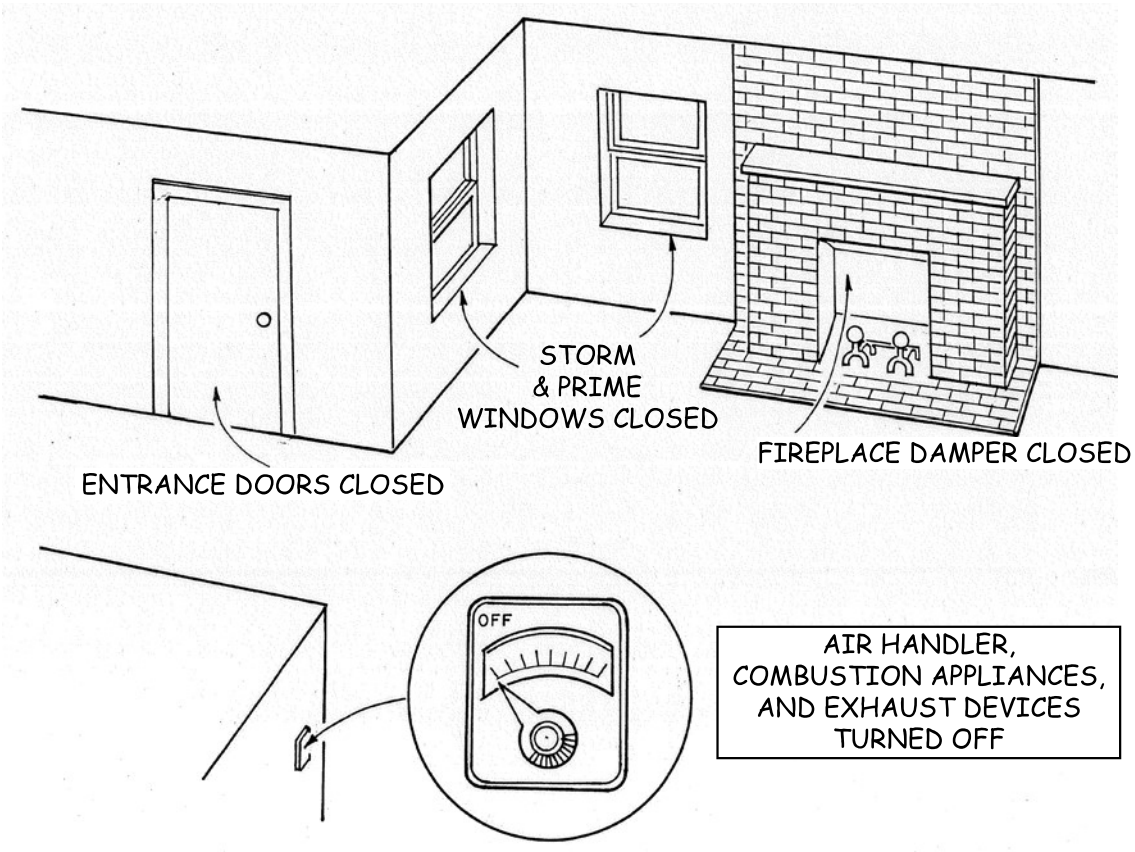
10. TEST CONDITIONS FOR *ROOM* AMBIENT CO TEST

- **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.



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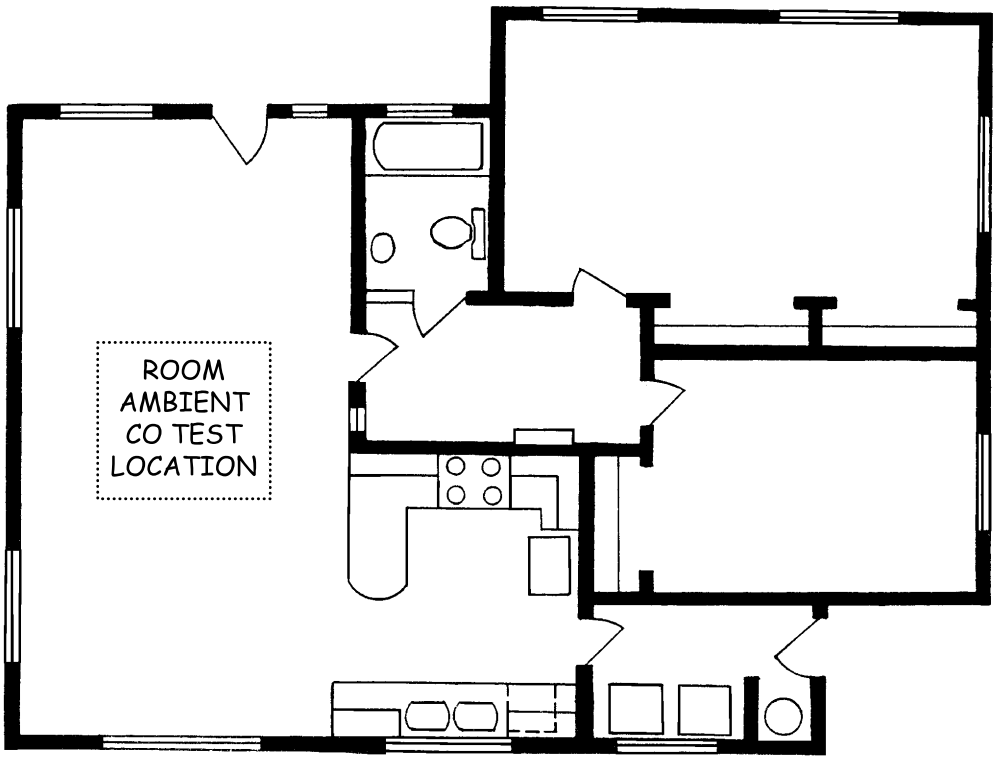
11. CONDUCTING ROOM AMBIENT CO TEST

- **CO analyzer shall be operated in accordance with manufacturer's instructions.**
- **Room Ambient CO test shall be conducted immediately after zeroing the CO analyzer in "as-measured" mode:**
  - Measure 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).
    - When a space heating appliance is above the 1st floor, Room Ambient CO testing begins there.
    - Moving downward, check Room Ambient CO at each level.
  - Measure Room Ambient CO:
    - 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 or 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.



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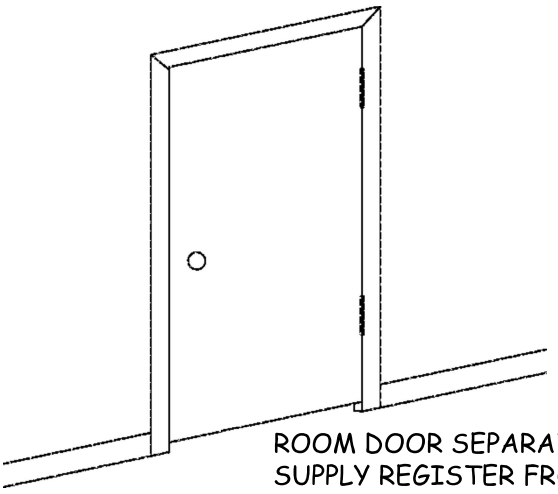
12. TEST CONDITIONS FOR APPLIANCE-ON CO AND DRAFT TESTS

- **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 in the garage.
  - All exhaust devices in the living space and the garage shall be operating.
- **Appliances located in attic, basement, and crawlspace**
  - Devices exhausting into the attic, basement, and crawlspace shall be off during draft tests on appliances in those locations.



ROOM DOOR SEPARATING SUPPLY REGISTER FROM A CENTRAL RETURN IS CLOSED

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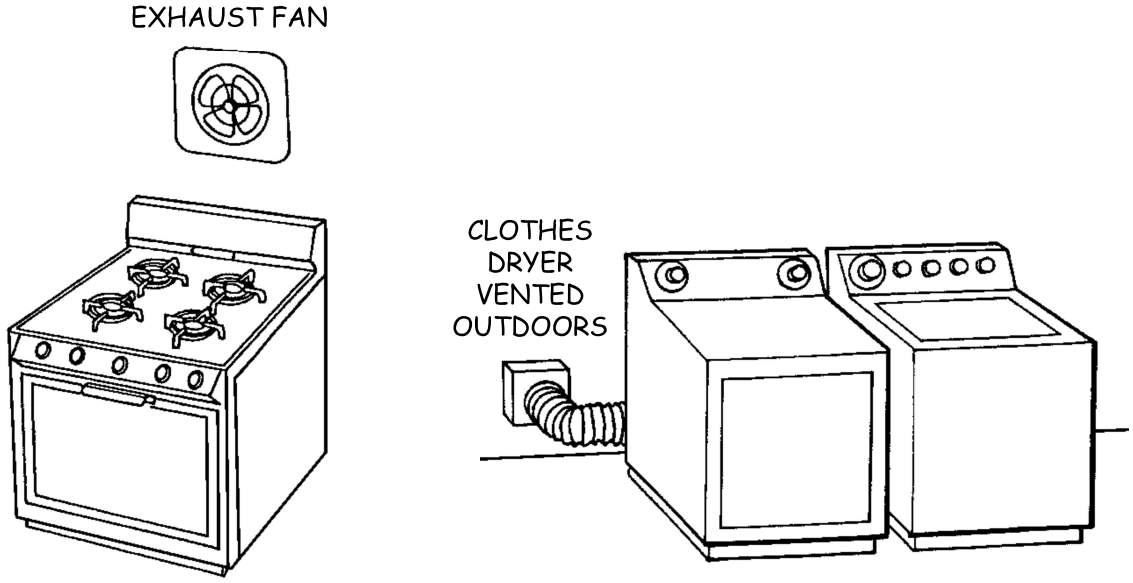
12. TEST CONDITIONS FOR APPLIANCE-ON CO AND DRAFT TESTS (cont.)

- **The following must be operating during testing of open combustion space heaters and water heaters:**
  - 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, whole dwelling unit exhaust and balanced mechanical ventilation systems, clothes dryer, central vacuum system, and manually-controlled attic ventilators.
    - Exclude whole house fan (different from whole dwelling unit *mechanical ventilation* system).
- **Other conditions**
  - 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 OUTDOORS

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13. TEST PROCEDURES FOR *APPLIANCE* AMBIENT CO TEST

- **Test conditions shall be established as prescribed in Item 12.**
- **Natural gas space heating appliances**[11]
  - Space heating appliance(s) are tested first, each operated individually.
    - The main burner(s) shall be operated for a minimum of 5 minutes.
    - All other gas appliances shall remain off (the pilot may be operating).
  - Appliance Ambient CO shall be measured in the following locations:
    - Ducted units: In the supply register nearest the furnace.
    - Non-ducted units (direct vent, wall and floor furnaces, and free-standing heaters): In the atmosphere directly above the top of the unit.
  - In a multi-story home with non-ducted heating appliance(s) above the 1st floor:
    - Testing begins on the highest floor and moves to each lower floor.
    - Each heating appliance is operated individually for a minimum of 5 minutes, tested, and turned off before testing the next heating appliance.
    - When two heating appliances are on the same floor, the one with lower Btuh input is tested first.
  - When supply ducts extend to an upper floor where a non-ducted heater (e.g., wall furnace) is located:
    - FAU CO is measured first, and the burner is turned off.
    - Ambient CO is then measured for the non-ducted heater.
    - If CO in the duct system is >9 ppm, the living space shall be ventilated before measuring non-ducted heater Ambient CO.
  - When supply registers are the only heat source on an upper floor, testing is performed on the FAU supplying heat to that floor.
- **Action level**
  - The space heating system shall be checked by a utility gas service technician (or designee) if Appliance Ambient CO ppm is:
    - 10 ppm or higher, or
    - Above Room Ambient CO by more ppm than individual utility policy allows.

[11] Horizontal NOx rod FAUs subject to CPSC recall must be identified and reported to owner/manager when they do not fail NGAT.

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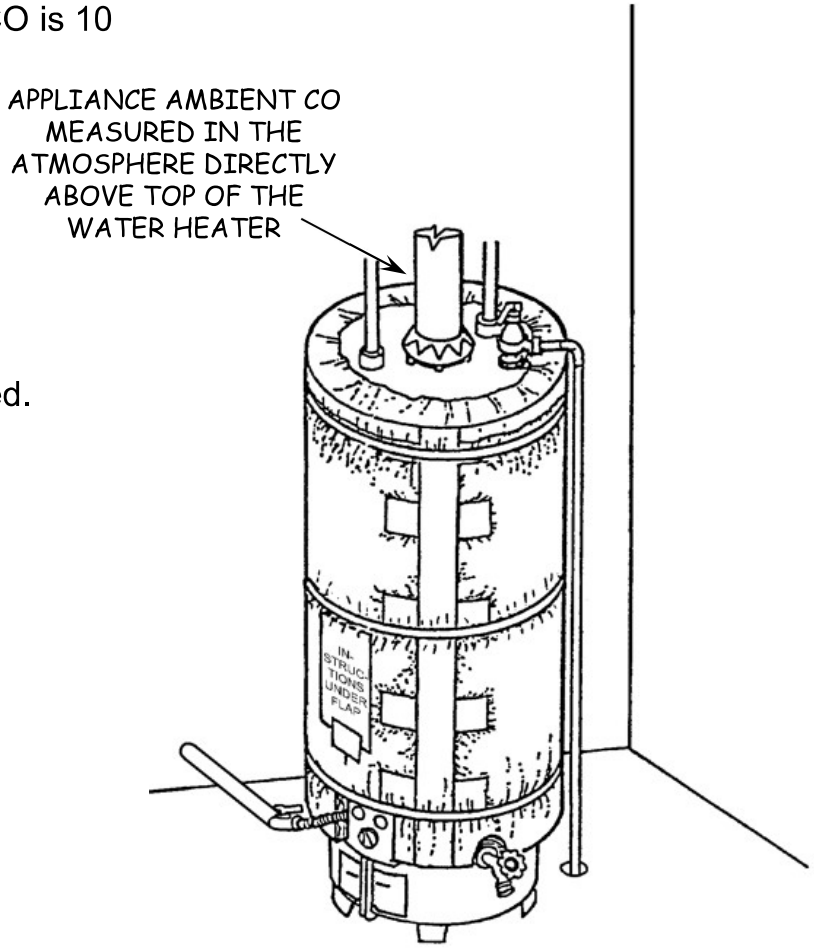
APPLIANCE AMBIENT CO TEST CO ANALYZER PROBE LOCATIONS FOR HEATING APPLIANCES AND WATER HEATERS
• DUCTED UNITS: INSIDE SUPPLY REGISTER NEAREST THE FAU WITH TEST PROBE DIRECTED INTO AIR FLOW.
• NON-DUCTED HEATERS: IN THE ATMOSPHERE ABOVE THE UNIT.
• WATER HEATERS: IN THE ATMOSPHERE ABOVE THE UNIT AND DRAFT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

13. TEST PROCEDURES FOR APPLIANCE AMBIENT CO TEST (cont.)

- **Draft tests**
  - Draft test is performed on each space heater before burner is turned off.
- **Natural gas storage water heater**
  - Water heater shall be operated for a minimum of 5 minutes.
  - 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 is 10 ppm or higher.
- **Natural gas log**
  - An exhaust/flue CO test shall be conducted per Item 15.
- **Natural gas clothes dryer**
  - No CO test required.



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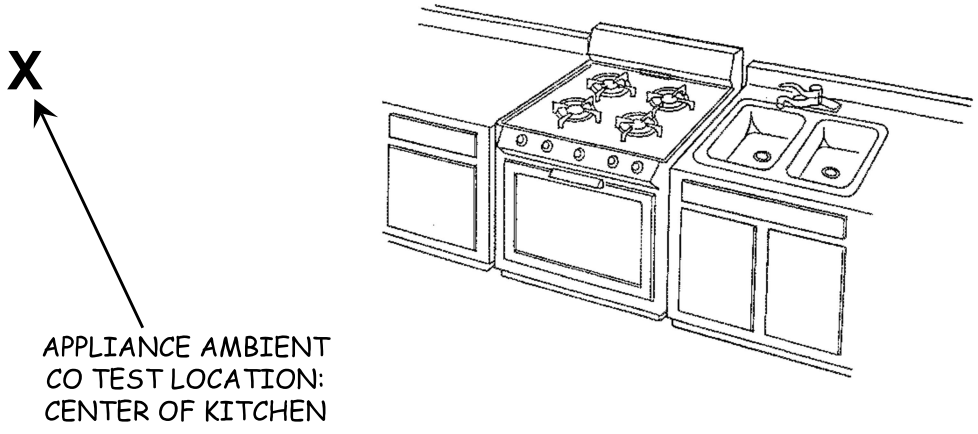
13. TEST PROCEDURES FOR APPLIANCE AMBIENT CO TEST (cont.)

- **Natural gas kitchen appliances**
  - All other gas appliances shall remain off (the pilot may be operating).
  - Exhaust fans and devices directly affecting the kitchen shall be turned off during tests of kitchen appliances that are not vented outdoors.
  - 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 individually 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 is 10 ppm or higher.



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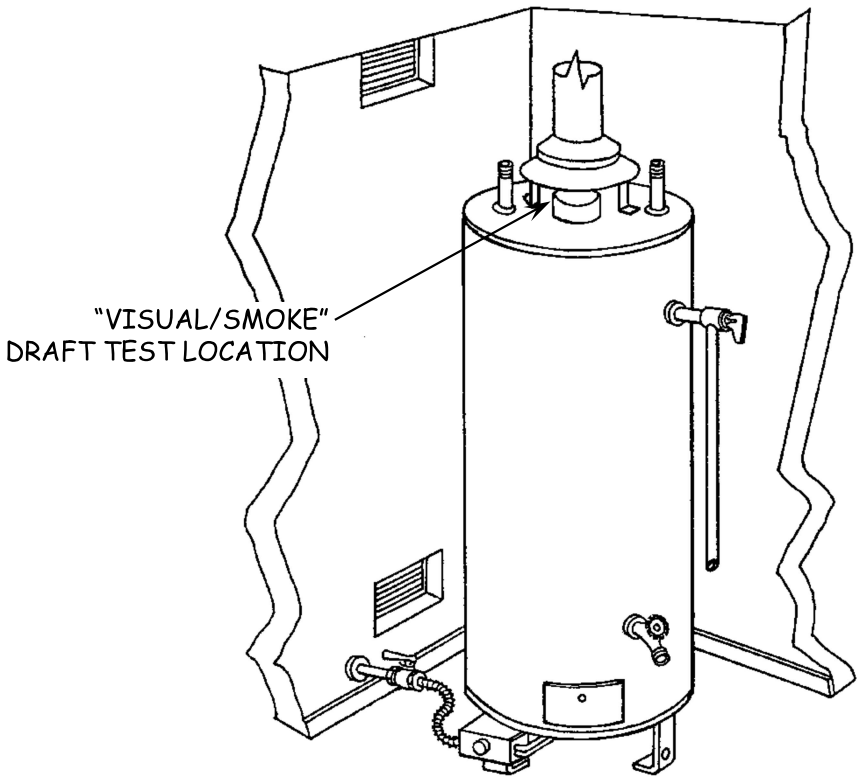
14. DRAFT EXAMINATION

- **Natural gas open combustion natural draft appliances**
  - Draft tests shall be performed after a minimum of 5 minutes of appliance operation.
    - For space heaters, draft test is performed immediately after the Appliance Ambient CO measurement.
  - 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, near the top of the opening.
    - Draft is adequate only if smoke is drawn into the draft hood opening, and continuous or excessive spillage is not present.
- **Gas logs**
  - Visual/smoke draft test shall be performed as prescribed in Item 15.
- **All units**
  - Corrective action is required when Draft not adequate.



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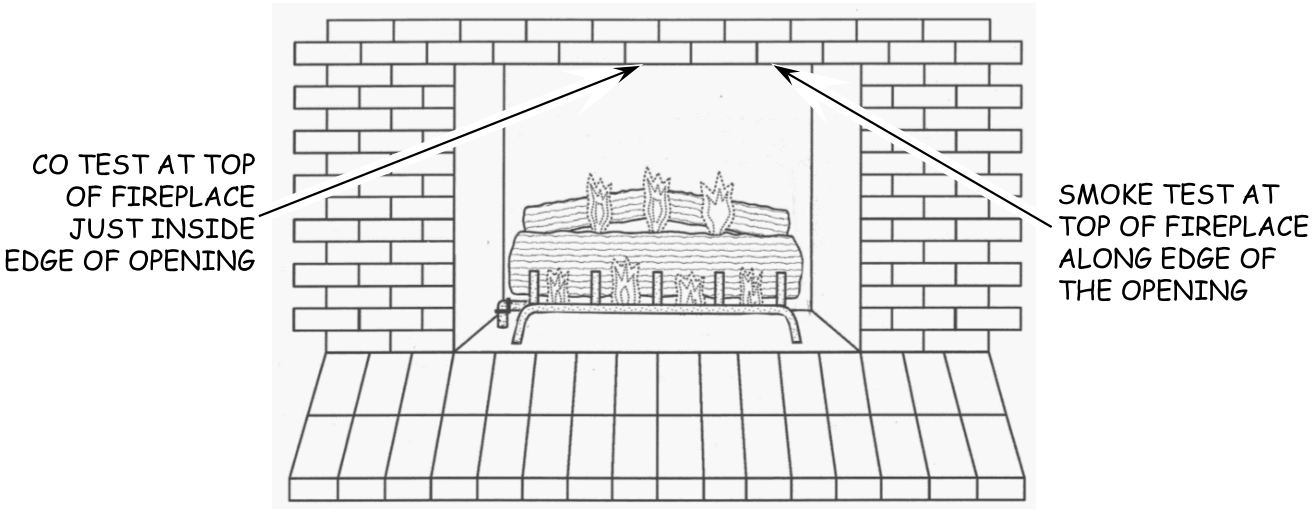
15. CO AND DRAFT TESTING FOR NATURAL GAS LOGS

- **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.
- **Glass doors**
  - 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 <u>just inside</u> the outer edge of the fireplace opening (<u>not</u> near or over 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.
- **Flue gas CO action level**
  - Greater than 25 ppm as-measured.
  - Greater than 400 ppm air-free.
- **Visual/smoke draft test**
  - Smoke shall be applied along the top of the fireplace at the outside edge of the opening.
  - Draft is adequate <u>only when</u> smoke is drawn inward along the entire fireplace opening.



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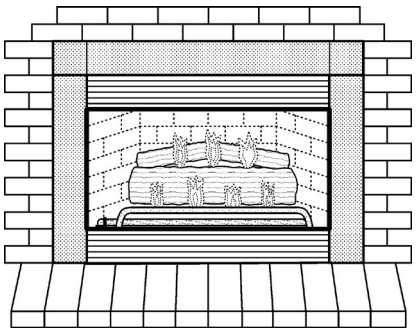
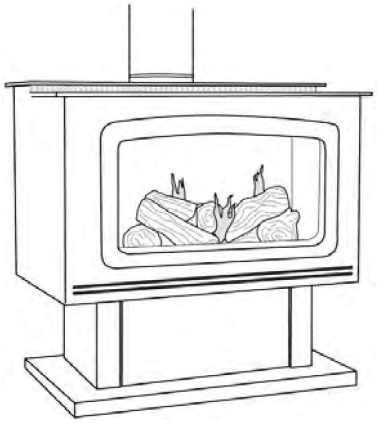
16. CO AND DRAFT TESTING FOR NATURAL GAS LOG APPLIANCES

- **Gas appliances to be tested**
  - Gas log heater–insert, with glass front (left image below)
  - Gas log heater–free-standing, with glass door (right image below)
  - Gas fireplace insert–gas burning heater
- **Exhaust/flue CO test**
  - Gas burner shall be operated for a minimum of 5 minutes before checking CO.
  - If CO exceeds action level after 5 minutes, warm up time shall be increased (up to 30 minutes), and unit shall be retested.
  - Open combustion units
    - Appliance Ambient CO shall be measured within 12" above heat outlet at the top of the unit
    - Flue gas CO is measured inside the flue, when accessible.
  - Closed combustion units
    - When vent terminal is accessible, Flue Gas CO shall be measured inside the vent terminal.[1]
    - When vent terminal is not accessible, CO measurement is limited to Appliance Ambient CO.
  - Service by a utility gas service technician (or designee) is required if CO exceeds the action level.
- **CO action level**
  - Appliance Ambient CO: >2 ppm (or individual utility policy maximum) above Room Ambient, or >9 ppm.
  - Flue Gas CO: >25 ppm as-measured (>400 air-free), when measurement is possible.
- **Visual/smoke draft test**
  - Smoke shall be applied along the combustion air inlet, if accessible.
  - Draft is adequate when smoke is drawn inward along the entire inlet.



GAS LOG FIREPLACE



FREE-STANDING GAS LOG

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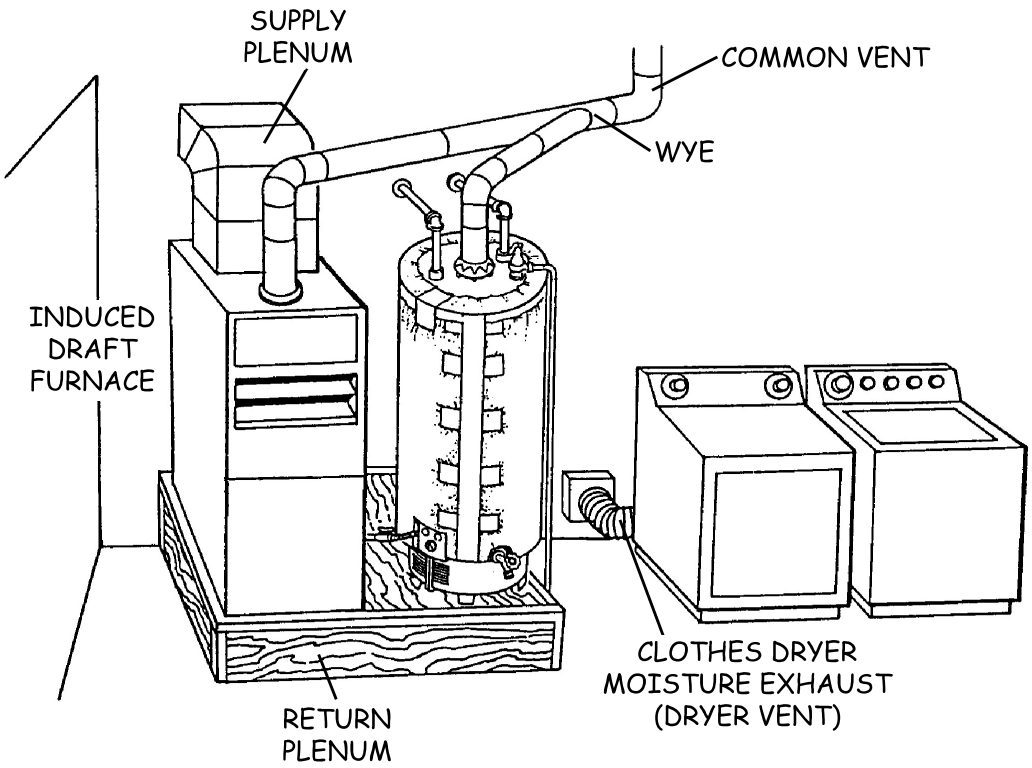
17. MULTIPLE APPLIANCES SHARING A COMMON VENT

- **Space heater and water heater**
  - Appliance Ambient CO measurements
    - Space heater Appliance Ambient CO shall be measured first after 5 minutes of burner operation.
    - Space heater shall then be turned off, and the water heater main burner turned on.
    - After a minimum 5 minutes of burner operation, water heater Appliance Ambient CO shall be measured.
    - With the water heater still operating, space heater shall be turned on again and operated for a minimum of 2 minutes.
  - Draft tests shall then be performed on both appliances.
- **Multiple water heaters (no space heater in CAZ)**
  - After the first unit's main burner is operated a minimum of 5 minutes, Appliance Ambient CO is measured, and the unit is turned off.
  - The same procedure is followed for each of the other units.
  - After Appliance Ambient CO has been measured for the last unit:
    - It stays on, and the other unit(s) shall be turned on again for a minimum of 2 minutes.
    - Draft testing shall then be performed on each unit.



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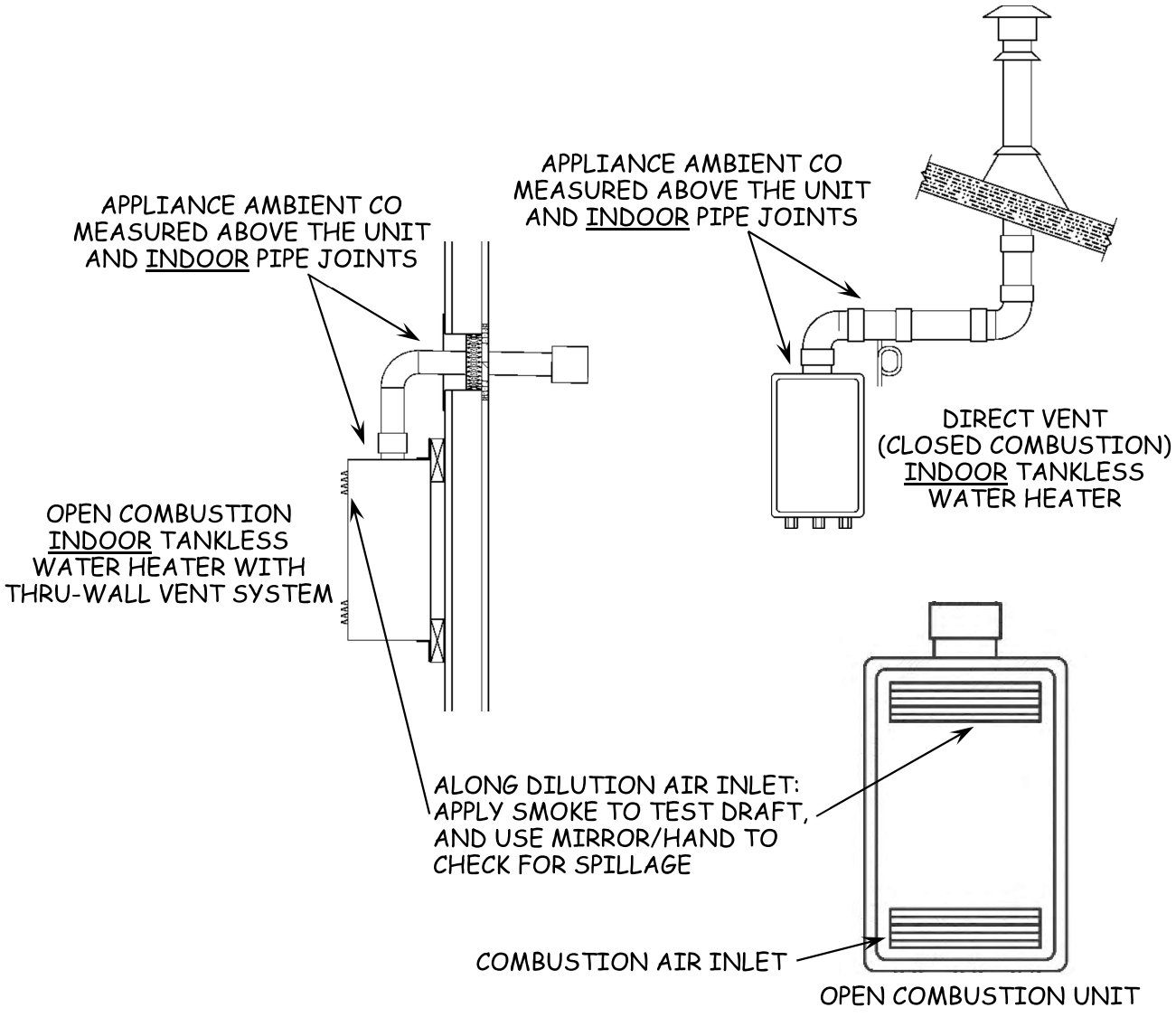
18. CO AND DRAFT TESTING—TANKLESS WATER HEATERS

- **Natural gas tankless water heaters located indoors**
  - Appliance Ambient CO test
    - Run hot water to keep the burner operating at maximum Btuh.
    - After at least 1 minute of burner operation, CO shall be measured in the atmosphere above the unit and indoor pipe joints.
    - CO action level: 10 ppm or higher.
  - Check draft and spillage along the dilution air inlet.
  - If CO exceeds the action level, or the unit fails draft or spillage check, the unit shall be checked/serviced by a qualified technician and brought into safe operating condition.



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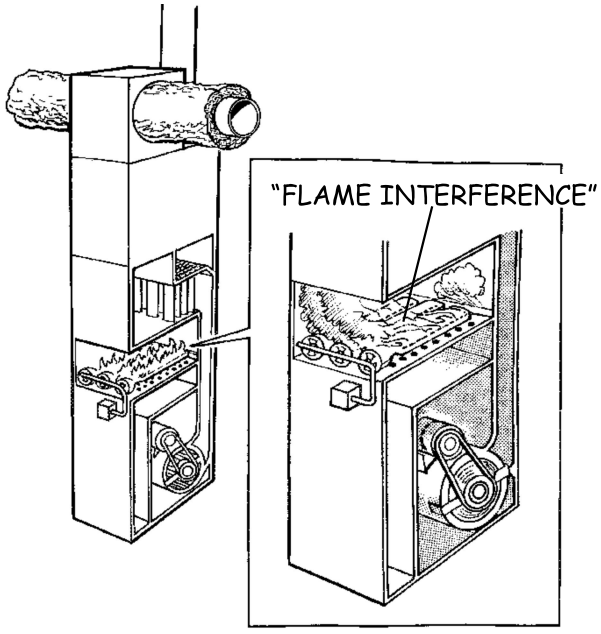
19. ADDITIONAL BURNER-ON APPLIANCE EXAMINATIONS

- **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.
- **Heat exchanger examination**
  - Natural Gas Open Combustion Furnaces/Heaters
    - Each accessible heat exchanger shall be inspected for cracks with a mirror.
    - 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.
- **Defect correction**
  - Defects shall be corrected by a utility gas service technician (or designee), or designated contractor licensed to repair HVAC appliances.



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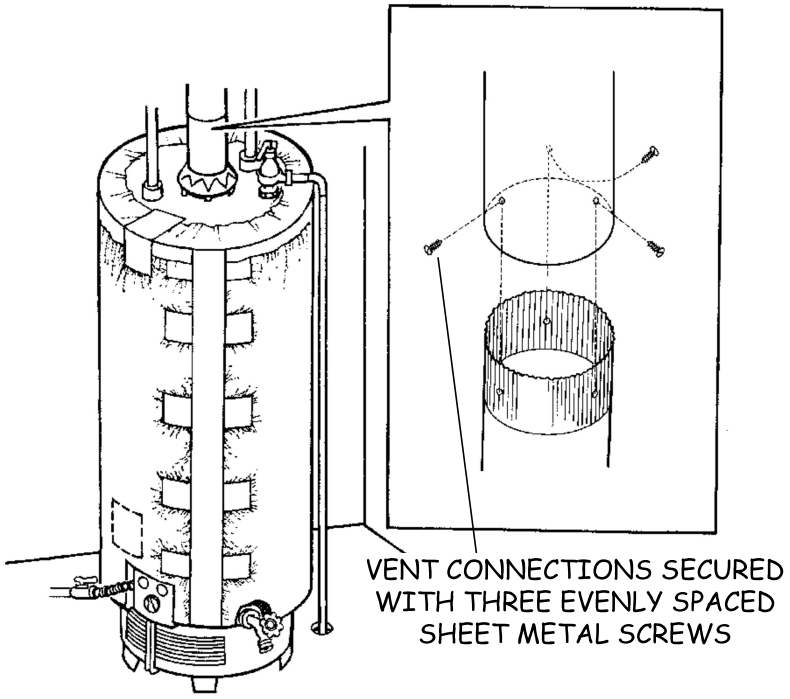
20. VENT SYSTEM REPAIR

- **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 vent systems**
  - New components shall conform to local code.
  - All single-wall 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 (Type B and BW) vent pipes shall not be drilled or have screws installed, when screws are not allowed by the pipe manufacturer or local code.

21. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.



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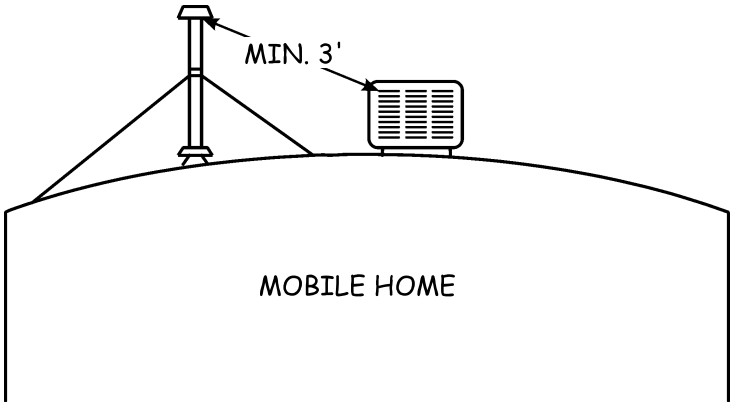
PART 5: MOBILE HOME INSTALLATION REQUIREMENTS

22. MOBILE HOME VENT PIPE TERMINATIONS

- **Vent pipes shall not terminate underneath the mobile home.**
- **Water heater vent pipe terminations**
  - A Water Heater vent pipe located near an evaporative cooler shall terminate at least 3' from the cooler intake.
    - Exception: Clearance does not apply when the cooler has been removed and the roof opening is sealed.
- **Furnace vent pipe terminations**
  - A Furnace vent pipe located near an evaporative cooler shall terminate at least 3' from the cooler intake.
    - Exceptions: Clearance not required under any of the following conditions:
      - The cooler is equipped with a cooler cover, or
      - All cooler discharge openings are equipped with a vent cover, or
      - The cooler has been removed and the roof opening is sealed.
    - When a cover-related exception applies, the occupants shall be advised to keep the cover(s) in place during the heating season:

23. MOBILE HOME GAS CLOTHES DRYERS

- **Moisture exhaust (dryer vent) system**
  - If the moisture exhaust (dryer vent) system is not ducted outdoors (terminating outside, not under the Mobile Home), the condition shall be reported to the customer in accordance with individual utility policy.



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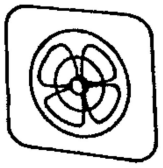
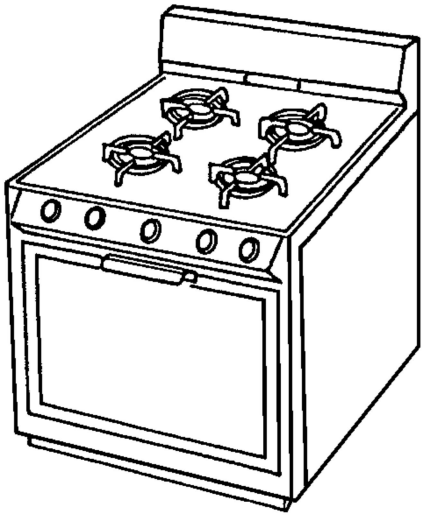
24. MOBILE HOME GAS COOKING APPLIANCES

- **All mobile homes with gas cooking appliances**
  - Determine if the following HUD Code criteria are met.
    - Exhaust vent present in the ceiling or a wall, within 10' of the appliances:
      - An operable ceiling fan or range hood equipped with an automatic damper, or
      - Operable wall fan with manual or automatic 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 or 4" round).
  - If cooking area ventilation is nonconforming, the customer shall be advised of the condition.



EXAMPLE OF AN EXHAUST FAN



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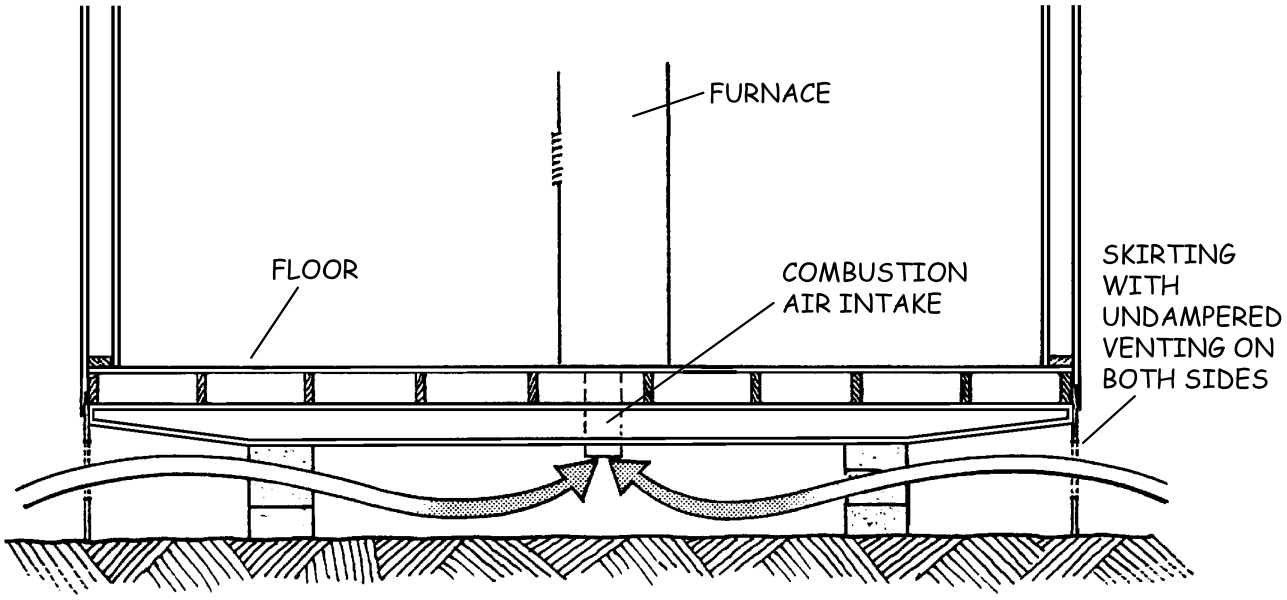
25. MOBILE HOME COMBUSTION AIR REQUIREMENTS

- **Appliances drawing combustion air from under the mobile home**
  - 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 vents shall provide a total of at least 1.0 sq. in. NFVA per 4,000 Btuh total input.
- **Open combustion water heater combustion air venting**
  - An upper combustion air vent shall be present, which may consist of one of the following:
    - A round pipe-within-a-pipe vent assembly in the ceiling.
      - NFVA is cross-sectional area of the outer pipe minus cross-sectional area of the inner pipe.
    - An existing 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 beginning not more than 1' above the floor.
  - An upper-only combustion air vent (per Item 6) is acceptable.
  - Upper and lower CVA venting can also be supplied by a continuous vertical or horizontal duct extending from the enclosure to outdoors.



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25. MOBILE HOME COMBUSTION AIR REQUIREMENTS (cont.)

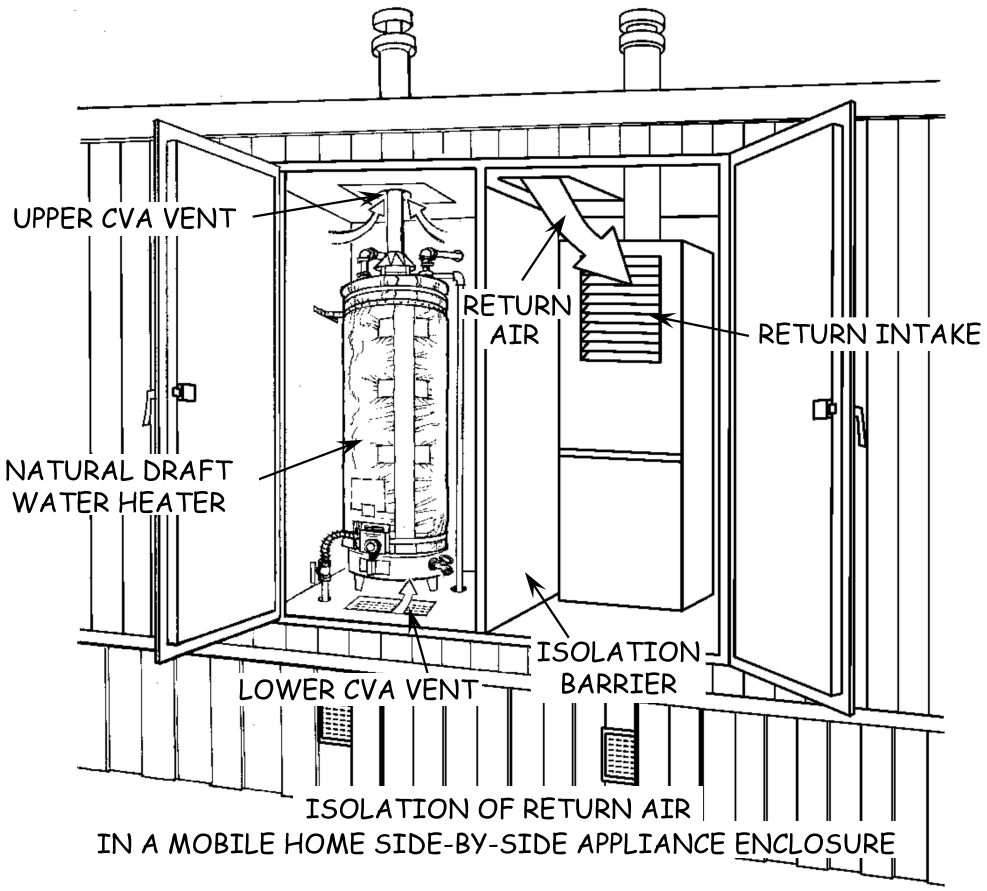
- **Space and water heater in living space**
  - When infiltration-reduction measures are installed, an open combustion space or water heater shall not draw combustion air from the living space.

26. MOBILE HOME ISOLATION OF RETURN AIR

- **Gas water Heater and FAU in adjacent enclosures**
  - Water Heater enclosure shall not be depressurized by an adjacent FAU enclosure that serves as the return plenum.
  - An “isolation barrier” that provides an airtight separation between enclosures must be present when infiltration reduction measures are installed.

27. MOBILE HOME GAS WATER HEATER COMPARTMENT FLOOR

- **Enclosure floor**
  - If the floor is not structurally sound, the condition shall be reported to customer in accordance with individual utility policy.



ISOLATION OF RETURN AIR
IN A MOBILE HOME SIDE-BY-SIDE APPLIANCE ENCLOSURE

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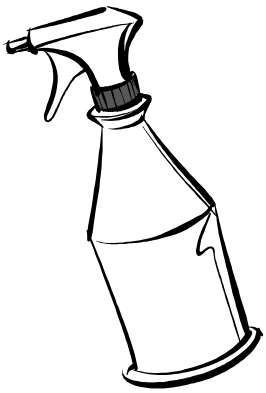
PART 6: POST-REPAIR/REPLACEMENT CHECKS

28. QUALITY ASSURANCE TESTING

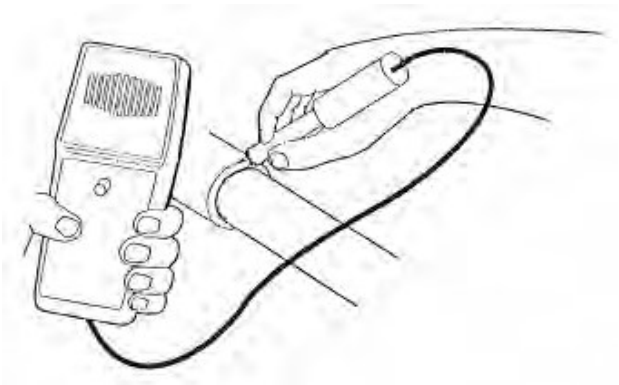
- **Natural gas appliances that have been repaired or replaced shall be checked for proper operation, which includes:**
  - Check for gas leaks.
  - Draft examination.
  - Carbon Monoxide testing.
- **Test conditions**
  - As prescribed in Item 12.
- **Corrections**
  - Problems identified during post-repair/replacement checks must be corrected.

29. 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, fittings on valves, flexible gas connectors, and pipe connections.
  - Air sampling with electronic leak detection equipment near line valves, fittings on valves, flexible gas connectors, and pipe connections.
- **Gas leaks shall be repaired.**



SPRAY BOTTLE WITH SPECIAL SOAP OR LEAK DETECTION SPRAY



ELECTRONIC LEAK DETECTOR

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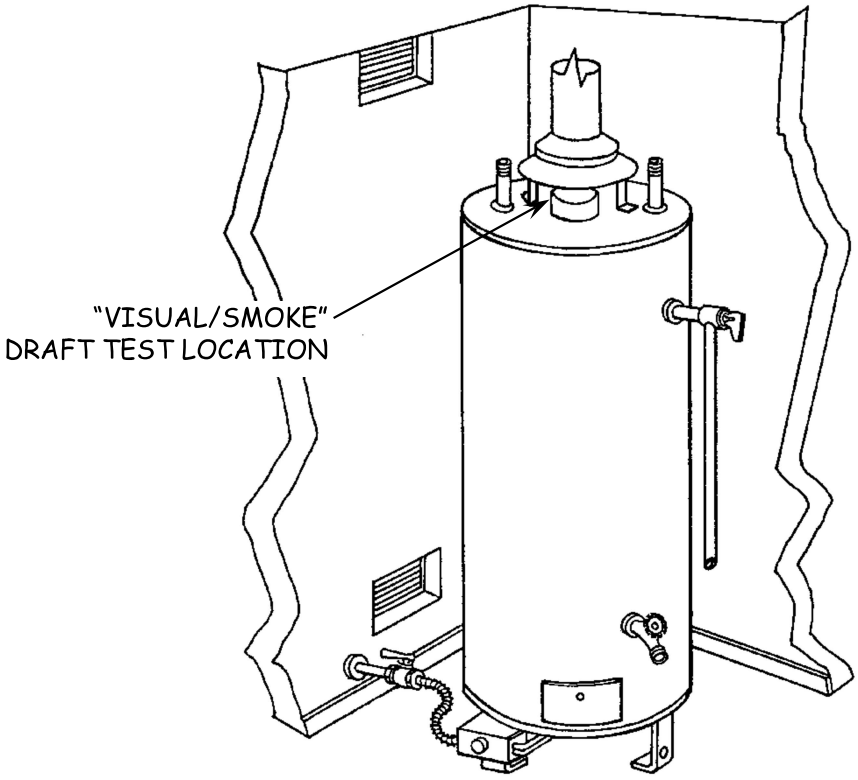
30. DRAFT EXAMINATION

- **Natural gas open combustion heating systems and water heaters**
  - Test conditions prescribed in Item 12 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, including ovens vented outdoors.
    - Smoke shall be applied along the entire draft hood opening, near the top of the opening.
    - Draft is adequate only if smoke is drawn into the draft hood opening, and continuous or excessive spillage is not present.



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31. CO TESTING FOR NATURAL GAS APPLIANCES

- **Appliance Ambient CO or Flue CO testing shall be performed.**
  - Appliance Ambient CO tests shall be conducted per Item 13.
- **Flue CO tests for space and water heaters**
  - Test conditions prescribed in Item 12 shall first be established.
  - CO Tests are performed after minimum 5 minutes of burner operation.
  - Flue Gas CO measurements shall be:
    - Taken in combustion gases free of dilution air.
    - Conducted in accordance with Table 24-3.
- **CO tests for cooking appliances and gas logs**
  - Test conditions prescribed in Item 12 shall first be established.
  - Cooktop burners shall operate one minute before testing.
  - Ovens and gas logs shall operate minimum 5 minutes before testing.
  - CO measurements shall be conducted in accordance with Table 24-4.

Table 24-3: Post-Repair/Replacement Flue CO Testing—Space and Water Heaters

APPLIANCE	CO MAXIMUM PPM "AIR FREE"	NATURAL DRAFT MEASUREMENT LOCATION
Forced Air and Gravity Furnaces	400	OC: Inside each exhaust port separately ID & DV: Inside the vent termination
Wall Furnace (OC)	200	Inside flue on each side of baffle
Wall Furnace (DV)	400	At the vent termination, when it is accessible from the ground
Floor Furnace	400	OC: Inside each exhaust port separately DV: Inside the vent termination
Vented Room Heater (OC)	200	Inside each exhaust port separately
Water Heater—Storage	OC & ID: 200 DV: 400	OC: Inside flue on each side of baffle ID & DV: Inside vent termination
Water Heater—Tankless, Indoor OC	200	Inside dilution air inlet, ahead of dilution air
Water Heater—Tankless, DV and Outdoor OC	400	OC: Inside dilution air inlet, ahead of dilution air DV: Inside the vent termination or built-in test port

CC= Closed Combustion (most are DV), DV= Direct Vent, ID= Induced Draft, OC= Open Combustion

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Table 24-4: Post-Repair/Replacement CO Testing—Ovens and Gas Logs

APPLIANCE	CO MAXIMUM PPM		NATURAL DRAFT MEASUREMENT LOCATION
	"AS MEASURED"	"AIR FREE"	
Oven/Broiler	225	—	Inside exhaust port
Top Burners and Griddle	25 (per burner)	—	Burner: 12" above flame Griddle: Inside port opening
Gas Log	25	400	Just inside top edge of fireplace opening

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BLOWER MOTOR RETROFIT

Lead Paint Risk Factor
NONE

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MOBILE HOME CRITERIA 4

6. Safety Requirements 4

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SECTION 25 PREFACE
for

BLOWER MOTOR RETROFIT
(HVAC BRUSHLESS FAN MOTOR [BFM] RETROFIT)

1. Nonfeasibility Criteria

1.1. The home is not in a utility-approved climate zone.

1.2. HVAC unit is not a central heating and/or cooling FAU or central heat pump, with direct drive PSC or shaded pole blower motor.

1.3. Existing blower motor is:

a. Rated at >0.5 horsepower, or

b. Already a DC brushless fan motor (BFM).

1.4. The existing HVAC unit:

a. Has a capacity >3.5 tons.

b. Is inaccessible, is non-operational, or is in need of service or repair (other than simple blower motor replacement).

c. Has a hazardous condition that cannot feasibly be corrected (e.g., gas leak, electrical hazard, cracked firebox).

d. Duct system:

- Has a defective or excessively-leaky plenum or ductwork that cannot feasibly be repaired or sealed.
- Includes ductwork that contains or is made of asbestos.

e. Has access panel(s) that do not close and secure properly, and repair is not feasible.

f. Is on a recall list (e.g., Consumer Product Safety Commission).

g. Will be replaced.

1.5. System airflow is <300 cfm/ton, or duct sealing is not feasible.

1.6. Replacement blower motor requires special mounting hardware/bracket that cannot feasibly be installed.

1.7. Customer refuses.

2. Installation Policies

2.1. Installation shall be performed by a licensed HVAC contractor or properly trained technician.

2.2. A permit shall be obtained and finalized when:

a. the mechanical or electrical system is altered (does not include splicing wires or installation of a mounting kit), or

b. it is required by the local jurisdiction.

2.3. This measure can be installed:

a. in all housing types.

b. only in utility-approved climate zones.

3. Installation Policies Specific to Mobile Homes

3.1. A retrofit blower motor shall not be installed when:

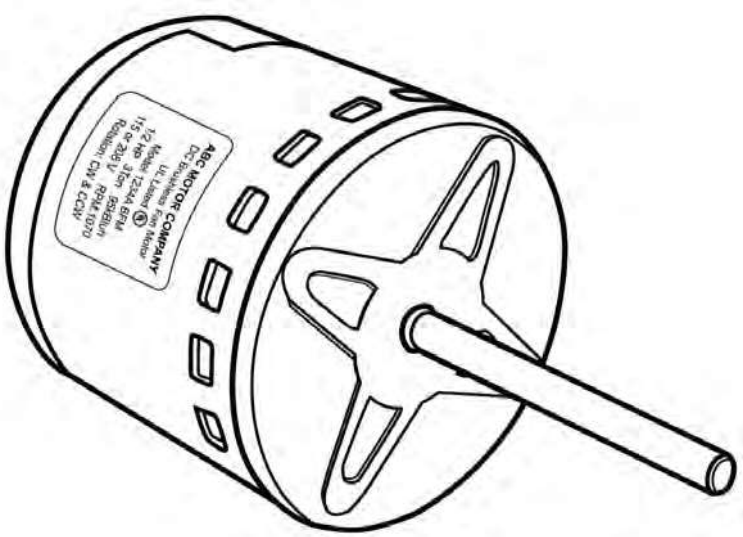
a. NIM condition is present (e.g., proper isolation of return air in a combination FAU/water heater enclosure cannot be achieved), or

b. HVAC return is a leaky belly cavity, and correction is not feasible.

BLOWER MOTOR RETROFIT STANDARDS

1. APPROVED MATERIALS

- **Motors**
  - UL or CSA Recognized variable speed DC brushless fan motor (BFM).
  - "Drop-in" replacement DC motor.
  - Rated horsepower matching that of the existing motor.
  - Torque to match or exceed existing motor.
- **Accessories**
  - Digital Programmer (for BFMs that require field programming).
    - Compatible with the BFM being programmed.
  - Motor Mounting Devices
    - Appropriate replacement mounting hardware.
    - Compatible with the BFM being installed.
- **Warranty**
  - Refer to IS Appendix F (Minimum Warranty Requirements).



EXAMPLE OF UL LISTED BRUSHLESS FAN MOTOR (BFM)

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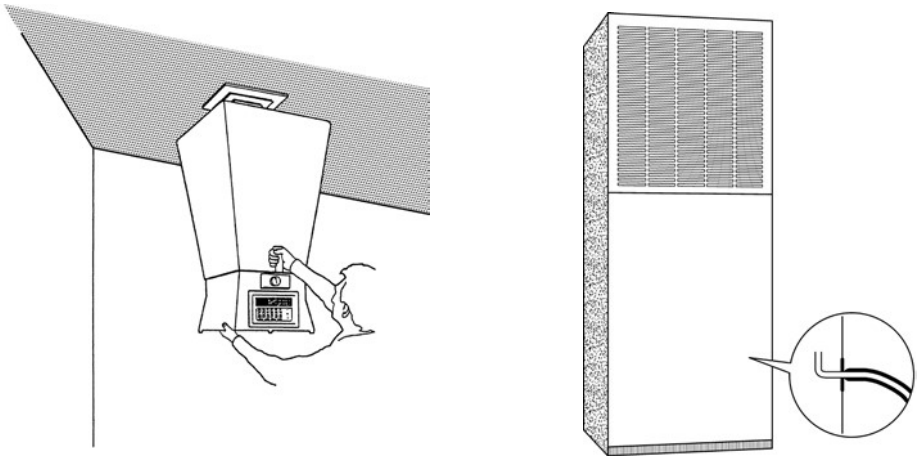
2. GENERAL REQUIREMENTS

- **All installations**
  - A permit for the installation shall be obtained and finalized when required.
  - Shall comply with manufacturer's instructions and local code.

3. PRE-INSTALLATION ASSESSMENT

- **All installations**
  - Assessment shall verify that:
    - System airflow is ≥300 cfm/ton (or can be brought up to that level).
    - The BFM can fit and be properly secured.
  - External static pressure (ESP) in the supply plenum shall be measured with FAU on highest speed (e.g., in cooling mode).
  - ID label shall be checked for horsepower, voltage, amperage, speed, rotation direction, and capacitor size, to identify the proper replacement motor.



METHODS FOR MEASURING SYSTEM AIRFLOW
AND EXTERNAL STATIC PRESSURE

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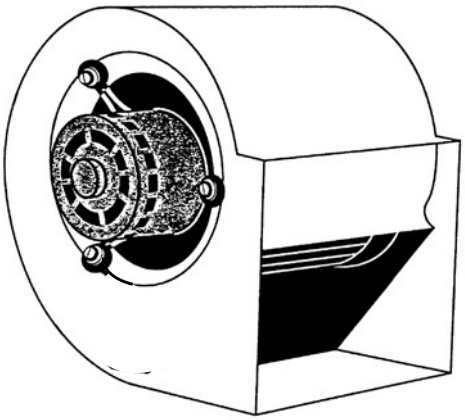
4. INSTALLATION

- **Existing motor and blower fan**
  - Replacement BFM shall be verified to be the correct motor (proper horsepower, voltage, amperage, speed).
  - All dirt/buildup shall be cleaned from the fan blades.
- **New motor**
  - The new motor shall be installed and properly secured.
  - The fan shall be centered side-to-side in the blower housing.
  - All functioning wires shall be properly routed, and unused wires shall be removed.
    - Splices shall be secured with code-compliant twist-on or pressure connectors.
    - Excess wire length shall be secured (e.g., with zip ties) in a safe location.
  - The proper speed(s) and rotation direction shall be selected and verified.



SQUIRREL CAGE FAN BLADES
THOROUGHLY CLEANED
AND
FAN CENTERED SIDE-TO-SIDE
IN THE BLOWER HOUSING

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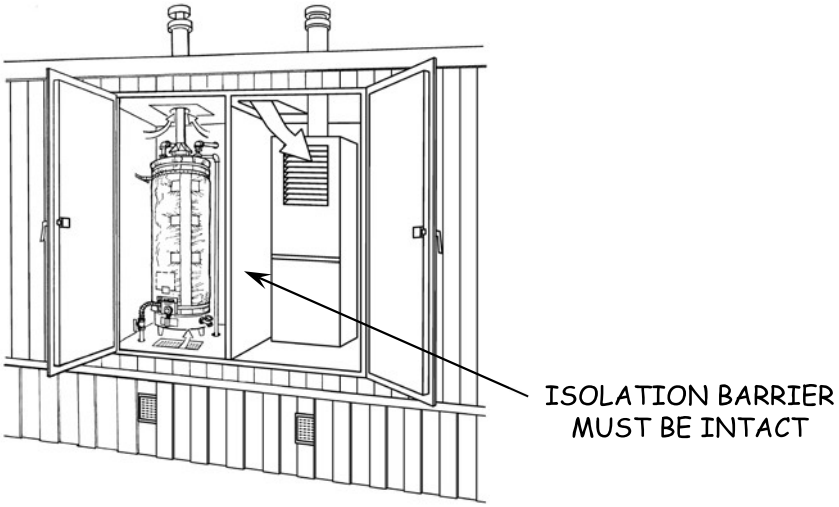
5. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Operational checks**
  - The FAU shall be operated in all modes to verify it is operating properly and no unusual noises are present.
  - ESP in the supply plenum shall be remeasured (with unit on highest speed), and shall be:
    - Verified to be correct, or
    - Adjusted as necessary to be correct.
  - Speed settings shall be:
    - Adjusted to meet FAU manufacturer's specifications, and
    - Verified to be correct (e.g., by temperature rise method).
- **Clean-up**
  - All packing materials and installation debris shall be cleaned up and removed from the premises.
  - Household items moved for blower motor installation shall be returned to their original positions.
  - All replaced parts shall be removed from the premises and disposed of properly.

MOBILE HOME CRITERIA

6. SAFETY REQUIREMENTS

- **Appliance Enclosures**
  - Proper isolation of return air in a combination FAU/water heater enclosure must be in place.



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FURNACE CLEANING AND TUNE-UP

Lead Paint Risk Factor
NONE

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MOBILE HOME CRITERIA 7

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SECTION 26 PREFACE
for

FURNACE CLEANING AND TUNE-UP

1. Nonfeasibility Criteria for Furnace Cleaning and Tune-Up

1.1. Furnace fuel is not supplied by the utility providing ESA Program services.

1.2. Repairs are required which exceed the scope of this measure.

1.3. Inadequate CVA affecting the furnace.

1.4. Any furnace-related non-correctable NGAT issue exists.

1.5. Furnace is condensing type (“90+”) or other closed combustion unit.

1.6. Furnace is a ducted gravity type located in a basement.

1.7. Furnace is inaccessible.

1.8. Conditions are such that the furnace cannot be left operating safely and properly.

1.9. The duct system cannot be brought into compliance with IS Section 10 (Duct Testing and Sealing).

1.10. The condition or location of the furnace makes it unsafe to provide the service.

1.11. Customer refuses.

2. Nonfeasibility Criteria for furnace Cleaning and Tune-Up Requiring Attic or Crawl Space Access

2.1. Crawl clearance is inadequate:

a. Attic Clearance
- Clearance is less than 24" between top of ceiling joists and bottom of ridge board.
- Obstruction(s) in the attic, such as truss cross embers, provide an opening with a minimum dimension of less than 18".

b. Under-Floor Clearance
- Clearance is less than 18" from the ground to bottom of floor joist system (girders under a mobile home).
- Crawling under or over an obstruction in the crawl area is required, and the crawl clearance is less than 12".

c. Confined Spaces: state and federal regulations regarding confined spaces cannot be met.

2.2. Unsafe condition exists:

a. Attic and Crawlspace

- Hazardous insect or pest infestation is present.
- Hazardous electrical wiring.
- Structural hazard.

b. Crawlspace
   - Excessive ground moisture (standing water or mud) is present.
   - Sewage waste is on the ground or other unsanitary condition is present which poses a health and safety hazard.

3. Installation Policies

3.1. Furnace cleaning and tune-up does not include repairs or replacement of parts.

3.2. If furnace repair or service/adjustment[1] is needed, that must be completed before performing furnace cleaning and tune-up.

3.3. The furnace must be open combustion and in a safe location with adequate accessibility clearances.

3.4. All NGAT fails/issues must be resolved before performing furnace cleaning and tune-up.

3.5. For an FAU, the duct system must be brought into conformance with IS Section 10 (Duct Testing and Sealing).

4. Installation Policies Specific to Mobile Homes

None.

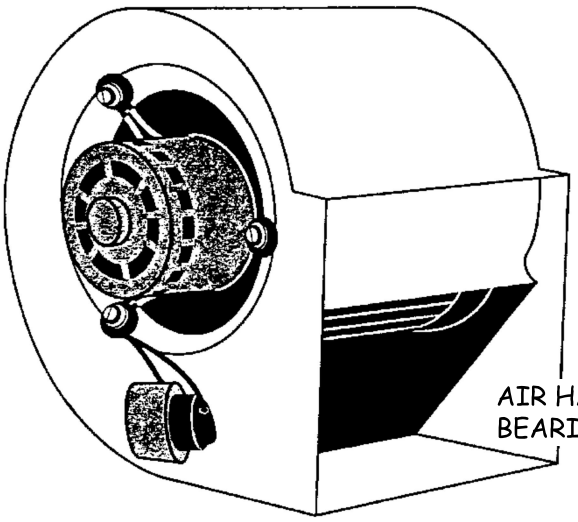
[1] See definitions.

FURNACE CLEANING AND TUNE-UP STANDARDS

PART 1: SCOPE OF SERVICE[1]

1. GENERAL REQUIREMENTS

- **Furnace type**
  - Furnace cleaning and tune-up is only feasible for open combustion furnaces.
- **Furnace cleaning and tune-up may include:**
  - Minor adjustments, including but not limited to:
    - Air/gas mixture based on flue gas CO ppm.
    - Manifold gas pressure, as needed, when air/gas adjustment does not bring CO down sufficiently.
  - Cleaning and removal, as needed, of the following components:
    - Pilot orifice
    - Burner orifice and air shutter
    - Burner venturi
    - Heat exchanger chamber(s)
    - FAU air handler fan
  - Oiling of blower motor and fan shaft bearings.
  - Minor repairs required to ensure safe and proper operation of the furnace.



AIR HANDLER FAN CLEANED AND BEARINGS LUBRICATED AS NEEDED

[1] Scope is subject to individual utility policy.

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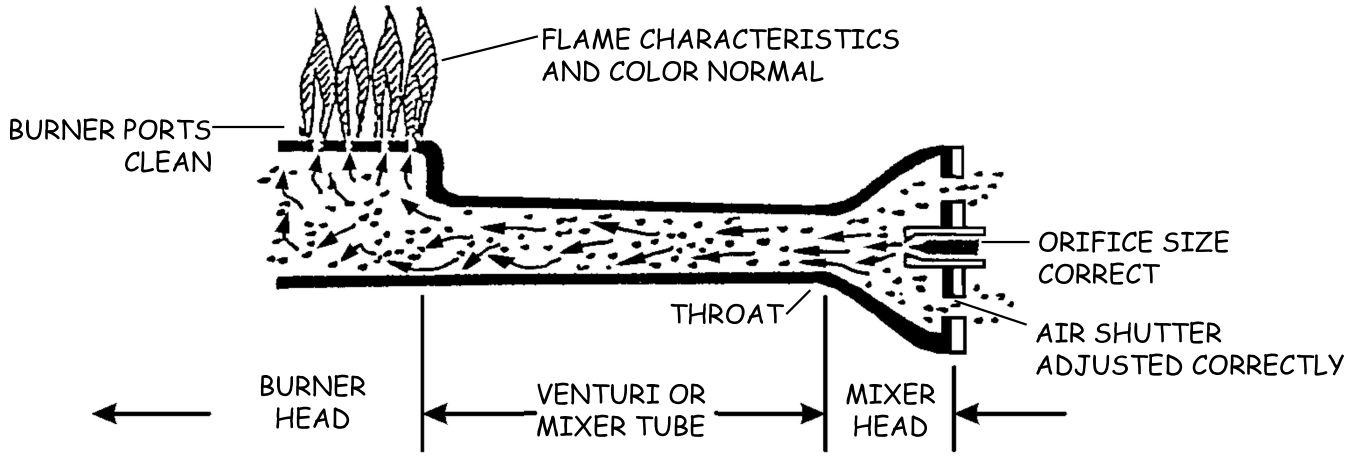
PART 2: FURNACE CLEAN AND TUNE-UP PROCEDURES

2. ALL FURNACES

- **Procedures, including but not limited to those listed below, shall be followed as needed to facilitate proper operation of the furnace.**
- **Check for dirty burner**
  - Clean burner as needed to establish proper operation.
    - Clean in place if possible; remove if necessary.
    - Clean burner ports (e.g., with a brush, air hose, and/or water).
  - Clean orifice (with orifice drill, if necessary).
  - Clean venturi (e.g., with a brush, air hose, and/or water).
- **Adjust burner flame**
  - Adjustment and diagnostic procedures shall be performed in the following sequence, as needed, to establish acceptable flue gas CO level and proper flame characteristics.
    - Adjust CO in flue gas
      - Adjust air/gas mixture to reduce CO as low as possible.
      - Adjust each burner individually.



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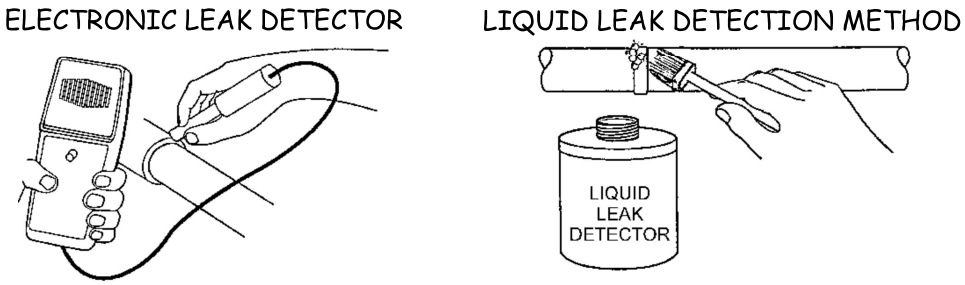
2. ALL FURNACES (cont.)

- **Standing pilot**[2]
  - Check pilot and clean as needed to establish a normal flame pattern (soft, steady flame heating top half-inch of thermocouple).
  - When required, remove pilot assembly and clean the orifice (e.g., with compressed air and, if necessary, an orifice drill).
- **Gas leaks**
  - Gas leaks must be repaired.
  - If adjustment of fitting does not stop leak, replacement parts shall be installed.



GAS FITTINGS, VALVES, AND CONNECTORS
CHECKED FOR GAS LEAKS

[2] Refer to IS Section 29 (FAU Standing Pilot Light Conversion) regarding replacement of standing pilot with electronic ignition.

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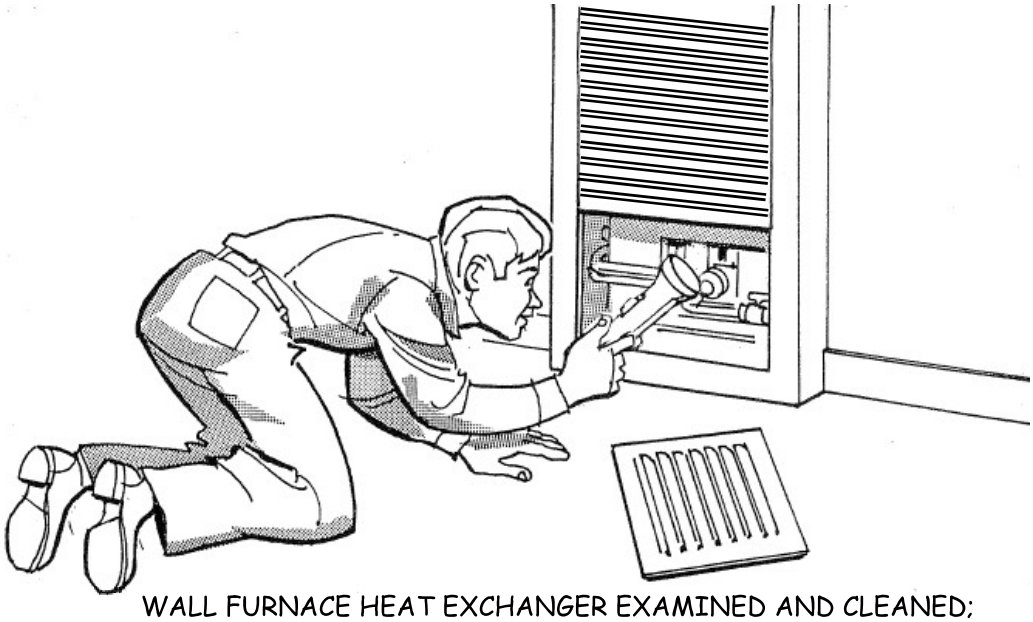
3. WALL FURNACES

- **Heat exchanger**
  - Check for soot build-up.
  - If dirty, clean in place with a brush, if feasible.
  - Remove burner and heat exchanger, if necessary, and clean outdoors (e.g., with brush and/or water).
  - Reinstall heat exchanger and burner.
- **Front cover/grille**
  - If loose/unsecure, it shall be properly secured (e.g., by installing screws).
  - Valve/pilot access door shall be adjusted as needed to function properly.
- **Circulating fan (when present)**
  - Dirty fan blades shall be cleaned (e.g., with a brush and/or vacuum).
  - If motor has oiling ports, electric motor oil shall be added as needed.
  - If fan is defective, the furnace shall be referred for service.



WALL FURNACE HEAT EXCHANGER EXAMINED AND CLEANED;
FRONT COVER AND VALVE/PILOT ACCESS DOOR SECURED/REPAIRED

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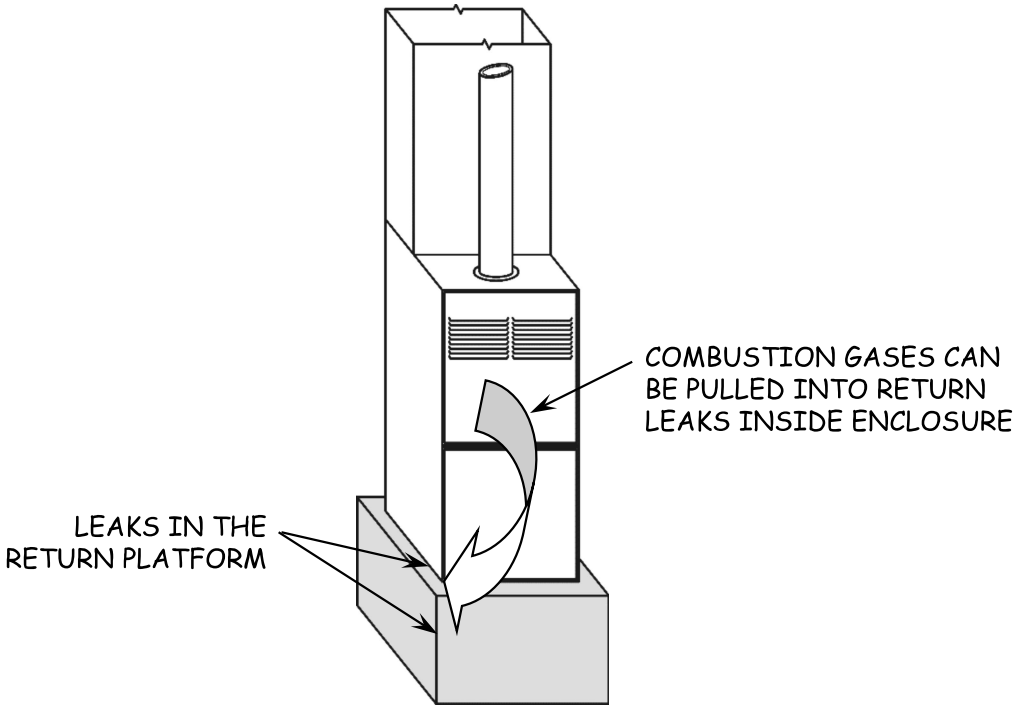
4. FAU

- **Air handler**
  - If the air handler fan is dirty, the unit shall be removed and cleaned outdoors (e.g., with a brush, compressed air, water, and/or vacuum).
  - If the fan shaft and/or fan motor has oiling ports, heavy-duty electric motor oil shall be added to each port, as needed.
  - If air handler is defective, the furnace shall be referred for repairs.
- **Cabinet/plenum leaks**
  - Return leaks shall be sealed to prevent communication between return air and combustion air.
  - Air leaks such as the following shall be sealed:
    - Leaks between the return plenum/platform and FAU base, and
    - Other return leaks in the CAZ that can allow CO to be drawn into the return system.
  - Leaks shall be sealed in accordance with IS Section 10 (Duct Testing and Sealing).
- **Air filter(s)**
  - Filter(s) shall be clean.
- **CVA vent screens**
  - Obstructed vent screens (e.g., from insulation over-blow) shall be cleared.



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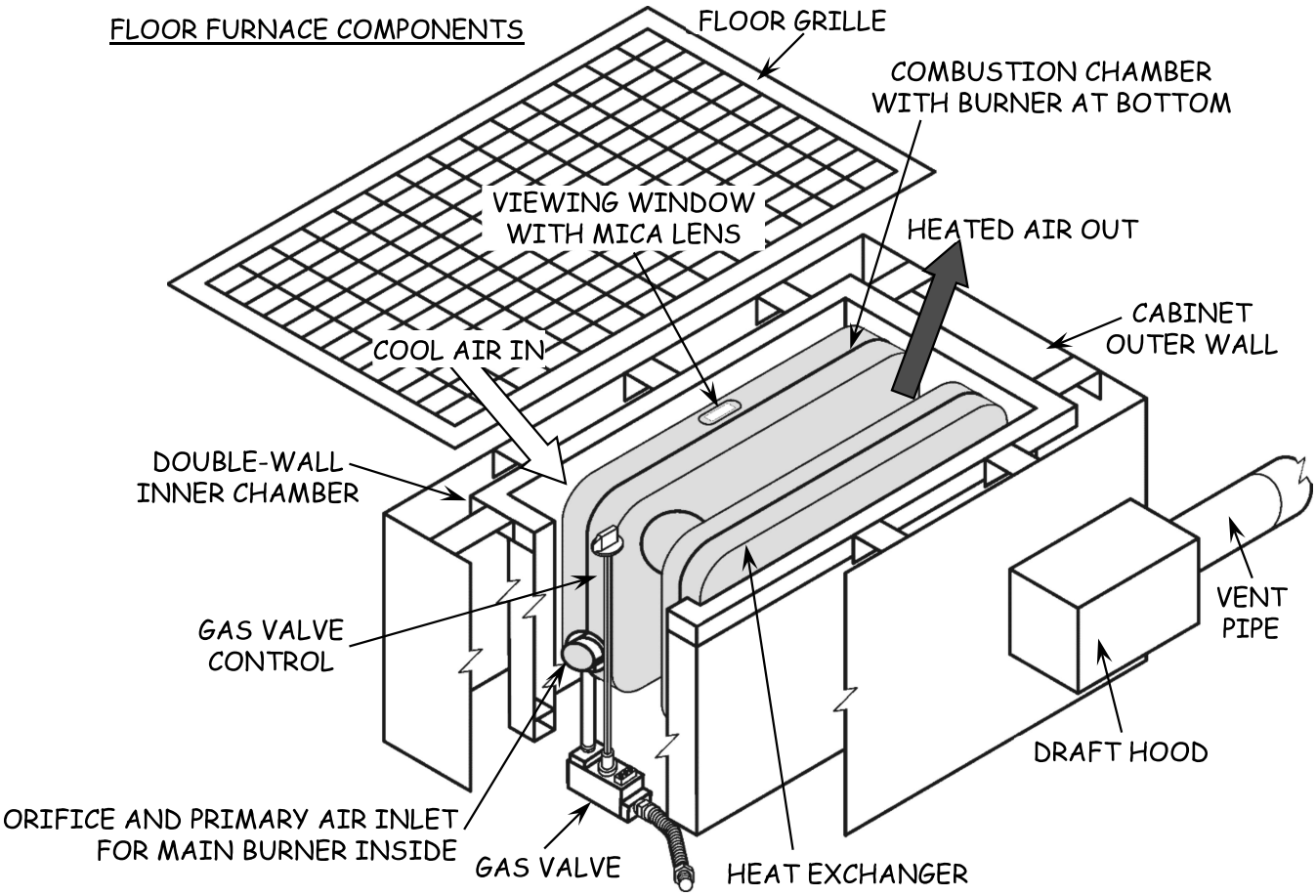
5. FLOOR FURNACES

- **Debris removal**
  - The floor grille shall be removed and unit shall be cleaned, as needed.
    - Solid objects shall be removed first.
    - Lint and small debris shall be removed with a vacuum cleaner.
- **Viewing glass**
  - Viewing glass shall be intact.
- **Access**
  - Adequate access under the house is required for examination, cleaning, adjusting combustion components (e.g., gas valve, pilot, pilot generator, burner, and combustion chamber).



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PART 3: POST-INSTALLATION REQUIREMENTS

6. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Instructions**
  - When improper use by occupants is evident, customer shall be informed and provided with education to prevent continued misuse.
- **Clean-up and disposal**
  - Debris created by work performed shall be cleaned up and removed from the premises.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

CUSTOMER RECEIVES USER EDUCATION AND WRITTEN WARRANTIES

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THERMOSTATIC SHOWER VALVES

Lead Paint Risk Factor
NONE

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MOBILE HOME CRITERIA **3**

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SECTION 27 PREFACE
for

THERMOSTATIC SHOWER VALVES

1. Nonfeasibility Criteria

1.1. Existing shower arm:
   a. Is made of plastic (including ball joint).
   b. Is missing or defective (cracked, broken).
   c. Requires removal.

1.2. A shower arm adapter is needed, and standard metal adapters will not work.

1.3. Tub and/or shower is in poor condition (has physical defects) and/or is not mechanically functional.

1.4. Piping in the home or bathroom is in poor condition, and installation of a thermostatic shower valve could cause plumbing problems.

1.5. Hot water is supplied by an on-demand or tankless water heater.

1.6. Hot water is supplied by a continuously-circulating system, unless allowed by individual utility policy.

1.7. Water pressure to the tub/shower is <30 psi or too high (out of the range specified by the manufacturer) and correction is not feasible.

1.8. Customer refuses.

2. Installation Policies

2.1. Thermostatic shower valves are installed only on functional showers that are free of plumbing problems and physical defects.

2.2. Thermostatic shower valves are installed only when:
   a. The water heater is storage type without a hot water circulation system, and
   b. The water heating energy source is supplied by the utility providing ESA Program services.

2.3. Thermostatic shower valves shall be installed in accordance with manufacturer's instructions, local code, and plumbing best practices.

2.4. Occupants receiving a Thermostatic Shower Valve shall be educated on the operation, care, and maintenance of the product.
   a. They shall be given verbal instructions, a demonstration, and manufacturer's printed materials.
   b. They shall be advised/cautioned that:

- Water heater temperature should be set at 120°F or lower, to reduce scalding hazard.
- After resuming water flow, water temperature should be checked before getting under the showerhead.

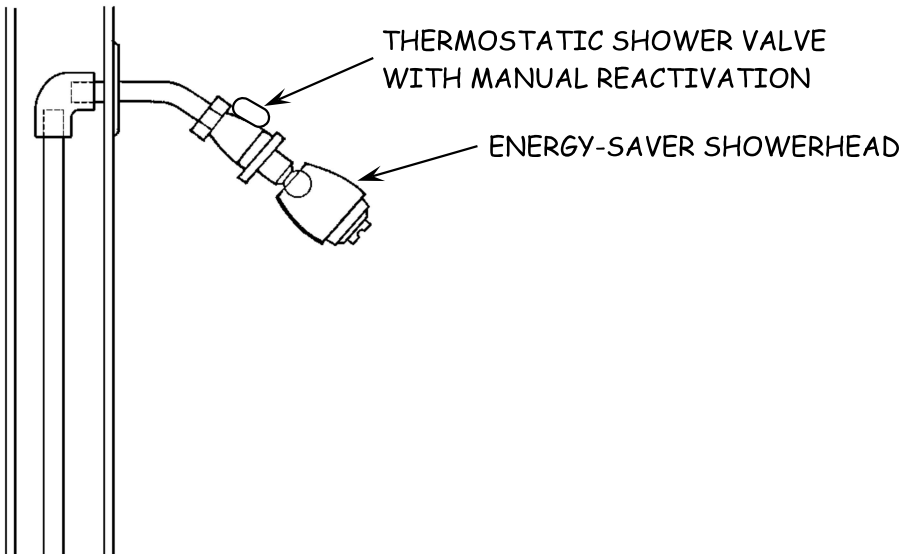
3. Installation Policies Specific to Mobile Homes

None.

THERMOSTATIC SHOWER VALVE STANDARDS

1. APPROVED MATERIALS

- **Thermostatic shower valves**
  - Compliant with the current version of IAPMO IGC 244-2015.
  - Designed to automatically reset after the valve cools down following completion of showering.
  - Threaded with a female 1/2" NPT to fit standard shower arms threaded with a male 1/2" NPT in accordance with ANSI/ASME B1.20.1.
  - May be a combination showerhead and thermostatic shower valve.
- **Temperature actuation**
  - The shower valve shall automatically reduce flow to a trickle in response to incoming water temperatures exceeding a preset actuation temperature.
  - Water flow shall be easily reactivated with a manual control.
- **Showerheads and shower arm adapters**
  - When a thermostatic shower valve is installed in conjunction with an energy-saver showerhead, installation of the showerhead (and adapter, if used) shall be in compliance with IS Section 8 (Energy-Saver Showerheads and Faucet Aerators).



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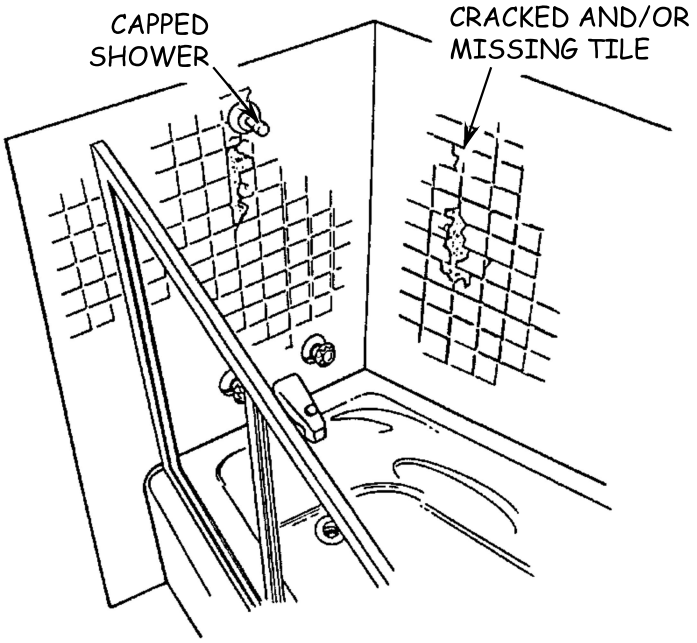
2. WARRANTY

- **Refer to IS Appendix F (Minimum Warranty Requirements).**

3. INSTALLATION

- **Thermostatic shower valves**
  - Shall be installed only on functional showers—not on showers that are not functional due to plumbing or physical defects.
  - Shall not be installed if the shower arm must be removed/replaced nor if the shower arm is made of plastic.
- **Shower arm adapters**
  - A shower arm adapter shall be installed when required for installation of the thermostatic shower valve.
- **Threaded connections**
  - Threads shall be sealed as needed (e.g., with Teflon® tape).
  - Connections shall be checked for leaks (i.e., at the thermostatic shower valve, shower arm, showerhead, and adapter).



NONFUNCTIONAL SHOWER

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4. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Function**
  - All components shall function properly (i.e., thermostatic shower valve, showerhead, and shower arm adapter).
  - Threaded connections shall not leak.
- **Instructions and warranties**
  - Occupants shall be:
    - Instructed in the proper operation and care of the thermostatic shower valve.
    - Provided with manufacturer's written instructions and warranty documents.
- **Clean-up and disposal**
  - All packaging materials and other debris shall be cleaned up and removed from the premises.
  - Replaced parts shall be removed from the premises.
    - *Exception:* Pre-existing showerhead, if replaced, may be left with the occupants upon their request.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

OCCUPANT RECEIVES VERBAL AND WRITTEN INSTRUCTIONS AND MANUFACTURER'S WARRANTY

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HIGH-EFFICIENCY CLOTHES WASHERS

Lead Paint Risk Factor
NONE

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MOBILE HOME CRITERIA 6

SECTION 28 PREFACE
for

HIGH-EFFICIENCY CLOTHES WASHERS

1. Nonfeasibility Criteria

1.1. A functional washer and dryer are not present or not accessible.

1.2. The existing clothes washer is less than 12 years old, or per individual utility policy.

1.3. Energy source for the washer and dryer, and/or the water heater, is not supplied by the utility providing ESA Program services.

1.4. A suitable location, with acceptable floor and proper clearances (including proper door swing), is not available.

1.5. A properly-grounded electrical receptacle is not located within reach of the washer's power cord.

1.6. A suitable water supply and/or drain system is not available.

1.7. The existing washer is a stacked unit.

1.8. The existing washer is exposed to the weather (outdoors).

1.9. Customer refuses.

2. Installation Policies

2.1. High efficiency clothes washers may be provided to both homeowners and renters—in all housing types and climate zones—when there are at least four persons in the household.

2.2. Hot water must be provided by an individual water heater under the occupants' control (not a central water heater).

2.3. The customer must have an active account with the IOU providing the water heating energy source, or be a sub-metered residential customer.

2.4. The water heating energy source must be supplied by the utility providing ESA Program services.

2.5. The customer must own the existing washing machine (in a rental, cannot be owned by the landlord).

3. Installation Policies Specific to Mobile Homes

None.

HIGH-EFFICIENCY CLOTHES WASHER STANDARDS

1. APPROVED MATERIALS

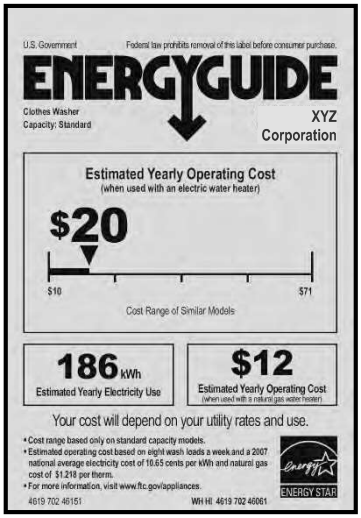
- **High-efficiency clothes washers**
  - Shall be ENERGY STAR-certified and shall meet the efficiency standards in Table 28-1.
  - Shall bear a yellow EnergyGuide label.
- **Washer shall have the following features:**
  - High-speed spin cycle.
  - Several options for water level and temperature, including:
    - At least three water levels and
    - A cold water setting.

2. WARRANTY

- **Refer to IS Appendix F (Minimum Warranty Requirements).**

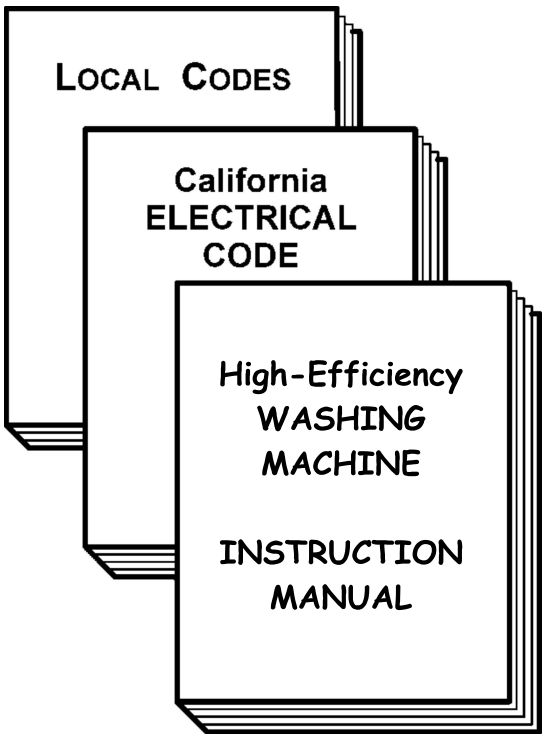
Table 28-1: Minimum Criteria for ENERGY STAR Residential Washers

Washer Type	Minimum Criteria*
Frontloading >2.5 cu. ft.	IMEF ≥2.76 IWF ≤3.2
Top-loading >2.5 cu. ft.	IMEF ≥2.06 IWF ≤4.3
Residential washers ≤2.5 cu. ft.	IMEF ≥2.07 IWF ≤4.2



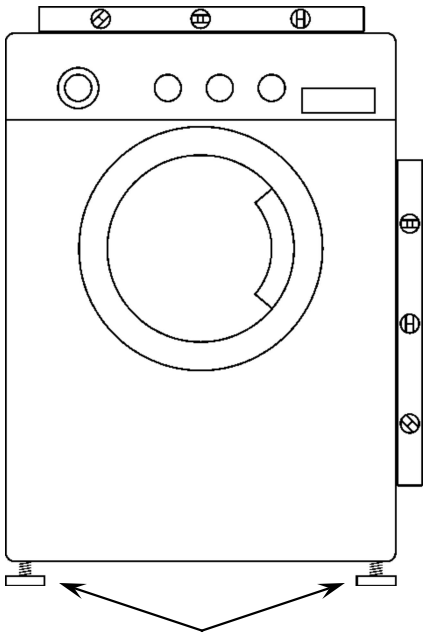
3. GENERAL REQUIREMENTS

- **Manufacturer's instructions and local code**
  - All installations shall be in compliance with appliance manufacturer's instructions and the requirements of the local jurisdiction.
  - A permit shall be obtained and finalized, if required by the local jurisdiction.
- **IS guidelines**
  - The installation criteria in this section are guidelines that shall be followed unless superseded by manufacturer's instructions/specifications or local code.



4. LOCATION AND SET-UP

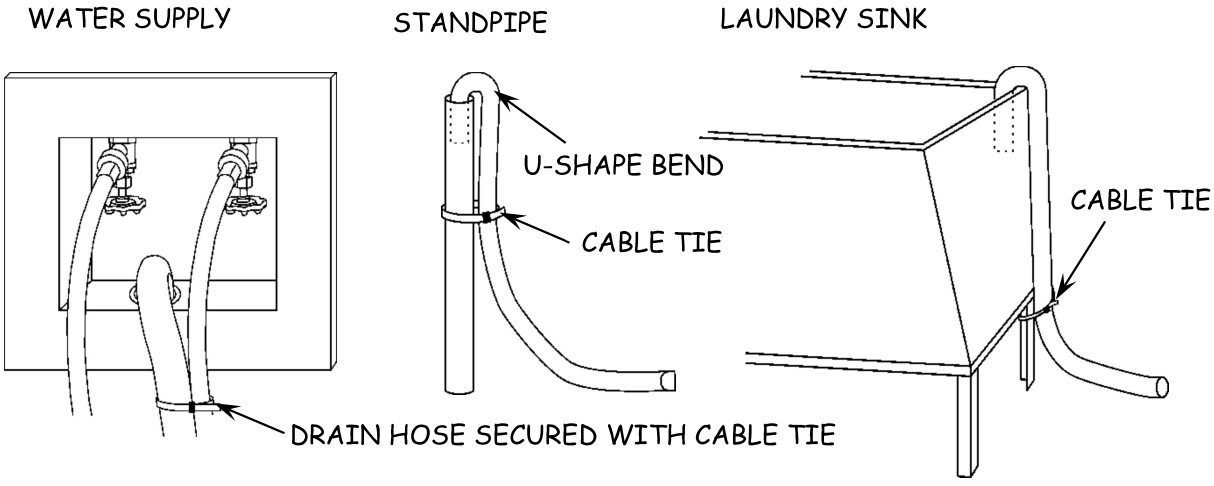
- **The washer location shall:**
  - Allow spacing of at least 1” on all sides or clearances specified by the manufacturer.
  - Be verified to have ample room for opening the door (i.e., minimum 90° door swing).
  - Have a solid and sturdy floor that:
    - Can support the washer with a full load and
    - Has a maximum slope of 1” under entire washer.
- **Unpacking**
  - Packaging and transit packing material (used to secure moveable parts for shipping) shall be removed.
- **Leveling**
  - These guidelines, or manufacturer’s instructions if different, apply:
    - Individual feet (on leveling legs) shall be adjusted to properly level the washer with all four feet resting on the floor.
    - After leveling, the locking nuts shall be tightened to hold the feet in place.
    - Leveling legs shall be extended the minimum needed to properly level the machine.
- **Pedestal**
  - When an optional matching pedestal is utilized, it shall be installed as instructed and leveled as described above.



“FEET” ADJUSTED TO LEVEL HIGH-EFFICIENCY WASHER

5. WATER HOOK-UPS

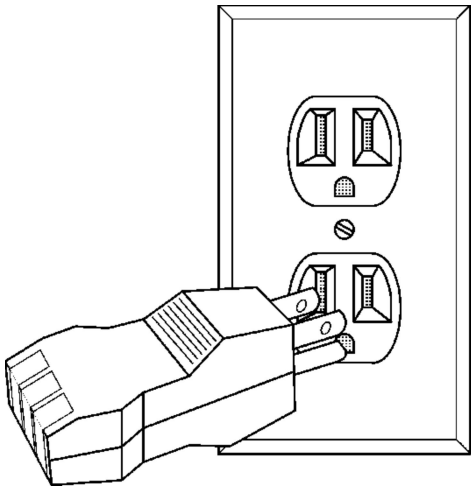
- **Water supply**
  - Water pressure at the hot and cold shutoff valve shall be within the manufacturer's specifications (not too high or low).
  - Hot and cold shutoff valve must be located within 4' of the washer or as allowed by the manufacturer.
    - Manufacturer's optional longer inlet hoses may be used.
    - Two fill hoses shall not be coupled together for extra length *unless* the manufacturer provides coupling parts and instructions.
  - All hoses shall be *new*:
    - Pre-existing hoses shall not be reused.
    - Braided hoses shall be installed (in lieu of standard hoses supplied with washer) when specified by the individual utility.
  - Hot and cold water hoses shall be properly connected and tightened.
    - Over-tightening shall be avoided.
- **Drain hose**
  - Shall be installed in a suitable drain (standpipe, laundry sink, or floor drain) with adequate capacity to accept the water discharge on the largest load setting.
  - Shall be properly secured (e.g., with a cable tie).
  - When installed in a standpipe, there must be a U-shape bend at the top and an adequate gap for air between the hose and the pipe.



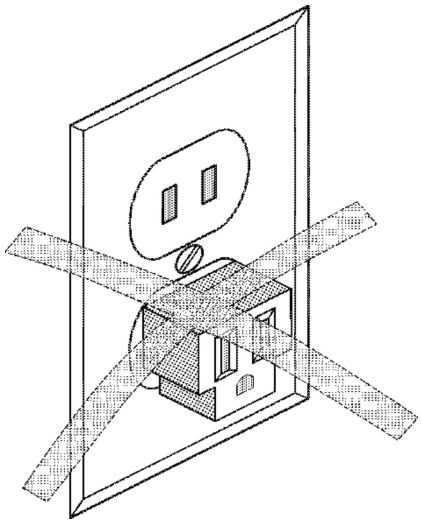
- **Drain system**
  - Must be functional and suitable to accept the maximum water discharge from the washer.
  - If the discharge hose connects to a drain pipe in/near the floor, a siphon break must be installed above the bottom of the washer in accordance with manufacturer's instructions or local code.

6. ELECTRICAL SUPPLY

- **Circuit**
  - Electrical supply shall be 120-volt, minimum 15-amp, and shall meet manufacturer's specifications.
  - Proper circuit conductors and overcurrent protection (fuse or breaker) shall be present.
  - The outlet:
    - Shall be a properly grounded three-prong receptacle with a functional equipment grounding conductor.
    - When a grounding conductor is not present, one shall be provided, or GFCI protection may be installed in accordance with IS Appendix C (Grounding Guidelines for Electric Measures).
  - An outlet cover plate is required.
- **Cords and adapters**
  - The grounding prong shall not be removed from the power cord.
  - An ungrounded three-prong adapter shall not be used.
  - An extension cord shall not be used.



RECEPTACLE MUST BE THREE-PRONG AND PROPERLY GROUNDED



UNGROUNDED THREE-PRONG ADAPTER IS NOT ALLOWED

7. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Operational check**
  - The washer shall be operated through either a test cycle or the shortest cycle that will determine that the following:
    - The washer fills and empties properly,
    - The drain system has adequate capacity and functions properly,
    - The washer is stable during the spin cycle, and
    - There are no water leaks.
  - Clearance for proper door swing shall be verified.
- **Instructions and warranties**
  - Customer shall be:
    - Instructed in the proper operation and care of the washer.
    - Provided with:
      - Manufacturer's written instructions.
      - Written warranty documents.
- **Clean-up and disposal**
  - All packing materials and other debris shall be cleaned up and removed from the premises.
  - The replaced equipment and parts shall be removed from the premises and disposed of properly.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

OCCUPANT RECEIVES VERBAL AND WRITTEN INSTRUCTIONS AND MANUFACTURER'S WARRANTY

FORCED AIR UNIT STANDING PILOT LIGHT CONVERSION

Lead Paint Risk Factor
NONE

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MOBILE HOME CRITERIA 11

SECTION 29 PREFACE
for

FORCED AIR UNIT
STANDING PILOT LIGHT CONVERSION

1. Nonfeasibility Criteria

1.1. Furnace is not an open combustion unit.

1.2. Inadequate CVA affecting the furnace.

1.3. Any furnace-related non-correctable NGAT issue exists.

1.4. The pilot burner is not operational, and it cannot be made operational.

1.5. Furnace is not operational, and:

a. It cannot be made operational, or

b. It will be replaced, or

c. Repairs will be performed that include installation of electronic ignition.

1.6. An appropriate REIK is not available.

1.7. Fuel used by the furnace is not supplied by the utility providing ESA Program services.

1.8. Disconnected or damaged space heating ducts are present and cannot be repaired.

1.9. Customer refuses.

2. Installation Policies

2.1. Furnace fuel must be supplied by the utility providing ESA Program services.

2.2. Pilot light conversion may be provided only on an operable natural draft FAU with:

a. 24-volt control system, and

b. operable standing pilot.

2.3. Furnace cleaning and tune-up must be performed before conversion of the standing pilot.

2.4. The furnace must be in a safe location with adequate accessibility clearances.

2.5. All NGAT fails/issues must be resolved before performing pilot light conversion.

2.6. The duct system must be brought into conformance with IS Section 10 (Duct Testing and Sealing).

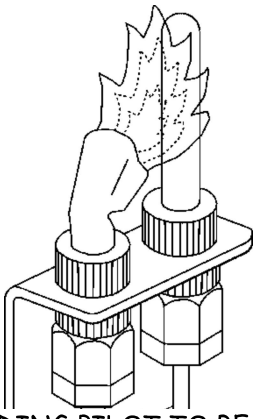
3. Installation Policies Specific to Mobile Homes

None.

FORCED AIR UNIT STANDING PILOT LIGHT CONVERSION STANDARDS

1. APPROVED MATERIALS

- **Retrofit components**
  - The REIK shall be:
    - Listed and compatible with:
      - Make and model of existing 24-volt AC natural draft FAU.
      - Electrical ratings (voltage and amperage).
      - Fuel type (i.e., natural gas).
      - Ambient temperature range at the control module.
      - Wall thermostat.
    - Compliant with ANSI Z21.71.
  - The REIK shall include:
    - Intermittent pilot gas ignition control module.
    - Wiring harness and ignition cable.
    - Gas control valve.
    - Electronic igniter (intermittent pilot or hot surface ignition).
  - Control module
    - Shall be the integrated circuit type, when available.
    - Shall provide 100% shutoff of pilot and main gas if burner fails to light (e.g., after continuous retry ignition sequence).
  - Gas control valve shall have a manual on-off valve that blocks flow of gas into the gas control when in the off position.
  - Pilot tubing shall be new aluminum (copper not allowed).



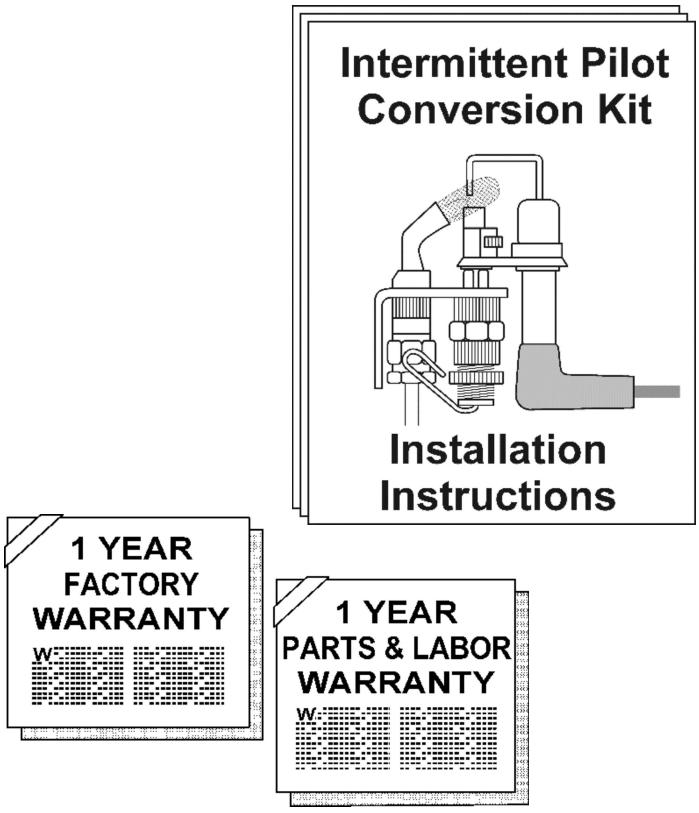
STANDING PILOT TO BE REPLACED WITH A REIK

2. WARRANTY

- **Refer to IS Appendix F (Warranty Requirements).**

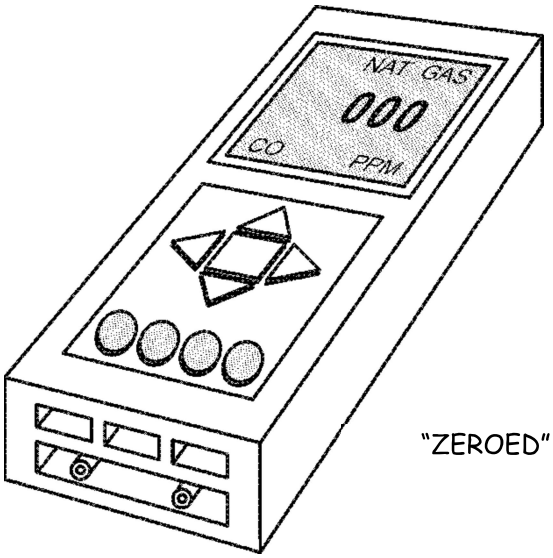
3. GENERAL REQUIREMENTS

- **Specifications and codes**
  - Installation shall be in compliance with furnace and REIK manufacturers' specifications and instructions and with local code.
- **Conversion label and instructions**
  - Manufacturer's retrofit identification label and instructions shall be attached to the appliance being converted.
  - Lighting instructions shall be clearly visible to anyone operating the gas control valve or electronic ignition system.



4. PRE-INSTALLATION SAFETY CHECK

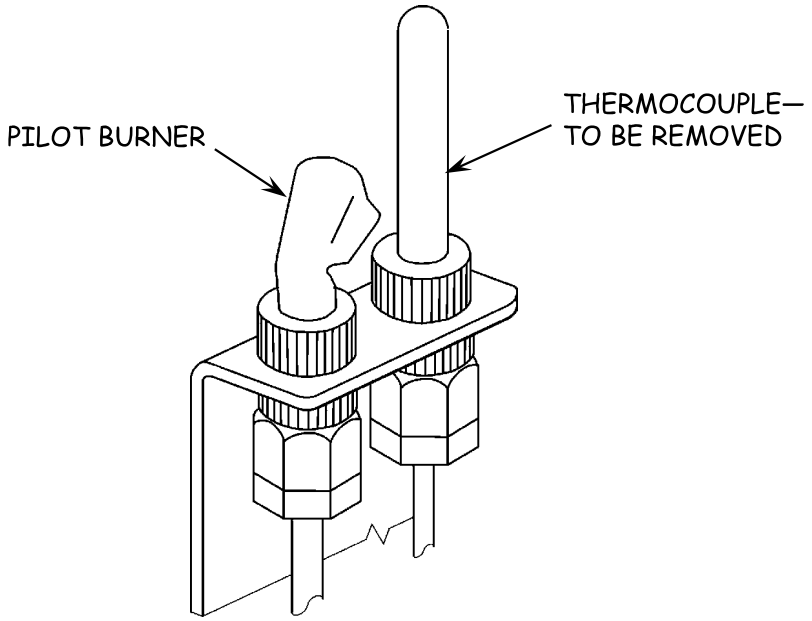
- **Gas piping**
  - The flexible gas connector and all valves and fittings past the appliance line valve shall be checked for gas leaks, in accordance with IS Section 24 (NGAT).
  - Gas leaks shall be corrected before installing the REIK.
  - If the gas supply line does not include an appliance line valve within 6' of the FAU, one shall be installed.
- **NGAT**
  - Prior to performing a pilot light conversion to electronic ignition:
    - NGAT shall be performed for the FAU in accordance with IS Section 24 (NGAT).
    - Defects shall be corrected.
- **Other appliance checks**
  - Determine manifold pressure to match input after the REIK has been installed.
  - Determine that both the fan control switch and high limit switch are functioning properly.
  - Defective parts that are not included in the REIK shall be repaired/replaced in conjunction with the new ignition.



"ZEROED" CO ANALYZER FOR NGAT

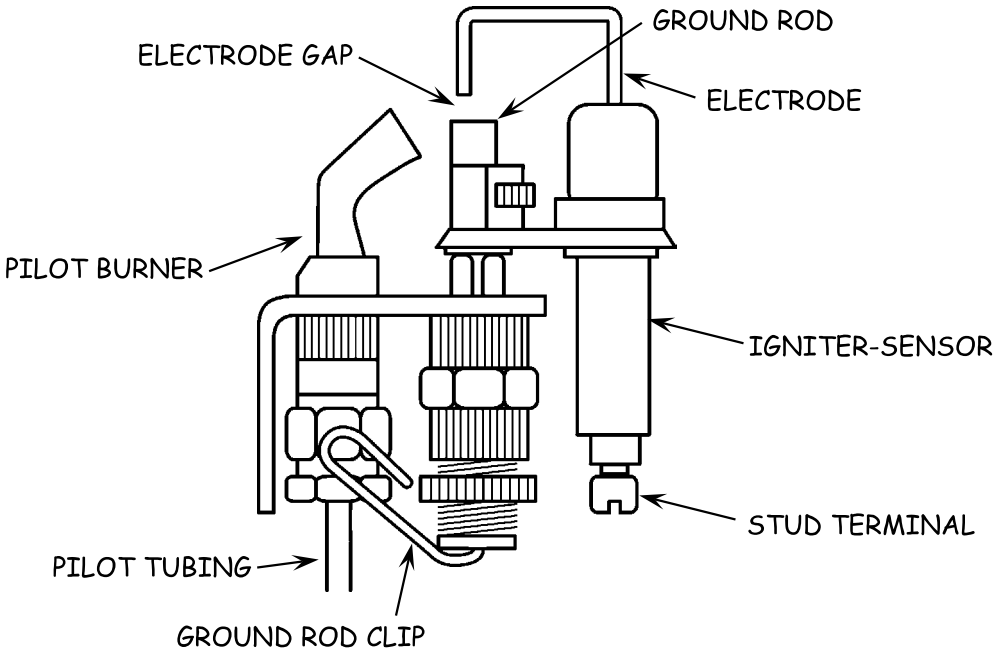
5. PRE-INSTALLATION PREPARATION

- **Thermocouple removal**
  - If necessary, the main burner shall be removed to access the pilot assembly.
  - Thermocouple shall be removed (unscrewed or snapped out).
  - The pilot burner shall not be relocated.
  - Pilot tubing near the pilot burner and gas control shall not be bent unless it is first disconnected.



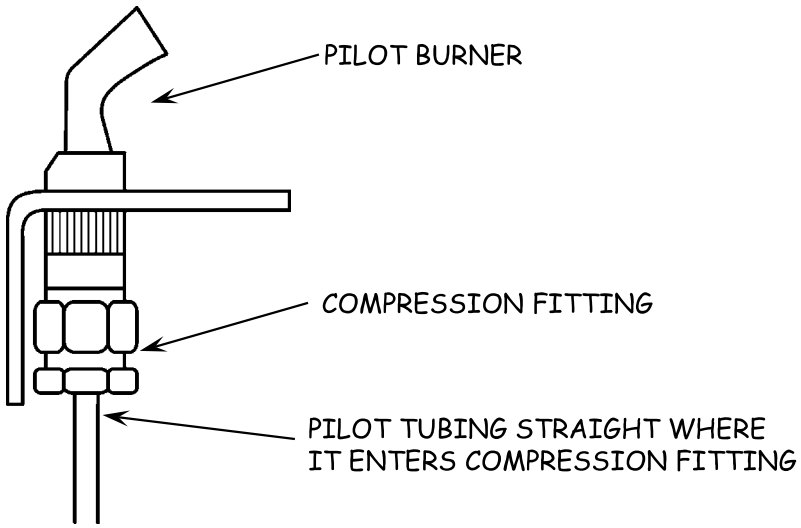
6. IGNITER-SENSOR INSTALLATION

- **Ground rod**
  - The ground rod shall be installed to replace the removed thermocouple.
- **Igniter-sensor**
  - The igniter-sensor shall be attached to the ground rod and secured by tightening the set screw.
  - The electrode position shall be adjusted to achieve proper gap between the electrode and the ground rod and to facilitate connection of the ignition cable to the stud terminal at the bottom of the igniter-sensor.
  - The ground rod shall be moved up/down to position the gap in the pilot flame.
  - The grounding connector (e.g., ground clip) on the ground rod must be in contact with the pilot burner or its gas line.



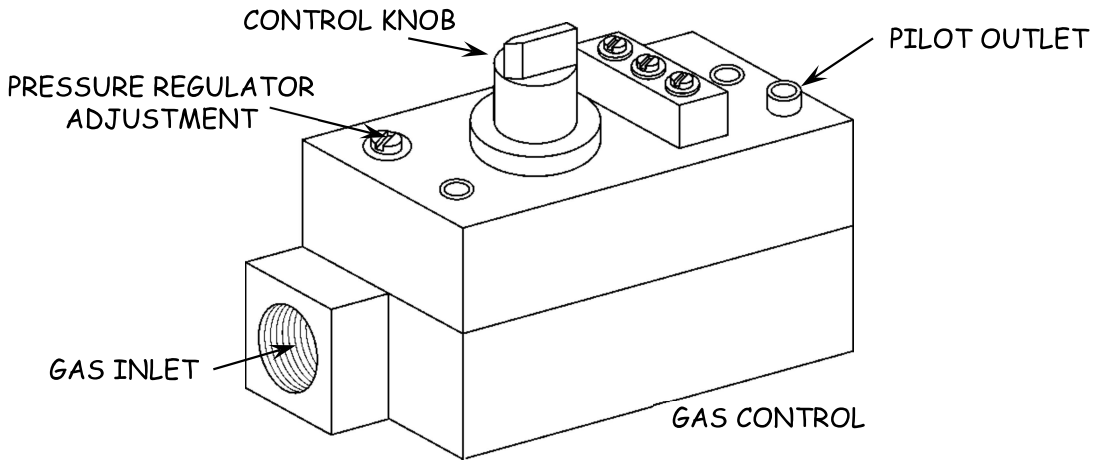
7. GAS PIPING

- **All pipes, tubing, and compression fittings shall be new and properly prepared.**
  - Pipe shall be properly reamed and free of chips.
  - When tubing is used:
    - Tubing ends shall be square, deburred, and clean.
    - Tubing bends shall be smooth and without deformation.
    - Tube-to-pipe coupling shall be used to connect the tubing to the gas control valve.
    - Existing compression fittings shall be discarded.
- **Tubing adjustments**
  - Tubing shall be straight where it enters the compression fitting.
  - Tubing shall not be bent in a manner that will distort its diameter in/near the fitting and cause a gas leak.
- **Sediment trap**
  - If not already in place, a sediment trap shall be installed in the gas supply line:
    - When specified by the REIK manufacturer and/or
    - When required by local code.



8. GAS CONTROL INSTALLATION

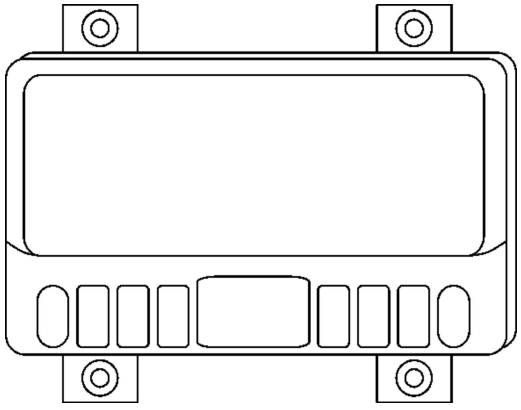
- **Control unit**
  - The gas control shall be installed per manufacturer's instructions.
    - The control knob shall be easily accessible and
    - Direction of gas flow through the unit shall be as marked.
  - Protective seals over inlet and outlet tappings shall be left in place until ready to connect piping.
- **Gas piping**
  - NPT pipe thread length and depth of pipe insertion into the gas control shall not exceed maximums specified by the manufacturer.
  - Pipe compound (*not* Teflon tape) shall be applied to the pipe only, leaving the two end threads bare.
  - Protective seals shall be removed from the gas control inlet and outlet just prior to insertion of piping, and the piping shall be tightened with a wrench as instructed.
- **Pilot gas tubing**
  - Pilot tubing shall be routed from the gas control to the pilot burner *without* sharp bends that deform the tubing.
  - Tubing shall be shaped/bent before connecting and it shall not be bent at the gas control after the compression nut has been tightened.
  - Gas control tubing compression fitting shall be properly installed *without* over-tightening:
    - Tubing shall be inserted all the way in.
    - Fitting shall be screwed hand tight, and then tightened with a wrench one more turn.
  - At the pilot burner, gas tubing shall be attached in accordance with pilot burner manufacturer's instructions.



