

Cascade Natural Gas Corporation

Washington Energy Efficiency Program

Trade Ally Manual

Prepared by Cascade Natural Gas Corporation (CNGC)

Also available online at www.CNGC.com/energy-efficiency



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ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual

Contents

Forward from the Cascade Natural Gas Energy Efficiency Program	3
Introduction.....	4
Insulation.....	6
Preparation.....	6
Attic	11
Preparation.....	11
Installation.....	11
Ventilation	17
Floor	21
Preparation.....	21
Installation.....	23
Wall	29
Preparation.....	29
Installation.....	29
Air Sealing.....	31
Duct Sealing.....	34
Windows.....	40
Door.....	44
HVAC.....	48
Heating Systems	48
High-Efficiency Natural Gas Furnace	48
High-Efficiency Condensing Boiler	51
Combination Residential Space and Water Heat System	53
Condensing Natural Gas Tankless Water Heater.....	55
Natural Gas Fireplace or Hearth	57
Thermostat.....	59
Glossary of Terms	60
Quick Reference Guide	62
Works Cited	64

ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual

Forward from the Cascade Natural Gas Energy Efficiency Program

The Cascade Natural Gas Corporation (CNGC) Energy Efficiency Program Trade Ally Manual provides information and direction to make your job easier while further increasing the energy efficiency of your customers' homes.

The specifications for windows, insulation, air sealing and duct sealing are for *retrofit* projects and are not intended to for new construction. CNGC requires all eligible upgrades to be installed by a Washington licensed and bonded contractor and/or a participating Trade Ally.

Please reference the tariff and Terms and Conditions when utilizing CNGC rebates:

<https://www.cngc.com/wp-content/uploads/PDFs/Rates-Tariffs/Washington/2022/Schedule-300.pdf>

Specific rebate requirements referenced in this manual were accurate at the time of assembly, however, please visit our website to ensure the most recent requirements are satisfied. This information can be found on the CNGC website at www.CNGC.com/energy-efficiency.

The CNGC team hope this manual is useful you and your company. Please note, it is not all inclusive and is intended as a guideline to addressing common installation situations. Please contact our Trade Ally coordinator at 1-866-626-4479 with any questions about this guide, if you are interested in becoming a participating Trade Ally, or if you would like to request additional hard copies of this guide. The CNGC Trade Ally Manual is also available on the CNGC website, noted above.

Thank you for your participation as a Cascade Natural Gas Trade Ally. Our programs would not exist without your hard work and commitment to providing energy efficiency services to the community.

Sincerely,

CNGC Energy Efficiency

ENERGY EFFICIENCY INCENTIVE PROGRAM 2024 Weatherization & HVAC Specification Manual

Introduction

IN 1.0 - Program Goals and Eligibility

The intent of the energy efficiency program is to encourage high-efficiency home upgrades to help homeowners and renters improve comfort, increase building durability and save energy through cost-effective weatherization and heating system improvements. Residential customers of Cascade Natural Gas (CNGC) within Washington State whose primary space or water heat energy is provided by CNGC shall be eligible for incentives. Please refer to our [Terms and Conditions](#) and [website](#) for information about qualifying homes. For a measure to be in compliance with these specifications, all aspects of the measure described herein must be installed as described.

IN 1.1- Code Compliance

In cases where a Federal, State, or local code or regulation exceeds the requirements herein, that code or regulation shall apply. If the Federal, State or local code or regulation does not exceed the requirements herein, then the requirements contained in this specification shall apply.

IN 1.2 - Materials

Materials used in the CNGC rebate program shall meet or exceed applicable local, State, and Federal codes and regulations. Materials, including manufacturers' installation instructions, which do not conform to these guidelines, shall not be eligible for incentives. CNGC does not keep a list of approved products. Adherence to applicable codes and regulations is the responsibility of the contractor or building owner. The CNGC rebate program reserves the right to refuse use of materials and supplies it deems unacceptable.

IN 1.3—Requirements for All Mechanical System Installations

Mechanical equipment shall be installed according to the manufacturer's specifications, except in circumstances where prevailing Federal, State, or local code, regulations or program standards exceed those specifications, in which case the applicable codes or program standards shall be followed. When working with natural gas equipment, all current Federal, State, and local safety specifications shall be followed. Mechanical equipment shall be installed as a permanent fixture on the property, including any connections to the home's electrical wiring, gas piping, or water piping, and including exhaust ventilation ductwork, if applicable. Mechanical equipment shall have a clearly visible, permanent, factory-affixed label identifying the serial number, make, and model number of the unit. Mechanical equipment shall in no way compromise the structural integrity of the area in which the unit is being installed.

IN 1.4 - Inspections

After energy efficient measures are installed, an inspection may be required to verify compliance with CNGC rebate program specifications for any project seeking an incentive. If the installed measures do not meet these specifications, the program will notify the customer and the contractor of the deficiencies and require the contractor to perform corrections as per program requirements. However, CNGC rebate program does not guarantee either energy savings or the performance of the installations under this program. Nor does CNGC assume responsibility for enforcing or determining compliance with codes and regulations, or their interpretation. CNGC is not supervising work performed for customers, nor is CNGC responsible in any way for proper completion of that work or proper performance of any equipment purchased. The customer assumes the risk of any loss or damage(s) that they may suffer in connection with the installation of the measures and equipment.

ENERGY EFFICIENCY INCENTIVE PROGRAM 2024 Weatherization & HVAC Specification Manual

The inspection is limited to applied measures or sections of measures that are reasonably visible from normal access locations. A reasonable effort will be made to see a representative section of the measure.

Although CNGC will work with both the customer and the contractor, it is the responsibility of the customer to see that any deficiencies are brought up to these specifications in order to qualify for incentives. It is also the responsibility of the customer or contractor to cover the costs of any potential remediations of deficiencies found.

IN 1.5 - Waivers for Unusual Conditions

When unusual conditions exist, CNGC may waive certain provisions of the specifications or may substitute a different standard or method.

IN 1.6 - Human Contact Areas

Insulation installed in attics, basements, garages, storage areas, or other areas where occupants go for routine maintenance or storage are classified as Human Contact Areas. Unless a barrier (such as drywall) exists, fibrous insulation shall be covered with a vapor- permeable air barrier to limit occupant exposure to insulation fibers. Vertical and overhead surfaces containing fiberglass insulation shall also be covered. All covering shall meet applicable codes.

Figure 1: IN 1.6 Covering Human Contact Areas



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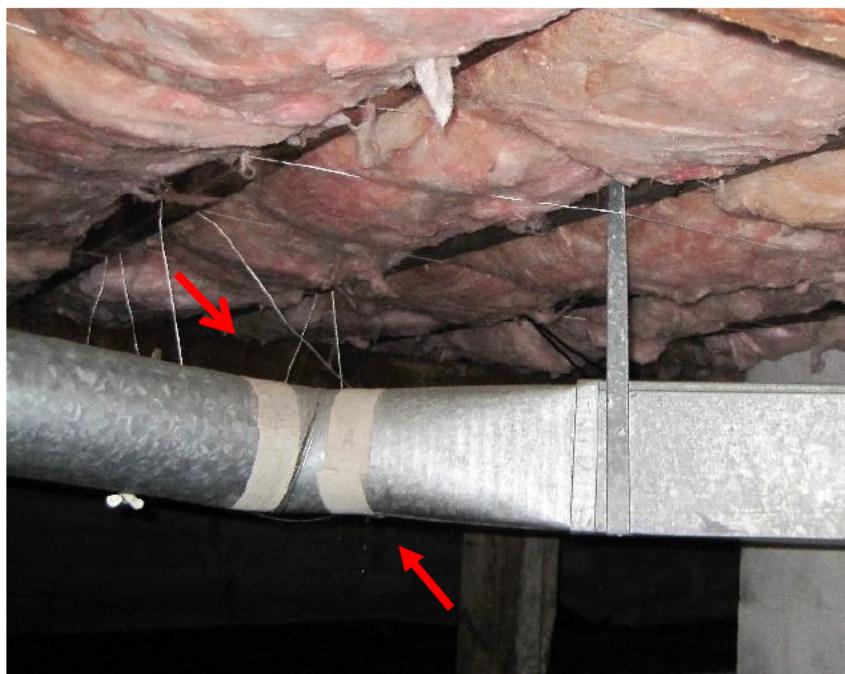
Insulation

Preparation

PR 1.1 – Asbestos, Mold or Lead

Check for the presence of asbestos-containing materials and confirm abatement of asbestos before continuing work. If a friable (can crumble when disturbed) asbestos-like substance is found to be present in an area that will be disturbed by work (white tape or vermiculite insulation), it must be tested.

Figure 2: PR1.1 Asbestos tape



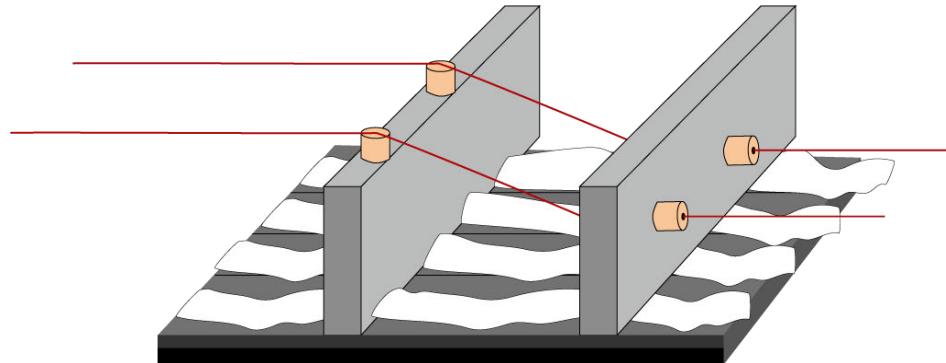
If suspected mold is found, determine the source and cause, repair issues if possible, and remove the suspected mold. If the abatement cannot be done inhouse, the homeowner is responsible for finding a company to treat the mold. It is not recommended to insulate until the mold issue has been remedied.

ENERGY EFFICIENCY INCENTIVE PROGRAM 2024 Weatherization & HVAC Specification Manual

PR 1.2 - Knob and Tube Wiring

Before installing insulation in cavities or in contact with active knob and tube wiring, the wiring shall be inspected and approved in writing by a licensed electrician. Insulating attics or walls with knob and tube wiring shall be at the discretion of the contractor and homeowner and shall adhere to state and local code jurisdictions.

Figure 3: PR 1.2 Knob & Tube Wiring



(4)

PR 1.3 - Dams

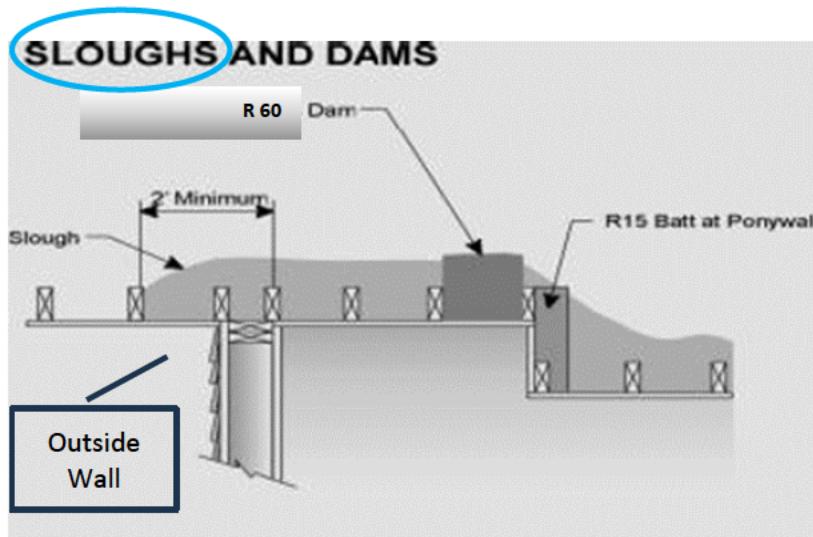
Figure 4a: PR 1.3.1 Dams



Dams shall be installed between heated and unheated areas, such as garages and covered porches. Dams shall also be required along the upper edge where ceilings differ in height. Either batting or rigid barrier, such as baffles, are acceptable.

ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual

Figure 4b: PR 1.3.1 Sloughs



As an alternative to damming, the insulation can be allowed to slough over the outside wall, pending customer approval.

An installer can use sloughs as an acceptable insulation method to insulate, using a two-foot extension over an outside wall.

Best materials for dam construction are plywood, rigid foam board, OSB, or drywall. Acceptable, but not best practice materials, use insulation batts laid flat, with an R-value equal to that in the attic. The batt shall be at least 14 ½ inches wide. Rigid cardboard, though not best practice, is acceptable assuming it is suitable for the project.

Figure 5: PR 1.3.2 Attic Access damming



Dams using insulation batts shall be installed around storage areas occasionally accessed and the covering should extend 2 feet into the insulated area to comply with Human Contact requirements, [see IN 1.7](#).

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2024 Weatherization & HVAC Specification Manual

Figure 6: PR 1.3.3 Damming in Attics



PR 1.4 Dams for Light Fixtures, Fan/Lights, Chimneys and Miscellaneous

Insulation shall be kept away from metal flues, non-IC (insulation contact) rated recessed lights, and other heat-producing objects by an approved baffle or dam. Dams shall be made of rigid non-combustible material such as sheet metal. Use Table PR 1.4 to determine requirements. Insulation batts are not an approved damming for any fixture.

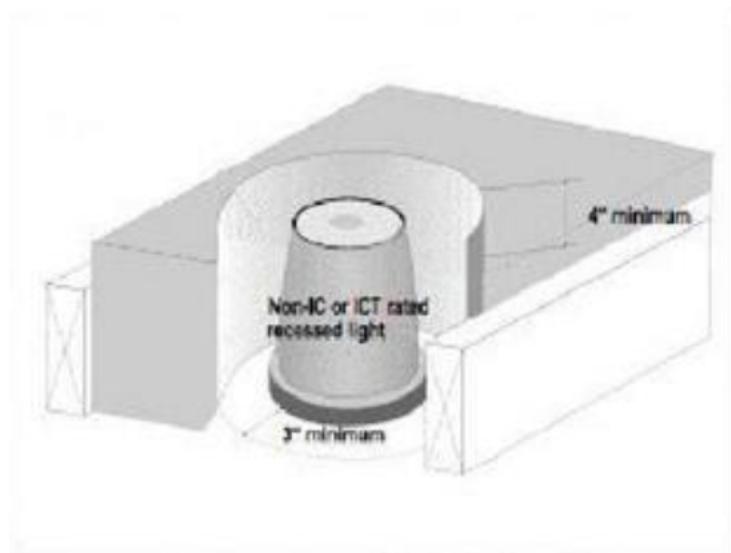
Table 1: PR 1.4 Baffle Requirements

Item	For noncombustible rated insulation (ASTM E136)	For non-rated insulation
Metal Flue	Approved Baffle	Approved Baffle
Masonry Chimney	No Baffle Required	Approved Baffle
Transformers	Approved Baffle	Approved Baffle
Vented fan/light or fan/heater combo	Approved Baffle	Approved Baffle
Miscellaneous Electrical	Approved Baffle	Approved Baffle
Non-IC Rated Can Light	Approved Baffle	Approved Baffle
IC-Rated Can Light	No Baffle Required	No Baffle Required
Vented Exhaust Fans	No Baffle Required	No Baffle Required

To prevent heat build-up, insulation shall not be in contact with fixtures as described above.

ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual

Figure 7: PR 1.4.1 Damming around Non IC Can Light



When needed, dams shall keep the insulation at least 3 inches, but not more than 4 inches, from the sides of the electrical fixtures, flues, and chimneys. Dams or baffles shall extend at least 4 inches above the final level of insulation.