9. INTERMITTENT PILOT GAS IGNITION CONTROL MODULE

- **Mounting location shall provide:**
  - Proper access to field wiring terminals.
  - Protection from temperatures exceeding specified maximum.
  - Cable route to pilot burner that meets manufacturer's length and heat exposure limits.
- **Mounting procedure**
  - New holes shall be drilled as required to properly mount the module.
  - The module shall be fastened securely with manufacturer's recommended machine or sheet metal screws.
- **Wiring**
  - A common ground shall be installed per manufacturer's instructions.
    - The pilot burner shall share a common ground with the control module, igniter, and flame sensor.
    - The ground wire shall be insulated (e.g., thermoplastic, not asbestos) with a minimum temperature rating of 221°F (105°C).
    - In any location where wires could be exposed to temperatures higher than the rating, a shield shall be used to protect the wire.
    - If the pilot burner is not well grounded (e.g., metal-to-metal contact), a conductor shall be installed from the burner to ground.
  - The supplied wiring harness shall be connected per manufacturer's instructions to the ignition module and the gas control.
  - If the existing transformer does not supply adequate VA to operate the control module plus all other devices in the control circuit, (e.g., pilot and main valves in the gas control), it shall be replaced with one meeting specifications of the pilot control manufacturer.
  - Wall thermostat anticipator shall be properly adjusted to the current draw of the control system.

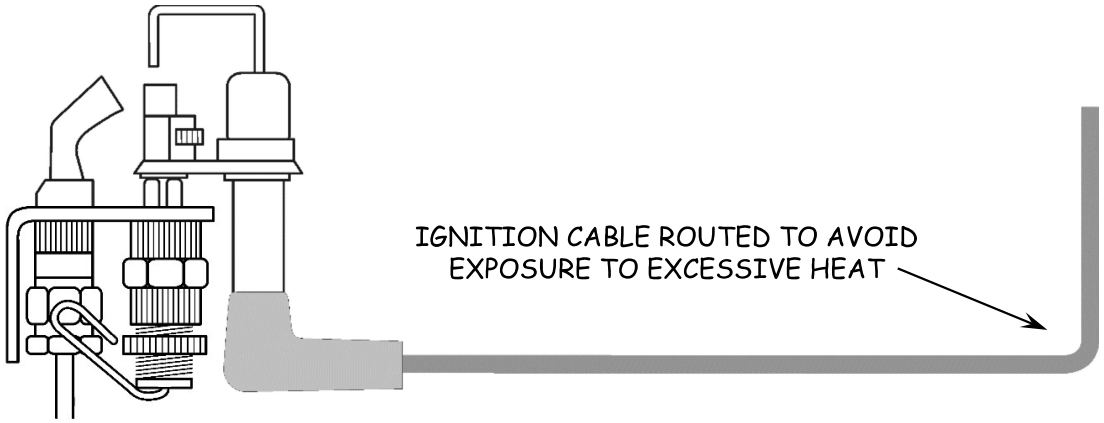
INTERMITTENT PILOT GAS IGNITION CONTROL MODULE



- **Vent damper connection**
  - If the FAU is equipped with a vent damper, its wiring shall be connected to the control module as instructed.
- **Ignition cable**
  - The ignition cable shall be properly routed to avoid exposure to excessive temperature.
  - Standoff insulators shall be used as needed to prevent direct contact with metal surfaces.
- **Settings**
  - Dip switches and jumper, if present, shall be set per manufacturer's instructions.

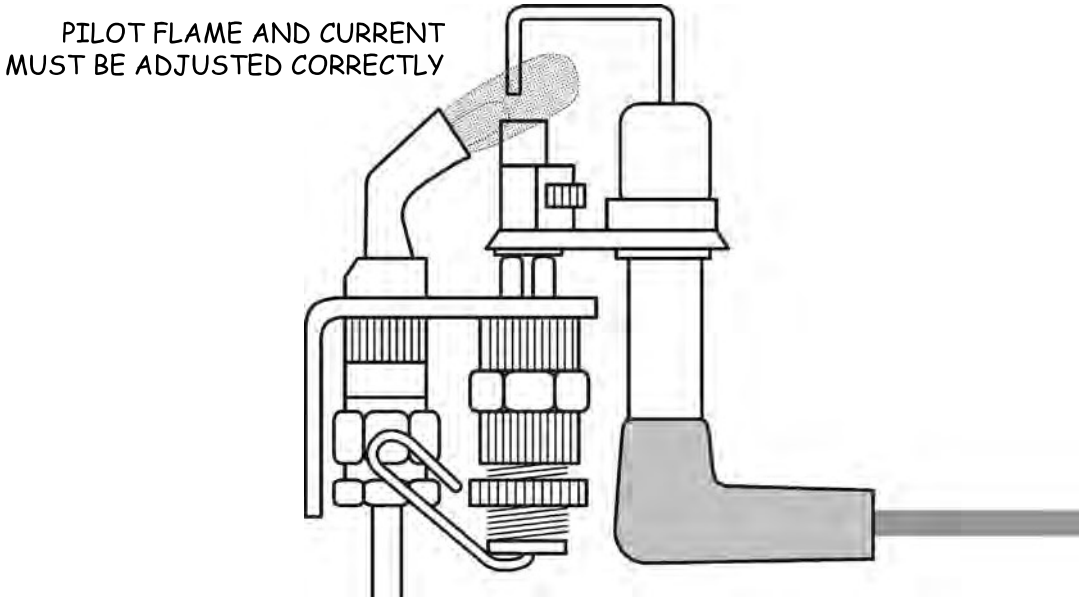
10. GAS CONTROL SYSTEM CHECKS

- **Following installation, the gas control system shall be checked to confirm proper operation.**
- **Visual inspection**
  - With power to the appliance off:
    - Verify all wiring connections are clean and tight.
    - Confirm that the pilot burner, control module, igniter, and flame sensor share a common ground.
  - With power to appliance and ignition module on:
    - Turn on the manual appliance line (shutoff) valve.
    - Following procedures outlined in IS Section 24 (NGAT), check for gas leaks in all joints, valves, and components affected by the installation.



10. GAS CONTROL SYSTEM CHECKS (cont.)

- **Safety shutoff operation check**
  - Reset the ignition module (e.g., turn room thermostat to lowest setting and wait one minute).
  - With appliance line valve off,
    - Raise room thermostat to its highest setting and
    - Check spark and safety shutoff per manufacturer's instructions.
  - Reset the ignition module again.
- **Manifold pressure**
  - With room thermostat at highest setting:
    - Test manifold pressure and
    - Adjust pressure regulator to match the original input (see Item 4).
- **Normal operation check**
  - Review normal operating sequence.
  - Turn appliance line valve on and follow manufacturer's instructions to verify proper unit operation.
  - Operate the appliance through at least three complete cycles.
- **Pilot flame and flame current**
  - Pilot flame shall be in compliance with manufacturer's instructions.
  - Igniter-sensor position shall be adjusted as needed to achieve specified flame current.



11. TROUBLESHOOTING

- **If the system does not perform as designed:**
  - Troubleshooting shall be performed in accordance with manufacturer's instructions.
  - Corrections shall be made as needed.
- **Installation is not complete until the system operates properly.**

12. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Instructions and warranties**
  - Customer shall be instructed in how to:
    - Shut down the FAU and turn off the gas, and
    - Restart the FAU.
  - Customer shall be provided with:
    - Manufacturer's written instructions.
    - Written warranty documents.
- **Clean-up and disposal**
  - All packing materials and other debris shall be cleaned up and removed from the premises.
  - All replaced parts shall be removed from the premises and disposed of properly.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

CUSTOMER RECEIVES SHUT-DOWN AND RESTART INSTRUCTIONS, MANUFACTURER'S WRITTEN INSTRUCTIONS, AND WARRANTY DOCUMENTS

ENERGY-EFFICIENT VARIABLE-SPEED POOL PUMP REPLACEMENT

Lead Paint Risk Factor
NONE-LOW

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SECTION 30 PREFACE
for

ENERGY-EFFICIENT VARIABLE-SPEED POOL PUMP REPLACEMENT

1. Nonfeasibility Criteria

1.1. Pool is above-ground.

1.2. Pool is abandoned.

1.3. Pool is not privately owned (e.g., a community pool).

1.4. Pool plumbing is not in working condition or is not compatible with an available replacement pump.

1.5. The filtration system is not in good working condition and operational (needs repair or replacement).

1.6. Proper electrical service is not available.

1.7. New pool pump is not compatible with existing pool equipment and/or the controller of additional pool features (waterfall, spa, etc.).

1.8. A suitable installation location is not available.

1.9. Customer refuses.

2. Installation Policies

2.1. Energy-efficient pool pump replacement is available only to single-family homes with an in-ground swimming pool.

2.2. The pool must be privately-owned, in-ground, filled with water, and functional.

2.3. The existing unit must be single speed and in working condition.

2.4. An anti-entrapment pool drain cover shall be installed in conjunction with pump replacement when a permit is required and anti-entrapment protection is required by the local jurisdiction.

a. *Exception:* Replacement pump has an integral anti-entrapment feature (e.g., safety vacuum release system) that automatically shuts off the pump when a drain blockage occurs.

3. Installation Policies Specific to Mobile Homes

None.

ENERGY-EFFICIENT VARIABLE-SPEED POOL PUMP REPLACEMENT STANDARDS

1. APPROVED MATERIALS

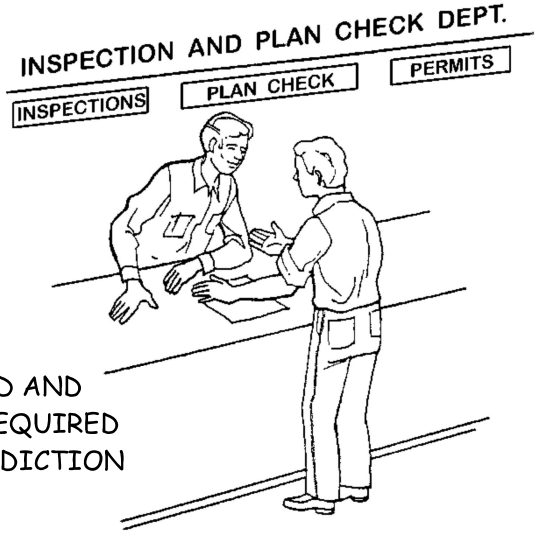
- **High-efficiency pool pump and motor unit**
  - Variable speed with built-in controller.
  - UL- and/or NSF-listed.
  - California Title 20 Compliant (Section 1605.3 of the Appliance Efficiency Regulations).
  - Listed in the CEC Appliances Database (available at: http://www.energy.ca.gov/appliances).
  - Listed in participating utility's rebate database of acceptable models, when applicable.

2. WARRANTY

- **Refer to IS Appendix F (Minimum Warranty Requirements).**

3. GENERAL REQUIREMENTS

- **Permit**
  - A permit shall be obtained and finalized when required by the local jurisdiction.
- **Installation shall be in compliance with:**
  - Manufacturer's instructions,
  - Local code, and
  - IS guidelines.
- **Electrical safety**
  - Prior to beginning replacement, the branch circuit serving the pump shall be turned off at the master on-off switch (e.g., circuit breaker controlling the branch circuit).
  - All electrical work shall be in conformance with the CEC and local code.



PERMIT OBTAINED AND FINALIZED WHEN REQUIRED BY THE LOCAL JURISDICTION

4. PUMP SIZING

- **General requirements**
  - Pump shall be smallest capacity practical, based on pool size, flow rate, plumbing, and accessories (e.g., pool cleaner) not operated by separate pumps.
  - Hydraulic characteristics of the pump shall be matched to the piping and flow characteristics of the pool (and spa, if present) in accordance with manufacturer's sizing guidelines and program policies.
- **Flow rates**
  - Minimum system flow rate ("minimum filtration rate")
    - Filtration flow rate (time required to circulate all water in pool) shall be set for a minimum "turnover time" in accordance with manufacturer's guidelines and local regulations, or
    - 36 gallons per minute, whichever is greater.
  - Maximum system flow rate ("maximum filter flow rate")
    - Shall be determined based on filter type and surface area.
    - A maximum velocity of 8 feet per second (fps) shall be provided in the return line and 6 fps in the suction line (Table 30-1 is provided as a guide).

Table 30-1: Recommended Maximum Flow Rate—Based on Pipe Size and Water Velocity

Pipe Size (Diameter)	Maximum Flow (gpm) Based on Water Velocity (fps)	
	6 fps	8 fps
1.5"	38 gpm	51 gpm
2.0"	63 gpm	84 gpm
2.5"	90 gpm	119 gpm
3.0"	138 gpm	184 gpm

4. PUMP SIZING (cont.)

- **Pump size/capacity**
  - Manufacturer's curves design flow rate, and friction loss of the circulation system shall be utilized.
  - Friction loss of the circulation system shall be determined based on:
    - Existing ancillary equipment (e.g., pool cleaner and spa jets, which require a specified flow rate to be effective), and
    - Diameter and total equivalent length of existing piping.
      - Table 30-2 is provided as a guide in estimating friction loss per 10 feet of pipe.
      - Table 30-3 is provided as a guide in estimating equivalent length of pipe for fittings and valves.
  - The pump's highest speed shall be sufficient for proper operation of the spa and/or ancillary features (e.g., cleaning equipment and spa, when present)—*without* exceeding the maximum flow rate of the plumbing or filter.
  - Replacement pump capacity shall not match that of the existing pump if it was oversized originally.

Table 30-2: Friction Loss per 10 feet of Pipe – Based on Flow Rate Through the Pipe and Pipe Diameter

Flow (gpm)	Friction Loss per 10 ft of Pipe (feet of H_2O)			
	1.5" Diameter	2.0" Diameter	2.5" Diameter	3.0" Diameter
20	0.30	0.10	0.03	0.01
30	0.65	0.18	0.08	0.03
40	1.1	0.30	0.12	0.05
50	1.6	0.47	0.20	0.065
60	2.0	0.67	0.28	0.10
70	--	0.90	0.40	0.13
80	--	1.17	0.50	0.17
100	--	--	0.70	0.25
120	--	--	1.05	0.37
140	--	--	1.35	0.48

Table 30-3: Equivalent Feet of Pipe for Different Fittings – Based on Pipe Diameter

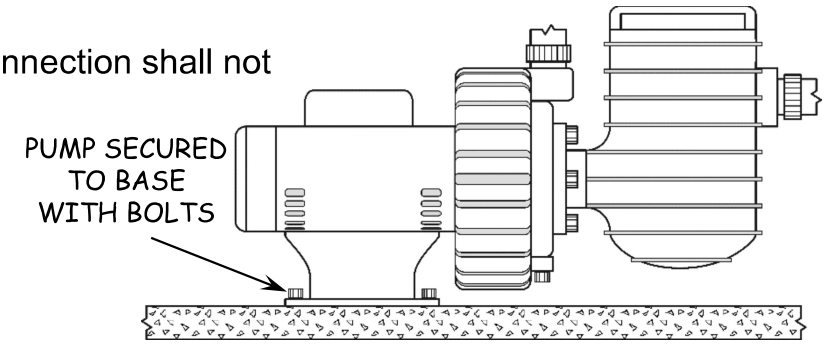
Fitting Type	Equivalent Length of Pipe (feet)			
	1.5" Diameter	2.0" Diameter	2.5" Diameter	3.0" Diameter
90° Elbow Curved, Threaded	3.75	5.0	6.25	7.5
90° Elbow Mitered	7.5	10.0	12.5	15.0
45° Elbow Curved. Threaded	2.0	2.7	3.3	4.0
45° Elbow Mitered	1.875	2.5	3.1	3.75
Tee Through-branch as an Elbow	7.5	10.0	12.5	15.0
Tee Run-through	2.5	3.3	4.2	5.0
Globe valve	42.5	56.7	70.8	85.0
Gate valve	1.0	1.3	1.7	2.0
Ball valve	0.375	0.5	0.6	0.75
Swing check valve	12.5	16.7	20.8	25.0
Lift check valve	75.0	100.0	125.0	150.0
Hose Coupling	0.625	0.8	1.0	1.25

5. LOCATION

- **Replacement units**
  - Mounting locations:
    - Shall meet manufacturer's requirements.
    - Shall not be damp or unventilated.
    - Shall not be subject to flooding.
    - Shall not be underground unless allowed by local jurisdiction.
    - When feasible, shall be shaded from continuous direct heat from the sun.

6. REPLACEMENT INSTALLATION

- **Suction lines**
  - Shall run as directly as possible to reduce friction loss.
  - Elbows and valves shall not be located within 4 pipe diameters of the inlet.
  - Joints must be tight but not over-tightened.
  - Suction line diameter must be equal to or larger than the discharge line diameter.
- **Mounting base**
  - Base shall be level, rigid, and vibration-free (e.g., a concrete slab or other rigid base) that conforms to manufacturer's specifications and local code.
  - Pump shall be secured to the base with screws or bolts.
  - The pump should be cushioned (e.g., placed on a rubber mat) when recommended by the manufacturer.
  - The pump base must:
    - Be protected from excess moisture and flooding.
    - Allow for adequate drainage to prevent the motor from getting wet.
    - Allow access for servicing the pump and the piping.
- **Plumbing**
  - Valves
    - Check valves and isolation valves shall be present in accordance with pump manufacturer's instructions.
    - A check valve should be installed on the suction line to the pump.
    - If the pump is located below water level, isolation valves must be present before and after the pump (to prevent back-flow of pool water during servicing).
  - Piping support
    - All piping connected to the pump shall be supported (so weight of the pipe is not borne by the connections).
    - Both suction and discharge pipes shall be independently supported near the pump.
    - Pump suction connection shall not be smaller than the suction pipe to which it is connected.

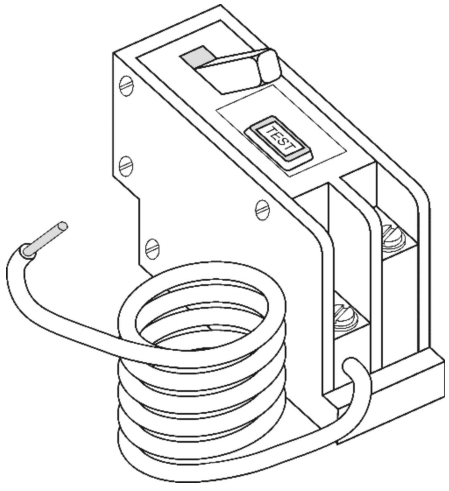


6. REPLACEMENT INSTALLATION (cont.)

- **Plumbing (cont.)**
  - Fittings
    - Plastic fittings shall be new.
    - Fittings shall conform to IAPMO standards.
    - The fewest possible fittings shall be used.
    - Efficient fittings shall be used when possible (e.g., short-radius 90° instead of hard 90° elbow).
    - Fittings that could cause an air trap shall be avoided.
  - Thread seal
    - Teflon tape (not plumber's pipe compound) shall be used to seal threaded connections on molded plastic components.
    - When Teflon tape is used, the entire threaded portion of the male fitting, beginning at the end, shall be wrapped with one to two layers.
  - Tightening fittings
    - Connectors shall not be forced past molded-in thread stops.
    - Fittings shall not be over-tightened.

7. ELECTRICAL CIRCUIT REQUIREMENTS

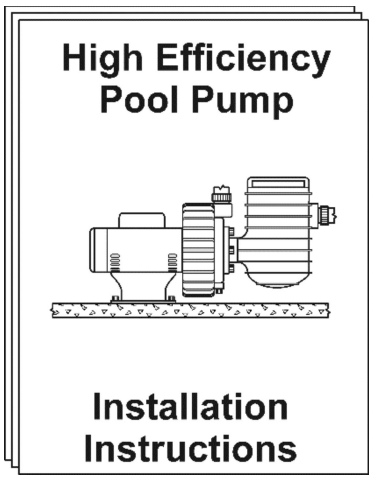
- **All units**
  - All electrical wiring shall comply with manufacturer's instructions and local code.
  - The pump/motor shall not be grounded to a *gas* supply line.
  - A GFCI shall be present in the circuit powering the pump (e.g., a GFCI breaker as the master on-off switch).
  - A disconnecting means shall be located within sight of the controller and pump, and at least 5' horizontally from the inside walls of the pool, unless a code-approved permanent barrier is in place.



GROUND FAULT CIRCUIT INTERRUPTER (GFCI)

7. ELECTRICAL CIRCUIT REQUIREMENTS (cont.)

- **Voltage**
  - Voltage at the motor must not be more than 10% above or below the motor's nameplate (rated) voltage.
  - The electrical supply shall match the motor's voltage, phase, and cycle.
  - The wire size shall be adequate for the pump's horsepower/wattage rating and distance from the power source.
- **Grounding, bonding, and wiring**
  - Copper conductors shall be used.
  - The motor and controller shall be permanently grounded to the electrical service ground.
    - The motor terminal labeled for grounding shall be used.
    - Size and type wire shall be in compliance with local code.
- **Bonding**
  - Pump motor shall be bonded to the pool structure, if connection to metal parts within and around the pool is possible.
  - A solid copper conductor shall be used that is sized according to the manufacturer's specifications.
  - The bonding conductor shall run from the appropriate connector provided on the motor housing to:
    - All metal parts of the pool and
    - All electrical equipment, metal piping (except *gas* piping), and conduit within 5' of inside walls of the pool.

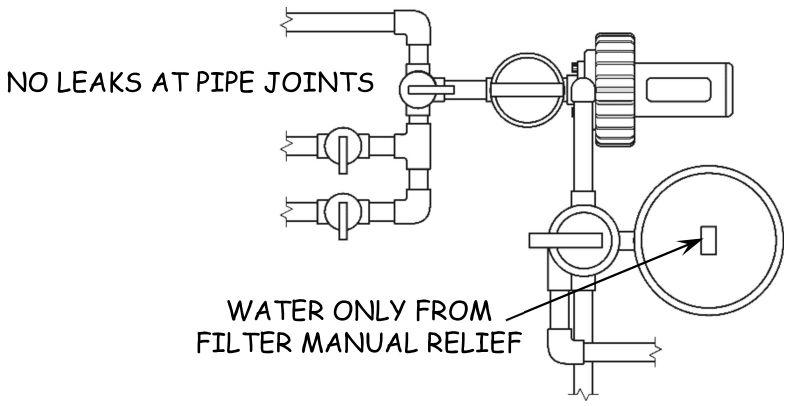


8. PROGRAMMING

- **All units**
  - Pump speed shall be set for maximum energy efficiency while still maintaining adequate circulation/filtration.
    - Lower speeds shall be used for normal filtering.
    - Higher speeds shall be used only as needed to operate special functions (e.g., pool cleaning and skimming functions, backwashing the filter, or starting a roof-mounted solar heater).
  - Timer shall be set to operate the system during non-peak hours.

9. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Testing**
  - With the pump off:
    - To check for leaks, the strainer housing shall be filled with water to the suction pipe level.
    - All leaks shall be corrected before starting the pump.
  - Pump shall be primed before operating, per manufacturer's instructions (pump must not be run dry).
  - With the pump operating:
    - The pump and piping shall be checked for leaks.
    - The filter's manual relief valve shall be checked for a steady stream of water (not air or a combination of air and water).
    - Water leaks and air discharge, if present, shall be corrected.
    - Proper operation during all functions (automatic cycles and manual override) shall be verified.



9. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS (cont.)

- **Instructions and warranties**
  - Client shall be instructed in the proper operation and care of the controller and pool pump.
  - Client shall be provided with:
    - Manufacturer's written instructions.
    - Written warranty documents.
- **Clean-up and disposal**
  - All packing materials and other debris shall be cleaned up and removed from the premises.
  - All replaced equipment and parts shall be removed from the premises and disposed of properly.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

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NATURAL GAS WATER HEATER REPAIR

Lead Paint Risk Factor
NONE

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SECTION 31 PREFACE
for

NATURAL GAS WATER HEATER REPAIR

1. Nonfeasibility Criteria

1.1. The property is renter-occupied.

1.2. Fuel used by the existing unit is not supplied by the utility providing ESA Program services.

1.3. Non-FVIR water heater is in a garage and is not positioned 18" above the floor.

1.4. The water heater is inaccessible.[1]

1.5. The water heater will be replaced.

a. Cost to repair is 50% of the cost to replace the unit, or more.

b. The tank leaks.

1.6. Water heater is FVIR type, and an event has activated the FVIR mechanism.

1.7. A safety hazard is present which cannot be repaired.

1.8. Proper combustion air cannot be provided.

1.9. The water heater compartment floor is structurally unsound and/or the tank is leaning (condition shall be reported to homeowner).

1.10. Confined Spaces: state and federal regulations regarding confined spaces cannot be met.

1.11. The tank is a central water heater serving more than one dwelling unit.

1.12. Customer refuses.

2. Installation Policies

2.1. Water heater repair may be provided only when the appliance fails NGAT, and correction cannot be achieved with service/adjustment[1] by utility gas service personnel (or their designated representative).

2.2. The water heater tank must be repairable and free of water leaks.

2.3. Repair and service limitations:

a. Service/adjustment may be conducted in both owner-occupied and renter-occupied homes.

b. Major repairs may be provided only if the residence is owner-occupied.

[1] See definitions.

2.4. Water heater repairs will be provided only if the fuel used by the appliance is supplied by the utility providing ESA Program services.

2.5. Water heaters will be repaired only if the cost of repairing the unit would be less than 50% of the cost of replacement.

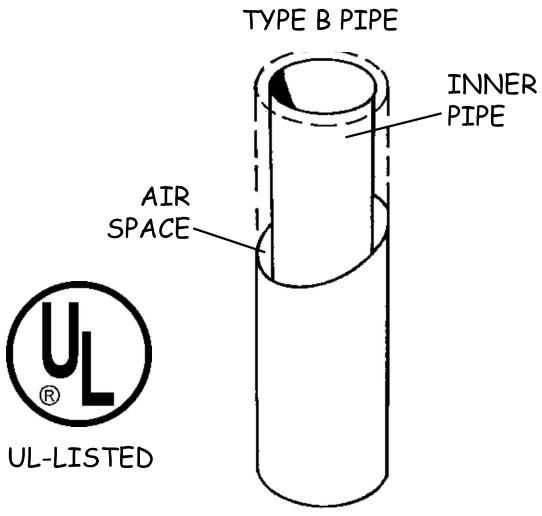
3. Installation Policies Specific to Mobile Homes

None.

NATURAL GAS WATER HEATER REPAIR STANDARDS

1. APPROVED MATERIALS

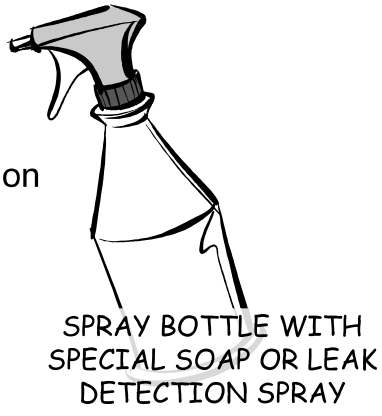
- **Combustion components**
  - Burner, thermocouple, pilot burner, electric igniter, etc.: Listed (e.g. UL, AGA, CSA) and compatible with water heater.
  - FVIR combustion system components: Specified by water heater manufacturer.
- **Gas piping and valves**
  - Gas valves: Listed (e.g., by UL) and AGA- or CSA-certified.
  - Flexible connectors: Listed (e.g., by IAPMO) stainless steel or plastic- or epoxy-coated brass connectors.
  - Fuel gas piping: Compliant with CMC, Chapter 13.
  - Copper gas lines and uncoated brass flexible gas connectors and soldered joints: Not allowed.
- **Safety relief and drain valves**
  - Temper and pressure relief
    - T&P valve: ASME-rated and -listed and manufactured to ANSI Z21.22.
    - Automatic gas shutoff valve (e.g., Watts 210): Listed or certified by UL or CSA.
  - Drain valve
    - Heavy brass body that meets NSF low lead standards.
    - Pipe and hose threads compliant with ANSI B1.20.1 and B1.20.7.
  - Valve caps
    - Rated for 150°F water or made of brass.
- **Vent systems**
  - UL-listed vent connectors, components, and Type B vent pipes.
  - Nonmetallic systems shall conform to ASTM D 1785 and D 2665.



METAL PIPES AND ASSEMBLIES UL-LISTED AND MANUFACTURER-COMPLIANT

2. PRELIMINARY EXAMINATION

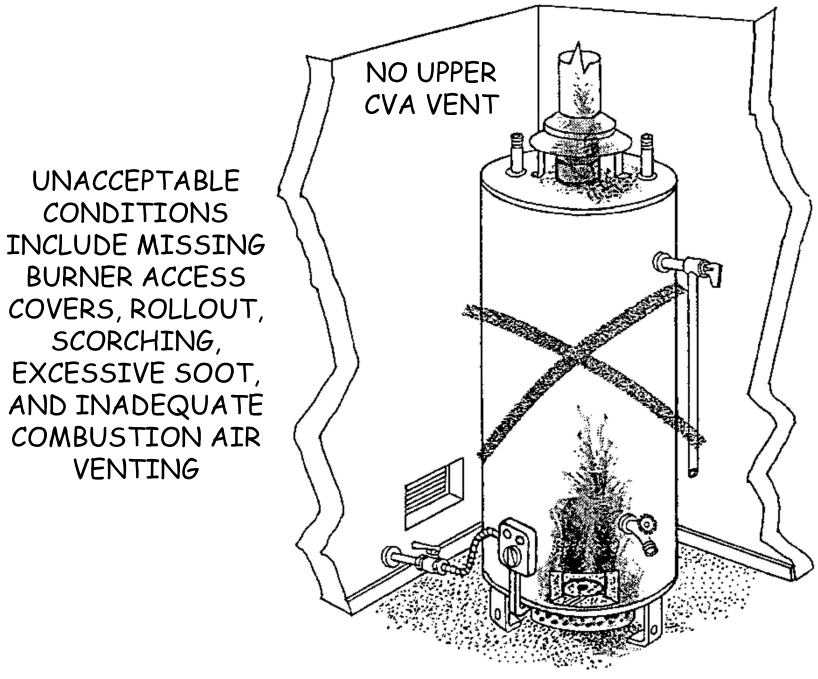
- **Checks for defects**[1]
  - The water heater shall be checked for defects, including but not limited to the following:
    - Gas leaks at valves, fittings, joints, or flexible gas connector.
    - Presence of copper gas line or *uncoated* brass flexible gas connector.
    - Gas control valve defective or improperly adjusted.
    - Loose or missing components (e.g., combustion access covers).
    - Leaking plumbing, including water heater drain valve.
    - Missing/defective temperature and pressure relief (T&P valve or automatic gas shutoff valve)
    - Seismic bracing defective or needed
  - Vent system defects, such as:
    - Disconnections, leaks, obstructions, etc.
    - Defective/missing vent cap
    - Misaligned, defective, missing, or multiple draft hoods
    - Inadequate clearance from combustibles
    - Improper termination
    - Double-wall pipe not used where required (e.g., past ceiling/wall).
  - Excessive soot or rust at the draft hood
  - FVIR combustion control system defect or activation by flammable vapor event
  - Defective induced draft fan or controls



[1] Subject to individual utility policy.

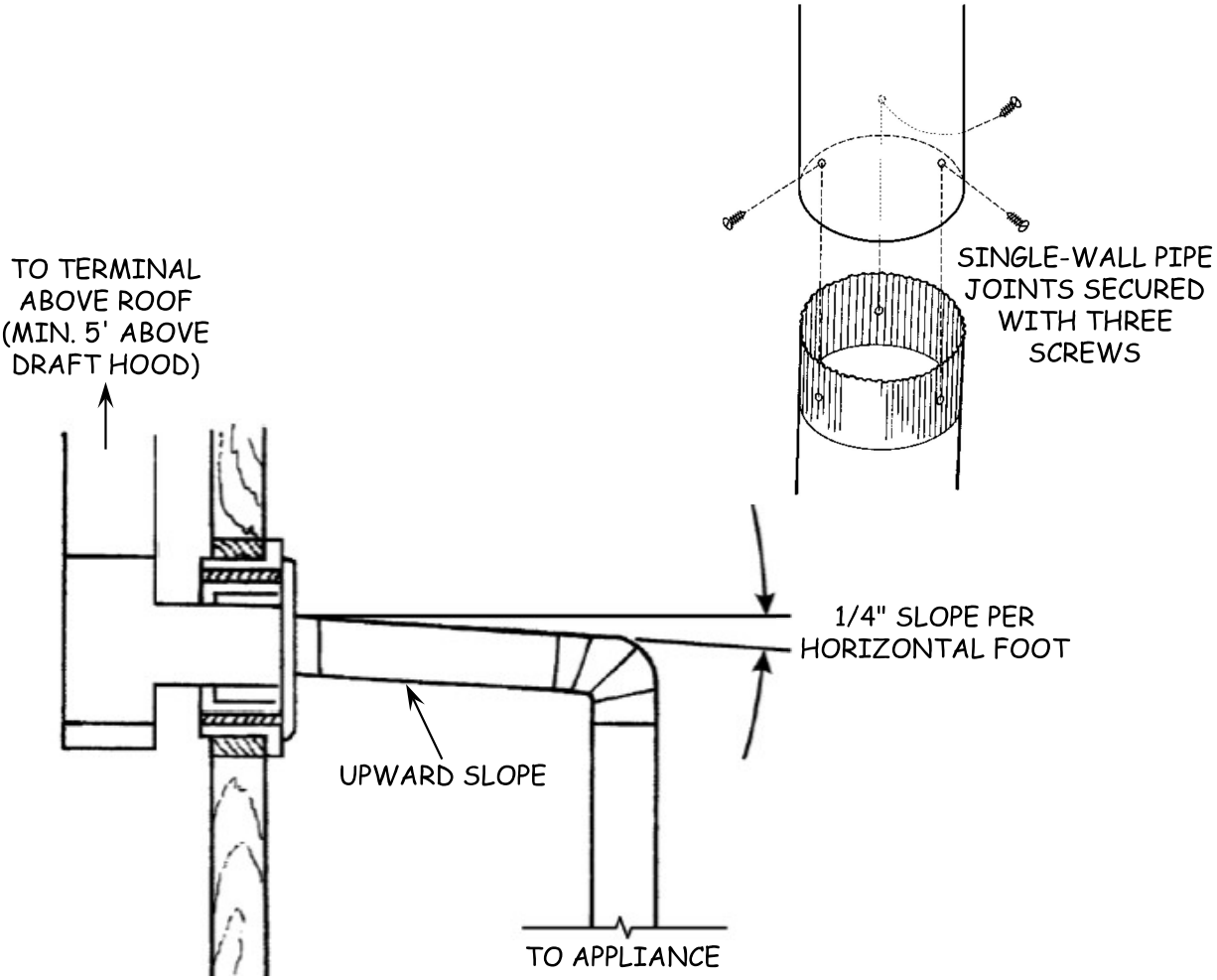
2. PRELIMINARY EXAMINATION (cont.)

- **Checks for defects[1]**
  - Pilot defects, such as:
    - Improper position of thermocouple or pilot flame.
    - Faulty pilot tubing or pilot burner.
    - Faulty thermocouple.
    - Faulty electric igniter.
  - Burner defects, such as:
    - Rollout and scorching.
    - Dirty or obstructed ports.
    - Improperly adjusted/positioned.
    - Excessive soot or rust.
    - Abnormal flame (e.g., large yellow, floating, etc.).
    - Incorrect air/gas mixture.
    - Improper gas pressure (over- or under-fired).
  - Inadequate/improper combustion air.
- **Water heater repairs[1]**
  - Contractor shall perform corrections necessary to eliminate appliance hazards and unsafe/improper conditions, including those listed above.



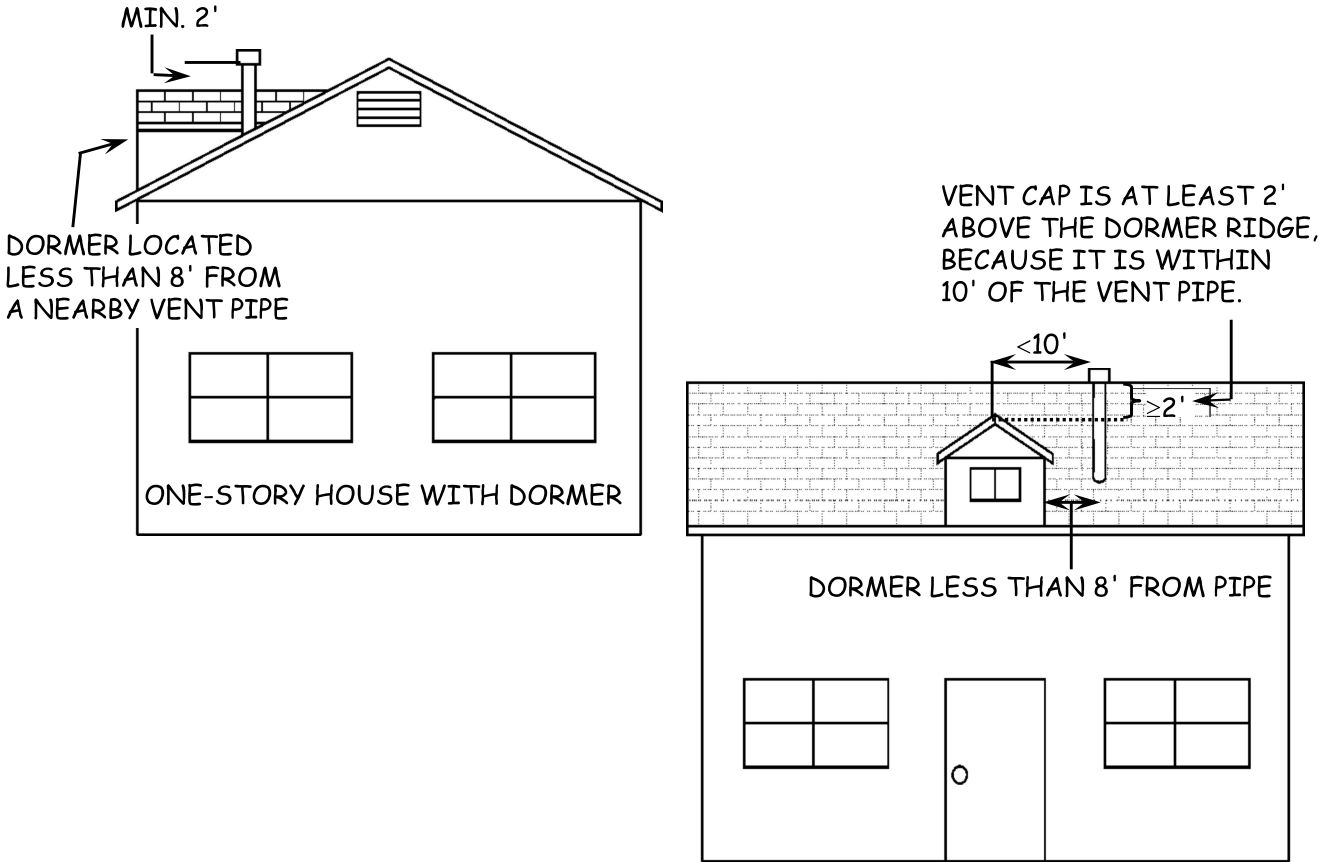
3. VENT SYSTEM REPAIRS (CONVENTIONAL HOMES)

- **All vent systems**
  - Repaired/replaced venting shall be in conformance with manufacturer's instructions and these guidelines.
  - Repair/replacement shall occur when there is present a vent hazard or a defect that causes improper combustion or venting.
  - Horizontal runs shall continuously slope upward a minimum of 1/4" per foot of horizontal length.
  - Pipe shall terminate minimum 5' in vertical height above the draft hood.
- **Type A single-wall vent connectors**
  - Joints and connections shall be secured with 3 sheet metal screws, evenly-spaced as feasible, when:
    - New components are installed.
    - Existing connections are loose or unsafe.



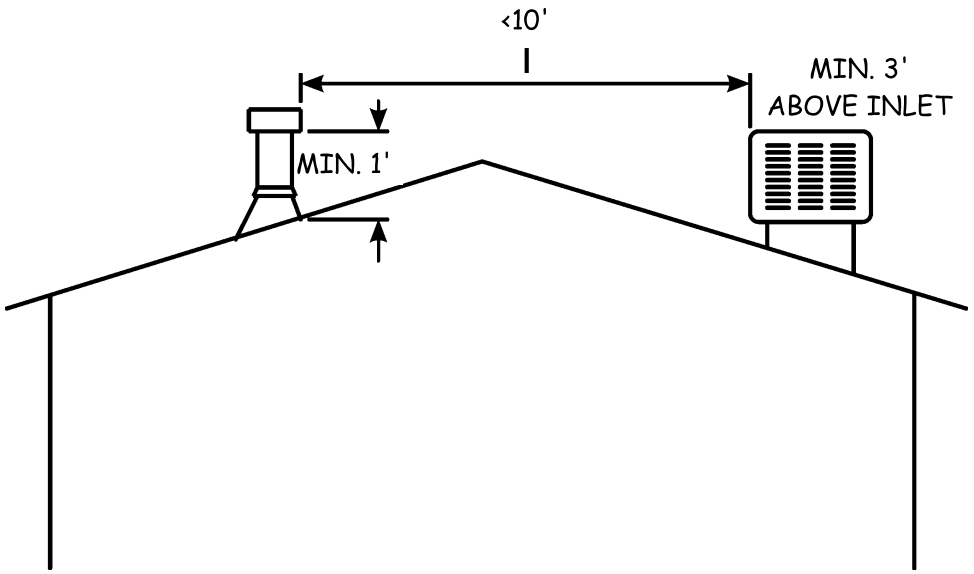
3. VENT SYSTEM REPAIRS (CONVENTIONAL HOMES) (cont.)

- **Type B double-wall gas vents**
  - Shall not be drilled or have screws installed, unless permitted by the manufacturer and local code.
  - Shall be present (rather than single-wall) where required by code.
  - Vents with listed vent caps 12" in size or smaller shall be in compliance with local code and the CMC, Chapter 8.
    - The vent shall terminate above a roof (minimum 1' above for slopes up to 6:12), provided the vent is located *at least 8' from* a vertical wall or similar obstruction.
    - Vents *within 8' of* a vertical wall or obstacle must terminate:
      - At least 2' above the highest point where they pass through the roof, and
      - At least 2' higher than any portion of the building within 10'.



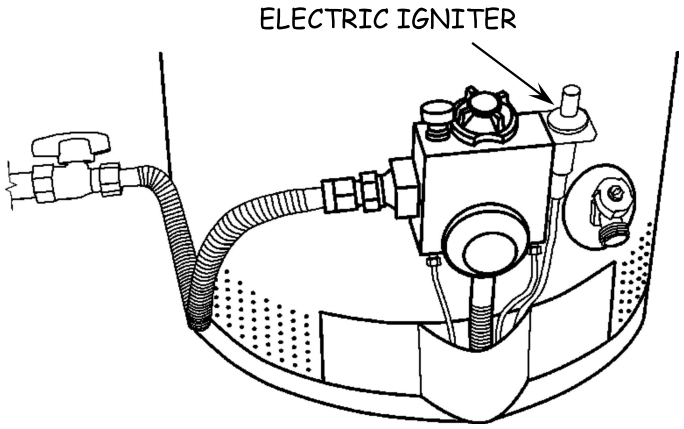
3. VENT SYSTEM REPAIRS (CONVENTIONAL HOMES) (cont.)

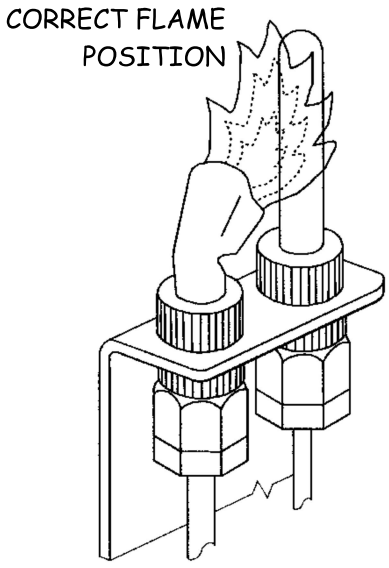
- **Type B double-wall gas vents (cont.)**
  - A gas vent passing through a wall shall terminate above the roof, extending through a roof flashing/jack/thimble and terminating in a listed cap or listed roof assembly.
  - Vent termination located within 10' of outside air, make-up air, or forced-air inlet (e.g., evaporative cooler) shall terminate at least 3' above such inlet.
- **Through-wall mechanical draft vent terminals**
  - A direct vent or mechanical draft venting system shall terminate at least 3' above any forced-air inlet (e.g., evaporative cooler) located within 10'.
  - A mechanical draft venting system (other than direct vent) shall terminate the following minimum distances from doors, operable windows, and gravity inlets into a building:
    - 1' above or 4' below, or
    - 4' horizontally from the door/window/inlet.
- **Common vents**
  - A common vent system serving both the water heater and another appliance shall be sized in accordance with local code.



4. IGNITION COMPONENT REPLACEMENT

- **Thermocouple**
  - Thermocouple shall be replaced when defective (e.g., does not properly hold open the gas control valve).
  - Replacement thermocouple shall be:
    - Appropriate for the water heater.
    - Appropriate length (free of excess tubing).
    - Correctly positioned in pilot flame.
  - Pilot flame shall be properly adjusted.
  - Voltage output shall be within specifications for proper operation of the gas control valve.
- **Pilot burner**
  - Replacement must be:
    - Listed and compatible with gas control valve and pilot assembly.
    - Installed per manufacturer's instructions, positioned correctly, and not have excess length or kinking of the pilot tubing.
- **Electric igniter**
  - Push-button electric pilot igniter must be:
    - Compatible with pilot assembly.
    - Installed per manufacturer's instructions and securely attached.



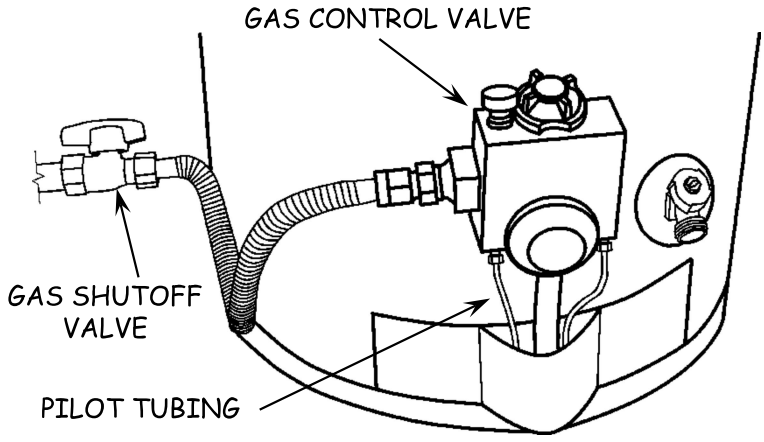


5. BURNER CLEANING, ADJUSTMENT, REPLACEMENT

- **Burner cleaning and adjustment**
  - Correctly align/position burner and clean ports as needed.
  - Clean, drill out, or replace orifice as needed for proper operation.
  - Clean air shutter and adjust for correct air/gas mixture as needed to produce proper flame characteristics.
  - Corrections shall be made as needed to eliminate abnormalities resulting in rollout, scorching, and excessive soot and rust.
- **Burner replacement**
  - Replace the burner assembly when cleaning/repair will not correct abnormal operation.
- **CO**
  - Flue gas CO must be in conformance with IS Section 24 (NGAT).

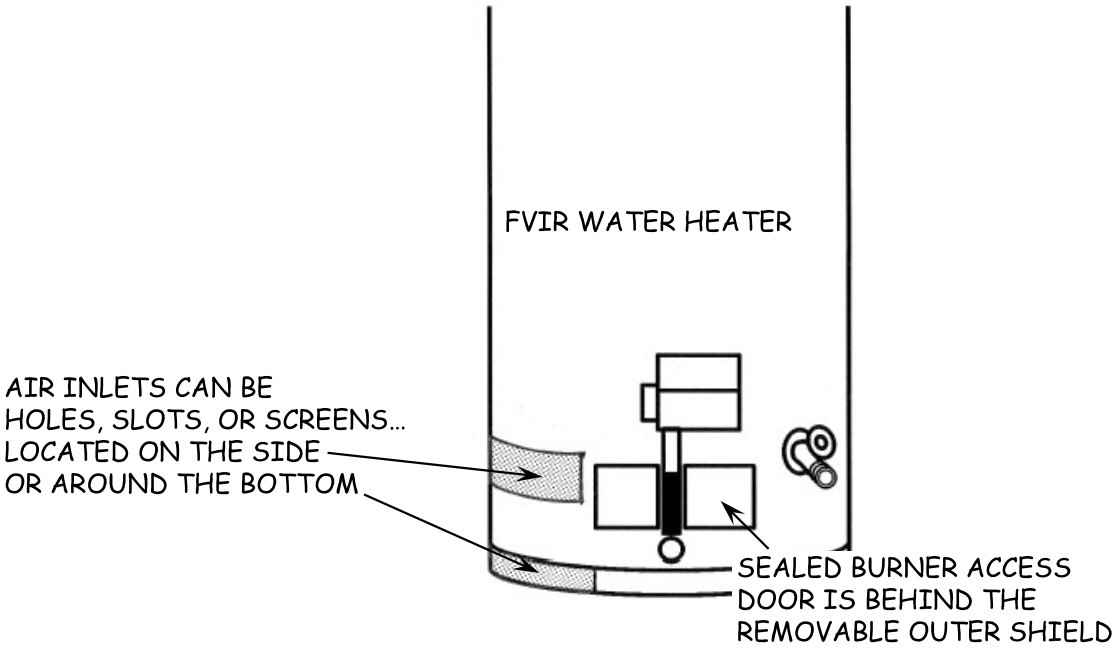
6. GAS CONTROL VALVE REPLACEMENT

- **Valve**
  - Malfunctioning gas control valve shall be replaced (not repaired).
  - Replacement shall be compatible with heater:
    - Meets water heater manufacturer's specifications (exact replacement when wired for FVIR rollout switch).
    - Has plumbing connections compatible with existing fittings.
- **Operation**
  - Shall function properly and be free of leaks and electrical defects.
  - Gas pressure shall be adjusted per manufacturer's specifications to produce a proper flame and acceptable CO.



7. CVA

- **Open combustion units**
  - CVA room volume, or venting to outdoors, shall be in compliance with local code. (See guidelines in IS Section 24 (NGAT) and Appendix A (CVA Requirements for Natural Gas Appliances)).
- **Units with a sealed combustion chamber access**
  - Applies to closed combustion/direct vent and units with FVIR open combustion system.
    - Check combustion air inlets for obstructions/debris (lint, animal hair, dirt, etc.).
    - Clean dirty/clogged inlets in accordance with these guidelines or manufacturer's instructions when available.
    - Use an appropriate brush and/or HEPA vacuum cleaner with brush attachment to remove obstructions/debris from dirty/clogged grilles/screens.
    - Do not remove FVIR sealed burner access doors to clean air inlets.
    - Inform/educate occupants regarding recommended regular cleaning of air inlets on FVIR water heaters.
  - Cleaning of units drawing air from under floor
    - Check accessible under-floor inlets for obstructions/debris and remove it. This is especially important when flame appears abnormal and/or flue gas CO exceeds the post-repair/-replacement action level of 200 ppm "air free."

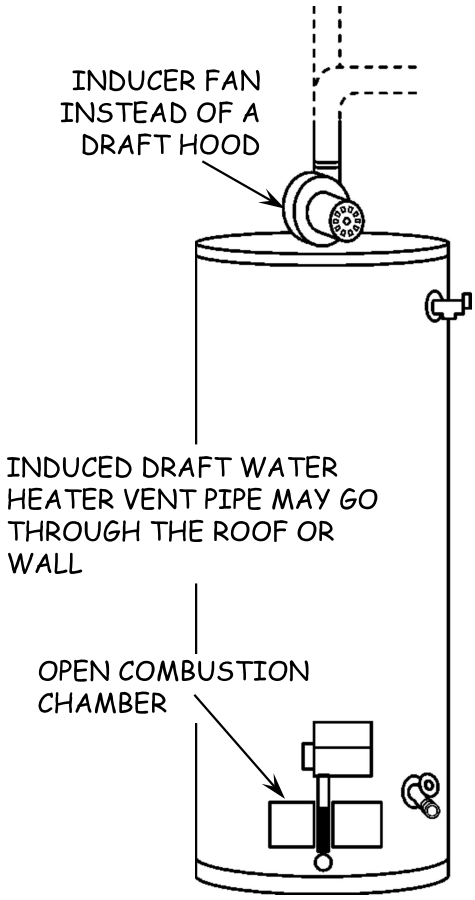


8. FVIR WATER HEATER COMBUSTION CHAMBER

- **Components**
  - Combustion chamber access panel must be properly sealed/secured.
  - External components (e.g., wiring to rollout switch/thermal fuse) and internal components must be undamaged and functional.
- **Flammable vapor event**
  - When a "flammable vapor event" occurs following vapors entering the combustion chamber, the anti-explosion flame arrestor and other components will be compromised.
  - When the water heater manufacturer does not allow repair, the water heater must be replaced.
  - When the manufacturer does allow component replacement, only factory-authorized components may be installed in accordance with manufacturer's specifications/instructions and local code.

9. INDUCED DRAFT AND CLOSED COMBUSTION WATER HEATERS

- **Induced draft**
  - Inducer fan must be checked for proper operation.
  - Defective fan, switches, and controls shall be repaired or replaced in accordance with manufacturer's specifications and instructions.
- **Closed combustion**
  - Combustion chamber access cover shall be intact and properly sealed.
  - Combustion air inlet shall be functional and free of obstructions.
- **Vent pipe**
  - Defective or nonconforming vent pipe shall be replaced.
  - Material, route, and termination shall be in conformance with water heater manufacturer's instructions and local code (HCD regulations for mobile homes).

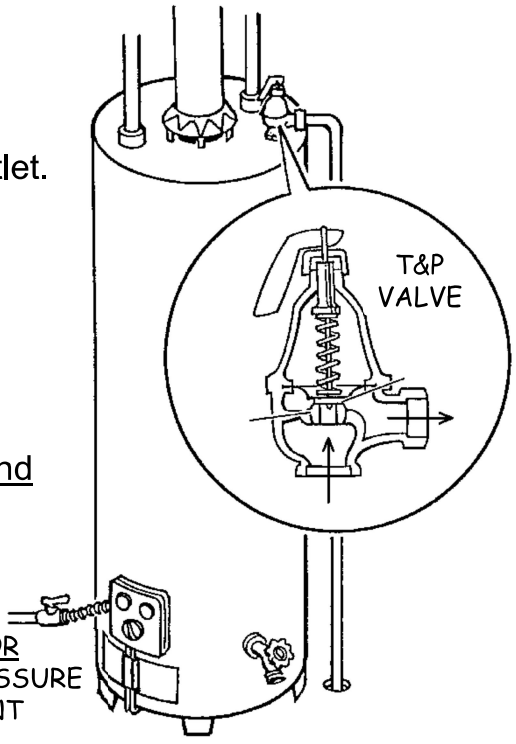


10. GAS LINE, FITTINGS, AND VALVES

- **All water heaters**
  - Copper gas lines and uncoated brass flexible gas connectors shall be replaced with stainless steel or plastic/epoxy-coated brass flexible connectors.
  - New installations shall be in conformance with local code.
  - If water heater repair includes disconnection of the flexible gas connector, it shall be replaced with a new flexible connector.
  - All new and affected gas lines, flexible gas connectors, fittings, and valves shall be checked for gas leaks using a code-compliant method.

11. TEMPERATURE AND PRESSURE RELIEF

- **T&P valve**
  - Replacement is required when existing valve leaks or is defective.
  - Valve shall meet the sizing/pressure requirements of the water heater manufacturer and local code.
- **Automatic gas shutoff valve**
  - Replacement required when existing valve is defective.
  - Valve shall meet the sizing/pressure requirements of the water heater manufacturer and local code.
  - A pressure relief valve shall be present in the water system in conformance with gas valve manufacturer's instructions and local code.
- **T&P valve drain line**
  - When T&P valve is replaced, a code-compliant drain line shall be present.
  - Internal diameter of the line and fittings shall equal/exceed that of the valve outlet.
  - The drain line shall:
    - Drain fully by gravity and be free of water traps.
    - Terminate outside the building or in a code-approved drain system and:
      - Terminate no more than 24" nor less than 6" above the surface and
      - Be unthreaded and pointing downward.



A T&P VALVE AND DRAIN LINE OR AUTOMATIC GAS SHUTOFF AND PRESSURE RELIEF VALVES MUST BE PRESENT

12. BACKFLOW PREVENTER AND EXPANSION TANK

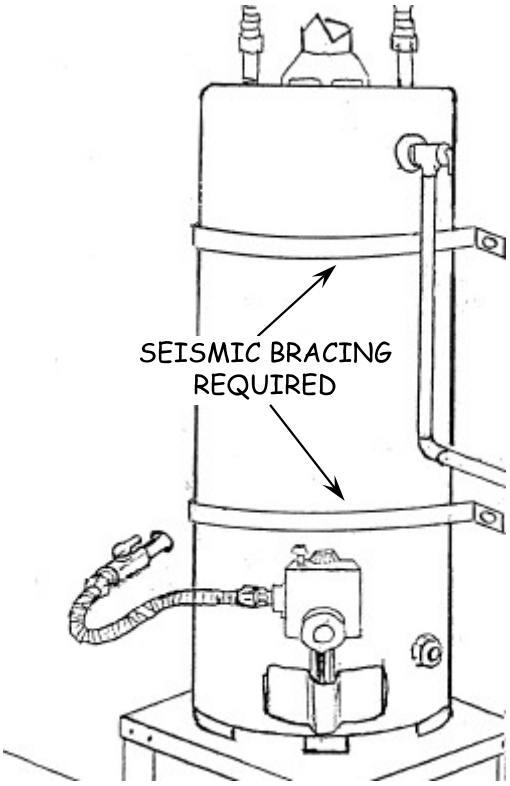
- **Permits**
  - When a building permit must be obtained, requirements of the local jurisdiction shall be followed regarding backflow prevention and expansion tank.

13. LEAKING DRAIN VALVE AND PLUMBING

- **Leaking drain valve**
  - Replace drain valve when removal is feasible.
  - When existing valve cannot safely be removed, screw onto it a:
    - Retrofit cap or
    - Add-on water valve.
- **Leaking water pipes/connectors**
  - Tighten leaking fittings to stop leak, when feasible.
  - Replace defective fittings as needed with new fittings.
  - Replace leaking flexible connector with a new code-compliant connector.
  - Where appropriate, sealant (e.g., Teflon tape) shall be used on threaded connections.

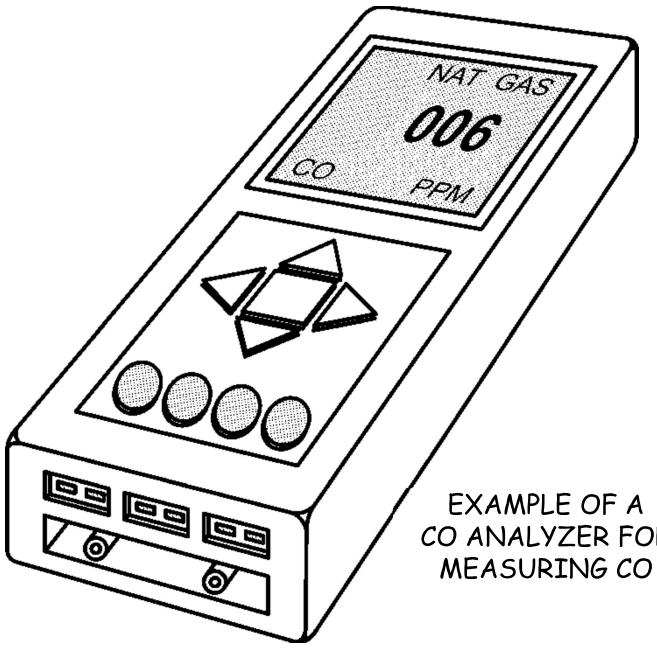
14. SEISMIC BRACING

- **Requirement**
  - When repairs are made on an improperly supported water heater, seismic bracing shall be installed to stabilize the unit.
- **Bracing shall be:**
  - Installed per manufacturer's instructions and local code.
  - Securely attached to structural framing or ledger board.
- **Strap locations**
  - Number of straps: Two for tanks ≤52 gallons; three straps >52 gallons.
  - The lower strap shall be at least 4" above the gas control valve.



15. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Water heater operation**
  - The water heater shall be tested and shall perform properly.
  - Applicable instructions and warranty documents shall be provided to the customer.
- **NGAT**
  - Post-repair/replacement NGAT shall be conducted in accordance with IS Section 24 (NGAT) and the program P&P.
- **Clean-up**
  - All packing materials and installation debris shall be cleaned up and removed from the premises.
  - Household items moved for water heater repair shall be returned to their original positions.
  - All replaced equipment and parts shall be removed from the premises and disposed of properly.



EXAMPLE OF A CO ANALYZER FOR MEASURING CO

MOBILE HOME CRITERIA

16. WATER HEATER REPAIRS

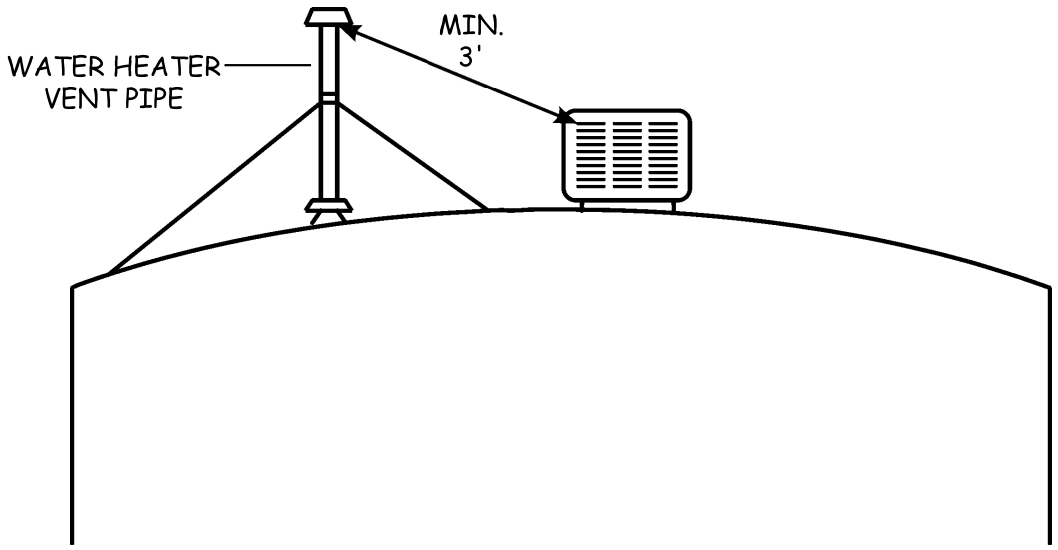
- **Repairs shall be in conformance with:**
  - Manufacturer's instructions,
  - HCD requirements, and
  - Guidelines in this section.

17. WATER HEATER ENCLOSURES

- **Isolation barrier in externally accessed enclosure**
  - Applies to an open combustion gas water heater enclosure next to an FAU enclosure that serves as the return plenum.
  - An intact "isolation barrier" must separate the two enclosures per IS Section 24 (NGAT).
- **Enclosure floor**
  - A structurally unsound and unsafe water heater enclosure floor must be repaired/replaced before water heater repairs are performed.

18. WATER HEATER VENT SYSTEM

- **All units**
  - The appliance vent system shall be in conformance with listing requirements, manufacturer's instructions, and HCD regulations.
  - Vent dampers shall <u>not</u> be used.
  - Vent shall <u>not</u> terminate within 3' of an evaporative cooler air intake.



EFFICIENT FAN CONTROLLER

Lead Paint Risk Factor
NONE

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MOBILE HOME CRITERIA 3

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SECTION 32 PREFACE
for

EFFICIENT FAN CONTROLLER

1. Nonfeasibility Criteria

1.1. Fuel used by the existing unit is not supplied by the utility providing ESA Program services.

1.2. Space conditioning appliance is not an FAU.

1.3. The HVAC unit needs service or repair, or is on a recall list.

1.4. A safety hazard is present which cannot be repaired.

1.5. A suitable mounting location is not available.

1.6. Customer refuses.

2. Installation Policies

2.1. Efficient fan controller must be compatible with the HVAC on which it is installed.

2.2. Time delay duration must be optimum recommended by the manufacturer for maximum energy savings.

3. Installation Policies Specific to Mobile Homes

None.

EFFICIENT FAN CONTROLLER STANDARDS

1. APPROVED MATERIALS

- **Smart fan delay/efficient fan controller**
  - Low-voltage (24 VAC) controllers: Listing not required.
  - Smart fan delay shall include a control module and wiring harness.

2. WARRANTY

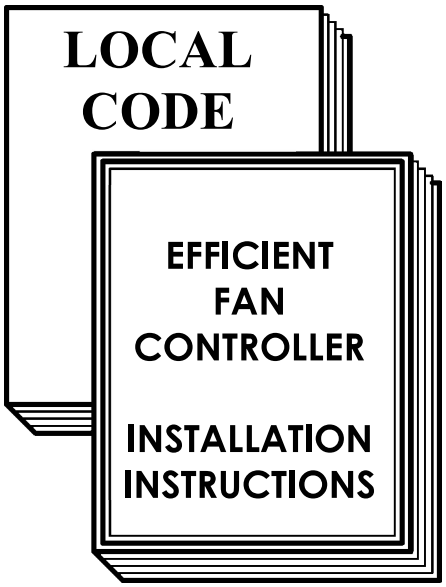
- **All units**
  - Refer to IS Appendix F (Minimum Warranty Requirements).

3. GENERAL REQUIREMENTS

- **Specifications and codes**
  - Installation shall be in compliance with manufacturers' specifications and instructions, and with local code.
  - Manufacturer's retrofit identification label and instructions shall be attached to the appliance being modified.

4. PRE-INSTALLATION SAFETY CHECK

- **Appliance checks**
  - Proper operation of the system fan shall be verified before attempting installation.



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5. INSTALLATION

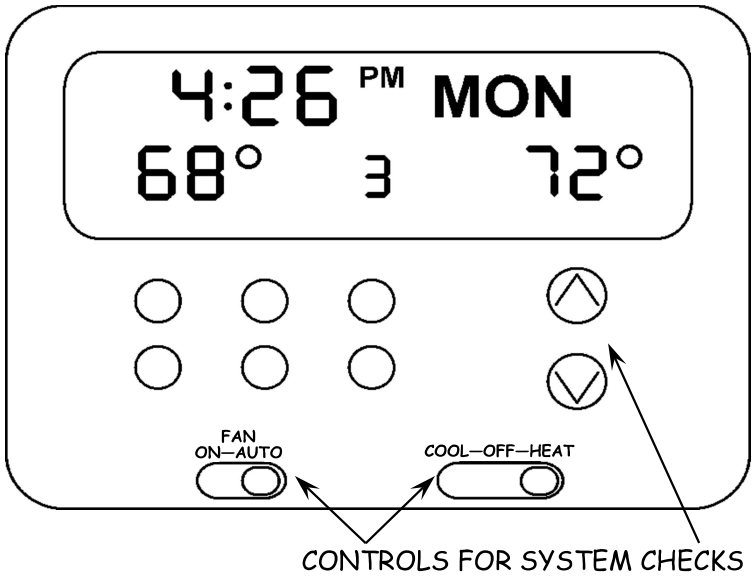
- **All units**
  - Manufacturer's instructions shall be followed.
  - Controller shall be installed in most feasible location.
  - Wires from controller shall be:
    - Connected as specified by manufacturer.
    - Verified to be tight and secure.

6. SYSTEM CHECKS

- **All units**
  - Following installation, the system shall be checked to confirm proper operation.
  - With power off, all wiring connections shall be verified to be clean and tight.
  - With power on, perform system checks and troubleshooting in accordance with manufacturer's instructions.

7. TROUBLESHOOTING

- **Time delay**
  - Time delay shall comply with manufacturer's guidelines and program policy.
  - If fan turns off prematurely during system checks, troubleshooting shall be performed.



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- **System Performance**
  - If the system does not perform as designed, corrections shall be made in accordance with manufacturer's instructions.
  - Installation is not complete until the system operates properly.

8. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Instructions and warranties**
  - Customer shall be instructed in how to:
    - Shut down the FAU,
    - Turn off the gas, and
    - Restart the FAU.
  - Customer shall be provided with:
    - Manufacturer's written instructions.
    - Written warranty documents.
- **Clean-up and disposal**
  - All packing materials and other debris shall be cleaned up and removed from the premises.
  - All replaced parts shall be removed from the premises and disposed of properly.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

CUSTOMER RECEIVES SHUT-DOWN AND RESTART INSTRUCTIONS, MANUFACTURER'S WRITTEN INSTRUCTIONS, AND WARRANTY DOCUMENTS

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TIER 1 SMART POWER STRIPS (SPS)

Lead Paint Risk Factor
NONE

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MOBILE HOME CRITERIA 3

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SECTION 33 PREFACE
for

TIER 1 SMART POWER STRIPS (SPS)

1. Nonfeasibility Criteria

1.1. There is no suitable location.

1.2. Fewer than two peripheral devices are present that can be connected to switched outlets.

1.3. A properly-installed/secured three-prong grounded receptacle is not available within reach of the SPS location.

1.4. Heavy or delicate furniture must be moved to facilitate installation, and it will not be moved by the customer. (Note: Customer must be given the opportunity to move furniture that would make SPS unfeasible.)

1.5. Unacceptable condition(s), such as the following is/are present:

a. Lack of proper grounding:
   - Two-prong receptacle (adapter not allowed) or
   - Three-prong receptacle without ground

b. Loose electrical box or receptacle

c. Evidence of loose/improper wiring connections, including charring.

d. Inadequate overcurrent protection.

1.6. Customer refuses.

2. Installation Policies

2.1. SPS may be installed in all housing types.

2.2. When an existing modem, fax, or computer has a phone or cable line plugged into an existing surge protector, the SPS must provide the same protection.

2.3. Install SPS in a location that has good air circulation and is free of moisture sources.

2.4. Do not plug two or more SPS in series (one into another).

2.5. There should be only one SPS plugged into a duplex electrical outlet.

2.6. SPS must be plugged directly into a receptacle that is in good, safe working condition, not into an adapter.

2.7. Do not secure the SPS in place with staples, tacks, tape, etc.

2.8. Do not use the SPS to plug in small appliances (heaters, lamps, toaster, coffee maker, etc.).

2.9. An extension cord shall not be used.

3. Installation Policies Specific to Mobile Homes

None

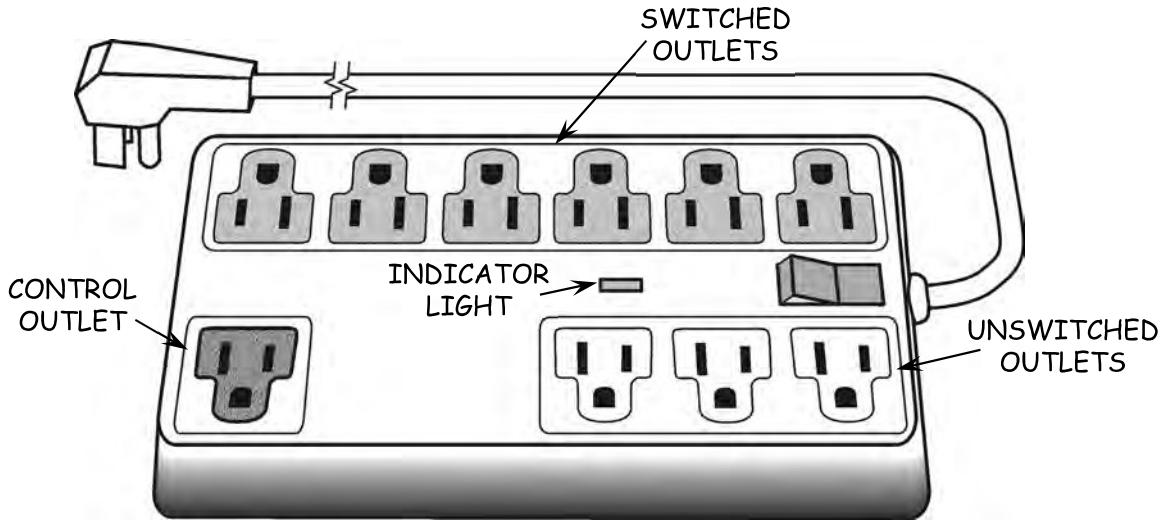
TIER 1 SMART POWER STRIP (SPS) STANDARDS

1. APPROVED MATERIALS

- **Shall be:**
  - Designed to provide surge protection.
  - Rated for 120 volts and minimum 10 amperes.
  - Listed to UL 1449 and tested to UL 1363.
- **Shall be equipped with:**
  - Three-prong plug.
  - Resettable circuit breaker.
  - On/off switch and signal light to indicate protection is active.
  - Minimum four switched outlets and two unswitched outlets.

2. WARRANTY

- **Refer to IS Appendix F (Minimum Warranty Requirements).**



EXAMPLE OF A SMART POWER STRIP

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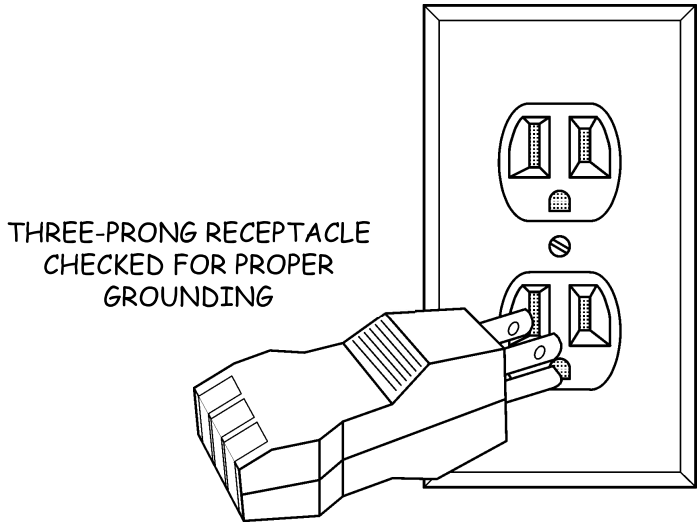
3. PRE-INSTALLATION

- **All units**
  - A check shall be made for measure feasibility.
  - SPS operation shall be explained to the customer and approval to install shall be obtained.
  - Wall outlet shall be tested to ensure it is properly grounded.
  - Existing equipment to be connected to the SPS shall be:
    - Checked to ensure it is working properly and
    - Turned off before being unplugged from present power source.

4. INSTALLATION

- **All units**
  - Manufacturer's instructions/recommendations shall be followed.
  - The control (primary) device shall be plugged into the "Control" outlet.
  - Peripheral devices plugged into switched outlets must be turned off when the control device is turned off or goes into sleep mode and turned back on when the control device is reactivated.
  - Any excess length of the power cord shall be secured out of the way (e.g., with cable ties).
  - If applicable, engage child safety protection for any unused SPS outlets.



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5. OPERATIONAL CHECKS

- **All units**
  - The SPS shall be checked to confirm proper operation.
  - When the control (primary) device is turned off or goes into sleep mode, SPS switched outlets must turn off.
  - If the SPS does not perform as designed, corrections shall be made in accordance with manufacturer's troubleshooting instructions.

6. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Instructions and warranties**
  - Customer shall be instructed on how to operate the SPS.
  - Customer shall be provided with:
    - Manufacturer's written instructions.
    - Written warranty documents.
- **Clean-up and disposal**
  - All packaging materials and other debris shall be cleaned up and removed from the premises.
  - Furniture and other household items moved for installation work shall be returned to their original positions.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

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VACANCY SENSOR SWITCHES

Lead Paint Risk Factor
LOW

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MOBILE HOME CRITERIA 8

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SECTION 34 PREFACE
for

VACANCY SENSOR SWITCHES

1. Nonfeasibility Criteria

1.1. Functional vacancy sensor switch is already in place.

1.2. General

a. No qualifying location, light or circuit is present.
b. Circuit or device(s) to be controlled not operational.
c. Load to be controlled is less than 50 watts, or is fluorescent lighting.
d. Physical risk may occur to occupant if sensor fails (such as in a stairway).
e. Physical limitations will impede occupant's ability to operate the switch.
f. Electrical box cannot physically contain the vacancy sensor switch.
g. Number of connectors exceeds NEC maximum in electrical box.
h. Electrical box or wiring is in a deteriorated or unsafe condition.
i. The switched load exceeds maximum specified by the manufacturer.
j. Functional grounding conductor is not present, when required by the manufacturer.
k. Electricity is not supplied by the utility providing ESA Program services to the dwelling.
l. Customer refuses.

1.3. Vacancy sensor switches may <u>not</u> be installed:

a. In the following locations:
   - Within six feet of a ceiling fan or supply air register
b. To control the following devices:
   - Fluorescent lighting
   - Ceiling fans
   - Single-wire light/fan switches
   - Device that may need to remain "On" (such as mechanical ventilators)
c. To control the following types of lighting:
   - Lighting in closets or garages, unless switch is located on interior
   - Security lighting
   - Outdoor lighting

2. Installation Policies

2.1. Vacancy sensor switches shall be installed in locations with potential for significant energy savings by controlling lights that might otherwise be

unintentionally left on for extended periods after the room is no longer occupied.

2.2. Typical appropriate locations include the following:
   a. Bathrooms and bedrooms
   b. Den/office
   c. Kitchen and pantry
   d. Closets with switch located on interior
   e. Garage (only if the sensor is located inside the garage, and the location does not violate Nonfeasibility Criteria).

2.3. Vacancy sensor switch shall be in the same room as the light/device it controls.

2.4. Vacancy sensor switch with LED "night light" may be installed where occupant requests nighttime illumination.

2.5. Vacancy sensor switch technology (type) selected/installed must the one best suited for the location (size and obstructions) and occupancy characteristics (minor or major motion).

2.6. Passive Infrared (PIR) Vacancy Sensor Switches:
   a. Most suitable for wall-switch applications in smaller, enclosed spaces.
   b. Require line-of-sight and work best when the sensor “sees” the entire room.
   c. Are more sensitive to lateral motion.
   d. Are not suitable for locations:
      - With low motion levels (e.g., office/computer or reading area)
      - Where obstacles can block the sensor’s “view”.
      - Where vibration and/or airflow from a supply register located within six feet can affect the sensor.

2.7. Ultrasound (US) Vacancy Sensor Switches:
   a. Generally, do not require line-of-sight because their high-frequency sound can detect movement around corners.
   b. Have high sensitivity to minor movement, making them more suitable for areas with low motion (e.g., typing, writing, reading).
   c. Typically have larger coverage area than PIR sensors.
   d. Are more sensitive to motion toward or away from the sensor.
   e. Are generally more suitable for open spaces and areas with obstructions and hard surfaces.

2.8. Dual Technology (Combination PIR/US) Vacancy Sensor Switches:
   a. Provide increased flexibility and accuracy.
   b. Can reduce any false on/off nuisance switching.

c. Allowed in any room/space that meets the manufacturer's installation recommendations.

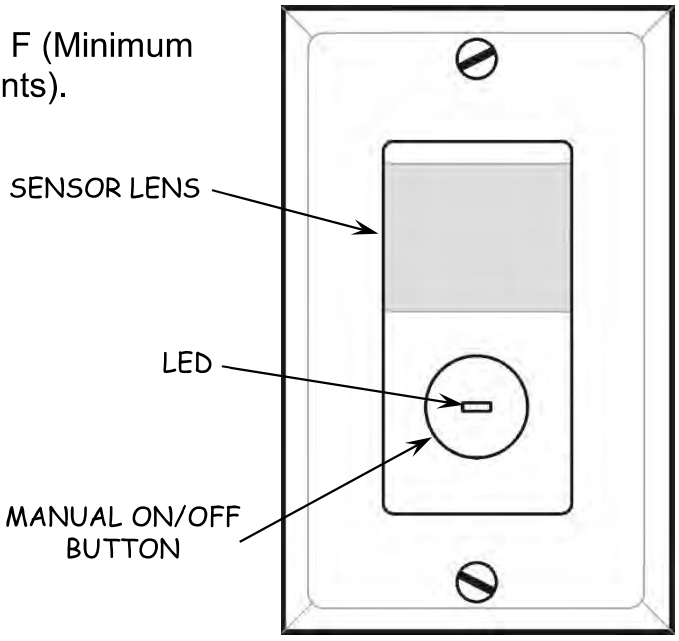
3. Installation Policies Specific to Mobile Homes

None

VACANCY SENSOR SWITCH STANDARDS

1. APPROVED MATERIALS

- **Vacancy sensor switches must be:**
  - UL-listed.
  - Title 24–compliant and listed in the CEC's Appliance Efficiency Database (http://www.energy.ca.gov/appliances/database/).
  - For light-only circuits: "Manual on/automatic off" with "manual off" capability.
  - For three-way lighting circuits: "Multi-way, manual on/automatic off" with "manual off" capability.
  - Equipped with adjustable time delay, with maximum 30-minute delay.
  - Equipped with one of the following technologies:
    - PIR,
    - US, or
    - A combination of both sensor types.
  - Available to accommodate switch circuits that do not have either a grounding conductor or a neutral.
- **Warranty**
  - Refer to IS Appendix F (Minimum Warranty Requirements).



EXAMPLE OF SWITCH BOX VACANCY SENSOR

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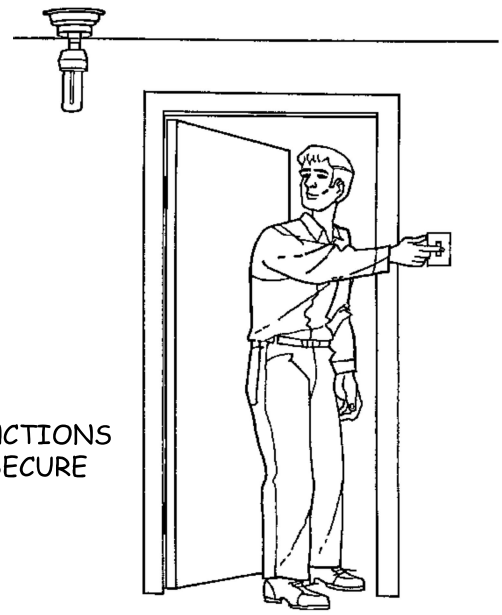
2. PRE-INSTALLATION REQUIREMENTS

- **Prior to installing a vacancy sensor switch:**
  - The circuit to be controlled shall be checked and determined to:
    - Be operational and properly grounded (when grounding is required).
    - Bear an electrical load that is within acceptable limits.
  - Assessment shall include making the following determinations:
    - Electrical box and wiring meet installation requirements,
    - Availability of neutral and grounding conductors, and
    - Type of sensor that is best suited to the location.

3. INSTALLATION

- **All installations**
  - All vacancy sensor switches shall:
    - Replace existing wall-mount light switches and
    - Be installed per manufacturer's instructions and local code.
  - The cover plate shall match the color of the vacancy sensor switch.



VERIFICATION THAT CIRCUIT FUNCTIONS PROPERLY AND SWITCH BOX IS SECURE

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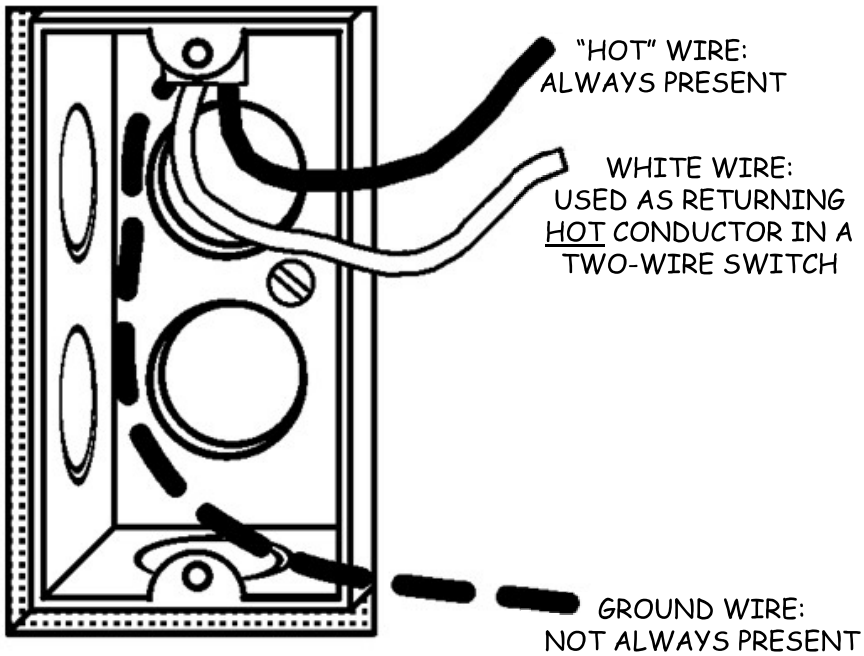
3. INSTALLATION (cont.)

- **Special use vacancy sensor switches**
  - For three-way lighting circuits, vacancy sensor switch shall be a multi-way unit designed for use in such circuits.
  - For dimmable lighting circuits, vacancy sensor switch shall be a dimmable unit designed for use in such circuits.
  - For a fluorescent or LED, vacancy sensor switch shall be:
    - Rated for use with the lamp it controls (CFL or LED).
    - Compatible with the lighting equipment and ballast(s) when it controls standard fluorescent lighting.
  - For switch circuits without a neutral or grounding conductor:
    - Sensor switch shall be appropriate for such circuits.
    - Switched load shall be adequate for proper sensor switch operation.



SWITCH LEG FOR LIGHTING
CIRCUIT: NO "NEUTRAL" PRESENT

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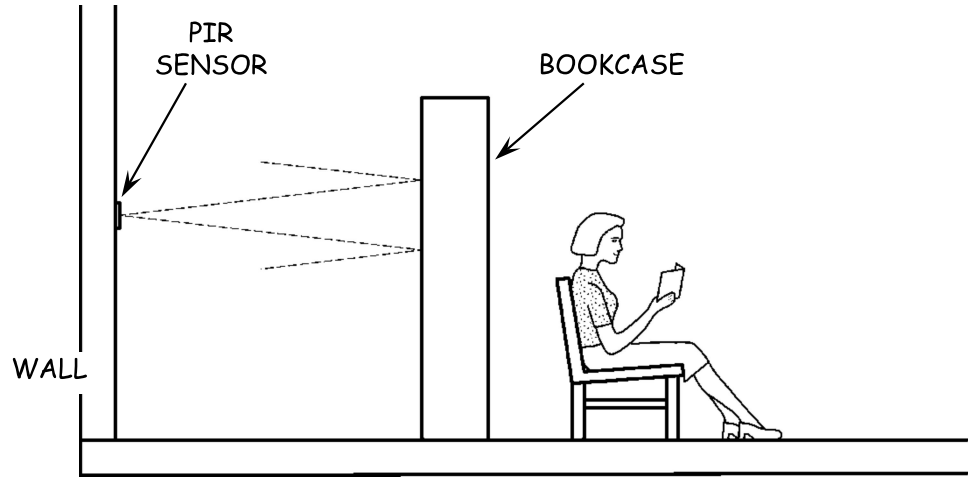
4. LOCATION

- **Vacancy sensor switch shall be located:**
  - In an energy-saving location per the policy preface (Item 2.1).
  - In compliance with manufacturer's specifications, including:
    - Room characteristics (e.g., obstacles and hard surfaces).
    - Acceptable range and coverage area of the sensor.
    - Type of occupant use (walking, reading, computer use, etc.).
    - Magnitude of motion:
      - Minor motion (reading, writing, and hand movements) or
      - Major motion (full-body and walking).
  - Where it can sense all occupants, to avoid turning off lights while the room is still occupied ("false off").
  - Where it does <u>not</u> monitor the area outside the door (which can cause nuisance switching).
- **Room characteristics**
  - PIR vacancy sensor switches shall be installed only in locations with an unobstructed line of sight of the entire room.
  - US vacancy sensor switches are allowed in rooms that may have obstructions and hard surfaces.
  - Dual Technology (combination PIR/US) vacancy sensor switches are allowed in any location conforming to installation criteria, primarily room size.
- **Inappropriate circuits**
  - Units shall <u>not</u> be installed on circuits of existing emergency lighting fixtures, lamps, inverters, standby generators, batteries, controls, etc., and any other circuit not approved by the manufacturer.



PIR SENSORS ARE LINE-OF-SIGHT, <u>NOT</u> USED WHEN OBSTACLES ARE PRESENT

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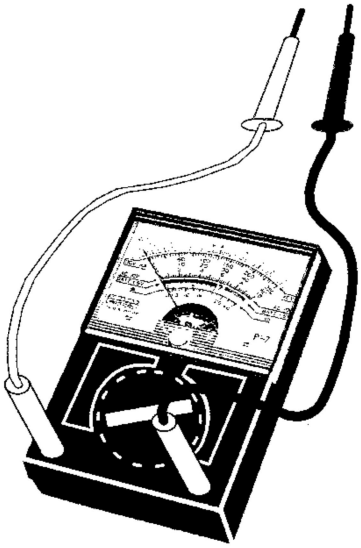
5. ELECTRICAL REQUIREMENTS

- **Circuit and grounding**
  - Must be a 110–120-volt circuit located in a wall switch box.
  - Vacancy sensor switch grounding lead shall be properly connected to the system grounding conductor, when present.
  - When a neutral or grounding conductor is not present in the electrical box, a compatible vacancy sensor switch shall be installed when feasible.
- **Wiring for multi-way systems**
  - Switch installation and electrical wiring shall be in conformance with manufacturer's instructions and local code.
- **Electrical load**
  - The total switched wattage shall:
    - Be at least 50 watts unless unit is installed to meet Title 24 requirements.
    - Not exceed manufacturer's load rating.
- **Fluorescent lighting**
  - Vacancy sensor switches shall be:
    - Rated for use with CFLs when the controlled circuit is equipped with CFLs.
    - Compatible with the fluorescent lighting equipment and ballast(s) when the controlled circuit is equipped with fluorescent lighting.

LOAD WATTAGE =
- MINIMUM 50 WATTS
- MAXIMUM PER MANUFACTURER



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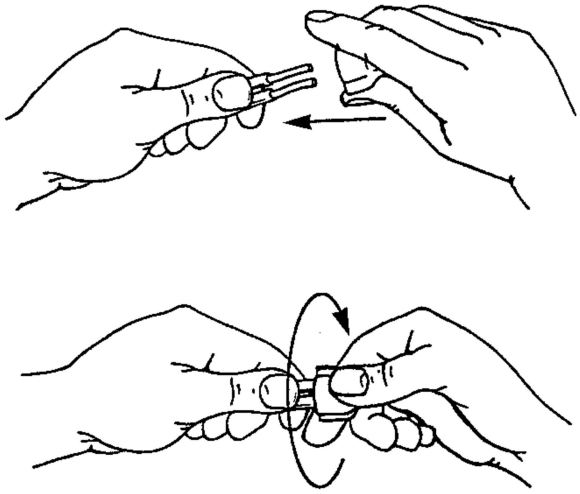
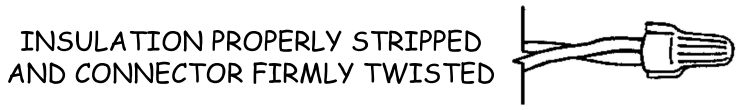
6. GENERAL INSTALLATION

- **Fixture wiring**
  - Vacancy sensor switch shall be mechanically secured to an electrical box with at least two fasteners.
  - Splices shall be contained within the box and conductors shall not be damaged (e.g., no slices, cuts, nicks, etc.).
  - All connectors
    - Connector shall be UL-listed, new, and properly sized (type and number of conductors).
    - Wires shall be stripped to the specified length and connectors shall be installed per manufacturer and local code requirements.
  - Twist-on wire connectors (e.g., wire nuts)
    - Connectors shall be firmly twisted to hold them securely in place.
    - Wires are pre-twisted when specified by manufacturer or code.
    - Electrical tape may be used as a *supplement* to the connector but not to secure the conductors.
  - "Poke-in" and "stab-in" type connectors may be used in lieu of twist-on connectors in accordance with fixture manufacturer and local code.
  - Screw-terminal wire attachments shall be securely tightened, with conductor wrapped around the screw no more than 360°.
  - Aluminum and copper wires shall not be spliced together except in accordance with manufacturer's instructions and code utilizing aluminum-to-copper wire connectors (and anti-oxidant paste when required).





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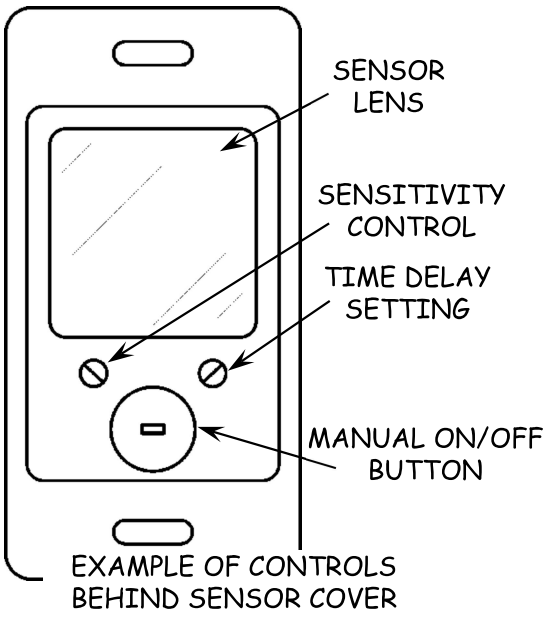
7. SENSOR SET-UP

- **Testing and troubleshooting**
  - Each vacancy sensor will be set up and tested by the installer.
  - If it does not perform as designed, corrections shall be made in accordance with manufacturer's troubleshooting instructions.
- **Time delay and sensitivity**
  - Time delay shall be set based on conditions at residence.
  - Default delays:
    - Fifteen minutes for standard light controls.
    - Thirty minutes for dual relay for a bathroom exhaust fan.
  - When the vacancy sensor switch has a sensitivity setting, it shall be adjusted to optimal sensitivity based on household conditions.



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8. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Post-installation requirements**
  - Customer shall be provided with:
    - Instruction for operation of the vacancy sensor switches.
    - Manufacturer's written instructions, when available.
    - Written warranty documents.
  - All replaced switches, cover plates, dust, scraps, and other debris resulting from switch installation shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Furniture and other household items moved for installation work shall be returned to their original positions.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

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LED TORCHIERE REPLACEMENT

Lead Paint Risk Factor
NONE

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6. Lead-Safe Weatherization and Post-Installation Requirements 4

MOBILE HOME CRITERIA 4

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SECTION 35 PREFACE
for

LED TORCHIERE REPLACEMENT

1. Nonfeasibility Criteria

1.1. Existing floor or table lamp:

a. is functional, and

b. has LED(s) or CFL(s) in place, or

c. can be retrofitted with thread-based LED bulb(s).

1.2. No floor or table lamp is present.

1.3. Acceptable, safe electrical outlet is not available:

a. The receptacle is not properly secured, or other unsafe/hazardous electrical condition present, and repair is not feasible.

b. The outlet is not polarized.

c. The outlet is controlled by a dimmer.

1.4. Customer refuses.

2. Installation Policies

2.1. LED torchieres shall replace existing incandescent and halogen torchieres and table lamps that cannot be retrofitted with LED bulbs.

2.2. LED torchieres may replace an existing floor or table lamp at all feasible locations in the dwelling.

2.3. Light output (lumens) shall be sufficient to maintain the pre-existing light level, or a light level acceptable to the customer, if different.

2.4. Broken or missing outlet cover plate shall be replaced before torchiere is installed.

2.5. All LED torchieres shall be assembled and installed (*not* left for the customer to assemble).

3. Installation Policies Specific to Mobile Homes

None.

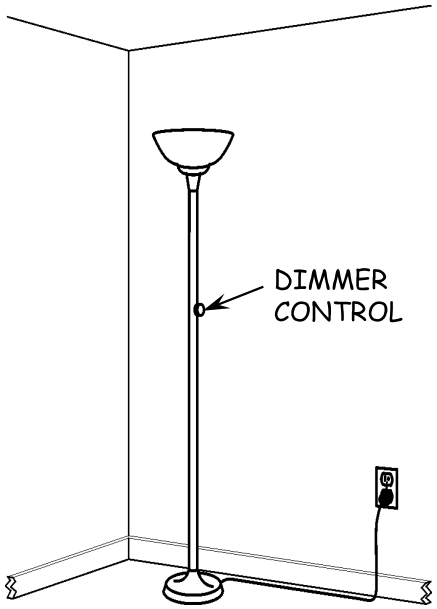
LED TORCHIERE REPLACEMENT STANDARDS

1. APPROVED MATERIALS

- **All units**
  - UL-listed or equivalent.
  - ENERGY STAR-certified.
  - Compliant with Voluntary CA Quality LED Lamp Specification 3.0.
  - Equipped with a light level control (e.g., dimmer).
- **Warranty**
  - Refer to IS Appendix F (Minimum Warranty Requirements).

2. ELECTRICAL SUPPLY

- **Circuit**
  - The electrical circuit shall be in working order.
  - If on a switch, the switch shall function properly.
  - The circuit shall not be equipped with a dimmer or solid state timer.



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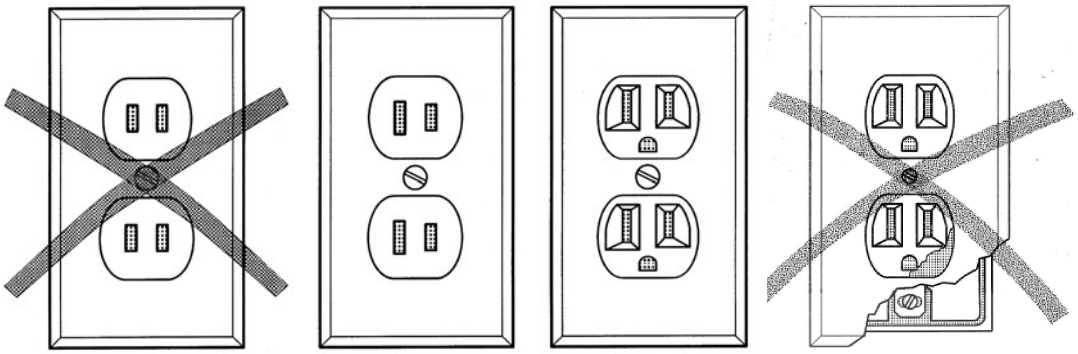
2. ELECTRICAL SUPPLY (cont.)

- **Receptacle**
  - The receptacle shall be:
    - In conformance with manufacturer's specifications and instructions.
    - In good, safe condition (the wiring and receptacle).
    - Securely installed in an electrical box.
  - Lamps with polarized plugs shall be plugged into:
    - A properly installed two-prong polarized receptacle (one slot is wider than the other), or
    - A three-prong grounded receptacle, or
    - A GFCI receptacle (grounding conductor not required).
- **Lamp's plug and adapters**
  - The lamp's plug shall not be altered to fit a non-polarized receptacle.
  - If the lamp is plugged into a multi-plug adapter, the adapter shall be in good condition and polarized to match the receptacle.
- **Cover plates**
  - Missing or damaged cover plates shall be replaced for the receptacle used to power the torchiere.



NON-POLARIZED RECEPTACLE | POLARIZED TWO-PRONG RECEPTACLE | THREE-PRONG GROUNDED RECEPTACLE | BROKEN/MISSING COVER PLATES REPLACED

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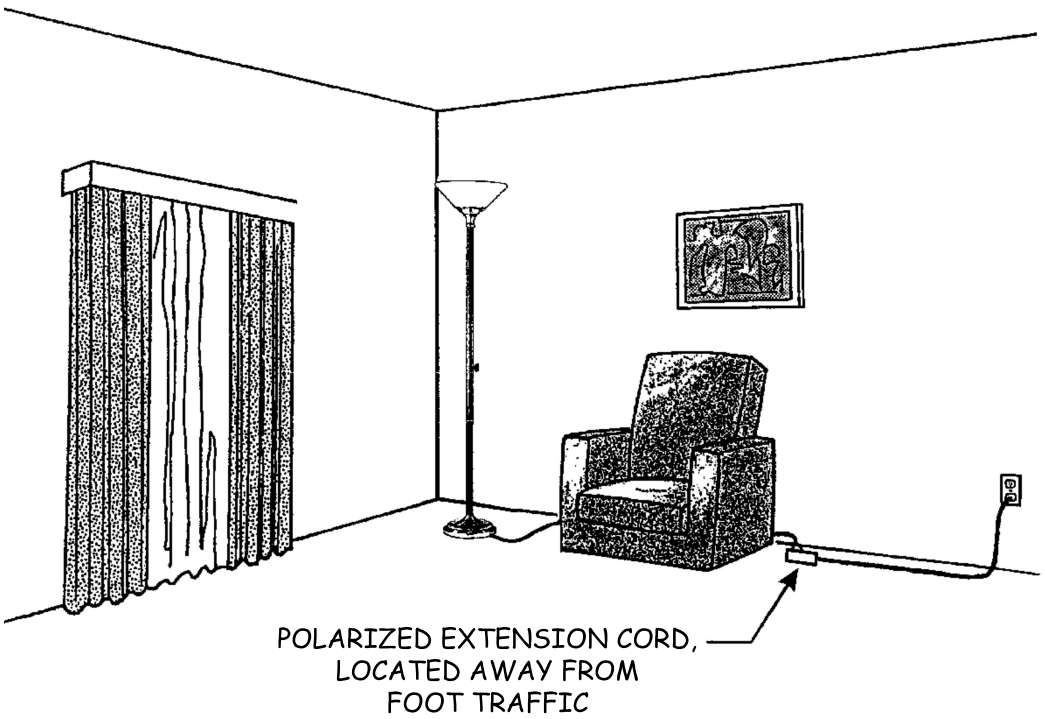
3. EXTENSION CORD

- **When allowed**
  - When not prohibited by manufacturer, an extension cord may be used, but only when necessary to place the LED torchiere in an acceptable location.
- **The extension cord shall be:**
  - UL-listed or equivalent.
  - Polarized (if torchiere plug is polarized).
  - In conformance with manufacturer's instructions, if addressed.
  - Rated appropriately for the torchiere, minimum 18 AWG.
  - The shortest feasible length.

4. ASSEMBLY AND INSTALLATION

- **Lamp**
  - All torchiere lamps shall be installed by the contractor.
  - The LED torchiere shall be fully assembled, plugged in, and operating properly.
- **Cord**
  - The appliance cord, and extension cord if applicable, shall be located away from foot traffic so that a tripping hazard is not created.



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5. OPERATIONAL CHECKS

- **All units**
  - The LED torchiere and light level control shall be tested for proper operation.
  - Any needed corrections shall be made, and the torchiere shall operate properly.

6. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Instructions and warranties**
  - Customer shall be instructed regarding:
    - The proper operation and care of the torchiere.
    - The replacement of the LED light source.
  - Customer shall be provided with:
    - Manufacturer's written instructions, when present.
    - Written warranty documents.
- **Clean-up and disposal**
  - All packing materials shall be cleaned up and removed from the premises and recycled.
  - All replaced halogen and incandescent lamps shall be removed from the premises, demanufactured, recycled, and/or disposed of properly.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

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TIER-2 ADVANCED POWER STRIPS (T2 APS)

Lead Paint Risk Factor
NONE

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3. Installation 2

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5. Lead-Safe Weatherization and Post-Installation Requirements 3

MOBILE HOME CRITERIA 3

SECTION 36 PREFACE
for

TIER-2 ADVANCED POWER STRIPS (T2 APS)

1. Nonfeasibility Criteria

1.1. Unsafe electrical conditions (receptacle or wiring) present in the location(s) where T2 APS must be plugged in.

1.2. A TV will not be connected to the T2 APS.

1.3. At least one peripheral device (such as a DVD player) is not present that can be connected to the switched outlets.

1.4. Heavy or delicate furniture must be moved to facilitate installation, and it will not be moved by the customer. (Note: Customer must be given the opportunity to move furniture that would make T2 APS unfeasible.)

1.5. Unacceptable condition(s), such as the following is/are present:

a. Lack of proper grounding:
   - Two-prong receptacle (adapter not allowed) or
   - Three-prong without ground.

b. Loose electrical box or receptacle.

c. Evidence of loose/improper wiring connections, including charring.

d. Inadequate overcurrent protection.

1.6. Customer refuses.

2. Installation Policies

2.1. Devices to be connected to the T2 APS

a. A TV must be present as the primary energy-consuming device, and plugged into the T2 APS per manufacturer's instructions.

b. In addition, at least one peripheral device (such as a DVD or CD player) must be plugged into a switched outlet on that T2 APS.

c. Devices that should not be turned off automatically (such as hard drive, game consoles, cable box, and DVR) are plugged into the unswitched (always-on) outlets.

d. Only electronics are connected to the T2 APS. (Note: Small appliances, such as a heater, lamp. toaster, coffee maker, shall **not** be plugged in.)

2.2. The operation of the T2 APS must be explained to the customer, and prior approval to install shall be obtained.

2.3. Explanation to customer regarding T2 APS performance shall include a description of how the following occur:

a. The APS is activated to operate the TV and switched devices.

b. The IR remote control is used to turn off the TV and the *switched* devices.
c. The T2 APS automatically turns *off* the TV and switched devices when activity has not been detected during a preset standby period.
d. The factory-set standby period (usually 1 hour) can be adjusted (usually to 2 or 8 hours).
e. A visual signal from the T2 APS IR remote sensor alerts occupants that power to the TV and switched devices will be turned off, if no IR signal is received.
f. Pressing a control button (e.g., volume control) on the TV or other IR remote control keeps the TV and switched devices on.
g. The motion sensor (if present) will also keep power on to the TV and switched devices, if motion is detected.
h. Install T2 APS in a location that has good air circulation and is free of moisture sources.
i. Do not plug two or more T2 APS in series (one into another).
j. There should be only one T2 APS plugged into a duplex electrical outlet.
k. T2 APS must be plugged directly into a receptacle that is in good, safe working condition, not into an adapter.
l. Do not secure the T2 APS in place with staples, tacks, tape, etc.
m. Do not use the T2 APS to plug in small appliances (heaters, lamps, toaster, coffee maker, etc.).
n. An extension cord shall not be used.

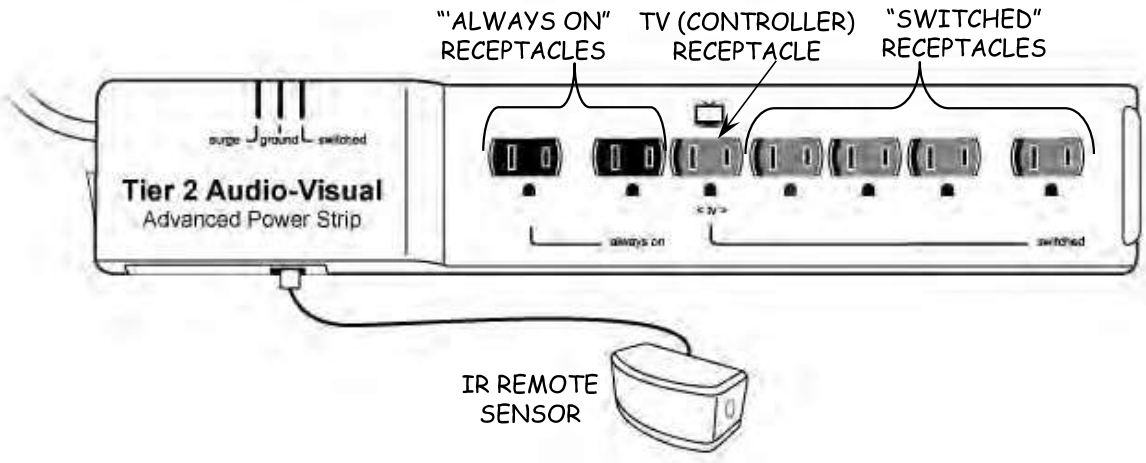
3. Installation Policies Specific to Mobile Homes

None.

TIER-2 ADVANCED POWER STRIP (T2 APS) STANDARDS

1. APPROVED MATERIALS

- **T2 APS**
  - Listed to the latest UL1449 standard, and listed to the latest UL1363 standard if corded.
  - Infrared (IR) controlled with an IR remote sensor or an IR remote sensor and motion detector.
  - Rated for 120 volts and 15 amps.
  - Minimum 1,000 joules of surge protection for all outlets.
  - Resettable circuit breaker.
  - Maximum standby power draw of 1 watt.
- **T2 APS shall be equipped with:**
  - "Smart" power-saving function that automatically turns off power to all switched devices within 5 minutes after the TV is turned off.
  - Adjustable timer (delay period)
    - Automatically turns off the TV and switched outlets after a minimum 1-hour delay period if no activity is detected.
    - Can be manually programmed for a longer delay period.
    - Produces a warning signal that alerts the user before power to the TV is turned off.
- **Warranty**
  - Refer to IS Appendix F (Minimum Warranty Requirements).



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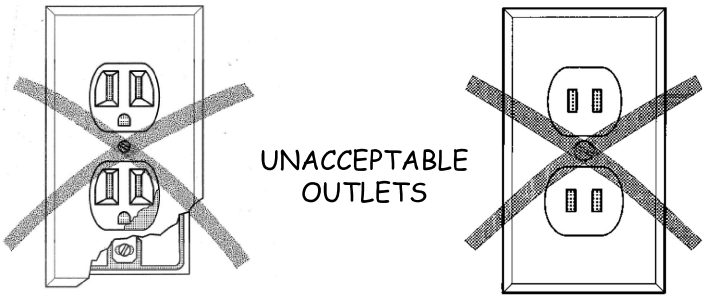
2. PRE-INSTALLATION

- **Location shall be checked to determine if:**
  - The outlet is acceptable.
  - Furniture and electronic equipment can safely be moved as needed for the T2 APS installation.
- **Existing equipment**
  - TV wattage must exceed T2 APS required minimum wattage.
  - Existing home entertainment equipment to be connected to the T2 APS shall be:
    - Checked to ensure it is working properly and
    - Turned off before being unplugged from its present power source.

3. INSTALLATION

- **Instructions**
  - T2 APS shall be installed in accordance with this section, manufacturer's instructions, 2013 CA Fire Code §605.4, and local code.
- **Location**
  - The T2 APS shall be installed in a location that has proper air circulation.
- **Power cord**
  - Cord shall not extend through a wall, ceiling, or floor; shall not extend under doors or floor coverings; and shall not be subject to physical damage.
  - Power cords shall not be secured with tacks, tape, etc.
  - Any excess cord length shall be safely secured out of the way (e.g., with cable ties).



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3. INSTALLATION (cont.)

- **Electrical connections**
  - T2 APS shall be plugged directly into a safe, permanently installed, and acceptable outlet (maximum one T2 APS per duplex receptacle).
  - Unit shall not be plugged into a three-prong adapter, extension cord, power strip, or surge protector.
  - A surge protector, power strip, extension cord, or separate T2 APS shall not be plugged into a corded T2 APS.

4. OPERATIONAL CHECKS

- **The T2 APS shall be checked to confirm proper operation.**
  - Turn **on** the TV and switched outlets using the TV IR remote control.
  - Turn **on** all peripheral devices plugged into both the *switched* and *always-on* outlets of the T2 APS.
  - Then, turn **off** the TV with the IR remote control.
    - All switched devices should automatically turn **off** within 5 minutes.
    - All always-on devices should remain **on**.
  - If the T2 APS does not perform as designed, corrections shall be made in accordance with manufacturer's troubleshooting instructions.

5. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up**
  - Paint dust and chips, scraps, and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Furniture and other household items moved for installation work shall be returned to their original positions.
- **Measure-specific requirements**
  - Removed power strips shall be disposed of in accordance with local recycling and disposal guidelines.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

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LED DOWNLIGHT RETROFIT KIT

Lead Paint Risk Factor
NONE-LOW

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MOBILE HOME CRITERIA 5

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SECTION 37 PREFACE
for

LED DOWNLIGHT RETROFIT KITS

1. Nonfeasibility Criteria

1.1. The fixture is nonfunctional.

1.2. An unsafe condition exists at the electrical box, switch, socket, or other circuit component (e.g., is damaged, defective, or improperly secured), and repair is not feasible.

1.3. Fixture already has a functional LED or CFL.

1.4. Fixture is not used ≥2 hours per day.

1.5. Circuit is controlled by a dimmer, solid-state timer, or vacancy/occupancy sensor not compatible with available LED Downlight Retrofit Kits, and replacement with a compatible controller is not feasible.

1.6. Fixture is not on the customer's electric meter/bill.

1.7. Customer refuses.

2. Installation Policies

2.1. Incandescent light bulbs replaced by LED Downlight Retrofit Kits shall be removed from the home, unless the customer asks to keep the old bulbs.

2.2. LED Downlight Retrofit Kits may only be installed in recessed light fixtures that have incandescent bulbs and are used ≥2 hours per day.

2.3. The number of LED Downlight Retrofit Kits to be installed in any single-family residence shall be in accordance with utility program policy.

2.4. LED Downlight Retrofit Kits shall:

a. Be sized to fit properly into the existing recessed light housing, with room for electrical conductors and connectors to fit safely.

b. Have attachment hardware (torsion springs or brackets) compatible with the housing.

c. Have a trim ring that covers the opening surrounding the housing, to reduce infiltration.

2.5. Electrical connection inside the fixture may be one of the following:

a. Threaded connector screwed into the existing Edison socket.

b. GU24 connector inserted into the existing GU24 socket.

c. Incoming power conductors attached by the quick disconnect directly to the retrofit LED kit conductors, constituting a "hard wired" installation.

2.6. Vacancy and Occupancy Sensors

a. When the light circuit is controlled by an existing vacancy or occupancy sensor, installed LED Downlight Retrofit Kits shall function properly (turn fully on and operate without flickering or other defect).

b. When improper operation occurs:

- If the existing sensor can be replaced by a compatible vacancy sensor,[1] LED Downlight Retrofit Kits may be installed.
- If not, installation is not feasible at that location.

3. Installation Policies Specific to Mobile Homes

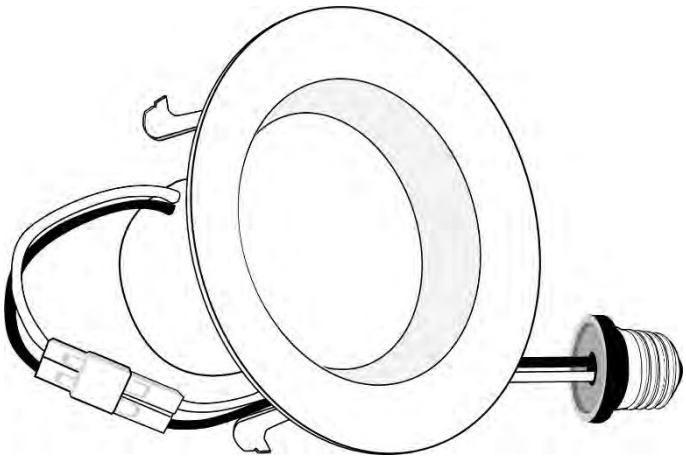
None.

[1] When the light switch circuit does not have a neutral conductor and/or equipment ground, the vacancy sensor for that application may require a minimum threshold wattage to operate. Total wattage of LEDs installed in that circuit must exceed sensor's minimum threshold.

LED DOWNLIGHT RETROFIT KIT STANDARDS

1. APPROVED MATERIALS

- **All LED Downlight Retrofit Kits**
  - UL-listed
  - Light source:
    - ENERGY STAR-certified.
    - Compliant with Voluntary CA Quality LED Lamp Specification 3.0.
    - Dimmable when controlled by a dimmer.
  - Trim that extends beyond gaps in ceiling around the downlight.
- **Hard-wired LED Downlight Retrofit Kits**
  - Marked “JA8-E.”
- **Warranty**
  - Refer to IS Appendix F (Minimum Warranty Requirements).



LED DOWNLIGHT RETROFIT KIT WITH SCREW-BASED CONNECTOR, QUICK DISCONNECT, AND SPRING METAL ATTACHMENT BRACKETS

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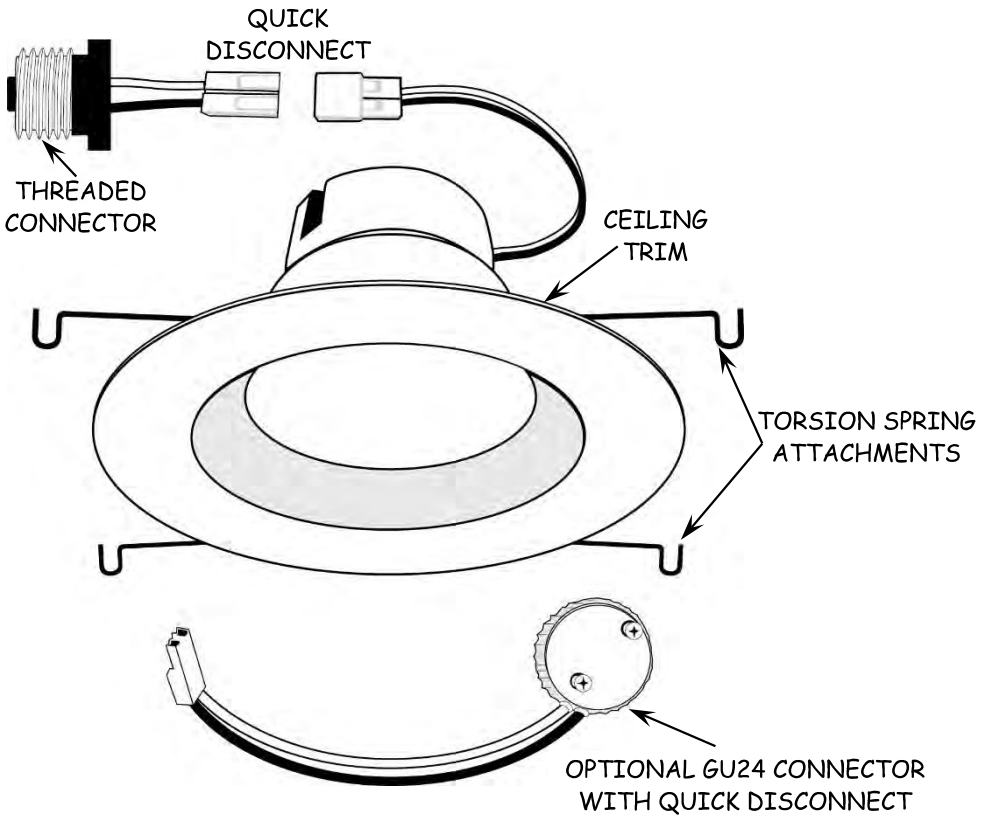
2. INSTALLATION REQUIREMENTS

- **All installations**
  - Installation shall be in conformance with manufacturer's instructions.
  - The LED downlight retrofit kit shall fit properly and safely into the existing recessed light housing.
  - Attachment hardware (e.g., torsion springs or brackets) shall properly secure the kit within the recessed light housing.
  - The kit's trim shall be held against the ceiling and cover the opening surrounding the recessed light housing.
  - When the circuit is controlled by a timer, dimmer, occupancy sensor, or vacancy sensor, the LED downlight retrofit kit shall be compatible with the controller.