Figure 8: PR 1.4.2 Dams around light fixtures



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PR 1.5 Vapor Retarders

When new vapor retarders are installed, they shall always face the heated area of the building; in attics facing down toward the ceiling of the conditioned space, or in crawlspaces facing up onto the floor.

In attic areas where no insulation exists, batts with vapor retarders may be used. The vapor retarder shall be in contact with the heated ceiling.

Do not install new insulation with a vapor retarder on top of pre-existing insulation. There should only be one vapor retarder in the assembly, and it should be in contact with the heated ceiling.

Attic

Preparation

Please review the previous section, [Insulation: Preparation](#), regarding attic preparation and safety before installation begins.

All aspects of the measure described herein must meet the recommendations of the specifications in order to qualify for an attic insulation incentive.

For Attic Insulation, CNGC requires a preexisting R value of 19 or less and a post installation R value or R-60 or higher.

Installation

Cascade Natural Gas expects insulation applied for incentives to work according to the claimed R-value as incentives are based on deemed therm savings. [R-value](#) measures the ability for a material to resist heat flow so the higher the R-value, the slower the heat flow.

AT 1.1 – Inside Attic Access Doors

Weather-stripping shall be permanently attached to create an effective air seal between the attic access frame and the door. Accesses with air leaks that cannot be weather-stripped shall be repaired or rebuilt to create an effective air seal.

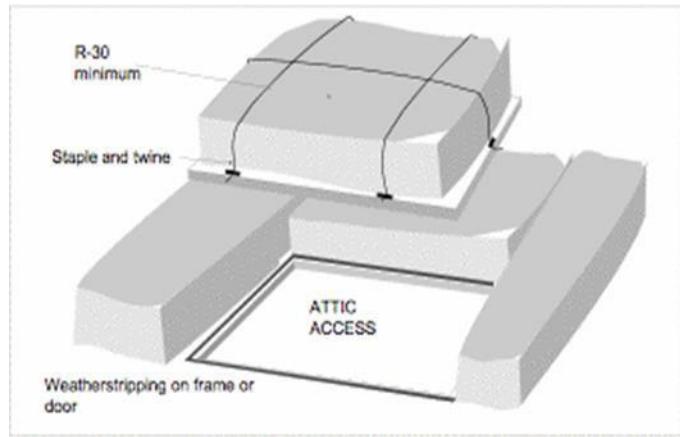
CNGC recommends and Washington State code requires attic access doors to be weather-stripped and insulated to a level equivalent to the insulation on the surrounding surfaces (WSEC R402.2.4).

Kneewall accesses shall be insulated to a minimum of R-15. A durable weather-stripping, which meets code requirements, shall be installed. Kneewall access doors should have a latch to hold the door in contact with the weather stripping. Also, see section [AT 2.3](#).

Batt insulation shall be attached to the door with twine. The twine shall be stapled to the edges of the door. Stapling the insulation directly to the door is unacceptable. Rigid insulation may be fastened to the door in lieu of batt insulation.

**ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual**

Figure 9: AT 1.1 - Attic Access Insulation



Attic accesses shall be protected from having loose-fill insulation fall through the opening. The full level of ceiling insulation shall be maintained to the edge of the attic access opening by one of the following methods:

- A. The opening may be framed with wood or plywood boards. The framing shall be permanently attached and extend at least 4 inches above the final level of insulation. Cardboard is not advisable.
- B. Not advisable, but a 14-1/2-inch wide (or wider) insulation batt laid flat, with an R-value equal to that specified for the attic, may be placed tightly around the perimeter of the access opening. This 14-1/2 inches shall be maintained in all outward directions from the access opening, including corners. Scoop out all loose-fill insulation from the edges before laying batts.

Figure 10: AT 1.1.1 Attic Access w/ Insulation leak



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Figure 11: AT 1.1.2 Attic Access w/ Dam



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If space allows or for storage access, a platform shall be dammed as in Figure 5: PR 1.3.2

ENERGY EFFICIENCY INCENTIVE PROGRAM 2024 Weatherization & HVAC Specification Manual

AT 1.2 - Pull-Down Stairs Attic Access

Pull-down stairs in heated areas shall be weather-stripped and insulated to a minimum of R-10. Insulation and weather-stripping shall not prevent easy operation of the stairs. Factory or site-built pull-down stair covers are recommended and shall have a minimum of R-10.

AT 1.3 - Outside Attic Access Doors

Any outside access shall have a door that is easily opened to permit inspection and shall be weather-proofed and vermin-proofed.

Access doors shall be weather-stripped and insulated to a level equivalent to the insulation on the surrounding surfaces (WSEC R402.2.4).

AT 2.0 - Attic Installation

In attics with no pre-existing insulation, when vapor retarders are installed, they shall face the heated area of the building as described in [PR 1.5](#).

If the added attic insulation compresses the existing insulation, **the final R-value shall be R-60, or greater.** After installing the insulation, eave and soffit vents shall remain unblocked where necessary.

Decked storage areas in attics are not recommended by CNGC. If storage areas are unavoidable, the area above conditioned space shall be insulated to the highest practical level. When decked storage areas exceed 5% of the attic area or 64 sq. ft., whichever is greater, they shall not be included in the calculation of the insulated areas for purposes of incentives but shall be insulated. When decked storage areas are less than that limit, they shall be included in the incentive area calculation. See [PR 1.4](#) for damming requirements around decked storage areas.

AT 2.1 - Installing Loose-Fill Insulation

Loose-fill insulation shall be level and smooth, with a uniform R-value. The number of bags used to attain the added R-value shall reasonably match manufacturer's estimated bag count. Baffling and damming requirement, as defined in [PR 1.3](#), as well as air and duct sealing, shall be reviewed prior to installing loose-fill insulation. R-value markers or tapes shall be affixed to the trusses or joists and have height numbering measured in inches.

Figure 12: AT 2.2.1 Insulation Marker



Figure 13: AT 2.2.2 Attic Baffle

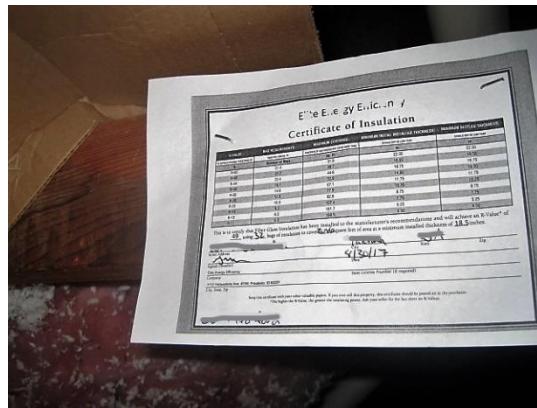


ENERGY EFFICIENCY INCENTIVE PROGRAM

2024 Weatherization & HVAC Specification Manual

Insulation certificates shall be filled out completely and affixed near the access hatch for easy reference.

Figure 14: AT 2.2.3 Posted Insulation Certificate



AT 2.2 - Installing Batt-Type Insulation

If batt-type insulation is installed, prepare the attic in the same way as for loose-fill insulation. As stated in section [PR 1.5](#), do not install vapor retarders over existing insulation.

Batts shall be cut to fit and placed tightly together with no gaps except those required for clearance around heat-producing fixtures. Where practical, place one row of batts between the joists and another row of batts on top of the first row and at right angles to the joists. When lower ventilation exists, or baffling is required to ensure effective R-value and prevent wind-washing of insulation; see [PR 1.3](#) for baffling requirements for fiberglass batt-type insulation installation, as well as [Figure 17: AT 2.4](#) and [Figure 18: AT 2.5](#).

AT 2.3 – Kneewall in Attic Areas

Due to the closed cavity structure of kneewalls, CNGC will incentivize them similar to wall insulation. To qualify, kneewalls need to meet CNGC's minimum requirement of existing levels at or less than R-4, and post insulation levels at R-11 or greater.

Kneewall accesses shall be insulated to R-15 and weather-stripped to create an effective air barrier. If kneewall attic is used for storage, fibrous kneewall door and wall insulation shall be covered to prevent human contact, see section [IN 1.7](#). All penetrations through the wall shall be sealed with caulk or foam.

Kneewall insulation shall be installed prior to installing ceiling insulation. Kneewalls that are un-insulated shall be insulated to fill cavity at a minimum of R-15 in a 2x4 cavity, and R-19 in a 2x6 cavity. When adding new insulation over existing kneewall insulation, the cavity shall be completely filled.

Figure 16: AT 2.3 Kneewall insulation



Blocking between joists below an attic kneewall should be confirmed and all joints around blocks sealed. If no blocks exist, all openings to the heated ceiling areas shall be sealed with a suitable air barrier and sealant. Rigid foam or drywall sealed with foam/caulk is acceptable materials for blocking between joists. This prevents air movement from the heated space between floors and the side attic, which is vented to the exterior.

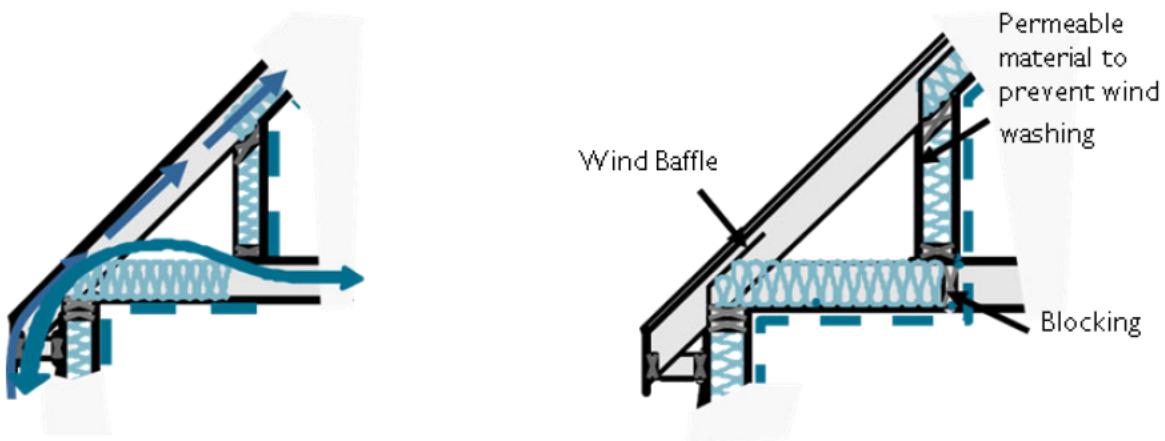


Figure 17: AT 2.4 Kneewall Insulation

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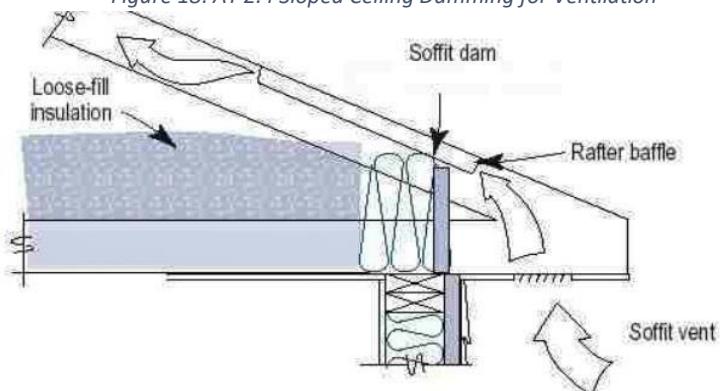
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Kneewall insulation, whether new or pre-existing, shall be covered with a durable, vapor-permeable air barrier material to prevent air penetration of the insulation, and to ensure that the insulation is held in full contact with the wall cavity. See [Figure 16: AT 2.4](#). Air barrier material shall be tested and labeled to meet Washington State fire protection standards. The air barrier material shall be permanently fastened so that it supports the kneewall insulation. Installation of "encapsulated batts" is an acceptable air barrier.

AT 2.4 - Sloped Ceilings with Side Attics and Upper Attics

Un-insulated sloped ceilings between attics shall be insulated with either batt or loose-fill insulation. When using loose-fill insulation, the lower opening of each cavity must be dammed to prevent insulation from falling out of the cavity. Fill the cavity.

Figure 18: AT 2.4 Sloped Ceiling Damming for Ventilation



AT 2.5 - Vaulted Ceilings: Vented and Non-vented

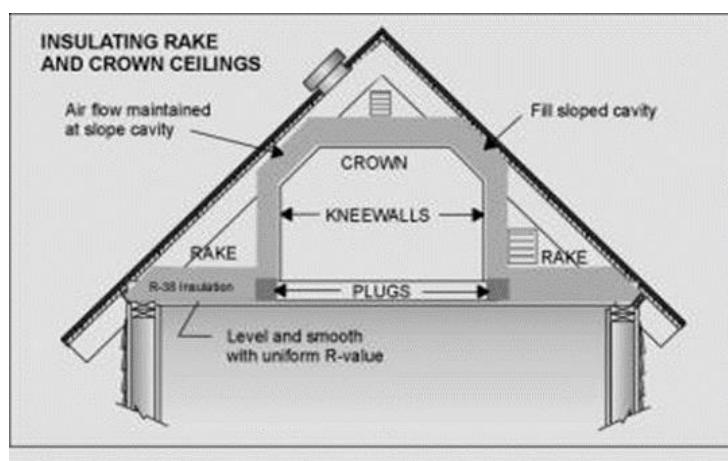
If insulation is added to a vented vaulted ceiling, a 1-inch air space shall be maintained above the insulation. Each cavity shall have an upper and lower vent.

If insulation is added to a non-vented vaulted ceiling, **FILL THE CAVITY**.

AT 2.6 - Insulating Side Attics

When insulating side attics, floor cavities from adjacent heated spaces shall be sealed with air-impervious materials.

Figure 19: AT 2.7 Insulating side attics



ENERGY EFFICIENCY INCENTIVE PROGRAM 2024 Weatherization & HVAC Specification Manual

AT 2.7 - Floored Attics

Insulation shall be installed under the boards of floored attics. To fill the cavities, the boards can be lifted, or holes can be drilled into them no more than 4 feet apart. Joist cavities shall be tightly packed with insulation, see [Figure 6: AT 2.4](#) (showing blocking at kneewall to attic side floor joint).

Areas with loose-fill insulation next to a floored attic shall be dammed to prevent insulation from falling onto the floored attic, see [Figure 2: PR 1.5](#).

Ventilation

VE 1.0 - Passive Attic Ventilation: Sizing and Distribution

CNGC recommends 1 sq. ft. of Net Free Area (NFA) of ventilation for each 150 sq. ft. of attic area, if all the vents are on one level. The area may be reduced to a ratio of 1 sq. ft. to 300 sq. ft. if the vent area is divided between upper and lower ventilation. When vent area is divided, at least half of the required area shall be lower ventilation and at least half of the required area shall be higher ventilation. The upper vent area shall not exceed 80% of the total installed vent area.

The vent area shall be the NFA, defined as the actual open area of the vent after subtracting any area blocked by screens or louvers. All vents shall be screened.

If used for lower ventilation within 6 inches of the final insulation level, roof jacks shall be baffled with a rigid material, such as moisture-treated cardboard, which shall be attached to the rafters underneath the vent.