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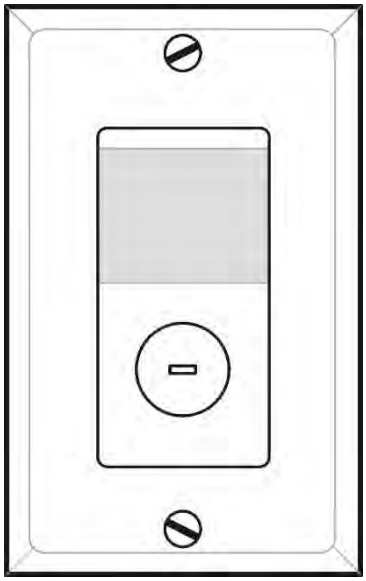
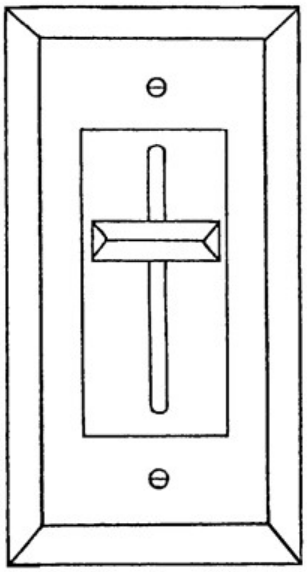
2. INSTALLATION REQUIREMENTS (cont.)

- **Controllers**
  - In a circuit controlled by a dimmer, photosensor, occupancy sensor, or vacancy sensor, an LED downlight retrofit kit may be installed only when the controller is compatible with the kit.
  - For LED downlight retrofit kits to be installed in fixtures controlled by a mechanical or solid-state timer, installation must be allowed by the LED manufacturer.
- **Outdoor locations**
  - The LED downlight retrofit kit may be installed in a protected location (e.g., covered porch).
  - It shall be rated for damp locations.
  - Grounding or GFCI protection shall be provided when required by local code.



VACANCY SENSOR MUST BE CORRECT FOR CIRCUIT TYPE AND TOTAL LIGHTING LOAD



DIMMER MUST BE COMPATIBLE PER LED DOWNLIGHT KIT MANUFACTURER'S SPECS

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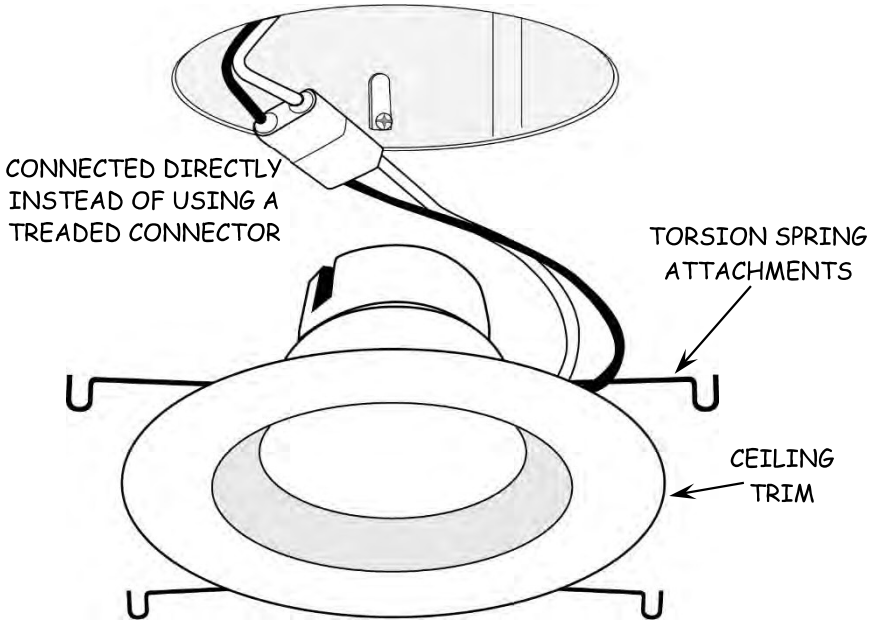
2. INSTALLATION REQUIREMENTS (cont.)

- **Electrical connections**
  - The existing recessed light bulb socket shall be disconnected from its mounting bracket and the bracket removed.
  - Kits wired with a quick-connect terminal may be plugged directly into conductors bringing power into the housing (instead of using a threaded connector). This is a "hard-wired" installation.[1]
  - Wiring is routed above the kit into the housing, and the kit is secured into place without pinching or damaging conductors or insulation.
- **Light level (lumens)**
  - LED downlight retrofit kit selection and lumen level shall be approved by the customer.
  - Correlated Color Temperature (CCT, in degrees Kelvin) shall be selected in accordance with customer's preference.



KIT CONNECTED DIRECTLY (HARD-WIRED) TO INCOMING POWER MUST BE MARKED "JA8-2016-E"

[1] Hard-wired LED downlight retrofit kits must comply with Title 24 requirements for new installations (marked "JA8-2016-E").

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3. OPERATIONAL CHECKS

- **All units**
  - Installers shall test all installed LED downlight retrofit kits and confirm that:
    - Lighting levels are adequate for the customer.
    - Controllers function properly.
    - LEDs turn on fully and operate without flickering or other defect.
  - If performance is not satisfactory, troubleshooting shall be performed and corrections made.

4. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up**
  - Paint dust and chips, scraps, and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Furniture and other household items moved for installation work shall be returned to their original positions.
  - Old light bulbs removed from the home shall be disposed of properly.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

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THERMOSTATIC TUB SPOUT (TTS)/TUB DIVERTER

Lead Paint Risk Factor
NONE

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SECTION 38 PREFACE
for

THERMOSTATIC TUB SPOUT (TTS)/TUB DIVERTER

1. Nonfeasibility Criteria

1.1. Water heating energy source is not supplied by the utility providing ESA Program services.

1.2. Tub and/or shower is in poor condition (has physical defects) and/or is not mechanically functional.

1.3. Piping in the home or the bathroom is in poor condition, and installation of a thermostatic valve could cause plumbing problems.

1.4. Water supply pipe does not meet TTS manufacturer's installation requirements (e.g., is too short) and correction is not feasible.

1.5. Existing tub spout:

a. cannot safely be removed.

b. is held in place by a specialized brass fitting that is soldered onto copper water supply pipe.

1.6. Tub/shower water valve(s) leaking, and repair/replacement is not feasible.

1.7. Hot water is supplied by an on-demand or tankless water heater, and showerhead flow rate is not above the flow rate required to activate water heating.

1.8. Existing showerarm:

a. is made of plastic,

b. is missing or defective (e.g., cracked, broken), or

c. requires removal.

1.9. Water pressure to the tub/shower is too low or high (out of the range specified by the manufacturer) and correction is not feasible.

1.10. Customer refuses.

2. Installation Policies

2.1. For in-spout diverter type TTS, the existing tub spout must have an integral shower diverter valve (i.e., pull-up, pull-down, push-in, or pull-out type of control).

2.2. For in-wall diverter type TTS, water must be diverted to the shower through a wall-mount diverter valve.

2.3. If water pressure to the tub/shower exceeds manufacturer's recommended maximum, the measure is not feasible when water pressure cannot be brought into the acceptable range.

2.4. TTS shall be installed in accordance with manufacturer's instructions, local code, and plumbing best practices.

2.5. Occupants receiving a TTS shall be educated on the operation, care, and maintenance of the tub spout, showerhead, and normally-closed valve.

a. They shall be given verbal instructions, a demonstration, and manufacturer's printed materials.

b. They shall be advised/cautioned that:

- Water heater temperature should be set at 120ºF or lower, to reduce scalding hazard.
- After resuming water flow, water temperature should be checked before getting under the showerhead.

2.6. When hot water is furnished by a tankless water heater, occupants shall be advised of the following considerations:

a. The heating mechanism (burner on a gas unit) will not operate while water flow is reduced to a trickle by the normally-closed valve.

b. A brief yet noticeable decrease in water temperature may occur shortly after resuming normal water flow in the shower.

3. Installation Policies Specific to Mobile Homes

None.

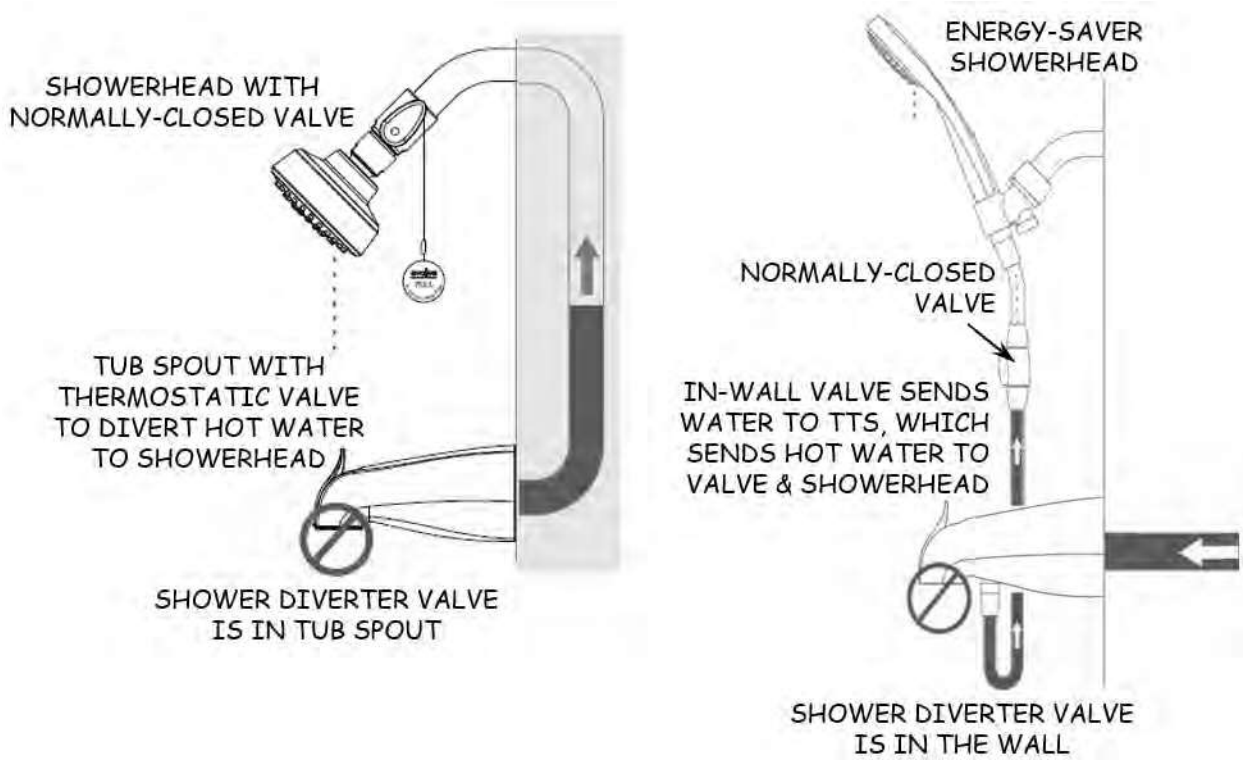
THERMOSTATIC TUB SPOUT (TTS)/TUB DIVERTER STANDARDS

1. APPROVED MATERIALS

- **TTS/Tub diverter**
  - Compliant with the current adopted version of IAPMO IGC 244-2015a.
- **TTS kit shall include:**
  - Tub spout with thermostatically controlled valve that diverts hot water to the showerhead,
  - "Normally closed" shower valve that reduces water flow at the showerhead to a trickle,
  - Connectors for installation on 1/2"- or 3/4"-diameter water supply pipe, and
  - A showerhead with flow rate in compliance with IS Section 8 (Energy-saver Showerheads and Faucet Aerators).

2. WARRANTY

- **Refer to IS Appendix F (Minimum Warranty Requirements).**



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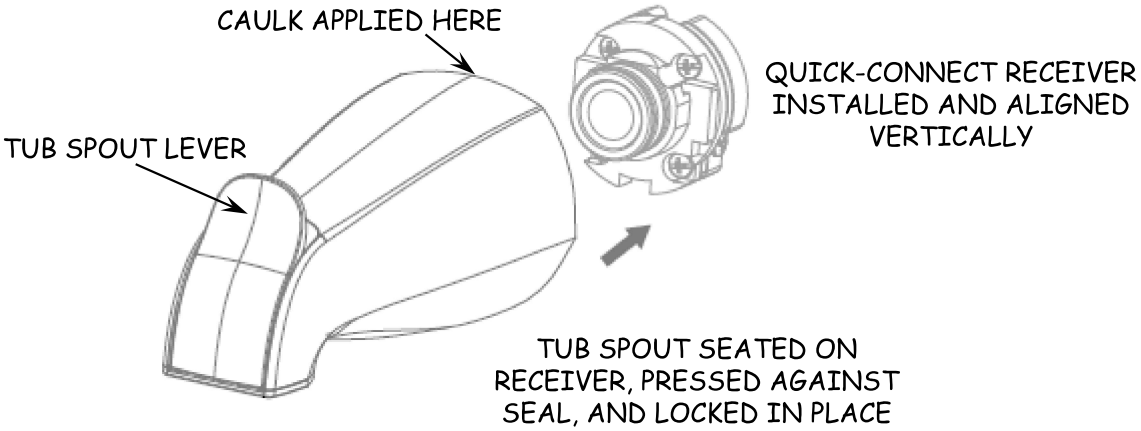
3. INSTALLATION—GENERAL REQUIREMENTS

- **Tub spout**
  - Shall be installed only on a functional tub/shower in accordance with manufacturer's instructions, local code, and plumbing best practices.
  - Care shall be taken to avoid damaging hidden plumbing and/or causing leaks in joints located behind the wall.
- **Showerhead**
  - The showerhead and normally-closed valve shall be installed to replace the existing showerhead.
  - Installation shall be in conformance with IS Section 8 (Energy-Saver Showerheads and Faucet Aerators).

4. INSTALLATION

- **Threaded connection**
  - Threaded connection may be used when threads are in usable condition and the correct distance from the wall.
  - The quick-connect receiver shall provide a leak-free connection.
  - The tub spout shall be seated on and locked to the receiver as instructed.
  - The trim plate shall be installed when applicable.
  - Connections shall be checked for leaks, and sealant shall be applied as needed to eliminate leaks.
  - Silicone-based caulking shall be applied around the back of the installed thermostatic tub spout to prevent water from leaking into the wall cavity.
  - Slip-fit connection may be used when threads are not in usable condition or supply pipe extends an improper distance from the wall.



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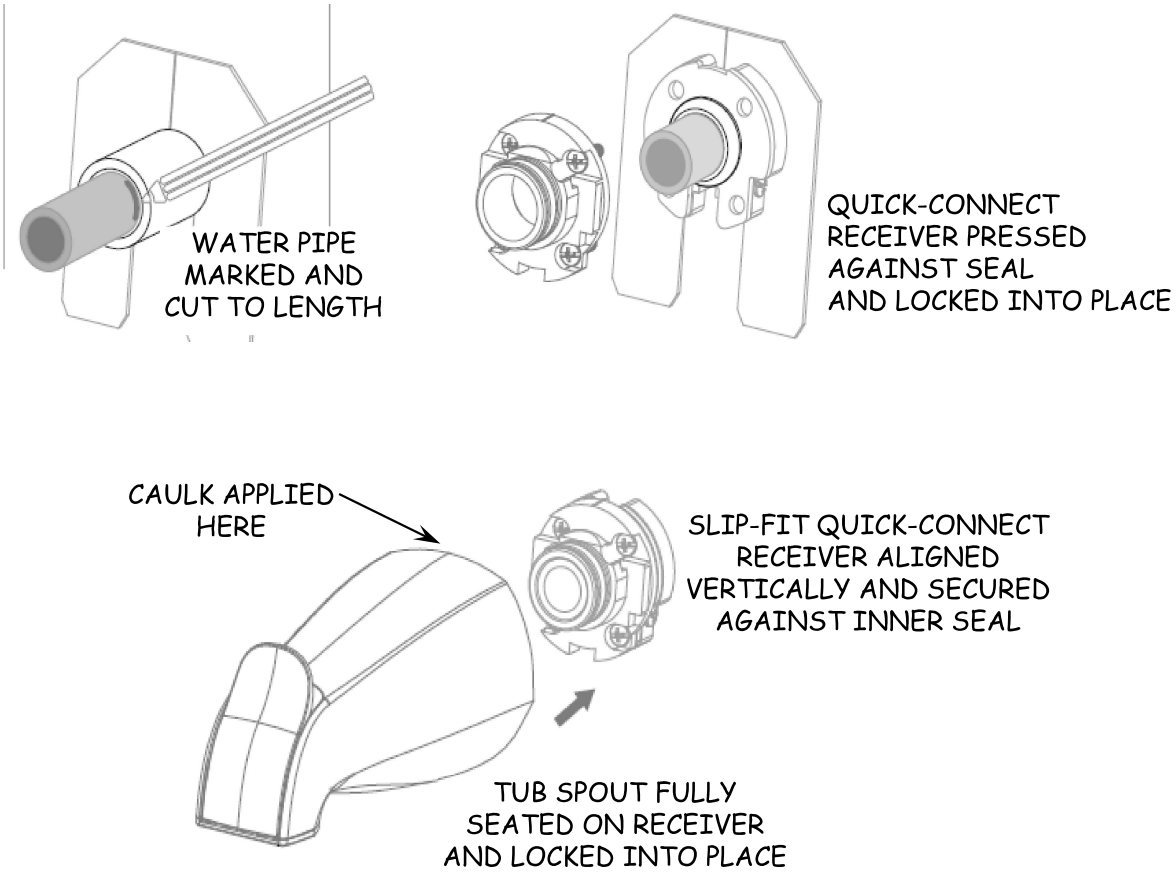
4. INSTALLATION (cont.)

- **Slip-fit connection**
  - Water pipe must be the prescribed length (cut if too long).
  - The slip-fit clamp, back plate, and receiver shall be installed as instructed.
  - The trim plate shall be installed when applicable.
  - Connections shall be checked for leaks, and sealant shall be applied as needed to eliminate leaks.
  - Silicone-based caulking shall be applied around the back of the installed thermostatic tub spout to prevent water from leaking into the wall cavity.



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5. OPERATIONAL CHECKS

- **All units**
  - All components (the thermostatic tub spout, normally-closed valve, and showerhead) shall function properly.
    - When actuation temperature is reached, the tub spout shall automatically divert hot water to the normally-closed shower valve.
    - Water flow through the showerhead must be a trickle until the normal flow is activated.
  - All connections shall be free of leaks.

6. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Instructions and warranties**
  - Occupants shall be:
    - Instructed in the proper operation and care of the thermostatic tub spout, normally-closed shower valve, and showerhead.
    - Provided with manufacturer's written instructions and warranty documents.
- **Clean-up and disposal**
  - All packaging materials and other debris shall be cleaned up and removed from the premises.
  - Replaced parts shall be removed from the premises unless customer asks to keep them.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

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PRESCRIPTIVE DUCT SEALING

Lead Paint Risk Factor
NONE

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SECTION 39 PREFACE
for

PRESCRIPTIVE DUCT SEALING

1. Nonfeasibility Criteria for Prescriptive Duct Sealing

All Homes

1.1. Fuel used by the HVAC system is not supplied by the utility providing ESA Program services.

1.2. No furnace or air conditioner is present.

1.3. Ducts were previously sealed and there is no evidence of leaks.

1.4. Ducts are made of, are sealed with, or are insulated with asbestos.

1.5. Ductwork has excessive damage/deterioration, or it is abandoned.

1.6. Ductwork is inaccessible or an unsafe condition exists, causing duct repair and sealing to be unfeasible (e.g., as delineated for crawl clearance and unsafe conditions in Preface Item 2).

1.7. Total length of ducts located in unconditioned space is less than 40 linear feet, unless there is an obvious leak that is accessible.

1.8. Required natural gas appliance hazard correction is not feasible.

1.9. FAU is inoperative, and repair unfeasible.

1.10. FAU is abandoned or inaccessible.

1.11. The dwelling is part of a multi-family building.

1.12. Customer refuses.

Mobile Homes

1.13. A leaky belly-cavity return exists and installation of a ducted central return is not feasible.

1.14. Proper isolation of return air at FAU cannot be achieved.

2. Nonfeasibility Criteria for Duct Sealing Requiring Attic or Crawl Space Access

2.1. Crawl clearance is inadequate:

a. Attic Clearance
   - Clearance is less than 24" between top of ceiling joists and bottom of roof framing members.
   - Obstruction(s) in the attic, such as truss cross members, provide an opening with a minimum dimension of less than 18".

b. Under-Floor Clearance

- Clearance is less than 18" from the ground to bottom of floor joist system (girders under a mobile home).
- Crawling under or over an obstruction in the crawl area is required, and the crawl clearance is less than 12".

c. Confined Spaces: State and federal regulations regarding confined spaces cannot be met.

2.2. Unsafe condition exists:

a. Attic and Crawlspace
- Hazardous insect or pest infestation is present.
- Hazardous electrical wiring.
- Structural hazard.

b. Crawlspace
- Excessive ground moisture (standing water or mud) is present.
- Sewage waste is on the ground or other unsanitary condition is present which poses a health and safety hazard.

3. Installation Policies

3.1. Duct repair and sealing feasibility

a. Duct repair and sealing work shall be performed:
- when leaks identified by visual or tactile means are present, and
- duct sealing is not prevented by a nonfeasibility criterion.

b. Duct repair and sealing work may stop when:
- duct sealing priorities have been completed, and
- all identified leaks have been sealed.

3.2. All sealing opportunities shall be addressed, with priority given to:

a. Disconnections and partial disconnections

b. Platform returns

c. High pressure leaks at the plenums and in trunk lines near the air handler, including:
- Plenums
- Air handler cabinet-to-plenum
- Start collars in plenums

d. Ducts in *unconditioned* space (attic and crawlspace), including:
- Supply and return boots
- Accessible finger and dovetail joints
- Duct-to-duct connections
- End caps (e.g., on mobile home ducts)
- Gores (slip joints) on adjustable elbows

e. Return leaks at/near the FAU shall be sealed, to prevent communication with the combustion appliance zone (CAZ).

4. Visual Inspection

4.1. High-pressure areas shall be checked for proper sealing of leaks.

a. Inspection shall include examination of the return plenum, air handler cabinet-to-plenum, supply plenum, and start collars located close to the FAU.

b. Return leaks at/near the FAU must be sealed.

c. Platform return wall cavities must be insulated, lined and sealed (cavity insulation not required when lined with duct board).

4.2. Lower-pressure leaks shall be checked for proper sealing, Including:

a. Supply and return boots (which must be mechanically secured to the surrounding material).

b. Start collars (finger joints), rigid duct/component connections (crimped or slip-fit), branch tees, wyes, and elbows (including gores on adjustable elbows).

c. Rigid duct/component connections mechanically secured with screws and sealed where insulation discoloration indicates a leak.

d. Flexible ducts connected to metal component/fitting, with inner core secured by a drawband, and outer jacked secured by a drawband or other approved means.

5. Installation Policies Specific to Mobile Homes

5.1. When the existing partition does not completely isolate the open combustion water heater from FAU return air, the isolation partition shall be repaired or replaced, in accordance with individual utility policy.

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PRESCRIPTIVE DUCT SEALING STANDARDS

APPROVED MATERIALS

1. ALL INSTALLATIONS AND REPAIRS

- **Conformance**
  - Duct installation and sealing shall be in conformance with guidelines in this section and the following standards:
    - Current Title 24 Residential Compliance Manual, Chapter 4.
    - Current California Mechanical Code, Chapter 6.
  - Only exterior-rated products shall be used outdoors.
  - UL 181A- and 181B-listed sealants and closure materials shall be used and shall be identified as shown in Table 39-1.
- **Approved tapes**
  - Mobile home ducts/components: “Butyl tape” without “181A-P” or “181B-FX” markings may be used to seal metal-to-metal connections.
  - High temperature applications: Metallic tapes with non-butyl (e.g., acrylic) adhesive and service temperature rating of at least 265°F.
  - UL listed cloth-backed rubber adhesive tapes:
    - May be used for flexible duct connections only when applied in combination with duct mastic and drawbands.
    - Shall not be used to seal start collars to plenums and junction boxes.

Table 39-1: Approved Sealing Materials

DUCT TYPE	SEALING MATERIAL	UL IDENTIFICATION
RIGID METAL DUCTS AND COMPONENTS	PRESSURE-SENSITIVE TAPE	MARKED “181A-P” OR “181A-P/181B-FX”
	MASTIC	LABELED “181A-M” OR “181A-M/181B-M”
FLEXIBLE DUCTS	PRESSURE-SENSITIVE TAPE	MARKED “181B-FX” OR “181A-P/181B-FX”
	MASTIC	LABELED “181B-M” OR “181A-M/181B-M”
	DRAWBANDS	MARKED “UL 181B-C”

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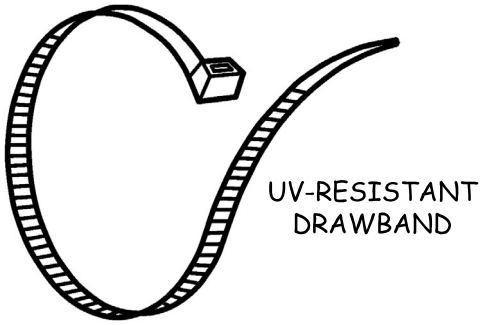
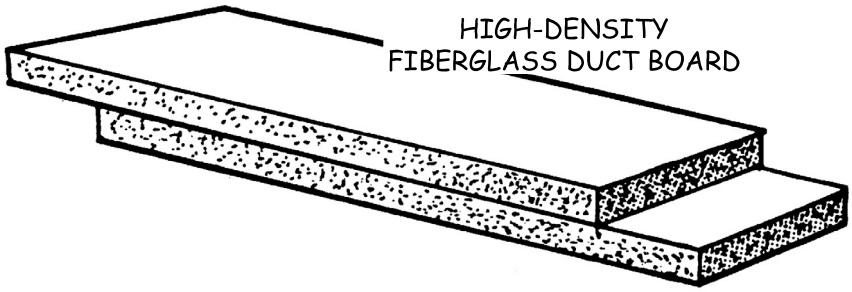
2. DRAWBANDS AND CLAMPS

- **Materials**
  - Drawbands and clamps used to secure flexible non-metallic ducts shall comply with duct manufacturer's installation instructions.
  - Drawbands shall be weather- and UV-resistant nylon duct straps/ties rated for outdoor use and marked "181B-C."
  - Clamps shall be stainless steel worm-drive clamps.
- **Drawband installation**
  - Drawbands shall be tightened with an adjustable tensioning tool in accordance with manufacturer's instructions.

3. DUCT BOARD

- **High-density fiberglass duct board**
  - Conformance to ASTM C726, NFPA 90B, or UL Class 1.
  - Minimum R-value: R-4.2
- **Foam board and foam sealant**
  - Not allowed as a barrier material or sealant in the repair of building cavities used as ducts, platforms, or other duct system components.





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4. CAULKING MATERIALS

- **All materials**
  - Shall be non-toxic and selected and applied in accordance with IS Section 1 (Caulking).
- **Sealant for refrigerant lines**
  - Cord tape shall be used for sealing gaps where refrigerant lines penetrate the coil box/plenum.

5. ALL FLEXIBLE DUCTS

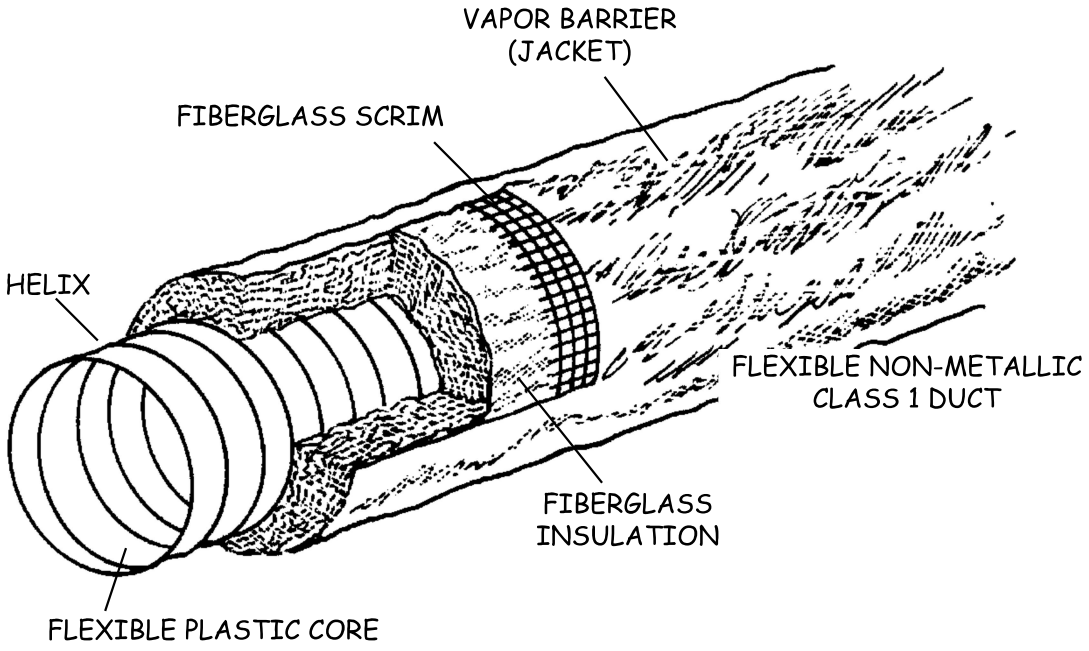
- **Duct material**
  - Ducts shall conform to NFPA 90B and UL 181 Class 1.
  - Non-metallic insulated ducts with air-permeable core are not allowed.
- **Vapor barrier (jacket):**
  - UV-resistant material.

6. DUCT INSULATION

- **R-value**
  - As shown in Table 39-2, or greater if required by local code.

Table 39-2: Duct Insulation Minimum R-values

Climate Zone	Minimum R-value
1–10, 12, 13	R-6
11, 14–16	R-8



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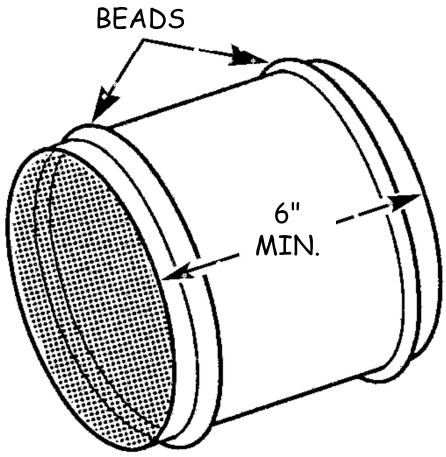
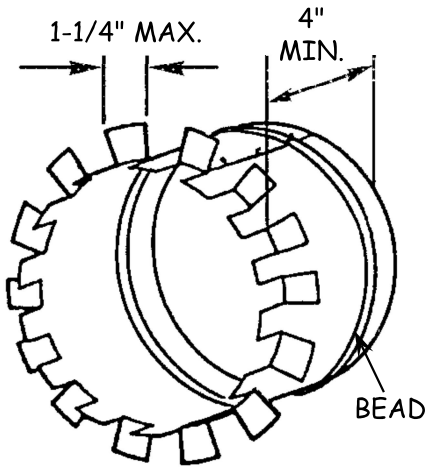
7. SHEET METAL

- **All rigid components**
  - Components shall be constructed of non-corrosive materials.
- **New fittings used with flexible <u>non-metallic ducts</u>**
  - Starting collars
    - 4" installed length
    - 26-gauge galvanized steel up to 14" diameter.
  - Splicing sleeves
    - 6" length
    - 26-gauge galvanized steel up to 14" diameter.
  - All fittings
    - Fittings shall be beaded at each core connection (e.g., both ends of a sleeve) when flexible non-metallic ducts are attached.
    - *<u>Exception</u>:* When a pre-existing fitting is <u>not</u> beaded, the core's wire coil shall be secured to the fitting as prescribed in Item 13.



BEADED SLEEVE MINIMUM 6" LONG FOR FLEXIBLE NON-METALLIC DUCTS



SHEET METAL COLLAR (DOVETAIL) MIN. 4" LONG AND BEADED FOR FLEXIBLE NON-METALLIC DUCTS

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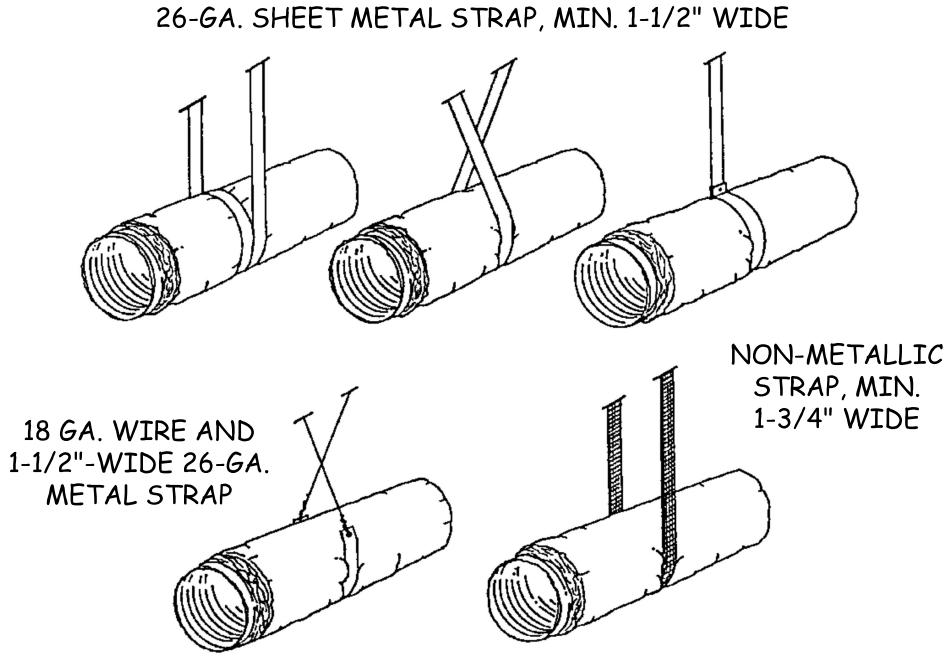
8. DUCT SUPPORTS

- **Support materials shall:**
  - Be corrosion-resistant and
  - Conform to duct manufacturer's installation instructions, Title 24 Standards, and CMC Chapter 6.
  - Be as shown in Table 39-3.

Table 39-3: Duct Supports

Flexible Ducts (Horizontal and Vertical)	**Horizontal Rigid Round Metal Ducts**	**Vertical Rigid Round Metal Ducts**
Non-metallic Straps • Polypropylene monofilament, woven polyester, polyester scrim reinforced vinyl laminate, or equivalent • Width: Minimum 1-3/4" • Tensile strength: Minimum 70 lb./in. of width **Sheet Metal Straps and Saddles** • Width: Minimum 1-1/2" • Thickness: Minimum 26-gauge	**Up to 10" Diameter** • Galvanized steel straps, same gauge as duct, 1" minimum width, or • 18-gauge galvanized steel wire. **11" to 40" Diameter** • Galvanized steel straps, same gauge as duct, 1" minimum width, or • 8-gauge galvanized steel wire tied to a galvanized steel band, 1" minimum width, surrounding the duct.	**Up to 10" Diameter** • 18-gauge galvanized steel straps, 2" minimum width. **11" to 20" Diameter** • 16-gauge galvanized steel straps, 2" minimum width.



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DUCT SYSTEM EVALUATION

9. INSPECTION OF DUCT SYSTEM

- **All units**
  - The duct system shall be inspected for disconnections and other leaks and evidence of damage and deterioration.
  - Registers and grilles shall be removed as needed for access.
  - Platform returns shall be checked to determine if a liner is needed and installation is feasible.

DUCT REPAIR AND SEALING

10. GENERAL INSTALLATION CRITERIA

- **All duct installations**
  - Installation and support shall comply with these standards, manufacturer's instructions, and local code, with the more stringent requirements taking precedence.
  - Substandard components and sections of ductwork – rusted, crushed, disconnected, or otherwise unserviceable – shall be repaired or replaced.
  - Ducts shall be:
    - Installed with at least 4" of separation from earth.
    - Protected from physical damage.
    - Installed in locations not exposed to the weather unless designed for exterior use.
    - Supported in accordance with Item 8.
  - Ducts installed within a closet or room shall be enclosed within a cavity constructed of materials equivalent to those used in construction of the closet/room.
  - A building cavity shall not be used as a duct without a sealed duct board or metal liner.
  - Existing platform returns shall be sealed per Item 18.
- **Air handler operation**
  - Air handler shall be:
    - Used to located leaks in the duct work (fan on).
    - Off when mastic is being applied and remain off for the drying time specified by the sealant manufacturer.
- **Combustion safety**
  - Natural gas appliances drawing combustion air from conditioned space must be draft tested, and must draft properly following completion of duct repair and sealing.

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11. DUCT CLOSURE SYSTEMS

- **Gap size and sealing materials**
  - Sealing materials shall be selected in accordance with Table 39-4.
  - Flexible duct connections with gaps wider than 1/4" shall be replaced with properly sized duct and/or fitting.
  - For rigid metal ducts, gaps 1" or wider shall be repaired with a sheet metal patch (Item 16) or sleeve.
  - For rigid fiberglass ducts, repairs shall be:
    - Made with duct board or sheet metal and screws, and
    - Sealed with mastic or metallic tape.
- **Mastic and tape**
  - Duct mastic and pressure-sensitive tape shall be applied per manufacturer's instruction and Title 24 standards.
  - Mastic shall be forced into gaps (not painted on).

Table 39-4: Gap Size and Approved Sealing Materials

GAP SIZE	FLEXIBLE METALLIC & NON-METALLIC DUCTS		RIGID METAL & FIBERGLASS DUCT	
	Sealing with MASTIC	Sealing with TAPE	Sealing with MASTIC	Sealing with TAPE
≤ 1/4"	Mastic	Tape	Mastic	Tape
> 1/4" - < 1"	Repair Required*	Repair Required*	Mastic & Mesh	Mastic over Tape
1" or more	Repair Required*	Repair Required*	Metal Patch or Sleeve & Mastic	Metal Patch or Sleeve & Tape

*Duct and/or fitting must be replaced with proper size.

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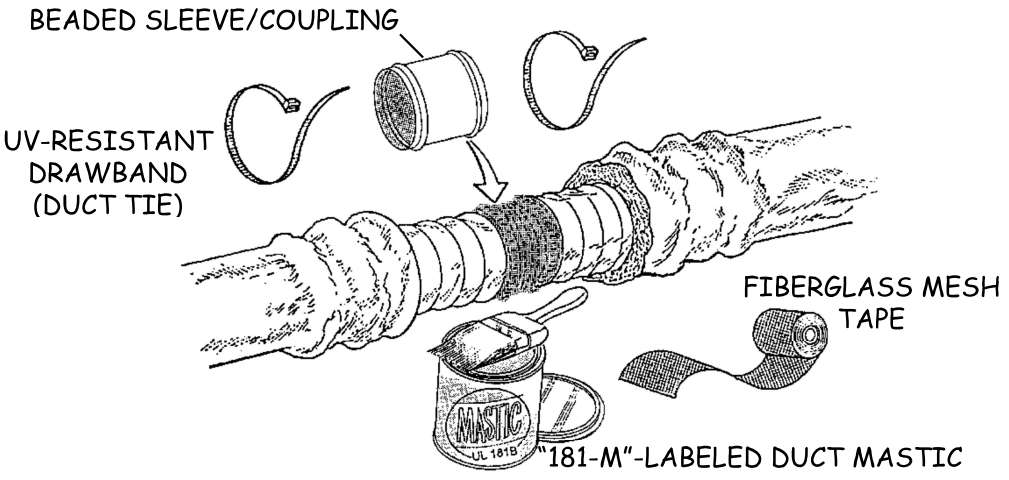
12. REPAIRING AND SEALING FLEXIBLE NON-METALLIC DUCTS

- **Beaded fittings—mastic sealants**
  - A uniform coat of mastic is applied to the outside of the fitting.
  - At least 2" of duct core is pulled onto the fitting extending past the bead.
  - A drawband (or metal clamp) is installed behind the bead.
  - Mastic is applied externally as needed to ensure a complete seal.
- **Beaded fittings—pressure-sensitive tapes**
  - At least 1" of duct core is pulled onto the fitting extending past the bead. (Fitting must provide additional 1" surface beyond duct core for application of tape.)
  - A drawband (or metal clamp) is installed behind the bead.
  - Connection is sealed with at least two staggered wraps of tape applied uniformly over both the core and the fitting.
- **Non-beaded pre-existing fittings—all sealants**
  - The duct core is secured to the fitting with internally placed mastic and a drawband, or
  - The duct core's wire coil is secured to the fitting with at least three evenly spaced #8 sheet metal screws that capture the wire.
    - Screws must penetrate "181B-FX" pressure-sensitive tape that is first applied over the duct core to protect it from tearing.
  - The connection is sealed with duct mastic or two staggered wraps of pressure-sensitive tape.
- **Core repairs**
  - Holes/damage in the duct core shall be repaired by removal of the damaged section and insertion of a sleeve/coupling.



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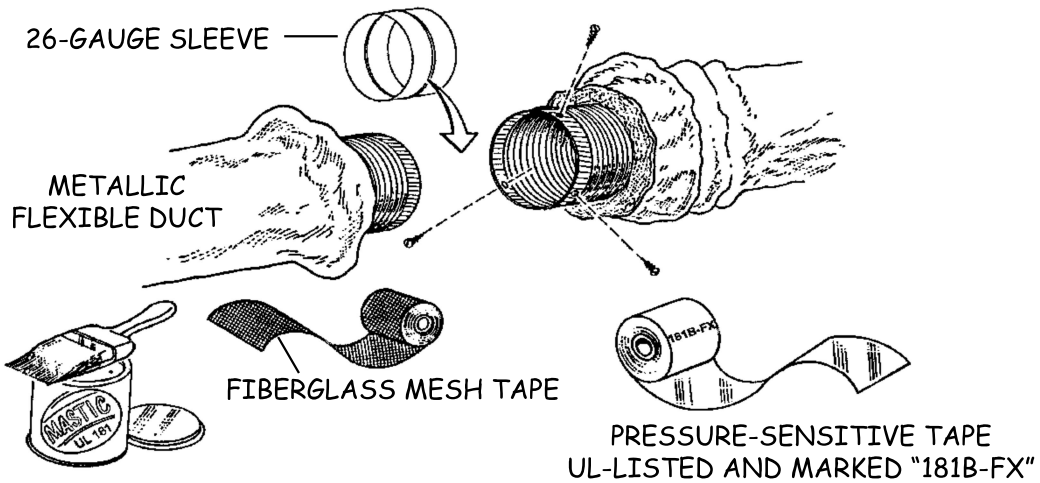
13. REPAIRING AND SEALING FLEXIBLE METALLIC DUCTS

- **Factory-installed sleeve present**
  - Connection shall be secured and sealed, like rigid metal ducts, per Item 15.
- **Factory-installed sleeve <u>not</u> present**
  - The end of the core shall be trimmed squarely, pulled over a metal sleeve or fitting at least 1", secured with at least three evenly spaced #8 sheet metal screws, and sealed with mastic or tape.
  - Mastic sealant
    - A uniform coat of mastic is applied to outside of the sleeve/fitting before the duct core is pulled on and externally as needed to ensure a complete seal.
  - Pressure-sensitive tape
    - Connection is sealed with at least two staggered wraps of tape applied uniformly over both the core and the fitting.
- **Core repairs**
  - Holes/damage in the duct core shall be repaired by removal of the damaged section and insertion of a sleeve/coupling.



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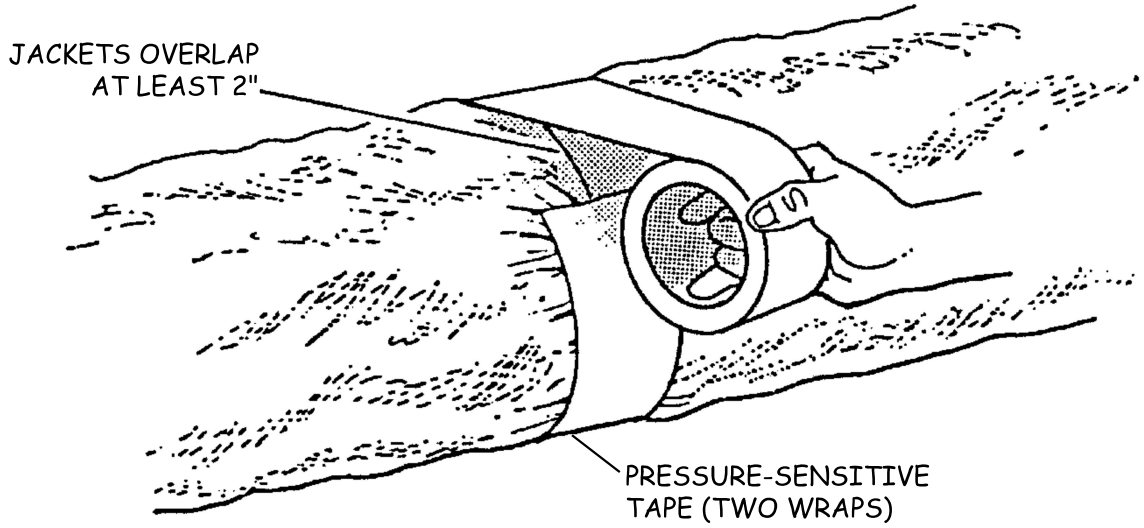
14. FLEXIBLE DUCT INSULATION AND JACKET

- **Insulation shall completely cover the duct core and fitting.**
- **Jacket (vapor barrier)**
  - The jacket shall be pulled back over the insulation.
    - The jackets shall overlap at least 2" at splices.
    - Jackets shall be secured/sealed with a drawband and/or two staggered wraps of pressure-sensitive tape.
- **Jacket repairs**
  - Rips and holes in the vapor barrier shall be repaired with pressure-sensitive tape or with mastic and mesh tape.



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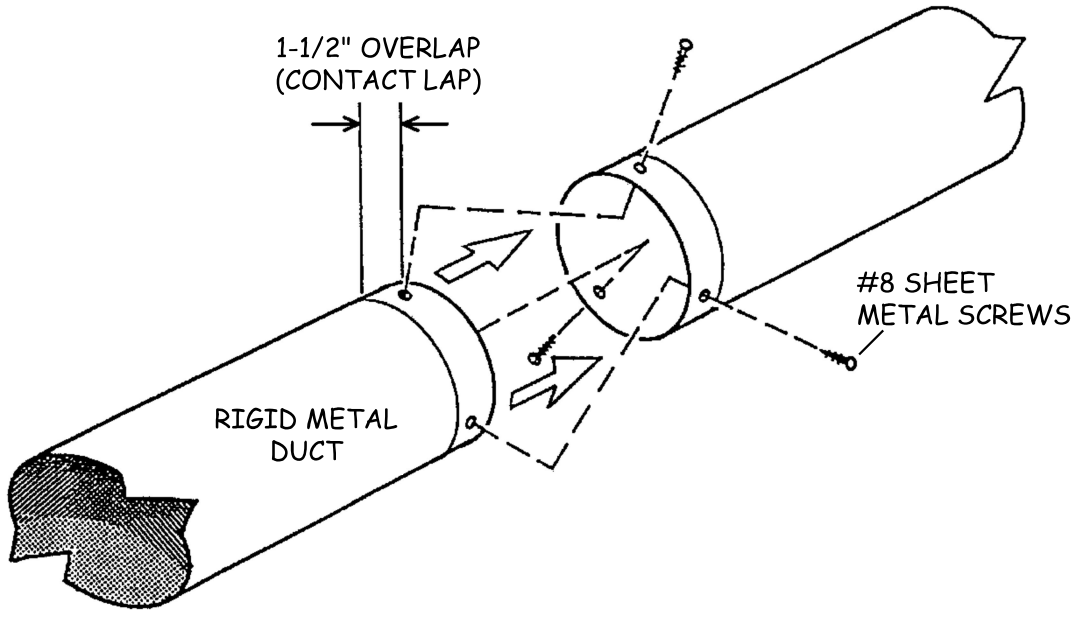
15. REPAIRING AND SEALING RIGID METAL DUCTS

- **Contact lap**
  - Crimp joints shall overlap at least 1-1/2" (e.g., connection of duct to fitting, or two sections of duct).
- **Mechanical fasteners**
  - Rigid metal duct connections shall be secured with equally spaced #8 sheet metal screws.
  - Round ducts
    - Three screws on diameters up to 14".
    - Four screws on diameters 15" to 19".
    - Five screws on diameters 20" to 24".
  - Rectangular ducts
    - At least one screw per side.
  - Lapped seams (field-fabricated metal plenums, etc.)
    - Overlapped surfaces shall be:
      - In substantial contact with each other along the entire seam.
      - Securely fastened together (e.g., with #8 sheet metal screws at intervals of 12" or less).



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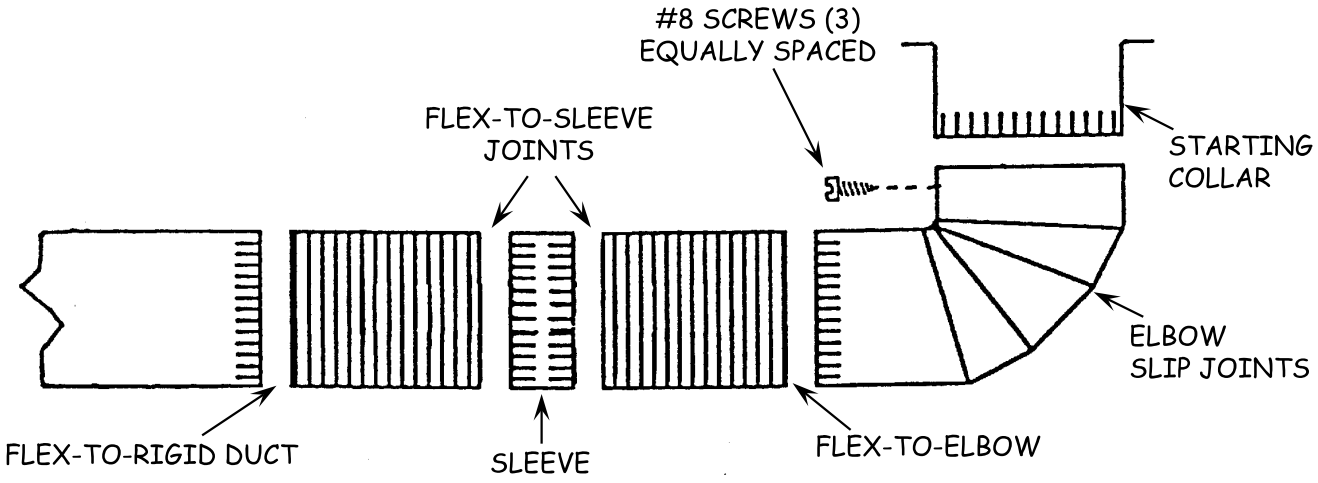
15. REPAIRING AND SEALING RIGID METAL DUCTS (cont.)

- **Taped joints**
  - Loose tape shall be removed, and secure tape that remains shall be covered with 1/8-inch-thick mastic extending 1" beyond both ends of the tape
- **Gaps 1/4" or smaller may be sealed with:**
  - Duct mastic or
  - Metallic pressure-sensitive tape.
- **Gaps >1/4" but <1" wide shall be sealed with:**
  - Duct mastic with embedded fiberglass mesh, or
  - Metallic pressure-sensitive tape covered with mastic.
- **Gaps ≥1" shall be:**
  - Repaired with a sleeve or a sheet metal patch (per Item 16) and
  - Sealed with mastic or tape.



- TAPE OR MASTIC ON GAPS UP TO 1/4"
- MASTIC & MESH, OR METALLIC TAPE COVERED BY MASTIC, ON GAPS OVER 1/4"

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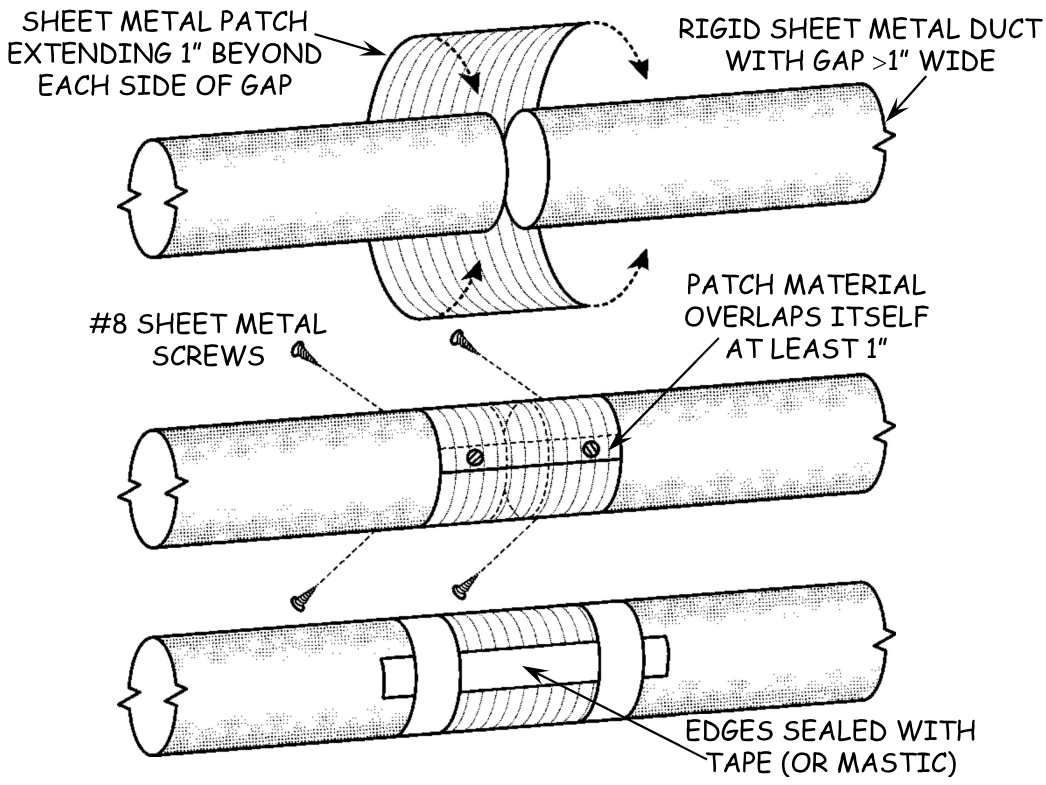
16. SHEET METAL PATCHES FOR RIGID METAL DUCTS

- **Material**
  - Patch material shall match the existing duct material (i.e., galvanized patch for galvanized duct, or aluminum patch for aluminum duct).
  - Gauge of the patch should equal or exceed gauge of the existing duct.
- **Installation**
  - Patch material shall:
    - Extend at least 1" beyond each edge of the gap and
    - Overlap itself by at least 1".
  - The patch shall be wrapped tightly around the duct and secured with #8 sheet metal screws.
    - Where the patch overlaps itself, at least one screw shall be installed on each side of the gap.
    - At least two more screws shall be evenly-spaced around the duct on each side of the gap.
- **Sealing**
  - All patch edges/gaps shall be sealed per Item 15.



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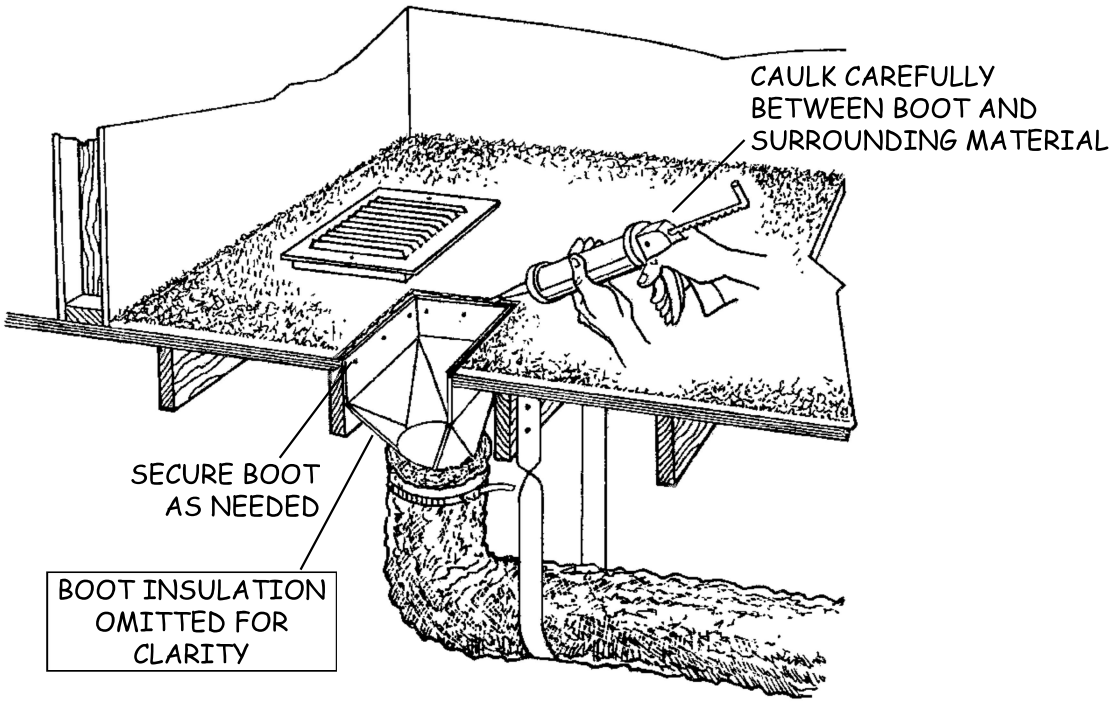
17. SEALING REGISTER BOOTS

- **Boot-to-duct connection**
  - Duct shall be secured and sealed as prescribed above for each duct type.
- **Leaks in the boot**
  - Gaps shall be sealed as prescribed above for repairing and sealing metal ducts.
  - Boot sealing material shall not interfere with removal or reinstallation of register.
  - Boots difficult to seal from the outside shall also be sealed from the interior.
- **Boot-to-floor/wall/ceiling connection**
  - Boot shall be mechanically secured to the structure and shall not rely on the duct for support or stability.
  - Sealants for gaps between boot and surrounding material shall be selected based on gap size:
    - Up to 3/8"—Elastomeric caulk.
    - 7/16" to 5/8"—Elastomeric caulk supported by backer rod.
    - Up to 1/4"—Duct mastic or metallic pressure sensitive tape.
    - Over 1/4" up to <1"—Duct mastic reinforced with fiberglass mesh, or metallic tape covered with mastic.
  - Sealants applied to the boot shall not interfere with the removal and replacement of the register.



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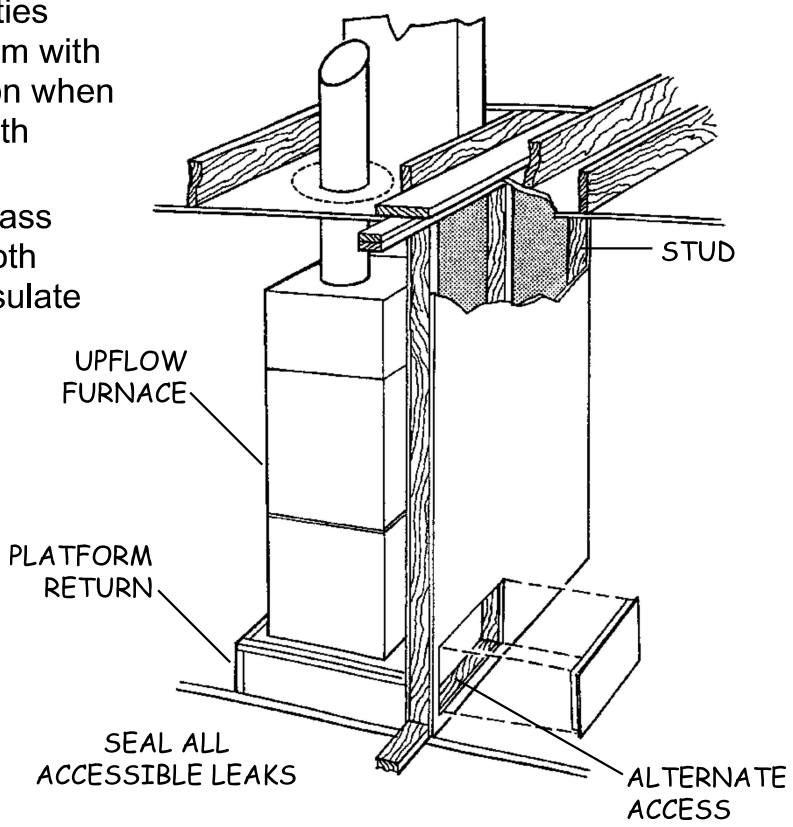
18. SEALING BUILDING CAVITIES

- **Accessible leaks shall be sealed.**
  - Building cavities being used as ducts (e.g., platform return, panned joists, building cavity/chase, cabinet toe-kick supply terminal, etc.) shall be sealed where accessible.
  - Corners of factory-made boxes and plenum shall be sealed.
  - Repair/liner materials may include sheet metal and fiberglass duct board.
  - For a platform return, an insulated duct may be installed to connect the return grille to the FAU in lieu of lining/sealing the platform.
- **Sealants may include:**
  - Gaps up to 1/4"—Duct mastic alone.
  - Gaps larger than 1/4" up to <1"—Duct mastic plus fiberglass mesh or metallic tape covered with mastic.
  - Approved caulk (e.g., elastomeric sealants).
  - Metallic pressure-sensitive tape (for metal and foil surfaces).
- **Materials <u>not</u> allowed**
  - Foam board, foam sealants, and gypsum wallboard shall <u>not</u> be used.
- **Platform plenum Insulation**
  - When uninsulated platforms are sealed, they shall also be insulated.
  - Insulation requirement may be met by:
    - Filling stud cavities inside the plenum with flexible insulation when lining/sealing with sheet metal <u>or</u>
    - Installing fiberglass duct board to both line/seal and insulate the plenum.



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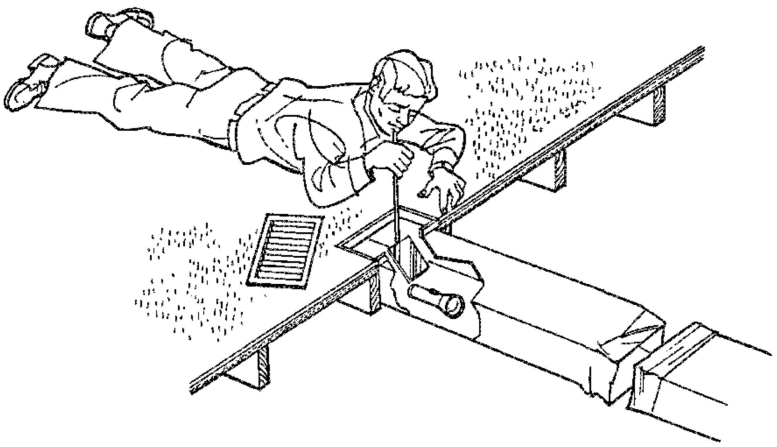
19. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up**
  - Scraps and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Furniture and other household items moved for installation work shall be returned to their original positions.

MOBILE HOME CRITERIA

20. DUCT SYSTEM INSPECTION AND ANALYSIS

- **Pre-inspection**
  - Supply registers and return grilles shall be removed to facilitate system inspection and the performance of repair/sealing work.
  - A mirror and light shall be used to perform inspection of:
    - Joints and connections in the boot and riser.
    - Each duct run to locate leaks, disconnections, and other defects.
    - Duct termination at the register nearest the end of each duct run to look for leaking “dead ends.”
    - Duct connector under furnace, when accessible.
    - Crossover duct connections, when accessible.
- **Post-inspection**
  - Internal repair and sealing work (e.g., boot/riser-to-trunk connection) shall be inspected with a mirror to ensure that:
    - Sealants have been applied correctly and
    - All leaks are completely sealed.



METHOD TO INSPECT FOR LEAKS AND DAMAGE AND TO VIEW COMPLETED REPAIRS

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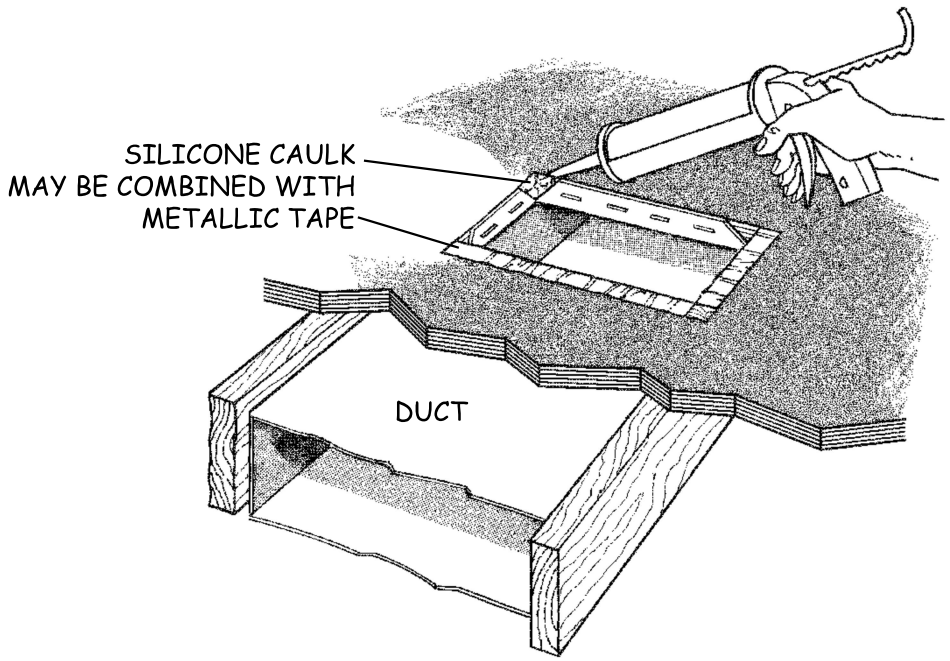
21. GENERAL INSTALLATION CRITERIA

- **New replacement ducts**
  - Ducts shall be sized, installed, and connected as prescribed in this section and HUD MHCSS Part 3280.715 and Title 25.

22. REGISTER BOOT/RISER REPAIR AND SEALING

- **Attachment**
  - Duct boots and risers that are loose or detached from the structure shall be reattached and mechanically secured (e.g., with screws, staples, or nails).
- **Boot/riser termination shall be sealed to the floor.**
  - Gaps up to 1/4" wide may be sealed with:
    - Elastomeric caulk (e.g., polyurethane or silicone), or
    - Duct mastic applied at least 1/8" thick.
  - Gaps over 1/4" up to <1" wide:
    - Gaps shall be sealed when possible with butyl tape or with duct mastic reinforced with mesh tape.
    - Elastomeric caulk and pressure-sensitive metallic tape may be used together where a thinner repair is required.
  - Gaps 1" or wider shall be:
    - Patched with sheet metal,
    - Mechanically secured as feasible and
    - Sealed with tape, mastic, or caulk.



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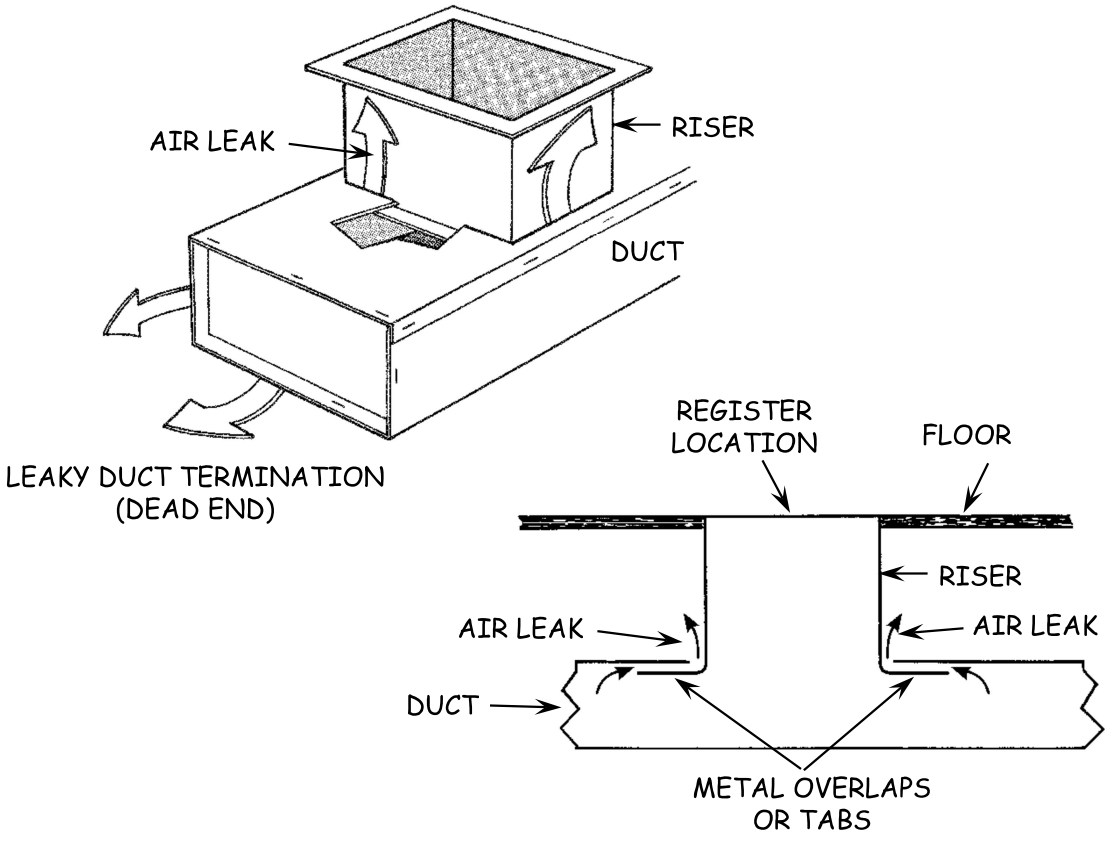
22. REGISTER BOOT/RISER REPAIR AND SEALING (cont.)

- **Risers**
  - Risers that are loose or are disconnected from the trunk shall be reattached, secured, and sealed (e.g., with butyl tape).
- **Metal overlaps/tabs**
  - Metal overlaps/tabs at joint between the riser and trunk duct shall be repaired and permanently sealed (e.g., with butyl tape).
- **Preparation of joint**
  - Metal overlaps/tabs shall be bent as needed to achieve the best possible metal-to-metal contact.
  - Dust and dirt shall be removed to the extent feasible from surfaces to which sealant will be applied (e.g., with vacuum cleaner hose/nozzle, a brush, or a damp rag).



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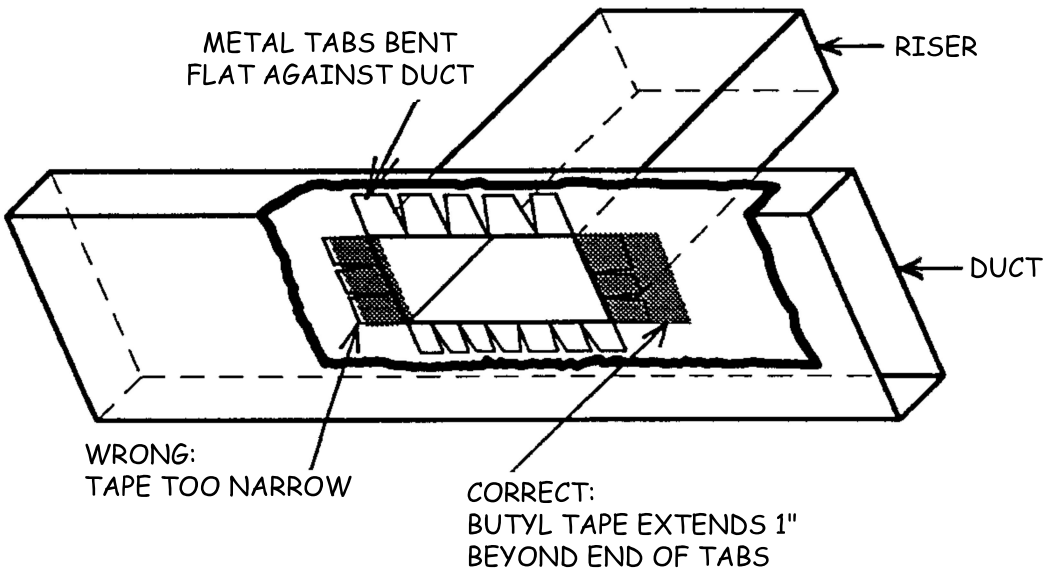
22. REGISTER BOOT/RISER REPAIR AND SEALING (cont.)

- **Application of sealant**
  - Joint overlaps/tabs shall be sealed with:
    - Butyl tape (e.g., 3" wide), or
    - Duct mastic and embedded fiberglass mesh tape.
  - Sealant shall cover all overlaps/tab and extend approximately 1" beyond the ends of the overlaps/tabs.
  - Pre-existing metallic tape:
    - If loose, shall be removed to the extent feasible.
    - If not loose, shall be covered with new sealant to achieve a complete, permanent seal.

23. SEALING OTHER LEAKS WITHIN REACH

- **Reachable leaks**
  - Other obvious leaks that can be reached through the register opening shall be sealed utilizing materials and methods prescribed in Items 15 and 16.
- **Such leaks may include:**
  - Duct joints/splices and other loose metal overlaps.
  - Duct terminations (dead ends).
  - Leaks in the duct connector underneath the furnace (accessed through removable bottom panel on front of unit).
  - Leaks inside terminals of crossover ducts(s).



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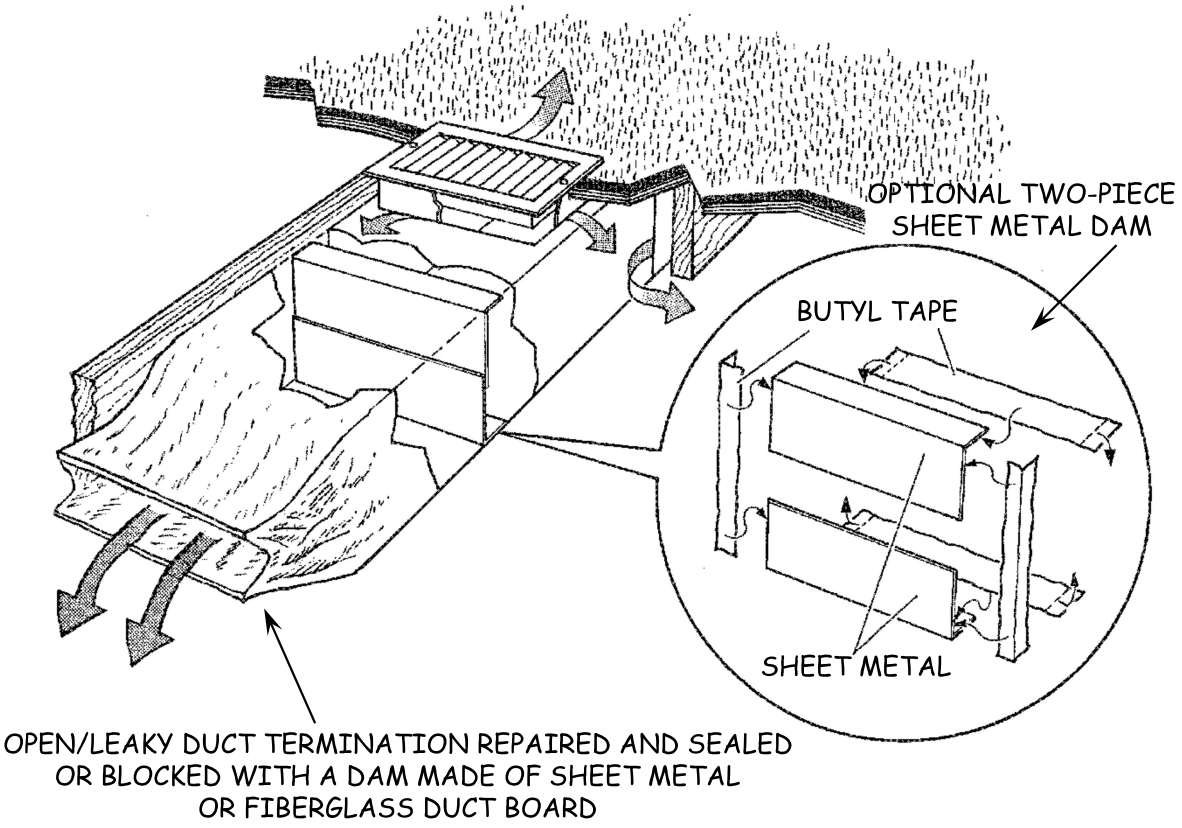
24. REPAIRING LEAKY DUCT TERMINATIONS

- **A duct termination (dead end):**
  - May be securely blocked (e.g., sheet metal dam or a fiberglass duct board dam) and permanently sealed.
  - Dams shall be:
    - Placed as far from the register opening as feasible.
    - Attached securely with butyl tape or mastic and mesh tape.



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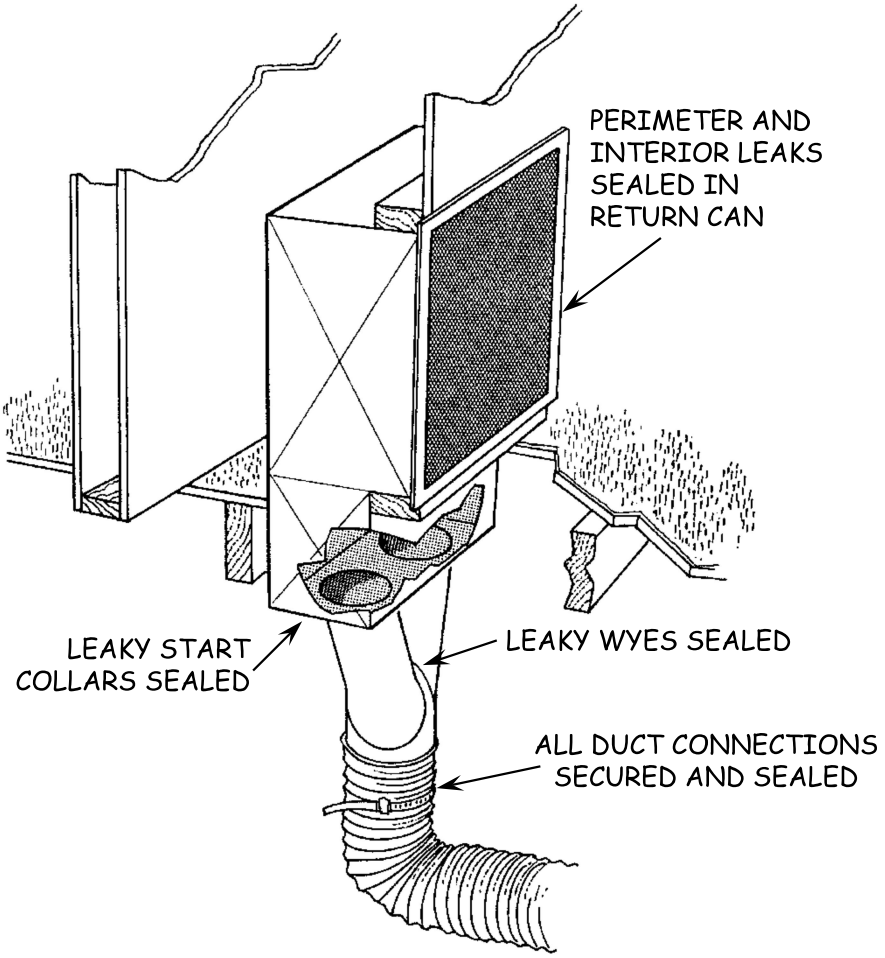
25. DUCTED RETURNS

- **Existing ducted returns**
  - All accessible components shall be inspected for decay, damage, and leaks and shall be repaired as needed.
  - Rodent barrier (bellyboard) sections shall be removed for access as needed.
  - Accessible leaks shall be repaired.



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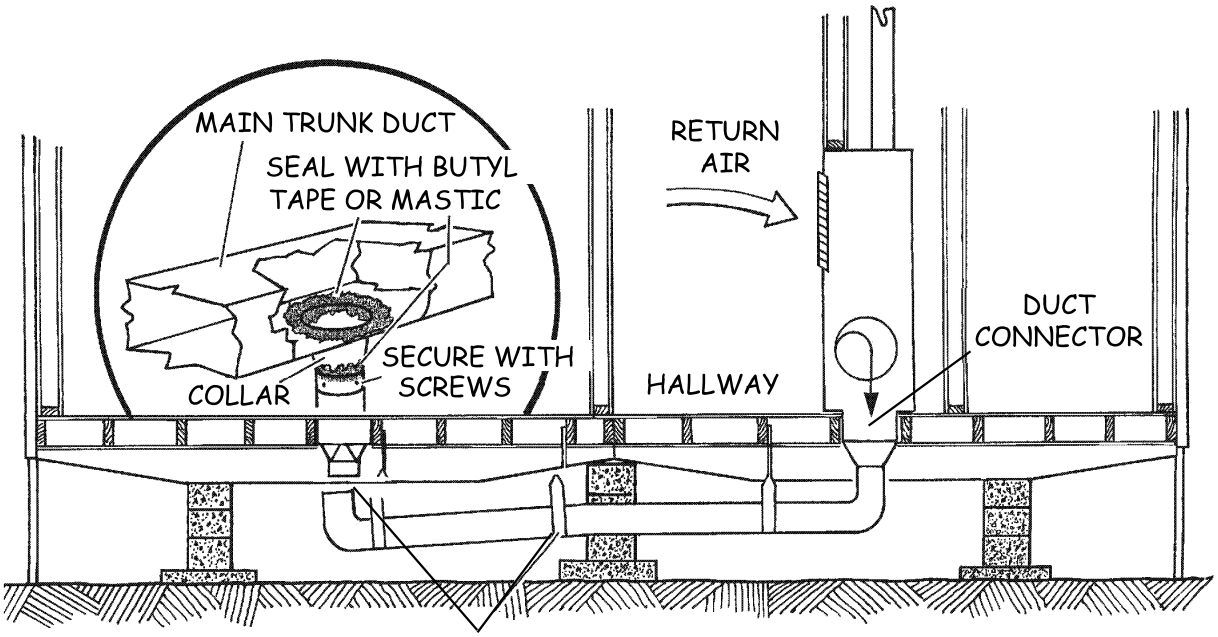
26. CROSSOVER DUCTS

- **Double-wide units**
  - Crossover ducts shall be disconnected at each terminal, and gaps reachable through the opening shall be sealed.
  - Disconnections shall be reconnected, mechanically secured, and sealed.
  - Other major leaks that are repairable shall be repaired and sealed.
  - Disconnected and damaged duct components that cannot be feasibly repaired shall be replaced.
- **Duct installation**
  - Ducts shall be installed, secured, supported, and sealed as prescribed in this section.
  - Ducts in the undercarriage area shall be protected from damage by animals.
  - When the crossover duct cannot be supported above the ground, contact with the earth shall be prevented by placing minimum R-4 closed-cell rigid insulation under the duct.



DISCONNECTED/DAMAGED CROSSOVER DUCT REPAIRED/REPLACED, LOOSE CONNECTION TO TRUNK REPAIRED AND SEALED

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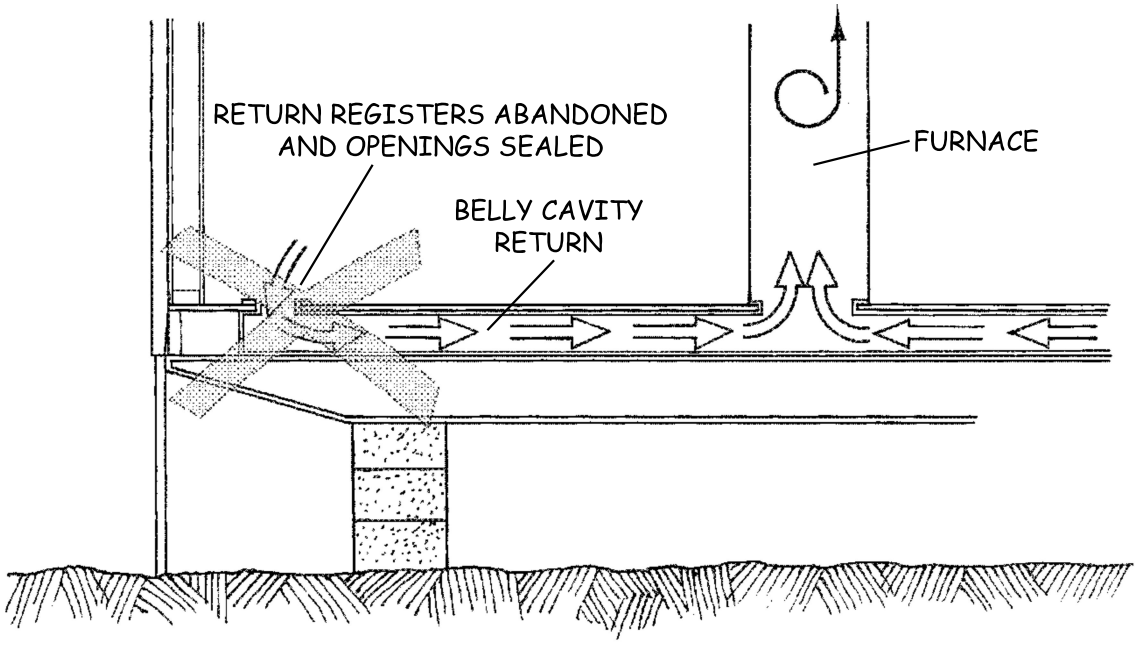
27. NEW CENTRAL RETURN

- **Upflow furnace with belly cavity return**
  - Duct sealing is not feasible when the return is a belly cavity.
  - When feasible and approved by the utility, a belly cavity return should be replaced with a ducted central return.
  - The new central return shall:
    - Be properly sized.
    - Be installed, supported, and sealed as prescribed in this section.
  - When a new central return is installed:
    - The existing belly cavity return shall be abandoned.
    - The abandoned register openings shall be blocked off and permanently sealed.



BELLY-CAVITY RETURN ABANDONED
WHEN A DUCTED CENTRAL RETURN IS INSTALLED

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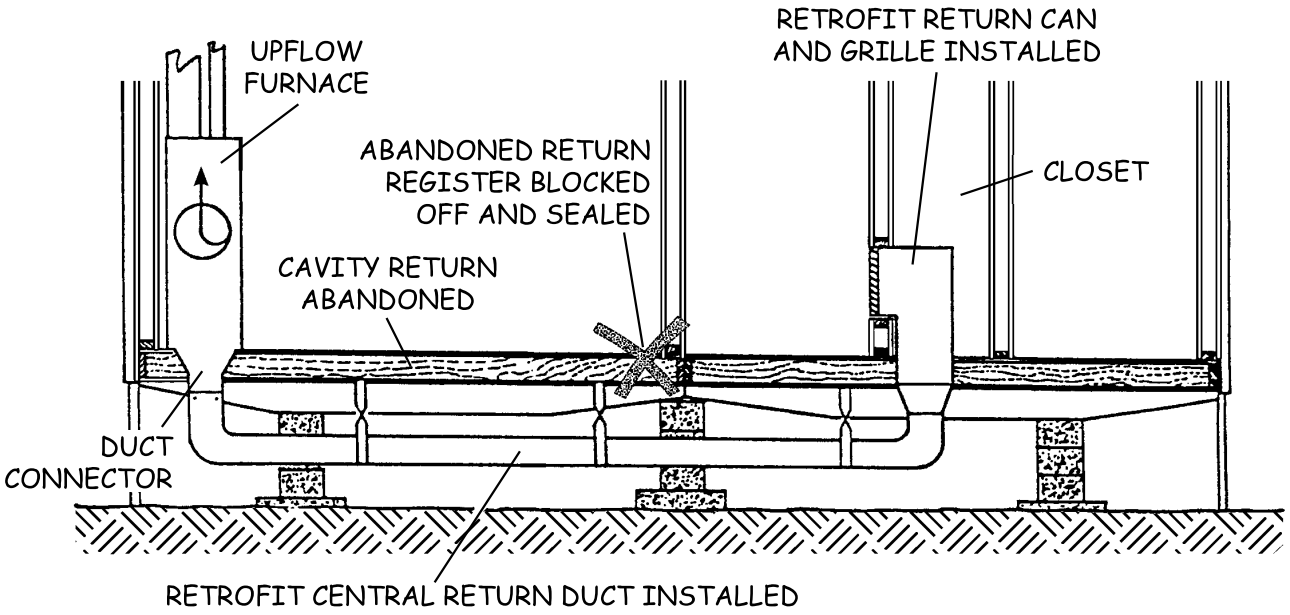
27. NEW CENTRAL RETURN (cont.)

- **Upflow furnace with belly cavity return (cont.)**
  - The return grille shall be:
    - Sized to provide a minimum of 2 sq. in. of NFVA for each 1,000 Btu/hr. furnace capacity.
    - Installed in the outside wall of a closet when possible or in the floor when necessary.
    - Located in a hallway or other open area.
    - Centrally located within the mobile home.
  - Proper air flow shall be provided for each room containing a supply register utilizing one of the following methods:
    - An uncloseable grille that provides a NFVA equal to at least 1 sq. in. for every 5 sq. ft. of total living area in the room may be installed in the door or wall.
    - Door bottom may be undercut 2" to 2-1/2".



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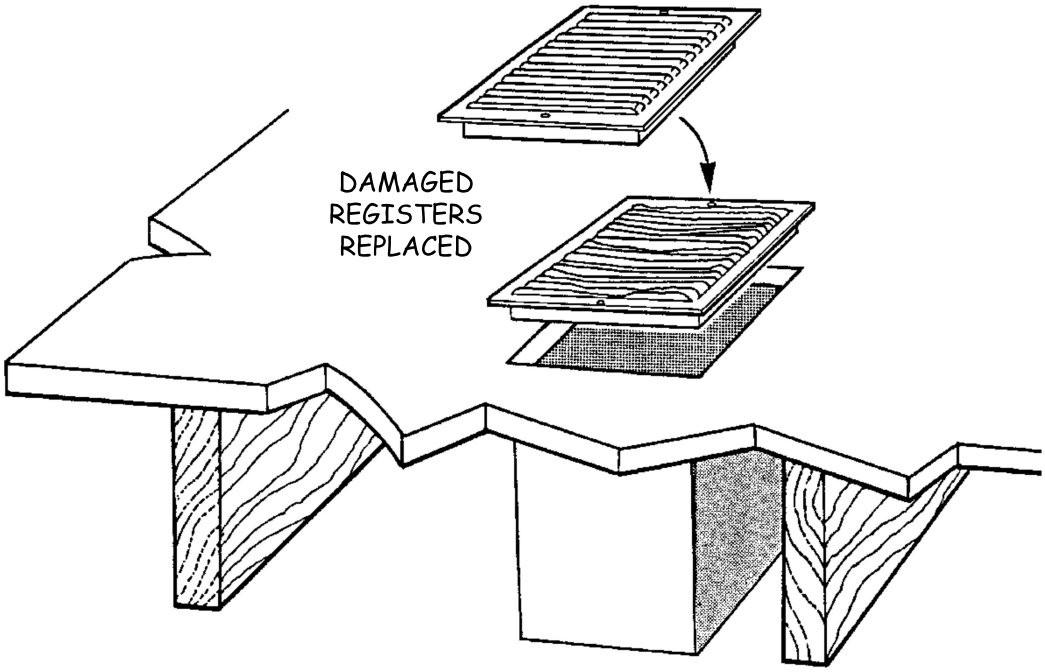
28. REGISTER GRILLES

- **Repair and replacement**
  - Dampers shall function properly.
  - Dampers which will not open or stay open shall be removed if register replacement is not feasible.
  - Damaged registers which do not allow proper airflow shall be repaired or replaced, in accordance with individual utility policy.
- **Removal and reinstallation**
  - Boot sealing shall not cause any register to be difficult to remove or reinstall.



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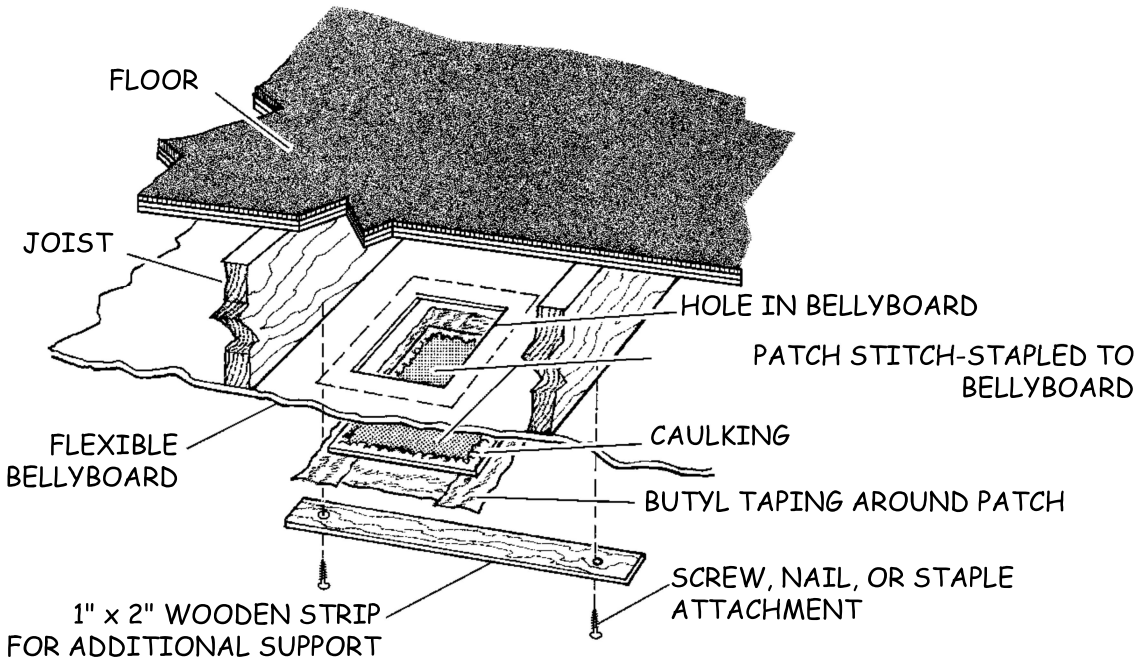
29. RODENT BARRIER (BELLYBOARD) REPAIR

- **Access holes**
  - Holes in the bellyboard created to access ducts from under the mobile home shall be repaired.
- **Rigid or flexible rodent barrier**
  - All holes shall be repaired with material equivalent or superior to the existing bellyboard.
  - All patches shall be securely and permanently attached and create a complete and permanent seal.
- **Patches in *flexible* rodent barrier**
  - All patches shall be secured and sealed by means of self-adhesive backing or caulk/adhesive sealant.
  - Patches shall be mechanically secured as needed to ensure permanence by such means as one or more of the following:
    - Outward clinch (“stitch”) staples, or equivalent, positioned to permanently and securely attach the patch directly to the existing bellyboard.
    - Fasteners penetrating the wooden joists a minimum of 1/2" and spaced a maximum of 4" OC.
    - Wooden strips attached permanently secured (e.g., with screws into floor joists or wedged above adjacent girders).



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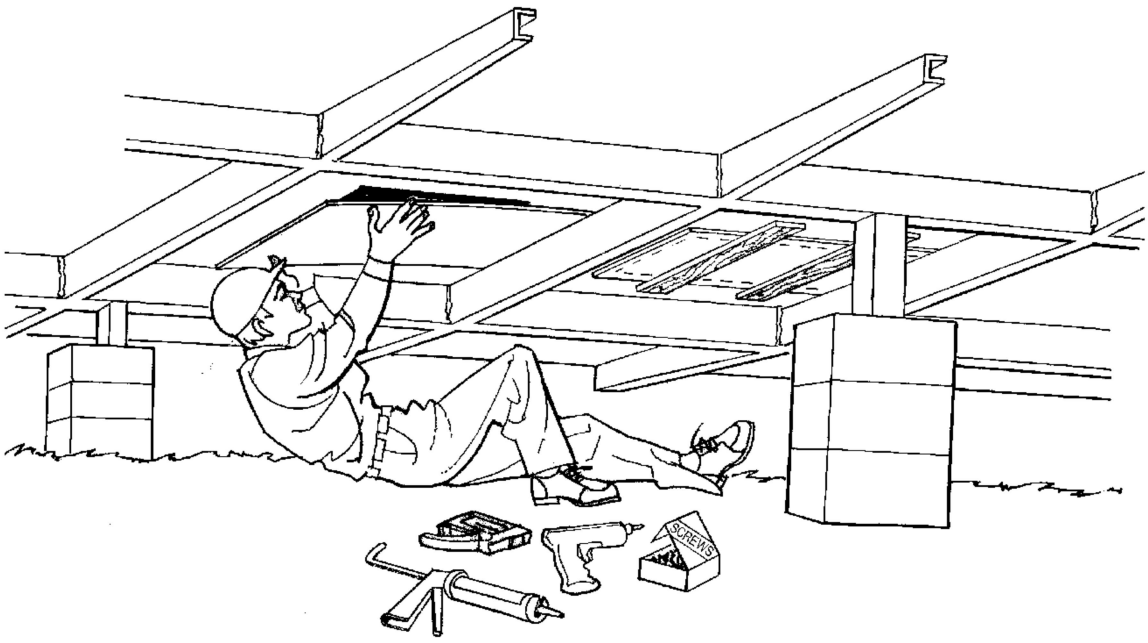
29. RODENT BARRIER (BELLYBOARD) REPAIR (cont.)

- **Patches in *flexible* rodent barrier (cont.)**
  - Tape recommended by barrier manufacturer, butyl tape, or other compatible sealant shall be placed around the perimeter of the flexible patch, as needed, to ensure a complete and permanent seal.
- **Patches in *rigid* rodent barrier**
  - Patches shall be sealed with suitable caulk/adhesive sealant and secured mechanically.
  - Approved mechanical attachments include:
    - Fasteners penetrating the wooden joists a minimum of 3/4" and spaced a maximum of 6" OC.
    - Wooden strip supports spanning beyond the patch and secured mechanically into the framework above.
    - Wedging the patching material between the existing bellyboard and the metal framing of the undercarriage.
    - Fasteners which penetrate only the existing bellyboard, for small patches in high density material.
    - A combination of methods which will provide a stable, permanent repair.



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HEAT PUMP WATER HEATERS

Lead Paint Risk Factor
LOW

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MOBILE HOME CRITERIA 9

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SECTION 40 PREFACE
for

HEAT PUMP WATER HEATERS

1. Nonfeasibility Criteria

All Homes

1.1. The existing water heater is not electric resistance type.

1.2. The existing water heater is not operational.

1.3. The existing water heater is in a/an:

a. attic,
b. occupied space where cooling and noise will be an issue,
c. location where condensate drainage cannot be achieved,
d. outdoor, unprotected area exposed to weather,
e. location where ambient temperature is frequently below manufacturer's recommended minimum,
f. location with substandard floor (e.g., weak, degraded, unlevel).

1.4. The existing water heater is located in conditioned space and ducting a heat pump water heater to the outdoors is not feasible.

1.5. The existing water heater is tankless, or is a central unit serving more than one dwelling unit.

1.6. A suitable covered and protected location, with adequate height and room volume, access, and clearances, is not available and correction is not feasible.

1.7. An unsafe electrical or plumbing condition exists, and correction is not feasible.

1.8. Water pressure is outside the acceptable range, and correction is not feasible.

1.9. Confined Spaces: state and federal regulations regarding confined spaces cannot be met.

1.10. Property is renter-occupied, as defined by individual utility policy.

1.11. Electricity used by the existing water heater is not supplied by the utility providing ESA Program services.

1.12. Customer refuses.

2. Installation Policies

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

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2.2. A mixing valve may be installed when required by local code, or per individual utility policy.

3. Installation Policies Specific to Mobile Homes

Mobile homes do not qualify for installation of a heat pump water heater.

HEAT PUMP WATER HEATER STANDARDS

1. APPROVED MATERIALS

- **Heat Pump Water Heaters—All Units**
  - ENERGY STAR-certified and in compliance with CEC Appliance Efficiency Regulations.
  - UL-listed or equivalent.
  - Compliance also with NEEA Advanced Water Heater Specification, tier 3 or higher.[1]
- **Drain pan**
  - Corrosion-resistant metal pan with 3/4" drain, or
  - As specified by the manufacturer and local code, if different.
- **Piping and valves**
  - Flexible connectors: Listed (e.g., by IAPMO) stainless steel or plastic- or epoxy-coated brass connectors.
- **Safety relief and drain valves**
  - Temper and pressure relief
    - T&P valve: ASME-rated and -listed and manufactured to ANSI Z21.22.
    - Automatic gas shutoff valve (e.g., Watts 210): Listed or certified by UL or CSA.
  - Drain valve
    - Heavy brass body that meets NSF low lead standards.
    - Pipe and hose threads compliant with ANSI B1.20.1 and B1.20.7.
  - Valve caps
    - Rated for 150°F water or made of brass.
- **Mixing valves**
  - Shall be in compliance with ASSE 1017.
  - Listed or certified by IAPMO and CSA.
- **Warranty**
  - Refer to IS Appendix F (Minimum Warranty Requirements).

[1] The Northwest Energy Efficiency Alliance (NEEA), publishes a list of qualifying products at http://neea.org/advancedwaterheaterspec

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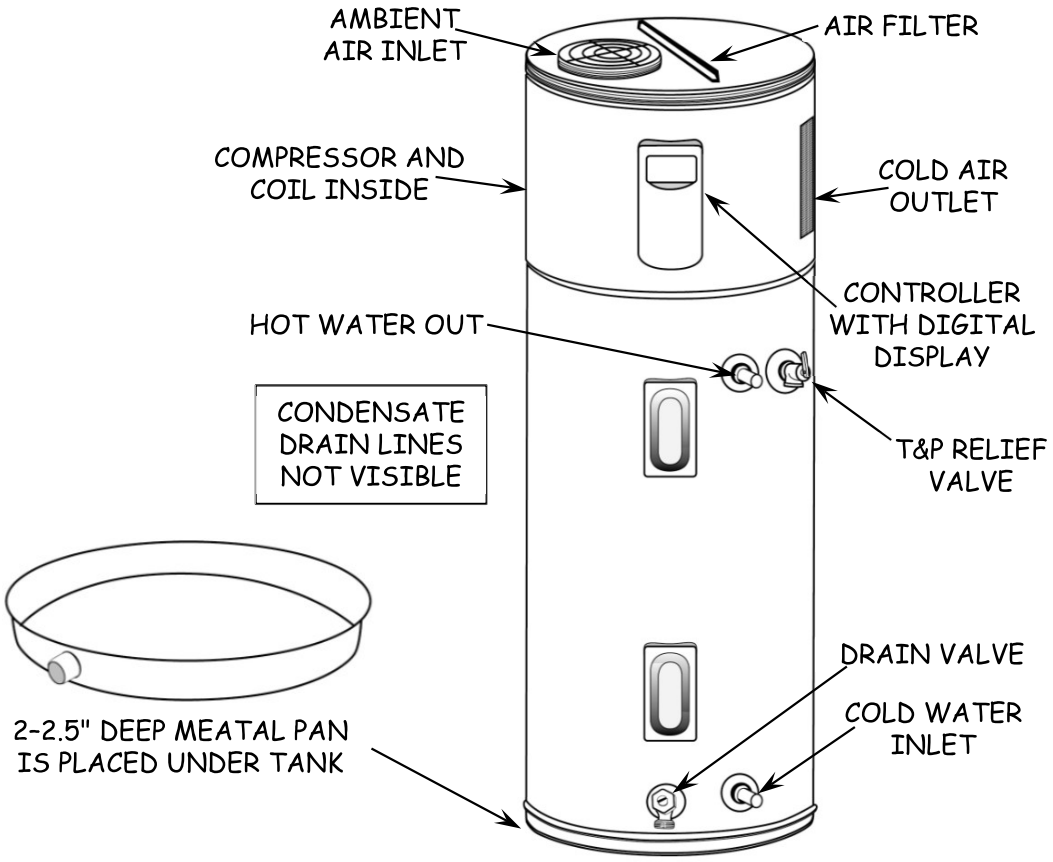
2. GENERAL REQUIREMENTS

- **Permits and conformance**
  - A permit for the installation shall be obtained and finalized.
  - Installation shall be in conformance with manufacturer's instructions, product listing, and local code.



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3. WATER HEATER SIZING

- **First hour rating (FHR)**
  - Unit shall comply with the greater of manufacturer's sizing recommendations, or local code requirements.
  - FHR shall be no less than the current CPC minimum guidelines, as summarized in Table 40-1.

Table 40-1: Storage Water Heater Minimum Capacity (FHR)

Number of Bathrooms	1 to 1.5			2 to 2.5				3 to 3.5			
Number of Bedrooms	1	2	3	2	3	4	5	3	4	5	6
FHR (gal./hr.)[2]	38	49	49	49	62	62	74	62	74	74	74

4. PRE-INSTALLATION

- **Location shall be checked for:**
  - Ambient temperature range (≥ 45°F and ≤ 120°F or as recommended by water heater manufacturer).
  - Adequate room volume or feasibility of adding venting to adjacent areas or ducting to outdoors.
  - Feasibility of achieving proper condensate drainage.
  - Proper clearances on sides and top of the unit.
  - Feasibility of installing seismic bracing.
  - Stable and level floor that will properly support the weight of the unit.
  - Water pressure (≥ 50 PSI and ≤ 80 PSI or per manufacturer).
- **Water heaters in garages and hazardous locations**
  - Unit shall be elevated or protected with barriers in accordance with code, when needed.
  - The area must be free of flammable vapors and corrosive elements in the air.

5. INSTALLATION

- **The tank shall be installed:**
  - In an area sheltered from moisture, freezing, and high temperatures and with unrestricted airflow.
  - Plumb and level in a stable vertical position.
  - With minimum clearances and access for servicing, filter cleaning, and anode rod replacement.
  - With information labels and controls facing outward.
  - With consideration given to impact of unit noise.

[2] First Hour Rating, the water heating capacity expressed in gallons, is the amount of hot water the heater can supply per hour (starting with a tank full of hot water).

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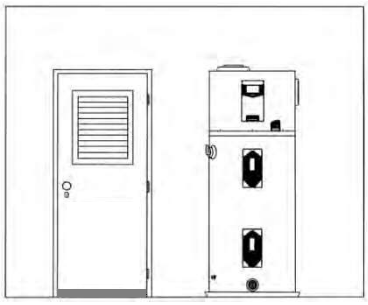
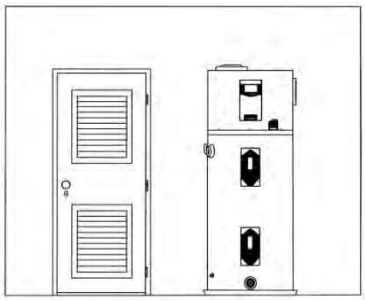
5. INSTALLATION (cont.)

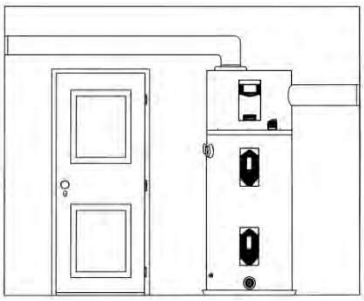
- **Room volume**
  - Installation location shall provide the required room volume with unrestricted airflow:
    - 700 cu. ft. minimum, or
    - Manufacturer's recommendations.
  - The following guidelines may be used to compensate for inadequate room volume:
    - Full louvered door.
    - Upper and lower louvered vents (240-380 sq. in.).
    - Upper vent and a gap ≥18 sq. in. under the door.
    - Venting to adjacent spaces of adequate size.
    - Ducting the air intake and/or cold air exhaust to another unconditioned space or outdoors (ducting to attics not allowed).
- **Clearances**
  - Clearances above and on all sides of the water heater shall be in compliance with manufacturer's instructions.
- **Bottom support**
  - Bottom support shall be structurally sized/constructed to safely support the weight of the tank.



UNDERCUT DOOR WITH UPPER VENT COMMUNICATING WITH ADJACENT SPACE



LOUVERED DOOR OR UPPER & LOWER VENTS COMMUNICATING WITH ADJACENT SPACE



SOLID DOOR, WITH AIR INTAKE AND COLD AIR EXHAUST DUCTED TO OTHER SPACE OR OUTDOORS

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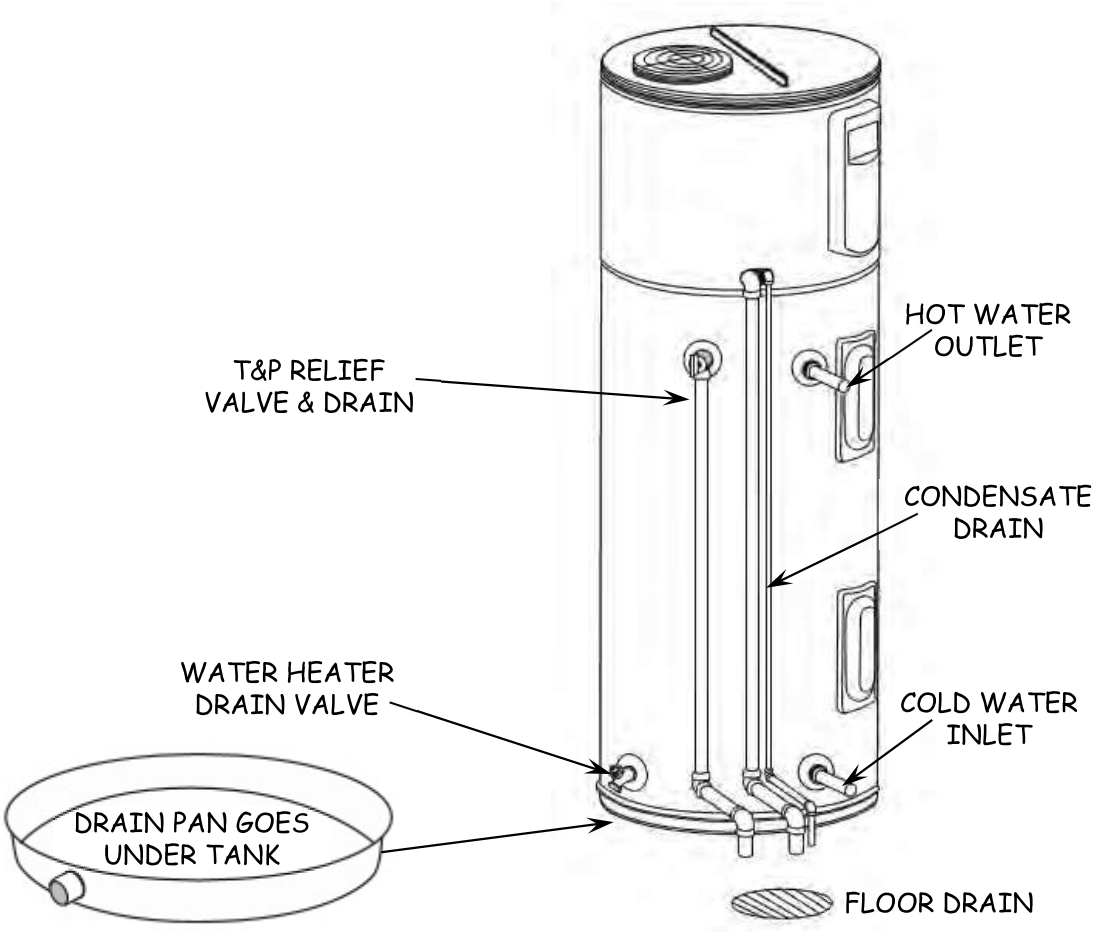
6. PLUMBING

- **All units**
  - Only new parts suitable for potable water shall be installed.
  - Threaded fittings shall be sealed with pipe thread tape or non-toxic pipe joint compound and shall be free of leaks.
  - A cold water supply shutoff valve shall be installed if not present.
  - Flexible connectors shall be used to connect the tank to the rigid hot and cold water lines.
  - Dielectric insulators shall be installed between water piping and the tank.
- **Drain pan**
  - A metal drain pan shall be installed under the water heater.
  - Minimum 1" space between tank and edge of pan.
  - It shall have a ≥ 3/4" drain line sloping downward to a suitable drain.
- **Condensate drain(s)**
  - Condensate drain line shall:
    - Empty into an approve floor drain (<u>not</u> water heater drain pan) or
    - Drain directly outdoors with a downward-sloping line.



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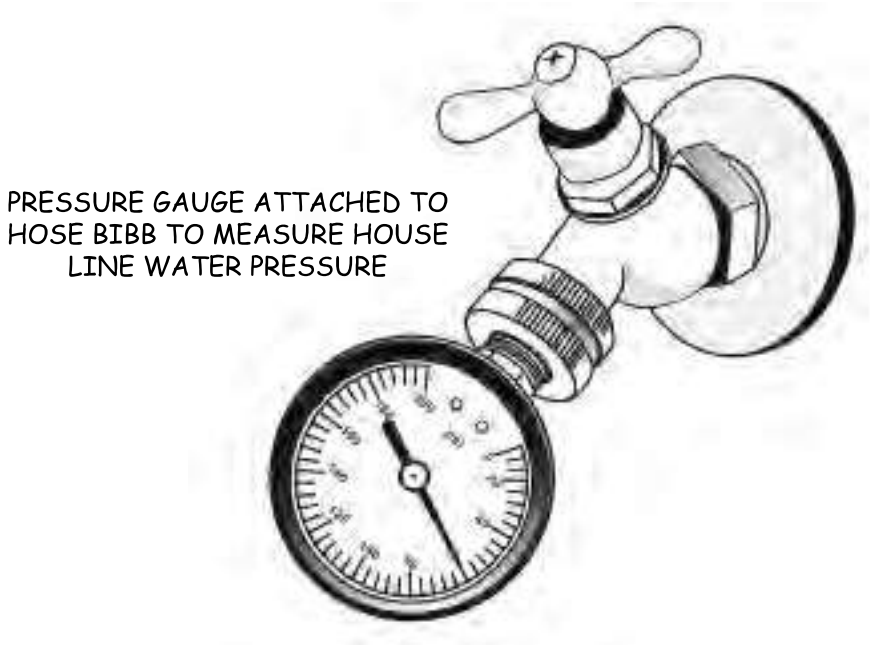
7. TEMPERATURE AND PRESSURE REGULATION

- **Safety controls**
  - A temperature and pressure (T&P) relief valve shall be installed so the temperature sensor is immersed in water at the top 6" of the tank.
  - The T&P relief valve shall meet the sizing and pressure requirements of the water heater listing.
- **T&P relief valve drain line**
  - The line shall drain fully by gravity.
  - It shall not discharge into the drain pan.
  - Drain line shall terminate outside the building or in an approved drain system, with the terminal end:
    - No more than 24" nor less than 6" above the surface, and
    - Unthreaded and pointing downward.
- **Backflow preventer and expansion tank**
  - The incoming water line shall have backflow prevention.
  - A thermal expansion tank shall be installed when specified by the manufacturer or required by code.
- **House line pressure**
  - House line pressure shall be verified to be in compliance with the water heater manufacturer's specifications.
  - A house line pressure regulator shall be installed or replaced when needed to limit water pressure to the tank.



PRESSURE GAUGE ATTACHED TO HOSE BIBB TO MEASURE HOUSE LINE WATER PRESSURE

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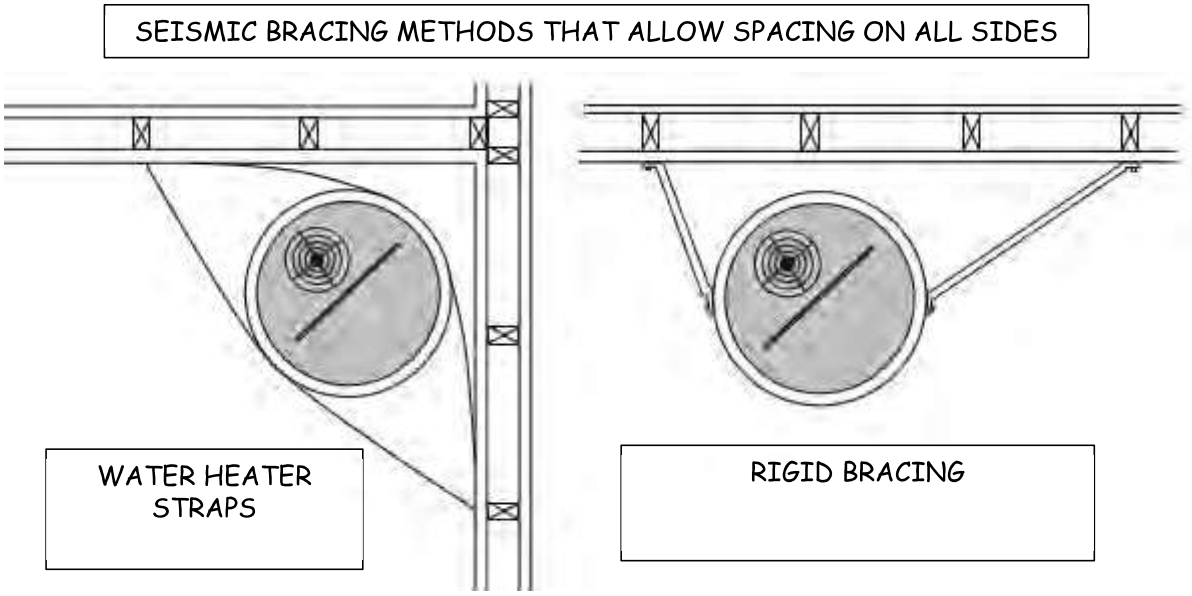
8. ELECTRICAL CONNECTIONS

- **Wiring to the unit**
  - The water heater shall be connected to a dedicated circuit with adequate overcurrent protection.
  - Exposed wiring shall be enclosed in a conduit, when required by local code.