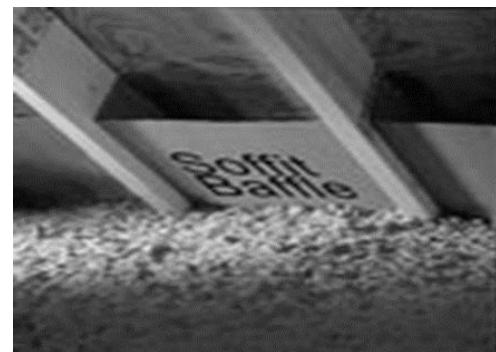
VE 1.1 - Baffles for Eave and Soffit Vents

Soffit and eave vents shall be baffled to maintain air flow and prevent wind washing through the insulation and blockage of the vents. See [Figure 18: AT 2.5](#). Baffles shall be installed before adding more insulation. Baffles shall maintain an opening equal to or greater than the size of the vent. Baffles shall be fastened between roof rafters with at least 9/16-inch staples or roofing nails and maintain a 1" clear air space between the baffle and the roof sheathing. Baffles should extend down to the exterior wall top plate near its outer edge where possible. Anchor points shall be spaced no more than 4 inches apart down each side, in the upper one-half portion of the baffles. They shall be rigid, impervious to wind, and resistant to moisture. All baffles shall extend 6 inches above the final level of insulation for batts, and 12 inches above the final level of insulation for loose fill.

Figure 20: VE 1.1 Attic baffles



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ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual

A continuous dam shall be installed along continuous soffit or eave vents. Where a continuous soffit vent is existing, baffles shall be installed somewhat equally spaced along the length of the soffit and allow enough net free area to satisfy the lower ventilation needs based on the standard set in section [VE 1.0](#). Un-baffled bays that open to a soffit shall be blocked and sealed with a rigid moisture resistant material so blown product is not able to enter the soffit. Baffle shall be installed far enough into the bay to reach the exterior side of the top plate. If compression occurs because of a narrowing roofline, that is acceptable.

VE 1.2 - Bath Fans

All exhaust fans shall be vented to the exterior of the structure and secured to the roof or wall mounted vent fitting with no gaps, in a manner to prevent any exhaust air from entering back into the house. At least one back-draft damper shall be functioning in each system either at the fan, or where the fan is vented to the outside. Existing exhaust ducts traveling through unconditioned space shall be insulated to prevent condensation and supported without sags.

Existing flexible plastic or metal vent ducts may remain if they are free of holes and kinks and are in otherwise good condition, provided they are vented to the exterior of the structure, free of gaps, sealed to prevent exhaust air from re-entering, and less than 25 feet in length. New exhaust ducts in unconditioned spaces shall be insulated to a minimum of R-8.

Figure 21: VE 1.2 Insulated Exhaust Vents to the Outside



Fan shall be vented to nearest feasible location. Exhaust ducts shall not sag nor have more than two turns. If attic vent is used for fan exhaust, it shall not be included in attic vent area calculations, see Section [VE 1.0](#).

Vent ducts shall be securely attached at each joint and to the fan housing using mechanical fasteners, such as screws or metal clamp-type straps mechanically tightened. A securely tightened metal clamp will be acceptable in locations where space prohibits installation of sheet metal screws.

VE 1.3 - Kitchen Fans

Kitchen exhaust fans shall be vented to the exterior of the structure. Kitchen exhaust shall be extended through to the outside, be free of gaps, and sealed to prevent any exhaust air from entering back into the attic. Duct shall be fastened to vent with mechanical fastener, such as sheet metal screws. A securely tightened metal clamp will be acceptable in locations where space prohibits installation of sheet metal screws. Existing plastic ducts are unacceptable.

ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual

If a new exhaust duct is required for a kitchen stove, it shall be at least 28-gauge galvanized steel, stainless-steel or copper, and have a smooth interior surface. The exhaust duct shall be airtight and extend directly into a code-approved, metal vent cap. Vent ducts shall be securely attached at each joint and to the fan housing using mechanical fasteners. The exhaust duct shall meet manufacturer's requirements and latest state ventilation codes. At least one back-draft damper shall be functioning in each system, either at the fan, or where the fan is vented to the outside.

Downdraft exhaust ducts may have a 90-degree turn, shall exit through the foundation or exterior wall, and shall end in a metal vent cap.

VE 1.4 - Dryer Exhaust Ventilation

Dryer exhaust fans shall be vented to the exterior of the structure and shall have a back-draft damper. Dryer exhaust ducts shall also be sealed to prevent exhaust air from entering the building and shall terminate in a metal vent cap. New dryer vents shall be rigid metal, securely connected with mechanical fasteners, and be permanently supported. Exhaust systems shall be as straight as practical and shall not exceed 25 feet.

To prevent blockage with lint, dryer vent ducts shall not be connected with screws. A metal clamp or UL-rated foil tape should be used to secure duct connections.

Existing flexible plastic or metal vent ducts may remain if they are in good condition, provided they are vented to the exterior of the structure.

VE 1.5 – Crawlspace Ventilation

Crawlspaces shall be ventilated by openings in exterior foundation walls. Such openings shall have a net area of not less than 1 sq. ft. for each 150 square feet of under floor area. Where moisture due to climate and ground water conditions is not considered excessive, the EEIP may allow operable louvers and may allow the required net area of vent opening to be reduced to 1/300 or less (minimum 1/1500), provided the ground surface area is covered with an approved ground cover.

Openings shall be located as close to corners as practical and shall provide cross ventilation. The required area of such openings shall be approximately equally distributed along the length of at least two opposite sides. They shall be covered with corrosion-resistant wire mesh with mesh openings not to exceed 1/4-inch in dimension. Existing vent openings covered with wire mesh need not be modified.

Figure 22: VE 1.5 Crawlspace Ventilation



ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual

Crawl space vents should be placed so that the top of the vent is below the lower surface of the insulation. When foundation vents cannot practically be placed below insulation, a permanently attached baffle shall be installed at an angle of 30 degrees from the horizontal, to divert air flow and prevent wind washing (WSEC 502.1.4.7) (12).

Where venting cannot be reasonably added except by breaching a foundation, ventilation requirements shall be waived.

VE 1.6 - Exhaust Vents

Downdraft exhaust ducts may have a 90 degree turn and shall exit through the foundation or exterior wall. They shall be sealed (with no visible gaps) to prevent exhaust air from entering back into the building, and shall end in a metal vent cap.

Exhaust systems for household appliances—dryers, ranges, and miscellaneous exhaust fans—shall be vented to the exterior of the structure and sealed with no gaps to prevent exhaust air from entering back inside the building. Exhaust devices with ducts in a crawl space shall meet the same specifications as exhaust devices venting through attics. See section [AT 2.6](#).

Figure 23: VE 1.5 Exhaust Vents



ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual

Floor

Preparation

FL 1.0 - Introduction

Floor Insulation measures include adding insulation, sealing floor penetrations, adding ventilation, installing a ground cover, and adding water pipe insulation. In order to qualify for Floor Insulation rebates, all aspects of the measure described herein must meet the recommendations of the specifications.

If standing water is found in the crawlspace, it shall be drained before the floor can be insulated. A sump pump may be needed for some situations. Draining the water is the responsibility of the owner.

A minimum R-30 insulation shall be used for under floor installations.

If floor cavity depth does not allow R-30 insulation, FILL THE CAVITY with the appropriate R value.

Minimum R-19.

Figure 24: FL 1.0 Supported crawlspace insulation and groundcover



Insulation shall be installed in a permanent manner in substantial contact with the surface being insulated. (WSEC 502.1.4.7 – there should be no air space between the surface of the insulation and the floor above). To accomplish this, string supports may have to be raised up into the joist bay and attached to joist sides, not the bottom. (12)

Before installing insulation in contact with active knob and tube wiring, review section [PR 1.2](#).

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2024 Weatherization & HVAC Specification Manual

FL 1.1 - Under Floor Area Preparation Work

Degradable scrap materials, especially wood and cardboard, shall be removed from the crawlspace. The floor system shall be checked for water leaks and wood decay before work begins. The owner shall be notified, and corrective measures taken, if any are needed.

FL 1.2 - Ground Cover

Existing ground cover is acceptable if it is in good condition and is continuous throughout the crawl space. If an existing ground cover does not meet EEIP specifications, it shall be repaired, or a new ground cover shall be installed.

New ground covers shall be a minimum of 6-mil black polyethylene. All seams shall be lapped at least 12 inches. The cover shall be continuous throughout the crawlspace and there shall be no rips, tears, or gaps.

Figure 25: FL 1.2 Ground Cover



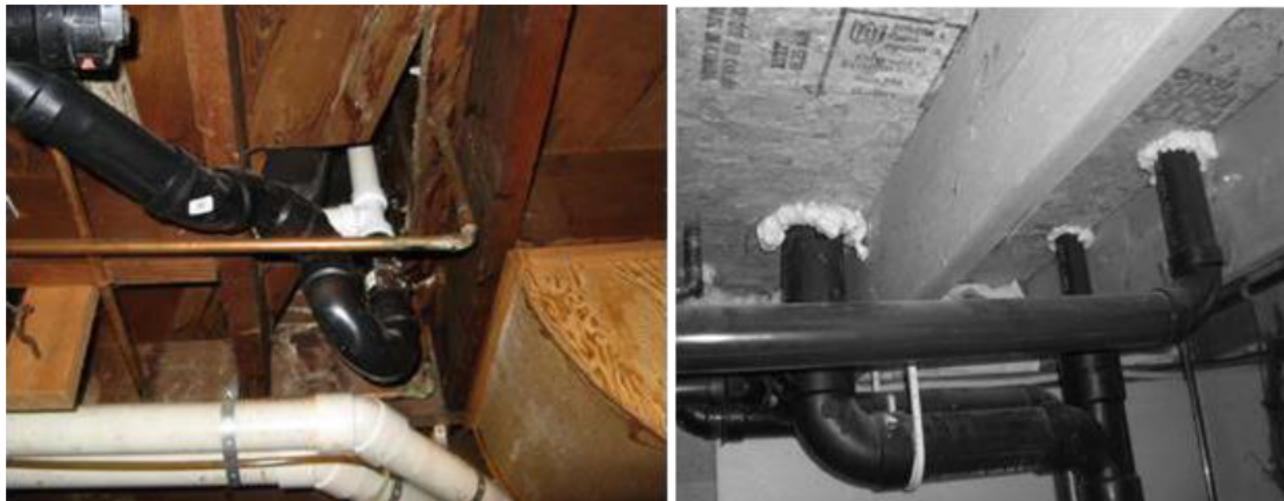
FL 1.3 - Sealing Floor Penetrations

All floor penetrations shall be sealed, including plumbing, wiring and duct penetrations. Caulk, foam, or other compatible sealants shall be used.

Bathtub/shower drain accesses shall be sealed. If the air seal is below the tub/shower trap, provisions to maintain accessibility shall occur.

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2024 Weatherization & HVAC Specification Manual

Figure 26: FL 1.3 Floor Penetrations



Incorrect

Correct

Installation

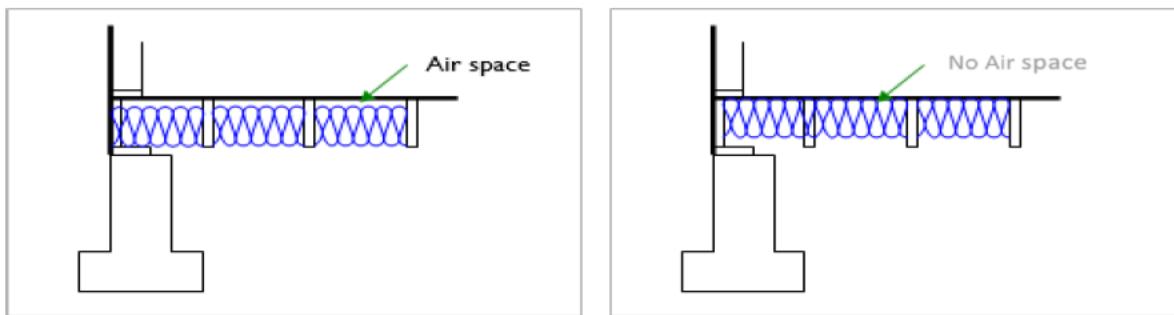
FL 2.0 - Basic Installation Procedures

Floor insulation shall be in contact with the heated floor sheathing above.

Figure 27: FL 2.0.1 Insulation in contact with floor

Incorrect

Correct



Fiberglass insulation shall not be compressed except where required for support, where it is necessary to open a path for crawlspace vents and when R-25 batts are installed in 6-inch cavities. New insulation installed in contact with existing insulation shall not have a vapor retarder.

Insulation shall be supported so that it does not block or restrict crawl space ventilation. Insulation may be compressed, if necessary, to meet this requirement, see Figure FL 2.0.2. Where vents are above the bottom level of insulation and it is compressed, a baffle or air barrier of suitable material shall be installed to prevent wind washing. See sections [PR 1.3-1.4](#). Spray foam and ridged board foam are acceptable to insulate under-floor areas. Foams must meet or exceed state and local codes.

Insulation shall be pulled free from any temporary stapling. Insulation shall be cut to fit without gaps or overlaps, see Figure FL 2.0.3. There shall be no gaps at the perimeter of the foundation.

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Figure 28: FL 2.0.2 Compressed Insulation for baffle

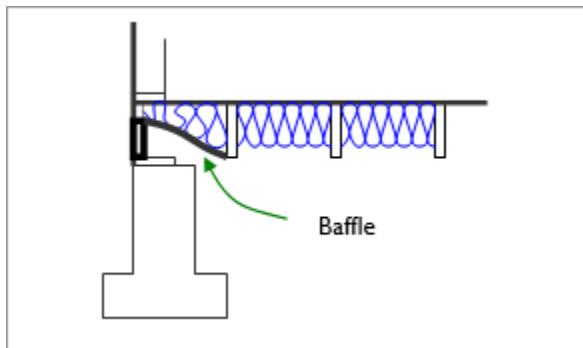
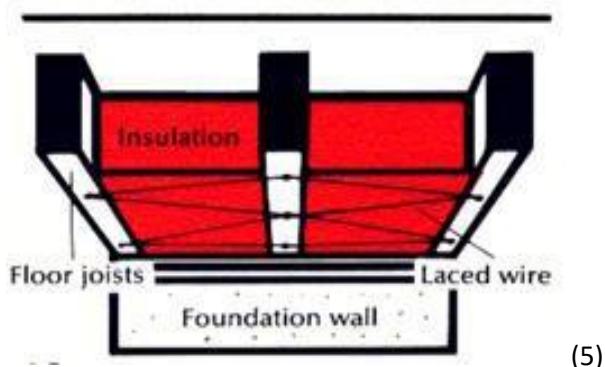


Figure 29: FL 2.0.3 Insulation filled cavity



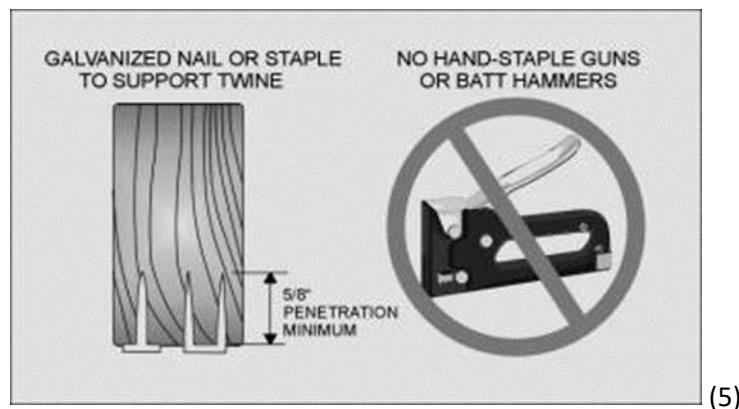
FL 2.1 - Floor Insulation Support Materials

Use one of the following materials to support floor insulation similar to Figure 29: FL 2.0.3:

- Wood lath – Wood lath shall be a minimum of $\frac{1}{4} \times 1$ inch
- Twine – Twine shall be non-stretching polypropylene or polyester
- Wire – Wire shall be stainless steel, copper, or an equivalent material of similar corrosion resistance, with a minimum diameter of 0.040 inch (Size 18 gauge). Self-supporting wire hangers are not acceptable.