9. SEISMIC BRACING

- **Requirement**
  - The tank shall be braced (strapped or anchored).[3]
  - Number of straps:
    - Two for tanks ≤ 52 gallons;
    - Three straps for tanks > 52 gallons.
- **Bracing shall:**
  - Allow for required spacing around the water heater.
  - Be installed per manufacturer's instructions and local code.
  - Be securely attached to structural framing or ledger board.
  - Plumbers tape not allowed.



[3] CA guidelines are available at: https://www.documents.dgs.ca.gov/dsa/pubs/waterheaterbracing.pdf

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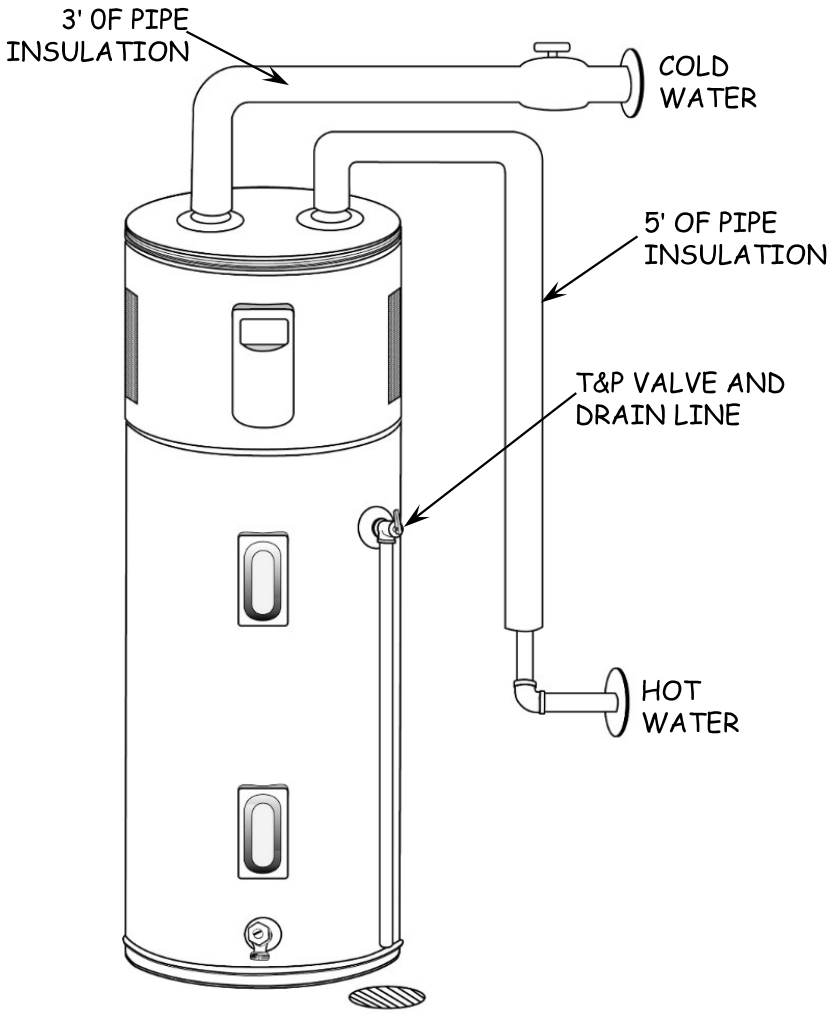
10. HEAT PUMP WATER HEATER OPERATION

- **Testing**
  - The water heater (and condensate pump when present) shall be tested in accordance with manufacturer's instructions and shall perform properly.

11. INSULATION

- **Tank**
  - External insulation is not required unless it is recommended by the water heater manufacturer or required by local code.
  - Insulation shall not:
    - Interfere with airflow into or out of the heat pump unit.
    - Cover the controller assembly, T&P relief valve, or T&P drain line.
- **Hot and cold water pipes**
  - Pipe insulation shall be installed on all accessible portions of the first five feet of both hot and cold pipes



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12. R-VALUE OF PIPE INSULATION

- **R-value shall be in conformance with Table 40-2.**

Table 40-2: Pipe Insulation Requirements

Condition (Pipe ≤ 1" OD)	**Water Temp.**	**Min. R-value**
New heat pump water heater and water pipes installed	105 to 140 °F	R-7.7
	141 to 200 °F	R-11.5

13. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up**
  - Paint dust and chips, scraps, and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Household items moved for installation work shall be returned to their original positions.
- **Customer education and warranty**
  - Customer education shall include:
    - A demonstration and verbal instructions on operation of water heater controls (and condensate pump when present).
    - Explanation of proper care and maintenance, including air filter cleaning.
    - Instructions on how to change operational modes.
    - Manufacturer's written instructions and warranty (including for the condensate pump when present).
- **Measure-specific requirements**
  - Removed water heaters shall be disposed of in accordance with local recycling and disposal guidelines.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

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ENERGY EFFICIENT FREEZERS

Lead Paint Risk Factor
NONE

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MOBILE HOME CRITERIA 6

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SECTION 41 PREFACE
for

ENERGY EFFICIENT FREEZERS

1. Nonfeasibility Criteria

1.1. No existing stand-alone freezer is present.

1.2. Existing freezer is less than 15 years old.

1.3. Less than six occupants live in the home.

1.4. The existing electrical receptacle is unsafe, ungrounded, or GFCI-protected and correction is not feasible.

1.5. Access to remove the existing freezer and/or install the new one is inadequate.

1.6. An appropriate location is not available, due to one of the following:

a. The floor is not structurally adequate to safely support the freezer.

b. Clearance requirements cannot be met.

c. The freezer cannot be installed in a level, plumb, and stable position.

1.7. Customer refuses.

2. Installation Policies

2.1. The minimum size for freezers to be replaced under the ESA Program is 5 cu. ft.

2.2. The customer may choose an upright or chest type freezer.

2.3. A second refrigerator/freezer unit may be replaced with a stand-alone freezer.

2.4. The size of the replacement freezer shall be approximately equal to the size of existing unit.

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

2.6. Replaced freezers shall be disposed of and recycled in an environmentally safe manner and in accordance with federal, state, and local regulations and codes.

3. Installation Policies Specific to Mobile Homes

None.

ENERGY EFFICIENT FREEZER STANDARDS

1. APPROVED MATERIALS

- **Freezer shall be:**
  - UL-listed.
  - ENERGY STAR-certified.
- **Extension cord shall be:**
  - UL-listed.
  - 3-conductor.
  - No smaller than 14 AWG, or the minimum size specified by the appliance manufacturer.
  - Maximum 6’ in length.

2. WARRANTY

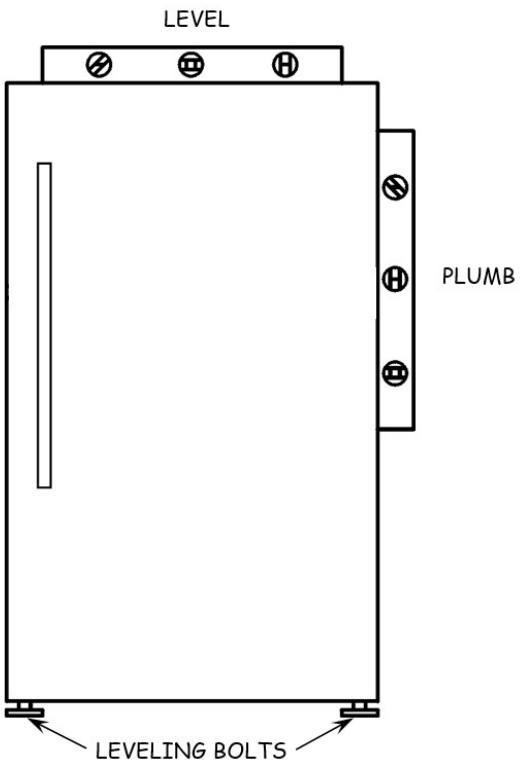
- **Refer to IS Appendix F (Warranty Requirements).**

3. DOOR SWING

- **Customer shall be allowed to select the direction of the door swing.**

4. INSTALLATION

- **All units**
  - Freezer shall be installed in a level, plumb, and stable position, using leveling devices supplied by the freezer manufacturer or supplementary supports (e.g., shims) as needed.
  - Installation shall not damage the floor covering or interior finishes.
- **Location**
  - Installation location shall be accessible without causing damage to the home or furnishings.
  - The floor shall be structurally sound to safely support the freezer.
  - Location shall provide manufacturer’s specified clearances.



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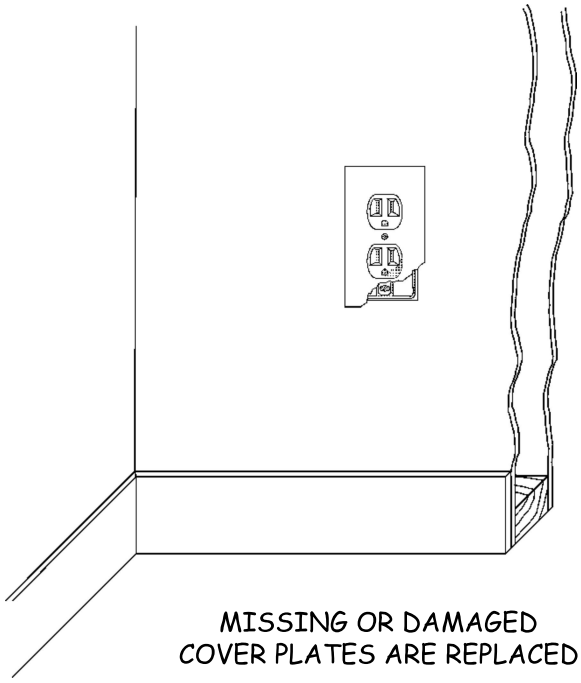
5. ELECTRICAL REQUIREMENTS

- **Electrical circuit**
  - Overcurrent protection and conductor size shall be in conformance with manufacturer's specifications and local code.
  - A GFCI-protected circuit or receptacle or a switched outlet shall not be used.
- **Electrical outlet**
  - Freezer shall be plugged into its own dedicated receptacle. Exception: The freezer may be plugged into a shared receptacle, but the amperage rating of the new freezer cannot exceed that of the existing freezer.
  - When the receptacle cover plate is cracked, damaged, or missing, a new one shall be installed.
  - 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, three-conductor cord with three-prong plug and receptacle.
    - Minimum 14 AWG.
    - Maximum 6' in length.
  - Appliance cord and extension cord shall not be located where it can create a walking hazard (where people can trip).



MISSING OR DAMAGED COVER PLATES ARE REPLACED

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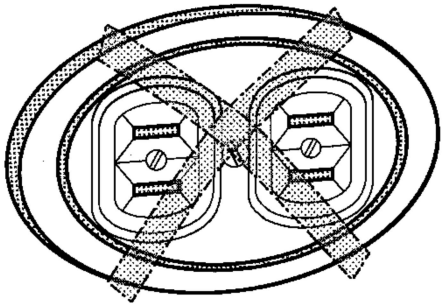
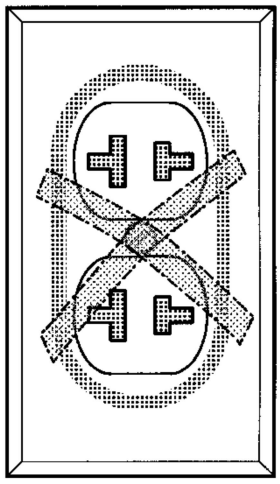
6. TWO-PRONG OUTLETS

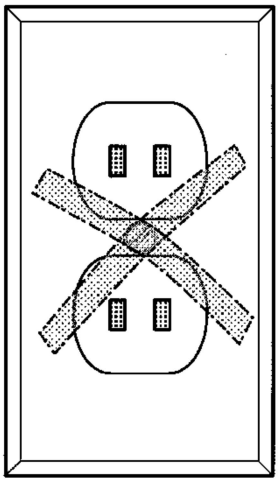
- **Freezers shall <u>not</u> be connected to two-prong ungrounded outlets.**
- **An ungrounded two-prong receptacle may be replaced with a new, properly grounded three-prong receptacle in accordance with Item 8.**



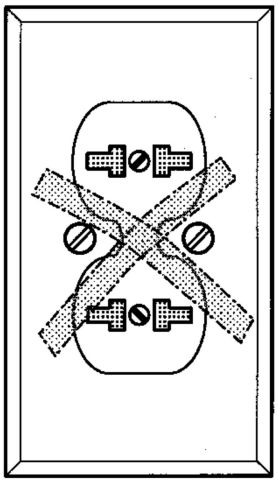
SURFACE-MOUNTED
UNPOLARIZED RECEPTACLE



POLARIZED
RECEPTACLE



CERAMIC DUPLEX
UNPOLARIZED RECEPTACLE



CERAMIC DUPLEX
RECEPTACLE

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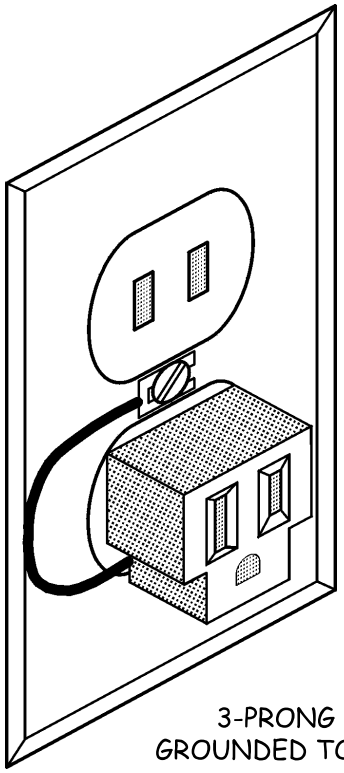
7. USE OF ADAPTERS

- **Three-prong adapters**
  - Shall not be used to permanently connect a freezer.
  - May be used as a temporary measure if allowed by local code and the freezer manufacturer's instructions and approved by the owner/occupant.
- **When adapters are used, they shall be:**
  - Aligned to provide proper polarity with the outlet and the power cord.
  - Connected to a ground source (e.g., a properly grounded two-prong receptacle or metal outlet box).



3-PRONG ADAPTER
GROUNDED TO RECEPTACLE

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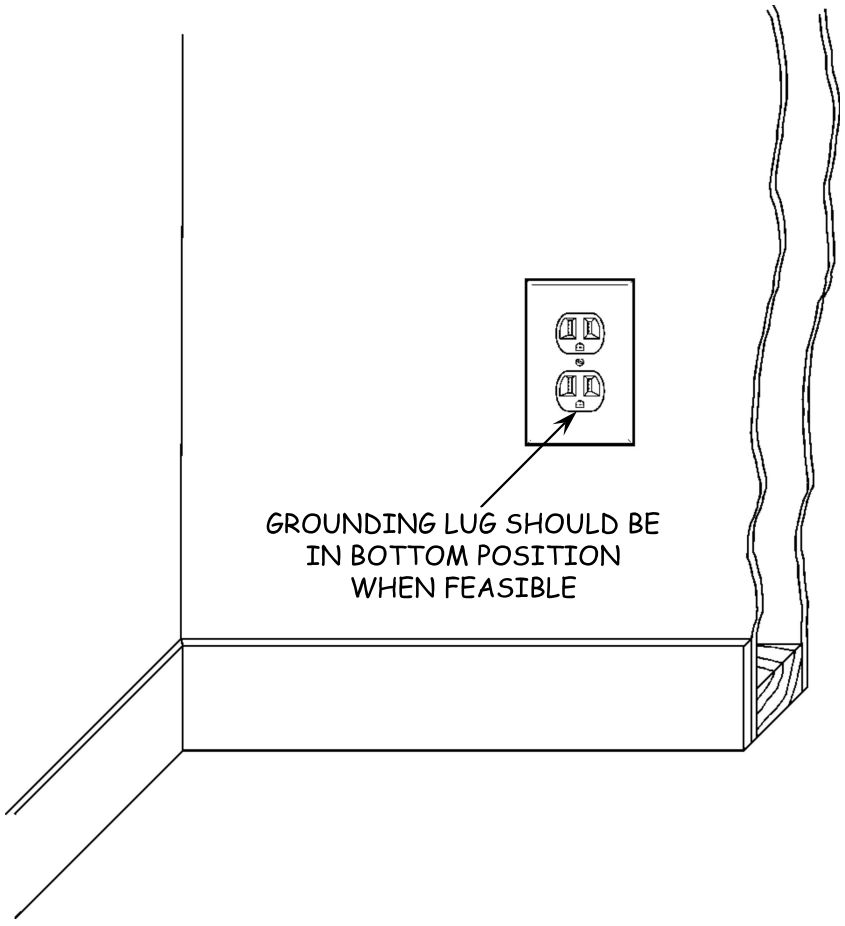
8. INSTALLATION OF NEW GROUNDED RECEPTACLE

- **A building permit shall be obtained and finalized when required by the local jurisdiction.**
- **New grounded receptacle**
  - A new three-prong receptacle with ground lug shall be installed when the pre-existing receptacle is nonconforming.
  - The new receptacle shall be properly grounded with the ground lug in the bottom position.
    Exception: The freezer cord has a right-angle plug designed to be installed with ground lug at top.
  - When installation of a grounding conductor is required to provide proper grounding, it shall be installed in conformance with local code and guidelines in IS Appendix C (Grounding Guidelines for Electrical Measures).



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9. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up**
  - Paint dust and chips, scraps, and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Furniture and other household items moved for installation work shall be returned to their original positions.
- **Customer shall be provided with the following:**
  - Written instructions for freezer operation and maintenance.
  - Written warranty documents with service phone numbers.
- **Temperature control shall be set appropriately.**

10. REMOVAL AND DISPOSAL OF EXISTING FREEZER

- **Packing materials and installation debris shall be removed from the premises.**
- **Existing freezer shall be removed from the premises by the installer, and disposed of and recycled in accordance with state and local waste disposal regulations.**

MOBILE HOME CRITERIA

None.

CUSTOMER RECEIVES WRITTEN INSTRUCTIONS AND WARRANTIES

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AIR PURIFIERS

Lead Paint Risk Factor
NONE

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MOBILE HOME CRITERIA 5

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SECTION X PREFACE
for

AIR PURIFIERS

1. Nonfeasibility Criteria

1.1. An air purifier is already present and operational.

1.2. A functional/accessible receptacle is not available.

1.3. The receptacle to be used is:

a. Not properly grounded, for units requiring grounding.

b. Unsafe (hazardous conditions exists).

1.4. An appropriate location is not available, due to such factors as the following:

a. Lack of a flat dry surface free of obstructions.

b. Presence of combustibles gases such as oxygen.

1.5. Customer refuses.

2. Installation Policies

2.1. Air purifier shall be installed in a room that is frequently occupied, such as a:

a. Den/office

c. Family room

d. Bedroom

3. Installation Policies Specific to Mobile Homes

None.

AIR PURIFIER STANDARDS

1. APPROVED MATERIALS

- **Air purifiers shall be:**
  - Portable.
  - ENERGY STAR-certified.
  - AHAM Verifide
  - UL-listed and compliant with UL 586.
  - CARB-certified and listed in the CARB-certified appliance database.
  - Equipped with a reusable pre-filter that can be cleaned.
- **Ionic air purifiers shall be:**
  - UL-listed and compliant with UL 2998.

2. WARRANTY

- **Refer to IS Appendix F (Minimum Warranty Requirements).**

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3. LOCATION

- **Air purifiers shall be installed:**
  - In an easily accessible location.
  - On a dry level surface.
  - In rooms with the highest number of potential pollution sources, such as pets or cooking.
  - A minimum of 6" from electrically sensitive devices, such as computers.
- **Air purifiers shall <u>NOT</u> be installed:**
  - In bathrooms, laundry rooms or any other damp location.
  - On soft, unstable surfaces such as a bed or sofa.
  - In areas or against furnishings that will reduce airflow such as under furniture, shelving, or behind curtains.
  - Near doors or under windows that allow clean air to exit the room.
  - Near open flames or sources of heat such as radiations, fireplaces, or ovens.
  - Within 5' of oxygen tanks or other combustible gases.
  - Near sources of vapor, metallic dust, or aerosol spray.
  - Near oil diffusers.
  - In corridors.
  - Outside.

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4. SIZING REQUIREMENTS

- **All units**
  - Air purifiers shall be sized:
    - To provide a Clean Air Delivery Rate (CADR) large enough for the area of the room being treated.
    - In accordance with manufacturer's recommendations and EPA's recommended minimums, as shown in Table X-1.

Table X-1: Estimated Minimum CADR of Air Purifiers Based on Room Area Being Served.

Room area (sq. ft.)	100	200	300	400	500
Minimum CADR (cfm)*	65	130	195	260	325

*The CADRs are calculated based on an 8-foot ceiling. If the room to be served has higher ceilings, select an air purifier with a higher CADR.

5. INSTALLATION

- **All units shall be:**
  - Installed in accordance with manufacturer's instructions.
  - Unboxed and all shipping material, (e.g., plastic wrap, cardboard, Styrofoam) shall be removed.
  - Inspected, ensuring the product is free of damage.

6. ELECTRICAL REQUIREMENTS

- **Electrical circuit**
  - Proper overcurrent protection shall be present or as recommended by appliance manufacturer's instructions.
  - Power cables shall not be placed under carpets, throw rugs, furniture, or appliances.
- **Electrical outlet**
  - Units with three-prong plugs shall be plugged into a properly grounded three-prong receptacle.
  - Units equipped with a two-prong polarized plug shall be plugged into a polarized receptacle.
  - The receptacle and cover plate shall be in good condition.

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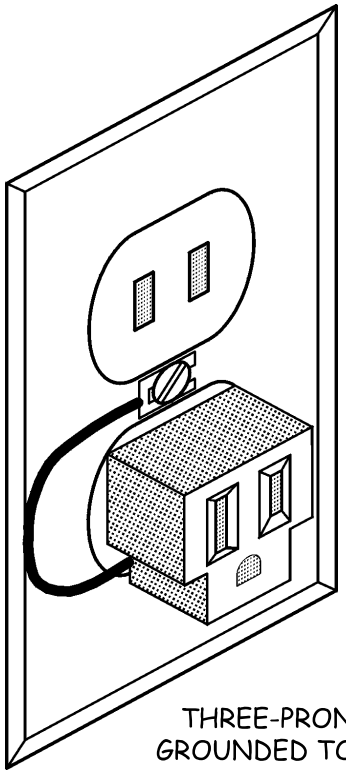
7. ADAPTERS AND EXTENSION CORDS

- **Three-prong adapters**
  - May be used when not prohibited by the manufacturer.
- **When adapters are used, they shall be:**
  - Aligned to provide proper polarity with the outlet and the power cord.
  - Connected to a ground source (e.g., a properly grounded two-prong receptacle or metal outlet box).
- **Extension cord**
  - An extension cord may be used when allowed by the manufacturer and with prior approval from the program manager.
  - Extension cords shall be:
    - UL-listed,
    - Minimum 14 AWG,
    - Maximum 6' in length, and
    - Matched with the air purifier plug.
  - Power cord and extension cord shall not create a tripping hazard.
  - The electric rating of the extension cord must be equal to or greater than the electric rating of the air purifier.



THREE-PRONG ADAPTER
GROUNDED TO RECEPTACLE

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8. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Operational check**
  - Air purifier shall be tested at all speeds to verify proper operation.
- **Instructions and warranties**
  - Customer shall be instructed of the proper use and care of the air purifier, including the filter replacement procedure.
  - Customer shall be provided with:
    - Manufacturer's written instructions.
    - Written warranty documents.
- **Clean-up**
  - All packing materials and other debris shall be cleaned up and removed from the premises.
  - Furniture and other household items moved for installation work shall be returned to their original positions.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

CUSTOMER RECEIVES WRITTEN INSTRUCTIONS AND WARRANTIES

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CLOTHES DRYERS

Lead Paint Risk Factor
NONE

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MOBILE HOME CRITERIA 7

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SECTION X PREFACE
for

CLOTHES DRYERS

1. Nonfeasibility Criteria

1.1. A functional dryer is not present or not accessible.

1.2. Energy source for the dryer heating element is not supplied by the utility providing ESA Program services.

1.3. Existing clothes dryer is 12 years old or newer.

1.4. A suitable location, with acceptable floor and proper clearances (including proper door swing), is not available.

1.5. Gas clothes dryers: Installation location does not provide adequate makeup air and correction is not feasible.

1.6. A properly-grounded electrical receptacle is not located within reach of the dryer's power cord.

1.7. A suitable clothes dryer vent is not available.

1.8. The existing clothes dryer is part of a stacked unit.

1.9. The existing dryer is exposed to the weather (outdoors).

1.10. Customer refuses.

2. Installation Policies

2.1. Clothes dryers may be provided to both homeowners and renters when there are at least four persons in the household.

2.2. The customer must have an active account with the IOU providing the clothes dryer heating element energy source, or be a sub-metered residential customer.

2.3. The clothes dryer heating element energy source must be supplied by the utility providing ESA Program services.

2.4. The customer must own the existing clothes dryer (in a rental, cannot be owned by the landlord).

3. Installation Policies Specific to Mobile Homes

None.

CLOTHES DRYER STANDARDS

1. APPROVED MATERIALS

- **Clothes dryer shall:**
  - Be ENERGY STAR-certified and
  - Meet the efficiency standards in Table X-1.
- **Dryer shall have the following features:**
  - Moisture sensor.
  - Multiple temperature settings.
  - Maximum test cycle time of 80 minutes.
- **Dryer vent pipe**
  - UL-listed, rigid metal.
  - *Exception*: Up to 6-feet of flexible metal duct may be allowed to aid in alignment.
- **Dryer vent connections shall be secured with:**
  - Dryer hose clamps, or
  - UL 181 A-P or UL 181 B-FX aluminum tape.
- **Gas piping and valves**
  - Gas valves: UL-listed and AGA- or CSA-certified.
  - Flexible connectors: Only new, IAPMO-listed stainless steel or plastic- or epoxy-coated brass connectors shall be used.
  - Fuel gas piping: Compliant with CMC, Chapter 13.

Table X-1: Minimum Criteria for ENERGY STAR Clothes Dryers

Dryer Type	Minimum Combined Energy Factor (lbs/kWh)
Vented Gas	3.48
Vented or Ventless Electric (4.4 cu-ft or greater capacity)	3.93
Vented or Ventless Electric – 120V (less than 4.4 cu-ft capacity)	3.80
Vented Electric – 240V (less than 4.4 cu-ft capacity)	3.45
Ventless Electric – 240V (less than 4.4 cu-ft capacity)	2.68

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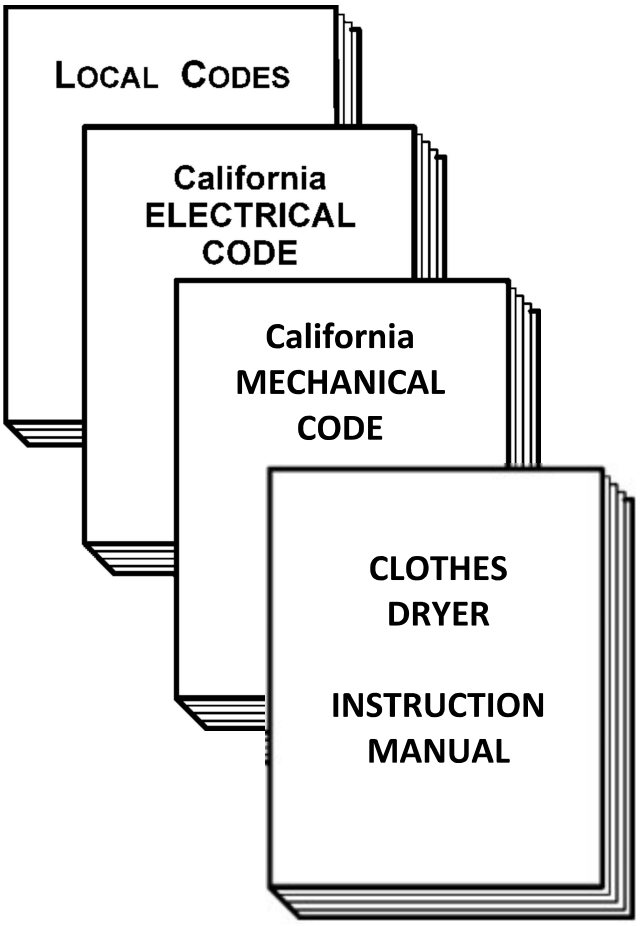
2. WARRANTY

- **Refer to IS Appendix F (Minimum Warranty Requirements).**

3. GENERAL REQUIREMENTS

- **Manufacturer's instructions and local code**
  - All installations shall be in compliance with appliance manufacturer's instructions and the requirements of the local jurisdiction.
  - A permit shall be obtained and finalized, if required by the local jurisdiction.
- **IS guidelines**
  - The installation criteria in this section are guidelines that shall be followed unless superseded by manufacturer's instructions/specifications or local code.



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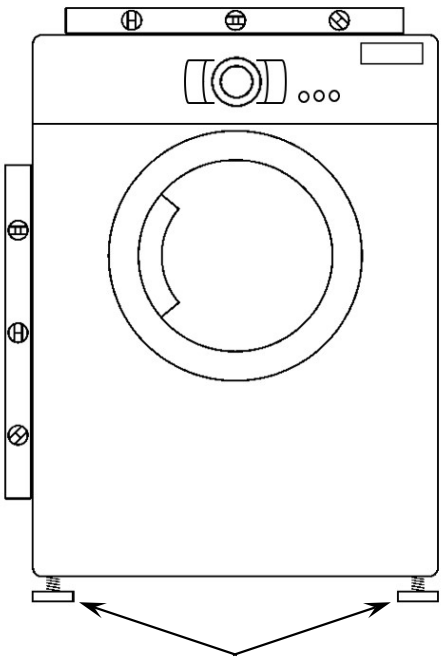
4. LOCATION AND SET-UP

- **The clothes dryer location shall:**
  - Allow spacing of at least 1" on all sides or as specified by the manufacturer.
  - Be verified to have ample room for opening the door (i.e., minimum 90° door swing).
  - Have a solid and sturdy floor that:
    - Can support the dryer with a full load, and
    - Has a maximum slope of 1" under entire dryer.
- **Makeup air – gas clothes dryers**
  - Makeup air shall be provided in accordance with the manufacturer's instructions.
  - When installed in a closet, the closet shall have a minimum opening of 100 sq. in. for makeup air or as specified by the manufacturer.
- **Unpacking**
  - Packaging and transit packing material (used to secure moveable parts for shipping) shall be removed.
- **Leveling**
  - These guidelines, or manufacturer's instructions if different, apply:
    - Individual feet (on leveling legs) shall be adjusted to properly level the clothes dryer with all four feet resting on the floor.
    - After leveling, the locking nuts shall be tightened to hold the feet in place.
    - Leveling legs shall be extended the minimum needed to properly level the machine.
- **Pedestal**
  - When an optional matching pedestal is utilized, it shall be installed as instructed and leveled as described above.



"FEET" ADJUSTED TO LEVEL CLOTHES DRYER

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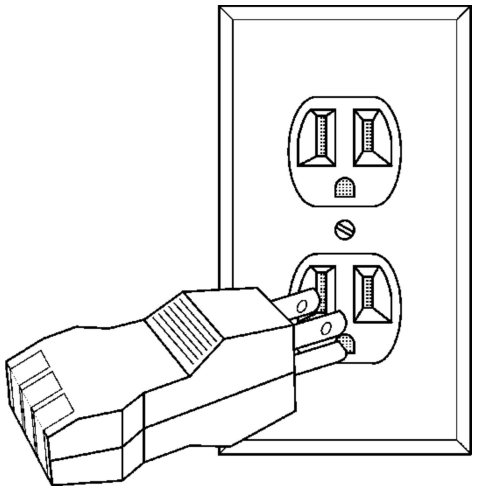
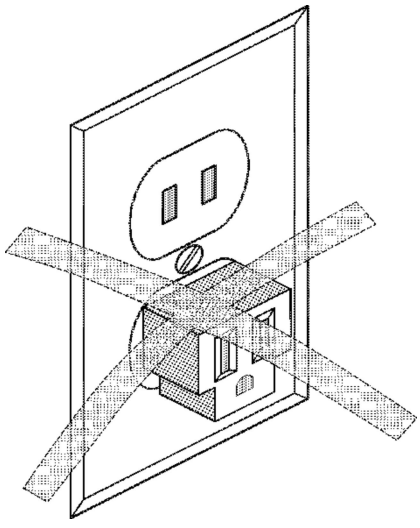
5. ELECTRICAL SUPPLY

- **Circuit**
  - Electrical supply shall be 220-volt (or 120V if appropriate for the dryer being installed) and shall meet manufacturer's specifications.
  - Proper circuit conductors and overcurrent protection (fuse or breaker) shall be present.
  - The outlet:
    - Shall be a properly grounded three-prong receptacle with a functional equipment grounding conductor.
    - When a grounding conductor is not present, one shall be provided, or GFCI protection may be installed in accordance with IS Appendix C (Grounding Guidelines for Electric Measures).
  - An outlet cover plate is required.
- **Cords and adapters**
  - Gas dryers
    - The grounding prong shall not be removed from the power cord.
    - An ungrounded three-prong adapter shall not be used.
    - An extension cord shall not be used.
  - Electric dryers
    - Extension cords and adapters shall not be used.



RECEPTACLE MUST BE THREE-PRONG AND PROPERLY GROUNDED



UNGROUNDED THREE-PRONG ADAPTER IS NOT ALLOWED

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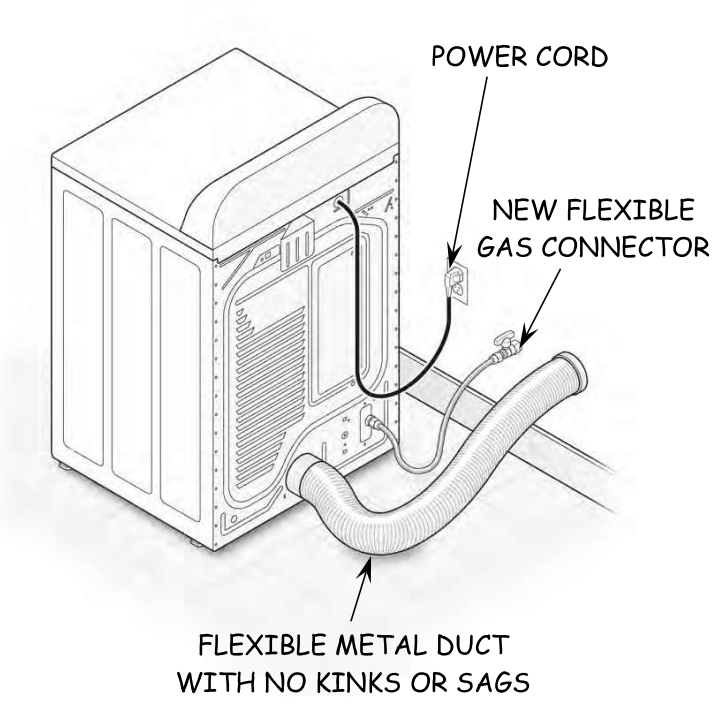
6. GAS REQUIREMENTS (GAS DRYERS ONLY)

- **Gas connections**
  - Fuel gas supply line shall be no more than 6-feet from the dryer to the valve.
  - New flexible connector with stainless-steel fitting and appliance valve shall be installed.
  - Flexible connector shall be listed epoxy-coated or stainless-steel units.
  - Threaded fittings shall be sealed with pipe thread compound or tape designed for use with gas lines.
  - All gas connections shall be tested for gas leaks in accordance with IS Section 24 (NGAT).

7. DRYER VENTING

- **Installation**
  - Intake and exhaust air volume shall be compliant with the manufacturer's specifications.
  - Existing dryer vents shall be verified for proper installation and termination, and corrected in accordance with IS Section 24 (NGAT) when needed.
  - The exhaust duct shall be a minimum of 4" in diameter.
  - Dryer vent shall not exceed 14' in total length, or as specified by the clothes dryer manufacturer and local code.
    - Subtract 2' from the total length (14' maximum) for each elbow, in excess of 2 elbows.
    - The first 6' of pipe may be flexible metal duct to aid in alignment.
  - Dryer vent connections shall be secured with dryer hose clamps or aluminum tape.



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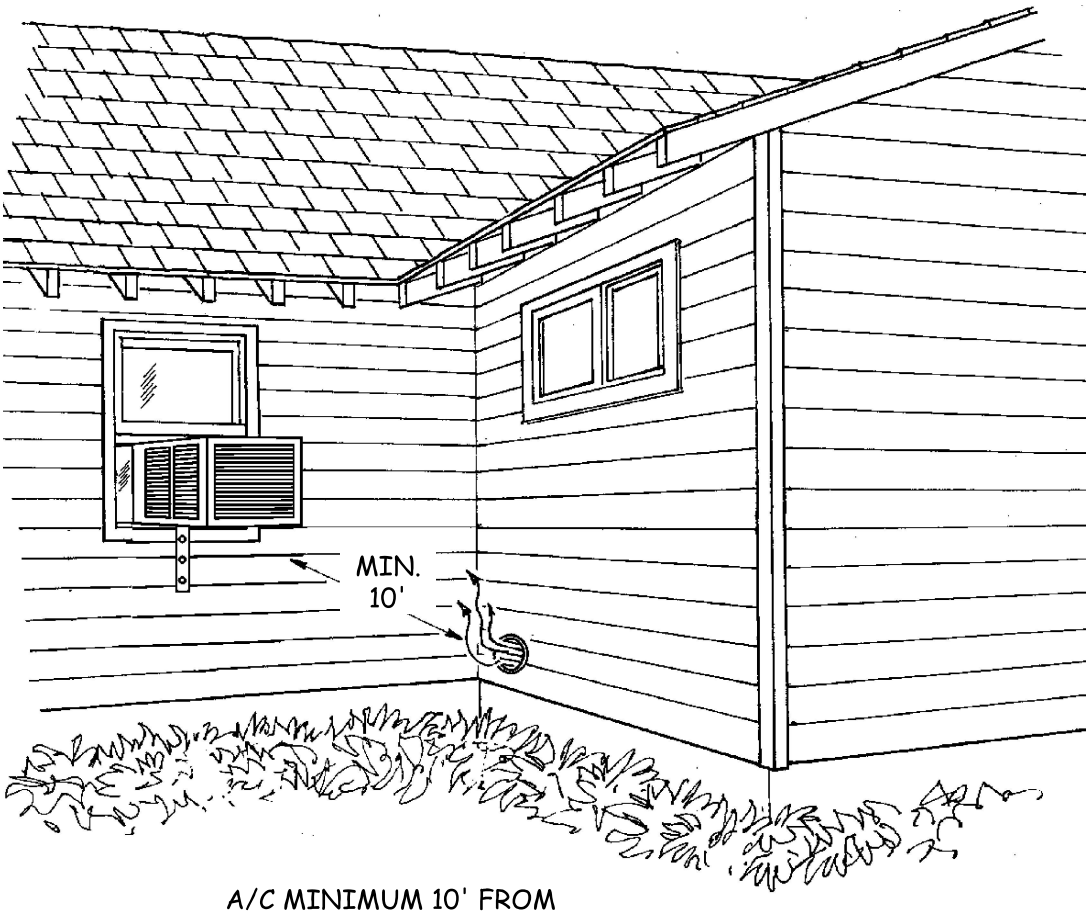
7. DRYER VENTING (CONT.)

- **Vent termination**
  - Dryer vent shall terminate on the exterior of the home and, unless otherwise specified by the manufacturer or local code, shall terminate in compliance with the following minimum clearances:
    - 3' from an openable door or window.
    - 3' from the property line.
    - 10' from window-mounted evaporative cooler or air-conditioner.
    - 5' from a central air conditioner or heat pump condensing unit.
  - Vent termination shall be equipped with a backdraft damper. Screens shall not be installed on the vent termination.
  - Dryer venting shall not pass through an FAU plenum.



A/C MINIMUM 10' FROM
CLOTHES DRYER MOISTURE EXHAUST

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8. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Operational check**
  - The clothes dryer shall be operated through a test cycle to verify proper operation and confirm the dryer is level.
  - Clearance for proper door swing shall be verified.
- **Post-installation safety testing**
  - All open combustion appliances occupying the same enclosure as the dryer shall be tested in accordance with IS Section 24 (NGAT).
- **Instructions and warranties**
  - Customer shall be instructed on the proper operation and care of the clothes dryer.
  - Customer shall be provided with:
    - Manufacturer's written instructions.
    - Written warranty documents.
- **Clean-up and disposal**
  - All packing materials and other debris shall be cleaned up and removed from the premises.
  - The replaced equipment and parts shall be removed from the premises and disposed of properly.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

OCCUPANT RECEIVES VERBAL
AND WRITTEN INSTRUCTIONS
AND MANUFACTURER'S WARRANTY

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CARBON MONOXIDE (CO) ALARMS

Lead Paint Risk Factor
LOW

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MOBILE HOME CRITERIA 8

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SECTION X PREFACE
for

CARBON MONOXIDE (CO) ALARMS

1. Nonfeasibility Criteria

1.1. Combustion appliances are not present in the home.

1.2. The dwelling is all-electric *and* does not have an attached garage.

1.3. Existing CO alarms provide required protection for all sleeping rooms/areas and other required locations.

1.4. Customer refuses.

2. Installation Policies

2.1. Homes may be eligible for CO alarms when:

a. Combustion appliances are present in the home, or

b. The dwelling is all-electric and has an attached garage.

2.2. CO alarms shall be installed:

a. In owner-occupied dwellings when required to fulfill requirements of a building permit, or

b. As a measure in all homes:

- Where a CO alarm is not present in each code-required location, or
- With attached garages (with or without a walk-through door to the living space), including all-electric homes.

2.3. Existing CO Alarms shall be replaced when:

a. It does not function properly when the “Test” button is pressed, or

b. It is functional but it is past the replacement date or the replacement date cannot be determined, or

c. The alarm is producing an end-of-life signal, or

d. It is damaged or non-functioning, or

e. It has been painted.

2.4. Combination Smoke and CO Alarms

a. Customers must be educated to understand that it is possible to erroneously think a CO alarm signal is a smoke alarm signal.

- If they hear the alarm but do not find any smoke or fire, it is most likely a CO warning.
- If there is a visible indicator on the alarm, that should be checked to determine which type of alarm is occurring.

- If the smoke and CO alarm sounds are different, the difference must be demonstrated to the occupants.

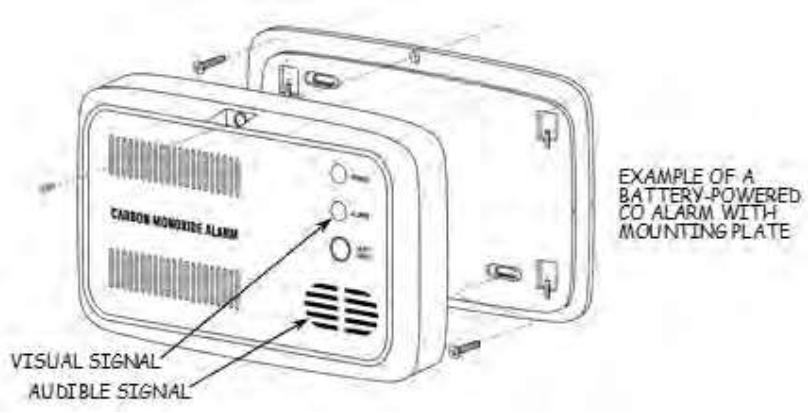
b. For alarms that have a voice feature to identify the alarm as CO or smoke, in a household that does not speak the language used in the alarm warnings, occupants must be educated to distinguish between CO or smoke warnings.

2.5. Wireless interconnected CO alarms—NOT allowed.

CARBON MONOXIDE (CO) ALARM STANDARDS

1. APPROVED MATERIALS

- **Single-purpose CO Alarms**
  - Listed to latest ANSI/UL 2034 standard.
  - Included in the CA State Fire Marshal's database of approved CO Alarms.
- **Combination Smoke and CO Alarms**
  - Included in the CA State Fire Marshal's database of approved *combination* Smoke and CO Alarms.
- **Interconnected CO Alarms**
  - Not allowed.
- **Battery-Powered Alarms**
  - Battery shall be non-replaceable, non-removable, and capable of powering the alarm for a minimum of 10 years.
- **Hard-Wired Alarms**
  - 120 VAC with factory-provided lithium battery backup.
- **Alarm warranty**
  - Single-Purpose Smoke Alarms: Alarm and battery shall have a minimum 10-year manufacturer's written material warranty.
  - Combination Smoke and CO Alarms: Alarm and battery shall have a minimum 10-year manufacturer's written material warranty.



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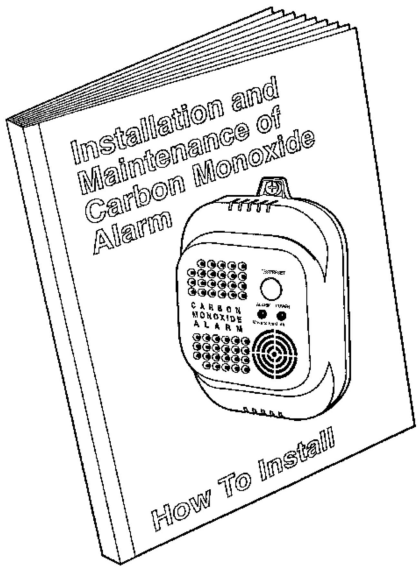
2. GENERAL INSTALLATION REQUIREMENTS

- **Instructions and date**
  - Installation shall be in compliance with this section, manufacturer's instructions, the California State Fire Marshal's requirements, and local code.
    - When a conflict occurs, the more restrictive provision shall be followed.
  - The date of installation shall be written with permanent ink in the space provided on the alarm.
    - The replacement date is the date of installation plus the expected life of the alarm, which is 10 years for both Single-Purpose and Combination CO and Smoke alarms or as stated by the manufacturer, if different.
- **Battery compartment**
  - The alarm manufacturer's original battery shall be used, and the battery compartment shall not be modified.

3. REQUIRED CO ALARM PROTECTION

- **Sleeping rooms/areas**
  - A properly functioning CO alarm shall be present in the following locations:
    - Outside (within 15') of:
      - All bedrooms and
      - Other areas used for sleeping (such as living room, den, converted garage, etc.)
    - Inside sleeping room(s) when:
      - There is no acceptable location to install the alarm outside the room, or
      - The sleeping room contains a combustion appliance.



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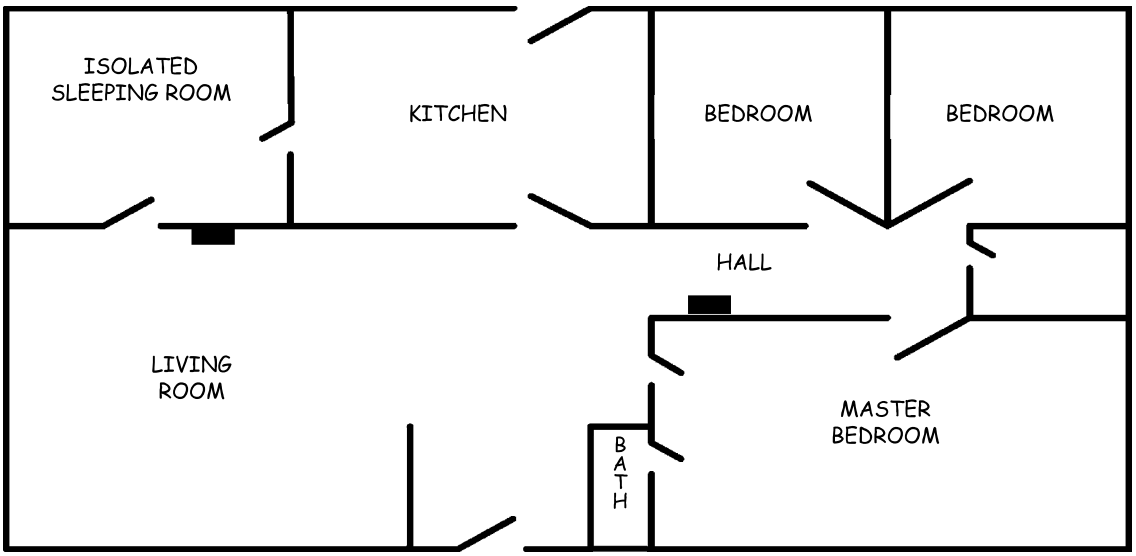
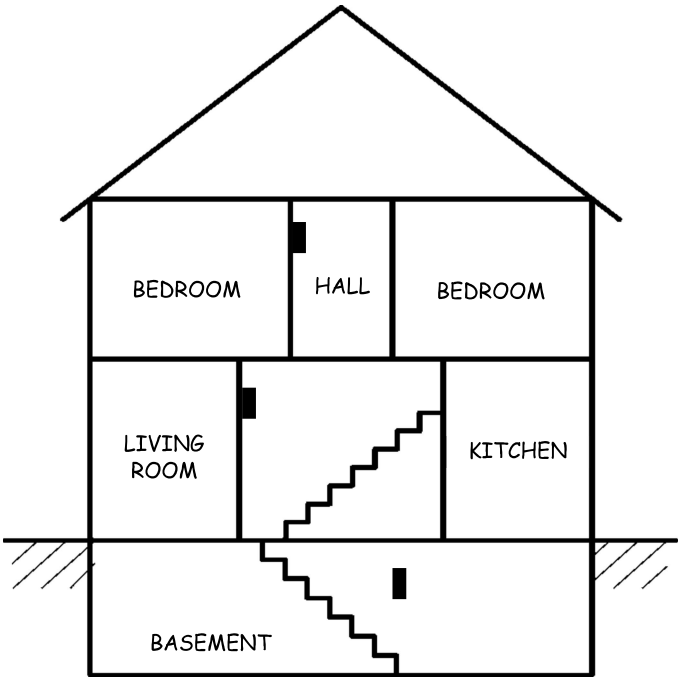
3. REQUIRED CO ALARM PROTECTION (cont.)

- **Single-story dwellings**
  - CO alarms shall, at a minimum, be installed in locations shown below.



CO ALARMS IN 1-STORY HOUSE (WITHIN 15' OF EACH BEDROOM)

- **Multi-story dwellings and basements**
  - In addition to sleeping area protection, a CO alarm shall be installed on each of the other levels of the dwelling, including basement and habitable attic.
  - Basement location: On the wall near the entry to the stairs.
  - Other levels and habitable attic: On the wall in a central location.



CO ALARMS IN 2-STORY HOUSE

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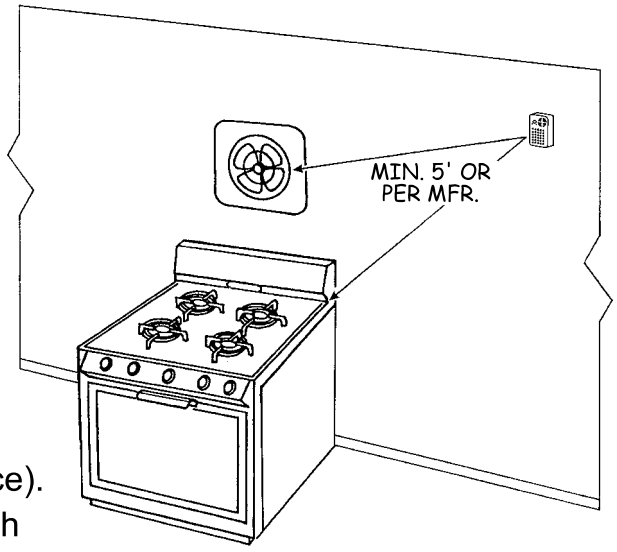
4. LOCATION RESTRICTIONS

- **Locations <u>not</u> allowed**
  - In an appliance enclosure or garage, or on an outside wall.
  - In unconditioned space (e*xcept basement,* where an alarm <u>is</u> required).
  - Locations with limited air circulation, such as:
    - Behind furniture or draperies, or behind a door in opened position.
    - Near an inside corner, in an alcove or closet, etc.
  - Storage area for household chemicals.
  - An area that may get hotter or colder than the alarm's high and low temperature limits.
  - Areas that are excessively greasy, dusty, or humid.
  - All other locations specified by the manufacturer to be avoided.
- **Minimum distances**
  - Alarm shall be installed at least <u>1 foot</u> away from the ceiling/wall junction.
  - Alarm shall be installed at least <u>3 feet</u> away from:
    - The air path of supply registers, return grille, fresh air vents, and exhaust fans.
    - The door or opening to:
      - Bathroom that contains a bathtub or shower,
      - Laundry room with washer or sink, or
      - Another moisture-producing source.
  - Alarm shall be installed at least <u>5 feet</u> horizontally away from the following:
    - Cooking appliances (gas or electric).
    - Openable windows or entrance doors from outdoors.
    - Ceiling fans.
    - Drafty locations (such as shell leaks).
    - A floor furnace (minimum 5' horizontally from the edge of the furnace grille).
    - Other furnace/heater and water heater (minimum 5' horizontally from the appliance).
    - Source of chemical odor, such as diaper pail or cat litter box.



  - Distances specified by the manufacturer, which *may be greater*.

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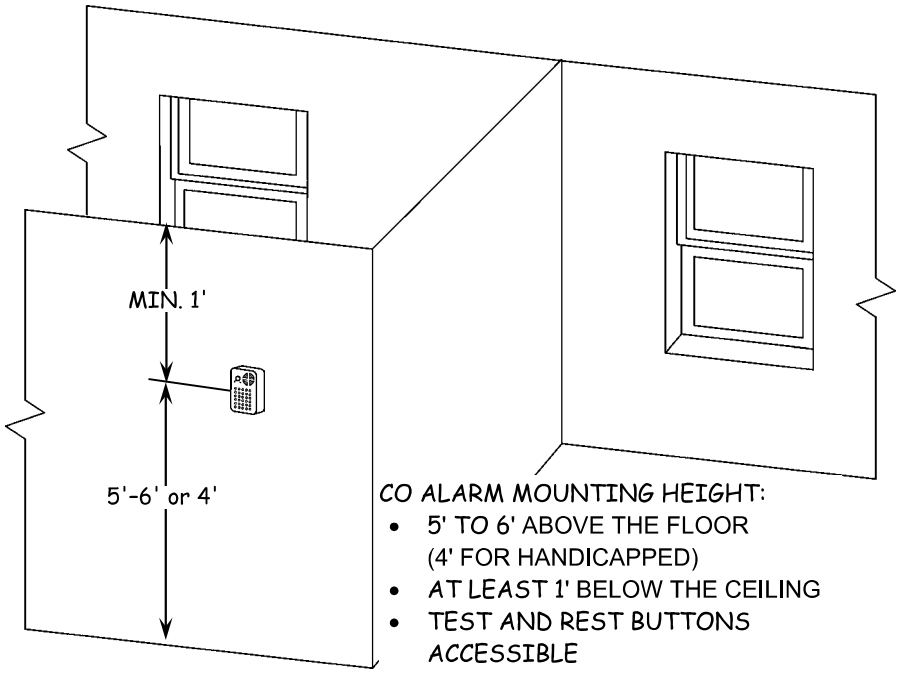
5. ACCEPTABLE LOCATIONS

- **Interior walls**
  - When possible, CO alarms shall be mounted on a wall (interior only).
  - Alarms shall be mounted 5' to 6' above the floor and at least 1' below the ceiling (measured to center of alarm).
    - *Exception:* Alarm may be mounted as low as 4' above the floor for adult occupants when:
      - Occupant is handicapped and using a wheelchair, or
      - Occupant's height justifies a lower location.
  - Alarms shall be in a position where the occupant can:
    - Reach the control buttons (test and reset), and
    - See the visual display (colored lights and/or readout).



- **Ceilings**
  - CO alarm installation on an insulated ceiling is allowed only when there is no acceptable wall location
  - Alarm shall not be installed on a ceiling with insulation levels less than R-11 or on ceilings of pre-1978 mobile homes.
  - Alarms shall be centrally located on the ceiling to the extent feasible.
- **All installations**
  - Alarm locations shall be in accordance with Item 4.

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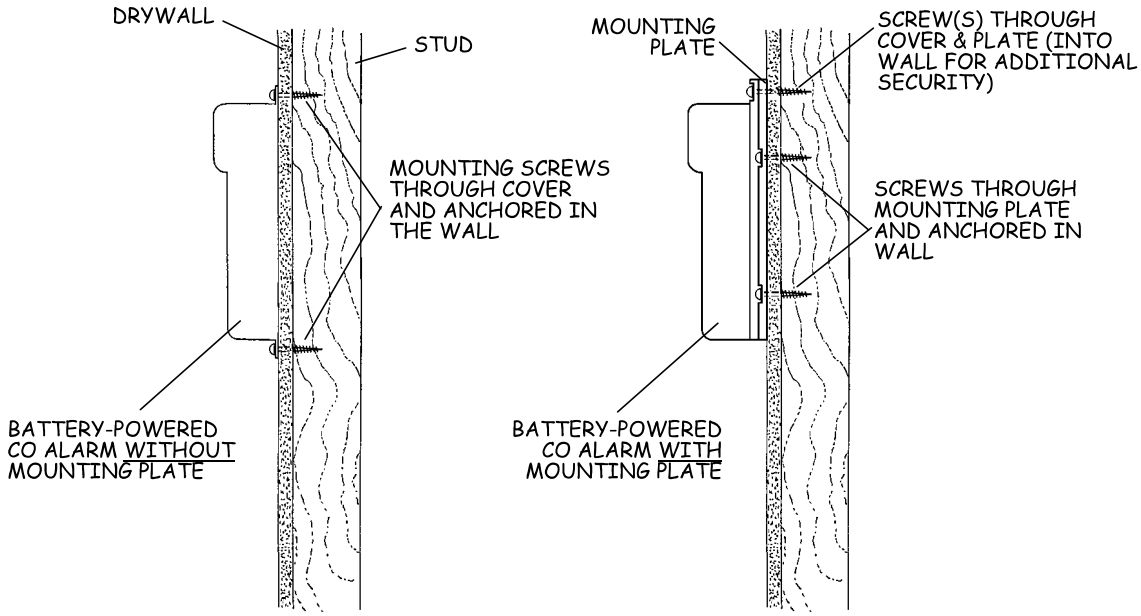
6. CO ALARM MOUNTING

- **All CO alarms**
  - Alarm shall be secured so it cannot be detached without removing one or more screws.
- **Alarms <u>with</u> mounting plate**
  - Mounting plate shall be secured to the wall with at least two standard screws (i.e., Phillips or slotted) that are properly anchored in the wall.
  - Alarm shall be secured to the mounting plate with one or more standard screws that extend through the alarm cover/body and into the mounting plate and/or the wall.[1]
- **Alarms <u>without</u> mounting plate**
  - Alarm shall be secured to the wall with at least two standard screws.
  - The screws shall:
    - Extend through the alarm cover/body and into the mounting surface, and
    - Be properly anchored in the wall.



[1] Tamper-resistant screws may be used to secure the alarm when requested by the owner or property manager. The tool to remove those screws shall be clearly labeled and provided to the owner/manager.

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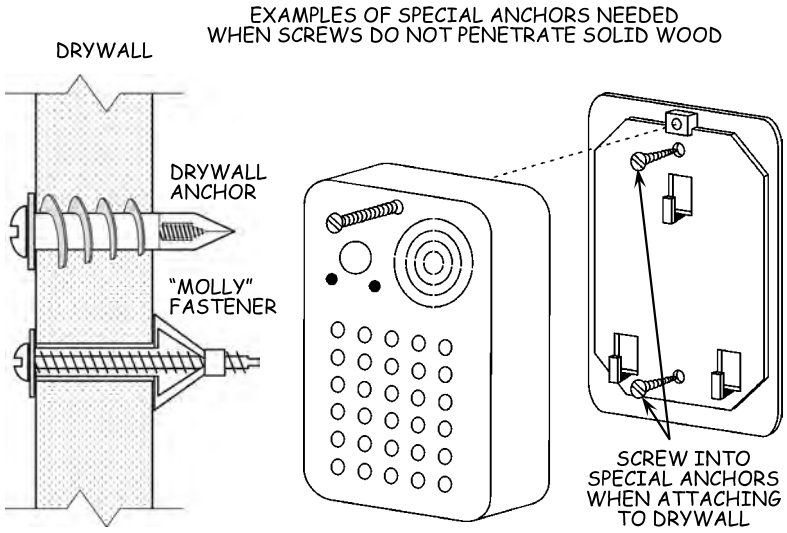
6. CO ALARM MOUNTING (cont.)

- **Screw installation/anchoring**
  - Mounting screws shall penetrate a framing member or solid wood sheathing when possible.
  - Screw-in or expansion anchor (e.g., drywall anchor, "molly" fastener, toggle bolt) shall be used when screw does not penetrate solid wood (e.g., is attached to drywall, plaster, paneling, etc.).



7. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up and disposal**
  - All packaging materials and other debris shall be cleaned up and removed from the premises.
  - Replaced units shall be removed from the premises and disposed of properly.
  - Household items moved for measure installation shall be returned to their original positions.
- **Alarm test**
  - Alarm shall be tested after installation.
    - Alarm sound shall be muffled during the testing process.
  - Alarm shall function properly in accordance with manufacturer's specifications.

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7. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS (cont.)

- **Customer instructions**
  - Both verbal and written *instructions* shall be provided regarding:
    - Maintenance of the alarm (e.g., periodic cleaning, protection from being painted, etc.).
    - Testing of the alarm.
    - Response to an activated alarm.
    - Response to failure signal (how to request replacement of the alarm or battery should failure occur during the warranty period).
    - Unique sound of the CO alarm(s), if different from that of smoke alarms.
- **Customer education**
  - Both verbal and written *educational information* shall be provided about:
    - Carbon monoxide.
    - The effects of CO on the human body.
    - The symptoms associated with CO poisoning.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.[2]

[2] Per Item 5, note that CO Alarms shall not be installed on ceiling with insulation levels less than R-11 or on ceilings of pre-1978 mobile homes.

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SMOKE ALARMS

Lead Paint Risk Factor
LOW

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MOBILE HOME CRITERIA 10

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SECTION X PREFACE
for

SMOKE ALARMS

1. Nonfeasibility Criteria

1.1. Existing smoke alarms are functioning properly, are less than 10 years old, and provide required protection for all sleeping rooms/areas and the other required locations.

1.2. Customer refuses.

2. Installation Policies

2.1. Smoke alarms shall be installed:

a. In owner occupied dwellings when required to fulfill requirements of a building permit, or

b. As a measure in all homes where a smoke alarm is not present in each code-required location.

2.2. Existing smoke alarms shall be replaced when:

a. It does not function properly when the “Test” button is pressed, or

b. It is functional but it is past the replacement date or the replacement date cannot be determined, or

c. The alarm is producing an end-of-life signal, or

d. It is damaged or non-functioning, or

e. It has been painted.

2.3. Combination Smoke and CO Alarms

a. Customers must be educated to understand that it is possible to erroneously think a CO alarm signal is a smoke alarm signal.
   - If they hear the alarm but do not find any smoke or fire, it is most likely a CO warning.
   - If there is a visible indicator on the alarm, that should be checked to determine which type of alarm is occurring.
   - If the smoke and CO alarm sounds are different, the difference must be demonstrated to the occupants.

b. For alarms that have a voice feature to identify the alarm as CO or smoke, in a household that does not speak the language used in the alarm warnings, occupants must be educated to distinguish between CO and smoke warnings.

2.4. Wireless interconnected smoke alarms—NOT allowed.

SMOKE ALARM STANDARDS

1. APPROVED MATERIALS

- **Single-Purpose Smoke Alarms**
  - Listed to UL 217.
  - Included in the CA State Fire Marshal's database of approved Smoke Alarms.
- **Combination Smoke and CO Alarms**
  - Included in the CA State Fire Marshal's database of approved combination Smoke and CO Alarms.
- **Interconnected CO Alarms**
  - Not allowed.
- **Battery-Powered Alarms**
  - Battery shall be non-replaceable, non-removable, and capable of powering the alarm for a minimum of 10 years.
- **Hard-Wired Alarms**
  - 120 VAC, and interconnectable, when required per Item 7.
  - Factory-provided lithium battery backup.
- **Alarm warranty**
  - Single-Purpose Smoke Alarms: Alarm and battery shall have a minimum 10-year manufacturer's written material warranty.
  - Combination Smoke and CO Alarms: Alarm and battery shall have minimum 10-year manufacturer's written material warranty.

2. GENERAL INSTALLATION REQUIREMENTS

- **Instructions and date**
  - Installation shall comply with this section, manufacturer's instructions, the California State Fire Marshal's requirements, and local code.
    - When a conflict occurs, the more restrictive provision shall be followed.
  - Date of installation shall be written in permanent ink in the space provided on the alarm.
    - The replacement date is the date of installation plus the expected life of the alarm, which is 10 years for both Single-Purpose and Combination CO and Smoke alarms or as stated by the manufacturer, if different.
- **Battery compartment**
  - The alarm manufacturer's original battery shall be used, and the battery compartment shall not be modified.

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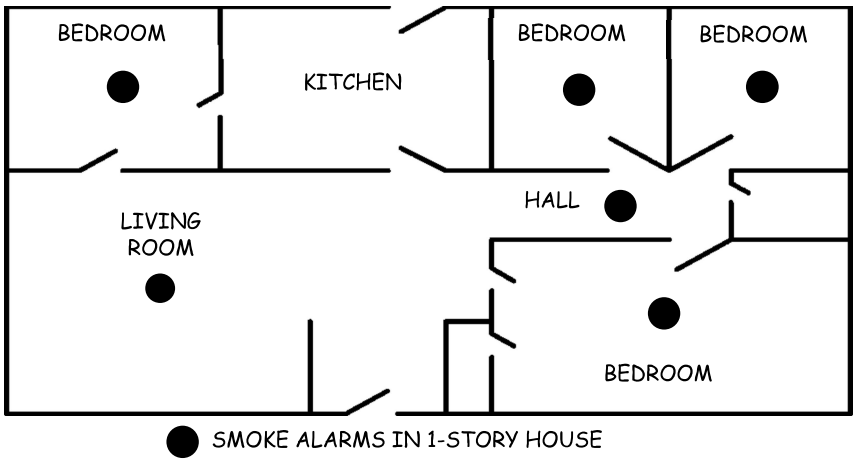
3. REQUIRED SMOKE ALARM PROTECTION

- **Sleeping areas**
  - A properly functioning smoke alarm shall be present in these locations:
    - Inside each bedroom and each separate area used for sleeping, and
    - Outside each sleeping area in the immediate vicinity of the bedrooms (within 15').



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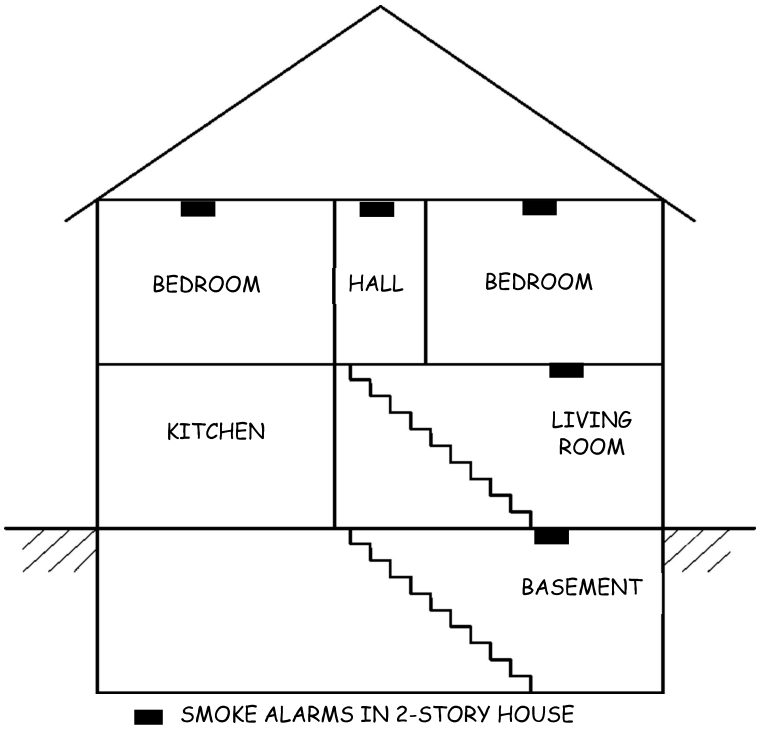
3. REQUIRED SMOKE ALARM PROTECTION (cont.)

- **Dwellings with basement or multiple stories**
  - In addition to sleeping area protection, a smoke alarm shall be installed on each of the other levels of the dwelling, including basement and habitable attic.
  - In a dwelling with split levels (less than one full story between levels) without an intervening door between adjacent levels, a smoke alarm installed on the upper level satisfies the protection requirement for the adjacent lower level.
- **Stairway locations**
  - When there is a stairway leading from one floor to another, an alarm is required at the top of the stairway.
    - Alarm must be in a location where an intervening door or obstruction will *not* prevent rising smoke from reaching the alarm.
    - When the alarm in the upstairs hallway (located within 15' of the upstairs bedrooms) can be placed at the top of the stairway, a second alarm is not required in that hallway.
- **Basement location**
  - When there is a basement, an alarm is required on the basement ceiling near the entry to the stairs.



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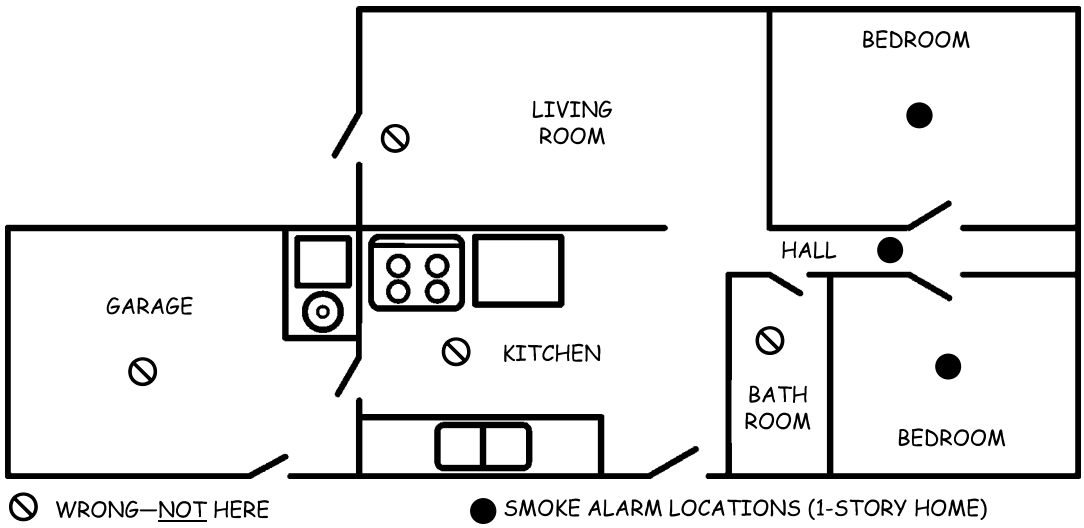
4. LOCATION RESTRICTIONS

- **Minimum distances**
  - Minimum 1-foot horizontal distance from fluorescent lights.
  - Alarms shall be installed a minimum 3-foot horizontal distance from:
    - The door or opening to a:
      - bathroom that contains a bathtub or shower.
      - laundry room with washer or sink, or other moisture source.
    - The outlet of a forced air supply register (and outside the direct flow from the register).
    - The return grille, an exhaust fan intake, and the blades of a ceiling fan.
    - A whole-house exhaust fan intake (does not apply to a mechanical ventilation unit).
    - Openable window or entrance door.
    - Source of draft (e.g., shell leaks).
  - Minimum horizontal distance from space and water heaters, and from cooking appliances:
    - Ionization alarms: 20'
    - Photoelectric alarms: 10'
    - *Exceptions:*
      - Photoelectric alarms: 6' distance allowed when the kitchen/cooking area and adjacent spaces have no clear interior partitions, and the 10' distance would prevent locating the alarm where required (e.g., near bedrooms).
      - Alarms *listed for use in close proximity* to cooking appliances may be installed per manufacturer's instructions, if less than specified above.
  - Distances specified by the manufacturer, which may be greater.



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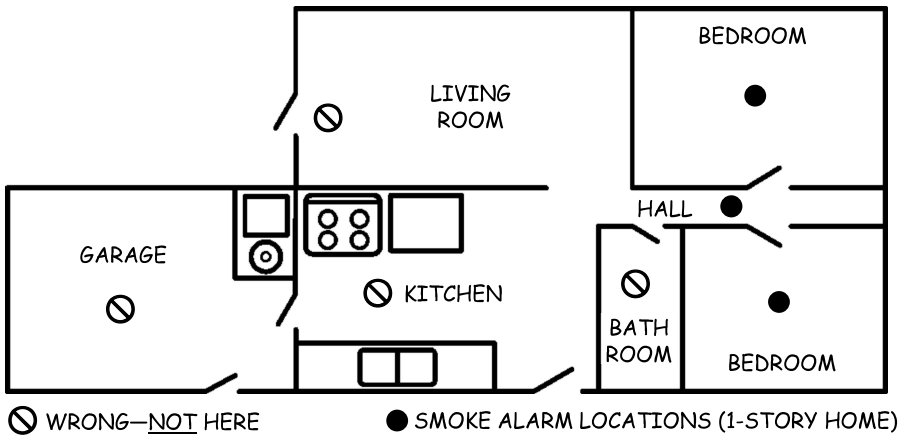
4. LOCATION RESTRICTIONS (cont.)

- **Locations not allowed**
  - In kitchen, garage, or unconditioned space (*except* basement, where an alarm is required), or insect-infested area.
  - Over an electrical junction box (if alarm is battery-powered).
  - Locations with limited air circulation, such as:
    - Less than 4 inches from the ceiling/wall junction or the peak of a sloped (cathedral) or peaked (A-frame) ceiling (see Item 5).
    - Behind furniture or draperies, near an inside corner, in an alcove or closet, etc.
  - All other locations specified by the manufacturer to be avoided, such as an area that:
    - Is excessively greasy, dusty, or humid.
    - May get hotter or colder than the alarm's temperature limits (e.g., on an outside wall or a poorly insulated ceiling).

5. SMOKE ALARM PLACEMENT

- **Acceptable locations**
  - Alarms shall be installed on the ceiling, when feasible.
  - *Interior* wall location acceptable, when ceiling installation is not feasible (e.g., when attic/roof cavity has little or no insulation).



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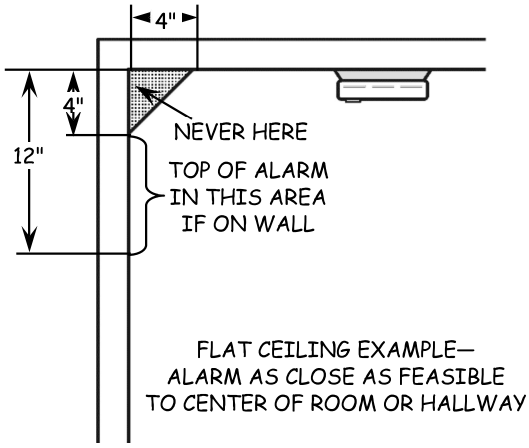
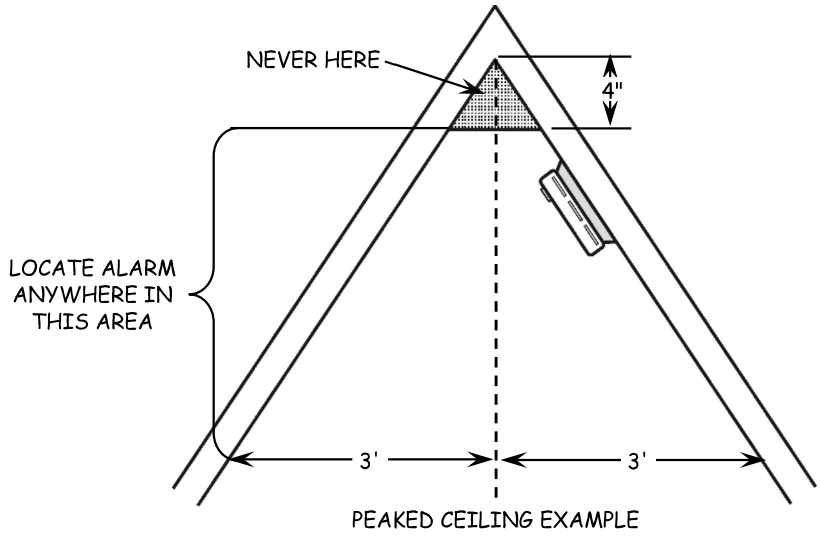
5. SMOKE ALARM PLACEMENT (cont.)

- **Flat ceilings**
  - Smoke alarm installed on the ceiling shall be:
    - Positioned at least 4" from the wall.
    - Located as close as feasible to the center of the room.
    - Centered between hallway walls.
  - Alarms installed on the wall shall have the top edge located from 4" to 12" below the ceiling.



- **Peaked (A-frame) ceilings**
  - Alarm shall be installed on either ceiling near the peak and located:
    - At least 4" vertically below the peak, and
    - Above the plane created by a 6-foot horizontal line extending ceiling-to-ceiling.



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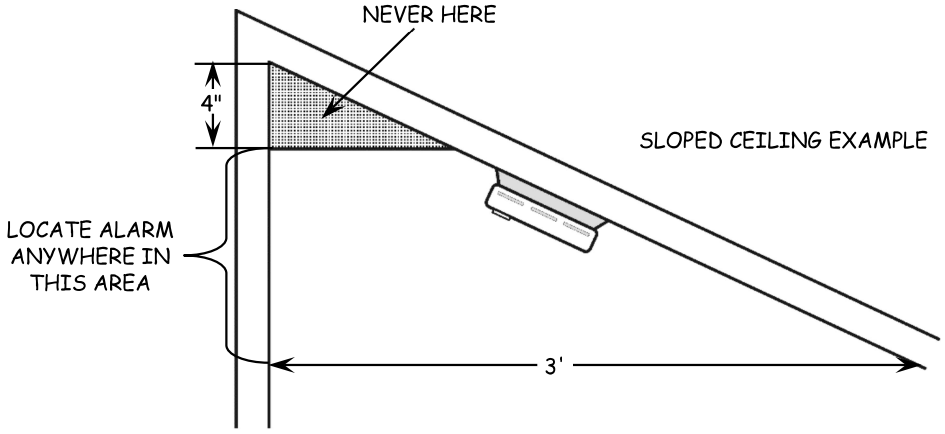
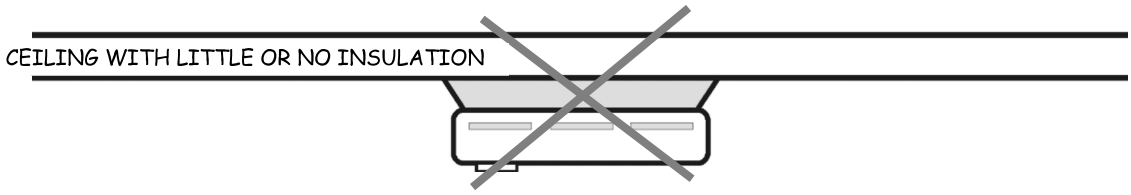
5. SMOKE ALARM PLACEMENT (cont.)

- **Sloped (cathedral) ceilings**
  - Alarm shall be installed on the ceiling or wall and located:
    - At least 4" vertically below the peak, and
    - Above the plane created by a 3' horizontal line extending wall-to-ceiling.



- **Coffered ceilings (tray-shaped with sunken panels)**
  - Alarm shall be installed on the:
    - Highest portion of the ceiling, or
    - Sloped portion of ceiling within 12″ vertically down from highest point.
- **Ceilings with joists or beams**
  - For ceilings with beam depth less than 10% of the ceiling height, alarm shall be located on the bottom of a beam, or as specified by the local jurisdiction, if more stringent.
  - For ceilings with greater beam depths, alarm shall be located in compliance with NFPA 72 and requirements of the local jurisdiction.
- **Ceilings with inadequate insulation**
  - Applies to homes with attic/roof cavity insulation levels less than R-11 and pre-1978 mobile homes.
  - Smoke alarms shall be installed on *interior walls* (not on the ceiling, and not on outside walls).



SMOKE ALARM IS NOT INSTALLED ON A CEILING (OR WALL) THAT WILL BECOME VERY WARM OR COLD DURING EXTREME WEATHER

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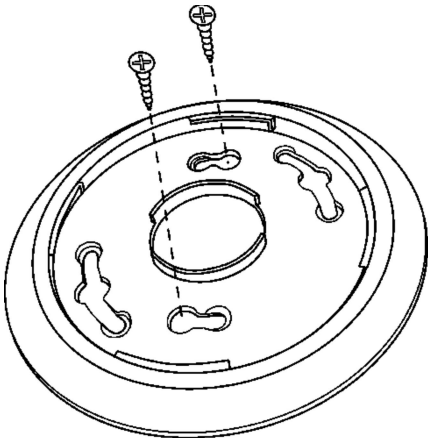
6. SECURE INSTALLATION

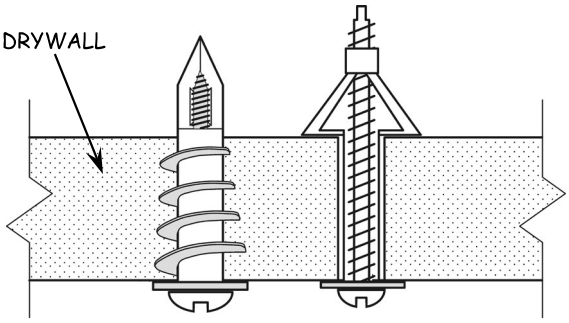
- **Mounting system**
  - Mounting plate shall be secured to the ceiling or wall with at least two screws.
  - Alarm shall be secured to the mounting plate per manufacturer's instructions.
- **Screw installation/anchoring**
  - Mounting screws shall penetrate a framing member or solid wood sheathing.
  - Screw-in or expansion anchor (drywall anchor, "molly" fastener, toggle bolt, etc.) shall be used when screw does not penetrate solid wood.

7. HARD-WIRED SMOKE ALARMS

- **All Units**
  - Hard-wired smoke alarms shall be installed when:
    - Required by the local jurisdiction, or
    - Replacing existing hard-wired smoke alarms.
  - Installation and wiring shall be in compliance with manufacturer's instructions and local code.



MOUNTING PLATE SECURED
TO CEILING OR WALL
WITH AT LEAST TWO SCREWS



SCREW-IN & EXPANSION ANCHORS
USED WHEN SCREW DOES NOT
PENETRATE SOLID WOOD

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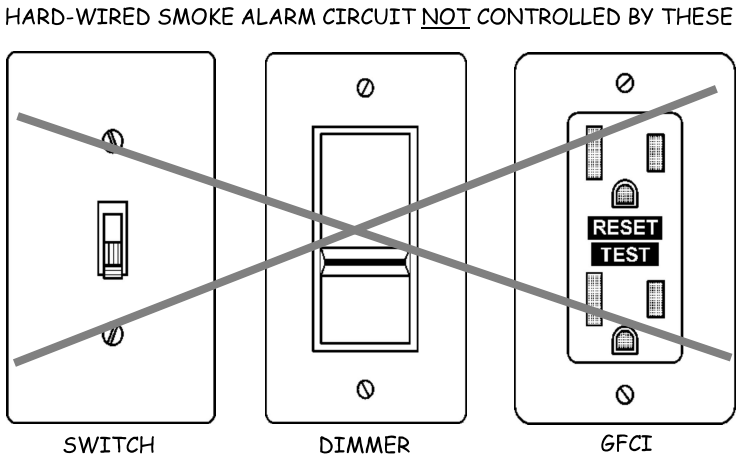
7. HARD-WIRED SMOKE ALARMS (cont.)

- **All units (cont'd)**
  - Circuit powering the alarm(s) shall be:
    - 24-hour, 120V AC 60 Hz.
    - Not controlled by a switch, dimmer, ground fault circuit interrupter (GFCI), or arc fault circuit interrupter (AFCI).
  - Alarm shall be mounted over a standard wiring junction box.
- **Interconnected alarms**
  - If more than one hard-wired alarm is installed, they shall be interconnected, if required by code.
  - If multiple hard-wired smoke alarms are present and interconnected, and at least one within the group will be replaced:
    - The replacement alarm shall be compatible with the existing interconnection system, or
    - All of the interconnected smoke alarms shall be replaced, when required by the local jurisdiction (condition shall be documented in the permanent file).



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8. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up and disposal**
  - All packaging materials and other debris shall be cleaned up and removed from the premises.
  - Replaced units shall be removed from the premises and disposed of properly.
  - Household items moved for measure installation shall be returned to their original positions.
- **Alarm test**
  - Alarms shall be tested after installation.
    - Alarm sound shall be muffled during the testing process.
  - Alarm shall function properly in accordance with manufacturer's specifications.
- **Customer education**
  - Both verbal and written instructions shall be provided regarding:
    - Maintenance of the alarm (e.g., periodic cleaning, protection from being painted, etc.).
    - Testing of the alarm.
    - Response to an activated alarm.
    - Response to failure signal (how to request replacement of the alarm or battery if failure should occur during the warranty period).
    - Unique sound of the smoke alarm(s), if different from that of CO alarms.

MOBILE HOME CRITERIA

9. CEILINGS WITH INADEQUATE INSULATION

- **Pre-1978 mobile homes**
  - Smoke alarms shall be installed on interior walls, instead of the ceiling, as prescribed in Item 5.
  - Alarms shall not be installed on *outside* walls.

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COLD STORAGE

Lead Paint Risk Factor
NONE

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MOBILE HOME CRITERIA 3

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SECTION X PREFACE
for

COLD STORAGE

1. Nonfeasibility Criteria

1.1. Customer is not located in a high wildfire threat area.

1.2. A cold storage product is already present and free of damages.

1.3. Customer refuses.

2. Installation Policies

2.1. All cold storage products must be contractor-installed.

2.2. Cold storage products shall not be dropped off or handed to the customer for unpacking.

3. Installation Policies Specific to Mobile Homes

None.

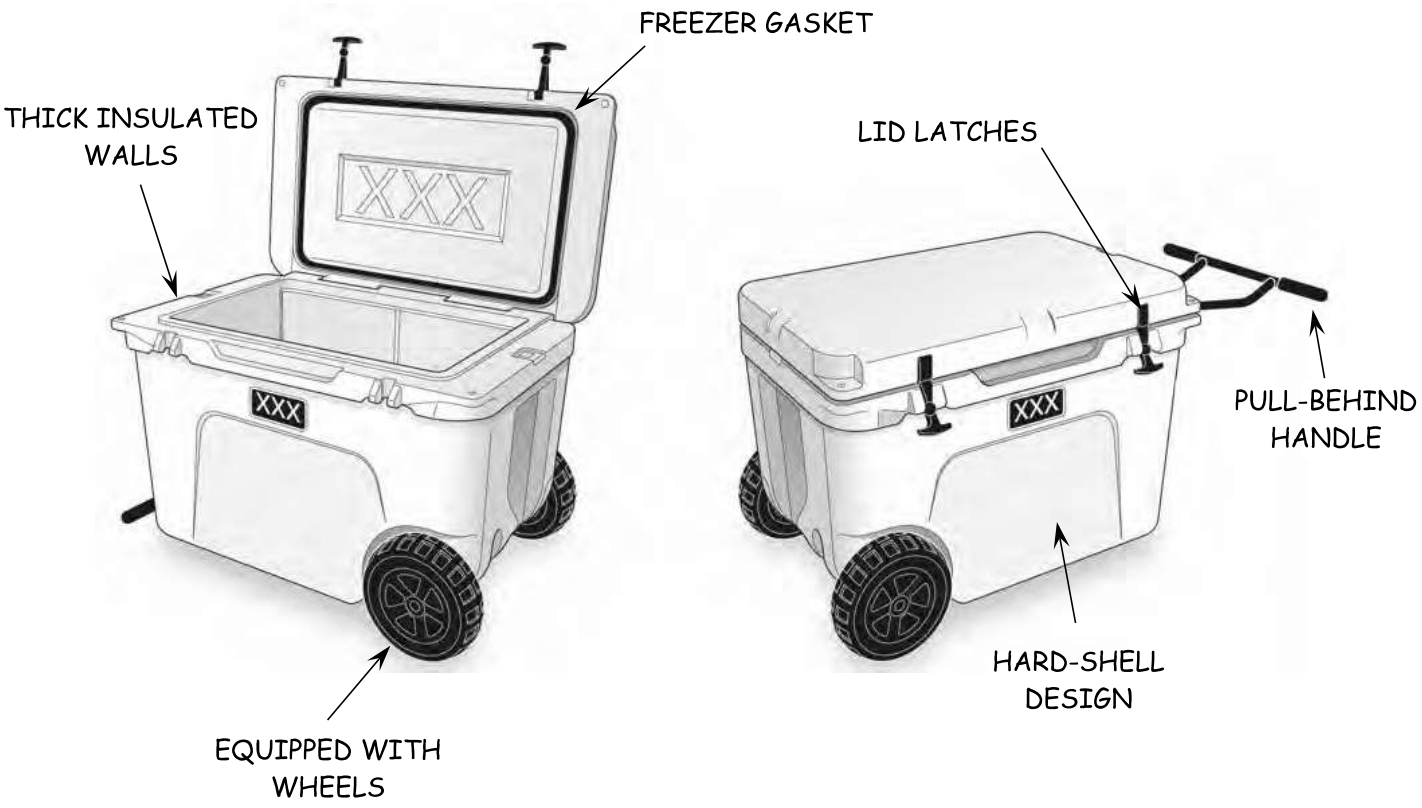
COLD STORAGE STANDARDS

1. APPROVED MATERIALS

- **All coolers shall be:**
  - Hard-shell type.
  - Polyethylene or polypropylene construction.
  - Insulated with a minimum of 2” polyurethane foam.
  - Manufactured via roto-molding or injection molding.
  - Rated for a minimum of 5-days ice retention.
  - 35-quart minimum storage capacity.
  - Equipped with wheels.
  - Interagency Grizzly Bear Committee (IGBC) certified bear-resistant.

2. WARRANTY

- **Refer to IS Appendix F (Minimum Warranty Requirements).**



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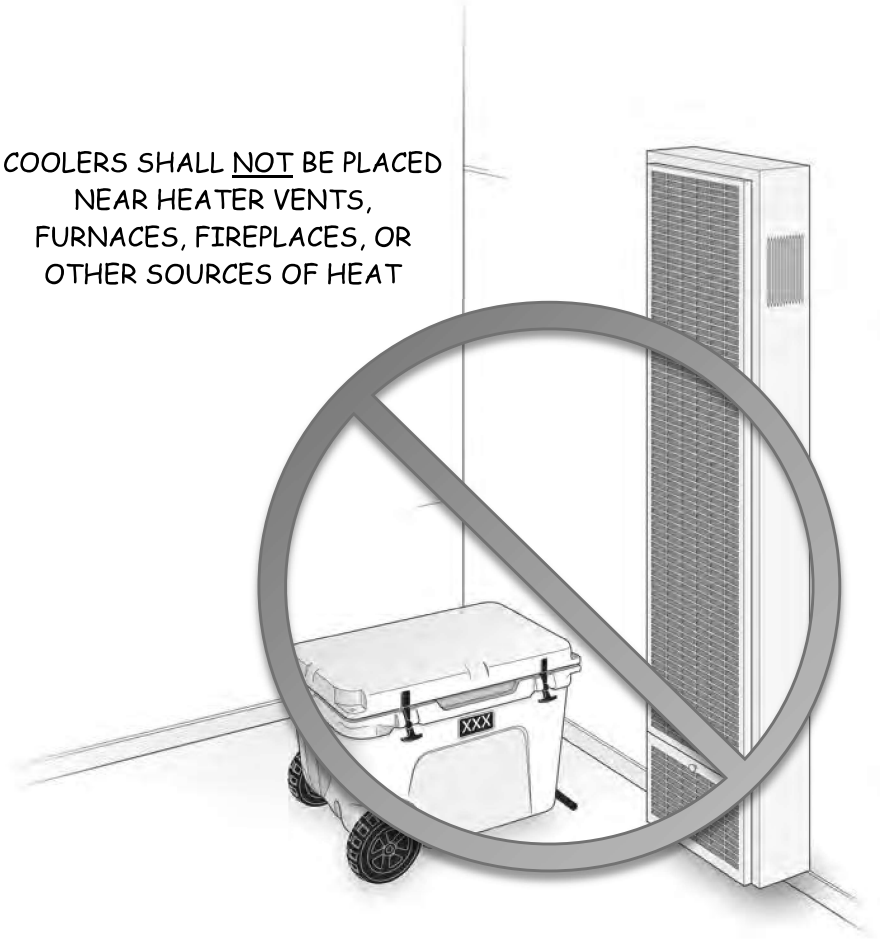
3. INSTALLATION

- **All coolers shall be:**
  - Unboxed and all shipping material (e.g., plastic wrap, cardboard, Styrofoam) shall be removed.
  - Inspected, ensuring the product is free of damage.
  - Assembled, when required.
- **Location**
  - Cooler shall be placed in a storage location that is:
    - Accessible,
    - Indoors and free of exposure to weather,
    - In accordance with customer's wishes.
  - Shall avoid heater vents, furnaces, fireplaces, and other sources of heat that may cause damage.
  - Shall not pose a tripping hazard.



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4. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Instructions and warranties**
  - Customer shall be instructed on the proper use and care of the cooler, including:
    - Avoiding sources of heat that could damage the cooler.
    - Avoiding use as step stool or seat.
    - Cleaning and sanitizing before and after use.
    - Heeding caution when storing medication.
  - Customer shall be provided with:
    - Manufacturer's written instructions.
    - Written warranty documents.
- **Clean-up**
  - All packing materials and other debris shall be cleaned up and removed from the premises.
  - Furniture and other household items moved for installation work shall be returned to their original positions.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

OCCUPANT RECEIVES VERBAL AND WRITTEN INSTRUCTIONS AND MANUFACTURER'S WARRANTY

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DIAGNOSTIC AIR SEALING

Lead Paint Risk Factor
LOW-HIGH

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SECTION X PREFACE
for

DIAGNOSTIC AIR SEALING

1. Nonfeasibility Criteria for Shell Leakage Testing

All Shell Leakage Testing

1.1. The dwelling is NIM.

1.2. A doorway suitable for installation and proper operation of shell leakage equipment is not available.

1.3. An operable FAU is present and duct sealing is not feasible per IS Section 10 (Duct Testing and Sealing) or IS Section 39 (Prescriptive Duct Sealing).

1.4. A non-compliant solid-fuel burning appliance is present and repair or replacement is not feasible.

1.5. A natural gas appliance hazard exists requiring repair or replacement per NGAT policy, and repair/replacement is not feasible.

1.6. Health or physical limitations of occupants makes shell leakage test inappropriate.

1.7. An open combustion gas-burning space heater or water heater, or solid-fuel burning appliance is present that draws combustion air from the living space.

1.8. A gas-log fireplace is present and dampers cannot be properly blocked.

1.9. Units in multi-family buildings with enclosed hallways: An operable common hallway door or window that communicates with the outdoors is not available.

1.10. Customer refuses.

Depressurized Shell Leakage Testing

1.11. Wood or other solid fuel heating fireplace or appliance is operating, or ashes/coals are present.

1.12. Vermiculite is present in the attic, and unless proved otherwise, asbestos is presumed to be present.

1.13. Friable asbestos is present.

1.14. Animal feces are found in the attic that may be a health hazard.

1.15. A sewage leak is present in the crawlspace.

Pressurized Shell Leakage Testing

1.16. A fire or hot coals are present and the ashes cannot be contained and covered.

1.17. Pressurization would cause an unsafe condition in the home.

2. Nonfeasibility Criteria for Air Sealing

2.1. Shell leakage testing is not feasible.

2.2. Shell leakage is below the start policy.

3. Installation Policies for Diagnostic Air Sealing

3.1. Diagnostic air sealing as a measure will be offered and performed only in accordance with individual utility policy.

3.2. Sealing shall be concluded when:

a. The home has reached a total shell leakage of 5 ACH_{50}, or

b. Less than 1 ACH_{50} difference in leakage is achieved after 1 hour of sealing.

3.3. Duct testing and sealing or prescriptive duct sealing shall be completed before shell leakage testing and sealing activities occur.

3.4. Pressurized shell leakage testing may be conducted when depressurization is not feasible and no conditions exist that would deem pressurization of the home unsafe.

3.5. The utility or its designee will review initial and verify final shell leakage rates, in accordance with the procedures in this section.

3.6. When extreme weather conditions are present, efforts shall be taken to reschedule testing so that measures received are not restricted unnecessarily.

4. Installation Policies Specific to Mobile Homes

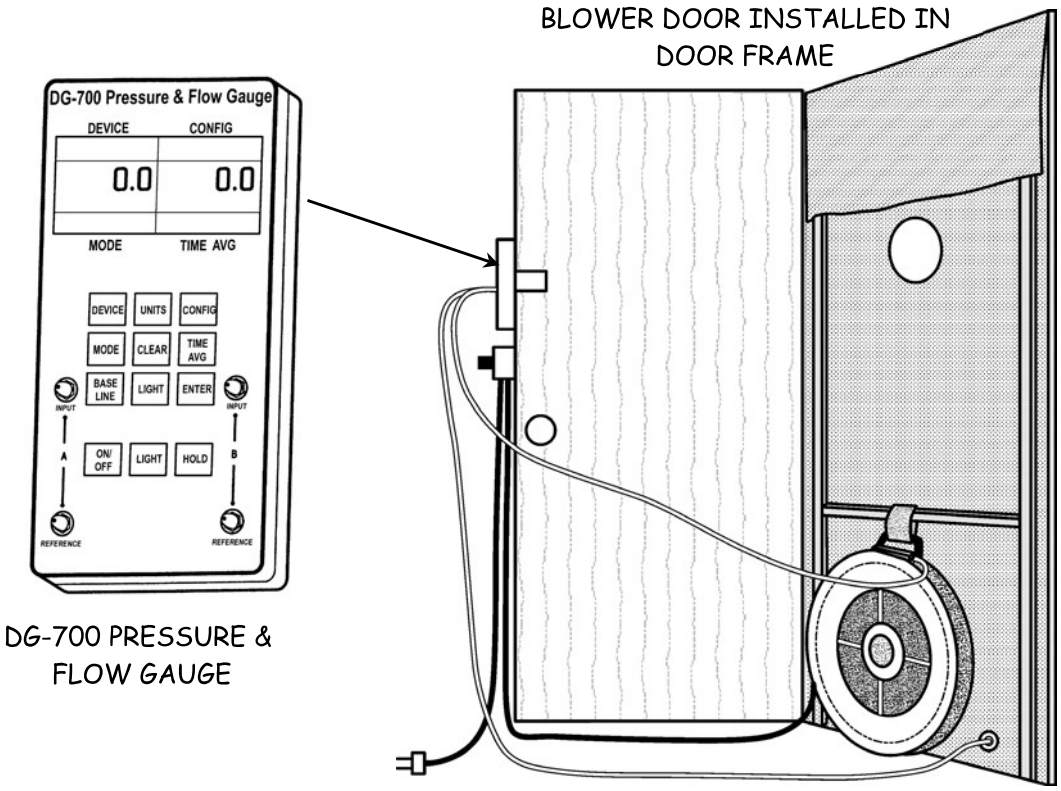
4.1. None.

DIAGNOSTIC AIR SEALING STANDARDS

PART 1: SHELL LEAKAGE TESTING

1. EQUIPMENT

- **Leakage measurement equipment**
  - Test equipment shall be in compliance with current Title 24 Residential Appendix RA3.
  - Commercially-produced equipment shall be used or as specified by individual utility policy.
  - Digital Manometers (pressure gauges) shall be used.
  - House pressure gauge shall display Pascals with a range from 0 to 60 Pa, and accuracy of ±10%.
  - Fan Flow gauge shall display Pascals and CFM with a range of 500 to 6000 cfm, and an accuracy of ±10%.
  - Gauges may be calibrated in inches of Water Column (IWC) if the range is between 0 and 0.25 IWC with an accuracy of ±5%.
  - Smoke pencil shall be used, in conjunction with Blower Door, as an additional leak detection method.



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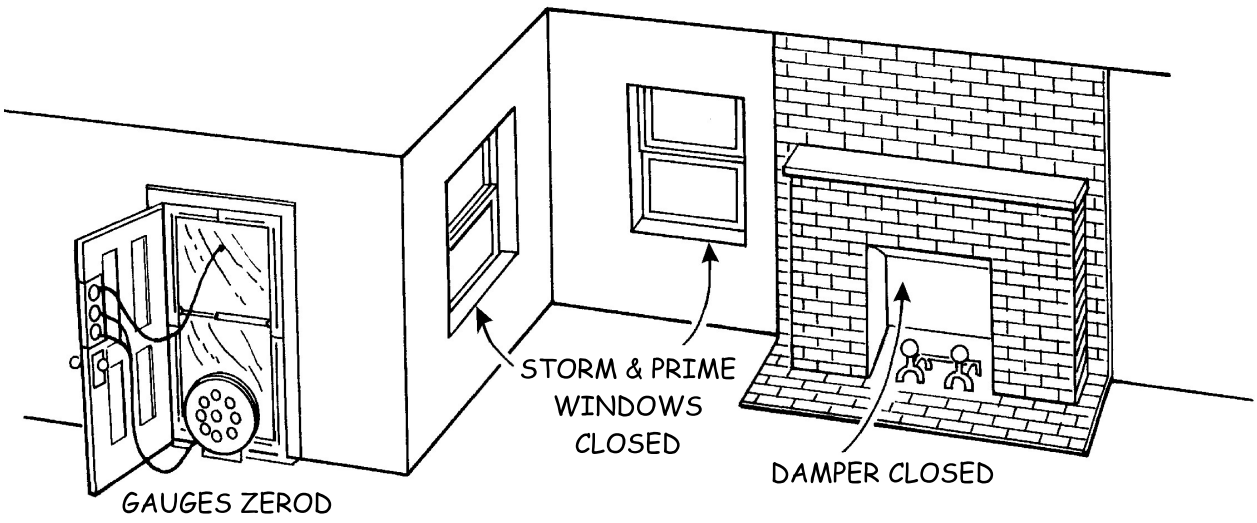
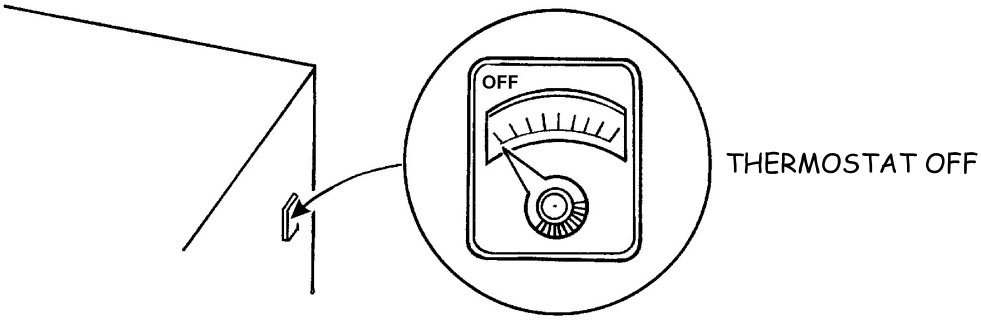
2. TEST CONDITIONS FOR ALL SHELL LEAKAGE TESTS

- **FAU and ducts**
  - Duct repair and sealing shall be completed before shell leakage testing is conducted
  - Registers and grills shall remain open and uncovered during test.
  - When a fresh air make-up is present on the FAU return, it shall be temporarily covered.
- **Doors, windows and access covers**
  - All prime windows and storm windows shall be closed.
  - Exterior doors, attic access covers, and crawlspace access covers shall be closed.
  - All interiors doors that lead to conditioned space shall be open.
  - Basement doors shall remain open if the basement is conditioned, otherwise, basement doors shall be closed.
- **Combustion appliances**
  - Furnace or heater thermostat shall be in the “Pilot” or OFF position.
  - Water heater shall be turned all the way down or on “Pilot” setting.





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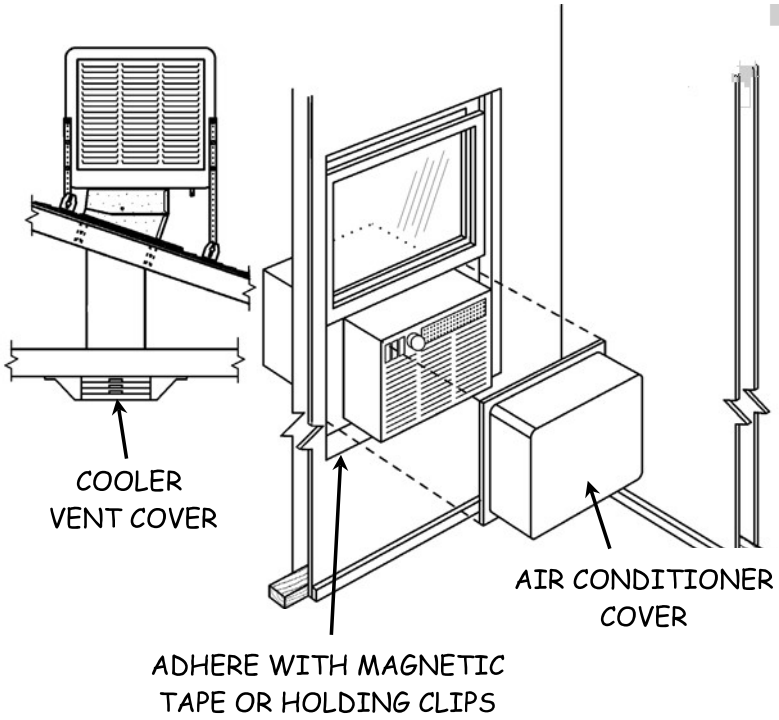
2. TEST CONDITIONS FOR ALL SHELL LEAKAGE TESTS (cont.)

- **Solid fuel appliances**
  - A fire or hot coals shall not be present.
  - The damper and air inlets shall be closed.
- **Exhaust devices**
  - Shall be turned off, including:
    - Bathroom and kitchen exhaust fans.
    - Controllable attic and crawlspace fans.
    - Mechanical ventilation fans.
  - Air openings of continuously-operating mechanical ventilation fans shall be temporarily sealed.
  - Pressurization only: For exhaust fans with functional backdraft dampers, the fan inlet shall be temporarily sealed.
    - If the backdraft damper is missing or inoperable, the fan inlet shall not be sealed.
  - Intentional openings between conditioned and unconditioned space (e.g., passive kitchen exhaust duct/vent) shall not be sealed.
- **Clothes dryers**
  - Shall be turned off.
  - Exhaust opening shall not be sealed even if no dryer is attached.
- **Coolers and air conditioners**
  - Shall be turned off.
  - Winter covers shall be in place.
  - Window/wall air conditioners:
    - Dampers shall be closed.
    - Sealed if the unit or surroundings leak air and the unit is removed during winter.
- **Plumbing drains and P-traps**
  - Shall be sealed or filled with water if empty.



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3. BLOWER DOOR INSTALLATION

- **All tests**
  - Test equipment shall be set up, calibrated, and operated in compliance with manufacturer*'s* instructions and Title 24 Residential Appendix RA3.

4. TOTAL SHELL LEAKAGE TEST

- **Testing shall consist of:**
  - *Initial shell leakage test*: Determines the amount of shell leakage before any sealing of catastrophic leaks begins.
  - *Interval tests*: Performed after each time increment (1-hour increments) to determine whether continued sealing work is feasible.
  - *Final shell leakage test*: After completion of shell sealing, this test calculates the final shell leakage reading and achieved leakage reduction.
- **Procedure**
  - Tests shall be performed in compliance with test equipment manufacturer's instructions and Title 24 Residential Appendix RA3.
  - Dwellings shall be depressurized to -50 Pa.
  - Target total shell leakage is 5 ACH_{50} or as specified by individual utility policy.
  - Units in multi-family buildings with enclosed hallways:
    - At least one common hallway door (or a window with adequate opening) that communicates with the outdoors shall be temporarily opened during testing.
- **Very leaky systems**
  - When a depressurization of -50 Pa cannot be achieved and the digital gauge does not automatically compensate for low pressure, the test equipment manufacturer's instructions shall be followed.

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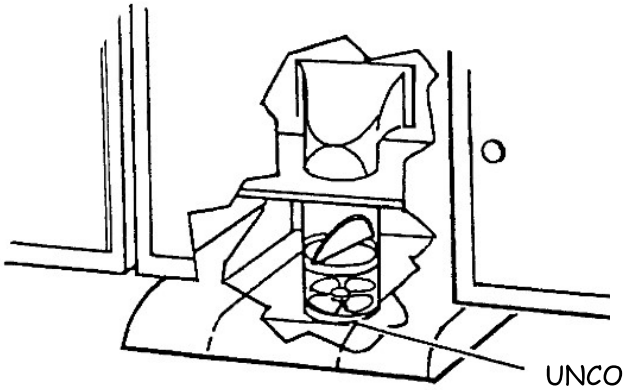
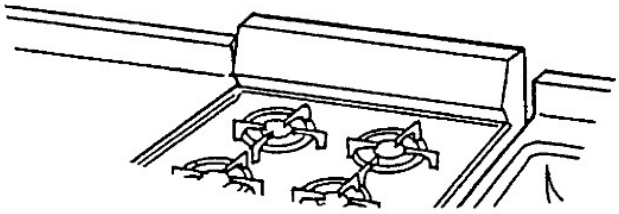
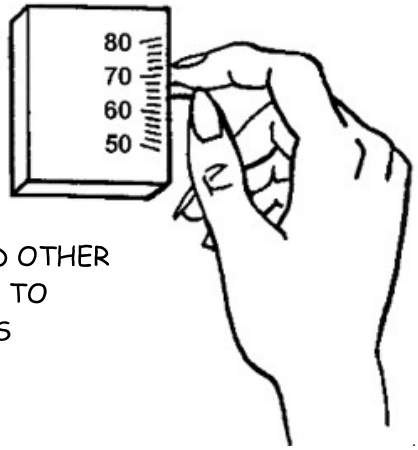
5. WRAP-UP PROCEDURE

- **Following completion of shell leakage testing, the HVAC system, appliances, and home shall be returned to their original condition.**
- **Temporary sealing removed:**
  - All temporary blocking materials shall be removed.
  - Ventilation air intakes shall be restored to normal.
- **Appliances and furnishings restored:**
  - Thermostats, water heater control, HVAC/air handler power, windows, doors, fans, room air conditioners, etc. shall be returned to pre-test settings.
  - Home furnishings shall be returned to their original locations.
  - All test equipment, tools, supplies, and trash shall be removed from the home.



UNCOVER VENTS AND AIR INTAKES





RETURN THERMOSTAT AND OTHER APPLIANCE CONTROLS TO PRE-TEST SETTINGS

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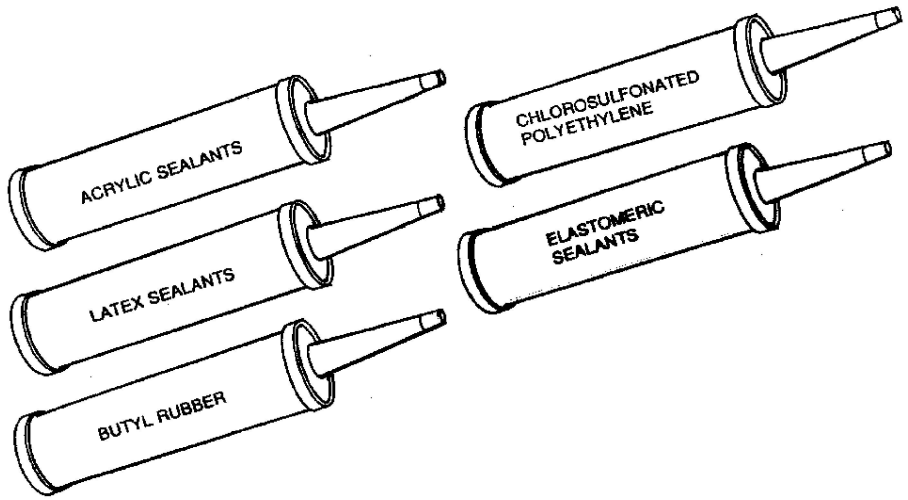
PART 2: SHELL SEALING

6. APPROVED MATERIALS

- **Caulking and sealants**
  - Shall be non-toxic and selected and applied in accordance with IS Section 1 (Caulking).
- **Weatherstripping and thresholds**
  - Shall be non-toxic and selected in accordance with IS Section 2 (Weatherstripping).
- **Patches**
  - Mesh patches shall be 28-30 gauge non-corrosive metal with self-adhesive backing.
  - Metal patches shall be galvanized steel.
- **Door-type and components**
  - Shall be selected in accordance with IS Section 11 (Exterior Door Replacement).
- **Windows and glass**
  - Shall be selected in accordance with IS Section 12 (Window Replacement) and IS Section 13 (Glass Replacement).
- **Fireplace chimney dampers**
  - Factory-built fireplaces: Replacement parts as specified by the fireplace manufacturer.
  - Masonry fireplaces: Top-sealing dampers sized to fit chimney termination.
- **Fireplace glass doors**
  - Sized and shaped to fit and seal off the fireplace opening.
  - Designed for use with fireplace receiving doors.



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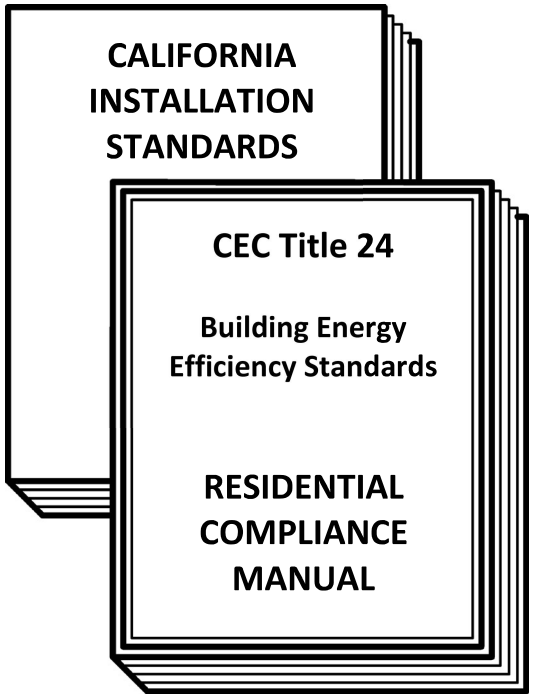
7. GENERAL REQUIREMENTS

- **Shell sealing shall be in conformance with guidelines in this section and the following standards:**
  - IS Section 00 (Minor Home Repair Policies)
  - IS Section 1 (Caulking)
  - IS Section 2 (Weatherstripping)
  - IS Section 11 (Exterior Door Replacement)
  - IS Section 12 (Window Replacement)
  - IS Section 13 (Glass Replacement)
  - Current Title 24 Residential Compliance Manual, Chapter 3
- **All sealing activities**
  - Cracks and gaps in the envelope shall be sealed from the interior side, whenever feasible.
  - A continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections.
  - Sealants shall be compatible with their intended surfaces.
  - When a supplemental barrier is created, it shall be secured with mechanical fasteners (e.g., screws, staples, nails) to ensure a complete and permanent seal.
  - Sealing material shall be evenly tooled with excess material removed to ensure a clean appearance and adequate seal.



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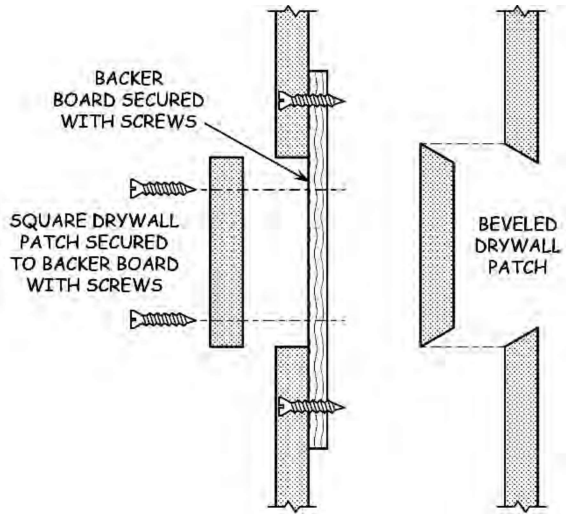
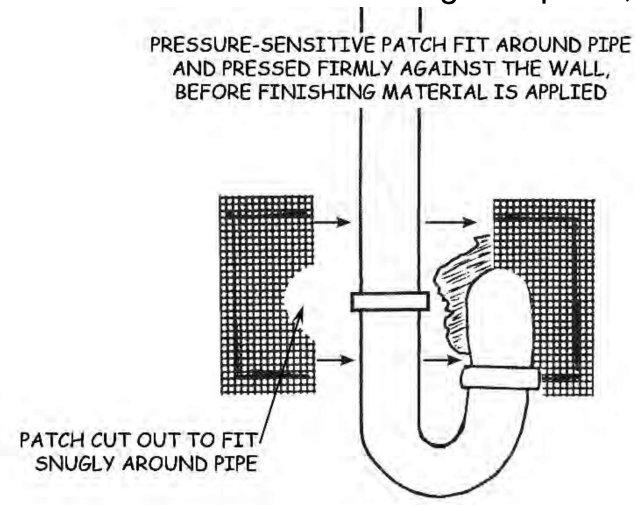
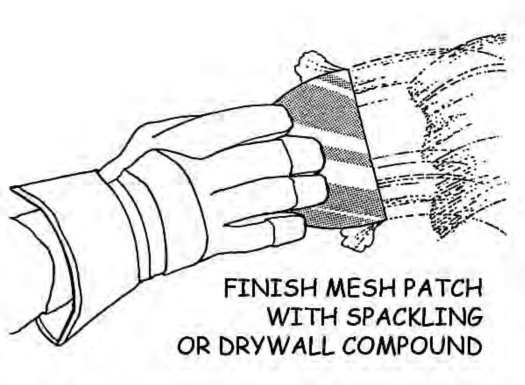
8. PENETRATIONS AND PATCHING

- **General requirements**
  - All lighting fixtures, wiring, plumbing, venting, ducting, and gas piping penetrations shall be sealed.
  - Gaps >5/8" wide shall be covered with a sheet metal collar or mesh plumbing patch that is sealed and secured.
  - Patches shall fit snugly around pipes.
  - Gaps ≥1/16" between the patch and pipes shall be sealed with caulk.



- **Metal patches**
  - Shall be installed on wall or floor penetrations, including floor in visible locations.
  - Patch shall be mechanically fastened and sealed.
- **Mesh wall patches**
  - Backing shall be reinforced with fiberglass mesh or equivalent.
  - The patch shall be sealed to mounting surface along the entire perimeter of the patch.
  - Wall patches shall be finished to match the surrounding wall surface.
- **Knee walls**
  - Cracks and gaps between the knee wall and the living space (at the attic floor, walls, and ceiling) shall be sealed.
- **Sill plate**
  - Cracks and gaps at the bottom of each wall shall be sealed.
  - When molding is in place, gaps ≥1/16" shall be caulked.
- **Top plate**
  - Cracks and gaps at the top of each wall shall be sealed.
  - When molding is in place, gaps ≥1/16" shall be caulked.





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8. PENETRATIONS AND PATCHING (cont.)

- **House-garage separation**
  - All cracks in the house and garage separation shall be sealed, including cracks between the bottom of the gypsum board and the mud sill, rim joists, and subfloor.
  - When sealing from the interior side is not feasible, seal from the garage side.

9. BALLOON FRAMING AND DOUBLE WALLS

- **Attics and crawlspaces**
  - The entire opening shall be spanned with rigid material cut to fit and mechanically fastened in line with the ceiling level.
  - All remaining gaps of the opening shall be sealed.
  - All remaining gaps at the top of the chase shall be sealed.

10. CHASES, DROPPED CEILINGS, TONGUE-AND-GROOVE CEILINGS

- **Chases and opening to the attic above a dropped ceiling or soffit**
  - The entire opening shall be spanned with rigid material in line with the ceiling level or airflow shall be blocked in locations where access allows.
  - Materials shall be cut to fit and mechanically fastened.
  - Rigid material shall meet fire code flame and smoke spread requirements.
  - All remaining gaps at the top of the chase/drop ceiling shall be sealed.
- **Tongue-and-groove ceilings**
  - Backing shall be installed behind tongue-and-groove ceilings.
  - Sealants shall be continuous and meet fire barrier specifications in conformance with local code.
  - No sealant shall be visible in the living space.

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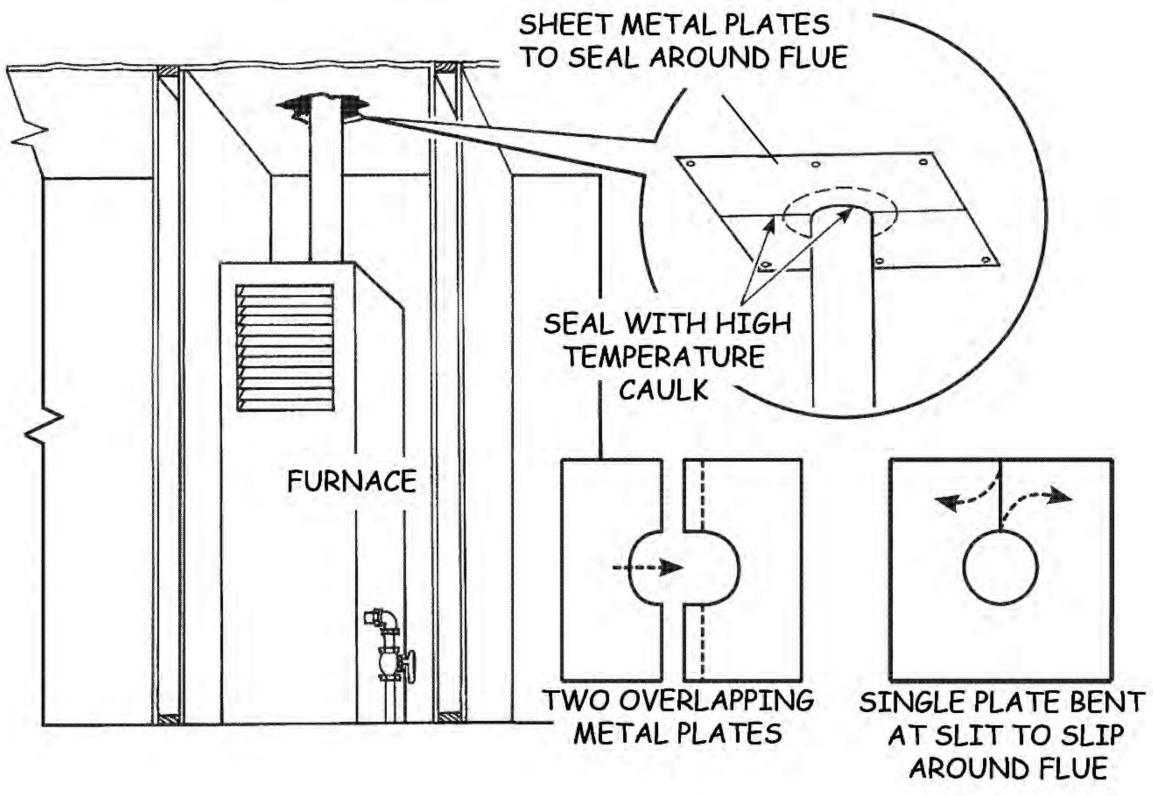
11. FURNACE VENTS

- **Open combustion furnace vent**
  - Ceiling bypasses at vent penetrations shall be sealed only when:
    - The bypass is not required for combustion air.
    - Installation of a metal collar does not cover a vented thimble or support system and does not violate local code.
- **Closed combustion furnace vent**
  - When no ceiling collar is present or gaps at the existing collar are ≥3/8", a metal collar shall be installed. Existing collars shall be secure and sealed.
  - Gaps <3/8" around the vent pipe shall be sealed with high temperature caulk.
  - Gaps ≥1/16" between the vent pipe and collar shall be sealed with high temperature caulk.
- **Ceiling vents not used for combustion air**
  - Vent opening shall be sealed with minimum 1/2" gypsum board, plywood, or metal and insulated.
  - Vents shall <u>not</u> be sealed with batts or foam board.



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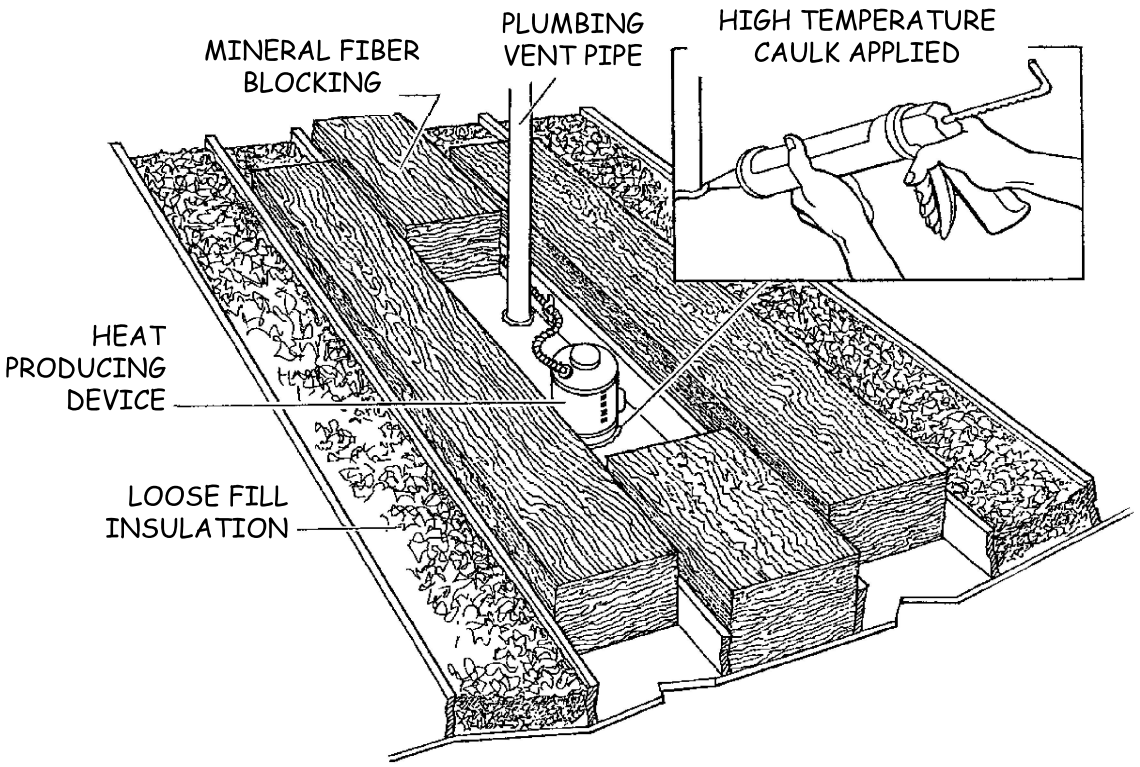
12. ELECTRICAL BOXES AND LIGHT FIXTURES

- **Electrical boxes**
  - All visible gaps around electrical boxes and lighting fixtures in the ceiling, wall, or floor shall be sealed.
- **All fixtures**
  - Shall be blocked in accordance with IS Section 3 (Attic Insulation).
- **Recessed lights**
  - Shall be sealed with high-temperature caulk.
  - Holes or ventilation openings in recessed light canisters or other heat-producing devices shall not be sealed.
- **Light boxes and fixtures in dropped ceilings or soffits**
  - An airtight seal shall be provided between the perimeter of the light box enclosure and interior ceiling.
  - All seams and penetrations of the enclosure shall be sealed.



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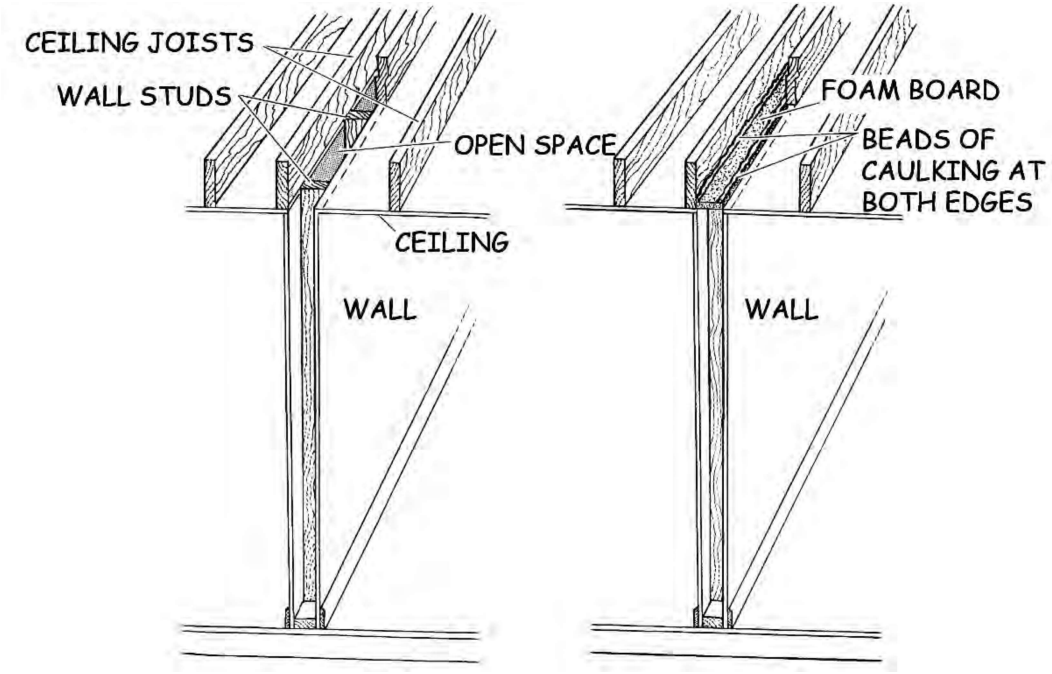
13. WALL BYPASSES

- **Interior and exterior wall openings**
  - Cavities shall be sealed with filler board and sealant.
  - Silicone or acoustical caulk or foam sealant shall be used to seal the filler board.
  - Filler board shall be secured as needed with mechanical fasteners to ensure a complete and permanent seal.
- **Cover plate gaskets**
  - Shall be installed in accordance with IS Section 7 (Cover Plate Gaskets).



14. CRAWLSPACE BYPASSES

- **Bathtub holes**
  - The floor opening under a bathtub shall be sealed with filler board and sealant.
  - Filler board shall be secured, as needed, with mechanical fasteners to ensure a complete and permanent seal.
- **Other floor bypasses**
  - Seal with caulk, foam, or other approved material.

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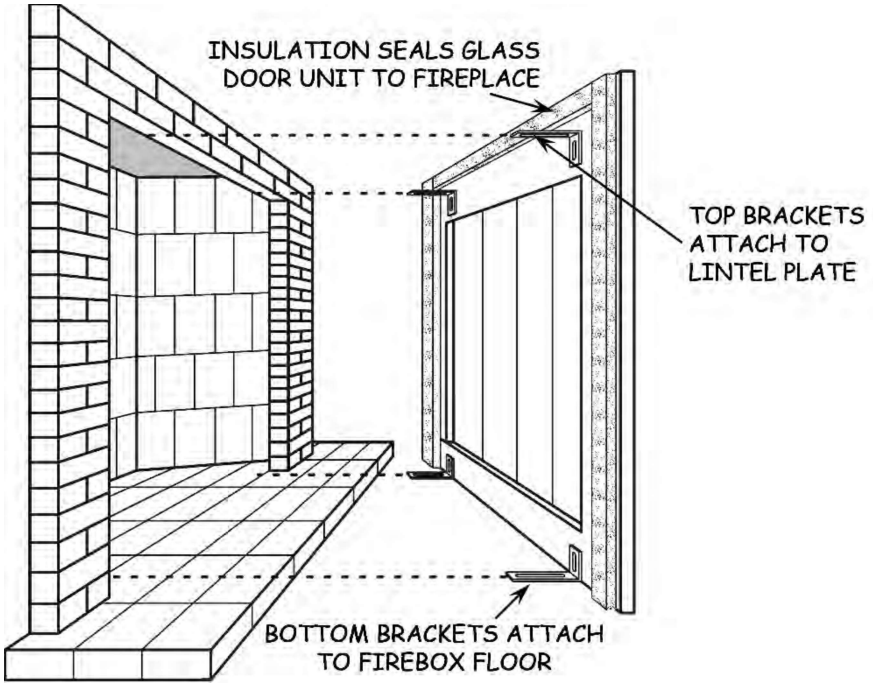
15. FIREPLACES AND CHIMNEYS

- **Masonry fireplaces and chimneys**
  - Attic penetrations by masonry chimneys shall be sealed with non-combustible barrier and high-temperature sealant.
    - Galvanized sheet metal or aluminum shall be a minimum of 0.007" thick.
    - Barrier shall be mechanically secured.
  - Malfunctioning dampers shall be repaired.
  - A properly sized, top-sealing damper shall be installed when no damper is present or repair is not feasible.
- **Factory-built fireplaces**
  - Malfunctioning dampers shall be repaired or replaced per manufacturer's specifications.
- **Gas log fireplaces**
  - Dampers shall be blocked partially open (e.g., permanently installed damper clamp.
- **Fireplace glass doors**
  - Existing glass doors shall seal against the fireplace.
  - When a fireplace damper is not present or cannot be installed, a properly sized glass doors shall be installed.
  - The top of the door shall be secured to the lintel bar.
  - The bottom of the door shall be attached to the firebox floor.
  - Insulation or gasketing shall create a tight seal between the glass and the fireplace surround.



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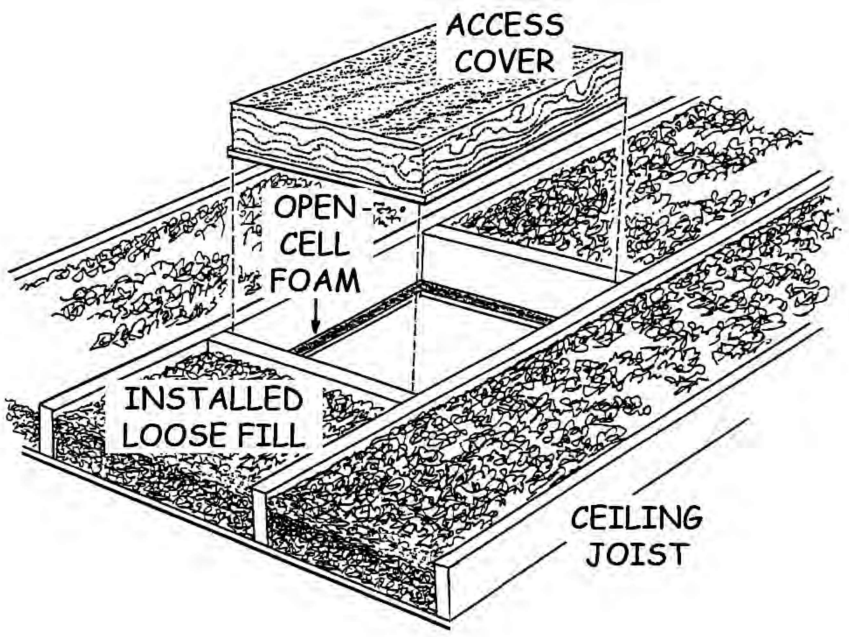
16. ACCESS HATCHES

- **All access hatches**
  - Access hatch shall create a full seal with no gaps or openings in the framing.
  - Finishing materials shall be installed in accordance with manufacturer's instructions.
  - Weatherstripping and insulation shall be installed when the access is located in conditioned space.
  - Weatherstripping shall be installed in accordance with IS Section 2 (Weatherstripping).



17. DOORS

- **Door replacement**
  - Exterior doors shall be replaced in accordance with IS Section 11 (Exterior Door Replacement).
- **Weatherstripping and thresholds**
  - Shall be installed in accordance with IS Section 2 (Weatherstripping).
- **Door repair**
  - Doors shall be repaired to correct infiltration or to support the installation of weatherstripping, safety glass replacement, etc.
  - Doors shall be adjusted to properly fit the jamb (e.g., hinge replacement, door planing, door strike adjustment).
  - Doors and new wood components shall be sealed (paint, primer, varnish) to prevent moisture intrusion.

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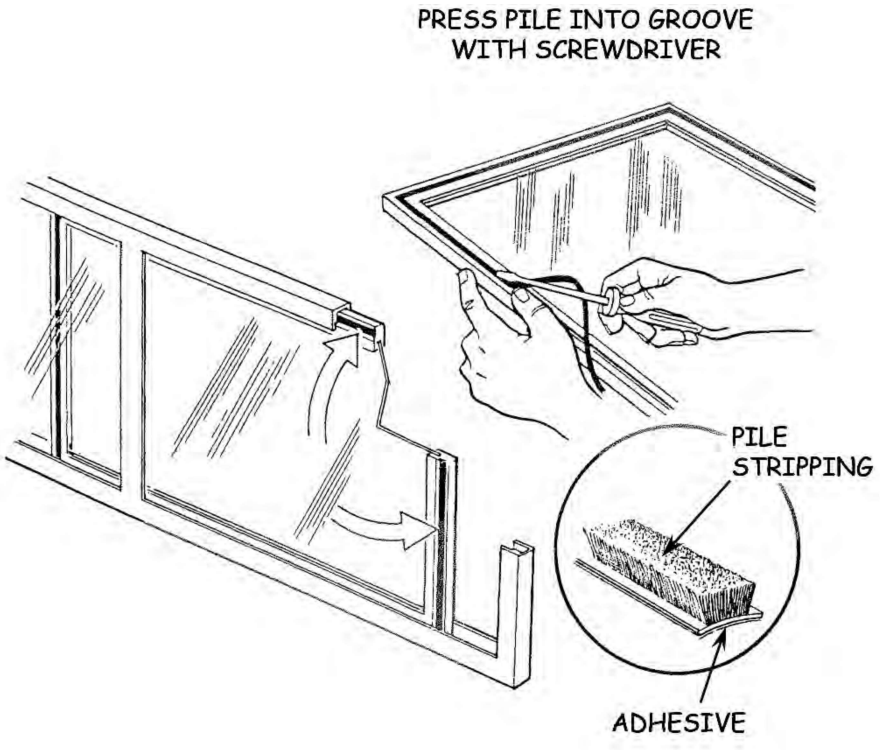
18. WINDOWS AND GLASS

- **Window replacement**
  - Shall be conducted in accordance with IS Section 12 (Window Replacement).
- **Glass replacement**
  - Shall be conducted in accordance with IS Section 13 (Glass Replacement).
- **Window weatherstripping**
  - The existing weatherstripping and sash sealant shall be removed, and the surface cleaned.
  - Weatherstripping shall be installed and adjusted to provide a continuous barrier along all edges of the window opening.
  - Weatherstripping shall be installed on the bottom of the lower sash where it makes contact with the sill, and at the top of the upper sash where it makes contact with the upper jamb.
  - Weatherstripping shall not impede proper operation of the window.
  - Replacement pile shall fit snugly in the retaining channel.
- **Sliding glass door weatherstripping**
  - The existing material shall be removed, and the surface cleaned.
  - Cushion synthetic, flanged bulb, or closed-cell foam tape shall be installed in the compression location only.
  - Worn pile in the retaining channels shall be replaced when feasible.



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19. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up**
  - Paint dust and chips, scraps, and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Furniture and other household items moved for installation work shall be returned to their original positions.

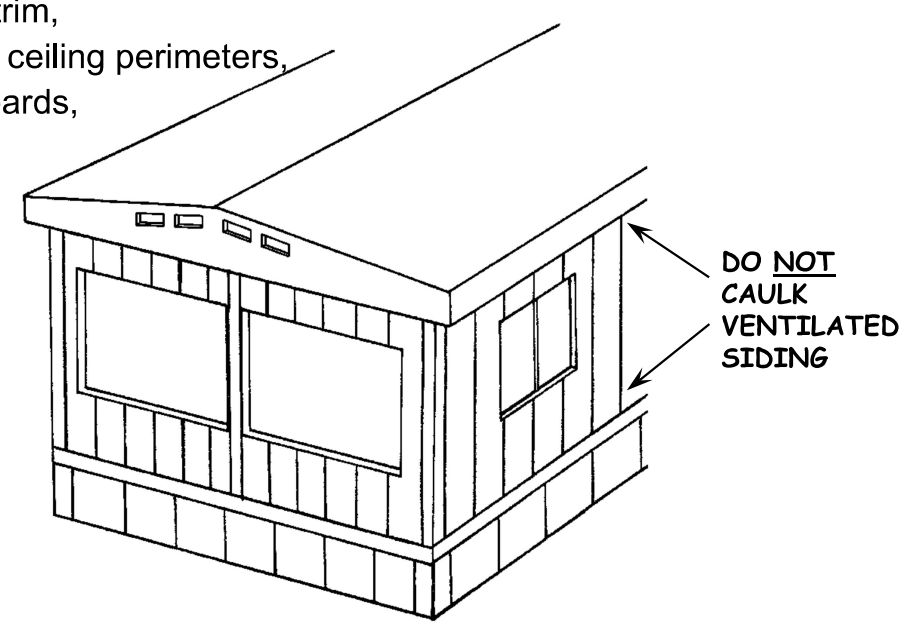
MOBILE HOME CRITERIA (SHELL SEALING)

20. GENERAL REQUIREMENTS

- **All mobile homes**
  - Top and bottom bypasses on ventilated metal exterior walls shall not be sealed.
  - Work shall not be attempted on any mobile home roof that is substandard or unsafe.

21. INTERIOR SEALING

- **Gaps and cracks**
  - Gaps <3/8" shall be caulked without filler material.
  - Gaps ≥3/8" shall be caulked only if filler material can be properly installed/secured and covered with at least 1/8"-deep bead of caulk.
- **Interior seams and joints**
  - Gaps 1/16"– 5/8" shall be caulked, including
    - Window and door trim,
    - Room corners and ceiling perimeters,
    - Accessible baseboards,
    - Marriage line trim.



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22. CEILINGS AND FLOORS

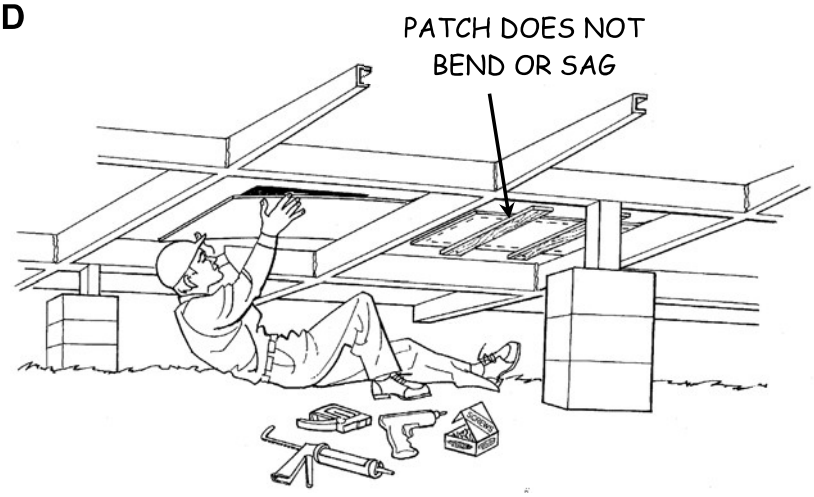
- **Ceiling repair**
  - Repair material shall meet or exceed the strength of the existing material.
  - Repair shall span from truss to truss, or blocking shall be added as needed for support.
- **Air and vapor barriers**
  - All accessible damaged penetrations through the ceiling air barrier shall be repaired.
  - All accessible damaged vapor barriers shall be repaired.
- **Floor repair**
  - Repair material shall meet or exceed the strength of the existing material.
  - Repairs shall span from joist to joist, or blocking shall be added as needed for support.
  - Exception: Patch is <1 sq. ft.

23. MARRIAGE LINE

- **Sealing**
  - All accessible holes and penetrations at marriage lines shall be sealed continuously at end walls, floors, and ceiling.
  - Backing or infill shall be provided at the marriage line as needed.
  - All remaining gaps shall be sealed with an approved material.
  - External caulking at marriage lines shall be selected in accordance with IS Section 1 (Caulking).

24. BELLYBOARD/BOTTOMBOARD

- **Repairs**
  - Patching material shall meet or exceed the characteristics of the existing bottom board.
  - That patch shall not bend, sag, or move once installed.
  - Combustion air supplied shall be labeled for identification and shall not be blocked or sealed.



PATCHING PENETRATIONS IN BELLYBOARD USING MATERIAL WITH EQUIVALENT CHARACTERISTICS

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DISHWASHERS

Lead Paint Risk Factor
NONE

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MOBILE HOME CRITERIA 6

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SECTION X PREFACE
for

DISHWASHERS

1. Nonfeasibility Criteria

1.1. The water heating energy source is not supplied by the utility providing ESA Program services.

1.2. The existing dishwasher is 11 years old or newer.

1.3. A suitable location, with acceptable flooring and proper clearances (including proper door swing), is not available.

1.4. A properly-grounded electrical receptacle is not located within reach of the dishwasher's power cord.

1.5. A suitable water supply and/or drain system is not available.

1.6. Customer refuses.

2. Installation Policies

2.1. Dishwashers may be provided to both homeowners and renters.

2.2. Hot water must be provided by an individual water heater under the occupants' control (not a central water heater).

2.3. The customer must have an active account with the IOU providing the water heating energy source, or be a sub-metered residential customer.

2.4. The water heating energy source must be supplied by the utility providing ESA Program services.

3. Installation Policies Specific to Mobile Homes

None.

DISHWASHER STANDARDS

1. APPROVED MATERIALS

- **Dishwasher**
  - Shall be ENERGY STAR-certified and shall meet the efficiency standards in Table X-1.
  - Shall bear a yellow Energy Guide label.
  - Shall feature an auto-sensing cycle or multiple cycle options, such as:
    - Energy-saving wash
    - Light duty
    - Heated dry OFF
- **Drain hose and fittings**
  - AHAM/IAPMO tested.
  - Heat and detergent resistant.
- **Hot water supply line**
  - NSF/ANSI 61 certified.
  - Copper tubing or flexible braided stainless steel.

Table X-1: Maximum Energy and Water Consumption for ENERGY STAR Residential Dishwashers

Equipment Type	Capacity	Maximum Energy Consumption	Maximum Water Consumption
Standard	≥8 place settings + 6 serving pieces	270 kWh/year	3.5 gallons/cycle
Compact	<8 place settings + 6 serving pieces	203 kWh/year	3.10 gallons/cycle

2. WARRANTY

- **Refer to IS Appendix F (Minimum Warranty Requirements).**

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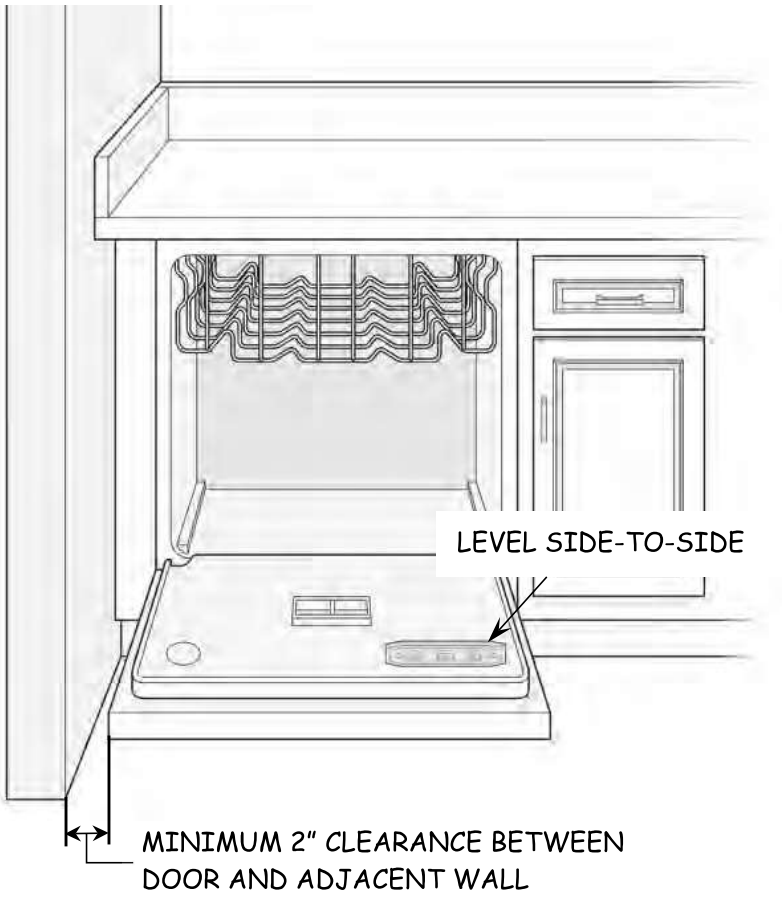
3. GENERAL REQUIREMENTS

- **Manufacturer's instructions and local code**
  - All installations shall be in compliance with appliance manufacturer's instructions and the requirements of the local jurisdiction.
  - A permit shall be obtained and finalized, if required by the local jurisdiction.
- **IS guidelines**
  - The installation criteria in this section are guidelines that shall be followed unless superseded by manufacturer's instructions/specifications or local code.

4. INSTALLATION LOCATION

- **The dishwasher location shall:**
  - Allow spacing of at least 0.1" on all sides or as specified by the manufacturer.
  - Provide adequate clearance between the motor and the flooring. Motor should not touch the floor.
  - Corner locations: Allow clearance of at least 2" between the side of the dishwasher door and the wall or cabinet.
  - Be verified to have ample room for opening the door.
  - Have a solid and sturdy floor that can support the weight of the dishwasher with a full load.



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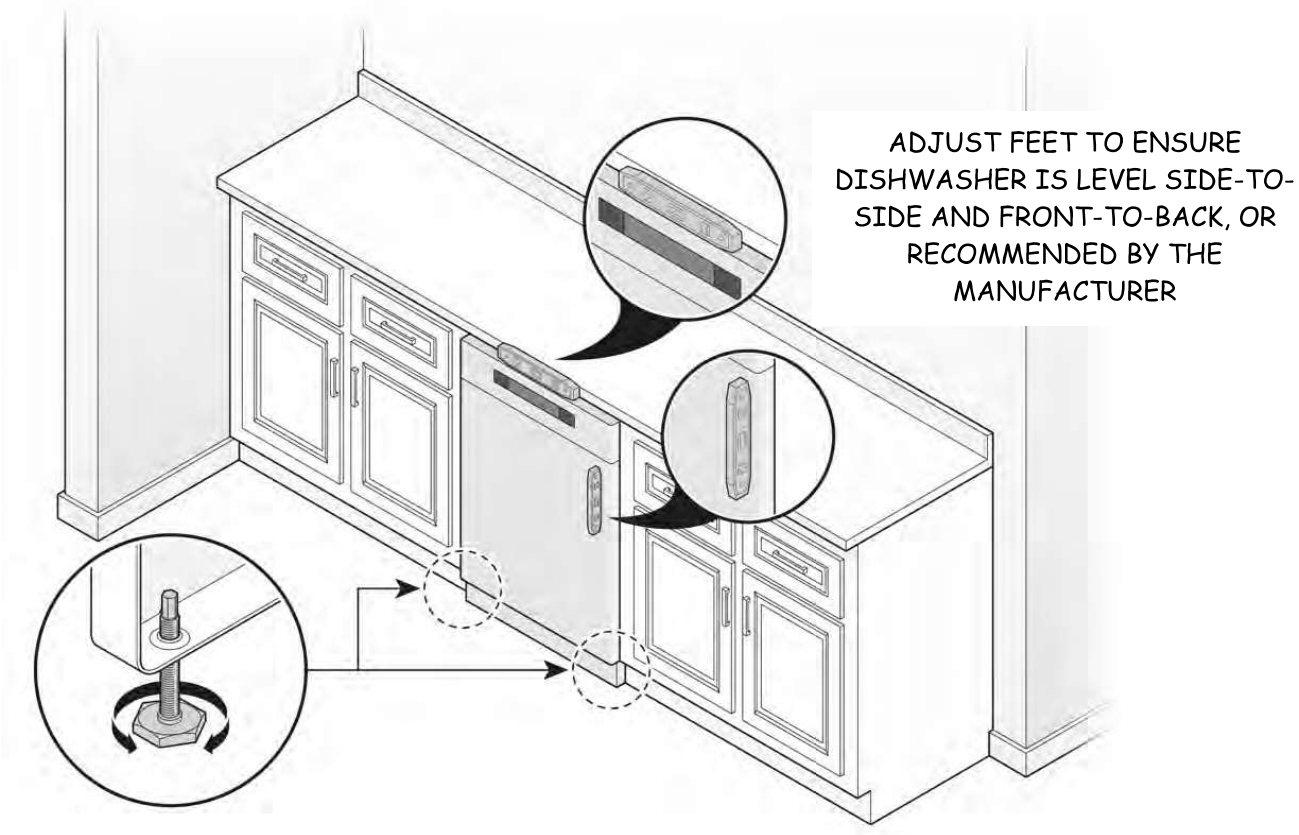
5. DISHWASHER INSTALLATION

- **Unpacking**
  - Packaging and transit packing material (used to secure moveable parts for shipping) shall be removed.
- **Leveling**
  - These guidelines, or manufacturer's instructions if different, apply:
    - Individual feet (on leveling legs) shall be adjusted to properly level the dishwasher with all four feet resting on the floor.
    - After leveling, the locking nuts shall be tightened to hold the feet in place.
    - Leveling legs shall be extended the minimum needed to properly level the machine.
- **Attachment and securing**
  - Manufacturer provided mounting brackets shall be installed.
  - Dishwasher shall be secured to the cabinet or countertop as specified by manufacturer's instructions.
  - Dishwasher shall not be secured to countertops that are granite, marble, stone, or any other material that can be damaged by drilling.



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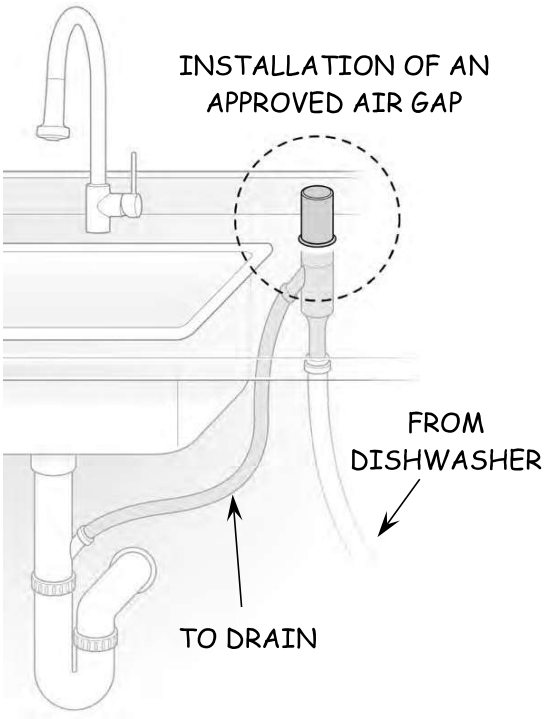
6. WATER SUPPLY

- **All installations**
  - Water supply to the dishwasher shall have a manual shutoff valve, located under the sink, within 6' of the dishwasher or as specified by the manufacturer.
  - Water pressure at the hot water shutoff valve shall be within the manufacturer's specifications.
  - Water temperature at the shut off valve shall be a minimum of 120°F (maximum 150°F) or as specified by the manufacturer or local code.
  - All hoses shall be *new*:
    - Pre-existing hoses shall not be reused.
    - Braided hoses shall be installed (in lieu of standard hoses supplied with washer) when specified by individual utility policy.
  - Hot water hose shall be properly connected and tightened, avoiding overtightening.
  - All connections shall be sealed with Teflon® tape or non-toxic pipe joint compound.

7. DRAIN REQUIREMENTS

- **Drain hose**
  - Manufacturer supplied drain hose shall be used. If supplied drain hose is not long enough, a new drain hose of shortest possible length may be installed.
  - Shall be installed in a suitable drain with adequate capacity to accept the water discharge on the largest load setting.
  - Shall be properly secured (e.g., with a cable tie).
- **Drain system**
  - Must be functional and suitable to accept the maximum water discharge from the dishwasher.
  - An approved air gap fitting shall be installed on the discharge side of the dishwasher with the flood-level marking at or above the flood level of the sink or drainboard, whichever is higher.



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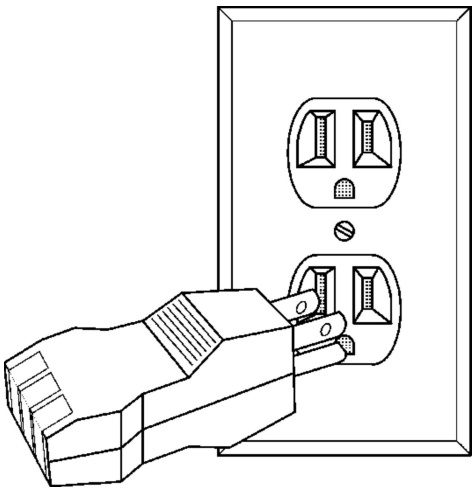
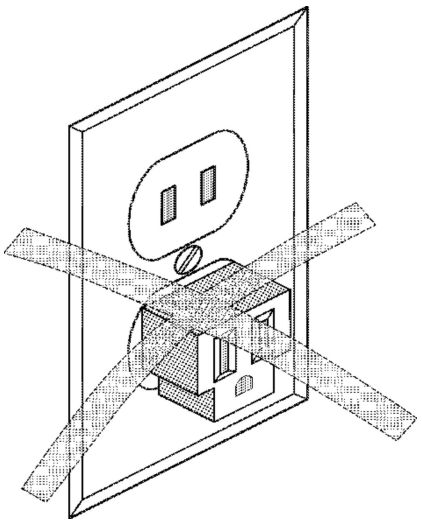
8. ELECTRICAL SUPPLY

- **Circuit**
  - Electrical supply shall be 120-volt, minimum 15-amp, and shall meet manufacturer's specifications.
  - Proper circuit conductors and overcurrent protection (fuse or breaker) shall be present.
  - The outlet:
    - Shall be a properly grounded three-prong receptacle with a functional equipment grounding conductor.
    - Shall be within 6' of the installation location, or as specified by the manufacturer.
    - A GFCI protected circuit or outlet, or a switched outlet, shall not be used unless required by manufacturer's instructions or local code.
    - Shall not be shared with another appliance when required by manufacturer's instructions or local code.
  - An outlet cover plate is required.
- **Cords and adapters**
  - Extension cords and adapters shall not be used.



RECEPTACLE MUST BE THREE-PRONG AND PROPERLY GROUNDED



UNGROUNDED THREE-PRONG ADAPTER IS NOT ALLOWED

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9. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Operational check**
  - The dishwasher shall be operated through either a test cycle or the shortest cycle that will determine that the following:
    - The dishwasher fills and drains properly,
    - The drain system has adequate capacity and functions properly,
    - There are no water leaks.
  - Clearance for proper door swing shall be verified.
- **Instructions and warranties**
  - Customer shall be instructed in the proper operation and care of the dishwasher.
  - Customer shall be provided with:
    - Manufacturer's written instructions.
    - Written warranty documents.
- **Clean-up and disposal**
  - All packing materials and other debris shall be cleaned up and removed from the premises.
  - The replaced equipment and parts shall be removed from the premises and disposed of properly.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

OCCUPANT RECEIVES VERBAL AND WRITTEN INSTRUCTIONS AND MANUFACTURER'S WARRANTY

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DUCTLESS MINI SPLIT HEAT PUMP

Lead Paint Risk Factor
LOW-HIGH

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SECTION X PREFACE
for

DUCTLESS MINI SPLIT HEAT PUMPS

1. Nonfeasibility Criteria for Ductless Mini Split Heat Pump

1.1. The existing heating system is an FAU or central heat pump, or one is being installed.

1.2. A ductless mini split heat pump is already present and operational.

1.3. Existing window/wall AC is inoperable.

1.4. Existing electric resistance heater or wall heater is inoperable.

1.5. For a roof-mounted unit, the roof is not structurally adequate to support the installation.

1.6. Electrical service requirements cannot be met.

1.7. A suitable installation location for either the interior air-handling unit or the exterior condensing unit is not available.

1.8. Proper condensate drainage cannot be achieved.

1.9. Customer lives in a cold climate and a qualifying system has not been identified by the Northeast Energy Efficiency Partnership (NEEP) for use in that climate zone.[1]

1.10. Customer refuses.

2. Nonfeasibility Criteria for Systems Requiring Attic or Crawl Space Access

2.1. Crawl clearance is inadequate:

a. Attic clearance
- Clearance is less than 24" between top of ceiling joists and bottom of ridge board.
- Obstruction(s) in the attic, such as truss cross members, provide an opening with minimum dimensions of less than 18".

b. Under-floor clearance
- Clearance is less than 18" from the ground to bottom of floor joist system (girders under a mobile home).

[1] NEEP lists air source heat pumps best suited for International Energy Conservation Code (IECC) identified, national climate zones 4 and higher. The following California counties have been identified by the 2021 IECC to reside in national climate zones 4 and higher ("Cold Climates"): Alpine, Amador, Calaveras, Del Norte, El Dorado, Humboldt, Inyo, Lake, Lassen, Mariposa, Modoc, Mono, Nevada, Plumas, Sierra, Siskiyou, Trinity, and Tuolumne.

- Crawling under or over an obstruction in the crawl area is required, and the crawl clearance is less than 12".

c. Confined Spaces: state and federal regulations regarding confined spaces cannot be met.

2.2. Unsafe condition exists:

a. Attic and Crawlspace
   - Hazardous insect or pest infestation is present.
   - Hazardous electrical wiring.
   - Structural hazard.

b. Crawlspace
   - Excessive ground moisture (standing water or mud) is present.
   - Sewage waste is on the ground or other unsanitary condition is present which poses a health and safety hazard.

3. Ductless Mini Split Heat Pump Replacement Policies

3.1. Replacements will be offered only in approved climate zones.

3.2. Ductless mini split heat pumps may only be installed to replace both window/wall AC(s) and at least one of the following heating sources:

a. Electric resistance heating.

b. Gas or propane wall furnaces.

3.3. Measure shall be installed only to serve interior spaces of 400 sq. ft. or less and is not intended to act as a whole-house system.

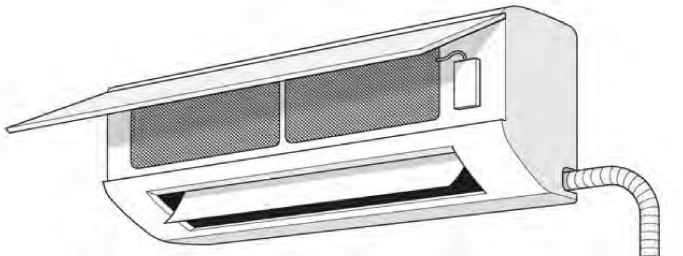
4. Installation Policies Specific to Mobile Homes

None.

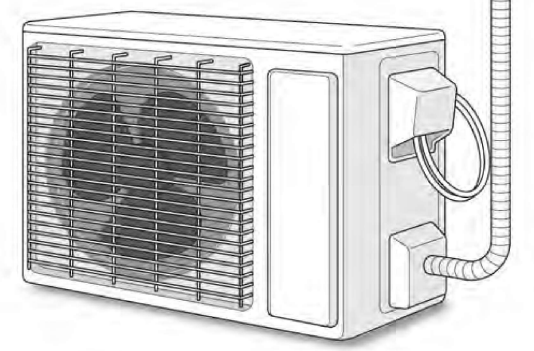
DUCTLESS MINI SPLIT HEAT PUMP STANDARDS

1. APPROVED MATERIALS

- **All units**
  - Shall be in conformance with the current CBC, CMC, DOE and Title 20 Appliance Efficiency Regulations.
  - All units and components shall be UL-listed (or equivalent) and/or have one of the following certifications: CSA or AHRI.
  - Indoor and outdoor units shall be part of an AHRI matched system.
  - ENERGY STAR-certified.
  - Minimum HSPF of 8.7
  - Minimum SEER of 15
  - Built-in condensate pump allowed, but not required.
- **Indoor units**
  - Wall mount units recommended; however, floor mount and ceiling cassette type allowed.
- **Units in cold climates**[1]
  - Shall be designed in accordance with the latest Northeast Energy Efficiency Partnerships (NEEP) Cold Climate Air Source Heat Pump (ccASHP) Specification.
  - Listed in NEEP's cold climate approved product database.



INDOOR UNIT – WALL-MOUNT AIR HANDLER



OUTDOOR UNIT – CONDENSER

[1]NEEP lists air source heat pumps best suited for International Energy Conservation Code (IECC) identified, national climate zones 4 and higher. The following California counties have been identified by the 2021 IECC to reside in national climate zones 4 and higher ("Cold Climates"): Alpine, Amador, Calaveras, Del Norte, El Dorado, Humboldt, Inyo, Lake, Lassen, Mariposa, Modoc, Mono, Nevada, Plumas, Sierra, Siskiyou, Trinity, and Tuolumne.

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2. WARRANTY

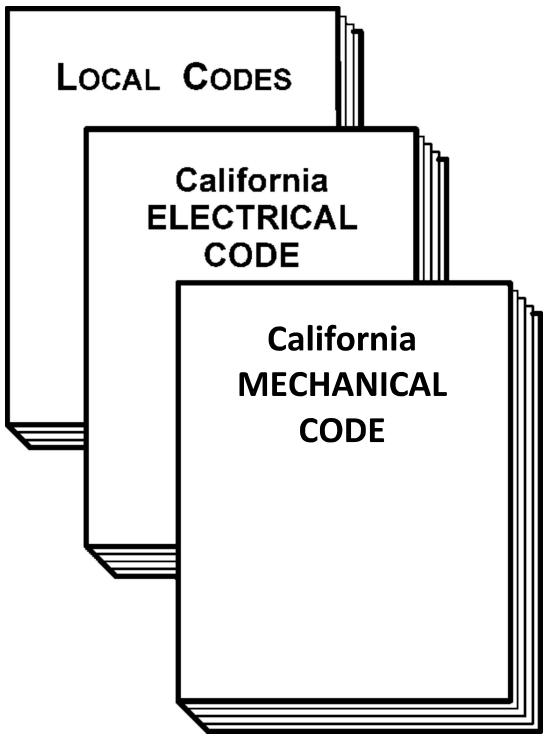
- **Refer to IS Appendix F (Minimum Warranty Requirements).**

3. GENERAL REQUIREMENTS

- **All installations**
  - A permit for the installation shall be obtained from and finalized by the local jurisdiction.
  - Installation shall be in compliance with:
    - Manufacturer's instructions and specifications.
    - Title 24 Residential Compliance Manual.
    - CEC, CMC, and local code.

4. SIZING CRITERIA

- **System size**
  - Unit shall be sized in accordance with:
    - Title 24 Residential Compliance Manual.
    - Air Conditioning Contractors of America (ACCA) Manual J or equivalent.
    - Manufacturer's recommendations.
    - NEEP, for units in cold climates.
  - Oversizing of equipment shall be avoided.



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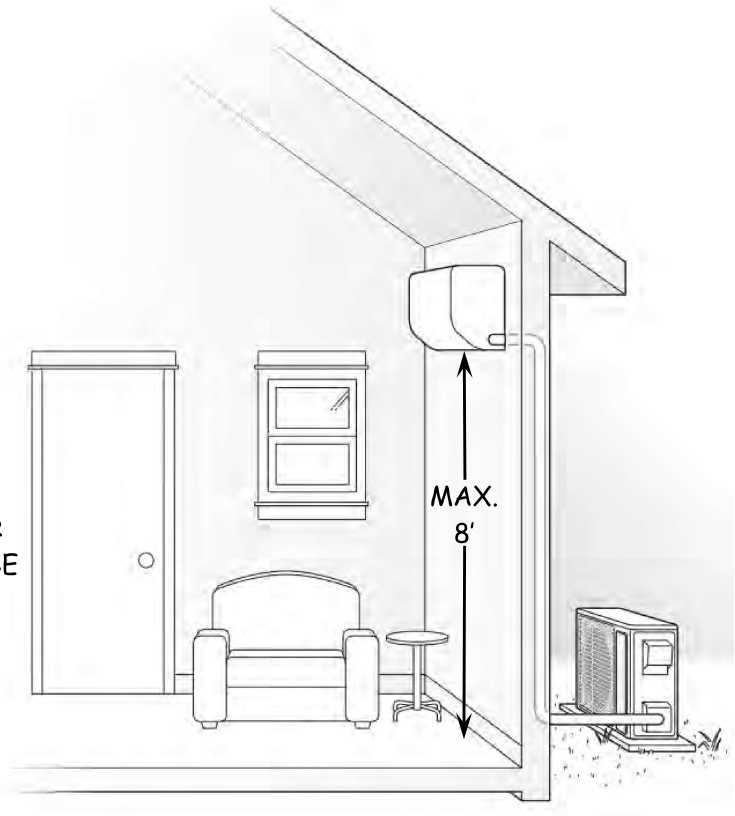
5. INDOOR UNITS

- **Installation location**
  - Wall/ceiling shall be structurally adequate to safely support the weight of the unit.
  - Unit shall be positioned to allow maximum airflow coverage of the living space being conditioned.
  - For wall mounted units in rooms with vaulted ceilings or ceilings greater than 8', units shall be installed so that their air discharge is no higher than 8' from the floor, whenever possible.
  - Consideration shall be given for noise, especially when installed in or near sleeping rooms.
  - Avoid locations:
    - In direct sunlight.
    - Near doorways, when prohibited by the manufacturer.
    - Near sources of heat or steam.
    - With obstacles that may limit air circulation.
- **Mounting**
  - Manufacturer provided mounting plate shall be installed, when applicable.
  - Unit shall be level and firmly secured, avoiding vibration during operation.
- **Clearances**
  - Manufacturer's recommended clearances shall be provided.



IN ROOMS WITH VAULTED CEILINGS, AIR DISCHARGE FOR WALL MOUNTED UNITS SHALL BE 8' MAXIMUM FROM THE FLOOR.

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6. CONDENSATE CONTROL

- **Overflow protection**
  - Additional protection for condensate overflow shall be provided in accordance with one of the following:
    - A water level detecting device that will shut off the equipment if the primary drain is blocked.
    - An additional drain line, minimum 3/4" nominal pipe size, located higher than the primary drain line connection.
- **Condensate drain line**
  - Condensate drain shall slope downward to a suitable drain site, avoiding crawlspaces and walkways, or as recommended by manufacturer.

7. OUTDOOR UNITS

- **Installation location**
  - Adequate clearances for proper airflow shall be provided to meet manufacturer's specifications.
  - Unit shall not be installed in a location where excessive shade would result in thermal isolation and improper operation of the system (e.g., not under a tree or overhang).
  - Unit shall not be located:
    - In areas exposed to strong winds, rain, excessive dust, or continuous direct sunshine.
    - In excessively salty areas or where sea water is present.
    - Where exposure to combustible gas leaks is possible.
    - In areas with excessive machine oil.
    - Where operation will create excessive vibration and noise may be a nuisance to the owner or neighbor(s).
    - Near high frequency or wireless equipment.

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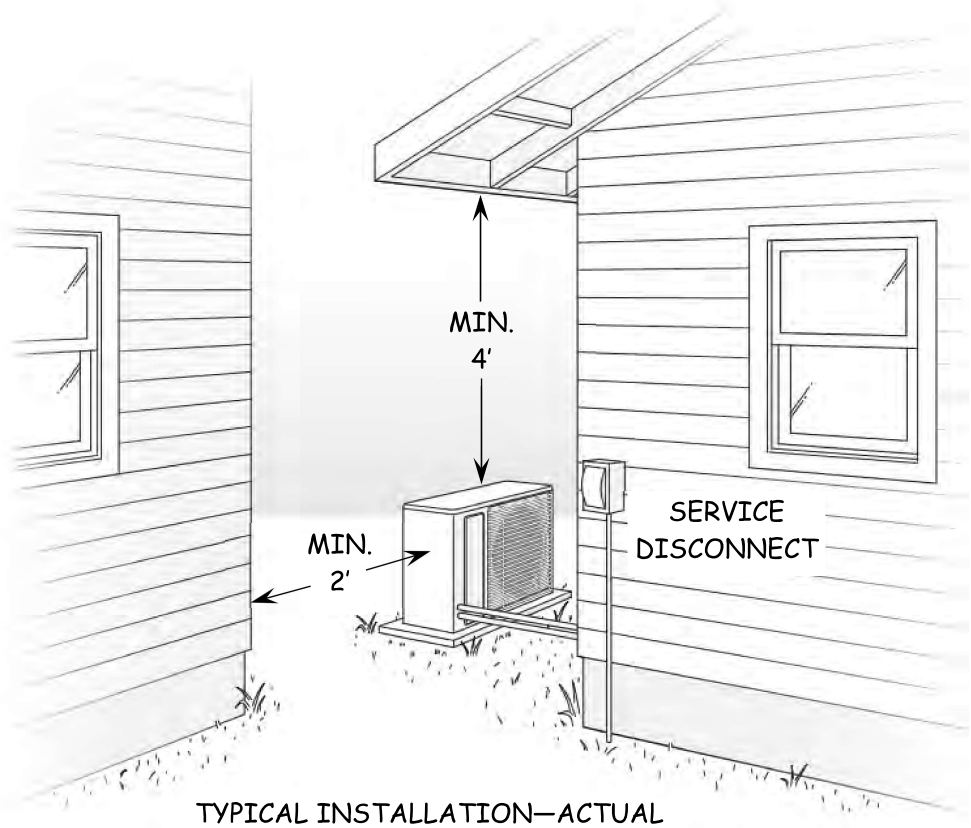
7. OUTDOOR UNITS (cont.)

- **Clearances**
  - The equipment shall be accessible for inspection, service, repair, and replacement without removing permanent construction.
  - Minimum clearances between equipment and the adjacent structure/wall/obstruction shall be:
    - 5’ from clothes dryer moisture exhaust (to avoid moisture and lint),
    - 3’ from gas meter set assembly,
    - 4’ above the unit,
    - 2’ on side(s) contain service access panels, and
    - 1’ on all other sides, or
    - As specified by manufacturer and local jurisdiction, of more stringent.



TYPICAL INSTALLATION—ACTUAL CLEARANCES MUST CONFORM TO MANUFACTURER’S INSTRUCTIONS & LOCAL CODE

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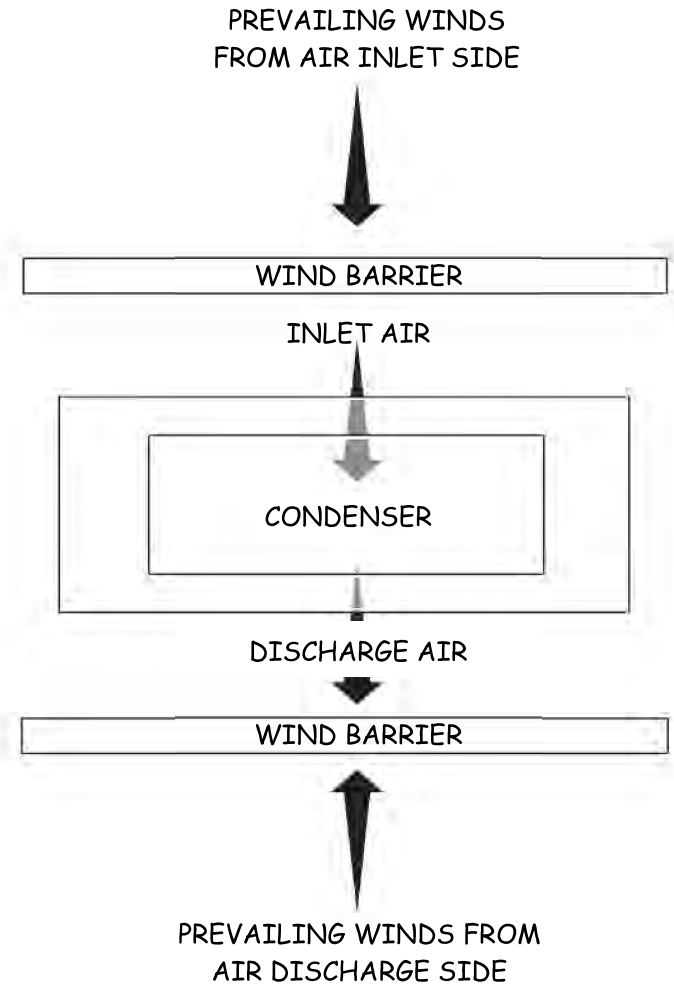
7. OUTDOOR UNITS (cont.)

- **Mounting**
  - Equipment shall be installed in conformance with CMC and local code.
  - Ground-mount units shall rest on concrete or other approved base extending at least 3" above the adjoining ground level.
  - Wall-mount units shall be anchored to structural members.
- **Protection**
  - Units subject to mechanical damage shall be protected in conformance with CMC and local code.
  - Unit shall be attached to base with seismic straps when required by local code.
  - Wind barriers shall be installed when required by the manufacturer.



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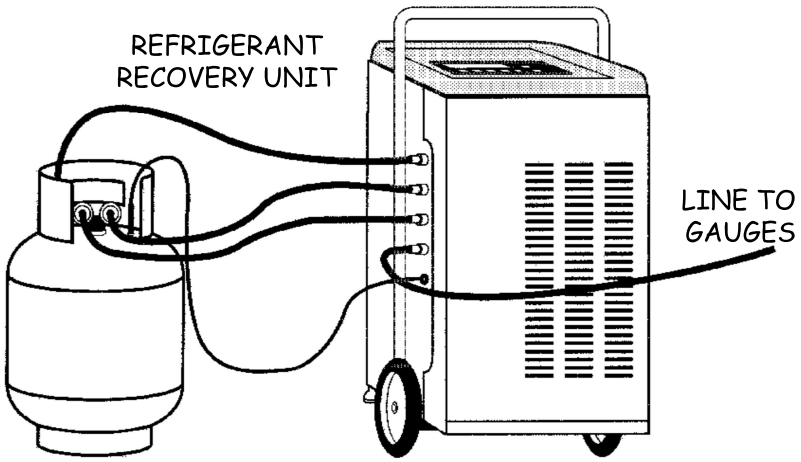
8. WALL AND FLOOR REPAIRS

- **All installations**
  - All openings, penetrations, and surfaces shall be repaired and sealed in a workmanlike manner.
  - Surface of repair shall match plane of adjacent material.
  - Patching shall match texture of, and blend with, surrounding surfaces.
  - All construction debris shall be removed from the crawl space and the premises.

9. REFRIGERANT SYSTEM

- **Refrigerant lines**
  - Shall be properly sized per manufacturer's specifications.
  - Shall be insulated and installed with UV-resistant, code-approved line set protection.
  - Shall provide the rated SEER for the combination condenser and evaporator coil match.
- **Refrigerant system charging**
  - Refrigerant system shall be properly charged using methods specified by the manufacturer.
  - Refrigerant recovery, handling, and disposal shall be performed in accordance with federal law by a technician with EPA-approved certification as a Type II or Universal Technician.
- **Refrigerant theft protection**
  - Locking caps shall be installed on accessible refrigerant service valves.
    - *Exception*: Locations requiring keyed access.
  - Locking caps shall be brass with integral O-ring and covering/plating that is color-coded or labeled for refrigerant type.



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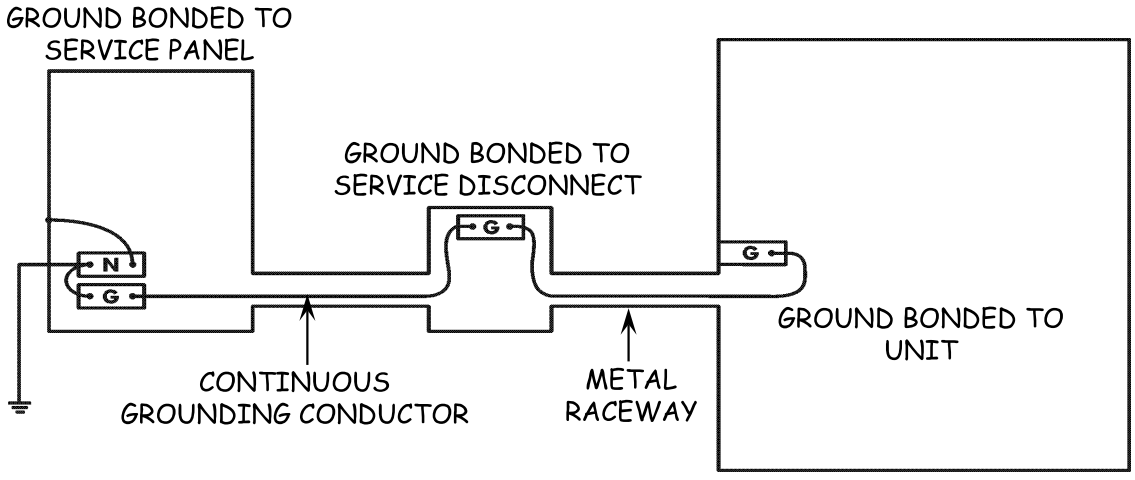
10. ELECTRICAL ACCESSIBILITY AND GROUNDING

- **All equipment installations**
  - Proper access and working space shall be provided per the CEC.
- **Open space for panels and equipment**
  - An open space shall be provided around electrical panels and equipment requiring servicing and shall be minimum 30" wide by 36" deep or as specified by local jurisdiction.
- **Service receptacle**
  - A 120-volt grounded exterior service receptacle shall be:
    - Located within sight of the equipment up to 25' (or attached to it).
    - On the supply side of the disconnect switch.
    - On the roof adjacent to the equipment (if unit is roof-mounted).
- **Grounding**
  - Equipment shall be grounded in conformance with manufacturer's instructions and local code.
  - Grounding shall provide a continuous path to the service ground with all disconnects and controllers in the open position.

11. BRANCH-CIRCUIT PROTECTION

- **General requirements**
  - Branch-circuit overcurrent protection, and ground-fault protection, shall be installed in accordance with manufacturer's instructions, CEC Article 440, and local code.
  - Equipment shall be provided with a disconnecting means.
  - The overcurrent protection device shall be the type and amperage specified on the equipment nameplate.



CONTINUOUS GROUNDING PATH FROM SERVICE PANEL TO UNIT PROVIDED BY CONDUCTOR OR RACEWAY

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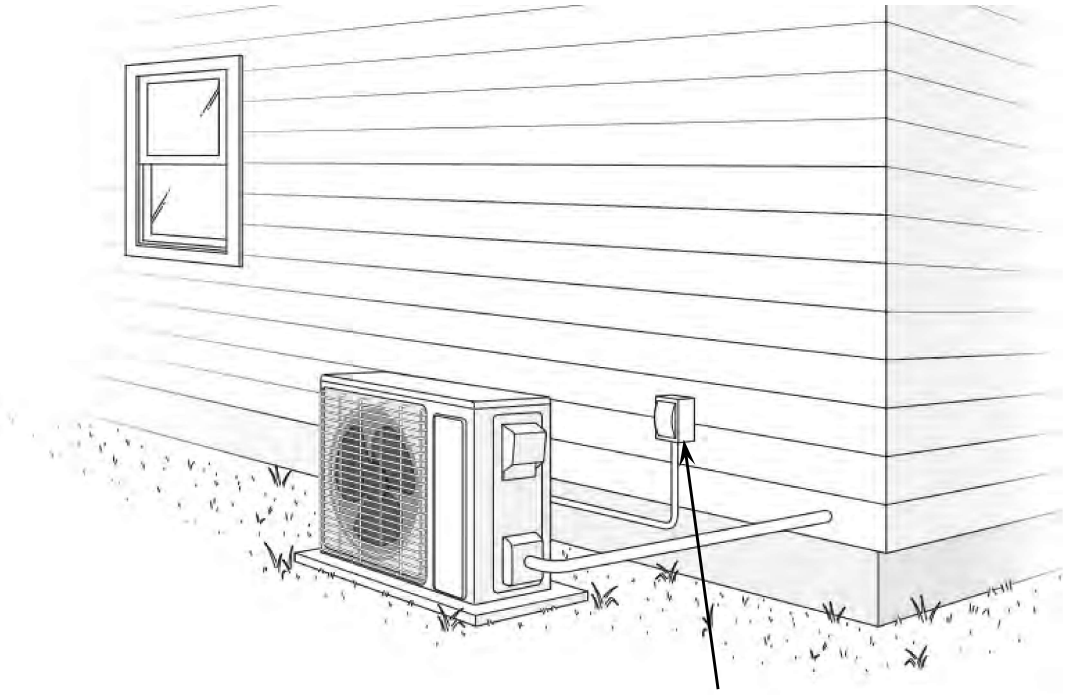
12. BRANCH CIRCUIT CONDUCTORS

- **Branch circuit conductors shall be in conformance with the CEC requirements for:**
  - Ampacity and rating of conductors.
  - Voltage drop and wire length.

13. UNIT DISCONNECTING MEANS (SERVICE DISCONNECT)

- **The service disconnect:**
  - Shall be located within sight of and be readily accessible from the equipment, or as required by the local jurisdiction.
  - May be installed on or within the equipment.
- **Rating**
  - The rating of the installed fuses or circuit breakers shall not exceed the rating of the installed equipment.



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14. FUEL SWITCHING AND SUBSTITUTION

- **Pre-installation electrical assessment**
  - The existing circuit shall be checked for proper:
    - Overcurrent protection.
    - Presence and gauge of continuous ground.
    - Number and capacity of conductors.
  - If existing circuit is not adequate, or a circuit is not present, the main distribution panel and subpanel shall be evaluated for the feasibility of adding a new circuit, including:
    - Required amperage.
    - Overcurrent protection.
    - Additional conductors and grounding.
- **Replacement gas appliances**
  - Replaced appliances shall be disconnected and removed from the premises.
- **Remaining gas lines**
  - Disconnected gas lines resulting from fuel switching or fuel substitution shall be capped.

15. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Appliance operation**
  - The installed unit shall be tested for proper operation.
  - Proper operation shall be explained and demonstrated to the customer, including:
    - Operation of all user-accessible controls.
    - Filter replacement.
    - Routine maintenance recommended by manufacturer.
  - Manufacturer's written instructions and warranty documents shall be supplied to the customer.

INSTRUCTIONS AND WARRANTY PROVIDED TO CUSTOMER

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15. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS (cont.)

- **Clean-up and disposal**
  - Paint dust and chips, scraps, and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Furniture and other household items moved for installation work shall be returned to their original positions.
  - All packing materials and installation debris shall be cleaned up and removed from the premises.
  - All replaced equipment and parts shall be removed from the premises and properly disposed of unless specified otherwise in the home improvement contract.
  - Refrigerant shall be recovered by a properly-licensed EPA-certified technician, and all hazardous waste materials shall be disposed of in conformance with federal, state, and local codes.

INFORMATION ABOUT HANDLING REFRIGERANT IS AVAILABLE AT THIS EPA WEBSITE:
https://www.epa.gov/section608

EPA United States Environmental Protection Agency

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Section X

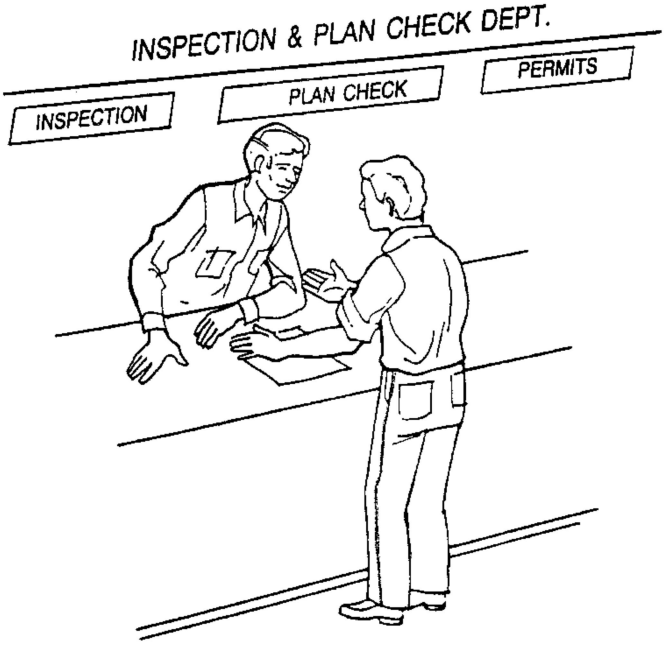
MOBILE HOME CRITERIA

16. GENERAL REQUIREMENTS

- **Permit**
  - A permit shall be obtained from and finalized by:
    - HCD for installations inside the mobile home.
    - HCD, or as applicable the local building department, for installations outside the mobile home.
- **Standards and specifications**
  - Installation shall be in compliance with manufacturer's instructions and specifications, and, as applicable, with requirements of HCD and/or the local building department.
- **Materials installed within a manufactured home:**
  - Shall be in compliance with HCD regulations and HUD MHCSS (CFR, Chapter XX, Part 3280).
- **Materials installed outside a manufactured home:**
  - Shall be in compliance with HCD regulations or, as applicable, requirements of the local building department.

17. ELECTRICAL WIRING, GROUNDING, AND ACCESSIBILITY

- **Unit shall be in conformance with:**
  - Manufacturer's instructions, and
  - HUD MHCSS, Section 3280, Subpart I, and/or, as applicable, requirements of the local building department.



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EVAPORATIVE COOLER REPAIR AND MAINTENANCE

Lead Paint Risk Factor
NONE-HIGH

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SECTION X PREFACE
for

EVAPORATIVE COOLER REPAIR AND MAINTENANCE

1. Nonfeasibility Criteria

1.1. The existing evaporative cooler is functioning properly and no maintenance is required.

1.2. The cost to repair is more than 50% of the replacement cost.

1.3. Conditions exist that require the unit to be replaced, including:

a. Inadequate and/or hazardous electrical connections.

b. Excessive leaks.

c. Window/wall deterioration presents an imminent hazard.

d. Platform is deteriorated and unsafe.

1.4. Unit is installed in a location that:

a. Is hazardous, or

b. Violates egress requirements.

1.5. Unit is not attached/supported properly, and required corrections are beyond the scope of maintenance.

1.6. Substandard wiring exists (e.g., ungrounded outlet, decayed insulation, exposed wires), and correction is not feasible.

1.7. Proper exhaust ventilation is not available and correction is not feasible.

1.8. Customer refuses.

2. Installation Policies

2.1. Customer must have an operational central A/C unit that is 14 SEER or less.

2.2. For single family homes and mobile homes, evaporative cooler repair and maintenance is available only in approved climate zones.

2.3. Evaporative cooler repair may be conducted when:

a. The unit is functional or nonfunctional, and

b. The repair cost is 50% of the replacement cost or less.

3. Installation Policies Specific to Mobile Homes

None.

EVAPORATIVE COOLER REPAIR AND MAINTENANCE STANDARDS

1. REPAIR CHECKLIST

- **Items 2 through 16 shall be checked and repaired when defective.**
- **Other procedures recommended by manufacturer shall be followed.**

2. PLATFORM/ATTACHMENT REPAIR

- **Existing installation shall be checked to ensure that the following requirements are met:**
  - Cooler is securely attached to the mounting assembly.
  - Unit is mounted level in all directions.
  - Mounting anchors are the correct size and properly installed.
  - Unit is installed in a manner which will safely support the operating weight (cooler plus water).
  - Existing platform is deteriorated or unsafe, and the condition is feasible to repair within the program scope.

3. ELECTRICAL WIRING

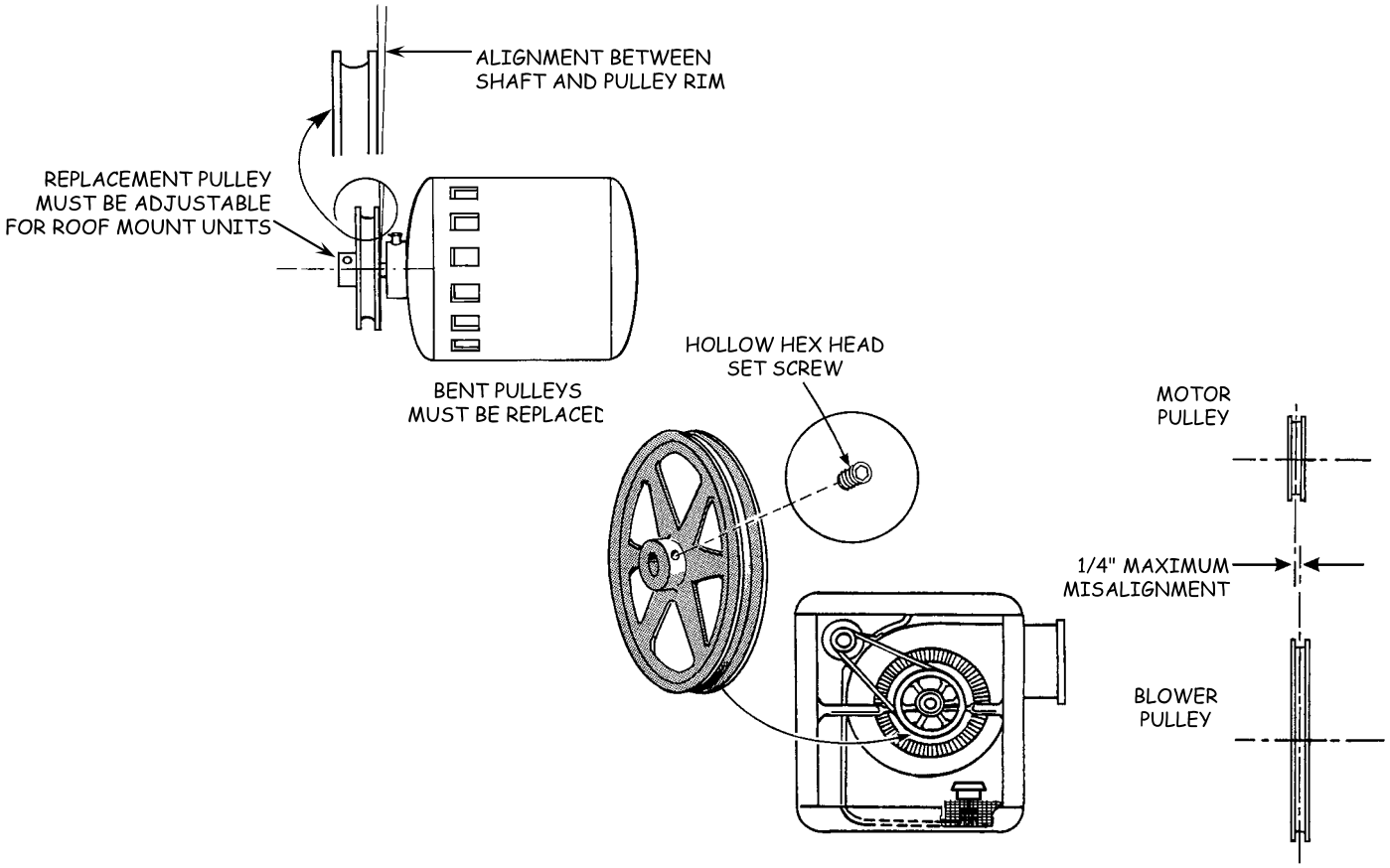
- **Electrical circuitry shall be checked for:**
  - Proper grounding of cabinet, electrical boxes, and conduit.
  - Safe and secure connections.
  - Adequate circuit capacity and overcurrent protection.
- **All Units**
  - All motors and pumps shall be grounded.
  - Newly installed (repaired) wiring or grounding shall be in compliance with the California Electrical Code requirements.

4. THERMOSTAT AND CONTROLS

- **All units**
  - Controls and/or thermostat shall be checked for proper operation.
- **Thermostats**
  - Ensure wiring connections are correct and tight, and the unit is level.
  - Replacement thermostats shall be:
    - Programmable, unless refused by the customer then a standard wall thermostat shall be offered.
    - Compatible with the equipment it will control.
    - Installed in accordance with IS Section 18 (Natural Gas Central Forced Air Heating System Repair and Replacement), Part 4.

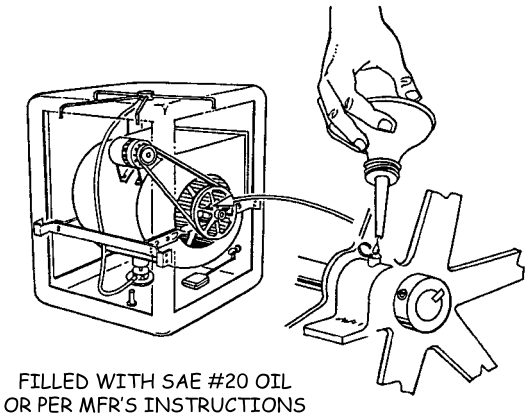
5. PULLEYS

- **Pulleys shall be checked for:**
  - Correct alignment.
  - Proper belt tension.
  - Tightly-installed set screws and nuts.
- **Bent pulleys**
  - Bent motor and blower pulleys shall be replaced.
- **Pulley pitch**
  - Replacement motor pulleys shall be adjustable for controlling motor amperage and speed of blower.
  - *Exception:* A fixed pitch pulley may be installed in a window- or wall-mount cooler if the pulley and motor size/speed match the original equipment.
- **Shaft/Pulley alignment**
  - Shaft and pulley rim must be in alignment.
- **Set screws**
  - Set screws shall be tightened properly to secure the pulley on the shaft.
- **Alignment**
  - Motor pulley and blower pulley shall be aligned to within 1/4".



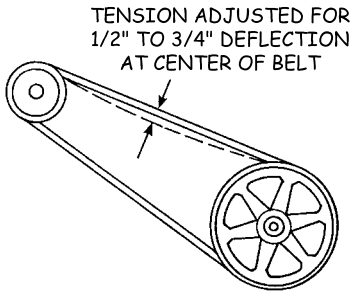
6. BLOWER MOTOR

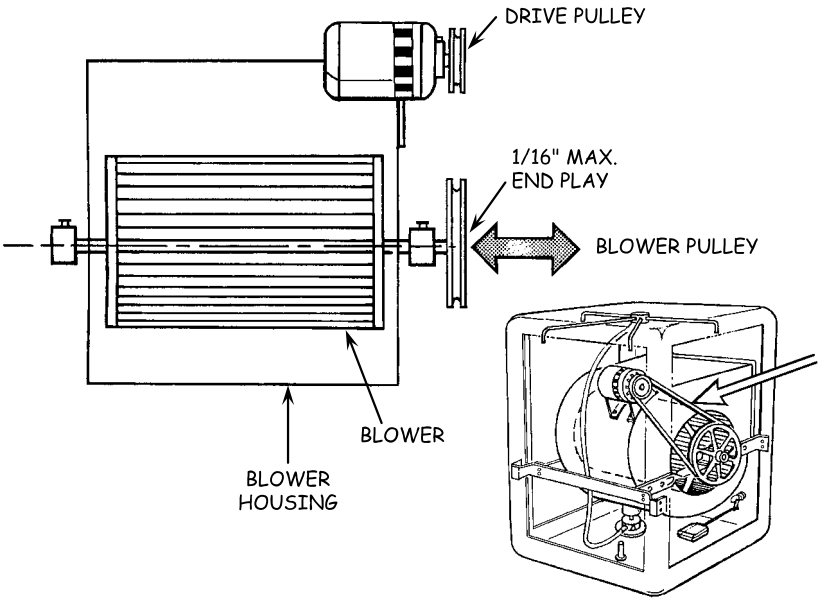
- **Blower bearing shall be checked for:**
  - Proper lubrication, if applicable.
- **Blower fan shall be checked to ensure:**
  - Proper clearance from housing.
  - Free rotation.
  - Proper operation of both motor and fan.
- **Motor shaft**
  - Motor shaft shall spin freely.
  - Motor shall be replaced if frozen or if shaft does not spin freely.
- **Unsealed bearings**
  - Oil cups on unsealed bearings shall be filled with SAE #20 non-detergent oil or lubricated per motor manufacturer's instructions.
- **Blower motor replacement**
  - Defective motors shall be replaced.
  - Replacement motors shall be 2-speed.
    - *Exception:* If the existing motor is single speed, the replacement may be single speed.
- **Mounting**
  - Motor shall be safely and securely mounted.
  - All nuts and bolts shall be checked.



7. BLOWER ASSEMBLY

- **Belt adjustment**
  - Belt tension shall be adjusted to:
    - A 1/2" to 3/4" deflection at the center of the span, or
    - Per manufacturer's specifications.
  - Motor sheave shall be adjusted to achieve specified motor amperage specified on the nameplate.
    - *Exception:* Does not apply to window/wall units with factory-specified motor speed and fixed pitch pulley.
- **Belt replacement**
  - Belt shall be replaced if cracked or worn unevenly.
- **Blower maintenance**
  - Oil cups or unsealed bearings shall be filled with SAE #20 non-detergent oil or lubricated per manufacturer's instructions.
- **Alignment**
  - Shaft end play shall not exceed 1/16".
  - Blower wheel shall be centered end-to-end in blower housing.



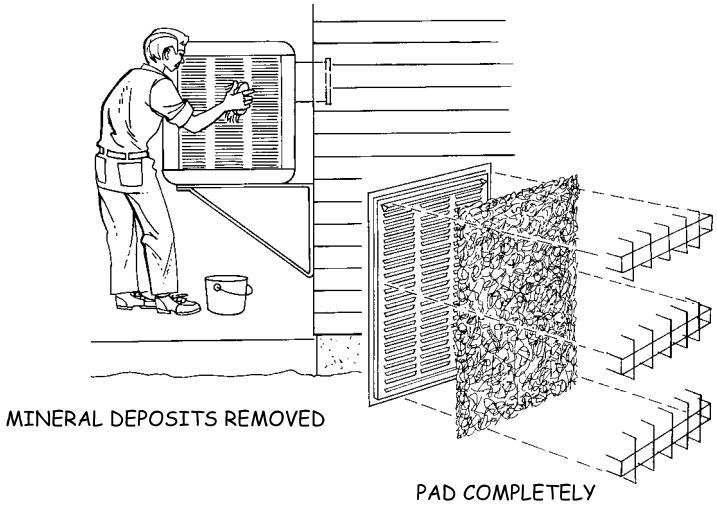


8. COOLER PADS AND FRAMES

- **Pad frames**
  - Frames shall be cleaned and scraped to remove mineral deposits.
  - If paint or coating is removed, frame shall be recoated/sprayed.
- **Pads**
  - Cooler pads shall be cut to ensure complete coverage of frame.
  - Pad thickness of at least 1" shall be achieved, with a single 1" pad, or with two thinner pads.

9. WATER SUPPLY

- **Water system shall be checked for:**
  - Proper flow and absence of leaks.
  - Proper adjustment of float, water level, and splash shield.
- **Leaks shall be repaired.**
- **Mineral/calcium deposits shall be removed.**
- **Copper supply lines**
  - Shall be minimum of 1/4" OD with brass fittings.

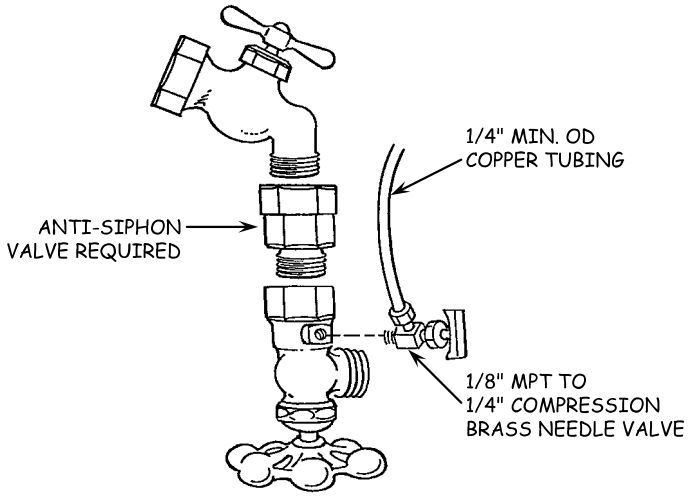


9. WATER SUPPLY (cont.)

- **Shut-off valve and fittings**
  - Brass shut-off valve shall be installed if no shut-off valve exists.
    - 1/4" x 1/8" needle valve, or as required by local code.
    - Self-tapping needle valve not allowed.
    - Outdoor shut-off shall be reachable from ground level.
- **Plastic supply lines**
  - Existing damaged or leaking plastic line shall be replaced with copper.
- **Fittings**
  - Brass fittings only.
- **Anti-siphon valve**
  - Anti-siphon valve shall be present.

10. WATER PUMP

- **Pump and screen shall be checked for:**
  - Properly-installed screen.
  - Debris-free inlet with proper clearance from obstructions.
  - Proper pump impeller operation (turns freely).
- **Pump shaft shall turn freely.**
- **Pump replacement**
  - Pump shall be replaced if defective.
- **Pump inlet**
  - Inlet cover shall be free and clear of debris.
  - Debris screen shall be cleaned and replaced if corroded or damaged.

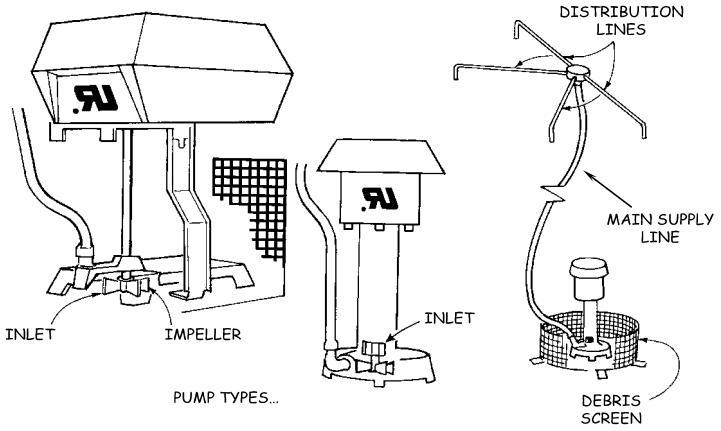


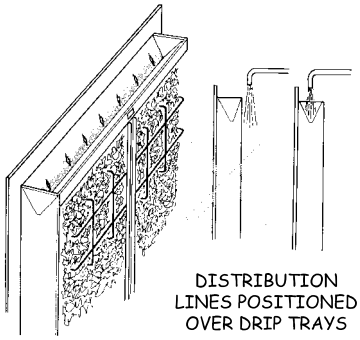
10. WATER PUMP (cont.)

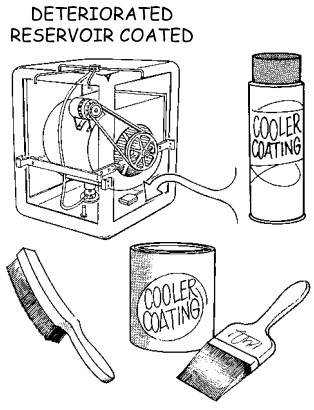
- **Water lines**
  - Water shall flow freely from pump.
  - Distribution lines shall be:
    - Free of all obstructions, including kinks in main supply line.
    - Sealed at all connections.
    - Replaced if deteriorated.

11. WATER DISTRIBUTION AND DRIP TRAYS

- **Water troughs**
  - Water in the troughs and reservoir shall be evenly distributed.
- **Water distribution**
  - Water shall be distributed evenly over cooler pads.
  - Distribution lines shall be positioned over trays.
  - Drip trays shall:
    - Be free of all debris.
    - Have clean, open holes.
    - Be level for proper operation.





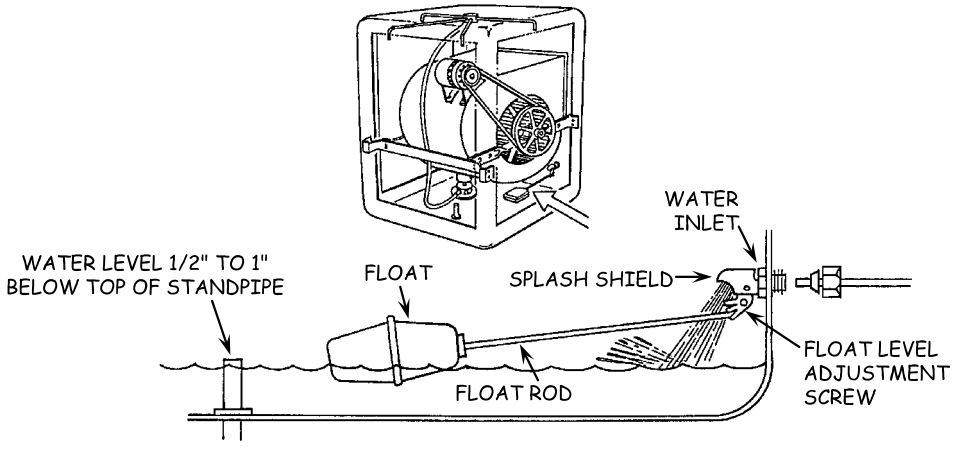


12. FLOAT VALVE

- **Float adjustment**
  - Water level shall be within 1/2" to 1" of the top of standpipe.
  - Water level may be adjusted with float level adjustment screw, or by bending the float rod.
- **Valve**
  - Float valve shall completely shut off incoming water when raised.
- **Splash shield**
  - Float splash shield shall prevent water from spraying away from reservoir.
- **Replacement**
  - All malfunctioning parts shall be replaced.

13. COOLER RESERVOIR

- **Reservoir and standpipe**
  - Reservoir and standpipe shall be checked for proper installation and shall be free of leaks.
  - Defective standpipe and/or gasket shall be replaced if leaking.
- **Maintenance and cleaning**
  - All debris shall be removed.
  - Rusted or deteriorated units shall be cleaned and coated with undercoating.
  - Other services, as identified by a qualified technician.

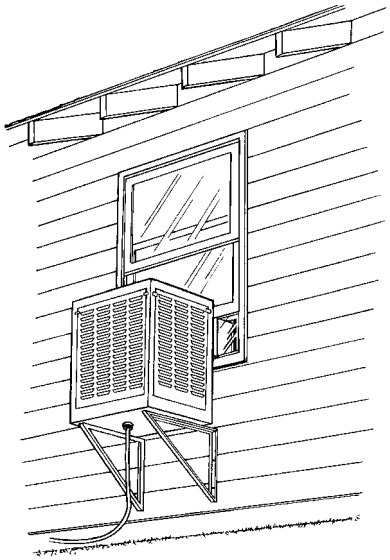


14. DRAIN SYSTEM

- **Drain line shall be checked to determine that it:**
  - Is properly installed and free of leaks.
  - Terminates correctly.
- **Drain water:**
  - Shall flow away from the house.
  - Shall not flow or splatter against wall.
- **Drain hose/line**
  - Water shall be diverted away from the structure.
  - End of hose/line shall be visible.
  - If missing, a drain line shall be added.

15. COOLER DUCTING

- **Ducts serving only the cooler**
  - Disconnections and damage/leaks shall be repaired per IS Section 10 (Duct Test and Seal) or IS Section 39 (Prescriptive Duct Sealing).
  - Routine duct testing of the evaporative cooler duct is not required.
  - When discharge is through supply registers, the registers shall be covered with magnetic sheet covers.



DRAIN WATER MUST
FLOW AWAY FROM THE HOUSE

16. ADDITIONAL CHECKS FOR ROOF-MOUNT UNITS

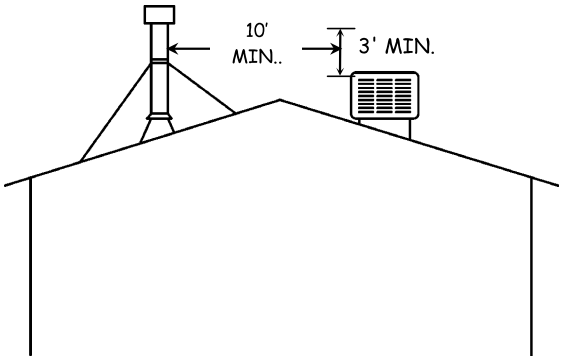
- **Roof jack must be securely installed and sealed at cooler and roof.**
- **Plumbing and electrical roof penetrations shall be properly sealed.**

17. EXTERIOR CLEARANCES

- **All conventional home units**
  - Cooler air intake shall be located at least 10' away from, or 3' below, combustion appliance vent terminations.
  - Cooler air intake shall be located at least 10' away from:
    - Plumbing vent terminations.
    - Kitchen and bathroom exhaust fan vent terminations.
  - Unit shall not be installed if clearance requirements cannot be met.

18. PRE-OPERATION CHECK

- **Installation shall be checked to ensure that the following requirements are met:**
  - Cooler is securely attached to the mounting assembly.
  - Unit is mounted level in all directions.
  - Mounting anchors are the correct size and properly installed.
  - Unit is installed in a manner that will safely support the operating weight (cooler plus water).
- **Electrical circuitry shall be checked for:**
  - Proper grounding of cabinet, electrical boxes, and conduit.
  - Safe and secure connections.
  - Adequate circuit capacity and overcurrent protection.



18. PRE-OPERATION CHECK (cont.)

- **Pulleys shall be checked for:**
  - Correct alignment.
  - Proper belt tension.
  - Tightly installed set screws and nuts.
- **Blower bearing**
  - Shall be checked for proper lubrication, if applicable.
- **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 ensure:**
  - 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…

19. START-UP CHECK

- **The following shall be checked for proper operation:**
  - Blower motor and fan.
  - Control/switch in all positions.
  - Even water distribution over pads (and pads correctly installed).
  - Automatic cleaning system (automatic flush or bleed-off).
- **Installed options**
  - Optional items, such as ceiling-mount exhaust vents, shall be checked.

20. INSTRUCTIONS

- **All units**
  - Customer shall be provided with written and verbal instructions for proper cooler operation and maintenance.
    - Manufacturer's written instructions shall be provided.
    - Verbal instructions shall include:
      - Explanation of cooler operation, and
      - Review of the written instructions, including operation and care of cleaning system and/or chemical additives.
  - Customer shall be provided with required warranties.

21. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up**
  - All packing materials and installation debris shall be cleaned up and removed from the premises.
  - All replaced equipment and parts shall be removed from the premises and disposed of properly unless owner requests otherwise.
  - Paint dust and chips, scraps, and other debris resulting from installation shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Furniture and other household items moved for the installation shall be returned to their original positions.

CUSTOMER RECEIVES VERBAL AND WRITTEN INSTRUCTIONS AND WRITTEN WARRANTIES

FLOOR INSULATION AND FOUNDATION VENTING FOR CONVENTIONAL HOMES

Lead Paint Risk Factor
NONE

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Section X

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SECTION X PREFACE
FOR

FLOOR INSULATION AND FOUNDATION VENTING FOR CONVENTIONAL HOMES

1. Nonfeasibility Criteria—Entire Home

1.1. Floor is already insulated or partially insulated.

1.2. Crawl space access is unsafe due to inadequate crawl area clearance and/or the presence of an unsafe condition, as outlined in Item 4.

1.3. The home has deteriorated or substandard framing or subfloor.

1.4. Floor contains Knob-and-Tube wiring.

1.5. Crawl space cannot be properly vented.

1.6. Square footage of floor that can be insulated is less than 100 square feet.

1.7. Confined Spaces: CalOSHA regulations regarding confined spaces cannot be met.

1.8. Customer refuses.

2. Nonfeasibility Criteria—Section of Floor

2.1. Inadequate clearance or safety hazard present, per Item 4.

2.2. Deteriorated or substandard framing or subfloor present.

2.3. Already insulated or partially insulated.

2.4. Floor section is over conditioned space.

3. Installation Policies

3.1. When required, a permit shall be obtained and finalized by the local jurisdiction.

3.2. Before insulation is installed:

a. Floor bypasses and leaks shall be sealed.

b. Any exhaust system (e.g., clothes dryer moisture exhaust) that terminates in the crawl space shall be vented outdoors.

c. All vegetation and organic material, and debris greater than 1", will be removed from the crawl space (e.g., rake the crawl space) and disposed of properly.

3.3. Insulation shall be installed per manufacturer's specifications and must achieve the manufacturer's recommended density for the installed R-value.

3.4. Installation shall be in harmony with guidelines in the 2019 Title 24 Building Energy Efficiency Standards, Residential Appendix RA3, §RA3.5, "Quality Insulation Installation Procedures."[1]

3.5. Safety practices outlined in Item 4 must be observed.

3.6. Homes with contiguous crawl spaces consisting of different sections with various clearances shall have insulation installed only in the sections with adequate crawl clearance.

3.7. When HVAC ducts are in the crawl space, duct testing and duct sealing shall be completed before insulation is installed.

3.8. Floor bypasses and air leaks shall be sealed before insulation is installed.

3.9. Any exhaust system (e.g., down-flow range exhaust or clothes dryer moisture exhaust) that terminates in the crawl space shall be vented outdoors.

3.10. NFVA Crawl space Vents

a. Crawl space venting shall conform to local building code.

b. When NFVA is provided by the manufacturer (e.g., stamped or labeled on the vent), that NFVA may be used.

c. When NFVA is not provided by the manufacturer, blocking effect of louvers and mesh shall be evaluated in accordance with the following table. In (A) or (B):

- Find the type of vent (including louvers and mesh) in the top row.
- Find the "reduction factor" in the bottom row.
- Multiply the "reduction factor" times the size of the vent opening to determine NFVA of the vent.
- Example: The open area of a screened vent of 1/4" mesh only (no louvers) is 10″ x 10″ = 100 sq. in. NFVA = 100 x 0.90 = 90 sq. in. net.

Screen and Louver Reduction Factors

(A) Mesh Only

1/4" Mesh (hardware cloth)	1/8" Mesh (wire mesh)	1/16" Mesh (insect screen)*
0.90 (90%)	**0.75** (75%)	**0.50** (50%)

(B) Louvers & Mesh

Metal Louvers **or** Metal Louvers and 1/4" or 1/8" Mesh	Metal Louvers and 1/16" Mesh	Wood Louvers **or** Wood Louvers and 1/16" to 1/4" Mesh
0.75 (75%)	**0.50** (50%)	**0.25** (25%)

**Note: 1/16" screen must be replaced on vents included in NFVA calculations.*

[1] Title 24 energy efficiency documents are available at: http://www.energy.ca.gov/title24/

3.11. Workmanship Practices

a. Square Footage Measurements:
   - Square footage is based on exterior measurements.
   - Measurements of length and width are to be rounded off to the nearest foot; i.e., 12'5" = 12' (feet) and 12'-6" = 13' (feet).

b. Work Practices
   - When crawl space access is indoors, the pathway from the entrance door to the access shall be protected with runners.
   - When entry is through an access inside a closet, the clothing and other personal property must be removed or protected.
   - All cutting of fiberglass batts and blankets shall occur outside the living space or inside the crawl space.

c. Clean-up following installation of ceiling insulation:
   - When access is inside the home,
     - All areas between an indoor access and the home entrance shall be vacuumed.
     - The area between the home entrance and the insulation truck shall be cleaned (swept and/or vacuumed).
   - When access is outside the living space, all areas between the access and the insulation truck shall be cleaned (swept and/or vacuumed).
   - A HEPA vacuum is required when fiberglass insulation is installed (and should be used for all other types of insulation).

4. Safety Practices

4.1. Electrical Safety

a. Crews should avoid areas with unsafe wiring (see 4.1.b.)

b. Unsafe electrical conditions must be corrected before insulation is installed—including open junction boxes, improper splices, and conductors with worn/damaged/missing insulation/covering.

4.2. Crawl space Clearances

a. Clearance should be at least 18″ from the ground to the bottom of floor joists.

b. Any obstruction in the crawl area, such as an HVAC duct, should provide clearance of at least 18″ to crawl over or under.

4.3. Crawl Area Safety: To crawl through an under-floor area, it must be free of unsafe conditions, such as the following:

a. Hazardous insect infestation

b. Fuel leaks

c. Hazardous electrical condition

d. Unsafe structural members

e. Plumbing leaks

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f. Sewage waste on the ground, or any other unsanitary condition
g. Excessive ground moisture, such as standing water or mud

4.4. Knob and Tube Wiring – Insulation shall not be installed when K&T wiring is present.

5. Installation Policies Specific to Mobile Homes

As specified in IS Section X (Floor / Undercarriage Insulation for Mobile Homes).

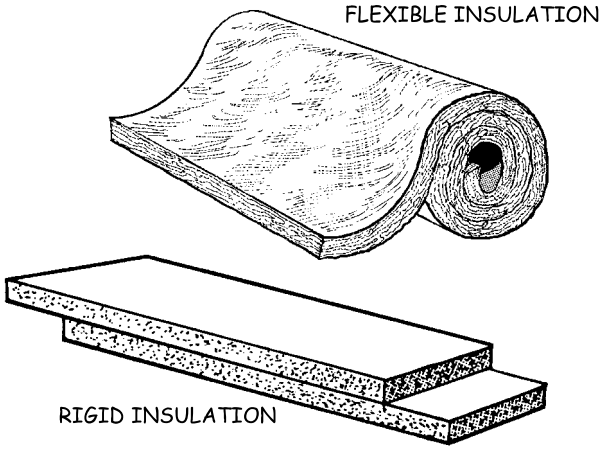
FLOOR INSULATION AND FOUNDATION VENTING STANDARDS FOR CONVENTIONAL HOMES

1. APPROVED MATERIALS

- **Code compliance**
  - All insulation shall be certified to comply with the CCR, Title 24, Part 12, Chapters 12-13, Standards for Insulating Material.
- **Mineral fiber**
  - Flexible (Batts and Blankets)
    - Conformance to ASTM C665.
  - High Density Fiberglass Board
    - Conformance to ASTM C726.
- **Rigid foam**
  - Preformed Polyisocyanurate Board Foil Faced on Both Sides
    - Conformance to FS HH-I-1972 or ASTM C1289.
  - Rigid, Cellular Polystyrene Thermal Insulation
    - Conformance to ASTM C578.
- **Cellulose**
  - Loose Fill
    - Licensed for sale in California.
    - Compliance with CPSC 16 CFR, Parts 1209 and 1404, and ASTM C739.

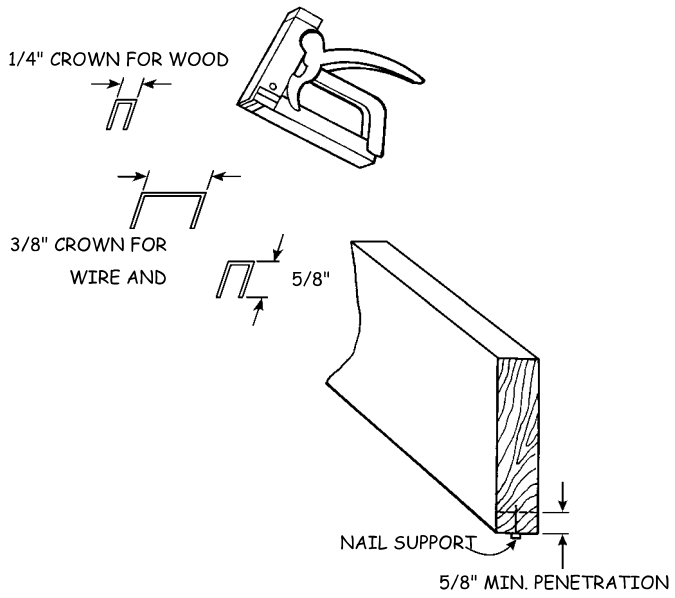
2. R-VALUE

- **All insulation materials**
  - Installed subfloor insulation shall have an R-value of R-19 unless otherwise specified by local code.
  - Perimeter insulation:
    - Interior: minimum R-13.
    - Exterior: minimum R-8.



3. APPROVED INSULATION SUPPORTS AND ANCHORS

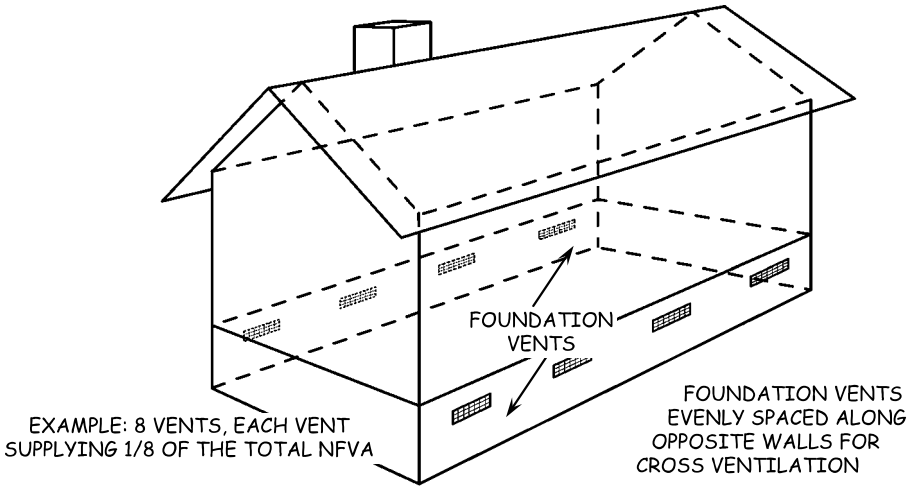
- **Staples**
  - Zinc coated, stainless steel, or similar corrosion-resistant material.
  - 18 gauge minimum diameter.
  - 1/4" crown for wood lath.
  - Minimum 3/8" crown for other insulation support systems.
  - 5/8" minimum joist penetration.
- **Nails**
  - Galvanized nails.
  - 5/8" minimum joist penetration.
- **Wire and twine**
  - For support of flexible insulation
  - Wire shall be:
    - Zinc coated, stainless, or similar corrosion-resistant material.
    - Minimum 20 gauge.
  - Twine
    - Polypropylene or polyester material.
    - Breaking strength of at least 150 pounds.
- **Spring wire support rods ("lightning rods")**
  - Spring steel wire with chisel point.
  - Minimum 13 gauge.
  - Zinc coated, stainless, or similar corrosion-resistant material.
- **Netting**
  - Woven wire shall be galvanized.
  - Synthetic netting shall be polypropylene, polyester, or equivalent with a minimum 75 lb. breaking strength.



PRE-INSTALLATION REQUIREMENTS

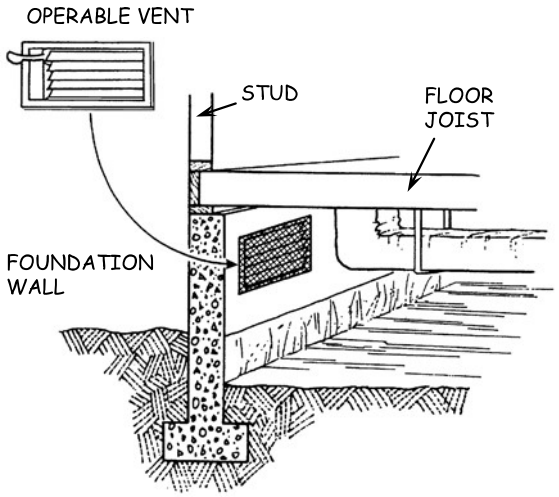
4. CRAWL SPACE VENTING

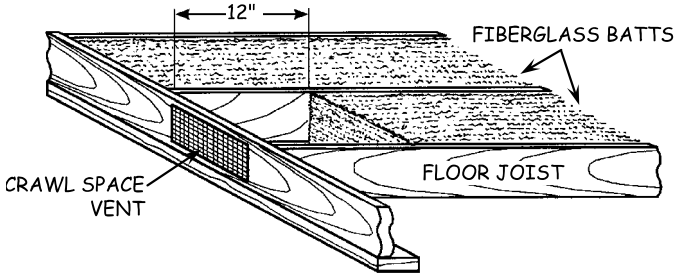
- **Venting requirement**
  - Crawl space venting shall conform to local building code requirements.
  - When required by the local building code, crawl space venting shall also conform to Wildland Urban Interface requirements.
- **Title 24 (CRC) requirements**
  - The crawlspace shall be vented by means of openings in the foundation walls.
  - Total NFVA of the openings shall equal at least:
    - 1 sq. ft. for each 150 sq. ft. of under-floor area (i.e., 1/150 ratio), or
    - 1 sq. ft. for each 1500 sq. ft. of under-floor area (i.e., 1/1500 ratio), *when approved by the local jurisdiction* on the basis that:
      - Moisture in the crawlspace is not considered excessive, and
      - The under-floor ground surface area is covered by an approved vapor retarder (see Item 5).
  - Vent openings shall:
    - be located as close to corners as practical (within 3' of each corner of the building),
    - provide cross-ventilation, and
    - be covered with corrosion-resistant wire mesh with 1/4" weave.
  - The required NFVA shall be approximately evenly distributed along the lengths of at least two opposite sides.
- **NFVA**
  - Net Free Venting Area (NFVA) of foundation vents shall be determined in accordance with Preface Item 3.10.

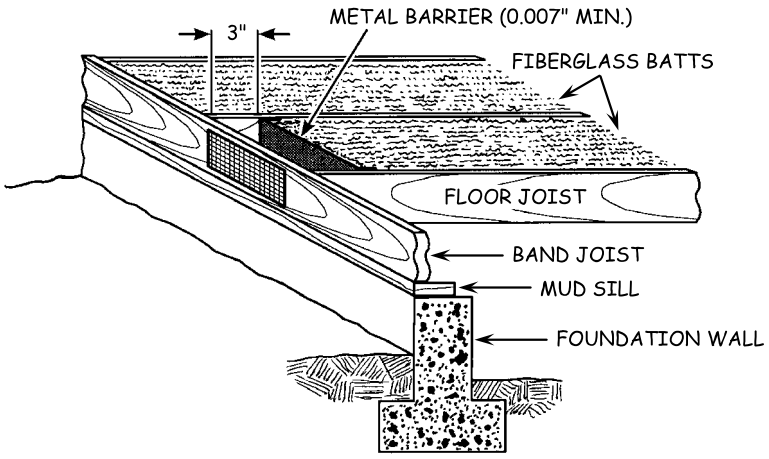


4. CRAWL SPACE VENTING (cont.)

- **Existing vents**
  - 1/8" to 1/4" mesh is acceptable; 1/16″ mesh must be replaced with 1/4" mesh on vents included in NFVA calculations.
  - Clogged mesh shall be cleaned or replaced as needed to provide the required NFVA.
  - Torn and defective mesh shall be replaced.
- **Installed vents**
  - Vent openings shall be covered with 1/4" corrosion-resistant mesh.
  - Operable vents are best for cold climates (i.e., Climate Zones 1, 2 and 11-16). (Note: Cold climates are those locations with winter design temperature listed at or below 32ºF in the Title 24 Residential Manual or per ASHRAE).
- **Clearance from vents**
  - Vents shall <u>not</u> be obstructed by insulation.
    - 12" clearance without barrier.
    - 3" clearance with barrier made of minimum 0.007" sheet metal.

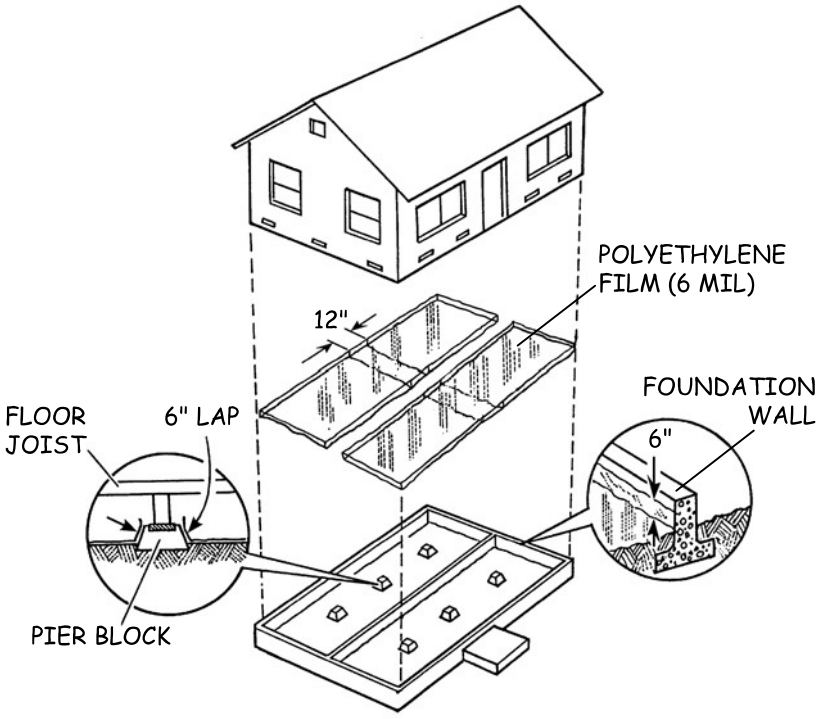






5. GROUND COVER VAPOR RETARDER

- **All insulation materials**
  - Vapor retarder shall be installed when required by local code, and when a ground water problem exists.
  - Existing undamaged ground cover is acceptable if at least 4 mil thick and in good condition after insulation is installed.
  - When installation of a ground cover vapor retarder is required:
    - It shall have a perm rating of 1.0 or less (e.g., minimum 6 mil thick opaque polyethylene).
    - Joints shall be lapped 12".
    - Moisture barrier shall extend 6" up the foundation wall.
    - Contact shall not be made with wood members.
    - Barrier shall be secured in place with a durable sealant, compatible with the retarder, or with brick or durable fasteners every 8' minimum.
      - If tape is used to secure polyethylene, surface must be clean, and tape must adhere to the polyethylene.
  - The earth shall be covered 100%.
  - Basements with exposed soil floor shall have ground cover over soil, *unless* vented and dry or excluded by local code.
  - Minimum 3" clearance required from heat producing devices.



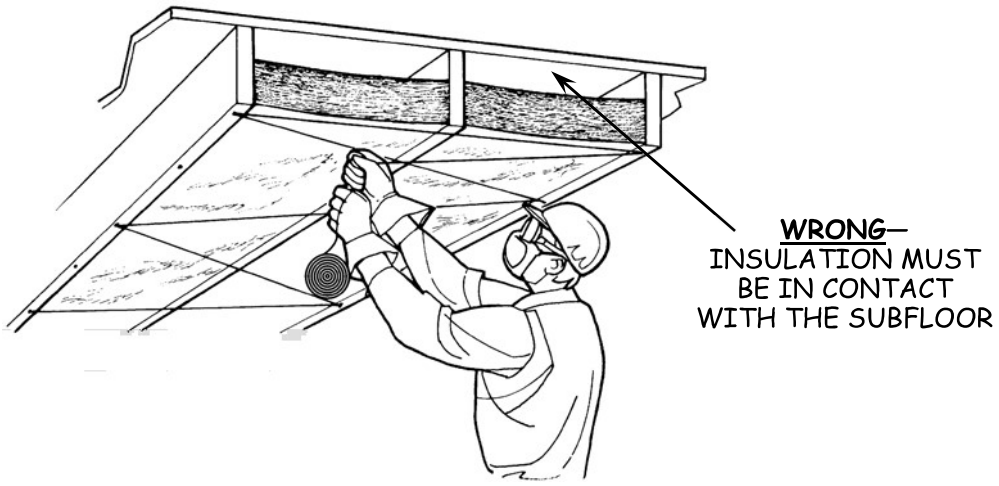
INSTALLATION REQUIREMENTS

6. LOCATION AND COVERAGE

- **All insulation materials**
  - Insulation shall be installed only between conditioned and unconditioned spaces (not be in floors over heated space).
  - Coverage shall be complete with no gaps on sides or ends.
  - Batt/blanket insulation shall be:
    - correctly sized and cut to fit snugly at sides and ends without gaps.
    - installed without being doubled over or compressed.
    - cut to butt-fit around wiring or plumbing—or be split so one layer can be fit behind it, and one layer fit in front of it.
    - properly supported to avoid gaps, voids, and compression.

7. PLACEMENT OF INSULATION

- **All insulation materials**
  - Insulation shall be in contact with subfloor and be held securely in place with support from underneath.
  - Faced batts shall be installed with facing against the subfloor.
  - Insulation shall not obstruct combustion air supply openings or foundation vents.
  - Minimum 3" clearance required between insulation and heat producing devices.



8. KNOB-AND-TUBE WIRING

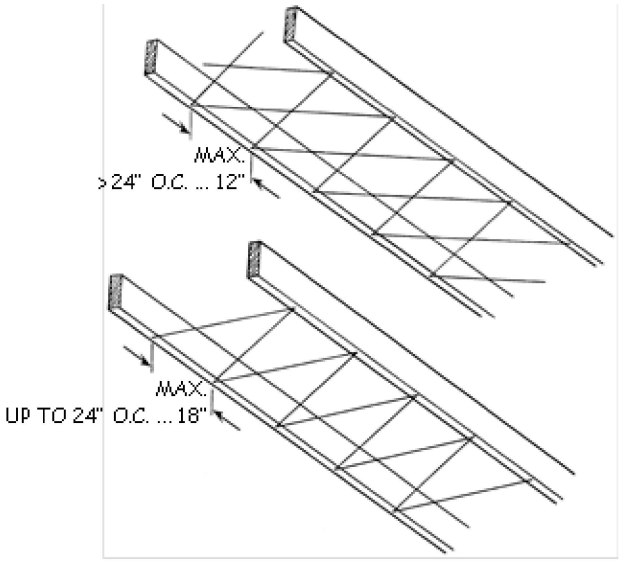
- **All insulation materials**
  - Insulation shall not be installed over knob-and-tube wiring.