Fasteners for lath, twine, or wire may be either hot-dipped galvanized nails or corrosion-resistant staples that are at least 18-gauge and long enough to penetrate wood at least $\frac{5}{8}$ inch.

Figure 30: FL 2.1 Fasteners



FL 2.2 - Spacing Requirements for Support Systems

Staples shall be driven with a power-actuated stapler to achieve at least $\frac{5}{8}$ inch penetration. Hand-staple guns and batt hammers are not advised.

The further apart the joists, the closer the support staples need to be to each other, shown by Figure 31: FL 2.2. The maximum spacing for support systems (Table 2: FL 2.2) are as follows:

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Table 2: FL 2.2 Support Spacing

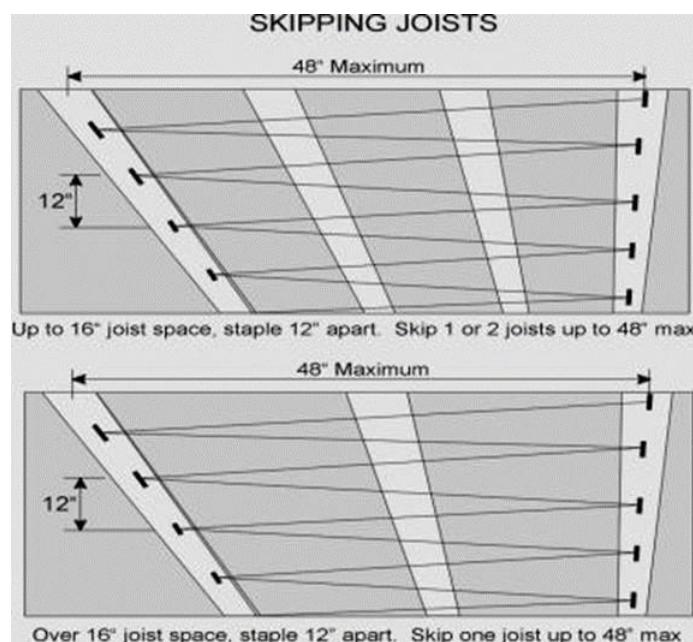
Spans	Maximum Spacing
24 inches or less	18 inches apart
48 inches	12 inches apart
60 inches	8 inches apart
72 inches	6 inches apart

Wood lath shall not be used for spans greater than 48 inches. Splicing is not allowed to meet this requirement. Wood of thicker dimensions may be used for wider spans.

Batts shall be supported no more than 3 inches from the ends. This support shall be parallel to the end of the batt. Small pieces of insulation shall be supported.

Joists may be skipped; however, the maximum spacing shall not exceed 12 inches. The maximum span of skipped joists shall not exceed 48 inches.

Figure 31: FL 2.2 Insulation support and skipping joists



Where joists are deeper than the insulation thickness, fasteners and supports shall be installed on the sides of the joists to hold the insulation up and keep it in full contact with the floor above. A minimum of R-30 needs to be achieved in these circumstances.

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2024 Weatherization & HVAC Specification Manual

FL 2.3 - Water Pipe Insulation

All hot and cold-water pipes not enclosed within the floor insulation shall be insulated to a minimum of R-3. Leaking water pipes shall be repaired before insulating them. Water pipe repair is the responsibility of the homeowner.

Water pipe insulation shall be secured with twine, corrosion resistant wire, or plastic compression ties every 12 inches. Tape is not allowed to secure water pipe insulation. Do not cover the handles and spigots of safety drain valves with insulation.

Fiberglass insulation shall have a minimum finished thickness of 1 inch. When water pipes run next to a beam or joist, the insulation shall be secured to the beam at a minimum of every 12 inches.

Figure 32: FL 2.3 Water Pipe Wrap



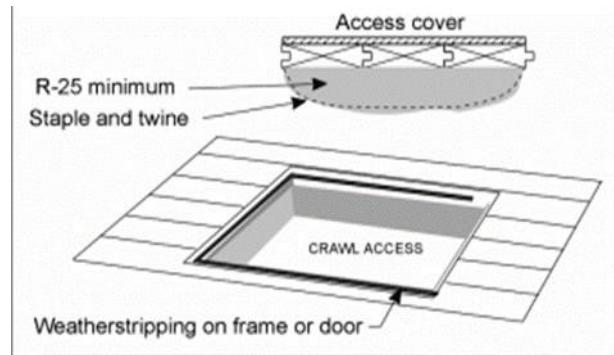
Pre-formed insulation (foam pipe wrap) shall be properly sized. Corners shall fit tightly. The inside diameter of the pre-formed insulation shall match the outside diameter of the water pipes. Pre-formed insulation shall be supported every 12 inches, and within 3 inches of the ends. If connections and corners are larger than piping, exposed joints shall be insulated with fiberglass or pre-formed insulation that matches the outside diameter of the connection and corners.

FL 2.4 - Inside Access Doors to Crawlspace Areas

Access doors between floors and heated spaces shall be insulated to R-25 for floor hatches. Insulation shall be securely fastened to access doors using staples and twine or a similar method that ensures the effectiveness and durability of the insulation. Interior access doors shall be weather-stripped.

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2024 Weatherization & HVAC Specification Manual

Figure 33: FL 2.4 Insulating Crawl Access Hatch



FL 2.5 - Outside Access Doors to Crawlspace Areas

Any outside access shall have a door that is easily opened to permit inspection and shall be weather and vermin resistant. Vertical accesses may be screened when it is part of the crawl space ventilation system. Horizontal hatch covers shall shed water. Wood in contact with soil or concrete shall be pressure treated.

Figure 34: FL 2.5 Horizontal Crawlspace Access



Existing covers are acceptable, provided that they are in good condition, weather, and vermin resistant.

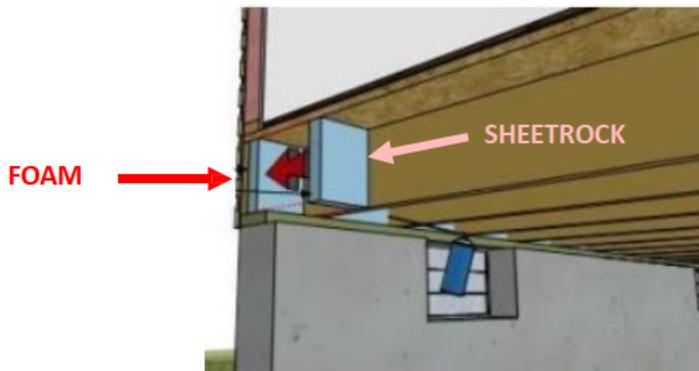
An air barrier or skirting shall protect under floor insulation that is exposed to the wind, including un-skirted crawl spaces and cantilever floors.

FL 2.6 - Rim Joist Insulation

When under floor insulation is not installed above a basement, insulation installed in direct contact with the wooden perimeter “band” or “rim” joist may qualify for the wall insulation incentive level. It is recommended that each joist bay is sealed for air leakage prior to installation of insulation. Batt-type or foam insulation used in this application shall be tightly installed, securely fastened, be at least R-15, and comply with state and local codes. A vapor-permeable air barrier rated for smoke and flame spread shall be installed over rigid foam insulation. A vapor-permeable air barrier shall be installed over batt-type insulation. Drywall, sealed at the edges with caulk/foam, is an acceptable material for covering the rigid foam.