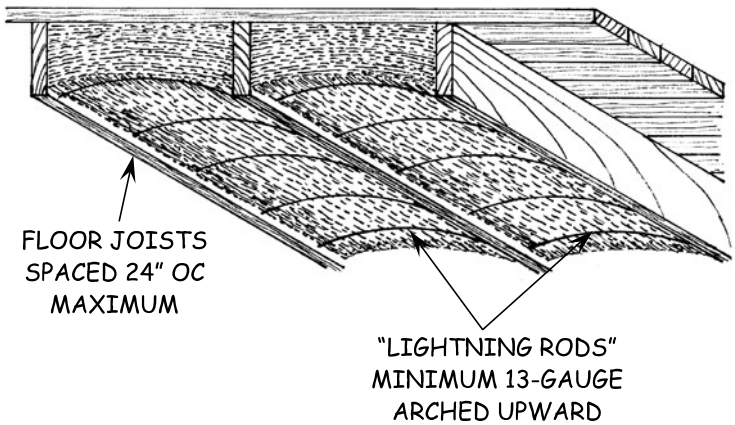
9. SPRING WIRE SUPPORT RODS ("LIGHTNING RODS")

- **Flexible insulation**
  - For joists up to 24" OC, rods shall be:
    - Installed under pressure, with minimum 1/16" joist penetration.
    - Arched upward.
    - Placed within 4" of each end of a batt and spaced elsewhere a maximum of every 18".
    - Maximum 10% compression of insulation.
  - Joists >24" OC – spring wire support rods are not allowed.

10. WIRE SUPPORT

- **Flexible insulation**
  - Joists up to 24" OC
    - Wire shall span twice in 18", with anchor points spaced maximum 18" apart.
  - Joists >24" OC
    - Wire shall span four times between anchor points (crisscross pattern), with anchor points spaced maximum 12" apart.
    - When batts are faced, facing shall be stapled to subfloor.
  - Maximum 10% compression of insulation.





11. WOVEN WIRE OR NETTING SUPPORT

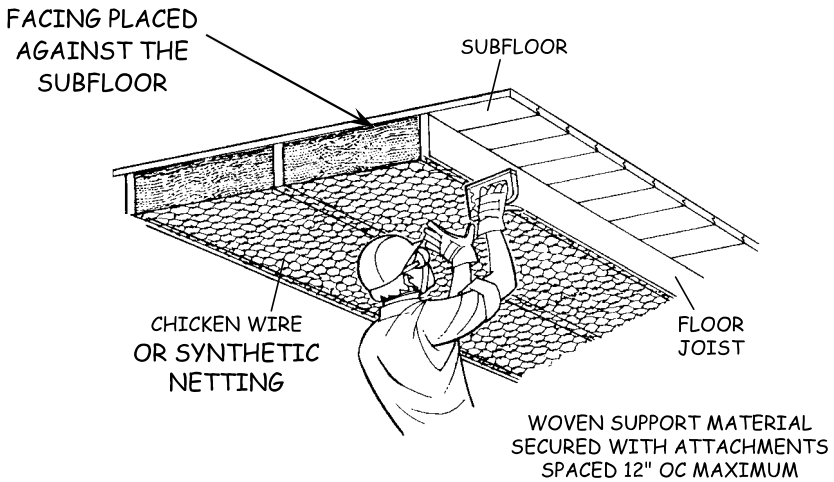
- **Flexible insulation**
  - Support Materials
    - Woven wire shall be galvanized.
    - Netting shall be propylene or equivalent with a minimum 75 lb. breaking strength.
  - Support shall be anchored to joists every 12".
  - Insulation thickness must equal or slightly exceed joist cavity depth, with 10% maximum overall compression of insulation.
  - Support shall not sag more than 1" per 24" of span in any direction.

12. WOOD LATH SUPPORTS

- **Flexible insulation**
  - Lath shall be spaced maximum 18" on center.
  - Lath shall be sized and spaced so insulation does not sag.
  - Lath may be attached with galvanized nails or corrosion-resistant staples.
  - Flexible insulation thickness must equal or slightly exceed joist cavity depth, with maximum 10% compression of insulation.

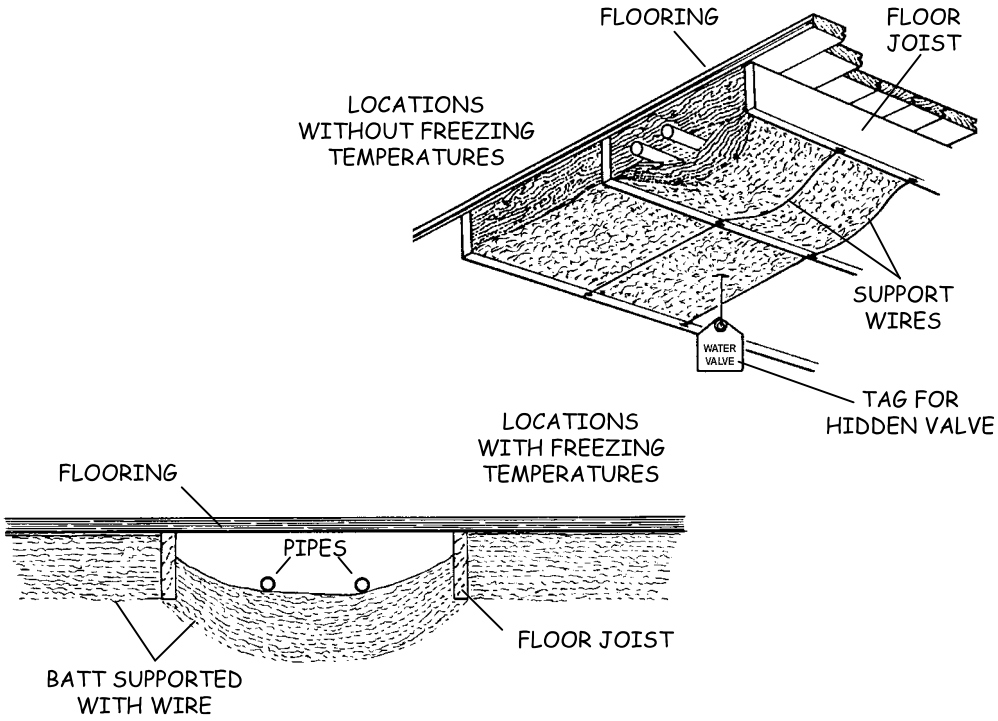
13. CRAWL SPACE ACCESS FROM CONDITIONED SPACE

- **All insulation materials**
  - Access cover/door shall be insulated:
    - R 19, if horizontal; R 13, if vertical.
  - Access cover/door shall be weatherstripped.
    - Horizontal openings: Hollow vinyl tube or self-adhesive foam tape.
    - Vertical openings: Weatherstripping shall comply with IS Section 2.



14. WATER PIPES IN CRAWL SPACE

- **All insulation materials**
  - Pipes shall not be isolated from the heated side.
    - In locations without freezing temperatures, pipes may be surrounded with insulation.
    - In locations with freezing temperatures, insulation shall be placed between pipes and cold side.
  - Locations with freezing temperatures are those with winter design temperature listed at or below 32°F in the California Energy Commission Residential Compliance Manual, or per ASHRAE.
- **Covered water valves**
  - Valve must be tagged if covered.
- **Water pipe heaters**
  - Water pipe heaters are not allowed.



15. UNDERFLOOR INSULATION, WHERE NO FOUNDATION WALL EXISTS

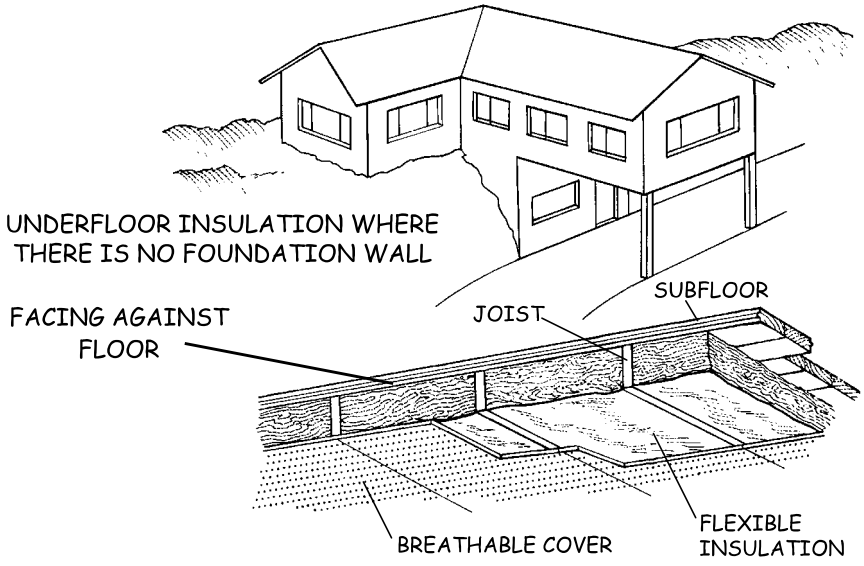
- **All insulation materials**
  - If exposed to precipitation, do not insulate.
  - If exposed to wind and animals:
    - Insulate with flexible mineral fiber or foil-clad foam board.
    - Support flexible insulation with woven wire or minimum 70 perm breathable cover.
  - Heat producing devices:
    - 3" clearance required.
  - Air barrier, when required by local jurisdiction, shall be installed between joists and sealed.

16. HVAC DUCTS

- **All duct insulation materials**
  - Ducts located within joist cavities shall be:
    - Surrounded with flexible insulation, or
    - Insulated in accordance with IS Section 10 (Duct Testing and Sealing).
  - Vapor barrier, when present, shall be on the exterior of the insulation.

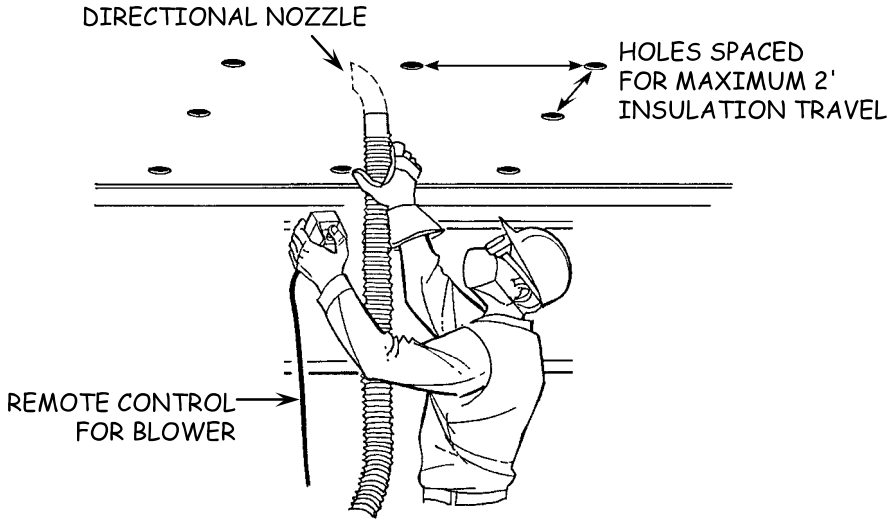
17. GAS APPLIANCES IN THE CRAWLSPACE

- **All insulation materials, clearance from combustibles:**
  - Minimum 3″ horizontal clearance from double-wall vent pipe
  - Minimum 6″ horizontal clearance from single-wall pipe and draft hood opening.
  - Minimum 12″ vertical clearance above draft hood.



18. FINISHED FLOOR CAVITIES (BLIND FILL)

- **Loose fill**
  - Cavities shall be drilled and pressure-filled with directional nozzle or fill tube.
  - Holes shall be spaced for maximum 2-foot horizontal insulation travel beyond the injector.
- **HPD clearance**
  - Minimum 3" clearance required for recessed lights, vent pipes, and other heat producing devices.
  - When 3" clearance cannot be achieved, the cavity containing the HPD shall not be insulated.
- **Coverage and finishing**
  - All portions of all fillable cavities shall be completely filled to required density as prescribed by insulation manufacturer.
  - Holes shall be plugged with tight-fitting plugs or patched with exterior-rated patching material.



Section X

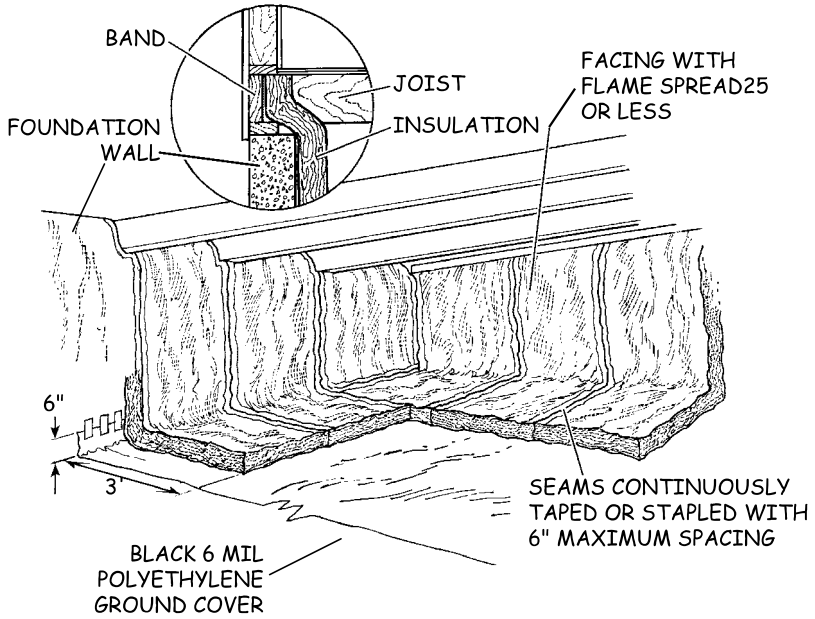
CRAWL SPACE PERIMETER INSULATION—INTERIOR

19. BASEMENT WALL INSULATION

- **Criteria**
  - Perimeter insulation may be installed in conditioned basements and in unvented crawl spaces as an alternative to floor insulation.
  - Ground cover shall be installed in accordance with Item 5.
  - Ground water shall not be present.
- **Foundation vents**
  - Vents shall not be blocked.
  - Foundation vents must be operable, so they can be closed during adverse weather.

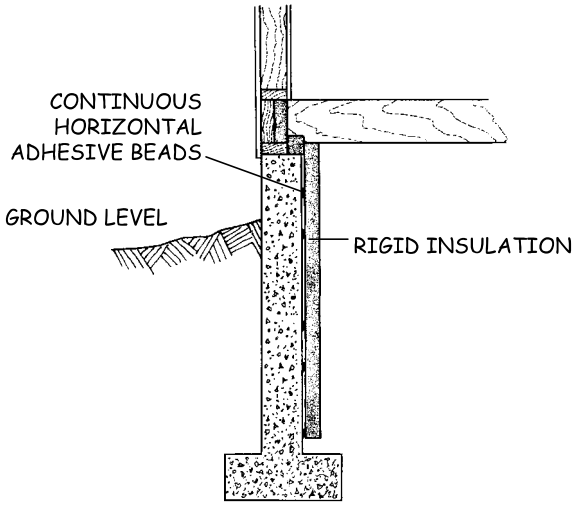
20. FLEXIBLE INSULATION

- **Criteria**
  - Shall cover band and header joists.
  - Shall extend 3' away from the walls on top of ground cover.
  - Seams shall be continuously taped or stapled at intervals not to exceed 6".
  - No gaps allowed between batts.
  - Facing shall meet applicable code requirements for flame spread and smoke density.



21. RIGID INSULATION

- **Installation requirements**
  - Band and header joists shall be insulated.
  - A minimum of one continuous horizontal bead of adhesive shall be installed on the foundation wall to block insect infestation.
  - Foundation wall shall be cleaned before adhesive is applied.
  - Mechanical fasteners, such as expansion bolts or suitable nails with washers, shall be used to permanently secure the insulation to the foundation wall.
  - Foam insulation shall be a code-approved fire-rated material.
- **Band joist and wood foundation walls**
  - A vapor-diffuse insulation shall be installed.
  - Where termite presence exists, removable band joist insulation must be installed.
  - In cold climates (i.e., Climate Zones 1, 2 and 11-16), insulation will be installed with a vapor barrier on the warm side of the insulation. (Note: Cold climates are those locations with winter design temperature listed at or below 32ºF in the Title 24 Residential Manual or per ASHRAE).



PERIMETER INSULATION—EXTERIOR

22. RIGID INSULATION PLACEMENT

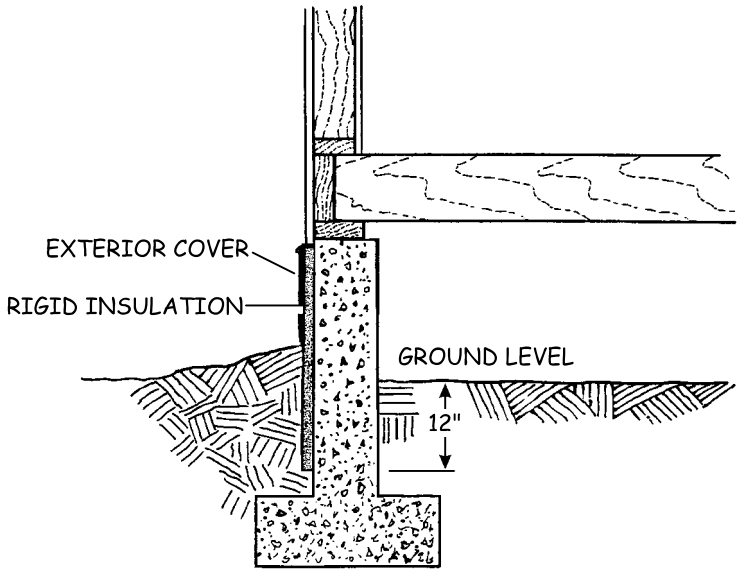
- **Installation requirements**
  - Band and header joists shall be insulated.
  - Insulation shall extend 12" below grade or below frost line, but not below footing.
  - If footing is less than 12" below grade, insulation shall extend horizontally from footing to a total of 12" of insulation below grade.
  - Only rigid polystyrene insulation is allowed.
  - That portion extending above grade shall be covered.

23. ATTACHMENT OF RIGID INSULATION

- **Installation requirements**
  - A minimum of one continuous horizontal bead of adhesive shall be installed on the foundation wall to block insect infestation.
  - Foundation wall shall be cleaned before adhesive is applied.
  - Mechanical fasteners, such as expansion bolts or suitable nails with washers, shall be used to permanently secure the insulation to the foundation wall.

24. FOUNDATION VENTS

- **Vents shall:**
  - Be operable.
  - Not be blocked.



POST-INSTALLATION REQUIREMENTS

25. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices shall be:**
  - Employed when working with pre-1978 painted materials per state codes T8 Section 1532.1 and T17 Section 36000, et seq.
  - Applied in accordance with guidelines in Appendix E.
- **Cleanup**
  - All insulation scraps shall be removed from the crawlspace and all outdoor work areas.
  - Access from Inside Home
    - All areas between an indoor access and the home entrance shall be vacuumed.
    - The area between the home entrance and the insulation truck shall be cleaned (swept or vacuumed).
  - Access Outside the Living Space
    - All areas between the access and the insulation truck shall be cleaned (swept or vacuumed).
  - Vacuum
    - A HEPA vacuum is required when fiberglass insulation is installed and should be used for all other types of insulation.
- **Documentation**
  - A durable (10-year life expectancy), easily seen sign (minimum 8-1/2" x 11") shall be posted at all accesses to the crawlspace when floor insulation and/or a vapor retarder is installed.
  - Manufacturer's information, and total installed R-value, shall be documented on an Insulation Certificate posted in the crawlspace.
  - The certificate shall be completed and signed by the contractor responsible for installing the insulation.
  - The installer also verifies compliance with code requirements for crawlspace ventilation.

FLOOR / UNDERCARRIAGE INSULATION FOR MOBILE HOMES

Lead Paint Risk Factor
NONE

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SECTION X PREFACE
FOR

FLOOR / UNDERCARRIAGE INSULATION FOR MOBILE HOMES

1. Nonfeasibility Criteria—Entire Home

1.1. Floor is already insulated or partially insulated.

1.2. Undercarriage access is unsafe due to inadequate crawl area clearance and/or the presence of an unsafe condition, as outlined in Item 4.

1.3. Floor contains aluminum wiring.

1.4. Undercarriage area cannot be properly vented.

1.5. Square footage of floor that can be insulated is less than 100 square feet.

1.6. Confined Spaces: CalOSHA regulations regarding confined spaces cannot be met.

1.7. Customer refuses.

2. Nonfeasibility Criteria—Section of Floor

2.1. Inadequate clearance or safety hazard present, per Item 4.

2.2. Already insulated or partially insulated.

3. Installation Policies

3.1. When required, a permit shall be obtained and finalized by HCD.

3.2. Installed floor area shall meet the R-value requirements of the IS, unless a higher R-value is required by code.

3.3. Safety Practices described in Item 4 must be observed.

3.4. When HVAC ducts are under the floor, duct testing and duct sealing shall be completed before insulation is installed.

3.5. Before insulation is installed:

a. Floor bypasses and leaks shall be sealed.

b. Any exhaust system (e.g., clothes dryer moisture exhaust) that terminates in the undercarriage area shall be vented outdoors.

c. All vegetation and organic material, and debris greater than 1", will be removed from the undercarriage (e.g., rake the area) and disposed of properly.

d. Bellyboard shall be intact, free from holes, and capable of supporting the insulation.

3.6. Workmanship Practices

a. Square Footage Measurements:
   - Square footage is based on exterior measurements.
   - Measurements of length and width are to be rounded off to the nearest foot; i.e., 12'5" = 12' (feet) and 12'-6" = 13' (feet).

b. All cutting of fiberglass batts and blankets shall occur outdoors or inside the undercarriage area.

c. All areas between the undercarriage access and the insulation truck shall be cleaned (swept and/or vacuumed).

d. A HEPA vacuum is required when fiberglass insulation is installed (and should be used for all other types of insulation).

4. Safety Practices

4.1. Insulation shall not be installed when aluminum wiring is present.

4.2. Unsafe electrical connections must be corrected before insulation is installed.

4.3. Undercarriage Clearances

a. Clearance should be at least 18″from the ground to the bottom of the girders under the mobile home.

b. Any obstruction in the crawl area, such as an HVAC duct, should provide clearance of at least 18″ to crawl over or under.

4.4. Crawl Area Safety: To crawl through an undercarriage area, it must be free of unsafe conditions, such as:

a. Hazardous insect infestation

b. Fuel leaks

c. Hazardous electrical condition

d. Plumbing leaks

e. Sewage waste on the ground, or any other unsanitary condition

f. Excessive ground moisture, such as standing water or mud

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FLOOR / UNDERCARRIAGE INSULATION STANDARDS FOR MOBILE HOMES

1. APPROVED MATERIALS

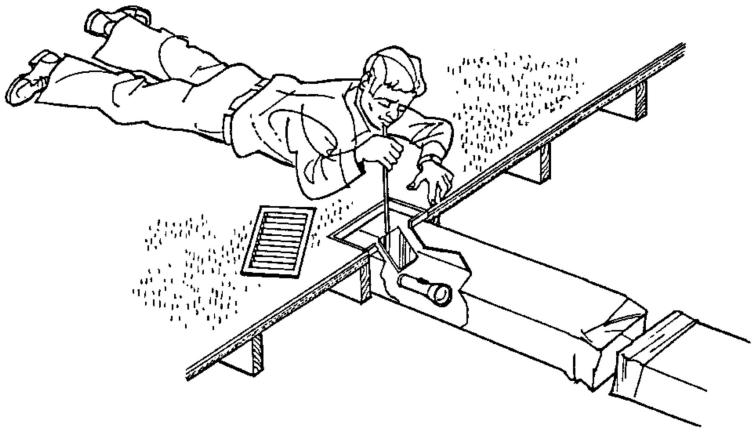
- **Mineral Fiber**
  - Flexible (Batts and Blankets)
    - Conformance to ASTM C665.
  - Loose Fill Fiberglass
    - Conformance to ASTM C764.
- **Sealing Materials**
  - Caulking, sealants, and tapes shall be as specified in IS Section 10 (Duct Testing and Sealing) and IS Section 1 (Caulking).

2. R-VALUES OF ADDED INSULATION

- **All Undercarriage Insulation**
  - R-11 minimum, with R-11 to R-30 in a single cavity fill allowed.
  - Missing insulation shall be replaced with equal or higher R-value.
  - Insulation shall be installed per manufacturers' specifications and recommended density for the installed R-value.

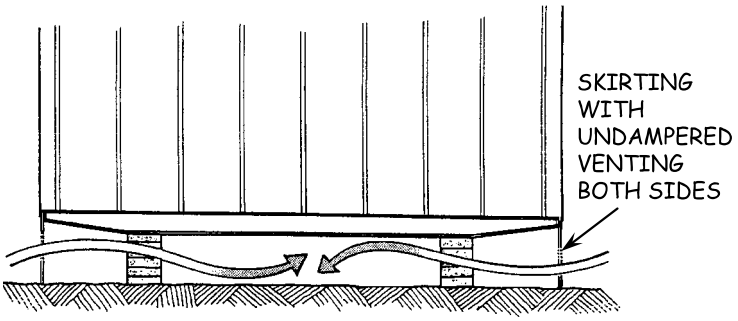
3. PRE-INSTALLATION EVALUATION

- **Undercarriage Inspection**
  - Duct system shall be analyzed by interior inspection with light and mirror through the register openings.
  - Undercarriage cavities shall be inspected through openings made in the rodent barrier ("bellyboard").
- **Inspection Holes in Rodent Barrier**
  - Holes shall be large enough to facilitate full visual inspection.
  - Holes shall be sized and located for use later as fill tube access.



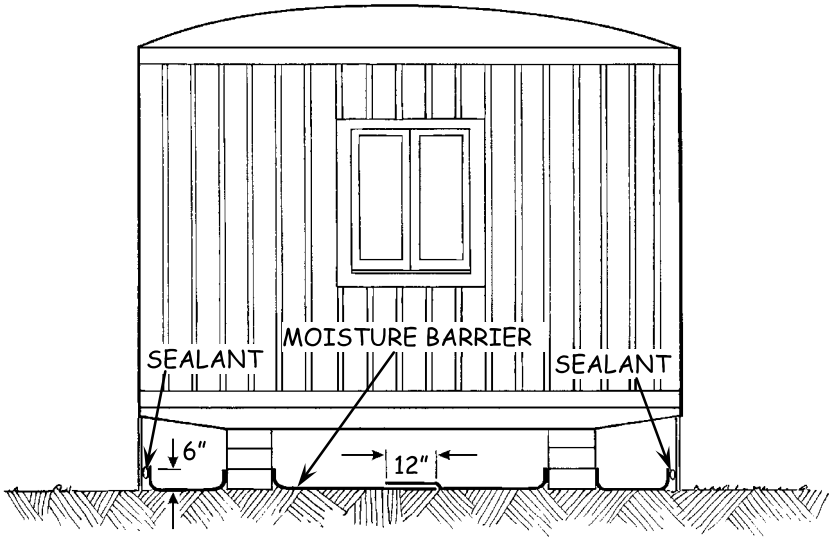
4. CRAWL SPACE VENTILATION

- **Skirted Mobile Home**
  - Crawl space ventilation must be present before installing insulation.
  - Openings in the skirting shall provide 1.5 sq. ft. of venting for each 25 linear feet of mobile home.
  - Vents shall be:
    - Non-operable *unless* ground cover is present.
    - Located as close to corners as practical.
    - Distributed evenly along the length of at least two opposite sides.
    - Covered with 1/4" corrosion-resistant mesh.



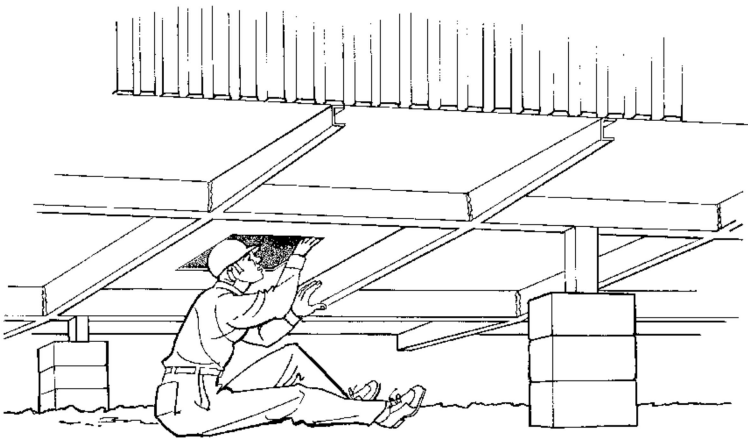
5. GROUND COVER VAPOR RETARDER

- **All Mobile Homes**
  - When required by HCD, vapor retarder shall be in place before floor insulation is installed.
  - Properly installed skirting shall be in place around the entire perimeter.
  - All plumbing leaks and pooling moisture shall be repaired first.
  - Thickness:
    - Minimum 6 mil black polyethylene or equivalent, if new.
    - Existing 4 mil acceptable, if in good condition and approved by HCD.
    - Fiber reinforced material recommended.
  - Moisture Barrier Installation Requirements
    - Earth shall be covered 100%.
    - All joints shall overlap a minimum of 12" using “up-slope lapping” technique.
    - Flaps at piers shall extend a minimum of 6" up the sides of the support foundation.
    - Extremities shall extend a minimum of 6" up the inside the skirting.
    - Edges should be attached to skirting with adhesive caulk or mechanical means.
    - Overlaps should be secured with outward clinch (“stitch”) staples and/or adhesive, or with material to weigh down the upper flap.



6. PRE-INSTALLATION REQUIREMENTS

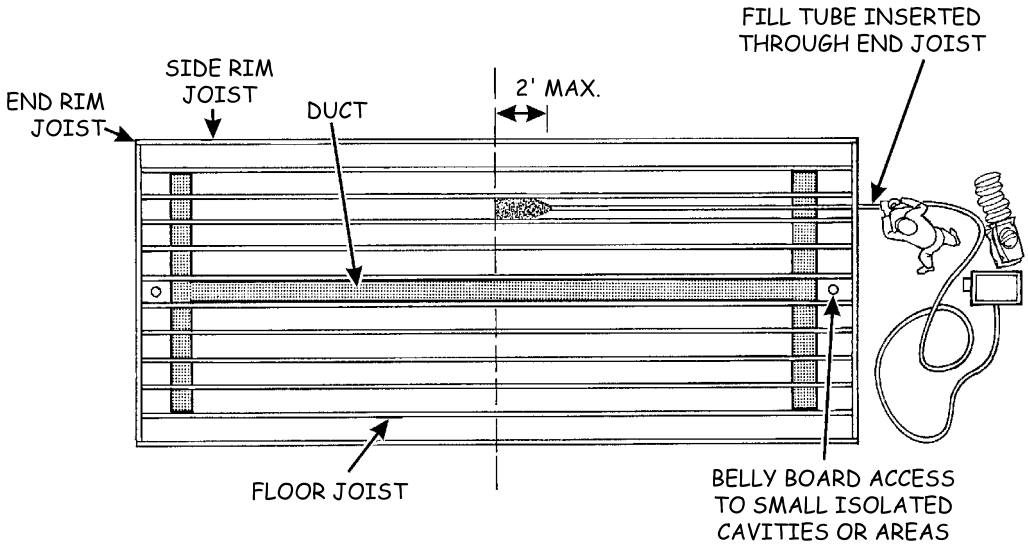
- **All Mobile Homes**
  - Preparatory repair work, at a minimum, shall include:
    - Existing belly return shall be blocked off and sealed, and a replacement return system shall be installed. [1]
    - Metal separations and other duct system leaks shall be repaired.[1]
    - All plumbing leaks, both supply and waste, shall be repaired.
    - Exposed wiring and other electrical hazards shall be repaired.
    - All damaged or deteriorated sections of rodent barrier, and holes in it, shall be repaired in accordance with Item 11.
    - Water pipes shall not be isolated from warm side of added insulation.
    - Any combustion air opening located in the floor of an appliance enclosure shall be ducted through the rodent barrier before the cavity is insulated.
    - Clearing debris from the undercarriage area (see Preface Item 4).
    - Undercarriage area shall be properly ventilated per Item 4.
- **Prohibited Installation Methods**
  - Rigid or flexible insulation shall not be attached underneath the rodent barrier.



[1] See Mobile Home criteria in IS Section 10

7. APPROVED INSTALLATION METHODS

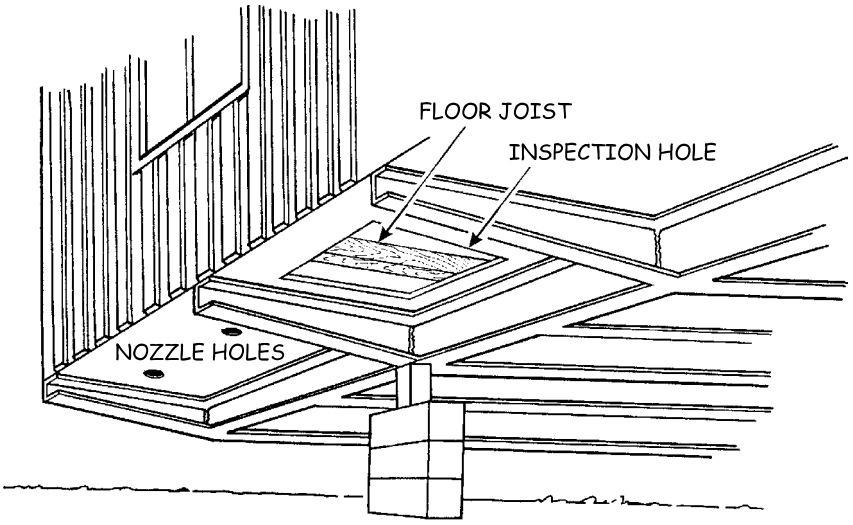
- **Cavity-Fill**
  - Belly injection through the rodent barrier is usually the best practice.
  - Rim joist injection
    - Injection through ends or sides of mobile home acceptable.
    - All interior areas not accessible from the outside perimeter shall be accessed through the belly (rodent barrier).
  - Hole size and spacing shall be in accordance with Item 8.
- **HPD Clearance**
  - Minimum 3" clearance required for vent pipes and other heat producing devices.
  - When 3" clearance cannot be achieved, the cavity containing the HPD shall not be insulated.
- **Flexible (Batt) Replacement**
  - Damaged and missing flexible insulation shall be replaced by installing new flexible insulation and restoring or replacing the rodent barrier.



CAVITY FILL INSTALLATION METHOD

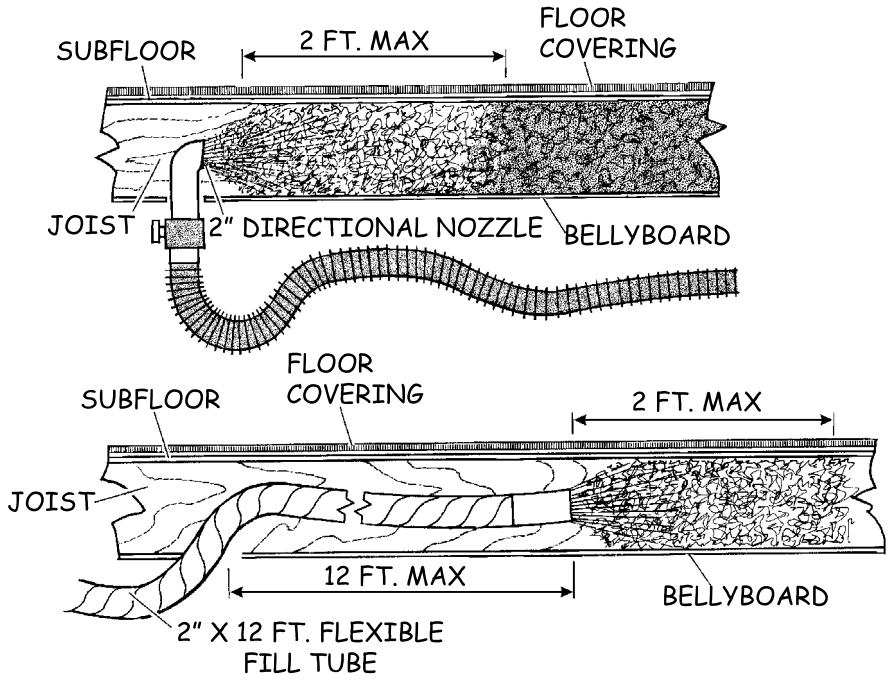
8. INSTALLATION CRITERIA

- **Coverage**
  - All areas shall be insulated *except* those occupied by ducts, plenums, combustion air intakes, or other obstructions.
  - Insulation shall not be installed when aluminum wiring is present.
- **Method of Access**
  - Rodent barrier penetration is:
    - preferred in all cases.
    - required to insulate interior areas not accessible through rim joists.
- **Flexible (Batt) Replacement**
  - Damaged and missing flexible insulation shall be replaced with flexible insulation of equal or greater R-value (minimum R-11).
  - Exposed HVAC ducts shall be protected with insulation and rodent barrier.
  - Incomplete rodent barrier shall be restored (repaired or replaced), in accordance with Item 12.
- **Blower Controls**
  - All Undercarriage Insulation
    - Installer shall be equipped with a remote-control switch to control the blowing machine.



9. BELLY INJECTION ACCESS

- **Access Holes**
  - Holes cut for inspection purposes shall also be used for fill tube.
  - Existing holes shall be used for fill tube access when feasible.
  - Additional penetrations shall be made, as needed, to achieve complete coverage.
- **Hole Size**
  - Holes shall be of sufficient size to properly accommodate the directional nozzle and/or fill tube utilized.
- **Nozzle and Fill Tube Diameter**
  - 1-1/2" minimum inside diameter.
- **Belly Injection**
  - Maximum 2' insulation travel past the injector.
  - Flexible fill tube shall:
    - be no more than 2' shorter than the length of the cavity being filled.
    - extend maximum12' into the cavity beyond the access hole.
  - Directional nozzle shall access a maximum of 2' of cavity depth in each direction.

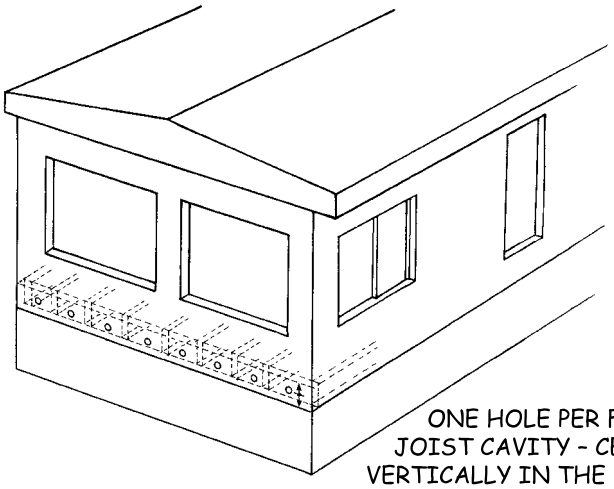


Section X

RIM JOIST INSTALLATION METHOD

10. RIM JOIST INJECTION ACCESS

- **Rim Joist Penetration:**
  - Acceptable method when joist size and condition allow for safe and proper installation.
  - Used to insulate joist cavities or portions of cavities which have unobstructed access from the outside perimeter.
- **Access Selection**
  - Penetration points shall be those which are most feasible.
  - A combination of belly and joist penetrations may be used as needed to achieve optimum results.
- **Access to Rim Joists**
  - Bottom wall trim shall be removed to expose the rim joist.
  - Exterior siding may be carefully pulled back if necessary.
  - Rim joist access shall be considered not feasible if it will result in visible damage to the siding.
- **Hole Location**
  - End and side joists
    - One hole shall be drilled for each floor joist cavity, taking care to not damage plumbing/electrical lines attached/adjacent to rim joist.
    - Holes shall be located as close as possible to the vertical center of the rim joist to minimize structural weakening.
  - Side rim joists
    - Adjacent joist cavities shall be accessed alternately from opposite sides of the mobile home, as feasible, to minimize the number of holes in each rim joist.



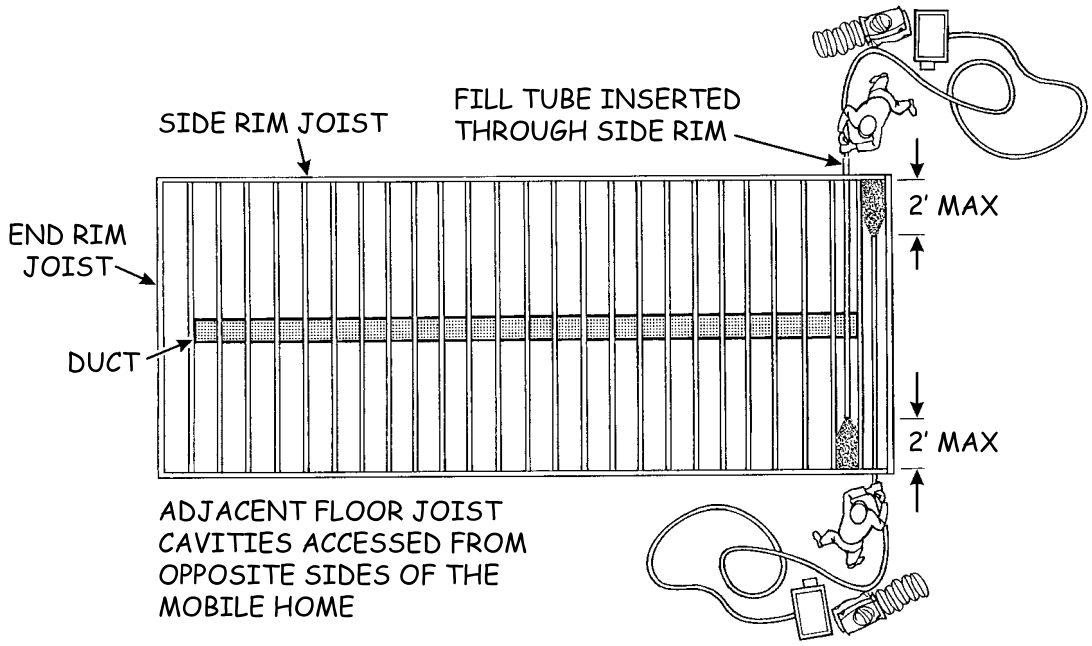
ONE HOLE PER FLOOR JOIST CAVITY - CENTERED VERTICALLY IN THE RIM JOIST

10. RIM JOIST INJECTION ACCESS (cont.)

- **Hole Diameter**
  - Holes shall be a small as possible to accommodate the fill tube, and shall not exceed the following limitations:

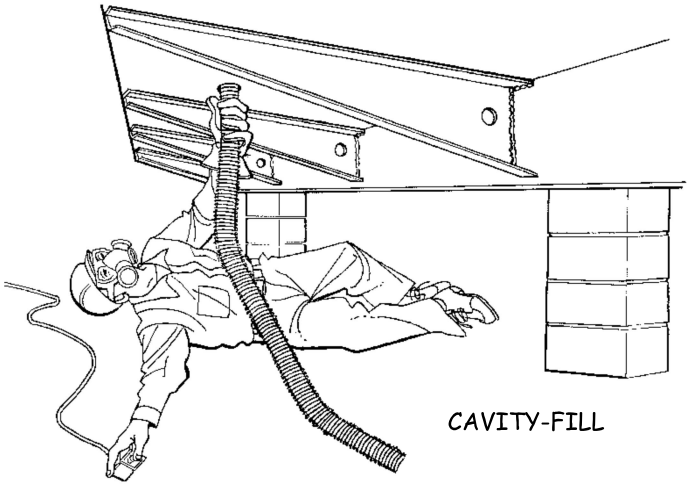
JOIST SIZE	MAXIMUM HOLE SIZE
2" x 8"	2-1/2"
2" x 6"	2"
2" x 4"	Not allowed

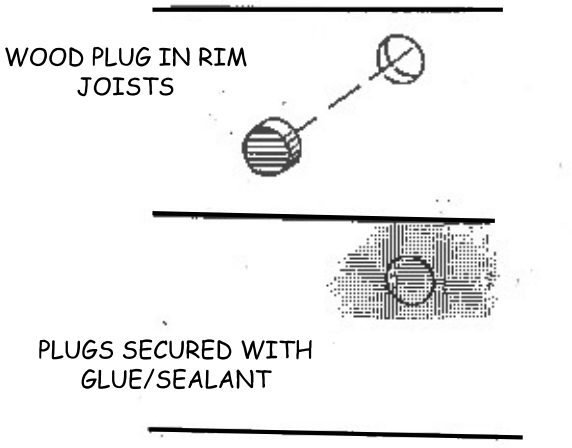
- **Rim Joist Injection**
  - Rigid or flexible fill tube shall be no more than 2' shorter than the length of the cavity being filled.



11. HOLE REPAIR

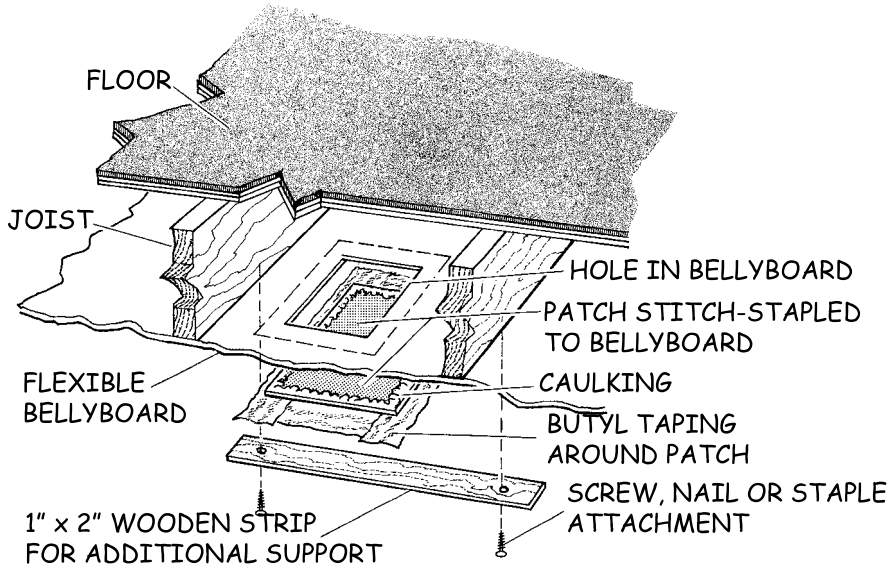
- **Rim Joists**
  - Solid wood plugs shall be installed in all fill holes.
  - Plugs shall be secured with exterior-rated glue or sealant.





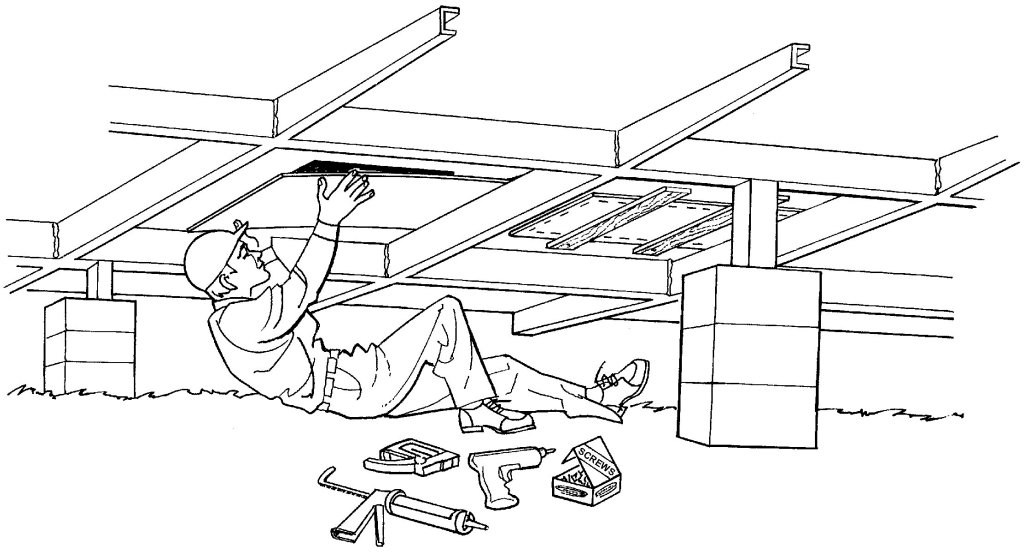
11. HOLE REPAIR (cont.)

- **Rigid or Flexible Rodent Barrier**
  - All holes shall be repaired with material equivalent or superior to the existing rodent barrier.
  - All patches shall be securely and permanently attached and create a complete and permanent seal.
  - Patches in Flexible Rodent Barrier
    - All patches shall be secured and sealed by means of self-adhesive backing, caulk or other suitable adhesive sealant.
    - Patches shall be additionally secured mechanically, as needed to ensure permanence, with one or more of the following:
      - Outward clinch (“stitch”) staples, or equivalent, spaced appropriately to permanently and securely attach the patch directly to the existing rodent barrier.
      - Fasteners penetrating the wooden joists a minimum of 1/2" and spaced a maximum of 4" OC.
      - Wooden strips attached with screws into floor joists, or wedged above adjacent girders, or otherwise permanently secured.
    - Butyl tape or other sealant shall be placed around the perimeter, as needed, to ensure a complete and permanent seal.



11. HOLE REPAIR (cont.)

- **Patches in Rigid Rodent Barrier**
  - Patches shall be sealed with suitable caulk and secured mechanically.
  - Acceptable mechanical attachments include:
    - Fasteners penetrating the wooden joists a minimum of 3/4" and spaced a maximum of 6" OC.
    - Wooden strip supports spanning beyond the patch and secured mechanically into the framework above.
    - Wedging the patching material between the existing rodent barrier and the metal framing of the undercarriage.
    - Fasteners which penetrate only the existing bellyboard, for small patches in high density material.
    - A combination of methods that will provide a stable, permanent repair.
  - Penetrations into the rodent barrier (e.g., for ducts, wiring, and pipes) shall be sealed (e.g., with butyl tape or equivalent).



12. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices shall be:**
  - Employed when working with pre-1978 painted materials per state codes T8 Section 1532.1 and T17 Section 36000, et seq.
  - Applied in accordance with guidelines in Appendix E.
- **Cleanup**
  - All insulation materials shall be removed from the undercarriage area and all outdoor work areas.
  - All areas between the access and the insulation truck shall be cleaned (swept or vacuumed).
  - A HEPA vacuum is required when fiberglass insulation is installed and should be used for all other types of insulation.
- **Documentation**
  - A durable (10-year life expectancy), easily seen sign (minimum 8-1/2" x 11") shall be posted at all accesses to the crawlspace when floor insulation and/or a vapor retarder is installed.
  - Manufacturer's information, and total installed R-value, shall be documented on an Insulation Certificate posted in the crawlspace.
  - The certificate shall be completed and signed by the contractor responsible for installing the insulation.
  - The installer also verifies compliance with code requirements for crawlspace ventilation.

NATURAL GAS HIGH EFFICIENCY OPEN COMBUSTION WALL FURNACES

Lead Paint Risk Factor
LOW-HIGH

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MOBILE HOME CRITERIA 6

Working Draft

SECTION X PREFACE

FOR

NATURAL GAS HIGH EFFICIENCY OPEN COMBUSTION WALL FURNACES

1. Nonfeasibility Criteria for Wall Furnace Replacement

1.1. Property is renter-occupied or is a mobile home.

1.2. Fuel used by the existing unit is not supplied by the utility providing ESA Program services.

1.3. Adequate combustion air cannot be provided.

1.4. Existing wall furnace location is not compliant with installation instructions, individual utility policy, or local code, and relocation to an approved location is not within program scope.

1.5. Customer refuses.

2. Nonfeasibility Criteria Applicable to Attic and Crawlspace Access

2.1. State and federal regulations regarding confined spaces cannot be met.

2.2. Attic crawl clearances:

a. Clearance < 24" between top of ceiling joists and bottom of ridge board.

b. Obstruction(s) in the attic, such as truss cross members and ducts, provide crawl clearance of < 18".

2.3. Under-floor clearances

a. Clearance is < 18" from the ground to bottom of floor joist system.

b. Crawling under or over an obstruction in the crawl area is required, and the crawl clearance is less than 12".

2.4. Unsafe condition exists:

a. Attic and Crawlspace

- Hazardous insect or pest infestation is present.
- Hazardous electrical wiring.
- Structural hazard.

b. Crawlspace

- Excessive ground moisture (standing water or mud) is present.
- Sewage waste is on the ground or other unsanitary condition is present which poses a health and safety hazard.

3. Furnace Replacement Policies

3.1. Furnace replacement may be provided when the existing furnace:

Working Draft

a. Has an AFUE of 68% or less, and the customer's winter season usage is greater than 200% of baseline
b. Is inoperable or has a defect that requires appliance replacement, as identified through Natural Gas Appliance Evaluation, or
c. Has failed Natural Gas Appliance Testing (NGAT) and cannot be repaired, or
d. No wall furnace is present and the household uses another gas appliance for space heating.

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

3.3. Installer must have a C-20 HVAC license.

4. Installation Policies Specific to Mobile Homes

4.1. An open combustion furnace drawing combustion air from the living space shall not be installed in a mobile home.

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NATURAL GAS HIGH EFFICIENCY OPEN COMBUSTION WALL FURNACE STANDARDS

1. APPROVED MATERIALS

- **Furnaces**
  - Minimum 80% AFUE
  - Conformance with ANSI Z21.86 and current CBC and CMC.
  - Furnace and components shall be UL-listed and/or have one of the following certifications: CSA, AGA, AHRI.
- **Gas pipes and valves**
  - Gas flexible connectors shall be AGA-certified epoxy-coated brass or stainless steel compliant with ANSI Z21.24-2015/CSA 6.10.
  - Manual gas shutoff valves shall be ANSI, CSA, or ASME listed.
  - Fuel gas piping:
    - Selected, sized, and installed per the current CMC.
    - Copper gas lines not allowed.
- **Metal vent pipes**
  - Vent connector, vent pipes, and components shall be UL-listed and in compliance with furnace manufacturer's specifications and local code.
- **Wall thermostat**
  - Supplied by furnace manufacturer or conformant to manufacturer's specifications.

2. WARRANTY

- **Refer to IS Appendix F (Minimum Warranty Requirements).**

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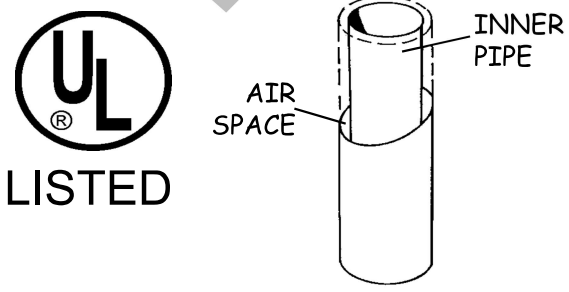
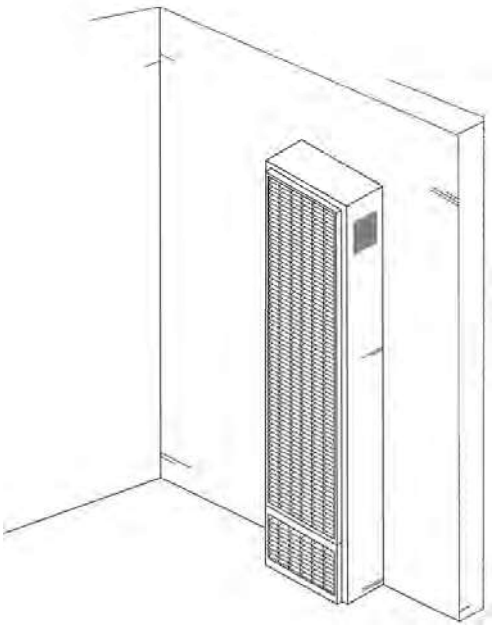


METAL PIPES AND ASSEMBLIES
UL-LISTED AND MANUFACTURER-COMPLIANT



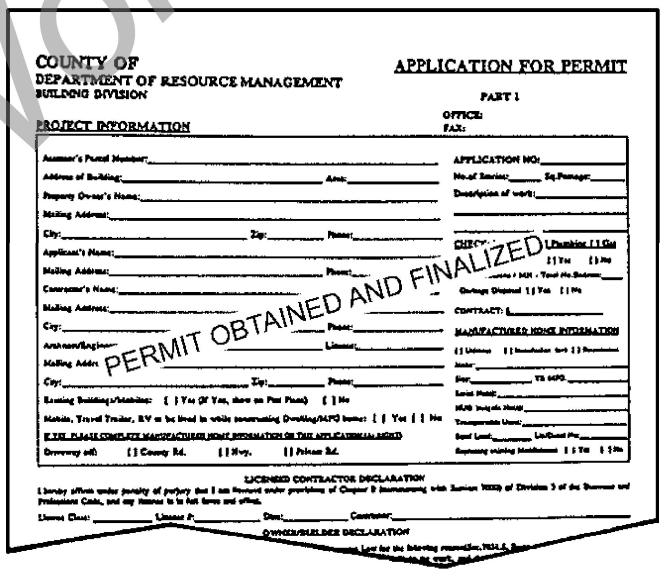
HIGH EFFICIENCY WALL FURNACE

3. GENERAL REQUIREMENTS

- **All installations**
  - A permit for the installation shall be obtained from and finalized by the local jurisdiction.
  - Installation shall be in compliance with:
    - Manufacturer's instructions and specifications.
    - Title 24 Residential Compliance Manual.
    - CMC, CEC, and local code.

4. REPLACEMENT FURNACE INSTALLATION

- **Vent System**
  - Appliance venting shall be in conformance with manufacturer's installation instructions and local code.
  - All nonconforming existing components shall be replaced with new materials.
- **Gas Plumbing/piping**
  - Only new parts shall be used.
  - Shutoff valve and flexible gas connector shall be present and compliant with local code.
  - All valves, components, and connections shall be free of leaks.
- **Electrical requirements**
  - All conductors and connections shall be in compliance with manufacturer's instructions and local code.
  - When fan-equipped, the blower circuit shall have adequate capacity.


COUNTY OF
DEPARTMENT OF RESOURCE MANAGEMENT
BUILDING DIVISION

APPLICATION FOR PERMIT

PART I

PROJECT INFORMATION

PERMIT OBTAINED AND FINALIZED

LICENSED CONTRACTOR DECLARATION

OWNER/BUILDER DECLARATION

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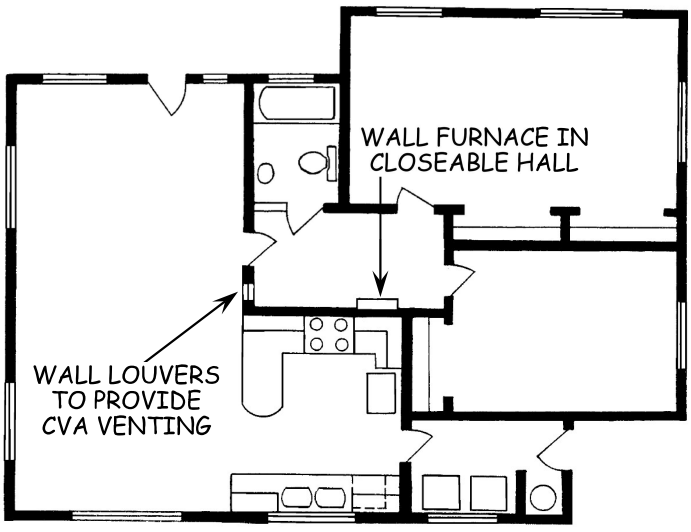
5. WALL FURNACE REPLACEMENT

- **General requirements**
  - An installed open combustion wall furnace shall not draw combustion air from a sleeping room, when prohibited by individual utility policy.
  - Modifications shall not be made to the furnace (e.g., cutting support legs) *unless* allowed by manufacturer.
  - Finished installation shall include blocking/sealing of all unnecessary holes in wall studs, floor, and bottom plate.
  - Unit shall be properly aligned and free of metal expansion stress that causes banging and metal ticking.
  - Clearances shall be maintained in accordance with the requirements of the listing, manufacturer's installation instructions, and local code.
- **Wall and Floor Repairs**
  - Surface of repair shall match plane of adjacent material.
  - Patching shall blend with surrounding surfaces.
  - Floor openings shall be closed in a workmanlike manner.

6. COMBUSTION AND VENTILATION AIR (CVA)

- **All installations**
  - CVA room volume shall be in compliance with manufacturer's instructions, local code, and IS Appendix A (Combustion and Ventilation Air Requirements for Natural Gas Appliances).
  - In confined areas with insufficient CVA volume (e.g., a closeable hallway), there shall be permanent communication with adjacent area(s) having sufficient room volume.
  - Wall furnace Btuh input rating shall not exceed the maximum supported by all available CVA room volume.



WALL LOUVERS MUST COMMUNICATE WITH ADEQUATE CVA ROOM VOLUME

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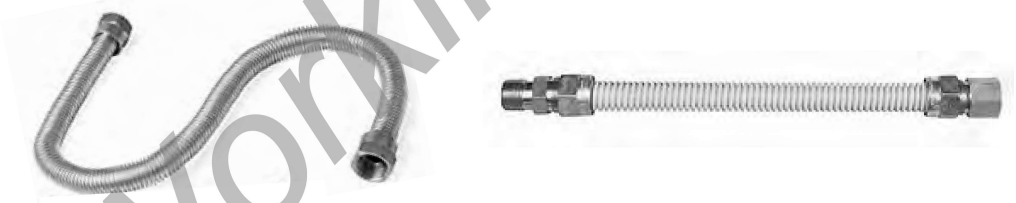
7. THERMOSTAT INSTALLATION

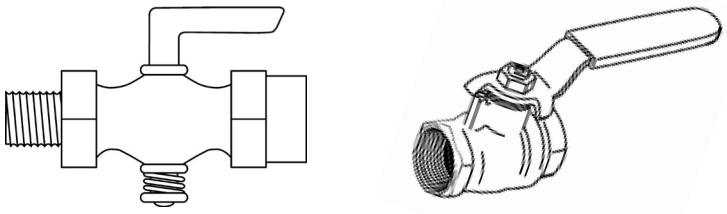
- **Location and mounting**
  - Thermostat installation shall be in compliance with Part 4 of IS Section 18 (Natural Gas Central Forced Air Heating System R&R).

8. GAS LINES, FITTINGS, AND VALVES

- **All installations**
  - All gas piping, fittings, and valves shall be installed in conformance with manufacturer's instructions and local code.
    - Gas shutoff valve shall be in good condition and in conformance with Item 1.
    - Gas flexible connector shall be new and completely exposed (shall not extend into or through framing).
    - Existing copper components shall be replaced with approved material.
  - All new and affected lines and components shall be checked for gas leaks by a method approved by the local jurisdiction and individual utility policy.



ALL FLEXIBLE GAS CONNECTORS MUST BE NEW



A DEFECTIVE GAS SHUTOFF VALVE MUST BE REPLACED WITH NEW LISTED VALVE

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9. VENT SYSTEMS (FURNACE REPLACEMENT)

- **Installation**
  - New vent system shall be installed, terminated, and secured in conformance with the manufacturer's instructions and local code.
  - Vent pipe termination within 10' of an evaporative cooler shall terminate at least 3' above the cooler inlet.

10. ACCESS AND CLEARANCES

- **All installations**
  - Access and clearances to combustibles shall be provided in accordance with manufacturer's instructions and local code.

11. CO AND DRAFT

- **Testing**
  - The appliance shall be tested and be in compliance with manufacturer's specifications and the requirements in IS Section 24 (NGAT).

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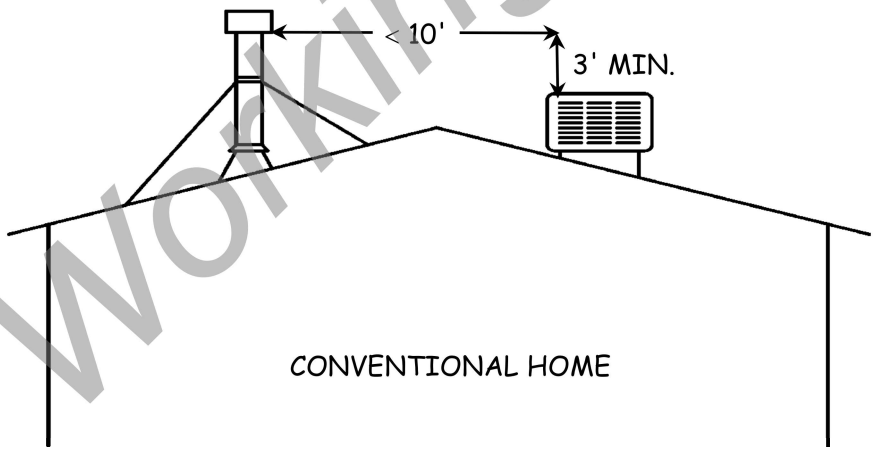

12. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS—FURNACE REPLACEMENT

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Appliance operation**
  - The installed unit shall be tested and shall operate properly.
  - Proper operation shall be explained and demonstrated to the customer, including:
    - Operation of all user-accessible controls,
    - Unobstructed combustion air supply,
    - Clearances from combustible furnishings, and
    - Routine maintenance recommended by the manufacturer.
  - Manufacturer's written instructions and warranty documents shall be supplied to the customer.
- **Clean-up and disposal**
  - All packing materials and installation debris shall be cleaned up and removed from the premises.
  - All replaced equipment and parts shall be removed from the premises and disposed of properly.

MOBILE HOME CRITERIA

- **Not Applicable**
  - Open Combustion furnaces shall not be installed in the living space of a mobile home.

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PORTABLE AIR CONDITIONERS

Lead Paint Risk Factor
NONE

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7. Lead-Safe Weatherization and Post-Installation Requirements **8**

MOBILE HOME CRITERIA **8**

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SECTION X PREFACE
for

PORTABLE AIR CONDITIONERS

1. Nonfeasibility Criteria

1.1. A window/wall AC or central AC is already present and functional.

1.2. Electrical requirements cannot be met: Wiring is substandard (e.g., ungrounded receptacle, decayed wire insulation, exposed wires), and correction is not feasible.

1.3. No feasible location available for window kits.

a. Windows are not vertical or horizontal slider or are otherwise incompatible with available factory window brackets.

b. A suitable mounting location is not available.

c. Exterior clearance requirements for intake air cannot be met.

d. Installation would violate egress requirements.

1.4. Customer refuses.

2. Installation Policies

2.1. Units with the highest Seasonally Adjusted Cooling Capacity (SACC) rating that is within program cost limitations shall be installed.

3. Installation Policies Specific to Mobile Homes

None.

PORTABLE AIR CONDITIONER STANDARDS

1. APPROVED MATERIALS

- **All units**
  - Unit shall be UL-listed, or equivalent and equipped with:
    - Wheels that allow easy portability for unit size and weight.
    - Flexible duct(s) and adjustable window kit with extender(s).
    - Minimum two-speed or variable-speed fan.
    - Programmable thermostat or energy saving mode:
      - Adjustable from 60° F to ≤ 86° F.
      - Adjustable runtime up to 12 hours.
    - Reusable filters for air intake and output.
    - Air direction control.
    - Remote control with timer adjustable up to at least 12 hours.
  - Sound level ≤ 60 dB.

LISTED

US

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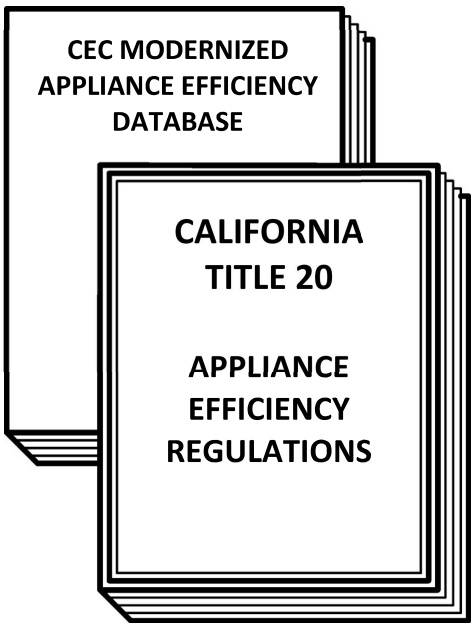
1. APPROVED MATERIALS (cont.)

- **All units (cont.)**
  - Condensate removal
    - Unit shall expel water vapor while operating, and shut off automatically when internal reservoir is full, and/or
    - Shall have a manual drainage system acceptable to the customer.
  - Energy efficiency (cooling)
    - Compliant with CA Appliance Efficiency Regulations (Title 20), and
    - Listed in the CEC Modernized Appliance Efficiency Database System (MAEDbS).
  - Include manufacturer's recommended coverage based on SACC[1] Btuh capacity.
- **Units supplying heat**
  - Heat shall be produced by the compressor (not electrical resistance).

2. WARRANTY

- **Refer to IS Appendix F (Minimum Warranty Requirements).**



[1] Manufacturers are now required to give portable air conditioner cooling capacity in terms of a new Seasonally Adjusted Cooling Capacity (SACC), which is lower than the previous ASHRAE standard. The unit may come with both ratings, but SACC must be used for sizing, when it is available.

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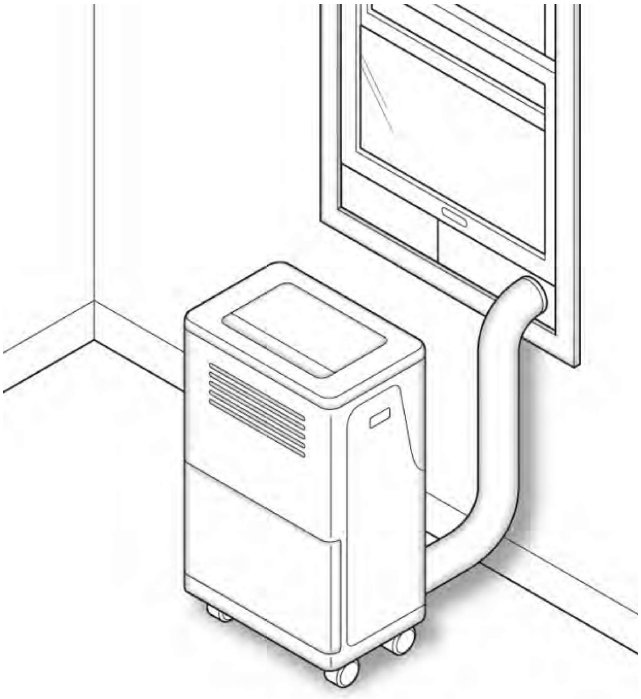
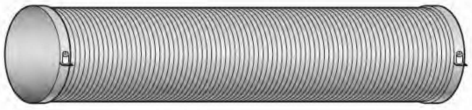
3. INSTALLATION

- **Compliance**
  - Units shall be installed in compliance with manufacturer's instructions.
  - Location shall allow for proper clearances and connections.
- **Sizing and coverage area**
  - Unit shall be sized in accordance with the manufacturer's reported SACC Btuh capacity.
- **Window kit**
  - Supplied window kit that is compatible with window type and dimensions shall be installed.
    - Extenders shall be installed as needed.
    - Excessive length shall be cut off and rough edges smoothed.
  - All leakage points shall be sealed.



PORTABLE AC THAT INTAKES FROM CONDITIONED SPACE AND EXHAUSTS TO THE OUTDOORS

WINDOW SLIDER ASSEMBLY



EXHAUST/INTAKE HOSE AND CONNECTORS

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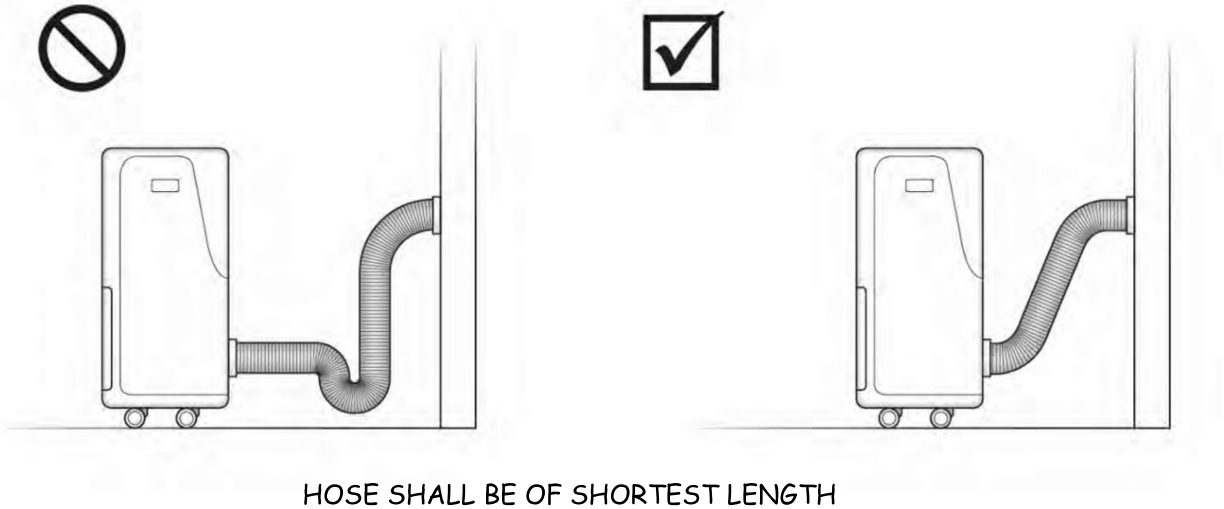
3. INSTALLATION (cont.)

- **Hose installation**
  - Proper connections, length, and placement required without sagging.
  - Hose termination shall comply with manufacturer's instructions.
  - Hose connections shall be sealed at both ends.
- **Condensate drainage**
  - Drain tube shall be installed in accordance with manufacturer's instructions.
  - Removal of excess condensate shall be demonstrated to customer.



HOSE SHALL BE OF SHORTEST LENGTH
POSSIBLE AND SHALL NOT DROOP OR SAG

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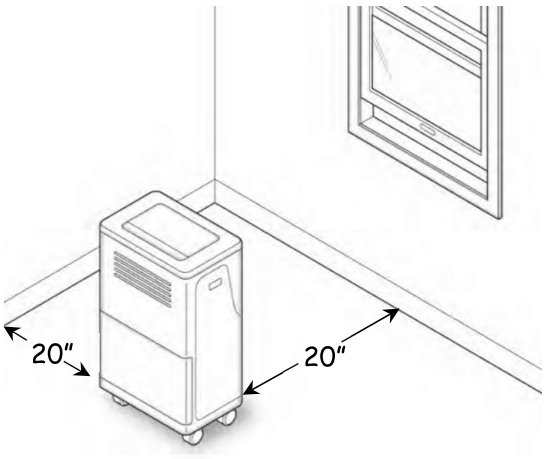
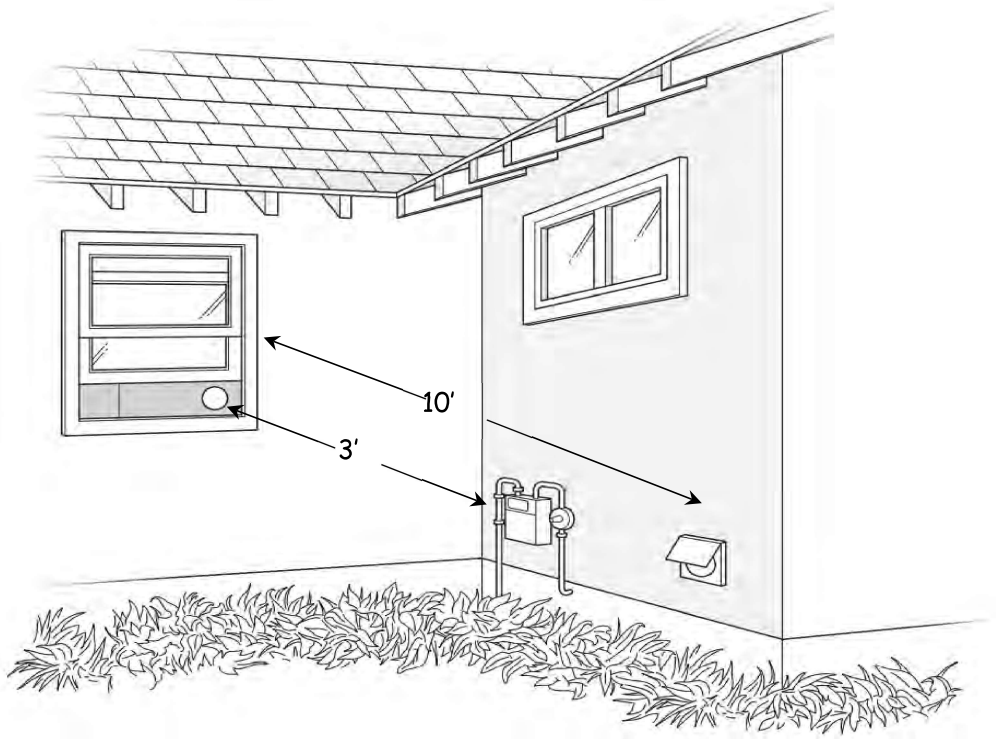
3. INSTALLATION (cont.)

- **Interior clearances**
  - Interior clearances shall comply with the following, or manufacturer's instructions, when different:
    - Minimum 20" from sides of unit,
    - Minimum 20" from back of unit.
- **Exterior clearances**
  - Exterior clearance from air unit's intake terminal shall be at least:
    - 3' from gas meter set assembly.
    - 10′ from clothes dryer outlet.





PORTABLE AC INTAKE (WHEN EQUIPPED) MINIMUM 3′ FROM GAS METER SET AND 10′ FROM CLOTHES DRYER MOISTURE EXHAUST

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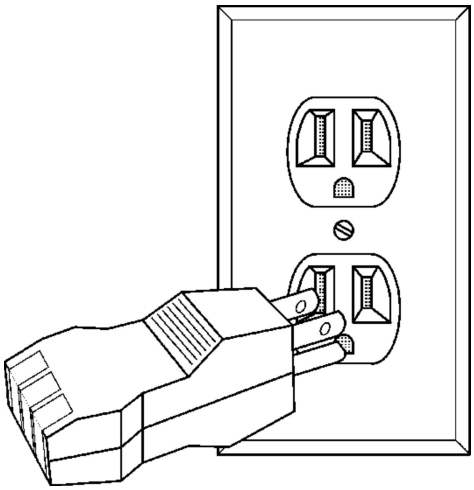
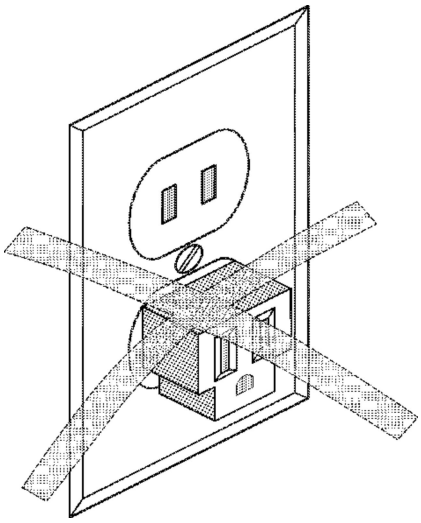
4. ELECTRICAL SUPPLY

- **All units**
  - The receptacle shall be:
    - In good condition (wiring, receptacle, and cover plate).
    - Securely installed in an electrical box.
    - Properly grounded.
  - Adapter and extension cord are not allowed.
  - The electrical circuit shall have:
    - Proper overcurrent protection.
    - Adequate capacity to avoid nuisance tripping.
    - Constant power (not switched).
- **Dedicated receptacle**
  - Unit shall be plugged into its own receptacle, unless plugging in another load is allowed by the manufacturer.



RECEPTACLE MUST BE THREE-PRONG AND PROPERLY GROUNDED



UNGROUNDED THREE-PRONG ADAPTER IS NOT ALLOWED

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5. START-UP CHECK

- **Before operation**
  - Installation shall be checked to ensure that the A/C unit is properly installed.
- **During operation**
  - Unit shall be determined to be functioning properly.

6. INSTRUCTIONS AND WARRANTY

- **Instructions**
  - Customer shall be provided with written and verbal instructions for proper operation and maintenance, including:
    - Manufacturer's written instructions.
    - Verbal explanation of:
      - Proper electrical outlet and connection (no adapter or extension cord).
      - Operation with remote control in heating and cooling modes, including unit placement and clearances for best air circulation.
      - Disposal of condensate.
      - Periodic maintenance (filter cleaning, condensate drain, etc.).
    - Review of written instructions.
- **Warranty**
  - Customer shall be provided with required warranties (per Item 2).

OCCUPANT RECEIVES VERBAL
AND WRITTEN INSTRUCTIONS
AND MANUFACTURER'S WARRANTY

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7. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Clean-up and Disposal**
  - All packing materials and installation debris shall be cleaned up and removed from the premises.
  - Furniture and other household items moved for installation work shall be returned to their original positions.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

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SOLAR WATER HEATING

Lead Paint Risk Factor
LOW-HIGH

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MOBILE HOME CRITERIA 4

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SECTION X PREFACE
FOR
SOLAR WATER HEATING

1. Nonfeasibility Criteria

1.1. The dwelling is not single family owner-occupied.

1.2. The dwelling is a mobile home.

1.3. A suitable location for collectors, storage tank, or other required equipment is not available.
   a. Satisfactory orientation is not feasible/possible.
   b. Shade from trees or adjacent structure prevents required solar exposure.
   c. Plumbing lines between collectors and storage tank cannot feasibly be installed.

1.4. Roof is not suitable:
   a. House is two-story or has a tile roof.
   b. Roof pitch exceeds manufacturer's recommended maximum.
   c. Expected life of the roofing is less than 15 years.
   d. Roof structure or condition will not safely support the weight of solar water heater collectors.
   e. Roof surface is unsafe to walk on (e.g., loose sand, gravel).
   f. Required safety equipment cannot be properly secured.
   g. Entering the attic is necessary, but safe access is not feasible/possible.
   h. Required plumbing is not feasible/possible.
   i. A condition is present that the equipment manufacturer advises to avoid.

1.5. Existing gas water heater:
   a. Has failed NGAT and cannot feasibly be repaired/replaced.
   b. Is in an unsafe or unprotected location, and correction is not feasible.

1.6. Water heating fuel is not supplied by the utility providing ESA Program services.

1.7. Customer refuses.

2. Installation Policies

2.1. A building permit shall be obtained and finalized.

2.2. Contractor shall have a current license in one of the following classifications:
   a. A or B (General Contractor),
   b. C-46 (Solar Contractor),

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c. C-36 (Plumbing Contractor), or
d. C-4 (Boiler, Hot Water Heating and Steam Fitting)

3. Installation Policies Specific to Mobile Homes

Mobile homes do not qualify for installation of solar water heating.

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SOLAR WATER HEATING STANDARDS

1. APPROVED MATERIALS

- **All solar water heating systems**
  - ENERGY STAR-certified.
  - Solar uniform energy factor (SUEF) ≥ 1.8 for gas backup.
  - SRCC certified:
    - OG-100 collectors, and
    - OG-300 whole systems, with freeze and stagnation protection.
  - Conformance with manufacturers' specifications and all applicable electrical, plumbing, and building codes and standards.
  - Equipped with adequate freeze protection and stagnation/overheat protection, when applicable.
  - Components must be new and unused.
    - *Exceptions:* Existing system components, such as:
      - De-scaled copper piping.
      - Racking with design that has been stamped and signed by a State of California Licensed Professional Engineer.
- **Ineligible equipment**
  - Direct Forced Circulation (DFC) systems, where potable water is pumped and heated directly in the collector.
  - Open loop thermosiphon systems with potable water in the collector loop.
  - Portable systems or systems that are not permanently installed.
  - Systems with a Surface Orientation Factor of less than 0.60.
  - Passive systems

2. WARRANTY

- **Refer to IS Appendix F (Minimum Warranty Requirements).**

3. GENERAL REQUIREMENTS

- **All systems**
  - Installation shall conform with:
    - Local code,
    - "California Solar Initiative–Thermal Program Handbook",
    - Component manufacturer's instructions, and
    - Solar Rating and Certification Corporation Standards or
    - International Association of Plumbing and Mechanical Officials Standards.

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4. SAFETY REQUIREMENTS

- **Installers shall**
  - Adhere to:
    - All federal, state, and local regulations, codes, and standards governing solar water heating systems and installation.
    - Building code requirements for the penetration of structural members and fire rated assemblies.
  - Utilize proper safety equipment when working with elevated surfaces and take all necessary precautions to ensure a safe work environment.

5. SYSTEM SIZING

- **All systems**
  - Sized according to the number of occupants in the household.
  - Total gallons per day (GPD) equals:
    - 20 GPD of hot water usage by the first occupant, plus
    - 15 GPD by the second occupant, plus
    - 10 GPD by each additional occupant.
  - Fluid collector area (in sq. ft.) shall not exceed 1.25 times the total GPD.

6. LOCATION / INSTALLATION

- **System installation**
  - Solar panels
    - Collector location and orientation shall comply with manufacturer's instructions.
    - Solar Orientation Factor of 0.60 or greater.
    - Azimuth: within 35° east or west of true south.
    - Tilt degrees: ≥ 14° (3:12 slope).
    - Average annual solar availability (10 AM to 3PM): ≥ 85%.
  - Expansion tank, temperature and pressure-relief valves, check valves, backflow preventers, bypass valves, tempering valves, and other safety devices shall be installed as prescribed in system instructions and local code.

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6. LOCATION / INSTALLATION (cont.)

- **Storage tanks and piping**
  - The solar storage tank shall:
    - Be situated near the gas water heater, such that all plumbing connections are accessible.
    - Be internally insulated with R-16 or greater or externally insulated with R-12 or greater.
    - Rest on an insulated pad, when prescribed by the manufacturer.
    - Be placed in a 24-gage galvanized steel pan (or other approved pan) with approved drainage when installed in a location where leakage could cause damage, or when required by local code.
    - Be secured with seismic bracing, per CPC Chapter 5.
  - Storage tank or drain-back tank *outdoors:*
    - Allowed only in CEC Climate Zones 6-9, and
    - Shall be inside a code-approved enclosure to prevent weather damage to tanks, controller, pump, or other vulnerable components.
  - Piping
    - Potable water piping shall be certified “lead free” per NSF 61.
    - Piping and tank installations shall provide clear access to the storage tank, pump, expansion tank, mixing valve, controller, etc.
    - Unions shall be used for the storage tank and heat exchanger connections.
    - Piping support shall be code compliant.
  - Pipe insulation
    - Solar water heating systems are required to have minimum R-2.6 value insulation on all exposed and accessible hot water piping.
    - Systems with recirculation loops must have insulation on all accessible piping with a minimum of R-2.6 value insulation.

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6. LOCATION / INSTALLATION (cont.)

- **Collector roof mounting**
  - Roof drainage shall not be impaired by installation of collectors.
  - Mounting hardware shall equal or exceed panel manufacturer's specifications.
    - Means to avoid galvanic corrosion shall be employed where dissimilar metals touch, especially when mounting on a metal roof.
  - Collectors shall be anchored to roof framing (not the sheathing), with minimum 2-inch lag bolt penetration into solid wood.
    - When that is not possible, a spanner block between the rafters shall be used to secure the mounting hardware.
  - Roof penetrations shall be made watertight:
    - Bolts, with proper washers and sealants.
    - Pipes, with flashing or neoprene boot and sealant.

7. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Compliance with guidelines in Appendix E.
- **Operational checks**
  - All systems shall be:
    - Checked for leaks and corrected as needed.
    - Functioning as designed.
- **Instructions and warranties**
  - Customer shall be instructed on the proper care of the solar water heater.
  - Customer shall be provided with:
    - Manufacturer's written instructions.
    - Written warranty documents.
- **Clean-up**
  - Paint dust and chips, scraps, and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Household items moved for installation work shall be returned to their original positions.

MOBILE HOME CRITERIA

None—this section does not apply to mobile homes.

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WHOLE HOUSE FAN

Lead Paint Risk Factor
NONE

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MOBILE HOME CRITERIA 9

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SECTION X PREFACE
for

WHOLE HOUSE FANS

1. Nonfeasibility Criteria

1.1. A whole house fan is present and operable.

1.2. A central A/C or ducted evaporative cooler does not exist or is inoperable.

1.3. Electricity used by the whole house fan is not supplied by the utility providing ESA Program services.

1.4. The required inlet air (openable doors/windows) and or exhaust air (attic venting net flow ventilation area) cannot be provided.

1.5. Windows screens are torn or missing on windows that would provide inlet air.

1.6. An open combustion gas appliance with a standing pilot is in the conditioned space or attic, or other combustion appliance safety hazards exist in the home.

1.7. Attic access is inadequate.

1.8. A structurally sound location with adequate clearances is not available.

1.9. Cutting of truss chord(s) or ceiling joists would be required for the installation.

1.10. A properly grounded electrical circuit is not present and cannot be installed.

1.11. The dwelling is a mobile home or part of multi-family building.

1.12. Customer refuses.

2. Installation Policies

2.1. Whole house fans may be installed only in approved climate zones.

2.2. The home must have an existing, operable central air conditioner or ducted evaporative cooler to be eligible for a whole house fan.

3. Installation Policies Specific to Mobile Homes

None.

WHOLE HOUSE FAN STANDARDS

1. APPROVED MATERIALS

- **All whole house fans**
  - UL-listed and compliant with UL 507
  - Equipped with a thermally protected motor rated for 120V AC
  - Featured with a minimum of two speeds or a variable speed control.
  - Shall be one of the three following designs:
    - Ceiling- or wall-mount with barometric shutter.
    - Ducted remote fan.
    - Ceiling-mount with insulated top cover.

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1. APPROVED MATERIALS (cont.)

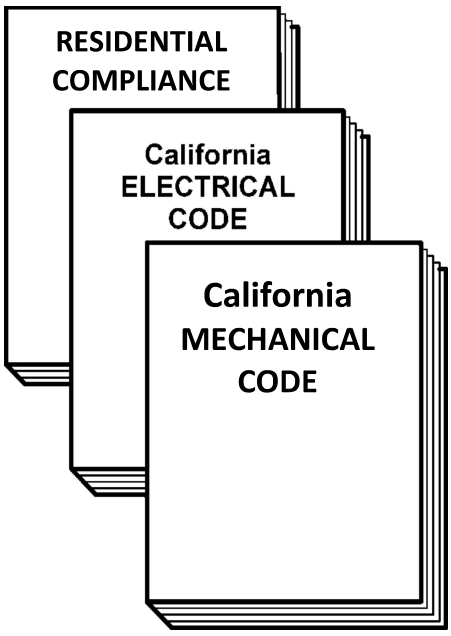
- **Flexible ducts**
  - Ducts shall conform with NFPA 90B and UL 181 Class 1.
  - Non-metallic insulated ducts with air-permeable core are not allowed.
- **Drawbands and clamps**
  - Drawbands and clamps used to secure flexible non-metallic ducts shall comply with duct manufacturer's installation instructions.
  - Drawbands shall be weather- and UV-resistant nylon duct straps/ties rated for outdoor use and marked "181B-C."
  - Clamps shall be stainless steel worm-drive clamps.
- **Approved sealants and tapes**
  - UL 181A- and 181B-listed sealants and closure materials shall be used.

2. WARRANTY

- **Refer to IS Appendix F (Minimum Warranty Requirements).**

3. GENERAL REQUIREMENTS

- **All installations**
  - When required by the local jurisdiction, a permit for the installation shall be obtained and finalized.
  - Installation shall be in compliance with:
    - Manufacturer's instructions and specifications.
    - Title 24 Residential Compliance Manual.
    - CEC, CMC, and local code.



4. SIZING CRITERIA

- **Whole house fan size**
  - Unit shall be sized in accordance with Title 24 Residential Compliance Manual and manufacturer's instructions.
  - Unit shall be capable of providing a minimum of 1.5 cfm per square foot of conditioned floor area.

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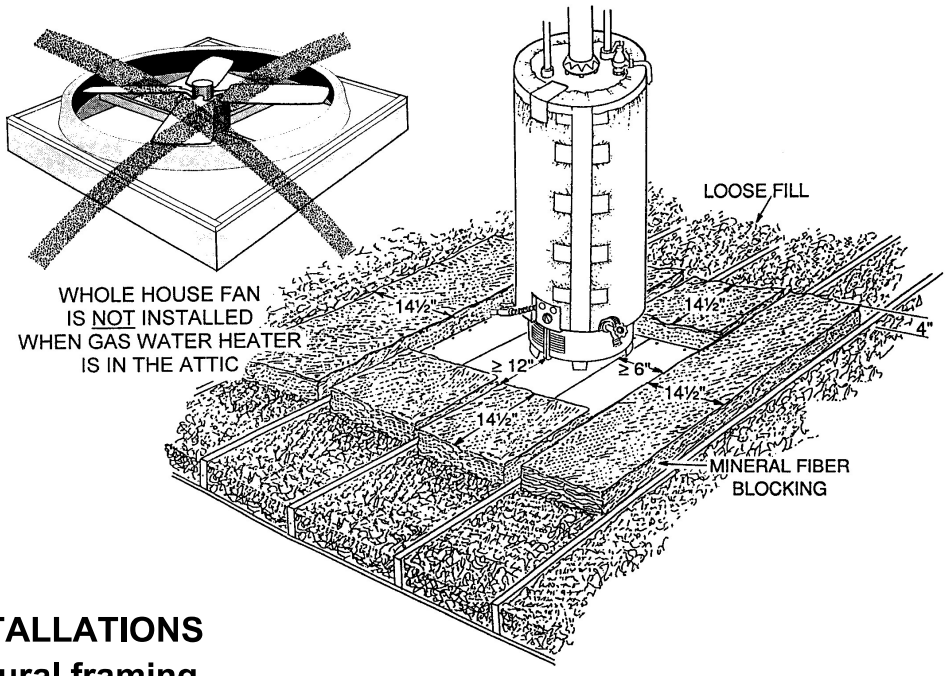
5. LOCATION

- **Whole house fans shall be installed:**
  - In a central location, when feasible (not in a bedroom, kitchen, utility room, etc.).
  - In the ceiling or a high wall between conditioned space and the attic.
  - In an area free of obstructions (e.g., pipes, wires, and ducts) where the opening can accommodate the ventilation capacity of the whole house fan.
  - In a structurally sound location where framing members are capable of supporting the unit.
  - With a minimum of 3' horizontal clearance from carbon monoxide and smoke alarms.
  - Where access to an acceptable electrical circuit is feasible.
  - Avoiding areas that can adversely affect the operation of open combustion appliances.



6. ALL INSTALLATIONS

- **Structural framing**
  - Ceiling joists and truss chords shall not be cut.
  - Framing/blocks shall be installed between joists when required to provide proper mounting surfaces for the fan, damper box, or return grille.
  - Wall-mount installations:
    - Studs may be cut when not part of the truss.
    - The opening shall be reframed with proper headers and cripples.

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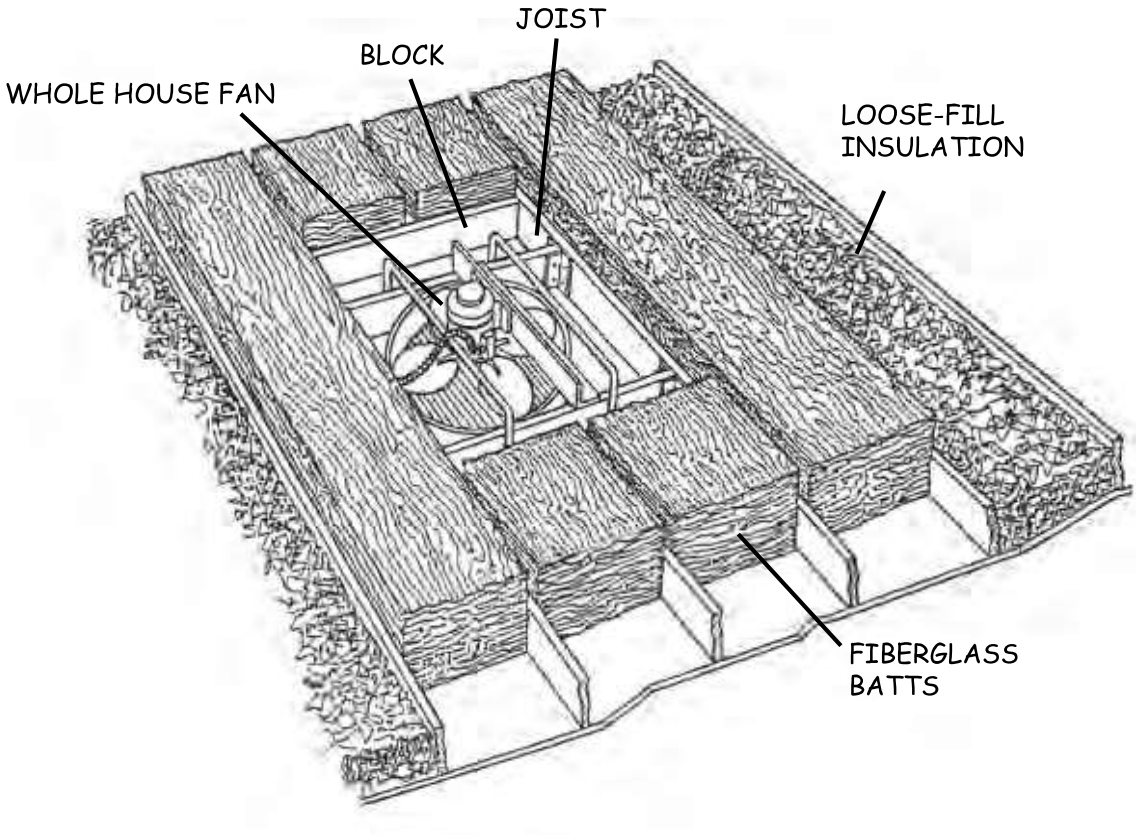
7. CEILING-MOUNT FAN INSTALLATIONS

- **Plenum**
  - The air path between the attic floor and fan housing shall be enclosed to form a plenum.
  - The plenum shall be sealed to prevent infiltration of attic air.
- **Fan mounting**
  - The fan shall be secured to the mounting surface per manufacturer's instructions.
  - The fan shall be cushioned at mounting points (e.g., with rubber grommets, foam gasketing, etc.) to minimize transfer of vibration to the structural framing.
- **Insulation blocking**
  - Perimeter blocking shall be installed around the whole house fan, in accordance with IS Section 3 (Attic Insulation), when loose-fill insulation is present.
- **Shutters**
  - Louvers and covers shall be assembled and installed per manufacturer's instructions.
  - When the whole house fan is equipped with an accessory winter cover, the cover shall have a minimum insulation value of R-4.2.



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8. WALL-MOUNT FAN INSTALLATIONS

- **Fan mounting**
  - Where a wall between conditioned space and the attic exists, the fan may be mounted vertically in the wall when allowed by the manufacturer.
  - The fan shall be secured to the mounting surface per manufacturer's instructions.
  - The fan shall be cushioned at mounting points (e.g., with rubber grommets, foam gasketing, etc.) to minimize transfer of vibration to the structural framing.
  - For belt driven fans, the belt shall be tensioned per manufacturer's instructions to ensure proper operation in the vertical orientation.
- **Plenum**
  - The air path between the attic wall and fan housing shall be enclosed to form a plenum.
  - The plenum shall be sealed to prevent infiltration of attic air.
- **Shutters**
  - Louvers and covers shall be assembled and installed per manufacturer's instructions.
  - When the whole house fan is equipped with an accessory winter cover, the cover shall have a minimum insulation value of R-4.2.
  - When required to ensure proper shutter operation, a manufacturer approved, vertical adapter shall be installed.

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9. DUCTED REMOTE FAN INSTALLATIONS

- **Damper box and return grille**
  - Structural framing shall be structurally adequate to support the weight of the damper box and return grille.
  - A damper box shall be secured to the attic floor and sealed to prevent infiltration of attic air.
  - The return grille shall be installed on the ceiling and secured to the damper box per manufacturer's instructions.
  - Vertical installation:
    - Where a wall between conditioned space and the attic exists, the return grille may be mounted vertically in the wall when allowed by the manufacturer.
    - Damper box and return grille shall be installed per manufacturer's instructions.
    - Shutters shall function properly. When required, a manufacturer approved, vertical adapter shall be installed.
- **Fan mounting**
  - The fan shall be hung from the rafters or from structural framing per manufacturer's instructions.
  - The fan shall not be in direct contact with the surrounding structural framing.
- **Ducting**
  - Ducting shall be secured to the fan and the damper box with UL 181B-listed tape or drawbands.
  - The duct shall be supported per manufacturer's instruction to prevent kinks and ensure proper airflow.

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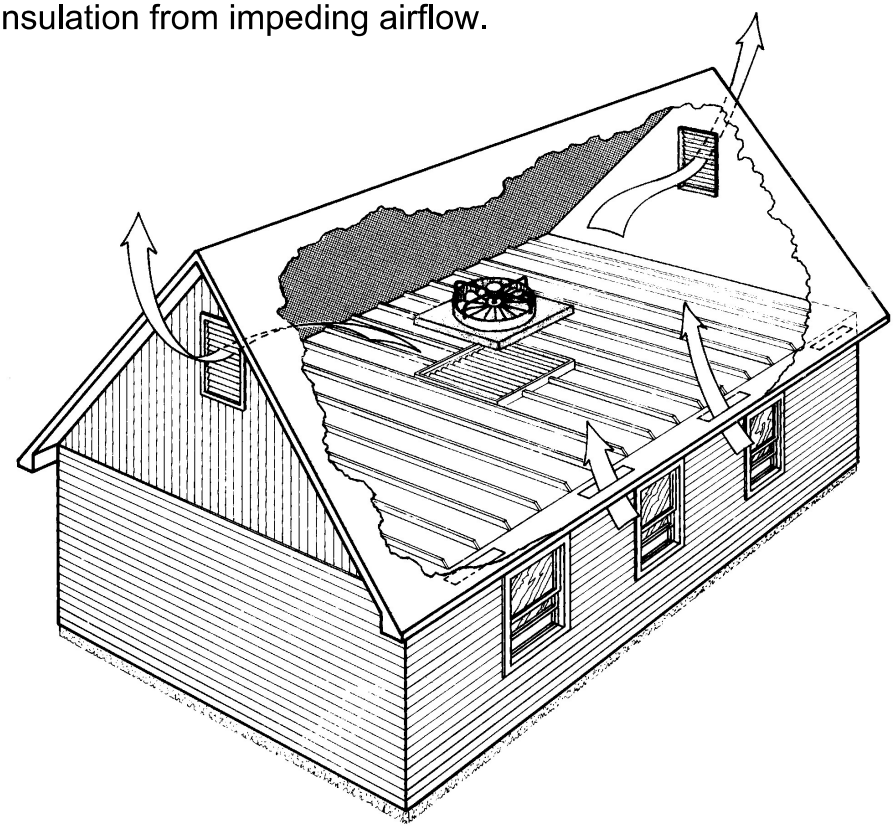
10. EXHAUST AND INLET REQUIREMENTS

- **Exhaust ventilation**
  - Exhaust ventilation Net Free Ventilation Area (NFVA) shall be:
    - A minimum of 1 sq. ft. per 750 cfm of whole house fan rated airflow, or
    - In accordance with manufacturer's specifications, whichever is greater.
- **Fresh air inlet**
  - Fresh air inlets (operable windows and doors) shall provide NFVA recommended by manufacturer.
  - Windows and doors used to provide inlet air during whole house fan operation shall have intact insect screens.
- **Attic vents**
  - When the minimum NFVA is inadequate and the existing vents are screened with #16 mesh (insect screen), the vents shall be re-screened with 1/4" weave (#4) mesh.
  - New screened vents shall have #4 mesh.
  - All vents shall be unobstructed and protected from loose-fill (via blocking), in accordance with IS Section 3 (Attic Insulation), to prevent insulation from impeding airflow.



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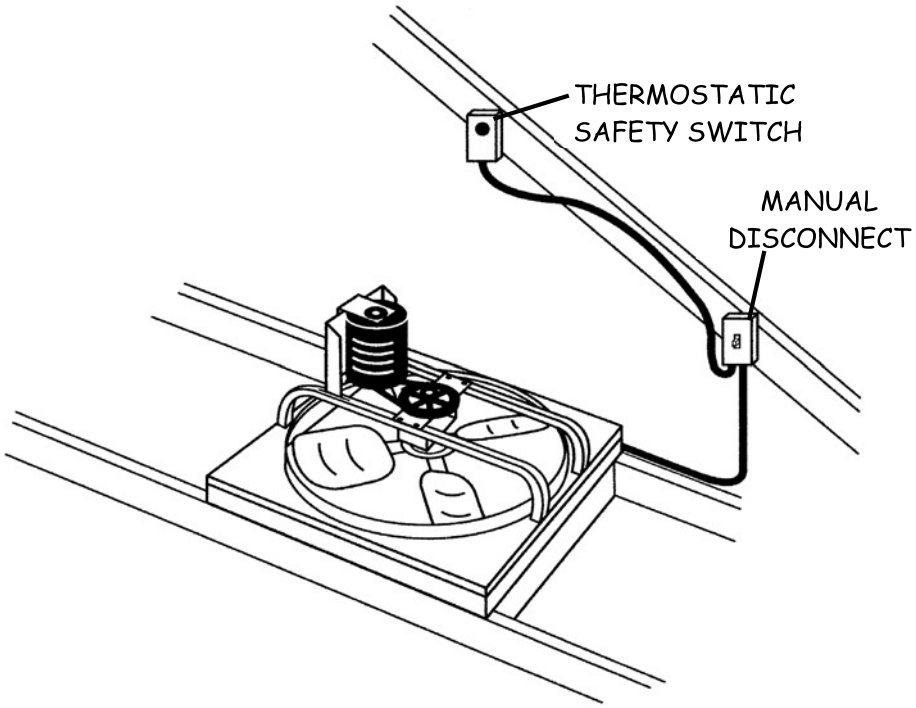
11. ELECTRICAL REQUIREMENTS

- **The circuit shall:**
  - Provide constant power to the fan controls.
  - Be grounded with adequate overcurrent protection.
- **Fan controls**
  - Shall consist of an on/off feature and timer. The whole house fan shall not be controlled by a device that turns it on automatically.
  - The timer and on/off switch (when present) shall be installed in an electrical box at least 5' above the floor (i.e., higher than nearby light switches).
    - *Exception*: Controls may be mounted a minimum of 4' above the floor when the occupant uses a wheelchair.
  - A wall-mounted controller shall be installed.
    - *Exception:* The whole house fan is equipped with a remote control and wall-mounted controls are not required by the manufacturer.
  - Wiring shall be enclosed within a wall cavity whenever feasible. When unfeasible, a raceway must be installed.
- **Safety disconnects**
  - A thermostatic safety switch to disconnect power to the fan in case of fire shall be installed.
  - A manual disconnect shall be installed in the attic near the fan.
  - An on/off switch shall be wired into the fan circuit within sight of the motor so the unit can be disabled during maintenance.



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12. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Operational check**
  - The whole house fan shall be tested for proper operations, including:
    - Power switch, speed control, and timer.
    - Hinged insulation lid, backdraft damper, shutter louvers, and separate winter cover, when present, to insure operation without binding or misalignment.
- **Instructions and warranties**
  - Customer shall be instructed on:
    - The proper operation and care of the whole house fan.
    - The need to open windows or doors before turning on the fan.
  - Customer shall be provided with:
    - Manufacturer's written instructions.
    - Written warranty documents.
- **Clean-up**
  - Paint dust and chips, scraps, and other debris resulting from installation activities shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
  - Furniture and other household items moved for installation work shall be returned to their original positions.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

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NATURAL GAS APPLIANCE EVALUATION (NGAE)

Lead Paint Risk Factor
NONE

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SECTION N PREFACE
for

NATURAL GAS APPLIANCE EVALUATIONS (NGAE)

1. Nonfeasibility Criteria

1.1. The combustion appliance uses non-IOU fuel.

1.2. A non-IOU fueled combustion appliance affecting the living space is present.

1.3. Location not suitable:

a. Location is structurally unsafe.

b. Clearances are nonconforming.

c. Nonconforming CVA cannot be corrected (e.g., total available room volume is inadequate).

1.4. Mobile Homes: Space or water heating appliance draws combustion air from the living space.

1.5. Customer refuses.

2. Installation Policies

2.1. NGAE shall be conducted:

a. Only in owner-occupied homes.

b. For natural gas space heating and water heating appliances prior to replacement.

c. Prior to the installation of weatherization and infiltration-reduction measures.

2.2. Natural gas appliances failing NGAE may be referred to weatherization for repair or replacement subject to Utility-specific Program policies and procedures.

2.3. If a defect causing an unsafe condition is identified through application of the overall NGAE protocol, (i.e., gas leak), the case will be referred for resolution to qualified utility-trained personnel.

2.4. If infiltration-reduction measures were installed after the appliance has been replaced, NGAT shall be performed for all natural gas appliances affecting the living space, in accordance with IS Section 24 (NGAT).

3. Installation Policies—SPECIFIC APPLIANCES

3.1. High Efficiency Forced Air Unit (FAU)

a. Existing FAU is less than 80% AFUE and the customer's winter season usage is greater than 200% of baseline, or

b. Existing FAU is inoperable or has a defect that requires appliance replacement.

3.2. High Efficiency Wall Furnace

a. Existing furnace AFUE is 68% or less and the customer's winter season usage is greater than 200% of baseline, or

b. Existing furnace is inoperable or has a defect that requires appliance replacement.

3.3. Water Heater—Existing water heater (one or more of the following apply):

a. Tank is leaking.

b. Is inoperable.

4. INSTALLATION POLICIES SPECIFIC TO MOBILE HOMES

4.1. When the gas water heater compartment floor is not structurally sound, the condition shall be corrected per individual utility policy.

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NATURAL GAS APPLIANCE EVALUATION STANDARDS

1. GAS LEAK DETECTION EQUIPMENT

- **Gas leak detection liquid or spray**
  - Non-corrosive, non-toxic, non-combustible
  - Commercially available specialty soap or other leak detection liquid (dish soap not allowed)
- **Electronic gas leak detector**
  - UL Classified for Class I
  - Detects natural gas
  - Flexible probe
- **Equipment calibration**
  - Electronic gas leak detectors shall be maintained and calibrated in accordance with manufacturer's specifications.

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2. ALL APPLIANCES—PRE-INSTALLATION EVALUATION

- **Application**
  - These natural gas appliance evaluations shall be performed prior to installing a replacement natural gas High Efficiency (HE) FAU, HE wall furnace, or open combustion water heater.
  - Evaluation shall include checks for conditions listed in Table N-1.

3. ALL APPLIANCES—GAS LEAKS

- **Natural gas appliances shall be checked for gas leaks:**
  - With all gas appliances turned off.
  - As prescribed in IS Section 24.
- **When a gas leak is detected:**
  - Inspection shall be conducted, and leaks shall be referred to the utility gas service department (or designee).

TABLE N-1: REPLACEMENT APPLIANCE PRE-EVALUATION CHECKLIST

Existing Appliance Visual Evaluation	HE FAU	HE Wall Furnace	Water Heater
1. Gas leaks	X	X	X
2. Location, accessibility, and clearances	X	X	X
3. FAU plenum/duct penetrated by dryer vent	X		
4. FAU plenum/duct has gas pipe fitting inside	X		
5. Proper CVA feasibility (Pipe, Vent NFVA, Room Volume)	X	X	X
6. Proper vent termination feasibility (e.g., above roof)	X	X	X
7. Proper vent termination feasibility from cooler/air intake	X	X	X
8. Mobile Home: proper isolation of return air feasibility			X
9. Cracked heat exchanger	X	X	
10. Other condition that makes replacement unfeasible	X	X	X

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4. WATER HEATERS—PRE-INSTALLATION EVALUATION

- **Visual evaluations for nonconformance shall include:**
  - Existing open combustion water heater is in:
    - A sleeping area or a bathroom,
    - An unfinished garage used as living space with sleeping area
    - An attic into which a whole house fan exhausts
  - Clothes dryer exhausts into the water heater appliance enclosure.
  - Any condition prohibited by manufacturer's instructions or code
  - Mobile Home:
    - Water heater draws combustion air from the living space.
    - Water heater isolation of return air is nonconforming and required corrections are not feasible.
    - Closet floor is structurally inadequate to safely support the weight of the unit and correction is not feasible.
- **Evaluations shall also include checking feasibility of:**
  - Meeting combustion air requirements (room volume or venting NFVA).
  - Properly installing:
    - The appliance (location and clearances)
    - Vent system and terminal, including proximity to cooler or other forced air intake into the living space
    - Gas piping and electrical service, as applicable.

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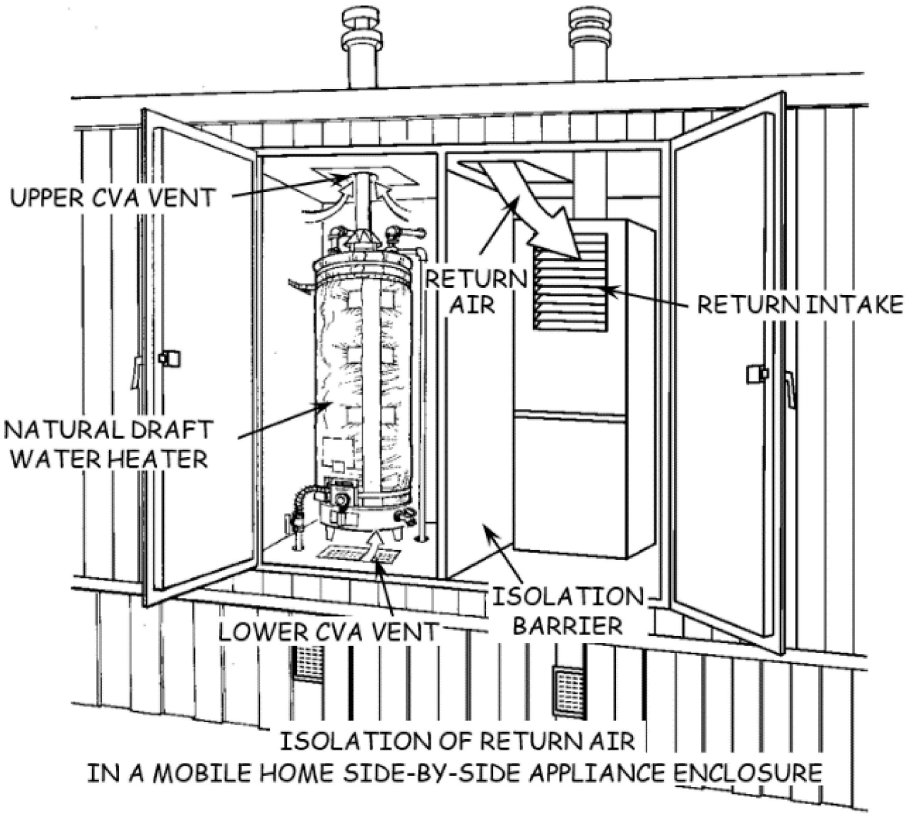
UPPER CVA VENT
RETURN AIR
RETURN INTAKE
NATURAL DRAFT WATER HEATER
ISOLATION BARRIER
LOWER CVA VENT
ISOLATION OF RETURN AIR
IN A MOBILE HOME SIDE-BY-SIDE APPLIANCE ENCLOSURE

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5. HE FORCED AIR UNIT (FAU)—PRE-INSTALLATION EVALUATION

- **Evaluations for nonconformance shall include:**
  - The FAU plenum is penetrated by:
    - Clothes dryer moisture exhaust, or
    - Gas pipe with fitting inside the plenum.
  - Visible return leak is present that can draw in combustion products from any open combustion appliances (e.g., in a garage or room containing supply or return plenum/ductwork).
  - Any condition prohibited by manufacturer's instructions or code.
- **Evaluations shall include checking feasibility of:**
  - Meeting combustion air requirements (intake piping).
  - Properly installing:
    - The appliance (location and clearances)
    - Vent system and terminal, including:
      - proximity to cooler or other forced air intake into the living space, and
      - installation of cooler vent covers, if needed
    - Gas piping and electrical service, as applicable.

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6. HE WALL FURNACE—PRE-INSTALLATION EVALUATION

- **Evaluations for nonconformance shall include:**
  - Any condition prohibited by manufacturer's instructions or code.
  - Mobile Home: Furnace draws combustion air from the living space.
- **Evaluations shall include checking feasibility of:**
  - Meeting combustion air requirements (room volume).
  - Properly installing:
    - The appliance (location and clearances)
    - Vent system and terminal, including:
      - proximity to cooler or other forced air intake into the living space, and
      - installation of cooler vent covers, if needed.
    - Gas piping and electrical service, as applicable.

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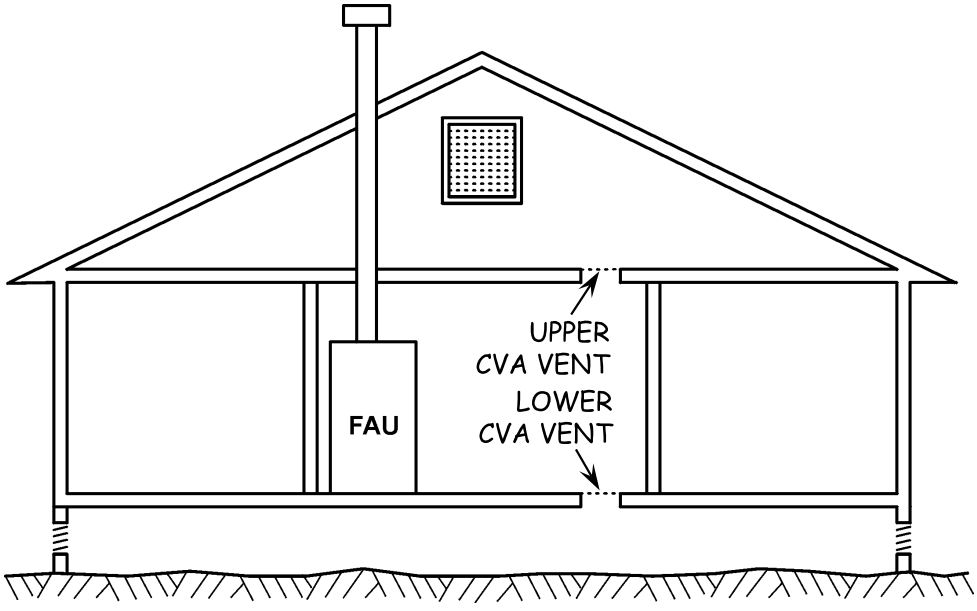
7. COMBUSTION AND VENTILATION AIR (CVA) EVALUATION

- **Open combustion natural gas appliances**
  - In homes built in 2008 or later, room volume CVA calculation shall include the sum of Btuh Input ratings for all separate burners in cooking appliances (cooktop burners, griddle, oven, and broiler).
  - CVA shall comply with these guidelines and IS Appendix A, unless superseded by manufacturer's instructions or code.
- **Appliances drawing *outdoor* air through combustion-air openings or ducts**
  - An *upper* opening or duct shall be in the ceiling or begin within 12" of the enclosure ceiling, and a *lower* opening or duct shall be in the floor or begin 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 an upper-only vent or duct to outdoors under the following conditions:
    - Vent/duct 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.



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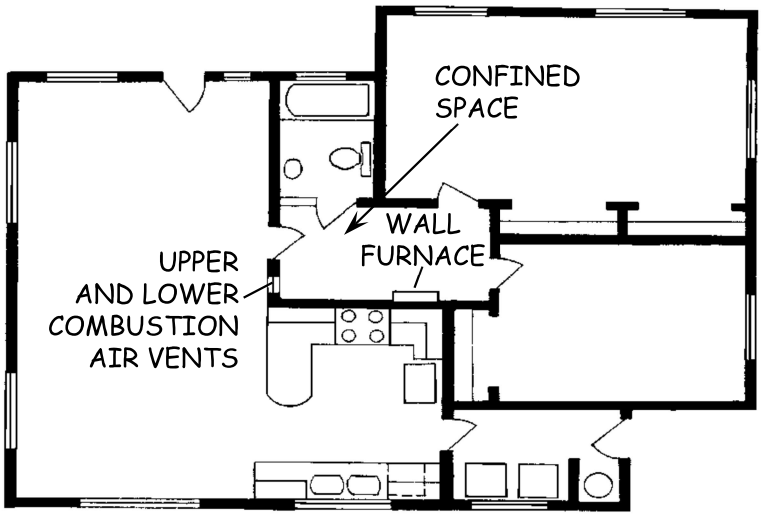
7. COMBUSTION AND VENTILATION AIR (CVA) EVALUATION (cont.)

- **When appliances draw combustion air from <u>indoors</u>**
  - <u>Unconfined</u> space—Combustion air <u>is</u> considered adequate:
    - It is a room/space that has a volume of ≥50 cu. ft. per 1,000 Btu/hr total input rating.[1]
  - <u>Confined</u> space—Combustion air <u>is not</u> adequate:
    - It is a room/space that has a volume of <50 cu. ft. per 1,000 Btu/hr total input rating.[1]
    - Proper vent openings to adjacent space(s) must be feasible.
- **Appliances located in an *indoor* <u>confined</u> space** [2]
  - Upper <u>and</u> lower vent openings must be present which: (a) freely communicate with other indoor rooms/spaces, and (b) provide a combined volume ≤50 cu. ft. per 1,000 Btu/hr total input.
    - <u>Each</u> vent opening must 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 must be in the floor or begin within 12" of the floor, and
    - Upper vents must be in the ceiling or begin within 12" of the ceiling.



WALL FURNACE LOCATED IN AN INDOOR CONFINED SPACE—VOLUME OF HALLWAY IS <50 CUBIC FEET PER 1,000 BTU/HR INPUT OF THE FURNACE

[1] Total of open combustion Btuh input ratings of the furnace and/or water heater in that room/space. Also, Btuh input ratings for all separate burners in cooking appliances in homes built in 2008 or later.

[2] For a double-sided wall furnace with burner access from both sides of the wall, CVA volume includes spaces on both sides of the wall, so transfer grilles between them are not required.

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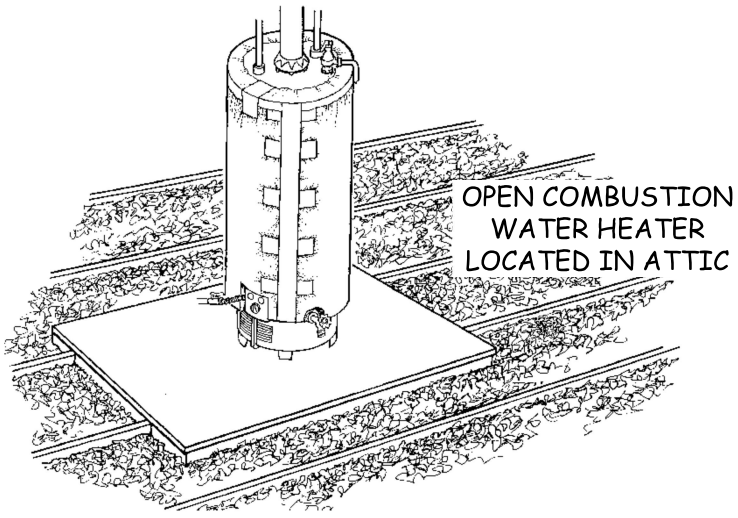
7. COMBUSTION AND VENTILATION AIR (CVA) EVALUATION (cont.)

- **Appliances located in attached garage or enclosed porch**
  - When a garage or enclosed porch is an unconfined space, combustion air is considered adequate.
  - When a converted (finished) garage is a confined space used as conditioned living space, CVA must be conforming.
  - When a garage or enclosed porch 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.
  - Lower CVA vents to outdoors must be at least 18" from a gas meter.
- **Appliances located in a crawlspace or partial basement**
  - When the 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 (e.g., foundation vents) shall provide at least 1 sq. in. NFVA per 4,000 Btuh total input.
- **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.



UPPER AND/OR LOWER ATTIC VENTS WITH CROSS VENTILATION REQUIRED WHEN ATTIC IS A CONFINED SPACE

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8. EVALUATION OF EXISTING GAS VENT SYSTEM

- **Vent system nonconforming conditions:**
  - Checks shall be made for corrections required for appliance replacement but are not feasible, such as:
    - Inadequate clearances from combustibles (with or without charring).[3]
    - Connection to a solid-fuel appliance chimney.
- **Vent system extending through the roof (except direct vent)**
  - If the exiting vent system will be reused, it must terminate in a vent cap and extend above the highest point where it passes through the roof in accordance with Table N-2.

TABLE N-2: REPLACEMENT APPLIANCE VENT TERMINATION

Roof Pitch	Minimum Terminal Hight (ft.) Above Roof
up to 6/12	1.00'
>6/12 to 7/12	1.25'
>7/12 to 8/12	1.50'
>8/12 to 9/12	2.00'
Steeper Pitches	per CMC or Code

[3] It must be feasible to install the new appliance vent system with clearances required by manufacturer's instructions and code.

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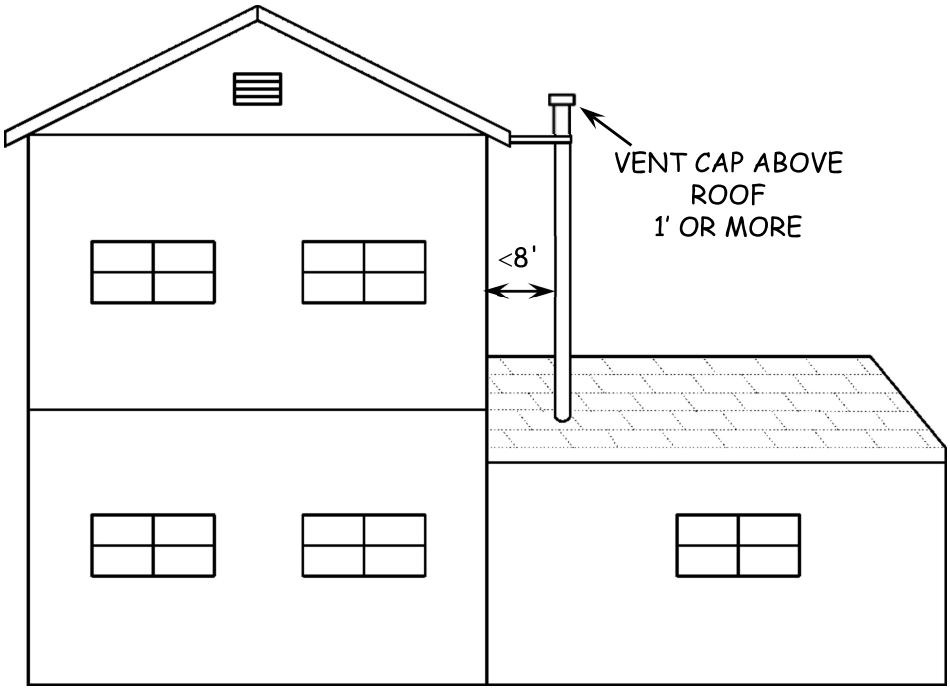
8. EVALUATION OF EXISTING GAS VENT SYSTEM (cont.)

- **Vent termination for pipe <8' from a wall (except direct vent)**
  - If the exiting vent system will be reused, it must terminate in a vent cap and extend above the adjacent roof the same distance shown in Table N-2.
- **Vent and combustion air pipe(s) for direct vent appliances**
  - It must be feasible to install the new appliance vent and combustion air intake pipe(s) with clearances required by manufacturer's instructions and code.



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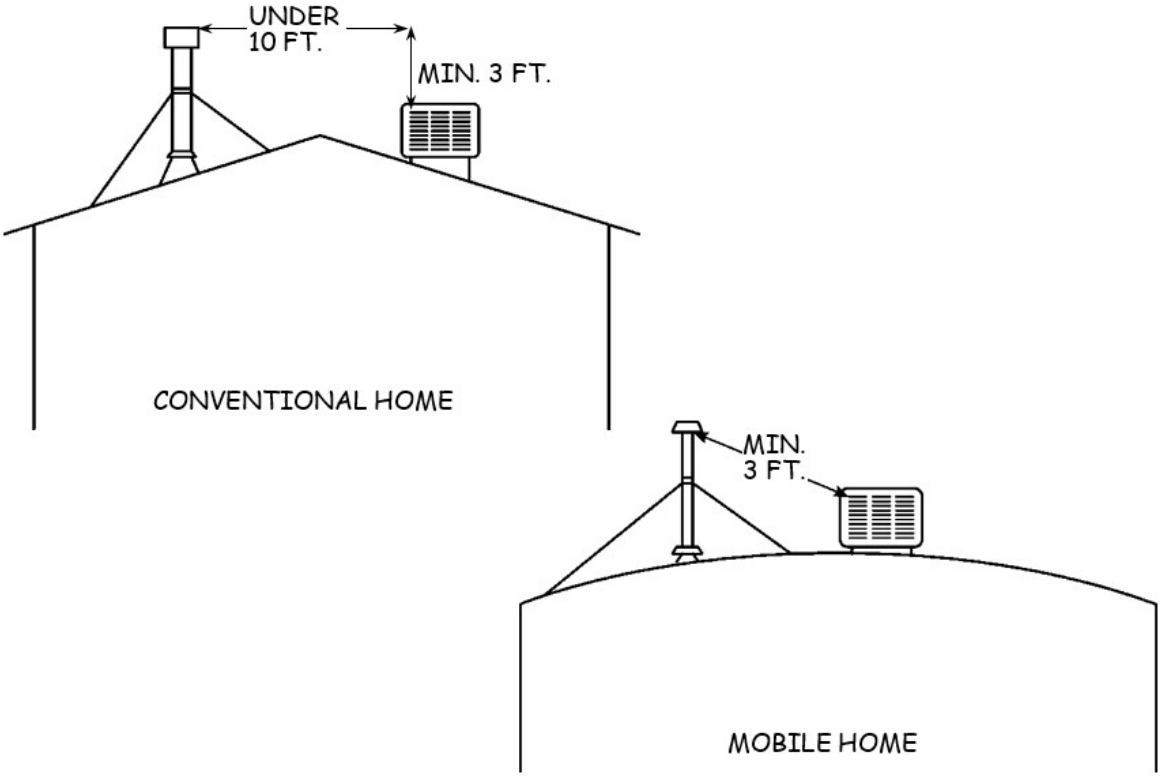
8. EVALUATION OF EXISTING GAS VENT SYSTEM (cont.)

- **Vent termination near a cooler or mechanical vent inlet**
  - Visual evaluation shall include checking feasibility of meeting the following requirements.
  - Conventional and Modular Homes
    - New gas appliance vent termination, including direct vent, located within 10' of an inlet must terminate at least 3' above the inlet.
  - Mobile Homes
    - New gas appliance vent termination must terminate at least 3' from the inlet.



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APPENDIX -A-

COMBUSTION AND VENTILATION AIR REQUIREMENTS FOR NATURAL GAS APPLIANCES

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3.0 CVA Equations 2

4.0 The CVA Requirements Matrix 2

APPENDIX -A-
COMBUSTION AND VENTILATION AIR REQUIREMENTS FOR NATURAL GAS APPLIANCES

1.0 PURPOSE

This appendix is based on Chapter 7 of the CMC and is a quick reference to determine room volume or CVA vent size requirements for open combustion *furnaces and water heaters*.

- Prior to 2008, CVA calculations were required only for open combustions space heaters and water heaters.
- Beginning with the 2008 CMC, CVA calculations include gas cooking appliances, and make-up air venting for clothes dryers is specified (see 3.3 below).

This is only a guide. Each installer is responsible for meeting all requirements of the local jurisdiction.

2.0 CMC CRITERIA

Some CMC requirements for combustion air are addressed in this section and in footnotes on the following pages. Equations used to calculate room volume and vent size are shown in Section 3.0.

2.1 **Louvers, Grilles, and Screens**: 1/4-inch mesh is required on combustion air openings to *outdoors—except* ducts that terminate in an attic, which are not screened on either end. Mesh is *not* required on vents to the *indoors*. The blocking effect of louvers, grilles, and screens must be deducted from the vent opening area to determine the NFVA. When NFVA is stamped on the vent, it may be used.

- When not stamped on the vent, **NFVA can be estimated** by *multiplying* gross opening area by a reduction factor from Table A-1. [(Gross area sq. in.) x (Reduction factor) = NFVA sq. in.].
- When the required NFVA is known, **gross size of the vent needed** can be determined by *dividing* the NFVA by the reduction factor. [(NFVA) ÷ (Reduction factor) = Gross area]

TABLE A-1: SUGGESTED SCREEN AND LOUVER REDUCTION FACTORS FOR COMBUSTION AIR VENTS

1/4" Mesh (hardware cloth)	1/8" Mesh (wire mesh)	1/16" Mesh (insect screen)	Metal Louvers **or** Metal Louvers and 1/4" or 1/8" Mesh	Metal Louvers and 1/16" Mesh	Wood Louvers **or** Wood Louvers and 1/16" to 1/4" Mesh
0.90 (90%)	**0.75** (75%)	**0.50** (50%)	**0.75** (75%)	**0.50** (50%)	**0.25** (25%)

2.2 **Combustion Air Openings:** Upper vent/duct shall be located in the ceiling or begin within 12" of the ceiling, and lower vent/duct shall be in the floor or begin within 12" of the floor. The smallest dimension of combustion air openings shall be at least 3". (Note: Pre-existing Upper vents are acceptable at any location higher than the draft hood.)

2.3 **Make-Up Air for Clothes Dryers:** For homes built in 2008 or later, when a closet is designed for the installation of a clothes dryer, a minimum opening of 100 sq. in. for makeup air must be provided in the door or by other approved means.

2.4 **All Combustion Air Ducts:**

2.4.1 Ducts must be galvanized steel or equivalent corrosion-resistant material.

2.4.2 Ducts shall terminate in an unobstructed space, allowing free movement of CVA to the appliances.

2.4.3 Each duct shall service a *single* space/enclosure.

2.4.4 Separate ducts shall be used to provide upper and lower CVA (a single duct cannot serve both).

2.4.5 Ducts terminating in an attic shall not be screened.

2.4.6 Horizontal upper CVA ducts must be level or slope *upward* toward the air source (i.e., must *not* slope downward toward outdoors).

2.5 **Round combustion air ducts:** In Table A-2, the cross-sectional area of a round duct is given when the diameter or circumference is known.[1]

TABLE A-2: AREA OF A ROUND DUCT BY DUCT DIAMETER

Duct Diameter (in.)	3"	4"	5"	6"	7"	8"	9"	10"
Duct Area (sq. in.)	**7.1**	**12.6**	**19.6**	**28.3**	**38.5**	**50.3**	**63.6**	**78.5**
Duct Circumference (in.)	9.4"	12.6"	15.7"	18.8"	22.0"	25.1"	28.3"	31.4"

3.0 CVA EQUATIONS

Equations used to calculate CVA are summarized in Table A-3.

TABLE A-3: CVA CALCULATIONS

Equation	Application	CVA Requirement [Equations in Brackets]
4-1	All air from **indoors**, based on room volume	**50 cu. ft. of room volume per 1,000 Btuh input.** **[NFVA = KBtuh x 50]**
4-2	All air from **indoors**, with one upper vent and one lower vent venting to another interior room/space	**Two indoor vents:** When volume of a room/space containing an appliance is too small, an upper and a lower vent may be installed into adjacent space with sufficient volume. Each vent must provide **1 sq. in. NFVA per 1,000 Btuh input**, with a *minimum size* of **100 sq. in. [NFVA = 100 + # of KBtuh above 100]**
4-3	All air from **outdoors**, using an ***Upper-only* vent or duct**	**Upper-only vent/duct:** One *upper* opening (or vertical or horizontal duct) may be used to provide the combustion air. (Lower vent not required.) • The appliance must have clearances of 1" on sides and back and 6" in front. • Vent/duct NFVA must equal the sum of the vent connector cross-sectional areas. • The vent/duct must provide **1 sq. in. NFVA per 3,000 Btuh input. [NFVA = KBtuh/3]**
4-4	All air from **outdoors**, using one upper vent or *vertical* duct and one lower vent or *vertical* duct	**Upper and lower vents/ducts:** Each opening and *vertical* duct must provide **1 sq. in. NFVA per 4,000 Btuh input.** **[NFVA = KBtuh/4]** [2]
4-5	All air from **outdoors**, using one upper *horizontal* duct and one lower *horizontal* duct	**Upper and lower horizontal ducts:** Each *horizontal* duct must provide **1 sq. in. NFVA per 2,000 Btuh input.** **[NFVA = KBtuh/2]**

4.0 THE CVA REQUIREMENTS MATRIX

The matrix on the following page is a quick reference to determine room volume or CVA vent and duct size. Column A lists several Btuh input totals. Column B is used when CVA is based on room volume. Column C gives minimum size of interior vents when additional volume is needed from an adjacent space. Column D applies to an upper-only CVA vent or vertical duct. Column E applies when both upper and lower vents (or vertical ducts) are used. Column F applies when upper and lower horizontal ducts are used.

[1] Duct area equals πr^2 (3.1415 x the radius squared). When circumference is known, divide it by 3.1415 to determine the diameter, then calculate the area.

[2] When an unconditioned garage or enclosed porch is confined space, but not living space, CVA venting to outdoors for existing appliances may be upper and/or lower, with 1 sq. in. NFVA per 4,000 Btuh (per IS Sec. 24, Item 6).

CVA REQUIREMENTS FOR OPEN COMBUSTION GAS-BURNING APPLIANCES

Open Combustion Furnace and/or Water Heater in a Room/Space	Homes with Infiltration of at Least 0.40 ACH[3] with Appliances Located in a Confined Space and All Combustion Air Obtained from Indoors		Room or Space with Inadequate Volume and All Combustion Air Obtained from Outdoors		
			[D] One Upper Opening (or One Vertical or Horizontal Duct)[4, 5, 6, 7, 8, 9] **[E]** One Upper Opening or V**ertical** Duct and One Lower Opening or Vertical Duct[4, 5, 6, 7, 9, 9]		Two **Horizontal** Ducts[5, 8, 10]
Total Input	Min. Room Volume	Min. NFVA per Vent	Min. NFVA Upper-Only Vent/Vertical Duct	Min. NFVA for Each of Two Vents/Vertical Ducts	Required NFVA per Duct for Two Ducts
[A] Btuh	**[B] Cu. Ft.**	**[C] Sq. In.**	**[D Sq. In.[10]**	**[E] Sq. In.[10]**	**[F] Sq. In.**
20,000	1,000	100	Rect: 9.0 • Rnd: 7.07	Rect: 9.0 • Rnd: 7.07	10.0
25,000	1,250	100	Rect: 9.0 • Rnd: 8.3	Rect: 9.0 • Rnd: 7.07	12.5
30,000	1,500	100	10.0	Rect: 9.0 • Rnd: 7.5	15.0
35,000	1,750	100	11.7	Rect: 9.0 • Rnd: 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

[3] For ACH greater than 0.40, see CMC Chapter 7 for an alternative called the "Known Air Infiltration Rate Method."

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

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

[6] Attic must be adequately vented to provide the required volume of combustion air. Vent openings must be protected from ceiling insulation (e.g., with sleeve 6" above it).

[7] Vertical ducts must extend into unobstructed space and may not be screened if terminating in the attic.

[8] New upper vent/duct shall be installed in the ceiling or begin within 12" of the ceiling, and lower vent/duct shall be in the floor or begin within 12" of the floor. A *pre-existing upper* vent is acceptable at any location above the draft hood.

[9] Crawl space must have free flow of air and unobstructed openings to outdoors that provide adequate crawlspace venting. Foundation vents should be screened with 1/4" mesh.

[10] The minimum cross-sectional dimension of CVA vents and ducts is 3". Minimum rectangular vent/duct is 3" x 3" (**9.0 sq. in.**); minimum round vent/duct is 3" diameter (πr^2 = 3.1415 x 1.5" x 1.5" = **7.07 sq. in.**).

APPENDIX -B-

ATTIC VENTILATION
NET FREE VENTING AREA TABLES

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APPENDIX -B-
ATTIC VENTILATION NET FREE VENTING AREA TABLES

1.0 INTRODUCTION TO ATTIC VENTILATION

1.1 Screen and Louver Reduction Factors

1. Table B-1 contains the "reduction factors" upon which the attic vent NFVA tables in this appendix are based.
2. In situations when the vent being evaluated does not "fit" an NFVA table, use Table B-1 to calculate NFVA.
3. Example: An eave vent has 1/4-inch screen (no louvers), with a vent opening (excluding the frame) that is 2.5″ x 17″. 2.5 x 17 = 42.5.
   - The screened opening is 42.5 sq. in. The reduction factor from Table B-1 is 0.90.
   - 42.5 x 0.90 = 38.25 sq. in.= NFVA. Divide square *inches* by 144 to calculate square *feet*.
   - 38.25 ÷ 144 = 0.27 sq. ft. NFVA

TABLE B-1: SCREEN AND LOUVER REDUCTION FACTORS

(A) Mesh Only	1/4" Mesh (hardware cloth)	1/8" Mesh (wire mesh)	1/16" Mesh (insect screen)
	0.90 (90%)	**0.75** (75%)	**0.50** (50%)

(B) Louvers & Mesh	Metal Louvers **or** Metal Louvers and 1/4" or 1/8" Mesh	Metal Louvers, **or** Metal Louvers and 1/16" Mesh	Wood Louvers **or** Wood Louvers and 1/16" to 1/4" Mesh
	0.75 (75%)	**0.50** (50%)	**0.25** (25%)

Note: 1/16" screen must be replaced on vents included in NFVA calculations.

1.2 Quick Reference for Determining Required Attic Venting NFVA

1. Tables B-2 and B-3 on the following page provide a quick reference for determining the amount of NFVA required for an attic (or rectangular attic section).
2. Table B-2 (1 to 150 ratio) applies when 1 sq. ft. NFVA is required per 150 sq. ft. of attic floor. Table B-3 applies when 1 sq. ft. NFVA is required per 300 sq. ft. of attic floor (1 to 300 ratio).
   a. Determine which ratio applies. (See IS Section 3, Attic Insulation.)
   b. In the applicable table, find the length of the attic (or section) in the left column.
   c. Move across that row to the column representing the attic width (in the top row).
   d. At the intersection of the length row and width column, the number in the table is the sq. ft. of NFVA required for an attic (or section) of that size.
   e. If the house is not a simple rectangle, determine the NFVA required for each rectangular section, and add the amounts together to calculate total NFVA.
3. Example: 1 sq. ft. NFVA per 150 sq. ft. of attic floor (1 to 150 ratio), use Table B-2.
   a. For an attic 40' long and 30' wide, 8.0 sq. ft. NFVA is needed.
   b. For an L-shaped house with a 20' x 20' section and another 20' x 30' section, the NFVA amounts are 2.7 + 4.0 = 6.7 sq. ft. total NFVA.
   c. For dimensions not shown in the table, calculate the attic area, and divide that square footage by 150. ► For a 31' by 41' attic, the area is: 31' x 41' = 1271 sq. ft. 1271 ÷ 150 = 8.47, rounded up = 8.5 sq. ft. NFVA.

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Table B-2: NFVA (Sq. Ft.) for 1 to 150 Ratio

Attic Length (Feet)	Attic Width (Feet)															
	10'	**12'**	**14'**	**16'**	**18'**	**20'**	**22'**	**24'**	**26'**	**28'**	**30'**	**32'**	**34'**	**36'**	**38'**	**40'**
10'	0.7	0.8	0.9	1.1	1.2	1.3	1.5	1.6	1.7	1.9	2.0	2.1	2.3	2.4	2.5	2.7
12'	0.8	1.0	1.1	1.3	1.4	1.6	1.8	1.9	2.1	2.2	2.4	2.6	2.7	2.9	3.0	3.2
14'	0.9	1.1	1.3	1.5	1.7	1.9	2.1	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.5	3.7
16'	1.1	1.3	1.5	1.7	1.9	2.1	2.3	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.1	4.3
18'	1.2	1.4	1.7	1.9	2.2	2.4	2.6	2.9	3.1	3.4	3.6	3.8	4.1	4.3	4.6	4.8
20'	1.3	1.6	1.9	2.1	2.4	2.7	2.9	3.2	3.5	3.7	4.0	4.3	4.5	4.8	5.1	5.3
22'	1.5	1.8	2.1	2.3	2.6	2.9	3.2	3.5	3.8	4.1	4.4	4.7	5.0	5.3	5.6	5.9
24'	1.6	1.9	2.2	2.6	2.9	3.2	3.5	3.8	4.2	4.5	4.8	5.1	5.4	5.8	6.1	6.4
26'	1.7	2.1	2.4	2.8	3.1	3.5	3.8	4.2	4.5	4.9	5.2	5.5	5.9	6.2	6.6	6.9
28'	1.9	2.2	2.6	3.0	3.4	3.7	4.1	4.5	4.9	5.2	5.6	6.0	6.3	6.7	7.1	7.5
30'	2.0	2.4	2.8	3.2	3.6	4.0	4.4	4.8	5.2	5.6	6.0	6.4	6.8	7.2	7.6	8.0
32'	2.1	2.6	3.0	3.4	3.8	4.3	4.7	5.1	5.5	6.0	6.4	6.8	7.3	7.7	8.1	8.5
34'	2.3	2.7	3.2	3.6	4.1	4.5	5.0	5.4	5.9	6.3	6.8	7.3	7.7	8.2	8.6	9.1
36'	2.4	2.9	3.4	3.8	4.3	4.8	5.3	5.8	6.2	6.7	7.2	7.7	8.2	8.6	9.1	9.6
38'	2.5	3.0	3.5	4.1	4.6	5.1	5.6	6.1	6.6	7.1	7.6	8.1	8.6	9.1	9.6	10.1
40'	2.7	3.2	3.7	4.3	4.8	5.3	5.9	6.4	6.9	7.5	8.0	8.5	9.1	9.6	10.1	10.7

Table B-3: NFVA (Sq. Ft.) for 1 to 300 Ratio

Attic Length (Feet)	Attic Width (Feet)															
	10'	**12'**	**14'**	**16'**	**18'**	**20'**	**22'**	**24'**	**26'**	**28'**	**30'**	**32'**	**34'**	**36'**	**38'**	**40'**
10'	0.3	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.9	0.9	1.0	1.1	1.1	1.2	1.3	1.3
12'	0.4	0.5	0.6	0.6	0.7	0.8	0.9	1.0	1.0	1.1	1.2	1.3	1.4	1.4	1.5	1.6
14'	0.5	0.6	0.7	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9
16'	0.5	0.6	0.7	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1
18'	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.4	1.6	1.7	1.8	1.9	2.0	2.2	2.3	2.4
20'	0.7	0.8	0.9	1.1	1.2	1.3	1.5	1.6	1.7	1.9	2.0	2.1	2.3	2.4	2.5	2.7
22'	0.7	0.9	1.0	1.2	1.3	1.5	1.6	1.8	1.9	2.1	2.2	2.3	2.5	2.6	2.8	2.9
24'	0.8	1.0	1.1	1.3	1.4	1.6	1.8	1.9	2.1	2.2	2.4	2.6	2.7	2.9	3.0	3.2
26'	0.9	1.0	1.2	1.4	1.6	1.7	1.9	2.1	2.3	2.4	2.6	2.8	2.9	3.1	3.3	3.5
28'	0.9	1.1	1.3	1.5	1.7	1.9	2.1	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.5	3.7
30'	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0
32'	1.1	1.3	1.5	1.7	1.9	2.1	2.3	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.1	4.3
34'	1.1	1.4	1.6	1.8	2.0	2.3	2.5	2.7	2.9	3.2	3.4	3.6	3.9	4.1	4.3	4.5
36'	1.2	1.4	1.7	1.9	2.2	2.4	2.6	2.9	3.1	3.4	3.6	3.8	4.1	4.3	4.6	4.8
38'	1.3	1.5	1.8	2.0	2.3	2.5	2.8	3.0	3.3	3.5	3.8	4.1	4.3	4.6	4.8	5.1
40'	1.3	1.6	1.9	2.1	2.4	2.7	2.9	3.2	3.5	3.7	4.0	4.3	4.5	4.8	5.1	5.3

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2.0 VENT TABLE INSTRUCTIONS

2.1 Using the Tables

1. The tables on the following pages can be used to determine the NFVA provided by a particular type and size of vent. The NFVA for that vent is given in square feet.
2. When vent measurements are between the sizes listed, calculate manually.

2.2 Sample NFVA Table

TABLE B-4: RECTANGULAR GABLE VENTS—1/4" OR 1/8" SCREEN WITH METAL LOUVERS
(Reduction Factor = 0.75)

		Width (Inches)												
		12	**14**	**16**	**18**	**20**	**22**	**24**	**26**	**28**	**30**	**32**	**34**	**36**
Height (Inches)	**12**	0.75	0.88	1.00	1.13	1.25	1.38	1.50	1.63	1.75	1.88	2.00	2.13	2.25
	14	0.88	1.02	1.17	1.31	1.46	1.60	1.75	1.90	2.04	2.19	2.33	2.48	2.63
	16	1.00	1.17	1.33	1.50	1.67	1.83	2.00	2.17	2.33	2.50	2.67	2.83	3.00
	18	1.13	1.31	1.50	1.69	1.88	2.06	2.25	2.44	2.63	2.81	3.00	3.19	3.38
	20	1.25	1.46	1.67	1.88	2.08	2.29	2.50	2.71	2.92	3.13	3.33	3.54	3.75
	22	1.38	1.60	1.83	2.06	2.29	2.52	2.75	2.98	3.21	3.44	3.67	3.90	4.13
	24	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50

2.3 Examples

1. **Example 1:** If 16" *high* by 14" *wide* gable vents are to be installed, first find the 16" *height* in the left column. Move across that row to the column representing the 14" *width* (shown in the top row). At the intersection of the 16" height row and 14" width column, you find "**1.17**."
   ►The "1.17" means 1.17 sq. ft. of NFVA is provided by **one** vent.
2. **Example 2:** If 18" *high* by 14" *wide* gable vents are to be installed, first find the 18" *height* in the left column. Move across that row to the column representing the 14" *width*. At the intersection of the 18" height row and 14" width column, you find "**1.31**."
   ►The "1.31" means 1.31 sq. ft. of NFVA is provided by **one** vent.

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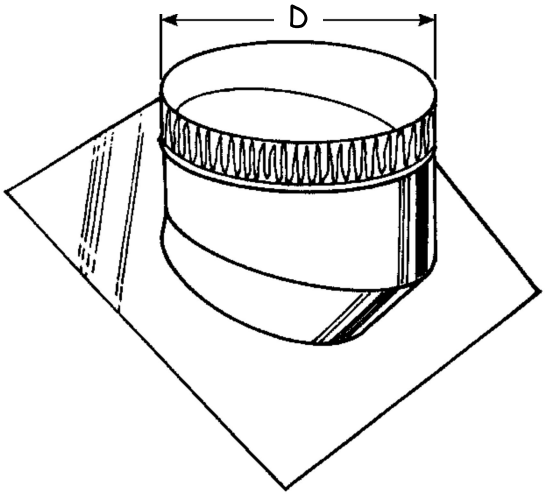
3.0 TURBINE VENTILATORS



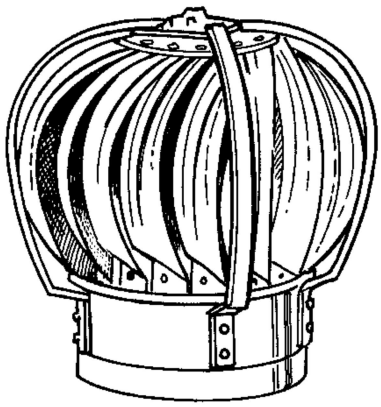


TABLE B-5: TURBINE VENTILATORS

# of 12" Turbines	1		2		3		4		5	
# of 14" Turbines		1		2		3		4		5
Sq. Ft. of NFVA Provided	0.79	1.10	1.60	2.20	2.40	3.30	3.20	4.40	4.00	5.50

Several styles of turbine ventilators exist, each with different NFVA specifications. Use the actual product manufacturer's NFVA specifications when available. Use the above table only when the manufacturer's NFVA specifications are not available.

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4.0 ROUND VENT HOLES

Bird Holes

TABLE B-6: BIRD HOLES—1/4" SCREEN, NO LOUVERS
(Reduction Factor = 0.90)

	Diameter (Inches)						
	1.5	1.75	2	2.25	2.5	2.75	3
Sq. Ft. of NFVA Provided by One Vent	0.0110	0.0150	0.0196	0.0248	0.0307	0.0371	0.0442
# of Vents Needed for 1 Sq. Ft. NFVA	91	67	51	40	33	27	23

NFVA calculations are for vents screened with 1/4" (#4) weave mesh (required on new vents).

TABLE B-7: BIRD HOLES—1/8" SCREEN, NO LOUVERS
(Reduction Factor = 0.75)

	Diameter (Inches)						
	1.5	1.75	2	2.25	2.5	2.75	3
Sq. Ft. of NFVA Provided by 1 Vent	0.0092	0.0125	0.0164	0.0207	0.0256	0.0309	0.0368
# of Vents Needed for 1 Sq. Ft. NFVA	109	80	61	48	39	32	27

NFVA calculations are for vents screened with 1/8" (#8) weave mesh (found on some existing vents).

Mini-Circular Vents

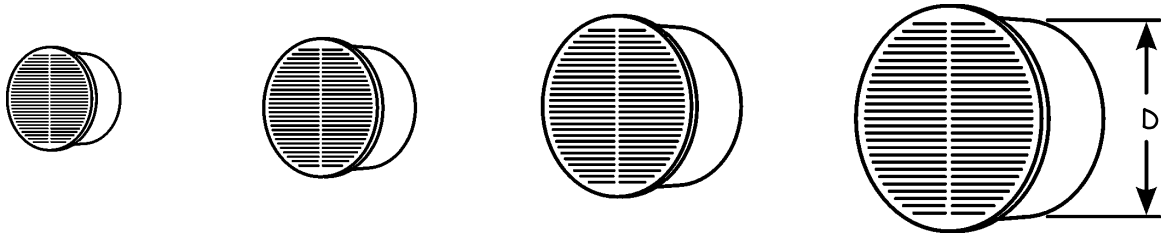

TABLE B-8: MINI-CIRCULAR VENTS

	Diameter (Inches)								
	1	1.5	2	2.5	3	4	5	6	8
Sq. Ft. of NFVA Provided by One Vent	.0019	.0043	.0076	.0119	.0172	.0305	.0477	.0687	.1222
# of Vents Needed for 1 Sq. Ft. NFVA	524	233	131	84	58	33	21	15	8

Many styles of mini-circular vents exist, each with different NFVA specifications. Use the actual product manufacturer's NFVA specifications when available. Use the above table only when the manufacturer's NFVA specifications are not available.

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5.0 EAVE VENTS—1/4" AND 1/8" SCREEN, NO LOUVERS

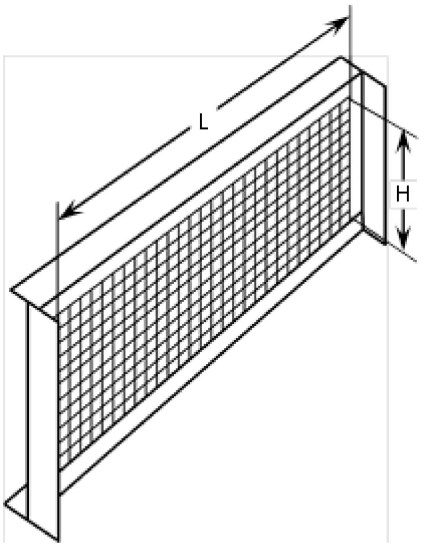

TABLE B-9: EAVE VENTS—1/4" SCREEN, NO LOUVERS
(Reduction Factor = 0.90)

		Length (Inches)								
		10	**12**	**13**	**14**	**14.5**	**16**	**18**	**21**	**22.5**
Height (Inches)	**3**	0.19	0.23	0.24	0.26	0.27	0.30	0.34	0.39	0.42
	3.5	0.22	0.26	0.28	0.31	0.32	0.35	0.39	0.46	0.49
	4	0.25	0.30	0.33	0.35	0.36	0.40	0.45	0.53	0.56
	4.5	0.28	0.34	0.37	0.39	0.41	0.45	0.51	0.59	0.63
	5	0.31	0.38	0.41	0.44	0.45	0.50	0.56	0.66	0.70
	5.5	0.34	0.41	0.45	0.48	0.50	0.55	0.62	0.72	0.77

NFVA calculations are for vents screened with 1/4" (#4) weave mesh (required on new vents).

TABLE B-10: EAVE VENTS—1/8" SCREEN, NO LOUVERS
(Reduction Factor = 0.75)

		Length (Inches)								
		10	**12**	**13**	**14**	**14.5**	**16**	**18**	**21**	**22.5**
Height (Inches)	**3**	0.16	0.19	0.20	0.22	0.23	0.25	0.28	0.33	0.35
	3.5	0.18	0.22	0.24	0.26	0.26	0.29	0.33	0.38	0.41
	4	0.21	0.25	0.27	0.29	0.30	0.33	0.38	0.44	0.47
	4.5	0.23	0.28	0.30	0.33	0.34	0.38	0.42	0.49	0.53
	5	0.26	0.31	0.34	0.36	0.38	0.42	0.47	0.55	0.59
	5.5	0.29	0.34	0.37	0.40	0.42	0.46	0.52	0.60	0.64

NFVA calculations are for vents screened with 1/8" (#8) weave mesh (found on some existing vents).

- Screens must be clean, and vents must be free of insulation and other obstructions.
- Tight weave (1/16" mesh) insect screen must be *replaced* on vents included in NFVA calculations.

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6.0 RECTANGULAR GABLE VENTS—1/4" OR 1/8" SCREEN WITH METAL LOUVERS

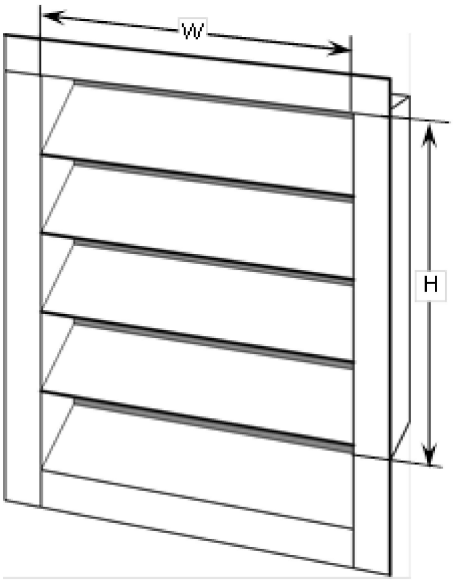

TABLE B-11: RECTANGULAR GABLE VENTS—1/4" OR 1/8" SCREEN WITH METAL LOUVERS
(Reduction Factor = 0.75)

		Width (Inches)									
		11	**12**	**14**	**16**	**18**	**20**	**22**	**24**	**30**	**36**
Height (Inches)	**8**	0.46	0.50	0.58	0.67	0.75	0.83	0.92	1.00	1.25	1.50
	10	0.57	0.63	0.73	0.83	0.94	1.04	1.15	1.25	1.56	1.88
	12	0.69	0.75	0.88	1.00	1.13	1.25	1.38	1.50	1.88	2.25
	14	0.80	0.88	1.02	1.17	1.31	1.46	1.60	1.75	2.19	2.63
	16	0.92	1.00	1.17	1.33	1.50	1.67	1.83	2.00	2.50	3.00
	18	1.03	1.13	1.31	1.50	1.69	1.88	2.06	2.25	2.81	3.38
	20	1.15	1.25	1.46	1.67	1.88	2.08	2.29	2.50	3.13	3.75
	22	1.26	1.38	1.60	1.83	2.06	2.29	2.52	2.75	3.44	4.13
	24	1.38	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.75	4.50
	26	1.49	1.63	1.90	2.17	2.44	2.71	2.98	3.25	4.06	4.88
	28	1.60	1.75	2.04	2.33	2.63	2.92	3.21	3.50	4.38	5.25
	30	1.72	1.88	2.19	2.50	2.81	3.13	3.44	3.75	4.69	5.63
	32	1.83	2.00	2.33	2.67	3.00	3.33	3.67	4.00	5.00	6.00
	34	1.95	2.13	2.48	2.83	3.19	3.54	3.90	4.25	5.31	6.38
	36	2.06	2.25	2.63	3.00	3.38	3.75	4.13	4.50	5.63	6.75

NFVA calculations are for vents screened with 1/4" (#4) weave mesh (required on new vents) or 1/8" (#8) weave mesh (found on some existing vents).

- Screens must be clean, and vents must be free of insulation and other obstructions.
- Tight weave (1/16" mesh) insect screen must be replaced on vents included in NFVA calculations.

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7.0 RECTANGULAR GABLE VENTS—1/4" OR 1/8" SCREEN WITH WOOD LOUVERS

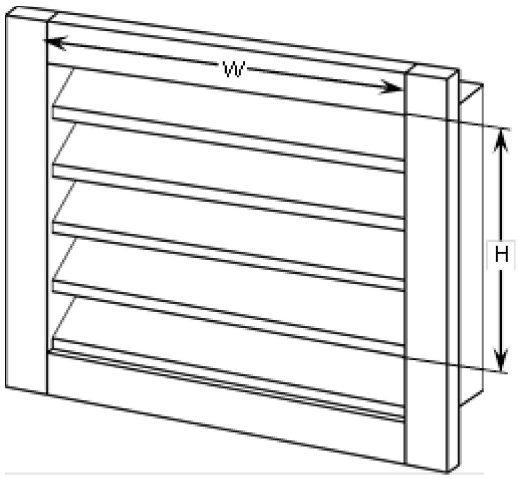

TABLE B-12: RECTANGULAR GABLE VENTS—1/4" OR 1/8" SCREEN WITH WOOD LOUVERS
(Reduction Factor = 0.25)

		Width (Inches)								
		12	**14**	**16**	**18**	**20**	**22**	**24**	**30**	**36**
Height (Inches)	**8**	0.17	0.19	0.22	0.25	0.28	0.31	0.33	0.42	0.50
	10	0.21	0.24	0.28	0.31	0.35	0.38	0.42	0.52	0.63
	12	0.25	0.29	0.33	0.38	0.42	0.46	0.50	0.63	0.75
	14	0.29	0.34	0.39	0.44	0.49	0.53	0.58	0.73	0.88
	16	0.33	0.39	0.44	0.50	0.56	0.61	0.67	0.83	1.00
	18	0.38	0.44	0.50	0.56	0.63	0.69	0.75	0.94	1.13
	20	0.42	0.49	0.56	0.63	0.69	0.76	0.83	1.04	1.25
	22	0.46	0.53	0.61	0.69	0.76	0.84	0.92	1.15	1.38
	24	0.50	0.58	0.67	0.75	0.83	0.92	1.00	1.25	1.50
	26	0.54	0.63	0.72	0.81	0.90	0.99	1.08	1.35	1.63
	28	0.58	0.68	0.78	0.88	0.97	1.07	1.17	1.46	1.75
	30	0.63	0.73	0.83	0.94	1.04	1.15	1.25	1.56	1.88
	32	0.67	0.78	0.89	1.00	1.11	1.22	1.33	1.67	2.00
	34	0.71	0.83	0.94	1.06	1.18	1.30	1.42	1.77	2.13
	36	0.75	0.88	1.00	1.13	1.25	1.38	1.50	1.88	2.25

NFVA calculations are for vents screened with 1/4" (#4) weave mesh (required on new vents) or 1/8" (#8) weave mesh (found on some existing vents).

- Screens must be clean, and vents must be free of insulation and other obstructions.
- Tight weave (1/16" mesh) insect screen must be replaced on vents included in NFVA calculations.

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8.0 TRIANGULAR GABLE VENTS—1/4" OR 1/8" SCREEN WITH METAL LOUVERS

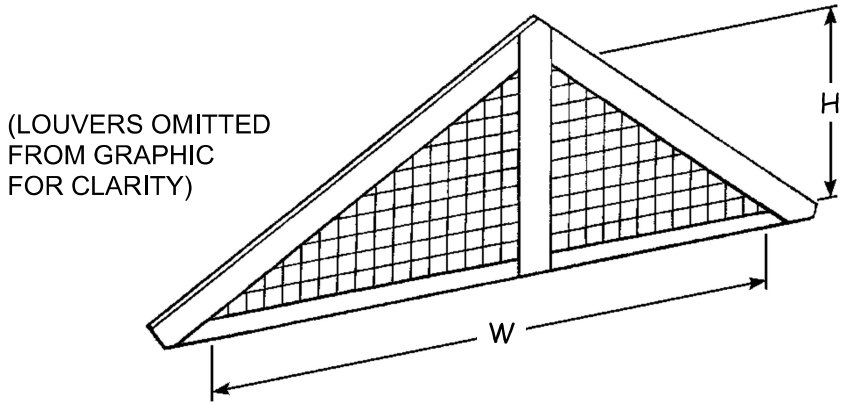

TABLE B-13: TRIANGULAR GABLE VENTS—1/4" OR 1/8" SCREEN WITH METAL LOUVERS
(Reduction Factor = 0.75)

Height (Inches)	Width (Inches)							
	24	**30**	**36**	**42**	**48**	**54**	**60**	**72**
10	0.63	0.78	0.94	1.09	1.25	1.41	1.56	1.88
12	0.75	0.94	1.13	1.31	1.50	1.69	1.88	2.25
14	0.88	1.09	1.31	1.53	1.75	1.97	2.19	2.63
16	1.00	1.25	1.50	1.75	2.00	2.25	2.50	3.00
18	1.13	1.41	1.69	1.97	2.25	2.53	2.81	3.38
20	1.25	1.56	1.88	2.19	2.50	2.81	3.13	3.75
22	1.38	1.72	2.06	2.41	2.75	3.09	3.44	4.13
24	1.50	1.88	2.25	2.63	3.00	3.38	3.75	4.50
26	1.63	2.03	2.44	2.84	3.25	3.66	4.06	4.88
28	1.75	2.19	2.63	3.06	3.50	3.94	4.38	5.25
30	1.88	2.34	2.81	3.28	3.75	4.22	4.69	5.63
32	2.00	2.50	3.00	3.50	4.00	4.50	5.00	6.00
34	2.13	2.66	3.19	3.72	4.25	4.78	5.31	6.38
36	2.25	2.81	3.38	3.94	4.50	5.06	5.63	6.75

NFVA calculations are for vents screened with 1/4" (#4) weave mesh (required on new vents) or 1/8" (#8) weave mesh (found on some existing vents).

- Screens must be clean, and vents must be free of insulation and other obstructions.
- Tight weave (1/16" mesh) insect screen must be replaced on vents included in NFVA calculations.

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9.0 TRIANGULAR GABLE VENTS—1/4" OR 1/8" SCREEN WITH WOOD LOUVERS

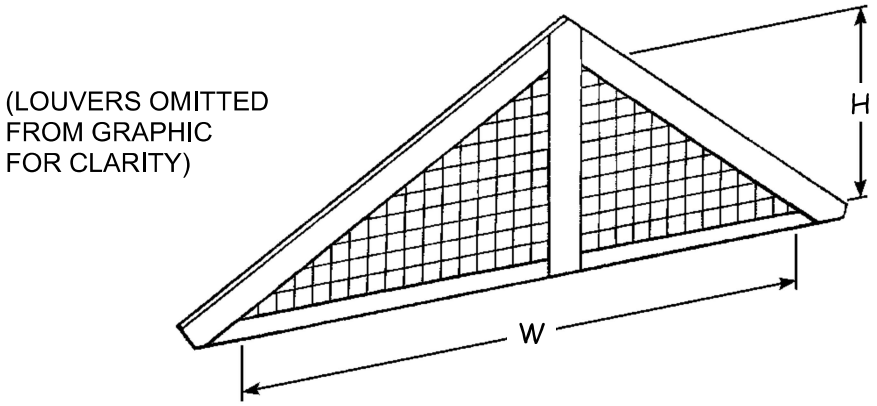

TABLE B-14: TRIANGULAR GABLE VENTS—1/4" OR 1/8" SCREEN WITH WOOD LOUVERS
(Reduction Factor = 0.25)

		Width (Inches)							
		24	**30**	**36**	**42**	**48**	**54**	**60**	**72**
Height (Inches)	**10**	0.21	0.26	0.31	0.36	0.42	0.47	0.52	0.63
	12	0.25	0.31	0.38	0.44	0.50	0.56	0.63	0.75
	14	0.29	0.36	0.44	0.51	0.58	0.66	0.73	0.88
	16	0.33	0.42	0.50	0.58	0.67	0.75	0.83	1.00
	18	0.38	0.47	0.56	0.66	0.75	0.84	0.94	1.13
	20	0.42	0.52	0.63	0.73	0.83	0.94	1.04	1.25
	22	0.46	0.57	0.69	0.80	0.92	1.03	1.15	1.38
	24	0.50	0.63	0.75	0.88	1.00	1.13	1.25	1.50
	26	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.63
	28	0.58	0.73	0.88	1.02	1.17	1.31	1.46	1.75
	30	0.63	0.78	0.94	1.09	1.25	1.41	1.56	1.88
	32	0.67	0.83	1.00	1.17	1.33	1.50	1.67	2.00
	34	0.71	0.89	1.06	1.24	1.42	1.59	1.77	2.13
	36	0.75	0.94	1.13	1.31	1.50	1.69	1.88	2.25

NFVA calculations are for vents screened with 1/4" (#4) weave mesh (required on new vents) or 1/8" (#8) weave mesh (found on some existing vents).

- Screens must be clean, and vents must be free of insulation and other obstructions.
- Tight weave (1/16" mesh) insect screen must be replaced on vents included in NFVA calculations.

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10.0 SOFFIT VENTS—1/4" OR 1/8" SCREEN WITH METAL LOUVERS

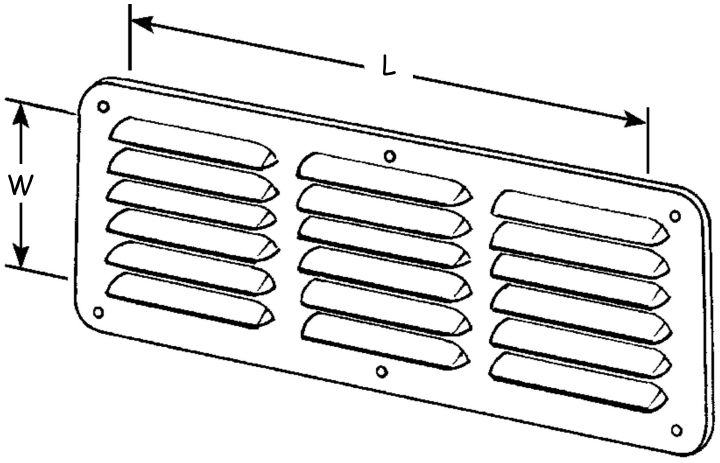

TABLE B-15: SOFFIT VENTS—1/4" OR 1/8" SCREEN WITH METAL LOUVERS
(Reduction Factor = 0.75)

		Length (Inches)								
		10	**12**	**14**	**15**	**16**	**18**	**20**	**22**	**24**
Height (Inches)	**2**	0.10	0.13	0.15	0.16	0.17	0.19	0.21	0.23	0.25
	3	0.16	0.19	0.22	0.23	0.25	0.28	0.31	0.34	0.38
	3.5	0.18	0.22	0.26	0.27	0.29	0.33	0.36	0.40	0.44
	4	0.21	0.25	0.29	0.31	0.33	0.38	0.42	0.46	0.50
	4.5	0.23	0.28	0.33	0.35	0.38	0.42	0.47	0.52	0.56
	5	0.26	0.31	0.36	0.39	0.42	0.47	0.52	0.57	0.63
	6	0.31	0.38	0.44	0.47	0.50	0.56	0.63	0.69	0.75
	8	0.42	0.50	0.58	0.63	0.67	0.75	0.83	0.92	1.00
	10	0.52	0.63	0.73	0.78	0.83	0.94	1.04	1.15	1.25

NFVA calculations are for vents screened with 1/4" (#4) weave mesh (required on new vents) or 1/8" (#8) weave mesh (found on some existing vents).

- Screens must be clean, and vents must be free of insulation and other obstructions.
- Tight weave (1/16" mesh) insect screen must be replaced on vents included in NFVA calculations.

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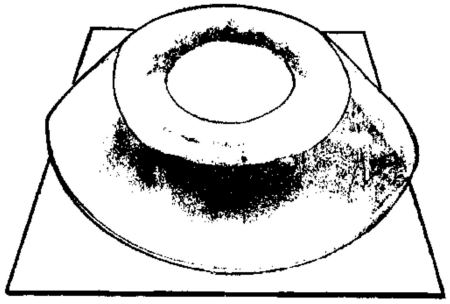
11.0 MUSHROOM VENTS—1/4" AND 1/8" SCREEN



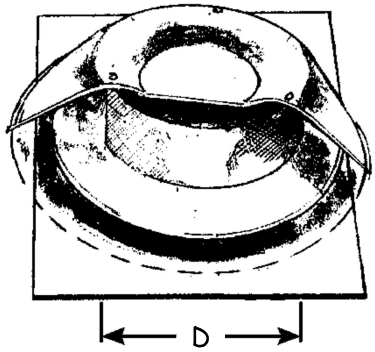


TABLE B-16: MUSHROOM VENTS—1/4" SCREEN
(Reduction Factor = 0.90)

	Diameter (Inches)									
	6	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Sq. Ft. NFVA	0.18	0.24	0.31	0.40	0.49	0.59	0.71	0.83	0.96	1.10

NFVA calculations are for vents screened with 1/4" (#4) weave mesh (required on new vents).

TABLE B-17: MUSHROOM VENTS—1/8" SCREEN
(Reduction Factor = 0.75)

	Diameter (Inches)									
	6	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Sq. Ft. NFVA	0.15	0.20	0.26	0.33	0.41	0.49	0.59	0.69	0.80	0.92

NFVA calculations are for vents screened with 1/8" (#8) weave mesh (found on some existing vents).

- Screens must be clean, and vents must be free of insulation and other obstructions.
- Tight weave (1/16" mesh) insect screen must be replaced on vents included in NFVA calculations.

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12.0 HOOD VENTS & ROOF JACKS—1/4" AND 1/8" SCREEN

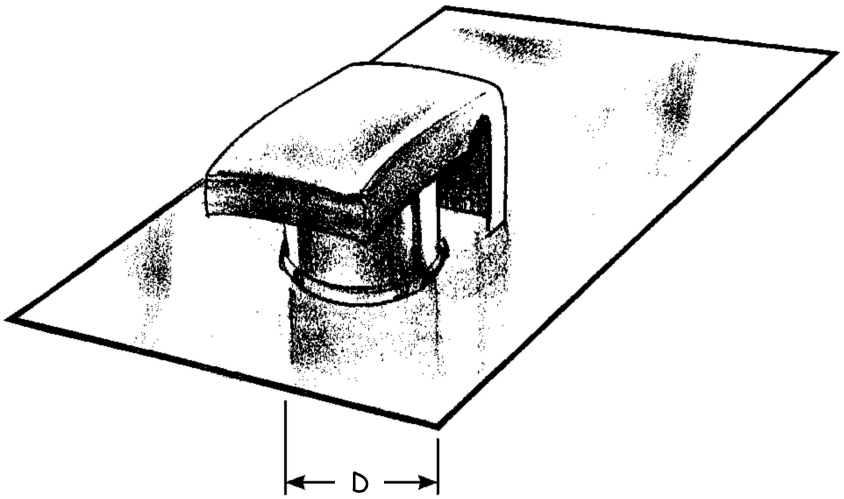

TABLE B-18: HOOD VENTS & ROOF JACKS—1/4" SCREEN
(Reduction Factor =0.90)

	Diameter (Inches)									
	6	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Sq. Ft. NFVA	0.18	0.24	0.31	0.40	0.49	0.59	0.71	0.83	0.96	1.10

NFVA calculations are for vents screened with 1/4" (#4) weave mesh (required on new vents).

TABLE B-19: HOOD VENTS & ROOF JACKS—1/8" SCREEN
(Reduction Factor =0.75)

	Diameter (Inches)									
	6	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Sq. Ft. NFVA	0.15	0.20	0.26	0.33	0.41	0.49	0.59	0.69	0.80	0.92

NFVA calculations are for vents screened with 1/8" (#8) weave mesh (found on some existing vents).

- Screens/louvers must be clean, and vents must be free of insulation and other obstructions.
- Tight weave (1/16" mesh) insect screen must be replaced on vents included in NFVA calculations.

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13.0 EYEBROW VENTS

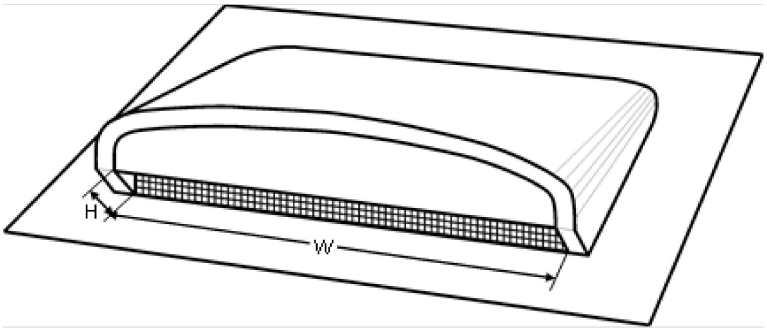

TABLE B-20: EYEBROW VENTS—1/4" SCREEN, NO LOUVERS
(Reduction Factor = 0.90)

		Width (Inches)							
		10	**12**	**14**	**15**	**16**	**18**	**20**	**22**
Height (Inches)	**3**	0.19	0.23	0.26	0.28	0.30	0.34	0.38	0.41
	5	0.31	0.38	0.44	0.47	0.50	0.56	0.63	0.69
	6	0.38	0.45	0.53	0.56	0.60	0.68	0.75	0.83
	7	0.44	0.53	0.61	0.66	0.70	0.79	0.88	0.96
	7.5	0.47	0.56	0.66	0.70	0.75	0.84	0.94	1.03
	8	0.50	0.60	0.70	0.75	0.80	0.90	1.00	1.10
	8.5	0.53	0.64	0.74	0.80	0.85	0.96	1.06	1.17
	9	0.56	0.68	0.79	0.84	0.90	1.01	1.13	1.24

NFVA calculations are for vents screened with 1/4" (#4) weave mesh (required on new vents).

TABLE B-21: EYEBROW VENTS—1/4" OR 1/8" SCREEN, NO LOUVERS
(Reduction Factor = 0.75)

		Width (Inches)							
		10	**12**	**14**	**15**	**16**	**18**	**20**	**22**
Height (Inches)	**3**	0.16	0.19	0.22	0.23	0.25	0.28	0.31	0.34
	5	0.26	0.31	0.36	0.39	0.42	0.47	0.52	0.57
	6	0.31	0.38	0.44	0.47	0.50	0.56	0.63	0.69
	7	0.36	0.44	0.51	0.55	0.58	0.66	0.73	0.80
	7.5	0.39	0.47	0.55	0.59	0.63	0.70	0.78	0.86
	8	0.42	0.50	0.58	0.63	0.67	0.75	0.83	0.92
	8.5	0.44	0.53	0.62	0.66	0.71	0.80	0.89	0.97
	9	0.47	0.56	0.66	0.70	0.75	0.84	0.94	1.03

NFVA calculations are for vents screened with 1/4" (#4) weave mesh (required on new vents) or 1/8" (#8) weave mesh (found on some existing vents).

- Screens must be clean, and vents must be free of insulation and other obstructions.
- Tight weave (1/16" mesh) insect screen must be replaced on vents included in NFVA calculations.

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14.0 DORMER VENTS—1/4" OR 1/8" SCREEN WITH METAL LOUVERS

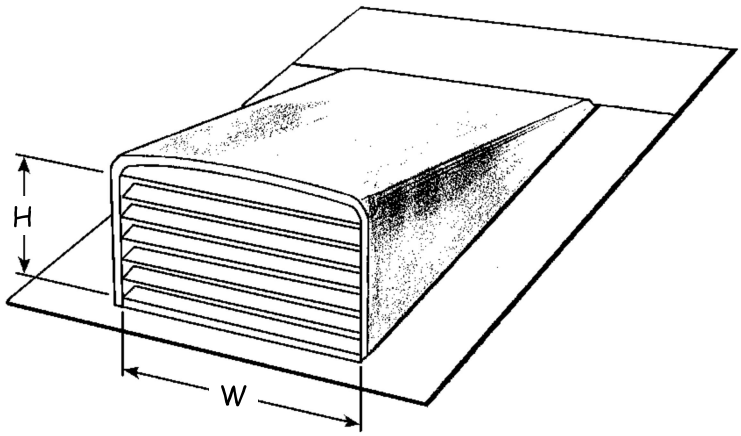

TABLE B-22: DORMER VENTS—1/4" OR 1/8" SCREEN WITH METAL LOUVERS
(Reduction Factor =0.75)

		Width (Inches)							
		10	**12**	**14**	**15**	**16**	**18**	**20**	**22**
Height (Inches)	**5**	0.26	0.31	0.36	0.39	0.42	0.47	0.52	0.57
	6	0.31	0.38	0.44	0.47	0.50	0.56	0.63	0.69
	7	0.36	0.44	0.51	0.55	0.58	0.66	0.73	0.80
	7.5	0.39	0.47	0.55	0.59	0.63	0.70	0.78	0.86
	8	0.42	0.50	0.58	0.63	0.67	0.75	0.83	0.92
	8.5	0.44	0.53	0.62	0.66	0.71	0.80	0.89	0.97
	9	0.47	0.56	0.66	0.70	0.75	0.84	0.94	1.03

NFVA calculations are for vents screened with 1/4" (#4) weave mesh (required on new vents) or 1/8" (#8) weave mesh (found on some existing vents).

- Screens must be clean, and vents must be free of insulation and other obstructions.
- Tight weave (1/16" mesh) insect screen must be replaced on vents included in NFVA calculations

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15.0 ROOF RIDGE VENT

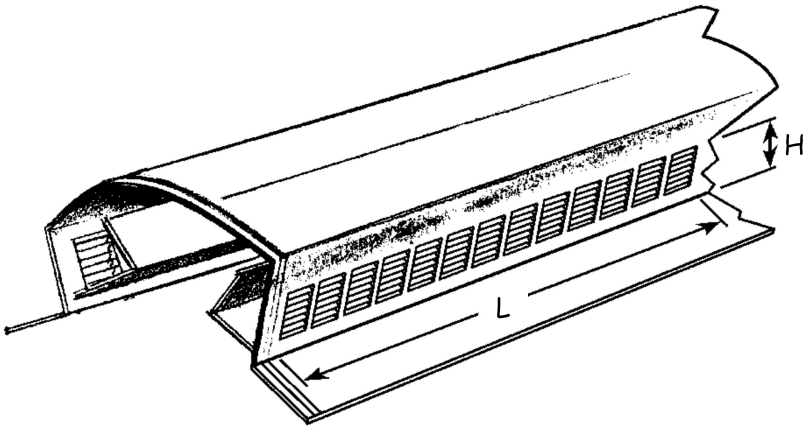

TABLE B-23: ROOF RIDGE VENT WITH LOUVERS
(Reduction Factor = 0.50)

		Length (Inches)								
		12	**120**	**144**	**168**	**192**	**216**	**240**	**264**	**288**
Height (Inches)	**1**	0.04	0.42	0.50	0.58	0.67	0.75	0.83	0.92	1.00
	1.5	0.06	0.63	0.75	0.88	1.00	1.13	1.25	1.38	1.50
	2	0.08	0.83	1.00	1.17	1.33	1.50	1.67	1.83	2.00
	2.5	0.10	1.04	1.25	1.46	1.67	1.88	2.08	2.29	2.50
	3	0.13	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00
	3.5	0.15	1.46	1.75	2.04	2.33	2.63	2.92	3.21	3.50

Several styles of ridge vent exist, each with different NFVA specifications. Use the actual product manufacturer's NFVA specifications when available. When possible, measure the openings and apply reduction factor 0.50. The last option is to use the above table only when the manufacturer's NFVA specifications are not available.

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APPENDIX -C-

GROUNDING GUIDELINES
FOR
ELECTRIC MEASURES

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1.0 Introduction 1

2.0 Installation of a Retrofit Ground Wire 1

3.0 Installation of a GCFI Receptacle or Switch 3

APPENDIX -C-

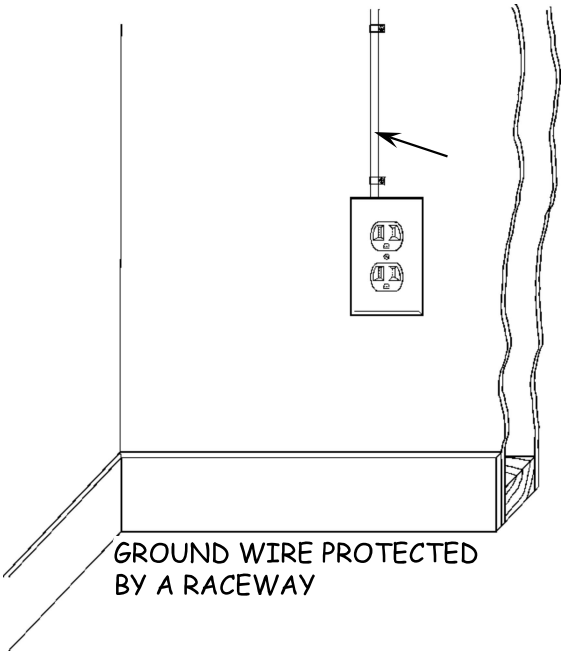
GROUNDING GUIDELINES FOR ELECTRIC MEASURES

1.0 INTRODUCTION

1. Purpose: This appendix provides guidelines for electrically protecting a receptacle or switch in a home with an ungrounded two-wire system. Options addressed are installation of a:
   - Retrofit ground wire, or
   - GFCI receptacle or switch.
2. Caveat:
   - These are basic guidelines. Detailed criteria may be found in the CEC.
   - Each installer is responsible for adhering to program policies and all requirements of the local jurisdiction, including acquisition of a permit when required.
3. Definitions:
   - Ground wire (also called the equipment ground wire): The wire (typically 12 AWG) that provides grounding to a receptacle, switch, or metal box.
   - Grounding electrode conductor **(GEC)**: A wire (typically 6 AWG) that extends from the service entrance ground rod to:
     - the main service panel grounding terminal bar, or
     - another location where grounding is needed.

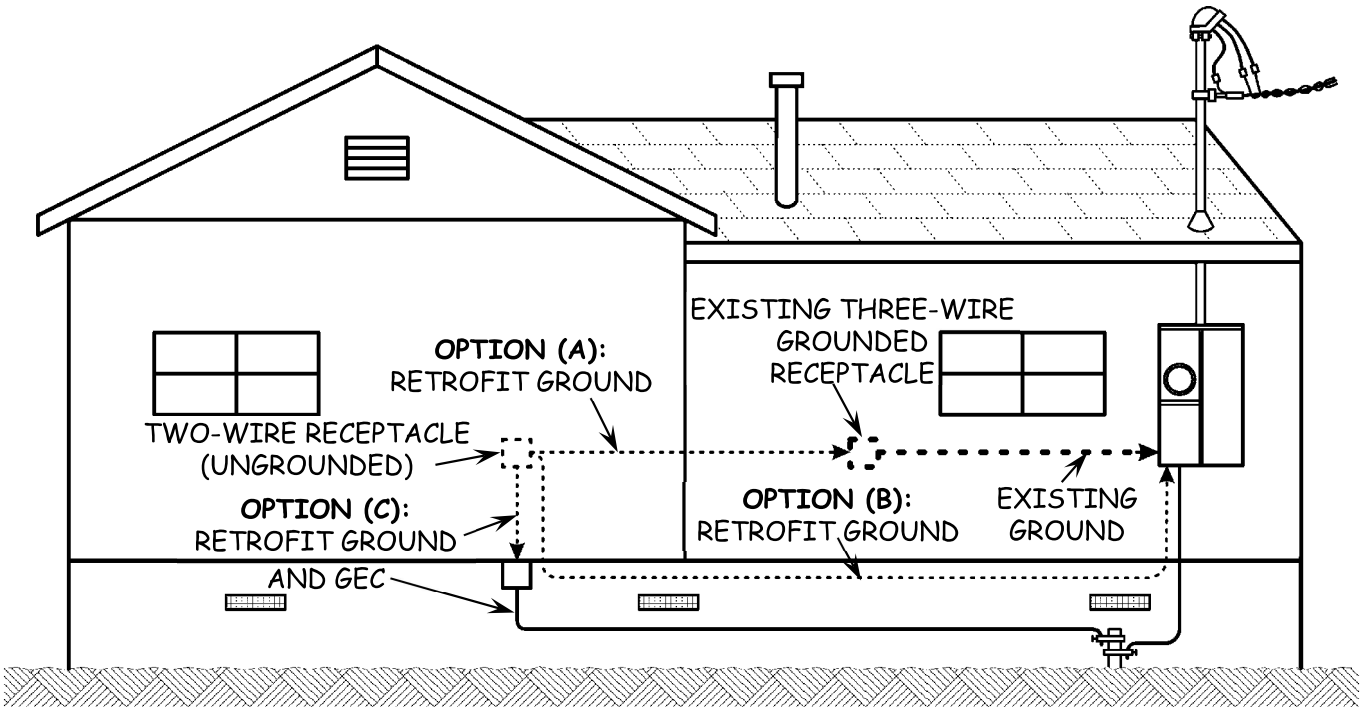
2.0 INSTALLATION OF A RETROFIT GROUND WIRE

1. Purpose: To install a retrofit ground wire that provides electrical protection for an ungrounded receptacle or switch, in a home with a two-wire ungrounded system.
2. Grounding sources: Grounding can be provided to an ungrounded receptacle or switch by connecting a ground wire from it to either of the following:
   - *Existing ground:* An existing three-wire grounded receptacle elsewhere in the structure, or the main service grounding system.
   - *Retrofit electrode conductor:* A retrofit grounding electrode conductor (GEC) connected to the main service grounding system (e.g., the ground rod).
3. Ground Wire Requirements
   - Wire: Must be a copper conductor meeting the following requirements.
     - Minimum 12 AWG for 20-amp circuits.
     - When insulated, colored green or green with one or more yellow stripes.
   - Protection: Where exposed, the ground wire must be secured and protected as needed to avoid damage, and to safeguard the occupants.
     - Indoors: Wires must be enclosed in a raceway.
     - Outdoors: Wires must be enclosed in a conduit or cable armor.
     - Attic or crawlspace: Wires that run across the joists must be run either through bored holes in the joists or on running boards.



4. GEC: When a GEC is installed, it must meet the following requirements:
    1. Size: Minimum 6 AWG, or as required by local code, properly clamped/bonded to ground at the main service (e.g., clamped to the ground rod).
    2. Splices: Any splices in the GEC must be secured with an irreversible compression-type connector or exothermic weld.
    3. Protection: The GEC must be protected.
        a. Where physical damage is not likely, the GEC may be securely fastened to the building.
        b. Where physical damage is likely, the GEC must be enclosed in a rigid metal or nonmetallic conduit, or encased in cable armor.

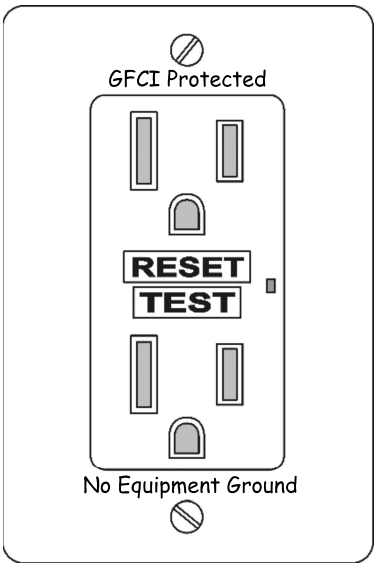
5. Grounding options: An ungrounded receptacle or switch may be grounded by connecting a ground wire (typically 12 AWG) from it to a grounding source.[1] Options include the following:
    1. Option A: Connect to an existing grounded receptacle in another part of the building:
        a. Applies when a three-wire grounded receptacle is available elsewhere in the home.
        b. Run a ground wire from the ungrounded receptacle/switch to the existing three-wire grounded receptacle.
    2. Option B: Connect to the grounding system at the main service panel:
        a. Applies when a ground wire can be routed without direct exposure to occupants or outdoors (e.g., in the crawlspace, wall, or attic).
        b. Run a ground wire (conduit not required) from the ungrounded receptacle/switch to the main panel grounding system.
    3. Option C: Connect to an existing ground rod in the home's grounding system:
        a. From the main service ground rod, run a retrofit GEC to a junction box near the ungrounded receptacle/switch.
        b. Run a ground wire from the ungrounded receptacle/switch to the GEC junction box, and connect it to the GEC inside.



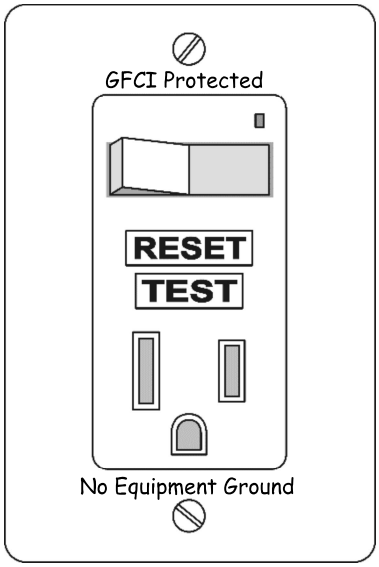
[1] Ground wire exposed in the living space must be in a raceway. Ground wire in the crawlspace or attic does not need to be in a conduit, unless required by local code.

3.0 INSTALLATION OF A GCFI RECEPTACLE OR SWITCH

1. Purpose: To install a GFCI unit, rather than a ground wire, to provide electrical protection for an ungrounded receptacle or switch, in a home with a two-wire ungrounded system.
2. The GFCI Alternative:
    1. Installation of a GFCI unit is an acceptable alternative for protecting an ungrounded receptacle or switch.
    2. This method may be used when installation of a retrofit ground wire is not a good option.
3. GFCI Installation:
    1. Receptacle—For a plug-in appliance (except refrigerator):
        a. A GFCI receptacle may be connected to an ungrounded two-wire circuit.
        b. Wires bringing power to the receptacle must be connected to the "line" terminals.
        c. When present, wires leaving the GFCI receptacle to provide power down-line must be connected to the "load" terminals.
        d. No wire is connected to the ground lug on the GFCI receptacle.
    2. Switch—For a switched fixture:
        a. A GFCI-protected switch may be connected to an ungrounded two-wire circuit.
        b. Wires bringing power to the unit must be connected to the "line" terminals.
        c. When present, wires leaving the unit to provide power down-line must be connected to the "load" terminals.
        d. No wire is connected to the ground lug on the GFCI-protected switch.
    3. All units
        a. Installation shall be in conformance with manufacturer's instructions and local code.
        b. When a GFCI receptacle or GFCI-protected switch is installed where a ground wire is not present, the cover plate shall be labeled "GFCI Protected" and "No Equipment Ground."
4. GFCI Limitation: GFCI protection may <u>not</u> be used for a circuit powering a <u>refrigerator</u>.



GFCI RECEPTACLE



GFCI-PROTECTED
LIGHT SWITCH

APPENDIX -D-

METHODS FOR DETERMINING AIRFLOW

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APPENDIX -D-
METHODS FOR DETERMINING AIRFLOW

PART 1: INTRODUCTION

1.0 METHODS FOR ESTIMATING AIRFLOW

1.1 A/C or Heat Pump (Tons)

- AC/HP unit capacity may be determined by the following methods using information obtained from the condenser nameplate:
  - Method A: The Preston Guide or Carrier Blue Book
  - Method B: Model number nomenclature
  - Method C: Floor area default

1.2 Gas Furnace (kBtuh Output[1])—Sec. 4

- Heating system capacity
  - Method A: Btuh output of gas furnace from the nameplate
  - Method B: Btuh output of gas furnace from clocking the meter
  - Method C: Floor area default

1.3 Combination Heating and A/C

1. Airflow CFM is estimated for both (A) the A/C based on tons, and (b) the furnace based on Btuh output, and
2. The greater of the two is the estimated system airflow.

1.4 Electric Furnace—Sec. 5

- Furnace capacity
  - Method A: Nominal air delivery on nameplate/label
  - Method B: Heating capacity on nameplate/label
  - Method C: Model number nomenclature

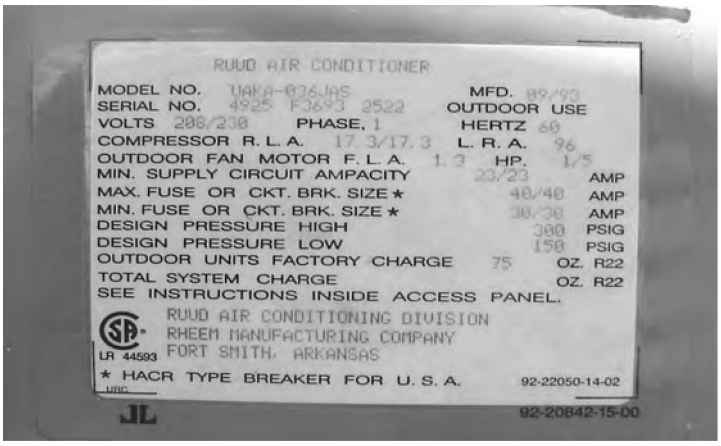
2.0 METHODS FOR MEASURING AIRFLOW

2.1 All FAUs—Part 5

1. Flow grid measurement
2. Plenum pressure matching measurement
3. Powered flow capture hood
4. Traditional flow capture hood measurement

2.2 Airflow Measurement

1. System fan shall be operated at the cooling speed when A/C is present.
2. Airflow shall be measured at the return grille(s).



EXAMPLE OF A CONDENSER NAMEPLATE

[1]Btu = British thermal unit; "Btuh" = Btu per hour; "kBtuh" = Thousand Btuh.

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PART 2: ESTIMATING AIRFLOW—HEATING AND A/C

3.0 A/C AND HEAT PUMP UNITS

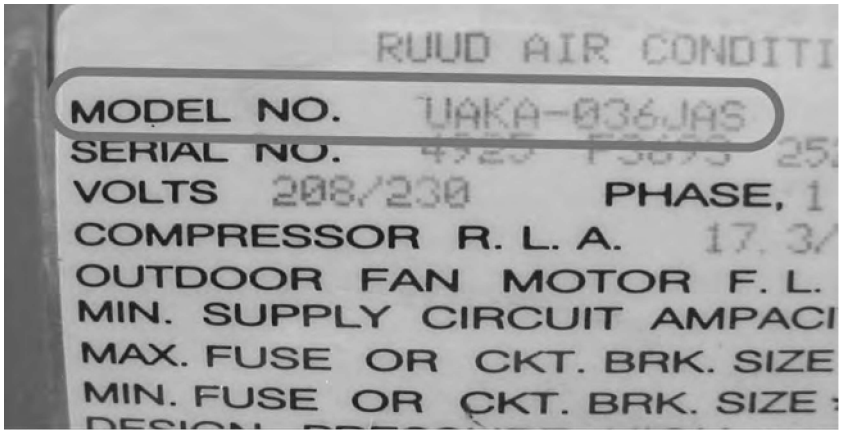
3.1 Table D-1

1. Table D-1 may be used to:
   a. Convert known or calculated Btu or tons to nominal tons[2], and
   b. Transform nominal tons into estimated CFM (system airflow).
2. For units outside the range of Table D-1, do the following:
   a. Use calculations shown below in steps A-3 and B-2, and
   b. Round tons to the nearest whole or half ton.

3.2 Method A—Preston Guide or Carrier Bluebook

1. **Step A-1:** Determine the model number and date of manufacture from the condenser name-plate.

NAMEPLATE SHOWS MODEL NUMBER TO BE "UAKA-036JAS"



NAMEPLATE SHOWS DATE OF MANUFACTURE TO BE "09/93"

[2] Nominal = In name only. A/C "nominal tons" is stated as the nearest whole or half ton. (See Table D-1.)

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2. **Step A-2:** Check the Preston Guide (or Carrier Bluebook) to determine cooling capacity of the unit based on model number and date of manufacture. In the sample Preston Guide page below, find:
   a. Model number = UAKA-036JA
   b. Year manufactured = 1993
   c. Cooling capacity = 34,400 Btu (34.4 kBtu).

Preston Guide

RUUD

YEAR	BTU	EER/ SEER
1987	36,600	9.7
UAHD-042JA		
1986	39,500	9.5
1987	39,500	9.5
UAHD-048JA		
1986	47,500	9.1
1987	47,500	9.1
UAHD-060JA		
1986	54,000	9.1
1987	54,000	9.1
UAHE-018JA		
1988	18,000	11.3
1989	18,000	11.3
UAHE-019JA		
1990	17,400	11.0
1991	17,400	11.0
1992	17,400	11.0
1993	17,400	11.0
UAHE-023JA		
1992	24,200	10.7
1993	24,200	10.7
UAHE-024JA		
1988	23,000	9.2
1989	23,000	9.2
UAHE-025JA		
1990	22,200	9.7
1991	22,200	9.7
1992	22,200	8.7
UAHE-030JA		
1988	30,800	11.0
1989	30,800	11.0
1990	30,800	11.0
1991	30,800	11.0
1992	30,800	11.0
1993	30,400	10.3
UAHE-036CA		
1988	35,000	9.5
1989	35,000	9.5
1990	35,000	10.5
1991	35,000	10.5
1992	35,000	10.5
1993	35,000	10.5
UAHE-036DA		
1992	35,000	10.5
1993	35,000	10.5
UAHE-036JA		
1988	35,000	10.5
1989	35,000	10.3
1990	35,000	10.5
1991	35,000	10.5
1993	35,000	10.5
UAHE-042CA		
1988	41,500	10.1
1989	41,500	10.1
1990	41,500	10.7
1991	41,500	10.7
1992	41,500	10.7
1993	41,500	10.7
UAHE-042DA		
1992	41,500	10.7
1993	41,500	10.7
UAHE-042JA		
1988	41,500	10.7
1989	41,500	10.3
1990	41,500	10.7
1991	41,500	10.7
1992	41,500	10.7
1993	41,500	10.7
UAHE-048CA		
1988	45,000	9.5
1989	45,000	9.5
1990	45,000	10.8
1991	45,000	10.8
1992	45,000	10.8
1993	45,000	10.8
UAHE-048DA		
1988	45,000	9.5
1989	45,000	9.5
1990	45,000	10.8
1991	45,000	10.8
1992	45,000	10.8
1993	45,000	10.8
UAHE-048JA		
1988	45,000	10.8
1989	45,000	10.8
1990	45,000	10.8
1991	45,000	10.8
1992	45,000	10.8
1993	45,000	10.8
UAHE-060CA		
1988	56,500	9.4
1989	56,500	9.4
1990	56,500	10.0
1991	56,500	10.0
1992	56,500	10.0
1993	56,500	10.0
UAHE-060DA		
1988	56,500	
1989	56,500	
1990	56,500	10.0
1991	56,500	10.0
1992	56,500	10.0
1993	56,500	10.0
UAHE-060JA		
1988	56,500	10.0
1989	56,500	10.0
1990	56,500	10.0
1991	56,500	10.0
1992	56,500	10.0
1993	56,500	10.0
UAHE-060YA		
1993	59,500	10.0
UAJA-024JA		
1989	22,000	9.9
1992	22,000	9.9
UAJA-030JA		
1988	30,200	12.3
1989	30,200	12.3
UAJA-036JA		
1988	35,000	12.1
UAJA-042JA		
1988	42,000	12.4
1989	42,000	12.4
UAJB-018JA		
1993	18,600	10.5
UAJB-024JA		
1990	23,200	9.9
1991	23,200	9.9
1992	23,600	11.4
1993	23,600	11.4
UAJB-030JA		
1990	30,200	12.3
1991	30,200	12.3
1992	30,200	12.3
1993	29,400	11.5
UAJB-036JA		
1990	35,000	12.1
1991	35,000	12.1
1992	35,000	12.1
1993	35,000	12.1
UAJB-042JA		
1990	42,000	12.4
1991	42,000	12.4
1992	42,000	12.4
1993	41,500	11.7
UAJB-048JA		
1993	43,500	12.0
UAJB-060JA		
1993	56,500	10.6
UAJC-018JA		
1993	18,600	10.5
UAJC-024JA		
1992	23,600	11.4
1993	23,600	11.4
UAJC-030JA		
1992	30,200	12.3
1993	29,400	11.5
UAJC-036JA		
1992	35,000	12.1
1993	35,000	12.1
UAJC-042JA		
1992	42,000	12.4
1993	41,500	11.7
UAJC-048JA		
1993	43,500	12.0
UAJC-060JA		
1993	56,500	10.6
UAKA-018JA		
1993	16,700	10.6
UAKA-024JA		
1993	23,000	10.3
UAKA-030JA		
1993	29,200	10.5
UAKA-036CA		
1993	[illegible]	
UAKA-036DA		
1993	34,400	10.5
UAKA-036JA		
1993	34,400	10.5
UAKA-042CA		
1993	42,000	10.5
UAKA-042JA		
1993	42,000	10.5
UAKA-048CA		
1993	46,500	10.7
UAKA-048DA		
1993	46,500	10.7
UAKA-048JA		
1993	46,500	10.7
UAKA-060CA		
1993	54,500	10.0
UAKA-060DA		
1993	54,500	10.0
UAKA-060JA		
1993	54,500	10.0
UALA-018JA		
1992	18,600	11.7
1993	17,900	10.4
UALA-024JA		
1992	23,000	11.7
1993	21,600	11.2
UALA-030JA		
1992	30,200	10.4
1993	29,800	10.5
UALA-036JA		
1992	36,400	11.1
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UALA-042JA		
1992	39,500	11.3
1993	39,500	11.3
UALA-048JA		
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1993	47,500	11.3
UALA-060JA		
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1993	57,500	11.0
UALB-018JA		
1993	18,000	10.4
UALB-024JA		
1993	23,400	11.2
UALB-030JA		
1993	29,200	11.0
UALB-036JA		
1993	35,000	10.7
UALB-042JA		
1993	41,000	11.3
UALB-048JA		
1993	45,500	11.1
UALB-060JA		
1993	56,500	10.6
UAMA-018JA		
1993	19,600	12.4
UAMA-018JB		
1993	19,600	12.4
UAMA-024JA		
1993	21,400	11.0
UAMA-024JB		
1993	21,400	11.0
UAMA-030JA		
1993	30,200	12.4
UAMA-030JB		
1993	30,200	12.4
UAMA-036JA		
1993	35,600	12.4
UAMA-036JB		
1993	35,600	12.4
UAMA-042JA		
1993	42,000	12.4
UAMA-042JB		
1993	42,000	12.4
UAMA-048JA		
1993	47,000	12.4
UAMA-048JB		
1993	[illegible]	12.4
UAMA-060JA		
1993	56,000	12.4
UAMA-060JB		
1993	[illegible]	12.4
UANA-018JA		
1993	18,600	12.2
UANA-[illegible]		
1993	[illegible]	12.1
UANA-030JA		
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UANA-036JA		
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UANA-042JA		
1993	41,500	11.7
UANA-048JA		
1993	48,000	11.7
UANA-060JA		
1993	51,000	11.9
UAWB-075CAS		
1986	90,000	8.2
1987	90,000	8.2
1988	90,000	8.2
1989	90,000	8.2
1990	90,000	8.2
1991	90,000	8.2
1992	90,000	8.2
UAWB-075DAS		
1986	90,000	8.2
1987	90,000	8.2
1988	90,000	8.2
1989	90,000	8.2
1990	90,000	8.2
1991	90,000	8.2
1992	90,000	8.2
UAWB-100CAS		
1986	119,000	8.2
1987	119,000	8.2
1988	119,000	8.2
1989	119,000	8.2
1990	119,000	8.2
1991	119,000	8.2
1992	119,000	8.2
UAWB-100DAS		
1986	119,000	8.2
1987	119,000	8.2
1988	119,000	8.2
1989	119,000	8.2
1990	119,000	8.2
1991	119,000	8.2
1992	119,000	8.2
UAWC-065CAS		
1993	76,000	10.0
UAWC-065DAS		
1993	76,000	10.0
UAWC-075CAS		
1992	89,000	9.4
1993	89,000	9.4
UAWC-075DAS		
1992	89,000	9.4
1993	89,000	9.4
UAWC-100CAS		
1992	124,000	8.9
1993	124,000	8.9
UAWC-100DAS		
1992	124,000	8.9
1993	124,000	8.9
UAWC-101CAS		
1993	115,000	9.0
UAWC-101DAS		
1993	115,000	9.0
UCAB-030JA		
1983	29,600	8.0
UCAB-042JA		
1983	41,000	8.0
RCUY-A-CB		
UAAZ-018AA		
1981	17,200	6.1
UAAZ-024AA		
1981	21,200	6.3
UAAZ-028AA		
1981	26,600	6.4
UACA-018AA		
1981	17,900	6.2
UACA-018BA		
1981	17,900	6.8
UACA-024BA		
1981	23,800	6.7
UACA-030AA		
1981	28,000	6.4
UACA-[illegible]		
198[illegible]		
UACB-[illegible]		
198[illegible]		
UACH-[illegible]		
198[illegible]		
UACB-[illegible]		
198[illegible]		
UACC-[illegible]		
1985	12,000	7.8
1986	12,000	7.8
1987	[illegible]	
1988	[illegible]	
1989	[illegible]	
UACC-0[illegible]		
1985	[illegible]	
1986	[illegible]	
1987	[illegible]	
1988	[illegible]	
1989	[illegible]	
1990	[illegible]	
1991	[illegible]	
1992	12,000	8.3
UACC-018JA		
1985	16,900	7.9
1986	16,900	7.9
1987	16,900	7.9
1988	16,900	7.9
1989	16,900	7.9
1990	16,900	7.9
1991	16,900	7.9
1992	16,900	7.9
UACC-018JB		
1985	16,900	8.4
1986	16,900	8.4
1987	16,900	8.4
1988	16,900	8.4
1989	16,900	8.4
1990	16,900	8.4
1991	16,900	8.4
1992	16,900	8.4
UACC-024JA		
1985	22,800	7.7
1986	22,800	7.7
1987	22,800	7.7
1988	22,800	7.7
1989	22,800	7.7
1990	22,800	7.7
1991	22,800	7.7
1992	22,800	7.7
UACC-024JB		
1985	22,800	8.2
1986	22,800	8.2
1987	22,800	8.2
1988	22,800	8.2
1989	22,800	8.2

UAKA-036DA
1993 34,400 10.5

UAKA-036JA
1993 34,400 10.5

UAKA-042CA
1993 42,000 10.5

DATA FROM THE PRESTON GUIDE SHOWS YEAR OF MANUFACTURE IS 1993 AND COOLING CAPACITY IS 34,000 BTU

Efficiency Ratings not available.

The 1994 BlueBook™ • 381

3. **Step A-3:** Calculate cooling capacity in tons based on kBtu.
   a. Per the Preston Guide, unit cooling capacity = 34,400 Btu.
   b. Use Table D-1: 34,400 Btu fits on Line 4; nominal tons = **3 tons** and estimated system airflow = **1,200 CFM** or
   c. Using Equation D-1, divide unit capacity by 12,000 Btu/ton to convert Btu to tons:
      - (34,400 Btu) ÷ (12,000 Btu/ton) = **2.87 tons**
   d. Establish tons of cooling capacity:
      - 2.87 tons fits on Line 4 of Table D-1;
      - Nominal tons = **3 tons**, so estimated system airflow is **1,200 CFM** (3 tons x 400 CFM/ton = 1,200 CFM).

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Equation D-1	$\frac{\textbf{Btu}\ (\text{Unit Capacity})}{\textbf{12,000}\ (\text{Btu/Ton})} = \textbf{Tons}^{3}$

3.3 Method B—Model Number Nomenclature

Use this method when kBtu can be determined from the model number.

1. **Step B-1:** Locate model number on the condenser name plate.
   a. For example, using the nameplate pictured on pages D-1 and D-2, the model number is "UAKA-**036**JAS."
   b. For kBtu, look for a three-digit number beginning with zero (i.e., 036).
   c. 36 indicates unit capacity in kBtu, which is 36 kBtu or 36,000 Btu.
2. **Step B-2:** Determine nominal tons and estimated system airflow.
   a. Use Table D-1: 36,000 Btu capacity fits on Line 4; nominal tons = **3 tons**, and estimated system airflow is **1,200 CFM** or
   b. Use Equation D-1: Divide unit Btu capacity by 12,000 Btu/ton to convert to tons.
      - (36,000 Btu) ÷ (12,000 Btu/ton) = **3 tons** [Simplified: 36 ÷ 12 = 3].
      - 3 tons fits on Line 4, so nominal tons = 3 tons and estimated system airflow is **1,200 CFM** (3 tons x 400 CFM/ton = 1,200 CFM).

TABLE D-1: NOMINAL TONS AND CFM BASED ON CALCULATED TONS

Line	Unit Capacity (Btu)	Calculated Tons[3]	Nominal Tons[4]	Estimated CFM[3]
1	**14,000–21,999**	1.17–1.82	**1.5**	**600**
2	**22,000–26,999**	1.83–2.24	**2.0**	**800**
3	**27,000–32,999**	2.25–2.74	**2.5**	**1,000**
4	**33,000–38,999**	2.75–3.24	**3.0**	**1,200**
5	**39,000–44,999**	3.25–3.74	**3.5**	**1,400**
6	**45,000–53,999**	3.75–4.49	**4.0**	**1,600**
7	**54,000–62,999**	4.50–5.24	**5.0**	**2,000**

3.4 Method C—Floor Area Default

1. The floor area default method may be used to roughly estimate A/C system airflow in special circumstances:
   a. Only for program measure duct testing—not for mandatory Title 24 duct testing and sealing.
   b. **Only when absolutely necessary**—such as when:
      - The A/C model number cannot be determined (e.g., unit is inaccessible or nameplate is unreadable/missing) and
      - System airflow measurement is not feasible.
2. Use Equation D-2 to calculate default system airflow:

Equation D-2		**Floor Area** (sq. ft.) **x 0.8** = **System Airflow CFM**

3. **Step C-1:** Determine square footage of the conditioned space.[5]
4. **Step C-2:** Determine default system airflow CFM using Equation D-2.

---

[3]Defaults: 12,000 Btu = One ton of A/C capacity; 400 CFM per ton = estimated system airflow.

[4]Nominal tons = Calculated tons *rounded* to the nearest *whole* or *half* ton (e.g., 2.75 rounds up to 3.0 nominal tons, and 3.74 rounds down to 3.5 nominal tons).

[5] Either interior or exterior dimensions may be used and rounded to the nearest foot or half foot. For a two-story house, square footage is the sum of the first- and second-floor areas.

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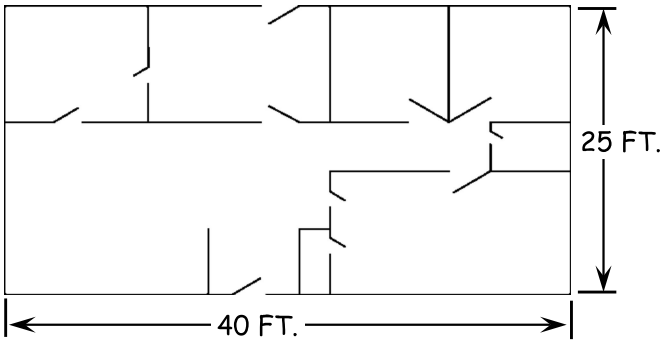
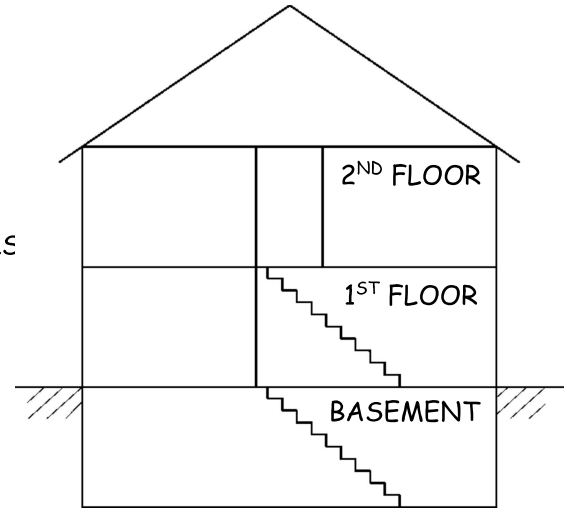
a. Note: The equation is based on (A) an ASHRAE assumption of 500 sq. ft. per ton, as an average for residential buildings and (B) the CEC default of 400 CFM per ton.
b. Example: Assume a 1,000-sq. ft. home.
   - 1,000 sq. ft./500 sq. ft. per ton = 2 tons
   - 2 tons x 400 CFM per ton = 800 CFM system airflow or
   - 1,000 sq. ft. x 0.8 = 800 CFM system airflow



25′ x 40′ = 1,000 SQ. FT. x 0.8 =
800 CFM SYSTEM AIRFLOW

25′ x 40′ = 1,000 SQ. FT. x 2 FLOORS
2,000 SQ. FT. x 0.8 = 1,600 CFM
SYSTEM AIRFLOW



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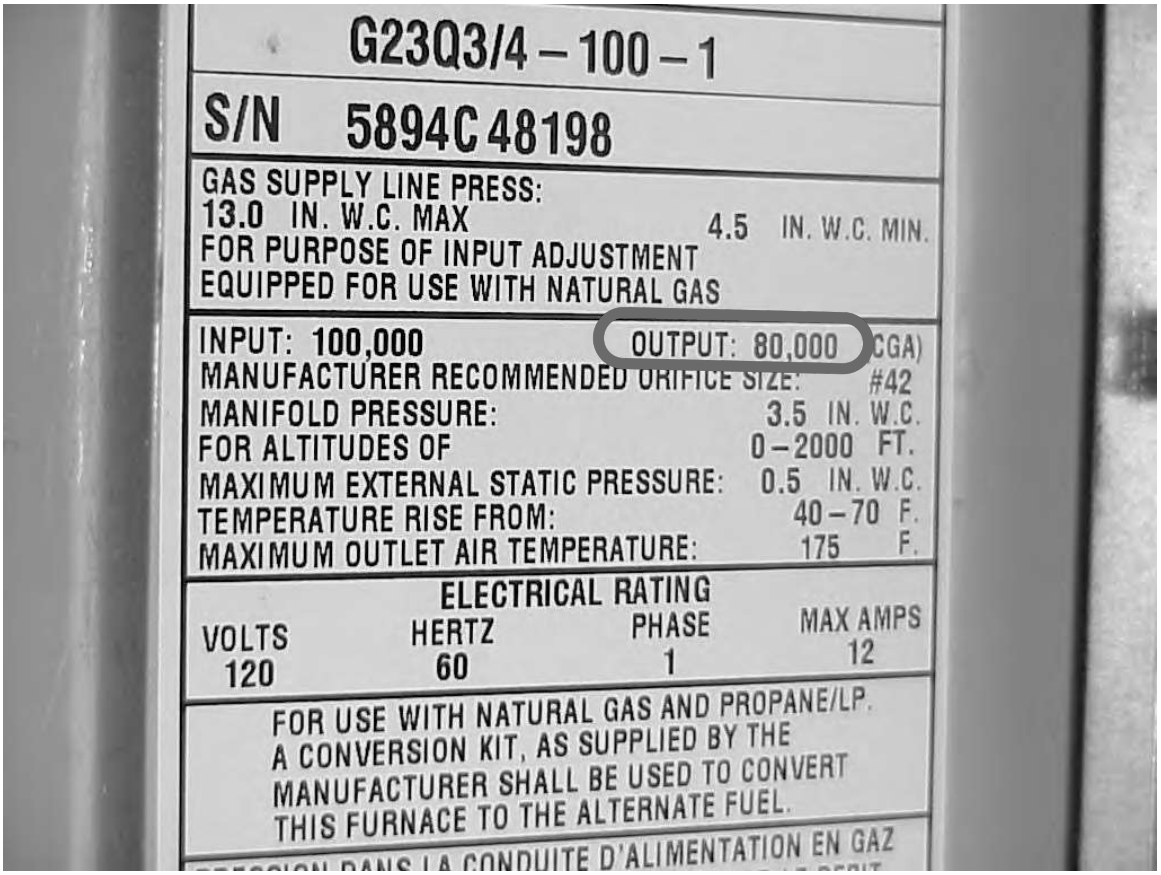
PART 3: ESTIMATING AIRFLOW—GAS HEATING

4.0 GAS FURNACES

4.1 Method A—Btuh Output

1. **Step A-1:** Determine Btuh output from unit name plate.
   a. Locate Btuh output on the nameplate.
      - Output is 80,000 Btuh, in example pictured below.
   b. If only input is listed, Output = (Input) x (% efficiency).
      - Assume 80% efficiency (0.80 AFUE), if not indicated on the nameplate.
      - *Example 1:* (**100** kBtuh Input) x (**0.80** AFUE) = **80 kBtuh output**
2. **Step A-2:** Convert Btuh output to estimated airflow in CFM.
   a. Assume 21.7 CFM per kBtuh output.
   b. Use Equation D-3 to determine estimated system airflow.
      - Example 2: (80 kBtuh) x (21.7 CFM/kBtu) = 1,736 CFM Estimated System Airflow

Equation D-3	**(kBtuh** Output**) x (21.7** CFM/kBtuh**) = CFM** Estimated System Airflow



EXAMPLE OF A GAS FURNACE NAMEPLATE SHOWING HEATING CAPACITY (OUTPUT) OF 80,000 BTUH

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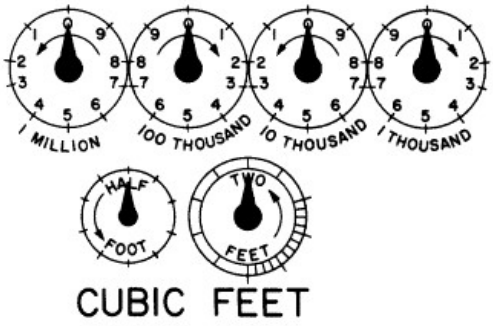
4.2 Method B—Clocking the Gas Meter

1. Use this method to determine Btuh input of a furnace when the nameplates information is not available (e.g., it is missing or unreadable, or unit is on the roof or otherwise inaccessible).[6]
2. **Step B-1:** With all other gas appliances in the home turned off (standing pilot can be on), turn up the thermostat for the furnace to be tested, and allow it to operate for at least 5 minutes.
3. **Step B-2:** Looking at the gas meter, clock the amount of time it takes a small volume test dial to make one complete revolution.
   a. For the meter illustrated below, the small volume test dials are the "Half Foot" and "Two Feet" dials at the bottom.
   b. For best accuracy, use the test dial that takes approximately one minute or more to make a complete revolution.



4. **Step B-3:** Using Table D-2, do the following:
   a. In the "Sec. for One Rev." column, find the number of seconds it takes the test dial to make one revolution.
   b. Move across to the column matching the size (in cu. ft.) of the test dial that was used. The number in that column is the gas consumption rate in cubic feet per hour (cu. ft./hr.).
5. **Step B-4:** Convert cu. ft./hr. to Btuh using Equation D-4:

Equation D-4	(_____cu. ft./hr.) x (**1,000** Btuh/cu. ft.) = _____ **Btuh** Input

   a. For example, if the "Half Foot" dial makes one revolution in 60 seconds, per Table D-2, that is 30 cu. ft./hr.
   b. Calculate Btuh input: (30 cu. ft./hr.) x (1,000 Btuh/cu. ft.) = 30,000 Btuh Input
6. **Step B-5:** Convert input to output: (Btuh Input) x (% efficiency) = Btuh Output
   - Example: (30,000 Input) x (0.80) = 24,000 Btuh Output. (See 4.1, Step A-1.)
7. Table D-2 is based on Equation D-5, which may be used if needed.[7] Round answer to nearest whole number (e.g., 25.7 = 26 and 25.4 = 25).

Equation D-5	$\frac{\text{(**Dial size** in cu. ft.) x (**3,600**)}}{\text{(**\# seconds** for one dial revolution)}}$ = **cu. ft./hr.** (used by the appliance)

[6] Btuh Input can be converted to Btuh output, which is then used to estimate CFM. For Title 24 duct testing and sealing, this method must be used instead of the floor area default described in Step 4.3.

[7] "Cu. ft./hr." = Cubic feet of gas per hour used by the furnace; 3600 = # seconds in an hour.

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TABLE D-2: GAS CONSUMPTION IN CUBIC FEET PER HOUR[8]

Sec. for One Rev.	Size of Test Dial				Sec. for One Rev.	Size of Test Dial			
	1/2 cu ft.	1 cu ft.	2 cu ft.	3 cu ft.		1/2 cu ft.	1 cu ft.	2 cu ft.	3 cu ft.
10	180	360	720	1800	**48**	37	75	150	375
11	164	327	655	1636	**49**	37	73	147	367
12	150	300	600	1500	**50**	36	72	144	360
13	138	277	555	1395	**51**	35	71	141	355
14	129	257	514	1286	**52**	35	69	138	346
15	120	240	480	1200	**53**	34	65	136	325
16	112	225	450	1125	**54**	33	67	133	333
17	106	212	424	1059	**55**	33	64	131	320
18	100	200	400	1000	**56**	32	64	129	321
19	95	189	379	947	**57**	32	63	126	315
20	90	180	360	900	**58**	31	62	124	310
21	86	171	343	857	**59**	30	61	122	305
22	82	164	327	818	**60**	30	60	120	300
23	78	157	313	783	**62**	29	58	116	290
24	75	150	300	750	**64**	29	56	112	281
25	72	144	288	720	**66**	29	54	109	272
26	69	138	277	692	**68**	28	53	106	264
27	67	133	267	667	**70**	26	51	103	257
28	64	129	257	643	**72**	25	50	100	250
29	62	124	248	621	**74**	24	48	97	243
30	60	120	240	600	**76**	24	47	95	239
31	58	116	232	581	**78**	23	46	92	231
32	56	113	225	563	**80**	22	45	90	225
33	55	109	218	545	**82**	22	44	88	219
34	53	106	212	529	**84**	21	43	86	214
35	51	103	206	514	**86**	21	42	84	209
36	50	100	200	500	**88**	20	41	82	204
37	49	97	195	486	**90**	20	40	80	200
38	47	95	189	479	**92**	20	39	78	195
39	46	92	185	462	**94**	19	38	77	191
40	45	90	180	450	**96**	19	36	75	187
41	44	88	176	439	**98**	18	37	73	183
42	43	86	172	429	**100**	18	36	72	180
43	42	84	167	419	**102**	18	35	71	177
44	41	82	164	409	**104**	17	35	69	173
45	40	80	160	400	**106**	17	34	68	162

[8] Numbers in columns under the heading “Size of Test Dial” are cu ft./hr. of gas consumed by appliance.

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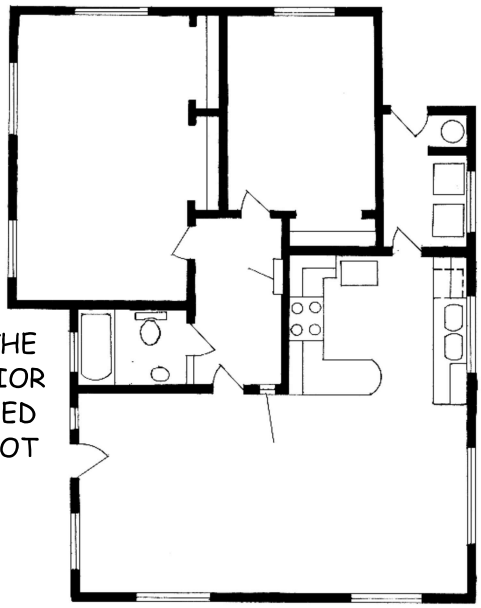
4.3 Method C—Floor Area Default

1. The floor area default method may be used to roughly estimate heating-only system airflow in special circumstances:
   a. Only for program measure duct testing—not for mandatory Title 24 duct testing and sealing.
   b. **Only when absolutely necessary**—such as when:
      - Furnace cannot be accessed or nameplate information is not available, and
      - Clocking the gas meter (a much more accurate method) and airflow measurement are not feasible.
2. **Step C-1:** Determine square footage of the conditioned space.[9]
3. **Step C-2:** Determine estimated system airflow CFM.
   a. Use simplified Equation D-6:

Equation D-6	____ **sq. ft.** conditioned area) x (**0.942**) = **CFM** (Estimated System Airflow)

   b. Or perform the following calculations:
      - (**Sq. ft.** conditioned area) x (**43.4** Btuh Output per sq. ft.) = estimated **Btuh** Output.
      - (**Btuh** Output) ÷ (**1,000**) = **kBtuh** Output.
      - (**kBtuh** Output) x (**21.7** CFM/kBtuh) = **CFM** (Estimated System Airflow).
4. Assumptions and defaults
   a. 43.4 Btuh output per sq. ft.
   b. 21.7 CFM per kBtuh output
5. Example for 1,000 sq. ft. of conditioned floor area.
   a. (**1,000** sq. ft.) x (**43.4** Btuh Output/sq. ft.) = **43,400** Btuh = **43.4** kBtuh
   b. (**43.4** kBtuh) x (**21.7** CFM/kBtuh) = **942 CFM** Estimated System Airflow
   c. Using simplified equation D-6: (**1,000** sq. ft.) x (**0.942**) = **942 CFM** Estimated System Airflow

DETERMINE SQUARE FOOTAGE OF THE CONDITIONED SPACE, USING INTERIOR OR EXTERIOR DIMENSIONS, ROUNDED TO THE NEAREST FOOT OR HALF-FOOT



[9] Either interior or exterior dimensions may be used and rounded to the nearest foot or half foot. For a two-story house, square footage is the sum of the two floor areas.

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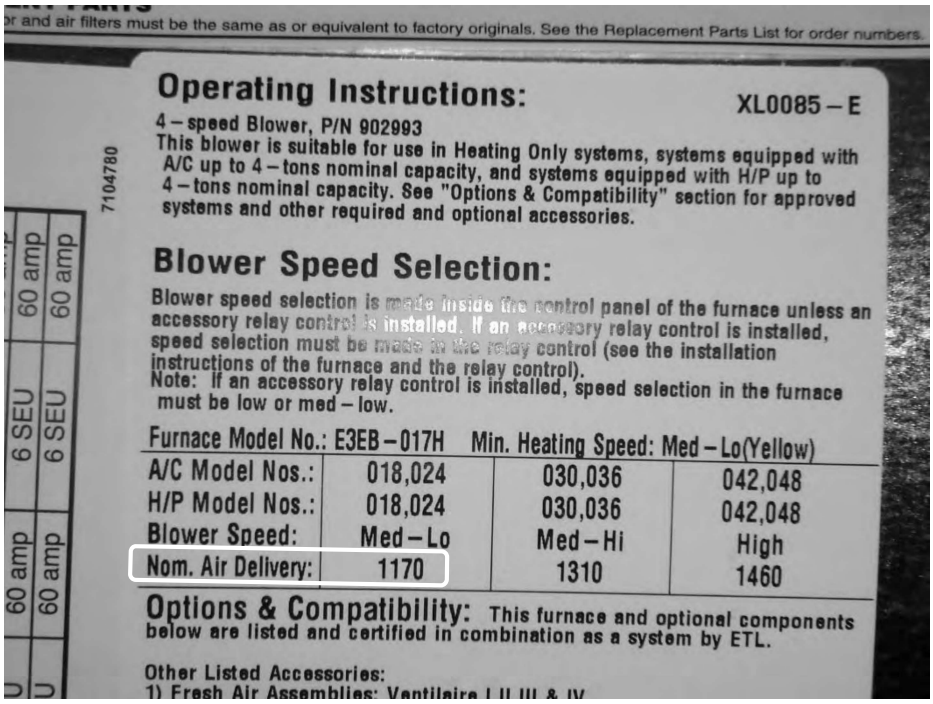
PART 4: ESTIMATING AIRFLOW—ELECTRIC HEATING

5.0 ELECTRIC FURNACES

5.1 Method A—Nominal Air Delivery on Nameplate/Label[10]

1. Use only for program measure duct testing and sealing. **When compliance with Title 24 is required (HVAC alteration), airflow must be measured, as described in Part 5, "Measuring Airflow."**
2. Determine nominal air delivery (CFM) from air handler label.
   a. When present, locate the label that lists blower speed and air delivery, such as shown in the example label pictured below giving Blower Speed Selection data for a Nordyne electric furnace.
   b. For multi-speed blowers, use the low speed (1,170 CFM in the example label).[11]
3. When air handler CFM cannot be obtained from the nameplate/label, use:
   a. Method B, Heating Capacity on Nameplate/Label (5.2) or
   b. Method C, Model Number Nomenclature (5.3).



r and air filters must be the same as or equivalent to factory originals. See the Replacement Parts List for order numbers.

Operating Instructions: XL0085 – E

4 – speed Blower, P/N 902993
This blower is suitable for use in Heating Only systems, systems equipped with A/C up to 4 – tons nominal capacity, and systems equipped with H/P up to 4 – tons nominal capacity. See "Options & Compatibility" section for approved systems and other required and optional accessories.

7104780

Blower Speed Selection:

Blower speed selection is made inside the control panel of the furnace unless an accessory relay control is installed. If an accessory relay control is installed, speed selection must be made in the relay control (see the installation instructions of the furnace and the relay control).
Note: If an accessory relay control is installed, speed selection in the furnace must be low or med – low.

Furnace Model No.: E3EB – 017H	Min. Heating Speed: Med – Lo(Yellow)		
A/C Model Nos.:	018,024	030,036	042,048
H/P Model Nos.:	018,024	030,036	042,048
Blower Speed:	Med – Lo	Med – Hi	High
Nom. Air Delivery:	1170	1310	1460

Options & Compatibility: This furnace and optional components below are listed and certified in combination as a system by ETL.

Other Listed Accessories:
1) Fresh Air Assemblies: Ventilaire I,II,III & IV

60 amp 60 amp
6 SEU 6 SEU
60 amp 60 amp

[10] This method is for heat-only units. When an electric furnace is part of a split system with A/C, (A) for program measure jobs, determine system airflow based on A/C tons (per Section 3.0); and (B) for Title 24 jobs, *measure* system airflow in *both* heating and A/C modes, and the greater of the two results is used.

[11] Heat-only units are usually wired for operation at low speed.

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5.2 Method B—Heating Capacity on Nameplate/Label

1. **Step B-1:** Determine heating capacity (Output), when listed on the nameplate/label as Btuh or kW (kilowatts).
   a. When present, locate Btuh rating on the nameplate (e.g., 57,000 Btuh on label shown below).
   b. If **Btuh is not given**, obtain kW (e.g., 16.6 kW on label below) and apply the following default assumptions:
      - 3.413 kBtuh per kW
      - (kW) x (3.413) = kBtuh Output
   c. In this example, (**16.6** kW) x (**3.413** kBtuh/kW) = **56,666 kBtuh.**
2. **Step B-2:** Calculate estimated airflow based on heating capacity (Btuh or kW).
   a. If **Btuh is known**:
      - Convert Btuh to kBtuh, using Equation D-7:
      - Convert kBtuh to CFM, using Equation D-8:

Equation D-7	$\frac{\text{Btuh}}{1{,}000} = \text{kBtuh}$
Equation D-8	(**kBtuh**) x (**21.7**) = **CFM** Estimated System Airflow

      - Thus: (**57** kBtuh) x (**21.7** CFM/kBtuh) = **1,237 CFM**
   b. If only kW is known, use Equation D-9:

Equation D-9	(____**kW**) x (**74.1**) = **CFM** Estimated System Airflow[12]

      - Thus: (**16.6** kW) x (**74.1**) = **1,230 CFM**

[12] This is a shortcut based on these equations: [(kW) x (3.413 kBtuh per kW) = kBtuh Output], and [(kBtuh) x (21.7 CFM/kBtuh) = CFM]. Simplified: [(3.413) x (21.7) = 74.1] and [(kW) x (74.1) = CFM].

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5.3 Method C—Model Number Nomenclature[13]

1. **Step C-1:** Locate model number on electric furnace nameplate/label.
2. **Step C-2:** Determine estimated airflow.
   a. *Example 1a:* For a Coleman electric furnace with a model number such as "MA12BN21," the first two-digit number represents **CFM** in hundreds.
      - Multiply that two-digit number by 100 to determine blower air delivery in CFM.
      - In this case: [(**12**) x (**100** CFM) = **1,200 CFM** Estimated System Airflow].
   b. *Example 1b:* For a Coleman electric furnace with a blower model number such as "EB10B," the two-digit number represents **kW**, but one blower capacity is used for multiple heating capacities. For example:
      - For EB10, EB12, and EB15, estimated system airflow is 924 CFM.
      - For EB17, EB20, and EB23, estimated system airflow is 1140 CFM.
      - If necessary, using the blower model number, check the manufacturer's website (see Table D-3) for information about that blower's CFM rating.
   c. *Example 2:* for a First Company electric furnace:
      - For a model number such as "30MBX10," the first two-digit number represents **thousands of Btuh** (in this case, 30,000 Btuh or 30 kBtuh).
      - Calculate CFM based on **kBtuh:** [(**30** kBtuh) ÷ (**12** kBtuh/Ton)] x (**400**) = (30/12) x (400) = **1,000 CFM** Estimated System Airflow.
      - Or, **use simplified Equation D-10[14]** and do a shorter calculation to get the same answer: (**30** kBtuh) x (**33.33**) = **999.9** = **1,000 CFM.**

Equation D-10	(____ **kBtuh**) x (**33.33**) = **CFM** Estimated System Airflow

   d. To convert **kW to kBtuh** output (based on the assumption that there are 3.413 kBtuh per kW), use Equation D-11:

Equation D-11	(____ **kW**) x (**3.413** kBtuh/kW) = **kBtuh** Output

3. When additional manufacturer technical data is required to calculate estimated system airflow, obtain contact information from the nameplate/label or refer to Table D-3.

TABLE D-3: CONTACT INFORMATION FOR SOME ELECTRIC FURNACE MANUFACTURERS

Manufacturer	Web Address	Telephone Number
Coleman	http://www.colemanac.com	(877) 874-7378
First Company	www.firstco.com	(214) 388-5751
Nordyne	www.intertherm.net www.millerac.com	Contact a distributor (numbers at website)

[13] May be used for heat-only units when kBtuh or CFM is not shown on the nameplate, but it can be determined directly from the model number. Note that model numbering formats vary by manufacturer.

[14] Math simplification: [(kBtuh) x (400/12)] = [(kBtuh) x (33.33)] = CFM Estimated System Airflow.

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PART 5: *MEASURING* AIRFLOW

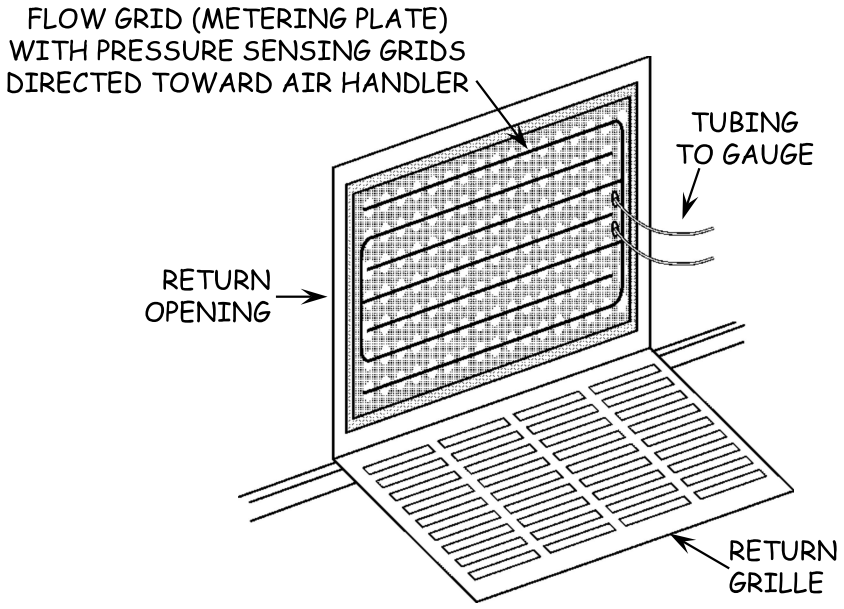
Part 5 covers three methods for measuring HVAC system airflow, which may be used when nameplate information is not available or for any reason *estimating methods are not feasible.*

- These measurement methods are far superior to floor area default methods, which are not accurate enough for Title 24 duct testing and sealing jobs. *These methods are approved by the CEC and can be used for both program measure and Title 24 duct testing.*
- For Title 24 airflow measurement requirements, see the Title 24 Residential Compliance Manual, and for equipment and procedures, see Title 24 Residential Appendix RA3.

6.0 FLOW GRID MEASUREMENT

6.1 Overview

1. This method uses a metering plate containing pressure sensing grids, which are directed toward the air handler.
2. The metering plate temporarily replaces the filter in a typical air handler system during the airflow measurement procedure.
3. Airflow measurement is most accurate when the metering plate is installed at or near the air handler.
   a. If the filter location is directly adjacent to the air handler (in a filter slot or at the bottom of the air handler cabinet), the metering plate will measure the total air handler flow.
   b. If the filter is located remotely at a single central return box, accuracy will be reduced by leaks in the return ductwork. The metering plate will measure the air entering the return box, but it will not measure return leaks located between the return box and the air handler.



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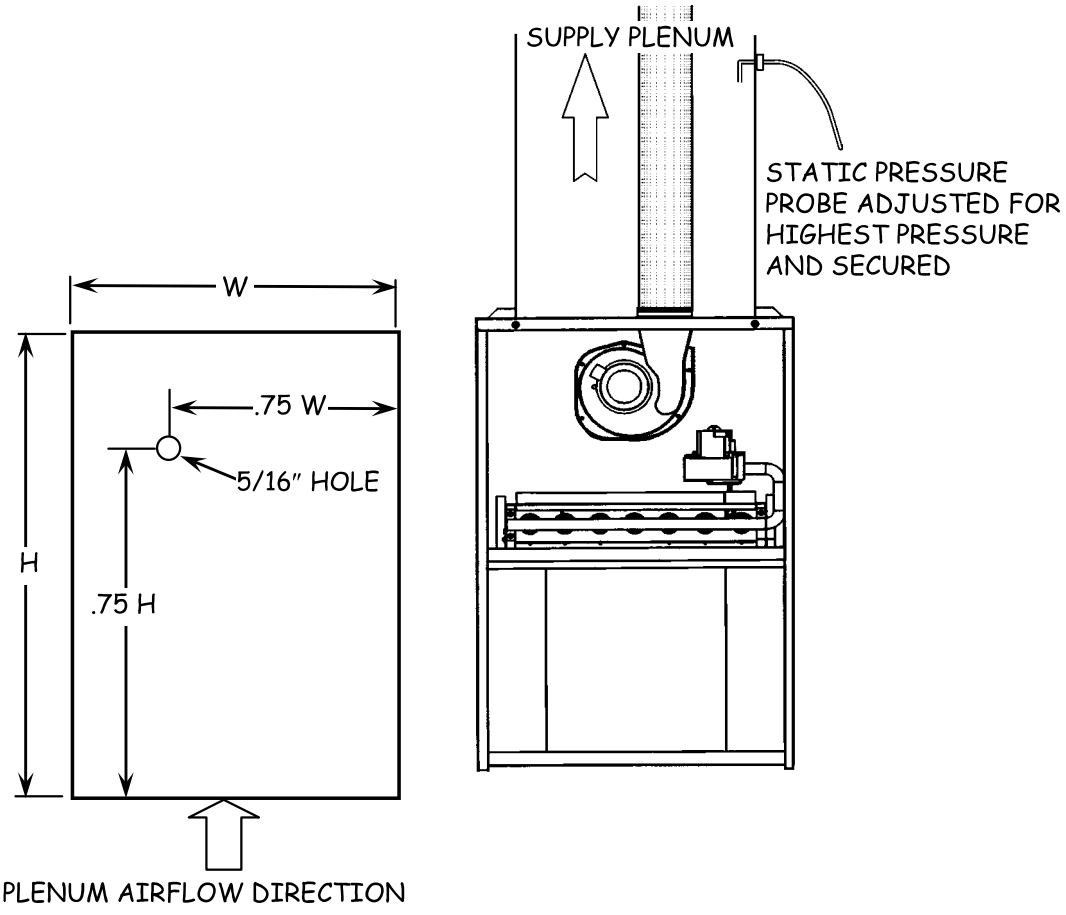
6.2 Protocol

1. For Title 24 duct testing, this procedure must be conducted in accordance with Title 24 Residential Appendix RA3.
2. *The following general guidelines are for reference only. Measurement shall be performed in accordance with test equipment manufacturer's instructions and Title 24 specifications.*

6.3 General Guidelines

1. **Step 1:** System operating pressure shall be measured with the air handler operating at maximum speed used in the system.
   a. A quarter-inch hole is drilled in the supply plenum in a location that is (A) 3/4 the distance from one side of the plenum to the other (width) and (B) 3/4 the distance from the bottom to the top of the plenum (height), as illustrated below.
   b. A static pressure probe directed into the air stream shall be installed in the hole, adjusted to achieve the highest pressure, and then secured in place during the fan flow test.
   c. Using a digital pressure gauge, pressure difference in Pa shall be measured between the supply plenum and the conditioned space (**P**sp).



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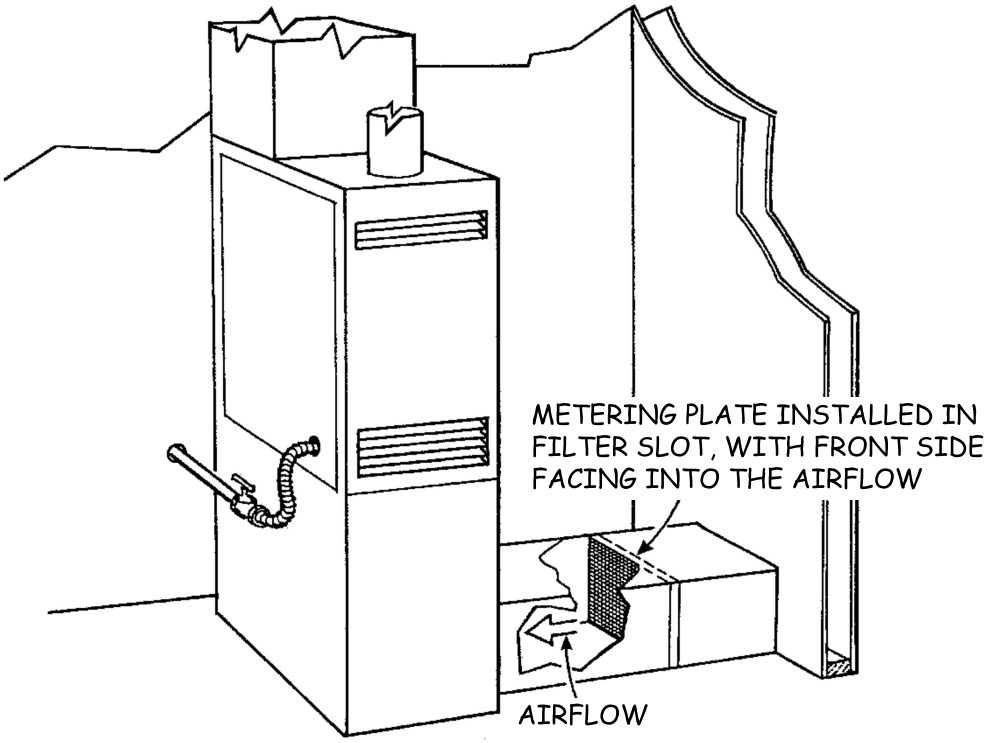
2. **Step 2:** With the air handler off, the flow grid measurement sensor (metering plate) shall be installed with the pressure sensing grids directed toward the air handler and with no obstructions within 6" upstream or 2" downstream of the metering plates, in the best available location (filter slot or filter grille) where all system airflow passes through the flow grid:
   a. In a filter slot as close to the air handler as possible, or
   b. In the filter grille of a single-return duct system, or
   c. In each filter grille of a multiple-return duct system simultaneously.
3. **Step 3:** Using a DG-700 fully-automated digital gauge, perform the following steps:
   a. Air handler shall be operated again at the same speed as used in Step 1, and time averaging shall be lengthened as needed to maximize accuracy when readings are fluctuating.
   b. Measured system airflow (**Q**ah) shall be obtained from the digital pressure gauge and recorded.
   c. When the flow grid is installed in a remote filter grille, manufacturer's correction factor shall be used to increase accuracy.



4. **Step 4:** Adjusted airflow shall be calculated—to correct for differences in system operating pressures measured in Steps 1 and 3—using manufacturer's flow resistance correction procedure.

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Appendix B Flow Resistance Correction Factors

Table B.1 Flow Resistance Correction Factors (using Pascals)

Normal System Operating Pressure in Pascals (NSOP)

TrueFlow System Operating Pressure in Pascals (TFSOP)	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
10	1.00	1.10	1.18	1.26	1.34	1.41	1.48	1.55	1.61	1.67	1.73	1.79	1.84	1.90	1.95	2.00	2.05	2.10	2.14	2.19	2.24
12	0.91	1.00	1.08	1.15	1.22	1.29	1.35	1.41	1.47	1.53	1.58	1.63	1.68	1.73	1.78	1.83	1.87	1.91	1.96	2.00	2.04
14	0.85	0.93	1.00	1.07	1.13	1.20	1.25	1.31	1.36	1.41	1.46	1.51	1.56	1.60	1.65	1.69	1.73	1.77	1.81	1.85	1.89
16	0.79	0.87	0.94	1.00	1.06	1.12	1.17	1.22	1.27	1.32	1.37	1.41	1.46	1.50	1.54	1.58	1.62	1.66	1.70	1.73	1.77
18	0.75	0.82	0.88	0.94	1.00	1.05	1.11	1.15	1.20	1.25	1.29	1.33	1.37	1.41	1.45	1.49	1.53	1.56	1.60	1.63	1.67
20	0.71	0.77	0.84	0.89	0.95	1.00	1.05	1.10	1.14	1.18	1.22	1.26	1.30	1.34	1.38	1.41	1.45	1.48	1.52	1.55	1.58
22	0.67	0.74	0.80	0.85	0.90	0.95	1.00	1.04	1.09	1.13	1.17	1.21	1.24	1.28	1.31	1.35	1.38	1.41	1.45	1.48	1.51
24	0.65	0.71	0.76	0.82	0.87	0.91	0.96	1.00	1.04	1.08	1.12	1.15	1.19	1.22	1.26	1.29	1.32	1.35	1.38	1.41	1.44
26	0.62	0.68	0.73	0.78	0.83	0.88	0.92	0.96	1.00	1.04	1.07	1.11	1.14	1.18	1.21	1.24	1.27	1.30	1.33	1.36	1.39
28	0.60	0.65	0.71	0.76	0.80	0.85	0.89	0.93	0.96	1.00	1.04	1.07	1.10	1.13	1.16	1.20	1.22	1.25	1.28	1.31	1.34
30	0.58	0.63	0.68	0.73	0.77	0.82	0.86	0.89	0.93	0.97	1.00	1.03	1.06	1.10	1.13	1.15	1.18	1.21	1.24	1.26	1.29
32	0.56	0.61	0.66	0.71	0.75	0.79	0.83	0.87	0.90	0.94	0.97	1.00	1.03	1.06	1.09	1.12	1.15	1.17	1.20	1.22	1.25
34	0.54	0.59	0.64	0.69	0.73	0.77	0.80	0.84	0.87	0.91	0.94	0.97	1.00	1.03	1.06	1.08	1.11	1.14	1.16	1.19	1.21
36	0.53	0.58	0.62	0.67	0.71	0.75	0.78	0.82	0.85	0.88	0.91	0.94	0.97	1.00	1.03	1.05	1.08	1.11	1.13	1.15	1.18
38	0.51	0.56	0.61	0.65	0.69	0.73	0.76	0.79	0.83	0.86	0.89	0.92	0.95	0.97	1.00	1.03	1.05	1.08	1.10	1.12	1.15
40	0.50	0.55	0.59	0.63	0.67	0.71	0.74	0.77	0.81	0.84	0.87	0.89	0.92	0.95	0.97	1.00	1.02	1.05	1.07	1.10	1.12
42	0.49	0.53	0.58	0.62	0.65	0.69	0.72	0.76	0.79	0.82	[illegible]	[illegible]	0.90	0.93	0.95	0.98	1.00	1.02	1.05	1.07	1.09
44	0.48	[illegible]	0.56	0.60	0.64	0.67	0.71	0.74	0.77	[illegible]	[illegible]	[illegible]	0.88	0.90	0.93	0.95	0.98	1.00	1.02	1.04	1.07
46	0	[illegible]	[illegible]	0.59	0.63	0.66	0.69	0.73	[illegible]	[illegible]	[illegible]	[illegible]	0.86	0.88	0.91	0.93	0.96	0.98	1.00	1.02	1.04
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.61	0.65	0.68	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.87	0.89	0.91	0.94	[illegible]	[illegible]	[illegible]	1.00	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.85	0.87	0.89	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

EXAMPLE OF FLOW RESISTANCE CORRECTION FACTORS USED TO CALCULATE ADJUSTED AIRFLOW

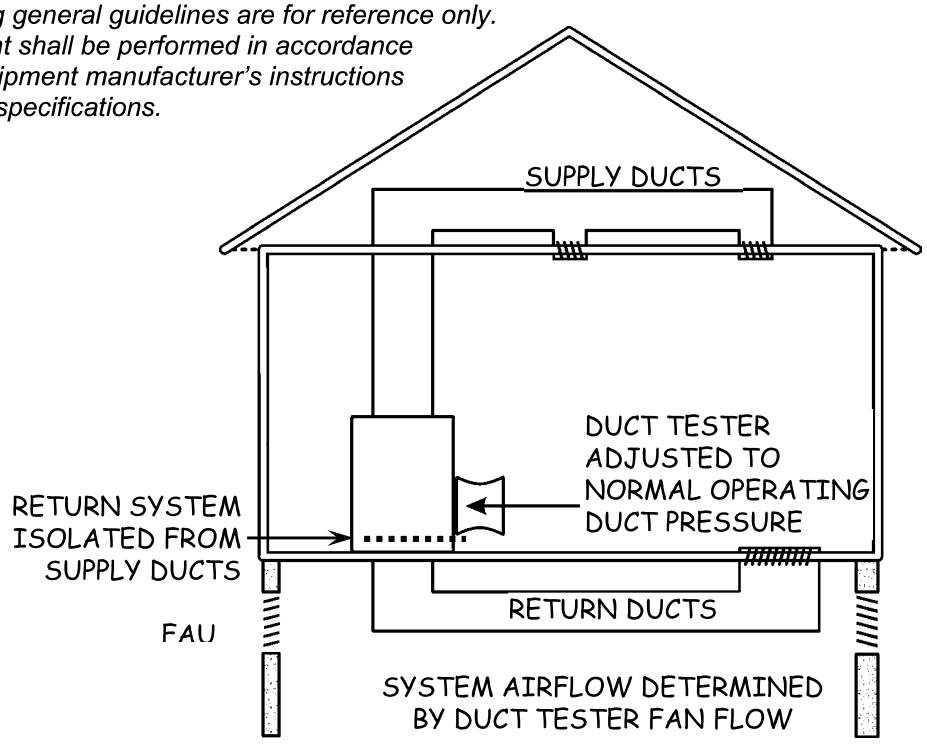
7.0 PLENUM PRESSURE MATCHING AND FAN FLOW METER

7.1 Overview

The duct tester is used to pressurize the system to equal the pressure created by the air handler so that airflow through the duct tester represents system airflow (fan flow).

7.2 Protocol

1. For Title 24 duct testing, this procedure must be conducted in accordance with Title 24 Residential Appendix RA3.
2. *The following general guidelines are for reference only. Measurement shall be performed in accordance with test equipment manufacturer's instructions and Title 24 specifications.*



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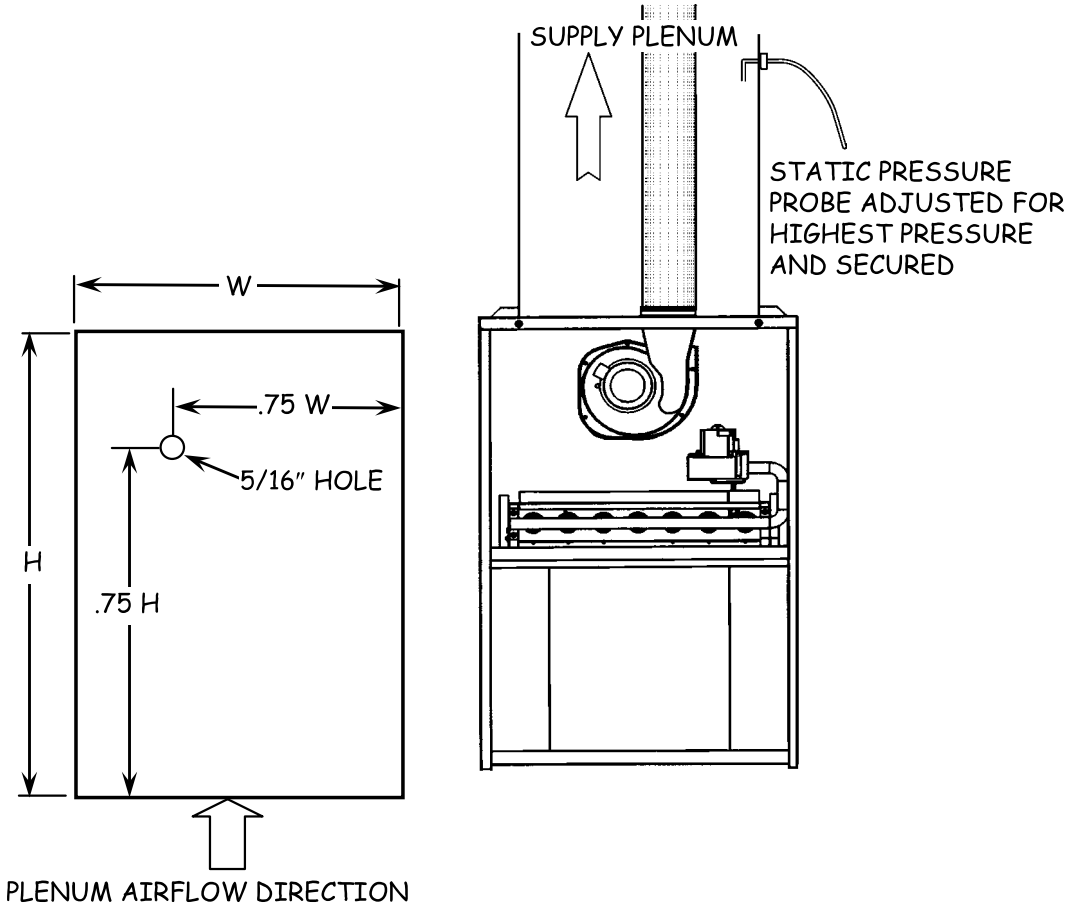
7.3 General Guidelines

1. **Step 1:** Supply plenum pressure test set-up:
   a. Air handler shall be off.
   b. Doors, windows, etc. shall be open to prevent pressure changes in the space containing the handler (e.g., outside door/window for air handler in conditioned space; or access doors, vents, etc. for air handler in garage, attic, etc.).
   c. All supply and return registers shall be open, and filter(s) clean.
   d. A quarter-inch hole is drilled in the supply plenum in a location that is (A) 3/4 the distance from one side of the plenum to the other (width) and (B) 3/4 the distance from the bottom to the top of the plenum (height), as illustrated below.
   e. A static pressure probe, directed into the air stream, shall be installed in the hole, adjusted (rotated) to achieve the highest pressure, then secured in place during the fan flow test.
   f. Tubing from the probe shall be attached to **Channel A** input tap of the digital pressure gauge, and the **Reference** tap shall be open to the conditioned space.
2. **Step 2:** *With the air handler fan operating at the maximum speed* used in the system (e.g., cooling speed when A/C is present), measure **P**sp.
   a. **P**sp is the pressure difference in Pa between the supply plenum and the conditioned space with the air handler on.
   b. **P**sp, the normal operating duct pressure, is the target pressure to be maintained during the system airflow (fan flow) tests.



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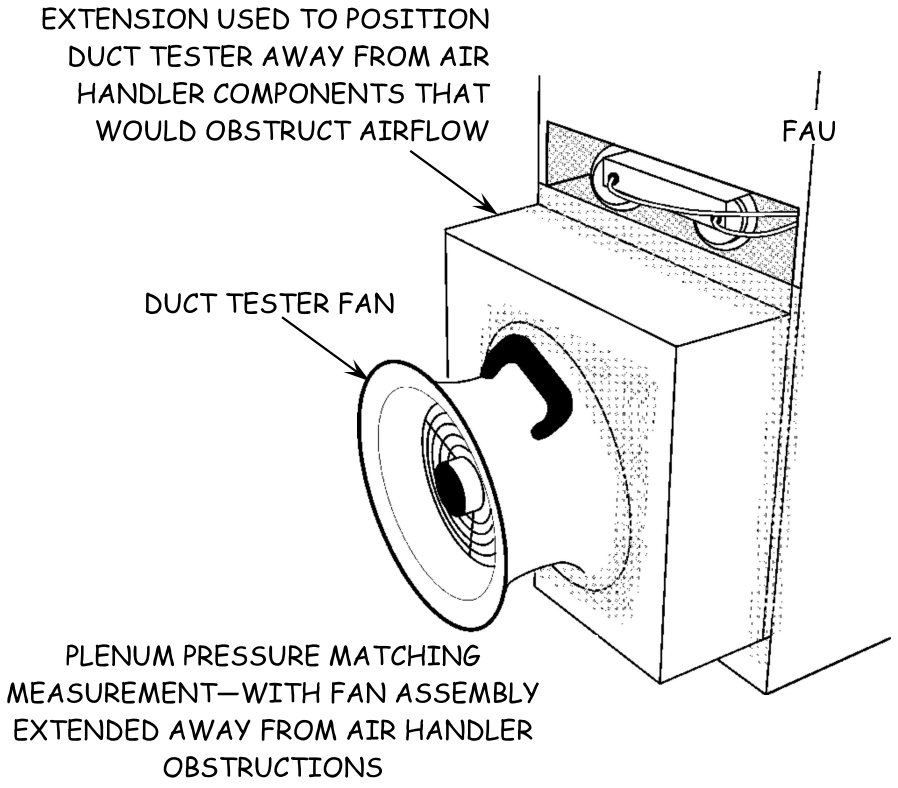
3. **Step 3:** *Duct Blaster® set-up at air handler housing*[15]
   a. With the air handler access panel removed, the return air opening inside the air handler housing shall be sealed (e.g., with cardboard and tape) to isolate the return system from the supply system.
   b. The Duct Blaster shall be installed in place of the air handler access panel. If air handler components will obstruct airflow, the Duct Blaster shall be mounted on an extension/box (illustrated below) that holds it away from the furnace housing.
   c. Tubing from the Duct Blaster is connected to the **Channel B** input tap on the digital pressure gauge.
   d. The **Reference** tap remains open to space where the Duct Blaster is located.



4. **Step 4:** *With the air handler operating,*
   a. Duct Blaster shall be turned on and adjusted until the duct pressure on **Channel A** equals the normal operating duct pressure (**P**sp) measured in Step 2.
   b. Airflow through the Duct Blaster is the estimated CFM system airflow through the air handler (**Q**ah).

[15]Attachment to the return grille of a single-return system (shown on next page) is possible. However, if the return duct is not substantially airtight, leaks will cause the airflow measurement to be inaccurate.

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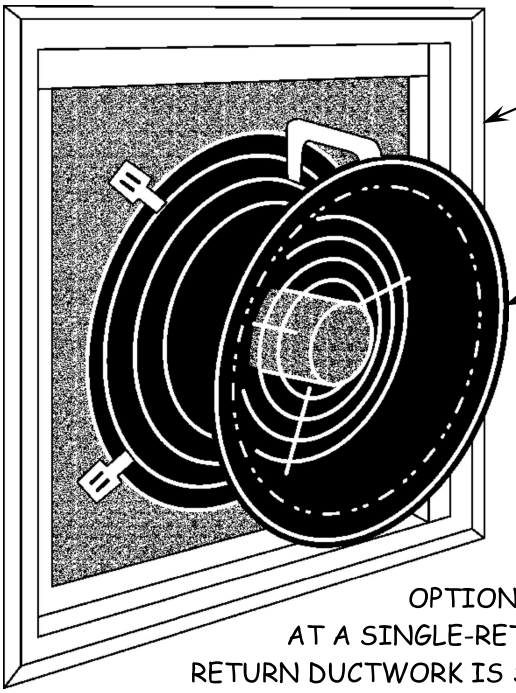
5. **Step 5:** Correction shall be made when the Duct Blaster cannot adequately pressurize the system to equal the normal operating duct pressure (Psp) recorded in Step 2:
   a. With the Duct Blaster producing the maximum attainable duct pressure on **Channel A** (**P**max), the airflow through the Duct Blaster (**Q**max) shall be determined.
   b. System airflow at normal operating duct pressure (**P**sp) shall be estimated using equation D-12:

Equation D-12	**Q**ah = System Airflow = (**Q**max) x (**P**sp/**P**max)$^{0.5}$



OPTIONAL DUCT TESTER LOCATION
AT A SINGLE-RETURN SYSTEM INLET (WHEN
RETURN DUCTWORK IS SUBSTANTIALLY AIRTIGHT)

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8.0 POWERED FLOW CAPTURE HOOD

8.1 Overview

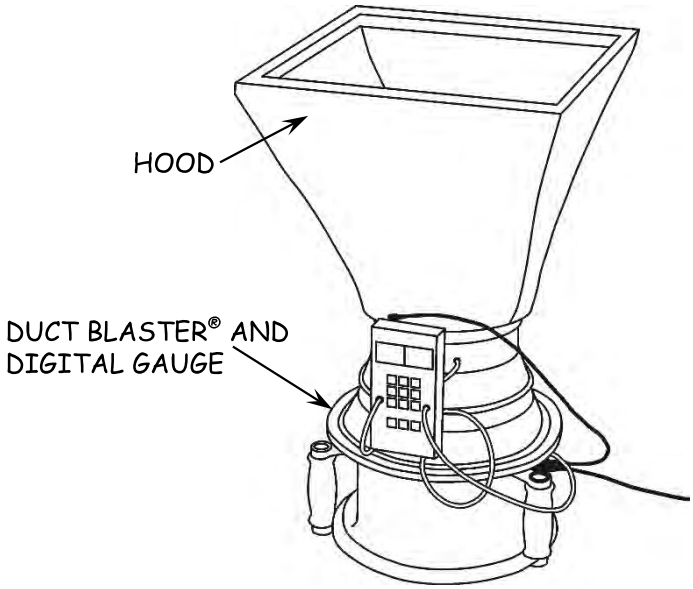
1. An approved powered flow capture hood is the FlowBlaster®, which is an accessory to the Minneapolis Duct Blaster® System. It requires the use of a Duct Blaster san and flow rings and a DG-700 digital pressure and flow gauge. It is designed to measure flows only up to 300 CFM. It works by adding necessary flow conditioning and then precisely adjusting the speed of the Duct Blaster fan to compensate for the pressure loss through the conditioners. This compensates for variations of construction and can measure airflow more accurately than traditional capture hood devices.

8.2 Protocol

1. For Title 24 duct testing, this procedure must be conducted in accordance with Title 24 Residential Appendix RA3.
2. **Do not use when measuring airflows above 300 CFM.**
3. *The following general guidelines are for reference only. Measurement shall be performed in accordance with test equipment manufacturer's instructions and Title 24 specifications.*

8.3 General Guidelines

1. Airflow measurement shall be taken at the return grille(s). The powered flow hood must have a capture area at least as large as the return grille in all dimensions.
2. The supply registers must be in their normal operating position (dampers open or closed as they normally would be).



POWERED FLOW CAPTURE HOOD
MEASURES AIRFLOW UP TO 300 CFM
ENTERING THE RETURN GRILLE

Graphic Courtesy of
The Energy Conservatory

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9.0 TRADITIONAL FLOW CAPTURE HOOD

9.1 Overview

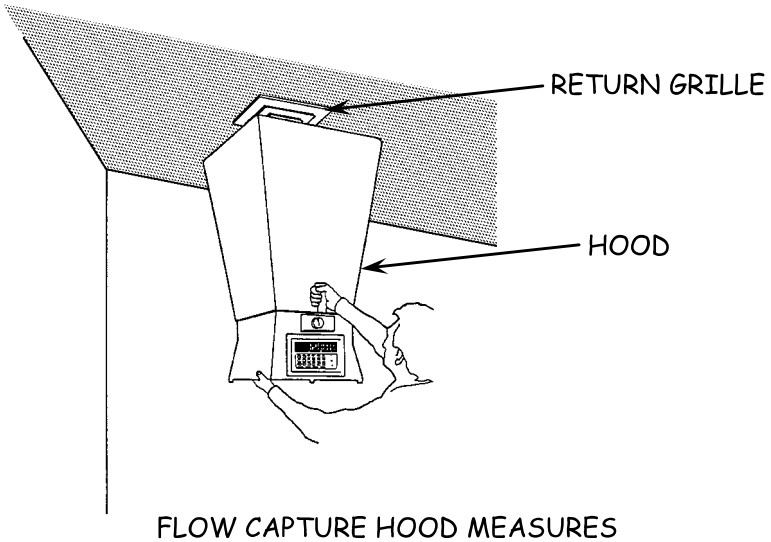
1. This method uses a flow capture hood, which is placed over a return grille to capture and measure the airflow going into the return system through that grille.
2. Flow capture hood measurement is a Title 24-approved method and can be a quick and easy method for measuring system airflow.

9.2 Protocol

1. For Title 24 duct testing, this procedure must be conducted in accordance with Title 24 Residential Appendix RA3.
2. *The following general guidelines are for reference only. Measurement shall be performed in accordance with test equipment manufacturer's instructions and Title 24 specifications.*

9.3 General Guidelines

1. Airflow measurement shall be taken at the return grille(s).
2. The hood must have a capture area at least as large as the return grille in all dimensions.
3. The supply registers must be in their normal operating position (dampers open or closed as they normally would be).



FLOW CAPTURE HOOD MEASURES
AIRFLOW ENTERING THE RETURN GRILLE

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PART 6: CALCULATIONS FOR AIRFLOW AND START/STOP CFM

10.0 START CFM (THRESHOLD) AND STOP CFM (TARGET)

10.1 Program Measure Duct Sealing

1. Applies to jobs (in all dwelling types) that are not subject to Title 24 requirements (an HVAC alteration[16] is not performed).
2. Start parameters
   a. Duct sealing is not required, unless initial leakage exceeds the threshold set by individual utility policy.
   b. Potential duct leakage reduction must be at least the percentage of system airflow set by individual utility policy.
3. Stop parameters
   a. Duct leakage reduction must equal or exceed the percentage of system airflow set by individual utility policy.
   b. Final duct leakage must be reduced to ≤15% of system airflow.
4. When stop parameters cannot be met, all accessible leaks must be sealed and verified by smoke tests.

10.2 Title 24 Duct Sealing

1. Applies to conventional homes in all CEC CZs when an HVAC system alteration occurs.[16]
2. Duct testing is always required, and duct sealing must be attempted if duct leakage exceeds 15% of system airflow.
3. Final duct leakage must meet one of the following primary standards/targets:
   a. Total leakage reduced to ≤15% of system airflow or
   b. Leakage to outside reduced to ≤10% of system airflow.[17]
4. If leakage cannot feasibly be reduced to one of the primary targets, all accessible duct leaks must be sealed, with smoke test and visual inspection performed by a HERS rater.

TABLE D-4: PROGRAM MEASURE DUCT SEALING VS. TITLE 24 DUCT SEALING

Program Measure Duct Sealing	
Start CFM_{25}	**Stop CFM_{25}**
Initial leakage per individual utility policy, and **potential reduction** per individual utility policy	Duct **leakage reduction** per individual utility policy, and **final leakage** reduced to ≤15% of airflow
Title 24 Duct Sealing	
Start CFM_{25}	**Total Leakage Stop CFM_{25}**
(Airflow) x (0.16)*	(Airflow) x (0.15)**

*Sealing is required only when duct leakage is *greater than* 15% of system airflow.

**When target cannot be reached, all accessible leaks are sealed and verified with a smoke test. Accessibility is addressed in the 2019 Title 24 Residential Compliance Manual, Section 9.4.6, "Alterations," under "HVAC Change-Outs" item E, "Accessible Ducts."

[16] HVAC alterations in conventional and modular homes that necessitate duct testing and sealing of the entire duct system are (A) installation of a new/replacement HVAC unit, (B) replacement of an HVAC component (air handler, outdoor condensing unit of a split system A/C or heat pump, or cooling or heating coil), or (C) installation or replacement of more than 40 feet of new/replacement ductwork in unconditioned space. Title 24 duct testing and sealing requirements do not apply to mobile homes.

[17] Title 24 measurement of leakage to *outside* requires using both a Duct Blaster and Blower Door together. For procedures, see test equipment manufacturer's instructions and Title 24 Residential Appendix RA3.

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11.0 AIRFLOW AND START/STOP CALCULATIONS

11.1 Determine Capacity to Estimate Airflow

1. Complete the line(s) applicable to the method(s) used to estimate capacity.
2. Estimate system airflow in accordance with Item 1.3.

11.2 Measured System Airflow

- Measure system airflow in accordance with Item 2.2.

TABLE D-5: DATA FORM FOR CAPACITY CALCULATION

(1a)	**A/C Condenser** (Heating & A/C or A/C-Only)		
	Mfr:	Model:	**A/C Tons:**[1]
(1b)	Floor Area Default[2]—Conditioned Space: _____ sq. ft.		**A/C Tons:**[3]
(2a)	**Gas Furnace** (Heating Only)[4]		
	Mfr:	Model:	**kBtu output:**
(2b)	Gas Meter Clocked[5]—(**Input** _____ kBtu) x (_____ % efficiency) =		**kBtu output:**
(2c)	Floor Area Default[6]—Conditioned Space: _____ sq. ft.		**kBtu output:**
(3)	**Electric Furnace** (Heating Only)[7]	From Nameplate/Label→	**CFM:**
	Mfr:	Model:	**Output:**

[1]See Table D-1. [2]See Step 3.4 (use only if nameplate info is not available). [3]See Equation D-2.
[4]See Section 4.0. [5]See Step 4.2 (preferred method when nameplate is not available).
[6]See Step 4.3 (use only when other methods are not feasible). [7]See Section 5.0.

TABLE D-6: AIRFLOW AND START/STOP CRITERIA—PROGRAM MEASURE DUCT SEALING

System	Capacity (Units)	CFM per Unit	Airflow (units) x (CFM/unit)	Start CFM Leakage ≥ IOU Policy %	Stop CFM Final CFM ≤ 15% Airflow
A/C	Tons	400	CFM	CFM_{25}	CFM_{25}
Gas Furnace	kBtuh	21.7	CFM	CFM_{25}	CFM_{25}
Electric Furnace	(per Section 5.0)		CFM	CFM_{25}	CFM_{25}
Measured Airflow (per Part 5)			CFM	CFM_{25}	CFM_{25}

TABLE D-7: AIRFLOW AND START/STOP CRITERIA—TITLE 24 DUCT SEALING[18]

System	Capacity (Units)	CFM per Unit	Airflow (units) x (CFM/unit)	Start CFM (airflow) x (0.16)	Stop CFM_T[19] (airflow) x (0.15)	Stop CFM_O[20] (airflow) x (0.1)
A/C	Tons	400	CFM	CFM_{25}	CFM_{25}	CFM_{25}
Gas Furnace	kBtuh	21.7	CFM	CFM_{25}	CFM_{25}	CFM_{25}
Electric Furnace	(per Section 5.0)		CFM	CFM_{25}	CFM_{25}	CFM_{25}
Measured Airflow (per Part 5)			CFM	CFM_{25}	CFM_{25}	CFM_{25}

[18] Step 11.3 is for crew convenience only. Title 24 procedures must be followed, CEC Residential Compliance Forms must be completed, and HERS verification must be obtained when required.

[19] **Stop CFM_T** applies when ***T**otal Leakage* is measured. Must be ≤*15%* of system airflow, so CFM_T can be (airflow x 0.15), but 14% allows for a margin of error.

[20] **Stop CFM_O** applies when *Leakage to **O**utside* is measured. Must be ≤*10%* of airflow, so CFM_O can be (airflow x 0.10), but 9% allows for a margin of error.

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APPENDIX -E-

LEAD-SAFE WEATHERIZATION RISK FACTORS

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APPENDIX -E-
LEAD-SAFE WEATHERIZATION RISK FACTORS

1.0 INTRODUCTION

This appendix provides guidance applicable to the ESA Program administered by the California investor-owned utilities. An important ESA Program goal is to enhance customers' quality of life without creating an adverse condition in the home, which includes contractors conducting all efficiency-related activities in a manner that ensures the health and safety of both workers and occupants.

ESA Program contractors and their subcontractors must follow all applicable local, state, and federal laws and regulations pertaining to lead-based paint and lead hazards. They must be aware of the potential hazards and conduct all activities in a "lead-safe" manner, to avoid contaminating homes with lead-based paint dust and debris, and to avoid exposing the customers, themselves, and their families to those hazards.

Lead-based paint and other leaded coatings can often be found on residences built before 1978, including mobile homes (that have been hand painted). Cutting, drilling, scraping, or disturbing these surfaces during weatherization and efficiency activities can generate lead dust that can poison children, adults, and workers if inhaled or ingested. Therefore, lead-safe work practices must be used whenever paint is disturbed in pre-1978 homes.

Appendix E contains a table of "risk factors" associated with energy efficiency measures; however, it is beyond the scope of this appendix to provide a detailed list of lead-safe practices. This can be found in various publications from sources such as those shown in the graphic in Section 3.2.

2.0 LEAD-RELATED REGULATIONS

Weatherization contractors are required to follow all regulations when weatherizing homes. With lead-based paint, there are a number of regulations that need to be followed:

- Local lead-based paint regulations (check local codes)
- CDPH, CCR Title 17, Chapter 8 Accreditation, Certification and Work Practices for Lead-Based Paint and Lead Hazards
- EPA RRP Rule
- HUD Lead-Safe Housing Rule, 24 CFR Part 35
- CalOSHA Title 8, Section 1532.1

2.1 CDPH Lead Regulations

In California, it is illegal to create a "lead hazard" while performing work on a residential structure built before 1978. A lead-hazard is defined as "disturbing lead-based paint or presumed lead-based paint on a residential structure built before 1978 without containment." Presumed lead-based paint is defined as: "any paint or coatings attached to a residential structure built before 1978 that has not been tested to determine the lead content." Therefore, everyone must presume painted surfaces on homes built before 1978 are leaded, unless the home is tested and determined to be lead-free.

California lead regulations require that anyone disturbing pre-1978 paint must use the following lead-safe work practices:

1. Contain—Use a system, process, or barrier to contain lead hazards inside a work area. (Lead-safe practices are considered "containment.")
2. Clean—Ensure that the work area has no visible dust or debris following the completion of a project.

3. Comply—Upon request, be able to demonstrate compliance with items 1 and 2 above to the regulatory department or a local enforcement agency (environmental health, environmental agency, housing department, or building department).

Under the CDPH lead rules, there are no additional training, certification, or paperwork requirements for contractors other than appropriate application of these three lead-safe work practices. However, additional regulations in these areas are part of the EPA RRP and HUD regulations that are also in effect for lead-safe practices.

2.2 EPA RRP Rule

In April 2010, the EPA RRP Rule went into effect, requiring all contractors/firms performing renovation, repair, and painting projects that disturb lead-based paint in pre-1978 homes, child care facilities, and schools to become certified firms and use certified renovators to supervise work.

The RRP Rule does not apply to any renovation activity:

- On residential structures, child-occupied facilities, or school structures built after 1977.
- If no lead-based paint is present on affected components.
- On minor repair and maintenance activities that disturb less than the de minimis levels listed below.

The RRP Rule does apply to:

- Window replacement, demolition, and activities involving prohibited practices.
- Minor repair and maintenance activities that disturb more than the de minimis levels listed below.

The EPA's *de minimis* levels are:

- 6 sq. ft. of paint disturbance in any one interior room or
- 20 sq. ft. on exterior surfaces.[1]

2.3 EPA-Certified Firm Requirements

The EPA RRP Rule requires that all contractors/firms performing renovation, repair, and painting projects that disturb lead-based paint in pre-1978 homes, childcare facilities. and schools be certified by the EPA.

Renovation is defined as "any activity that disturbs painted surfaces and includes most repair, remodeling, and maintenance activities, including window replacement." Weatherization is included in the activities that trigger this rule. To become certified, a contractor/firm must submit to the EPA a completed "Application for Firms" signed by an authorized agent of the firm and pay the correct amount of fees ($300 for the 5-year certification).

EPA-certified firms are required to:

- Use certified renovators who are trained by EPA-approved training providers to follow lead-safe work practices. (A certified firm is not required to have a certified renovator on staff; however, it is considered a best practice for the weatherization program.)
- Provide owners, tenants, and/or child-care facilities with a copy of the EPA's lead hazard information pamphlet and obtain a signed acknowledgement before beginning work.
- Use lead-safe work practices when disturbing leaded or presumed leaded surfaces.
- Document lead paint identification, safe practices, thorough cleaning, and cleaning verification.
- Retain documents for three years.

Information and certification applications are available on the EPA's website (www.epa.gov/lead).

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[1] HUD Lead-Safe Housing Rule, 24 CFR 35, subparts B–R, page 70.

2.4 EPA-Certified Renovator Requirements

Certified renovators are responsible for ensuring overall compliance with the Lead-Based Paint Renovation, Repair, and Painting Program's requirements for lead-safe work practices. To become a certified renovator, a person must attend a one-day, EPA-accredited RRP training program.

A certified renovator:

- Determines if compliance with the RRP Rule is required.
- Must use an EPA recognized test kit to determine whether components affected by the renovation contain lead-based paint or assume lead-based paint is present for housing and buildings covered by this rule, unless testing is done that determines the components affected are lead-free. (See note below.)
- Must determine the type and extent of lead-safe work practices at each job site and provide on-the-job training to other workers (who have not taken the certified renovator training course) on the lead-safe work practices to be used in performing their assigned tasks.
- Must be physically present at the work site when warning signs are posted, while the work area containment is being established, and while the work area cleaning is performed.
- Must regularly direct work being performed by other individuals to ensure that the work practices are being followed, including maintaining the integrity of the containment barriers and ensuring that dust or debris does not spread beyond the work area.
- Must be available, either on-site or by telephone, at all times when renovations are being conducted.
- Must perform work site cleaning verification.
- Must have with them at the work site copies of their initial course completion certificate and their most recent refresher course completion certificate.
- Must prepare the required records. (For a sample checklist of required records, see www.epa.gov/lead/pubs/samplechecklist.pdf.)
- Must be recertified every five years.

Note: The CDPH does not allow the use of lead test kits to make a determination about the presence or absence of lead, no matter how much area may be disturbed. Currently, CDPH only recognizes the use of an x-ray fluorescence (XRF) spectrometer or identification by a certified laboratory test to identify the presence of lead. Because the EPA and CDPH both hold jurisdiction under the weatherization program, the most stringent applies (which is CDPH, regarding the test kits). However, CDPH also permits contractors to presume that lead is present for pre-1978 dwellings and if they apply lead-safe practices when working on those homes, then no testing of any kind is required.

2.5 EPA RRP Prohibited Practices

Prohibited methods—The EPA does not allow the following equipment/methods to be used:

- Open-flame burning or torching of painted surfaces
- Heat gun above 1,100ºF
- Machines designed to remove paint or other surface coatings through high-speed operation such as sanding, grinding, power planning, needle gun, abrasive blasting, or sandblasting unless such machines have shrouds or containment systems and are equipped with a HEPA vacuum attachment to collect dust and debris at the point of generation.

2.6 EPA RRP Compliance

Weatherization contractors and their subcontractors are required to be EPA-certified firms. Each firm is required to use a certified renovator to assess the needs of each lead-safe job

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and be on-site during work to ensure that crews follow lead-safe practices for containment and clean-up when de minimis levels will be exceeded by weatherization activities.

While the EPA's containment and cleaning practices themselves are not different from standard lead-safe weatherization practices, the rule requires certified renovators to certify and document that workers have complied with these practices and conduct a visual inspection and cleaning verification process when the project is completed.

2.7 HUD Lead-Safe Housing Rule

HUD's lead regulations (24 CFR Part 35) apply to work performed on residences funded by federal housing programs such as:

- Housing receiving a federal subsidy that is associated with the property rather than with the occupants (project-based assistance).
- Public housing.
- Housing occupied by a family receiving a tenant-based subsidy (i.e., Section 8 voucher or certificate).
- Housing receiving federal assistance for rehabilitation, reducing homelessness, and other special needs.

When weatherization work is conducted on pre-1978 federally-funded housing, HUD's Lead-Safe Housing Rule must be followed if:

- Lead-based paint or lead hazards are present (or presumed to be present) and
- More than the HUD de minimis level of paint will be disturbed. Note: If less than the de minimis level will be disturbed, the Lead-Safe Housing Rule does not apply.

HUD's de minimis levels are:

- 2 square feet of paint disturbance in any one interior room or
- 10 percent of the surface area of small building components and/or
- 20 square feet on exterior surfaces.

HUD's Lead-Safe Housing Rule requires that the following lead-safe work practices be followed:

- Occupant protection—Occupants may not enter worksite.
- Worksite preparation and containment—It is required to use practices to minimize the spread of lead dust, paint chips, soil and debris, and place warning signs at entries to work areas.
- Prohibited methods—The following practices/methods shall not be used:
  - Open flame burning or torching,
  - Heat guns above 1100°F for charring the paint,
  - Machine sanding or grinding without a HEPA local exhaust control,
  - Dry scraping or sanding farther than 1 ft. of electrical outlets, and
  - Paint stripping in a poorly ventilated space using a volatile stripper that is a hazardous substance in accordance with regulations of the Consumer Product Safety Commission at 16 CFR 1500.3 and/or a hazardous chemical in accordance with the OSHA regulations at 29 CFR 1910.1200 or 1926.59, as applicable to the work.
- Worksite clean-up—HEPA vacuuming and detergent/wet-wash cleaning is required.

2.8 HUD Compliance

In order to comply with HUD guidelines, a clearance inspection conducted by a certified inspector/assessor or clearance technician is required when the project is completed. A key difference between EPA RRP and HUD is the clearance procedure because the EPA RRP allows the inspection to be done by a certified renovator while the HUD program guidelines require that the clearance inspection be conducted by a certified inspector/assessor or clearance technician.

3.0 LEAD-SAFE WEATHERIZATION "RISK FACTORS"

Weatherization efficiency measures and activities have been placed into three risk categories, based on their likelihood of generating hazardous amounts of lead dust and debris. The categories are "High-Risk," "Low-Risk," and "No-Risk" activities. The list of measures/activities on the following pages is not all-inclusive and only represents instances in which there may exist the probability of disturbing lead-based paint in a conventional or mobile home unit built before 1978. Actual risk must be assessed by, and appropriate containment and cleaning methods shall be prescribed by, the onsite certified renovator.

3.1 Risk Factor Icon

Lead Paint Risk Factor
LOW-HIGH

Standardized risk factors for each weatherization/efficiency measure/activity are identified in each section of the California IS by an emblem like the one shown here. However, in pre-1978 dwellings, any painted surface that is disturbed should be considered to contain at least a "low risk" unless testing has proven otherwise. Additional information on lead safety may be obtained from organizations identified in the graphic in Section 3.2.

3.2 Lead-Safe Information Resources

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH

Childhood Lead Poisoning Prevention Branch
850 Marina Bay Parkway
Building P, Third Floor
Richmond, CA 94804-6403

Lead Hotline: 1-800-597-LEAD (5323)
Ph: (510) 620-5600
Fax: (510) 620-5656
www.cdph.ca.gov/programs/CLPPB

NATIONAL LEAD INFORMATION CENTER
1-800-424-LEAD (5323)

EPA United States Environmental Protection Agency

US EPA Region 9
75 Hawthorne St.
San Francisco, CA 94105
Ph: (415) 947-4280
www.epa.gov/lead

U.S. Department of Housing and Urban Development
Office of Lead Hazard Control and Healthy Homes (OLHCHH)
451 7th Street S.W.
Washington, DC 20410
Ph: (202) 755-1785
Fax: (202) 755-1000
https://www.hud.gov/program_offices/healthy_homes

4.0 RISK CATEGORIES

4.1 High Risk

High-risk activities are associated with weatherization measures that have the potential to generate significant quantities of lead dust and debris that may be hazardous and those that disturb more than the EPA RRP or HUD de minimis levels. Examples of high-risk activities

may include sawing door bottoms, planing doors, installing vents, replacing windows, drilling holes into painted surfaces, some minor home repair activities, etc. Such activities have been shown to produce significant amounts of lead hazards, if not done in a lead-safe manner utilizing advanced containment, lead-safe work methods, and adequate clean-up procedures. It is the responsibility of the Certified Renovator to determine the extent of the lead-safe containment and cleaning practices that must be performed appropriate to the amount of material disturbed.

4.2 Low Risk

Low-risk activities are associated with weatherization/efficiency measures that may generate minimal lead dust or debris if performed improperly. This applies when the amount of surface area to be disturbed is less than the EPA RRP or HUD de minimis levels (when applicable) and considered "minor repair" or maintenance. When conducting these activities, containment via lead-safe practices and thorough cleaning is required. Examples of potential low-risk activities include installing weatherstripping and some minor home repair activities (such as wall patching). While this type of work is not likely to disturb significant amounts of lead-based paint, it is again the responsibility of the certified renovator to determine the extent of the lead-safe containment and cleaning practices that must be performed appropriate to the amount of material disturbed.

4.3 No Risk

No risk activities include weatherization and efficiency measures that are unlikely to disturb painted surfaces. Examples include installation of attic insulation, thread-based compact fluorescent lamps, duct insulation, and other measures that do not disturb painted surfaces through their installation.

5.0 LEAD-SAFE RISK FACTOR EVALUATION TABLE

The Lead-Safe "Risk Factor" for each measure/activity must be evaluated before beginning work. Based on the types of work to be performed and the year the home was built, appropriate lead-safe weatherization practices must be employed.

To use Table E-1 below:

1. In Column 2, find the year of construction and other applicable criteria.
2. In Column 3, find the measures to be installed.
3. In Column 1, find the risk level associated with the work to be done.

TABLE E-1: LEAD-SAFE RISK FACTOR EVALUATION TABLE

Risk Level	Criteria	Measure/Activity
NO Risk	• Pre-1978 • No painted or coated surfaces disturbed. • If tested, no lead-painted surfaces disturbed. • Certified lead-free by an inspection. • Post-1977 residential structures. • Pre-1978 factory-painted mobile or manufactured homes.	• A/C (Central) and Heat Pump Replacement • A/C (Central) Tune-Up • Air Filters for Central HVAC • Air Purifiers • Attic Insulation • Attic Ventilation (roof vents) • Blower Motors • Clothes Dryer Replacement • Cold Storage • Cover Plate Gaskets

TABLE E-1: LEAD-SAFE RISK FACTOR EVALUATION TABLE

Risk Level	Criteria	Measure/Activity
NO Risk (cont.)		• Dishwashers • Duct Testing & Sealing • Efficient Fan Controller • Energy Efficient Freezers • Energy Efficient Variable Speed Pool Pump Replacement • Energy-Saver Showerheads & Faucet Aerators • Evaporative Cooler Installation • Evaporative Cooler Repair & Maintenance • Evaporative Cooler & A/C Vent Covers • Floor Insulation • Freezer Replacement • Furnace Cleaning and Tune-Up • Furnace (Central) Repair & Replacement • High Efficiency Clothes Washer • LED Downlight Retrofit Kits • LED Fixtures • LED Night Lights (SMJUs) • LED Screw-Based Bulbs • LED Torchieres • Microwave Ovens (SMJUs) • NGAT • Pilot Light Conversion • Portable A/C • Prescriptive Duct Sealing • Refrigerator Replacement • Smart Thermostats • Thermostatic Shower Valves • Thermostatic Tub Spout/Tub Diverter • Thermostats • Tier 1 Smart Power Strips • Tier 2 Advanced Power Strips • Water Heater Pipe Insulation • Natural Gas Water Heater Repair

TABLE E-1: LEAD-SAFE RISK FACTOR EVALUATION TABLE

Risk Level	Criteria	Measure/Activity
NO Risk (cont.)		• Natural Gas Storage Water Heater Replacement • Water Heater Tank Insulation
LOW Risk	• Pre-1978 • Minor disturbance of painted surfaces. • Less than 6 sq. ft. on interior surfaces disturbed as part of work activity. • No paint dust generating activity or paint pulverizing work activity.	• A/C (Window/Wall) and Heat Pump Replacement • Caulking • CO & Smoke Alarms • Diagnostic Air Sealing • Ductless Mini Split Heat Pumps • Energy Efficient Variable Speed Pool Pump Replacement • Evaporative Cooler Installation • Evaporative Cooler Repair & Maintenance • Furnace (Wall/Floor) Repair and Replacement • Glass Replacement • Heat Pump Water Heaters • LED Downlight Retrofit Kits • Minor Home Repair • Solar Water Heater • Vacancy Sensor Switches • Weatherstripping • Whole House Fan
HIGH Risk	• Pre-1978 • More than 6 sq. ft. of interior or more than 20 sq. ft. of exterior painted surfaces disturbed as part of work activity. • Painted surfaces in deteriorated condition, and disturbance is inadvertent. • Dust generating or paint pulverizing work activities.	• A/C (Window/Wall) and Heat Pump Replacement • Attic Ventilation (Eaves) • Diagnostic Air Sealing • Ductless Mini Split Heat Pumps • Evaporative Cooler Installation • Evaporative Cooler Repair & Maintenance • Exterior Door Replacement • Furnace (Wall/Floor) Repair and Replacement • Glass Replacement • Minor Home Repair • Solar Water Heater • Storm Windows and Doors (SMJUs)

TABLE E-1: LEAD-SAFE RISK FACTOR EVALUATION TABLE

Risk Level	Criteria	Measure/Activity
HIGH Risk (cont.)		• Whole House Fan • Window Replacement

APPENDIX -F-

MINIMUM WARRANTY REQUIREMENTS

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2.0 Minimum Warranty Requirements per Measure 1

APPENDIX -F-

MINIMUM WARRANTY REQUIREMENTS

1.0 INTRODUCTION

1.1 This appendix lists warranty requirements, in accordance with state-wide policy, for each measure installed in the ESA Program. These are *minimum* requirements. Each individual utility may have more stringent warranty requirements.

1.2 Warranty Categories/Types

1. Warranty requirements are divided into two categories:
   a. Contractor Warranty and
   b. Manufacturer Warranty.
2. Each category is subdivided into two types:
   a. Materials and
   b. Labor.

1.3 Warranty Time Periods

1. Time periods are stated in years, unless identified as being in days (e.g., "90 days").
2. The appearance of "n/a" in a field indicates that there is no warranty requirement for that category.
3. The appearance of "---" in a field indicates that, for that type of coverage, there is no warranty requirement.

1.4 Repair/Replacement: Within some fields, there is a time period for a unit that is repaired, indicated by "(Repair)," and a different time period for a unit that is replaced, indicated by "(Replacement)."

1.5 Component Type: Within some fields, the type of component for which the warranty period applies is indicated in parentheses. For example, for Sec. 12, Window Replacement:

1. "(IGU)" means the warranty period applies only to the insulated glazing unit (IGU).
2. "(Other)" means the warranty period applies to all other components of the window.

2.0 MINIMUM WARRANTY REQUIREMENTS PER MEASURE

IS Section No.	IS Measure	Contractor Warranty		Manufacturer Warranty	
		Materials	Labor	Materials	Labor
1	Caulking	1	1	10	n/a
2	Weatherstripping	1	1	3	n/a
3	Attic Insulation	1	1	1	n/a
4	Central A/C Tune-Up	1	1	1	n/a
5	Water Heater Tank Insulation	1	1	1	n/a
6	Water Heater Pipe Insulation	1	1	1	n/a
7	Cover Plate Gaskets	1	1	1	n/a
8	Energy-Saver Showerheads and Faucet Aerators	1	1	3 (showerheads) 1 (aerators)	n/a
9	Evaporative Cooler and A/C Vent Covers	1	1	1	n/a
10	Duct Testing and Sealing	1	1	1	n/a
11	Exterior Door Replacement	1	1	1	n/a

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IS Section No.	IS Measure	Contractor Warranty		Manufacturer Warranty	
		Materials	Labor	Materials	Labor
12	Window Replacement	1	1	10 (IGU) 3 (Other)	n/a
13	Glass Replacement	1	1	1	n/a
14	LED Screw-Based Bulbs	1	1	1	n/a
15	LED Fixtures	1	1	1	n/a
16	Window/Wall Evaporative Cooler Installation	1	1	5 (Pan) 1 (Other)	n/a
17	Refrigerator Replacement	1	1	1	n/a
18	Natural Gas Central Forced Air Heating System Repair and Replacement	1 (Replacement) 90 days (Repair)	1 (Replacement) 90 days (Repair)	5 (Compressor) 90 days (Other)	n/a
19	Natural Gas Wall and Floor Furnace Repair and Replacement	1 (Replacement) 90 days (Repair)	1 (Replacement) 90 days (Repair)	1 (Replacement) 90 days (Repair)	n/a
20	Smart Thermostats	1	1	1	n/a
21	Central High-Efficiency A/C and Heat Pump Replacement	1	1	5 (Compressor) 1 (Other)	n/a
22	Window/Wall A/C and Heat Pump Replacement	1	1	5 (Compressor) 1 (Other)	n/a
23	Natural Gas Storage Water Heater Replacement	1	1	5 (Tank) 1 (Other)	n/a
24	Natural Gas Appliance Testing (NGAT)	n/a	n/a	n/a	n/a
25	Blower Motor Retrofit	1	1	2	n/a
26	Furnace Cleaning and Tune-up	n/a	90 days	n/a	n/a
27	Thermostatic Shower Valves	1	1	1	n/a
28	High-Efficiency Clothes Washers	1	1	1	n/a
29	Forced Air Unit (FAU) Standing Pilot Light Conversion	90 days	90 days	90 days	n/a
30	Energy Efficient Variable Speed Pool Pump Replacement	1	1	1	n/a
31	Natural Gas Water Heater Repair	90 days	90 days	90 days	n/a
32	Efficient Fan Controller	1	1	1	n/a
33	Tier 1 Smart Power Strips	1	1	1	n/a
34	Vacancy Sensor Switches	1	1	1	n/a
35	LED Torchiere Replacement	1	1	1	n/a
36	Tier 2 Advanced Power Strips	1	1	1	n/a
37	LED Downlight Retrofit Kits	1	1	1	n/a
38	Thermostatic Tub Spout/Tub Diverter	1	1	1	n/a

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IS Section No.	IS Measure	Contractor Warranty		Manufacturer Warranty	
		Materials	Labor	Materials	Labor
39	Prescriptive Duct Sealing	1	1	1	n/a
40	Heat Pump Water Heaters	1	1	10	n/a
41	Energy Efficient Freezers	1	1	1	n/a
SA.1	Storm Windows and Doors	1	1	1	n/a
	Floor Insulation and Foundation Venting – Conventional Homes	1	1	1	n/a
	Floor/Undercarriage Insulation – Mobile Homes	1	1	1	n/a
SA.4	LED Night Lights	1	1	1	n/a
SA.5	Microwave Ovens	1	1	1	n/a
	Air Purifiers	1	1	1	n/a
	Clothes Dryers	1	1	1	n/a
	CO Alarms	1	1	10	n/a
	Smoke Alarms	1	1	10	n/a
	Combination CO & Smoke Alarms	1	1	10	n/a
	Cold Storage	n/a	n/a	1	n/a
	Diagnostic Air Sealing	1	1	1	n/a
	Dishwashers	1	1	1	n/a
	Ductless Mini Split Heat Pumps	1	1	7 (Compressor) 5 (Other)	n/a
	Evaporative Cooler Repair & Maintenance				n/a
	High Efficiency Wall Furnace	1	1	1	n/a
	Portable A/C	1	1	1	n/a
	Solar Water Heaters				n/a
	Whole House Fans	1	1	10	n/a

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SUPPLEMENT -A-

SMJU ESA PROGRAM DOCUMENTS

For specific program measures that may be provided to participants in the SMJUs' ESA Program, refer to the Statewide ESA Program P&P Table A-2.

This supplement includes Installation standards for additional measures that may be provided to participants through the SMJUs' ESA Program. At this time, these measures apply specifically to the SMJUs and do not apply to the IOUs.

- ***SA.1**: Storm Window and Door Standards*
- ***SA.4:** LED Night Lights*
- ***SA.5:** Microwave Ovens*

STORM WINDOWS AND DOORS

Lead Paint Risk Factor
HIGH

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SUPPLEMENT A.1 PREFACE
FOR
STORM WINDOWS AND DOORS

1. Nonfeasibility Criteria

1.1. An NGAT fail exists (including a CVA fail) that cannot be repaired.

1.2. The existing storm window/door is functioning properly, even if not installed in accordance with the IS.

1.3. Storm window installation is not feasible when the prime window:

a. Is dual-pane, or will be replaced with a dual-pane window.
b. Is decayed, dry rotted, or deteriorated.
c. Has a broken pane (must be repaired first).
d. Is in a sleeping room and does not meet egress requirement.

1.4. Storm door installation is not feasible when the entrance door:

a. Is insulated.
b. Is decayed or dry rotted, or has deteriorated sill, jambs, header, or casing, and repairs are not feasible.
c. Frame is not secure and cannot feasibly be repaired.
d. Swings outward.

1.5. Customer refuses.

2. Installation Policies

2.1. Type and movement of the storm window shall match that of the prime window.

2.2. The following types of storm windows may be installed:

a. Operable or fixed glass
b. Operable or fixed polycarbonate

2.3. When required by the local jurisdiction, a permit shall be obtained and finalized.

3. Safety Practices

3.1. Installation of this measure shall not cause a natural draft combustion appliance to spill or fail draft testing.

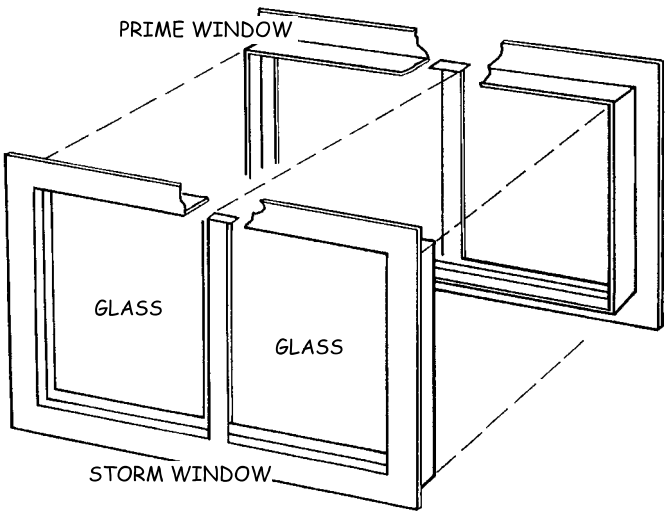
4. Installation Policies Specific to Mobile Homes

4.1. When required by HCD, a permit shall be obtained and finalized.

STORM WINDOW AND DOOR STANDARDS

1. APPROVED MATERIALS

- **Glass**
  - Conformance to AAMA 1701.2.
- **Safety glass**
  - Conformance to ANSI Z97.1 and permanently labeled.
- **Polished wire glass**
  - Conformance to ANSI Z97.1.
- **Plastic glazing**
  - UV and scratch-resistant polycarbonate, minimum 1/8".
  - Conformance to ANSI Z97.1.
- **Window glazing**
  - Glass recommended; plastic glazing acceptable.
  - Safety glass or polycarbonate where safety glazing is required.
- **Door glazing**
  - Safety glass or polycarbonate required.
- **Aluminum frame windows**
  - Conformance to ANSI/AAMA 1002.10.
- **Wood frame windows**
  - Conformance to Section 3 of ANSI/AAMA/NWWDA 101/I.S.2-97
- **Rigid vinyl frame windows**
  - UV resistant.
  - Conformance to ASTM D4099.
- **Hardware and fasteners**
  - Aluminum, stainless steel, or other non-corrosive material compatible with frame.
- **Sealants**
  - Glazing Tape
    - Closed cell foam, minimum 1/8" thick.
    - Conformance to ASTM C509.
  - Preformed Gaskets: Conformance to ASTM C509.
  - Caulk: Conformance to material specifications in IS Section 1 (Caulking).



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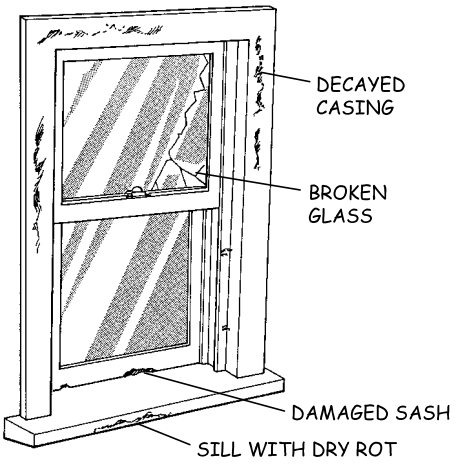
2. GLASS THICKNESS—CONVENTIONAL HOMES

- **Code**
  - Glass shall be selected in conformance with the currently-adopted California Residential Code (CRC).
- **Pane size**
  - The maximum pane size for each frame type and thickness of glass shall be in conformance with local code.

PRE-INSTALLATION REQUIREMENTS

3. PRIMARY WINDOWS AND DOORS

- **Existing components**
  - All existing components associated with the installation shall be structurally sound.
    - All necessary repairs shall be made to facilitate a proper storm unit installation.
    - Decay and dry rot damage shall be repaired in wooden members.
    - Water penetration points shall be sealed.



- **Mounting surface**
  - All mounting surface contact areas shall be smooth, clean, and free of protrusions.
- **Glass repairs shall be made as needed:**
  - Cracked and broken panes shall be replaced.
  - Small holes 1/4" or less in diameter may be sealed with clear silicone caulk or clear glass repair tape.
- **Glazing compound**
  - Loose and missing glazing compound shall be replaced.
- **Bare wood**
  - Sealer is required on all bare wood, except redwood, before installing storm unit.

4. PRIMARY WINDOWS

- **Air/moisture sealing**
  - Bypasses shall be repaired to prevent moisture accumulation between the primary and storm windows.

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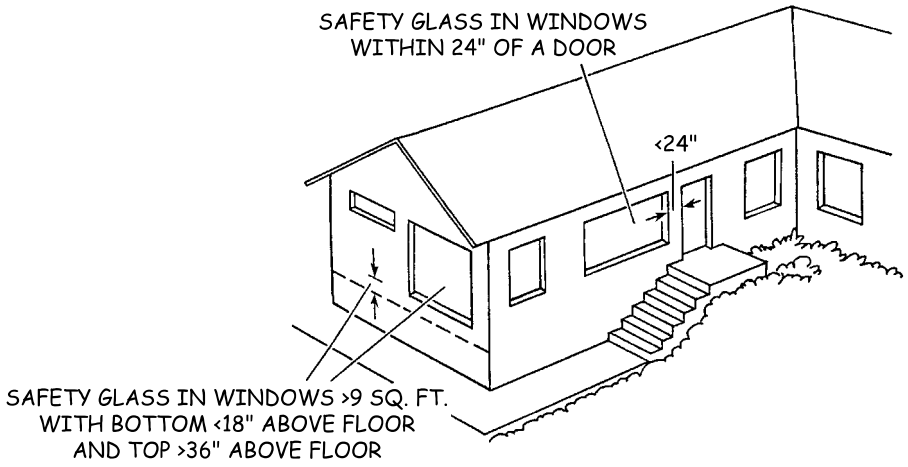
5. PRIMARY DOORS

- **Door bottom**
  - The threshold shall provide adequate surface for sweep contact and proper bottom seal of the storm door.

INSTALLATION REQUIREMENTS

6. SAFETY GLASS—CONVENTIONAL HOMES

- **Windows and doors**
  - Storm windows/doors shall have safety glazing in locations where it is required.
  - Safety glass shall be permanently labeled and installed in accordance with the CRC Section 308, part of which is summarized below.
- **Windows**
  - Safety glazing is required in any window adjacent to a door where:
    - The nearest vertical edge is within 24" of the door, and
    - The bottom edge is *less* than 60" above the floor.
    - *Exception:* *Not* required when there is an intervening wall or other permanent barrier between the door and the glazing.
  - Safety glass is required in panes *larger* than 9 sq. ft. where:
    - The bottom edge is *less* than 18" above the floor, and
    - The top edge is *more* than 36" above the floor, and
    - A walking surface is within 36" horizontally of the window.
    - *Exception:* As specified in the CRC Section 308.



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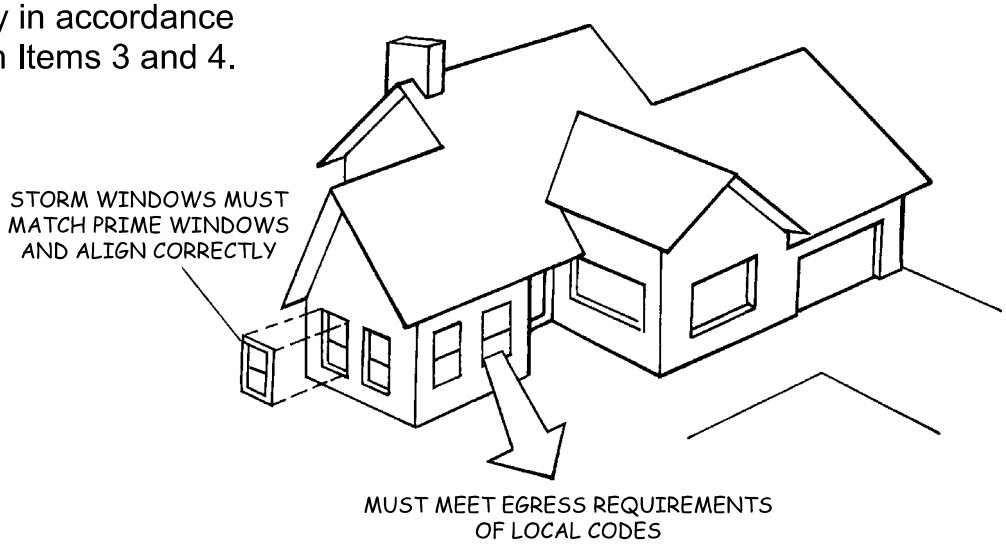
- **Entrance doors with glazing**
  - Safety glass is required in all doors with glazing.
  - *Exceptions:* (a) jalousie windows, and (b) windows with panes *less* than 3" in width or height.
- **Plastic glazing**
  - Polycarbonate may be used in lieu of safety glass.

7. TYPE, SIZE, AND SHAPE

- **Storm windows**
  - Egress windows in conventional homes shall conform to Item 8.
  - Type, size, and shape of the storm window shall match the primary window.
  - Storm window frames, muntins, and meeting rails shall align with those of the primary window.
- **Interior storm windows**
  - Windows built for interior use shall be installed only on the interior.
  - Windows installed on the interior shall not contain solar control glazing or film.
- **Exterior storm windows**
  - Windows built for exterior use shall be installed only on the exterior.
  - Clear glazed storm windows shall not be installed outside of primary windows with tinted glass or solar control film.
- **Operable primary windows**
  - Fixed storm windows may be installed over operable primary windows:
    - only on the interior, and
    - only in accordance with Items 3 and 4.



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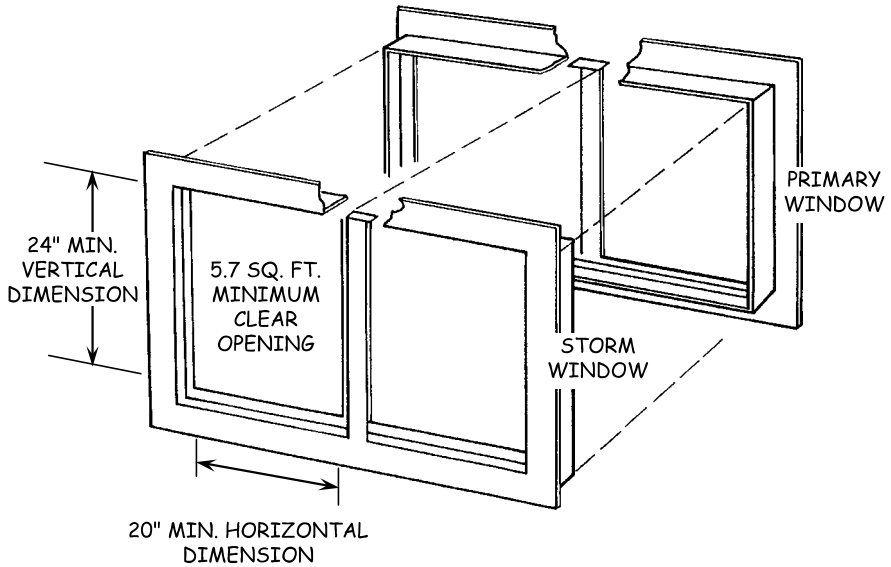
- **Storm doors**
  - The storm door shall match the primary door size and type.
    - Shall be hinged compatibly with the primary door, or
    - Shall slide the same as the primary door.

8. EGRESS WINDOWS—CONVENTIONAL HOMES

- **All storm windows**
  - Storm windows placed in emergency egress locations (bedrooms) shall be installed in conformance with local codes.
- **Opening size**
  - Storm windows shall have a clear opening which is no smaller than that of the primary window and conforms to the following egress opening requirements:
    - Minimum clear horizontal dimension = 20".
    - Minimum clear vertical dimension = 24".
    - Minimum clear opening area = 5.7 sq. ft.
      - *Exception:* Grade floor or below-grade openings = ≥5.0 sq. ft.
- **Non-conforming primary windows**
  - Operable storm windows shall not be installed in egress locations where the primary window clear opening is non-conforming.
- **Defective primary windows**
  - A primary egress window shall operate properly before a storm window may be installed.



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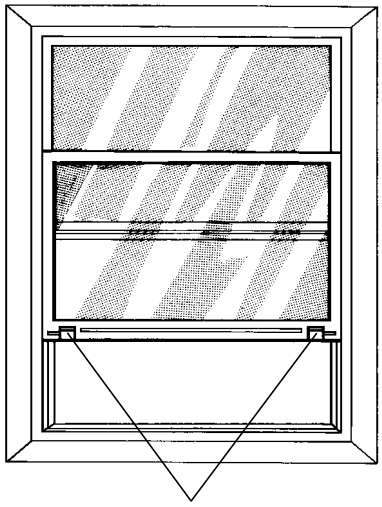
9. SASH REQUIREMENTS

- **All storm windows**
  - Moveable Lites and Sash Panels
    - Windows shall be constructed to allow easy and accessible removal of moveable lites and fixed sash panels for cleaning, “set-aside” storage, and egress.
    - Such removal shall not require special tools.
  - Sash Operation
    - All operable windows shall be operable from inside the home.
    - All removable lites and sash panels shall be free of sharp edges or other conditions which could cause injury during normal use.
- **Vertical sliders**
  - Sash travel shall be controlled to prevent “free fall”.
  - All vertical sliders shall be equipped with one of the following:
    - An automatic sash lock mechanism which stops at the next lower latch position when the sash is allowed to drop.
    - A pressure/friction system which will effectively prevent “free fall”.



AUTOMATIC LATCHES
OR A FRICTION SYSTEM
REQUIRED TO PREVENT “FREE FALL”

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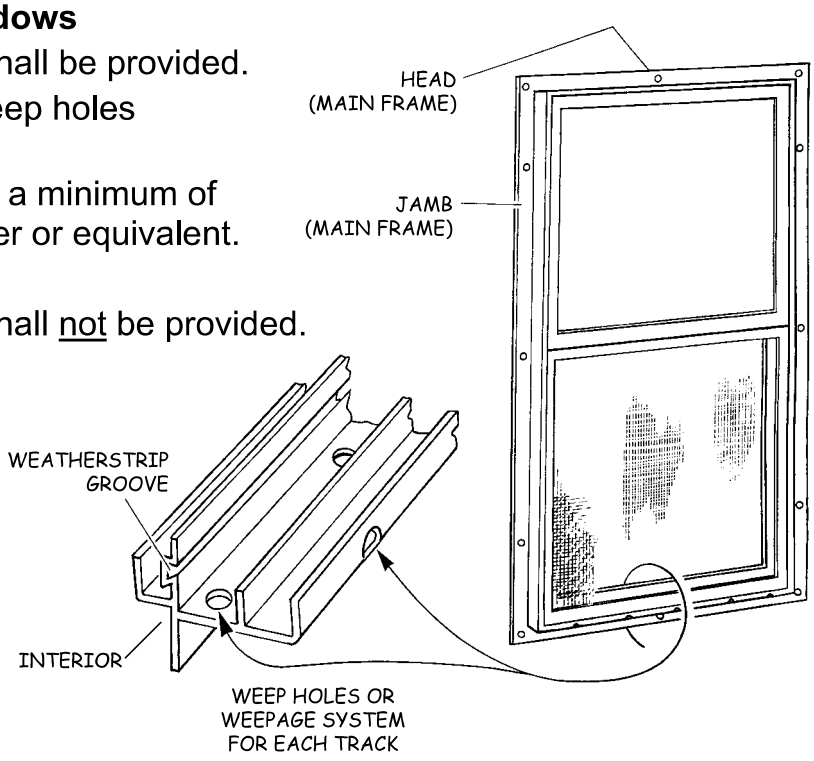
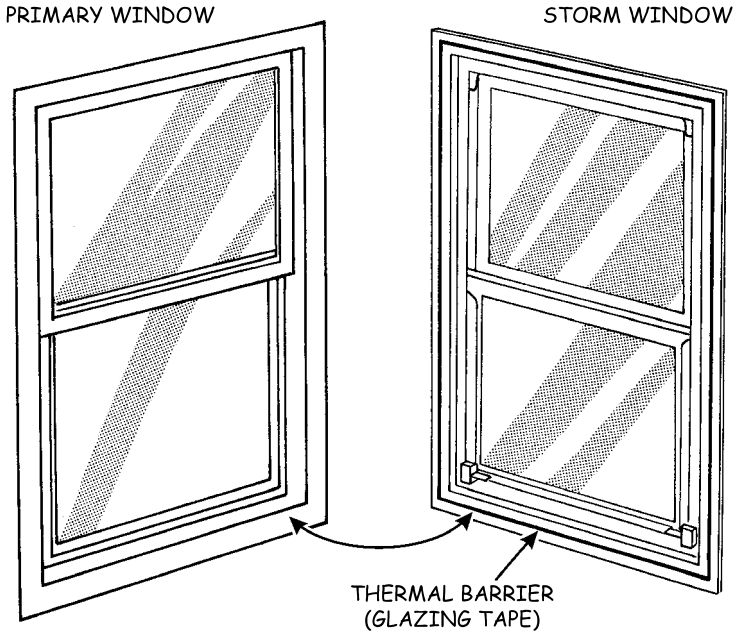
10. WEEP SYSTEM

- **Exterior storm windows**
  - A weep system shall be provided.
    - Minimum 2 weep holes per track.
    - Holes shall be a minimum of 1/8" in diameter or equivalent.
- **Interior storms**
  - A weep system shall not be provided.



11. THERMAL BARRIER

- **Metal storm windows and doors**
  - A thermal barrier shall be installed to prevent metal-to-metal contact between metal primary and storm units.
  - Barrier shall be:
    - Glazing tape, gasket, or elastomeric material.
    - Minimum 1/8" thick.



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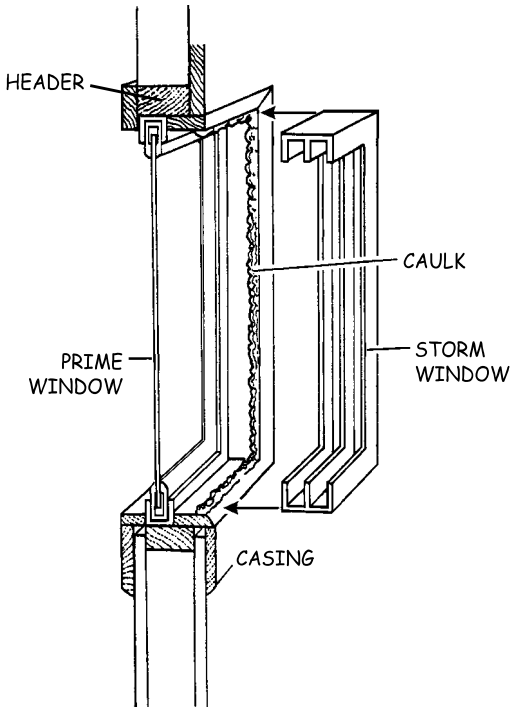
12. CORROSION PREVENTION

- **Storm windows and doors**
  - Dissimilar materials shall be separated by a non-corrosive material, such as:
    - Glazing tape, gasket, or elastomeric material.
    - Minimum 1/8" thick.

13. SEALING

- **Storm windows and doors**
  - Sealants shall be resilient, non-hardening, long-life materials.
  - All framed storm units shall be installed with a permanent airtight seal between the storm frame and the mounting surface.
  - All joints and gaps over 1/32" shall be sealed.
  - All exterior attachment penetrations shall be watertight.
  - Weep holes shall not be sealed.
- **Interior storm windows**
  - The storm windows shall be sealed tighter than the exterior primary window.
- **Framed interior storm windows**
  - The frame shall be installed using glazing tape, caulking, or other effective sealant between the storm frame and the mounting surface, so that a complete and permanent seal is provided around the entire perimeter of the storm window.
- **Unframed interior storm windows**
  - The mounting surface shall be sealed with a minimum 1/8" thick closed cell foam tape or equivalent.
  - Panels attached with continuous magnetic strips require no additional gaskets, if the attachment system provides an airtight seal.



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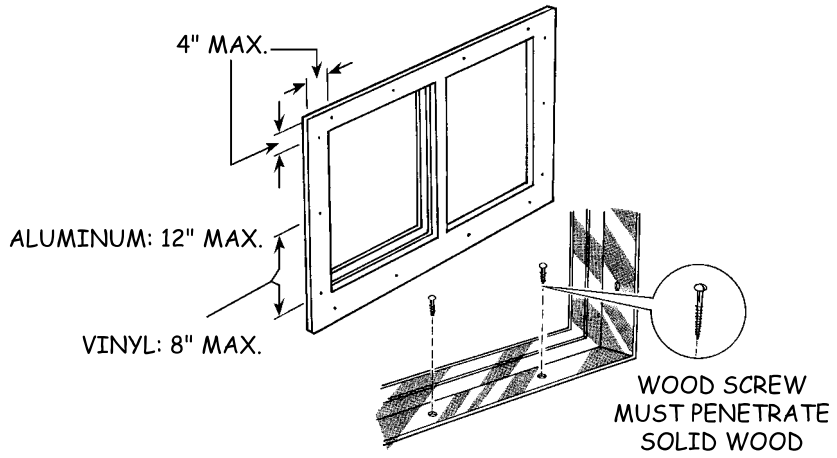
14. AIR SPACE

- **All storm windows**
  - The space between the storm and primary windows shall range between 1/2" and 4".

15. ATTACHMENT

- **All storm windows and doors**
  - Installation of storm products shall conform to manufacturer's instructions and applicable code.
  - Attachment of the storm window/door shall in no way impede the proper operation of the primary window/door.
- **Exterior storm windows**
  - Frames shall be permanently anchored with corrosion-resistant screws per manufacturer's instructions or the following guidelines, whichever is more stringent.
  - Screws into Wood
    - Screws anchoring into solid wood shall penetrate the wood at least 3/4".
    - Screws shall be placed within 4" of each corner.
  - For metal frames:
    - Additional screws shall be placed 12" apart maximum.
    - Minimum of 3 screws on each side exceeding 18" in length.
  - For vinyl frames:
    - Additional screws shall be placed 8" apart maximum.
    - Minimum of 3 screws on each side exceeding 14" in length.



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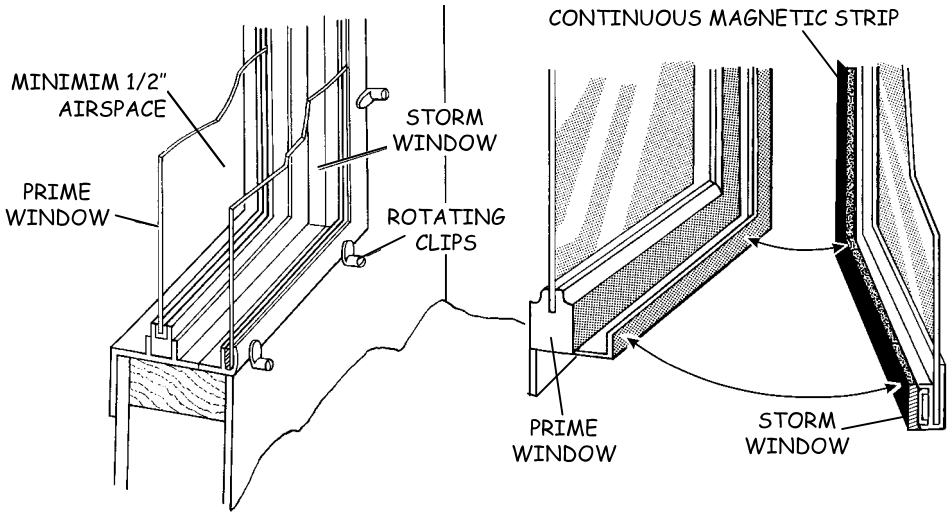
15. ATTACHMENT (cont.)

- **Framed interior storm windows**
  - Windows with mounting fins shall be installed as prescribed above for exterior storm windows.
  - Block frame windows (without fins):
    - Shall be securely attached within the prime window opening with screws.
    - Minimum 2 screws per jamb, for preassembled frames.
    - Minimum 2 screws per piece, when jambs, header, and sill are independent.
    - Shims shall be installed, as needed, to prevent torqueing or warping the frame.
- **Unframed fixed interior storm windows**
  - Applies to windows not in egress locations.
  - When secured with rotating clips:
    - Clips shall be located within 4" of each corner, and
    - Elsewhere, as needed, to provide a tight seal around the entire sash perimeter.
  - When secured with magnetic strips, attachments shall:
    - Be permanently bonded to the sash and mounting surface.
    - Have sufficient holding strength to retain the panel securely and maintain an airtight seal.



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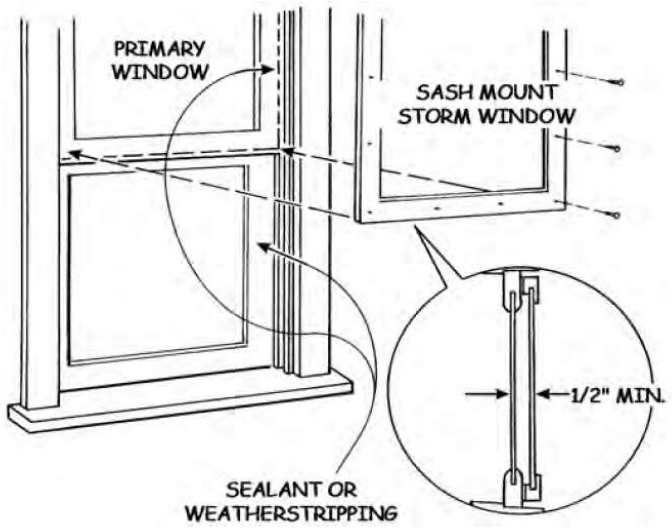
- **Sash mount storm windows**
  - Storm sash shall be securely attached to prime sash with screws:
    - Within 4" of each corner, and
    - Elsewhere as required to create a complete seal.
  - Perimeter of storm sash shall be made airtight with sealant or weatherstripping.
  - Minimum 1/2" air space between storm and prime windows.



16. PRIME WINDOW OPERATION

- **Permanently mounted "self-storing" operable storm windows**
  - Openable prime windows shall remain operable without removal of storm window sash or frame.
  - Interior access to prime window latches shall not be impaired.

POST-INSTALLATION REQUIREMENTS

17. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices shall be:**
  - Employed when working with pre-1978 painted materials per state codes T8 Section 1532.1 and T17 Section 36000, et seq.
  - Applied in accordance with guidelines in Appendix E.

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- **Operating instructions**
  - The customer shall be provided with both written and verbal instructions for the maintenance, safe operation, and/or removal of all storm windows. This includes specific instructions for egress windows, when applicable.
  - Instructions shall be in a durable form.
  - When supplied by the manufacturer, lubricant and maintenance instructions shall be provided to the customer.
  - Compliance with these requirements shall be verified by customer signature on the work order.
- **Cleanup**
  - All scraps, packing materials, and debris shall be cleaned up and removed from the premises.
  - Home furnishings moved during installation shall be returned to their original positions.

MOBILE HOME CRITERIA

18. GLASS THICKNESS AND WEIGHT REQUIREMENTS

- **Panel Weight**
  - When installed in egress windows, removable panels requiring "set-aside" storage shall have a maximum weight of 20 lbs.
- **Pane Size**
  - The maximum pane size for each frame type and thickness of glass shall be as specified in Table SA.1-1, or as required by HCD, if different.

TABLE SA.1-1: GLASS THICKNESS AND MAXIMUM LITE SIZE – MOBILE HOMES

Glass Thickness[1]	MAXIMUM LITE SIZE
Single Strength (SS)	11 sq. ft.
Double Strength (DS)	15 sq. ft.
3/16" Plate	30 sq. ft.
1/4" Plate	43 sq. ft.
[1] Based on Title 25, Section 4070, §280.403.	

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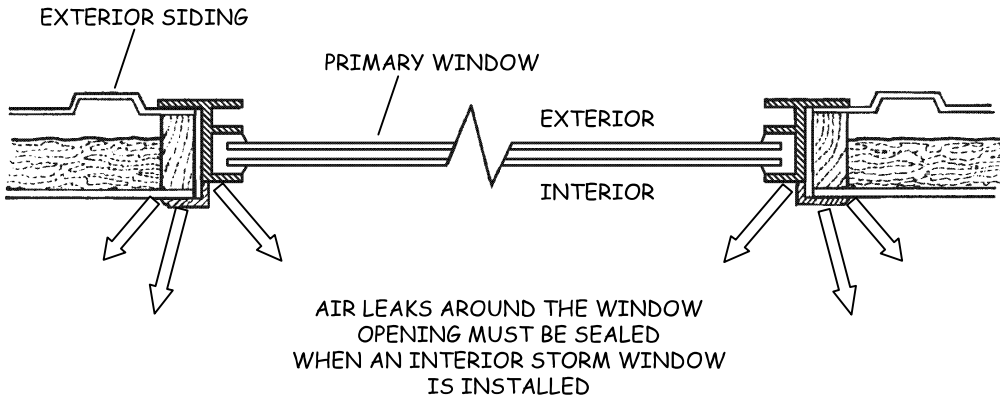
19. PRE-INSTALLATION REQUIREMENTS—MOBILE HOMES

- **Primary Windows**
  - Significant bypasses shall be repaired to prevent moisture accumulation between the primary and storm windows.
    - Leakage at the glass perimeter shall be sealed by such means as:
      - Replacing missing or damaged gasket material when feasible.
      - Neatly sealing the perimeter with clear silicone or equivalent, when gasket cannot be replaced.
      - Worn or damaged weatherstripping shall be replaced if possible.



  - All air infiltration bypasses to the wall cavity shall be repaired for interior storm window applications.
- **Primary Doors**
  - The sill shall provide adequate surface for sweep contact and proper bottom seal of the storm door.

20. EGRESS WINDOWS—MOBILE HOMES

- **All Storm Windows**
  - Windows placed in emergency egress locations (sleeping rooms) shall be installed in conformance with AAMA 1704.
- **Defective Primary Windows**
  - A storm window shall not be installed over a primary egress window that does not operate properly.

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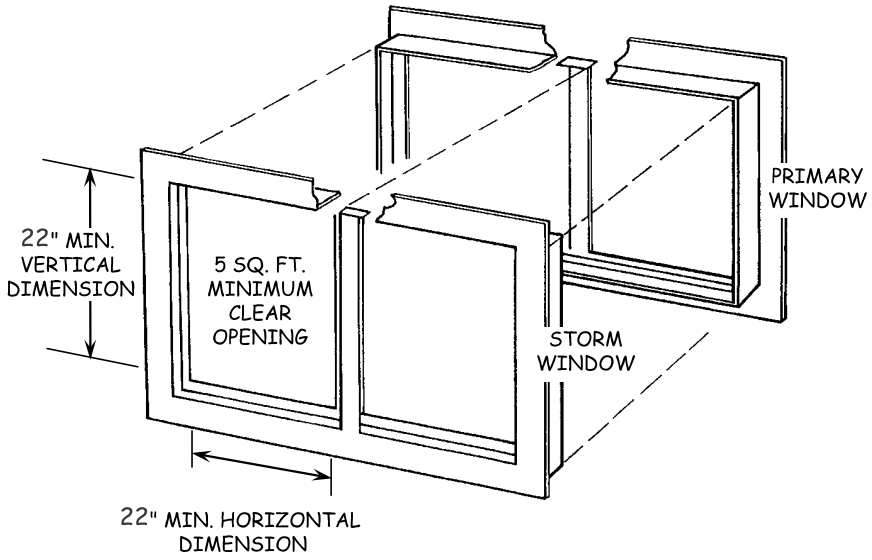
- **Opening Size**
  - Storm windows shall have a clear opening which is the greater of:
    - The primary window clear opening, or
    - The following egress opening requirements:
      - Minimum clear openable area = 5.0 sq. ft.
      - Minimum clear openable horizontal dimension = 22".
      - Minimum clear openable vertical dimension = 22".
  - The bottom of the window opening must be ≤36″ above the floor.



- **Operable Interior and Exterior Storm Windows**
  - The horizontal or vertical force required to open the window for egress shall not exceed 20 lbs.
  - Windows shall have a maximum of 2 locks or latches that require operation to achieve egress.

21. SAFETY GLASS—MOBILE HOMES

- **Windows and Sliding Glass Doors**
  - Safety glazing is required in all entrance doors, sliding glass doors, storm doors, and in panels within 12″ on either side of entrance doors.
- **Standards**
  - Compliance with ANSI Z97.1.

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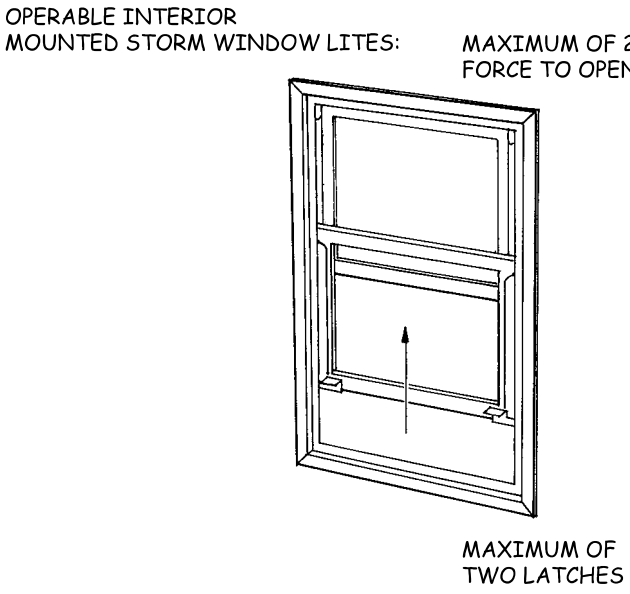
22. INSTALLATION—MOBILE HOMES

- **Fixed Storm Windows**
  - Shall be installed only on the interior.
  - Removable lites and panels (with or without sash) which require "set aside" for egress shall:
    - Have a maximum weight of 20 lbs.
    - Be removable by application of force not to exceed 20 lbs.
  - Storm windows that are held in place with pivot or swivel devices (rotating clips) shall have no more than 4 such devices requiring operation for egress.
    - Rotating clips shall be placed a maximum of 54" above the floor.
    - Rotating clips shall turn to open by application of force not exceeding 5 lbs.
- **Sealing**
  - All sealing of storm windows or doors for mobile homes shall be in compliance with Item 13 of this section.



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LED NIGHT LIGHTS

Lead Paint Risk Factor
NONE

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2. Warranty 1

3. Installation 1

4. Lead-Safe Weatherization and Post-Installation Requirements 2

MOBILE HOME CRITERIA 2

SUPPLEMENT A.4 PREFACE
FOR
LED NIGHT LIGHTS

1. Nonfeasibility Criteria

1.1. Receptacle is not properly secured, has defective wiring or other unsafe condition, or is non-functional.

1.2. Cover plate is damaged or missing and cannot feasibly be replaced.

1.3. No suitable location has an acceptable receptacle.

1.4. Receptacle is not operated by the customer (is not on their meter bill).

1.5. Customer refuses.

2. Installation Policies

2.1. This measure may be installed in all housing types.

2.2. An LED night light shall be installed only:

a. In a safe, secure receptacle in an interior location.

b. Where the night light is not the primary light source.

c. In a duplex receptacle where it will not cover up both outlets.

2.3. A properly installed cover plate shall be present on the receptacle.

2.4. Night lights shall be located in accordance with customer's preference and needs.

2.5. Night lights shall not be installed in a storage room, closet, or multifamily common area.

2.6. All night lights shall be installed by the contractor.

3. Safety Practices

3.1. None.

4. Installation Policies Specific to Mobile Homes

4.1. None.

LED NIGHT LIGHT STANDARDS

1. APPROVED MATERIALS

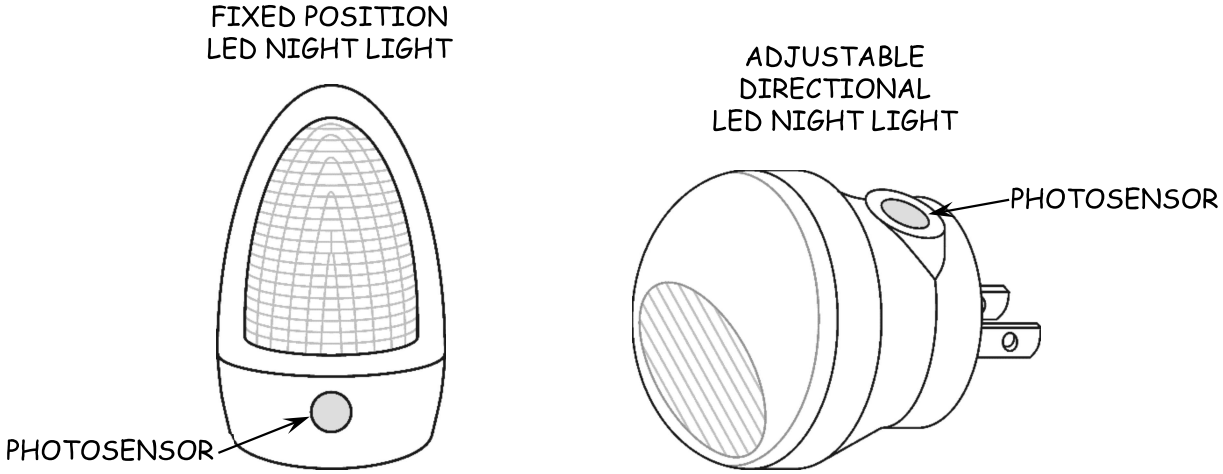
- **LED night lights**
  - Maximum wattage 0.5 watts.
  - UL-listed or equivalent.
  - Equipped with an integrated photoelectric (auto-on) switch that turns on the night light when the room is dark.

2. WARRANTY

- **Refer to IS Appendix F (Minimum Warranty Requirements).**

3. INSTALLATION

- **All units**
  - Manufacturer's installation recommendations shall be followed.
  - If receptacle is switched, the switch shall function properly.
  - Devices unplugged for night light installation shall be plugged in again.



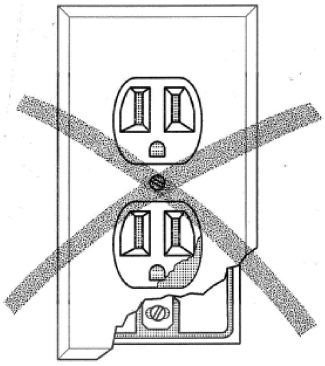
- **The receptacle shall be:**
  - In good condition (wiring, receptacle, and cover plate).
  - Securely installed in an electrical box.
- **Cover plates**
  - Missing or damaged cover plates shall be replaced for the receptacle used to power the night light.
- **Extension cords**
  - The night light shall be plugged directly into a secure receptacle, not into an extension cord.

4. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Testing**
  - All installed LED night lights shall be tested for proper operation.
  - When light level is too high to activate the unit, the photo sensor shall be covered to simulate darkness.
- **Instructions and warranty**
  - Occupants shall receive manufacturer's instructions and written warranty, when present.
- **Clean-up**
  - Installation/packaging materials shall be removed from the premises.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.



MISSING/DAMAGED
COVER PLATES REPLACED

MICROWAVE OVENS

Lead Paint Risk Factor
NONE

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MOBILE HOME CRITERIA 7

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SUPPLEMENT A.5 PREFACE
FOR
MICROWAVE OVENS

1. Nonfeasibility Criteria

1.1. The residence is not equipped with at least one electric or natural gas cooktop, range, or oven.

1.2. Functional microwave oven already present.

1.3. Appropriate location is not available.

1.4. Acceptable electrical outlet is not available.

1.5. Customer refuses.

2. Installation Policies

2.1. For a microwave oven to be installed, the residence:

a. Must have at least one electric or natural gas cooktop, range, or oven, and

b. Must not have a functional microwave oven.

3. Safety Practices

3.1. None.

4. Installation Policies Specific to Mobile Homes

4.1. None

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MICROWAVE OVEN STANDARDS

1. APPROVED MATERIALS

- **Microwave oven shall meet the following specifications:**
  - UL-listed.
  - Electronic controls with ten or more power settings.
  - Minimum capacity and power rating as indicated in the following table:

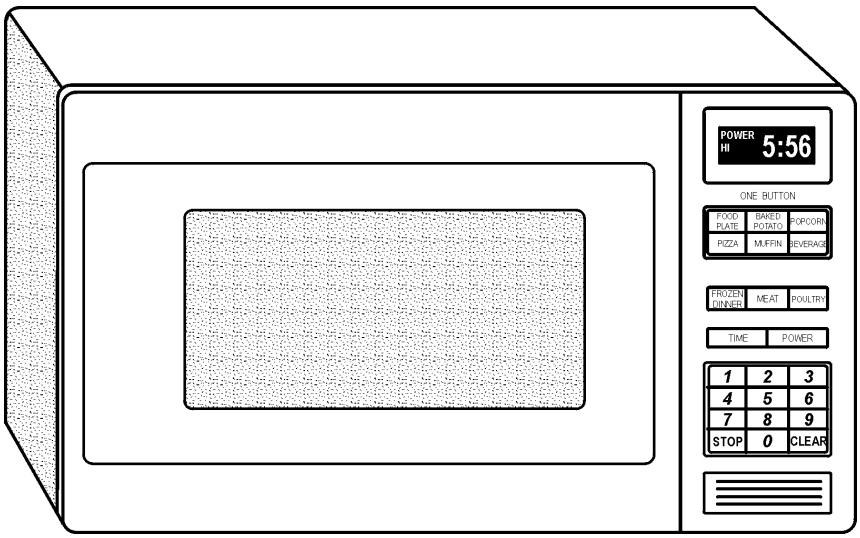
Number of Occupants	Minimum Cubic Footage	Minimum Power Rating
1–2	0.7 cu. ft.	700 W
2 or more	0.8–1.0 cu. ft.	800 to 1100 W

2. WARRANTY

- **Refer to IS Appendix F (Minimum Warranty Requirements).**

3. GENERAL REQUIREMENTS

- **Installation shall be in conformance with:**
  - Product listing.
  - Manufacturer's instructions and specifications.
  - Local code.
- **The contractor shall deliver and install all units.**



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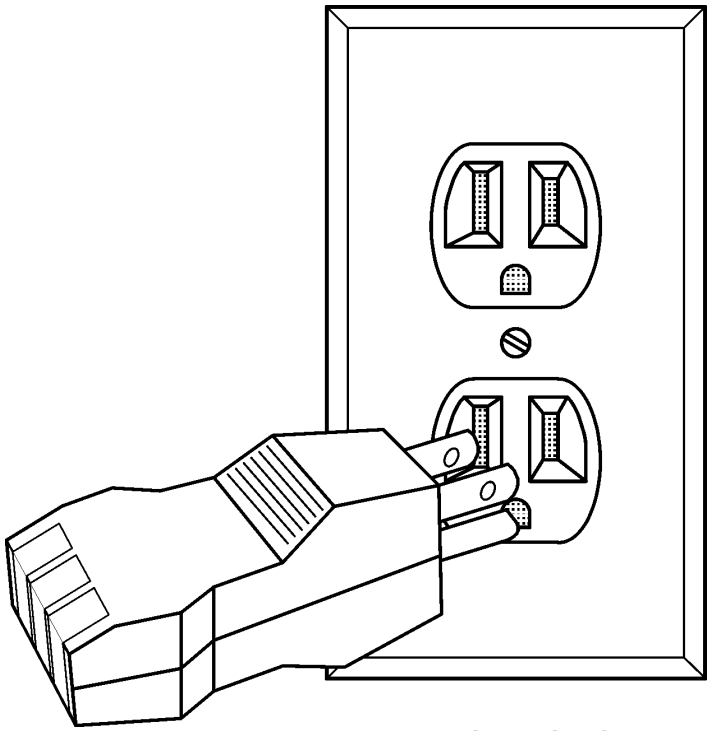
4. PRE-INSTALLATION EVALUATION

- **Qualification**
  - The residence shall be equipped with at least one electric cooktop, range, or oven.
- **Location**
  - A location in conformance with manufacturer's instructions shall be present.
  - Area shall be:
    - Adequate size and height with room for air circulation.
    - Level and unobstructed.
    - Stable and safe.
- **Electrical supply**
  - A safe electrical outlet in conformance with manufacturer's instructions shall be available.



OUTLET CHECKED
FOR PROPER GROUNDING

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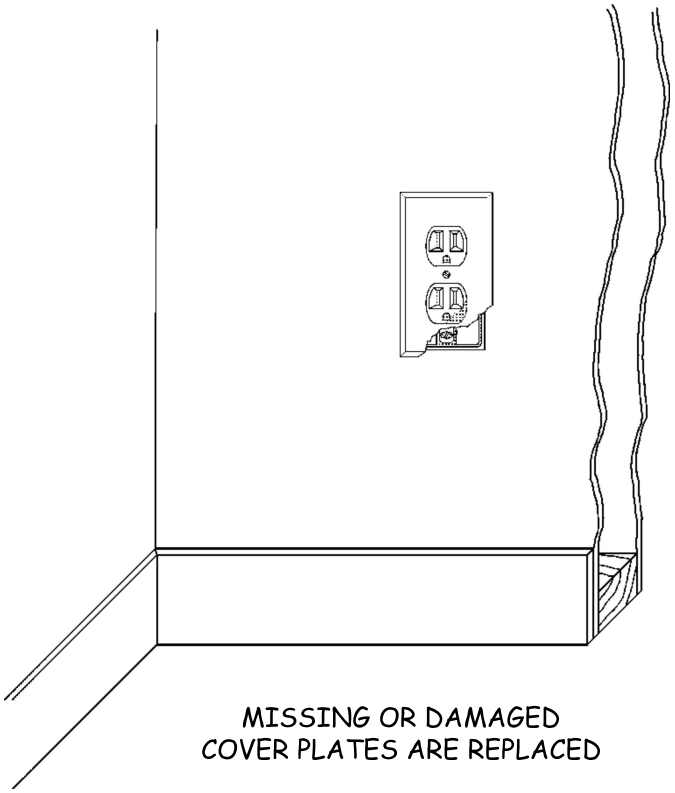
5. ELECTRICAL SUPPLY

- **Receptacle**
  - Microwave oven shall be plugged into its own separate receptacle when feasible.
  - The receptacle shall:
    - Conform to manufacturer's instructions and local code.
    - Be in good condition (wiring, receptacle, and cover plate).
    - Be securely installed in an electrical box.
    - Provide grounding or GFCI protection to the microwave oven when it is sold with grounded power cord.
- **Cover plates**
  - Missing or damaged cover plates shall be replaced.
- **The electrical circuit shall have:**
  - Proper overcurrent protection.
  - Adequate current capacity available to avoid nuisance tripping of breaker/fuse by the microwave oven.



MISSING OR DAMAGED
COVER PLATES ARE REPLACED

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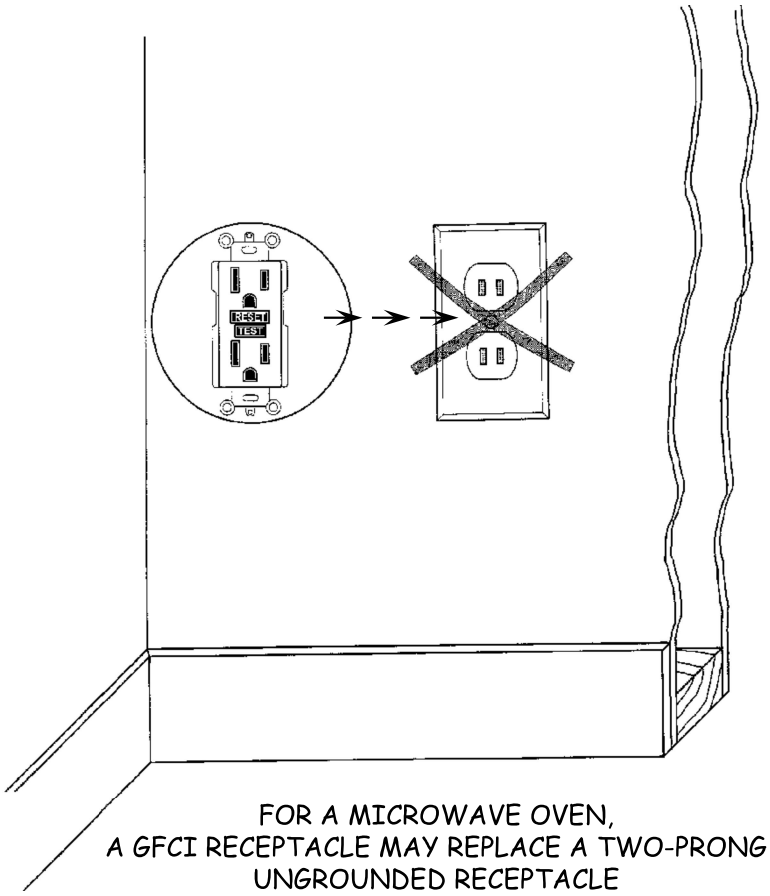
5. ELECTRICAL SUPPLY (cont.)

- **Ungrounded receptacles**
  - Microwave ovens shall not be connected to an ungrounded two- or three-prong receptacle.
  - An ungrounded two-prong receptacle should be replaced with one of the following:
    - A GFCI-type receptacle installed in conformance with the CEC and marked “GFCI Protected” and “No Equipment Ground.”
    - A standard three-prong grounded receptacle when an equipment grounding conductor is provided.



FOR A MICROWAVE OVEN,
A GFCI RECEPTACLE MAY REPLACE A TWO-PRONG
UNGROUNDED RECEPTACLE

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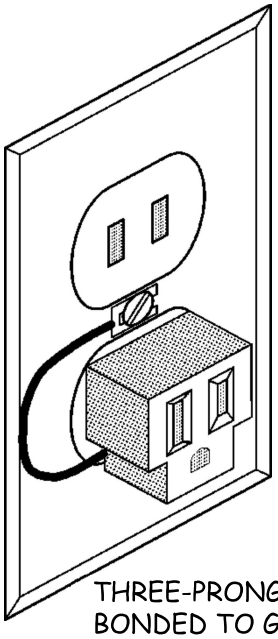
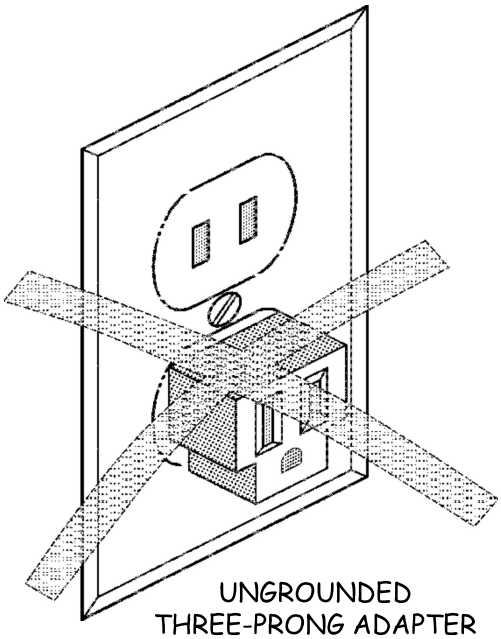
5. ELECTRICAL SUPPLY (cont.)

- **Three-prong adapters**
  - *Ungrounded* three-prong adapters shall not be used.
  - A *grounded* three-prong adapter may be used (in lieu of installing a grounded three-prong receptacle) only if:
    - Manufacturer's instructions do not prohibit an adapter and
    - Adapter provides proper polarity and grounding to the appliance with the adapter ground lug/wire securely attached to a grounding source, such as a:
      - Grounded receptacle.
      - Grounded electrical box.
      - Alternate grounding conductor, per IS Appendix C (Grounding Guidelines for Electric Measures).



THREE-PRONG ADAPTER BONDED TO GROUNDED RECEPTACLE IS ALLOWED



UNGROUNDED THREE-PRONG ADAPTER IS NOT ALLOWED

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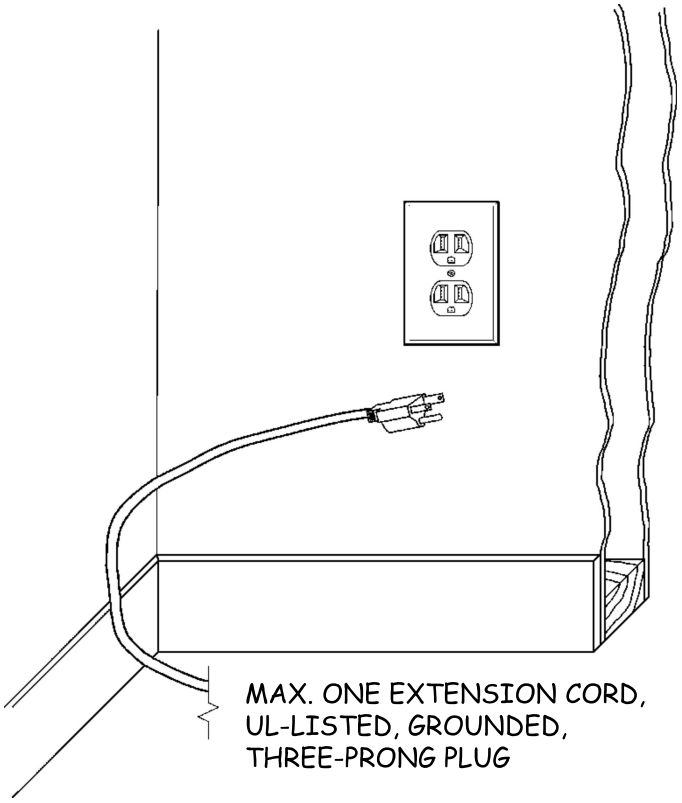
6. EXTENSION CORD

- **All units**
  - One extension cord may be used when allowed by appliance manufacturer's instructions.
  - Extension cord shall be:
    - UL-listed and in conformance with manufacturer's specifications.
    - A three-conductor cord with three-prong grounding plug.
    - Rated appropriately for the appliance, minimum 14 AWG.
    - The shortest feasible length, maximum 6'.
- **Cord safety**
  - Appliance cord and extension cord shall not be draped over a countertop or furnishings in a manner which:
    - Allows access to children (to reach and pull on them).
    - Creates a walking hazard (where people can trip).



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7. LEAD-SAFE WEATHERIZATION AND POST-INSTALLATION REQUIREMENTS

- **Lead-safe practices:**
  - Shall be applied in accordance with guidelines in Appendix E.
- **Instructions and warranties**
  - Customer shall be instructed in the proper operation and care of the microwave oven.
  - Customer shall be provided with:
    - Manufacturer's written instructions.
    - Written warranty documents.
- **Cleanup and disposal**
  - All packing materials and other debris shall be cleaned up and removed from the premises.
  - All replaced equipment and parts shall be removed from the premises and disposed of properly.

MOBILE HOME CRITERIA

No additional criteria for mobile homes.

CUSTOMER RECEIVES WRITTEN INSTRUCTIONS

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