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2024 Weatherization & HVAC Specification Manual

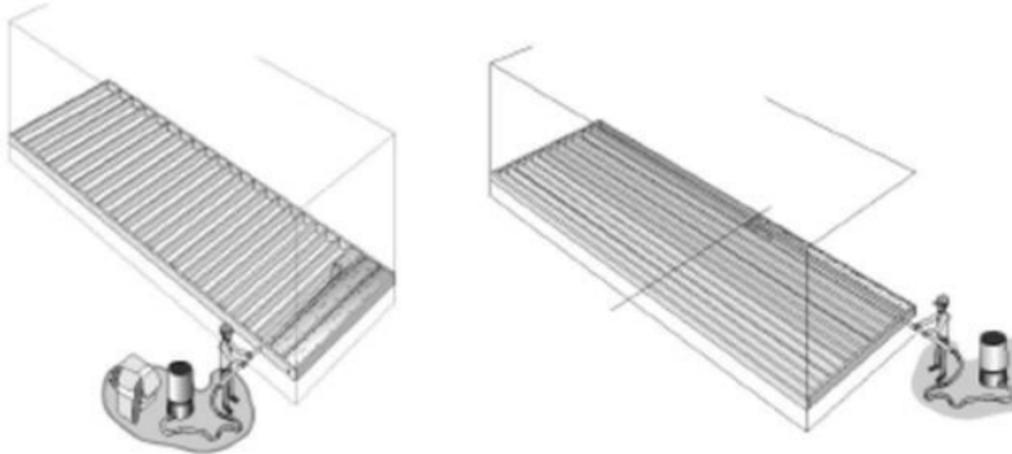
Figure 35: FL 2.6 Rim Joist Insulation with foam



FL 2.7 Belly Blow/ Mobile Homes

All prior floor work should be done, such as air sealing, duct work and pipe insulation, before floor insulation. Secure belly wrap in a permanent fashion. Blown fiberglass, fiberglass batts, or rockwool should be installed to a minimum of R-30 or **FILL THE CAVITY** if you can't reach R-30.

Figure 36:FL 2.7 Blowing Insulation in a Mobile Home



Blowing crosswise cavities:

Blowing insulation into belly is easy if the floor joists run crosswise. However, the dropped belly requires more insulation than a home with lengthwise joists.

Blowing lengthwise cavities:

Floors with lengthwise joists can rarely be filled completely from the ends because of the long tubing needed. The middle can be filled from underneath.

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2024 Weatherization & HVAC Specification Manual

Wall

Preparation

While insulating, occasionally inspect interior walls to ensure no damage has occurred from blowing insulation.

If unsafe wiring, lead paint, mold, or other issues are observed or suspected in the walls to be insulated, review sections [PR 1.1](#) and [PR 1.2](#)

Installation

WA 1.0 - Closed Wall Cavity

Closed wall cavities shall be insulated to a minimum of R-11 for 2x4 walls or to the highest practical R-value. Insulation shall not be installed in wall cavities that serve as air ducts for heating or cooling. Cavities containing wall-mounted heaters or water heaters shall not be insulated unless there is blocking to prevent contact with insulation. For inspection purposes, the contractor may be required to open and re-plug selected entry holes. An infra-red camera may be used to identify consistency of thermal quality and coherence with these specifications.

All cavities shall be filled, including small cavities above, below, and on the sides of windows and doors.

WA 1.1 - Plugs and Finish Work

Plugs shall be sealed, weatherproofed, and ready to paint. Plugs shall not be vented. Plugs shall be made of material that will not shrink or expand, which would result in damage to the siding or finish.

Figure 37: WA 1.1 Exterior Wall Plugs



If the surface of the plug is below the surface of the siding, the hole shall be filled with non-shrinking, waterproof filler. If siding is removed and holes are drilled in the sub-siding, the holes shall be plugged and sealed.

Lead safe practices (section [PR 1.1](#)) should be implemented when drilling through walls where lead paint is may be present.

ENERGY EFFICIENCY INCENTIVE PROGRAM 2024 Weatherization & HVAC Specification Manual

WA 1.2 - Removing and Replacing Siding

If at all possible, siding should be removed to access wall cavities. Before replacing siding, holes shall be filled with fitted plugs or covered with tar paper, counter flashed and stapled. Shingles or shakes shall be nailed every 4 inches with a minimum 4d galvanized finish nail and at each corner. Clapboard type siding shall be nailed at every wall stud, or 16" O.C., using galvanized nails and all bare wood shall be primed and made tight to the weather.

WA 1.3 - Open Wall

Open walls in garages that face a conditioned space (does not apply to remodel or new construction) shall be insulated in compliance with the requirements of WA State Energy Code, which requires combustible Kraft facing not be left exposed. A minimum of R-11 or fill the cavity should be achieved.

WA 1.4 - Interior Installations

Walls that are inaccessible from the exterior shall be filled from the interior with the homeowner's permission. Every effort should be made to control and clean up dust inside the home. Inspect interior walls for cracks or damage while insulating (note CNGC will not be held responsible should issues arise). Dense pack insulation should be installed to 3.5 lb./ft³ but without bowing or damaging the interior walls.

Figure 38: WA 1.4 Interior blown insulation



ENERGY EFFICIENCY INCENTIVE PROGRAM 2024 Weatherization & HVAC Specification Manual

Air Sealing

AS 1.0 – Carbon Monoxide Monitor

Whenever there is a combustion appliance present in the house, garage, or other attached space, a UL listed, CSA listed, or equivalent carbon monoxide detector shall be installed. A new carbon monoxide (CO) alarm or detector should be offered for install if a working one is not already present.

Figure 39: AS 1.0 Carbon Monoxide Detector



Carbon monoxide alarms should be installed in each bedroom of a house or at minimum within 15 feet of each sleeping area. Contractors should educate their customers on the use of carbon monoxide alarms and precautions that should be taken if the alarm activates. The intention of the alarm is to warn occupants before they experience the symptoms of carbon monoxide poisoning.

Do not install CO alarms within 5 feet of a combustion appliance, vent or chimney, within a furnace closet or room, nor within 12 inches of an exterior door or window.

AS 1.1 – Whole House Air Sealing

CNGC offers whole house air sealing rebates when total air leakage reduction of 400 [CFM₅₀](#) is achieved. Recommended areas: AS 1.1.

Table 3 AS 1.1 Whole House Air Sealing Checklist

Item	Sealing Recommendation
Chimney Chases	Fire-rated materials shall be used in contact and within 1" of masonry or metal chimneys, flues, and vents
Hatch/ Door	Install weather-stripping to air seal between the access frame and hatch/door for attics and crawlspaces
Duct Chases	Seal with foam or caulk. If opening is larger than ½ inch, cover with rigid material to attic/floor level and seal

ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual

Duct Penetrations	Apply mastic, caulk, or other airtight seal around the perimeter of the duct boot and between the boot and ceiling/floor
Plumbing chases	Seal with foam or caulk. If opening is larger than $\frac{1}{2}$ inch, cover with rigid material to attic/floor level and seal
Drop soffits	Cover with rigid material to close off soffit from attic and seal
Open wall cavities	Cover with rigid material, foam or caulk to attic floor level and seal
Wall Top Plates	Pull old insulation away and look for dust marking. Seal along top plate to drywall joints on attic side of ceilings, wood to wood seams, and penetrations
Light Fixtures	Pull old insulation away and look for dust marking. Seal fixture box holes and joint to drywall with fire rated caulk or foam
Recessed Cans	Seal between the interior finish and the fixture with foam or caulk. An airtight drywall box of non-flammable material is acceptable
Bath Fans	Apply foam, caulk or another sealant around the fixture perimeter. Use fire resistant caulk for fans with a heat source. If gap is larger than 1 inch, span with sheet metal
Electric & Plumbing penetrations	Apply foam, caulk or other sealant around perimeter of electrical fixtures and plumbing penetrations. Use moisture resistant material in crawlspace
Knee wall doors and transitions	Weather-strip between the attic access frame and door, install rigid material, and seal with foam or caulk between and around joists
Sill plate/ stem wall/ Rim Joists	Between conditioned and unconditioned spaces, seal the sill plate to the stem wall connection and perimeter of rim joints with caulk or foam
Walls	For walls between conditioned and unconditioned areas, seal the connection between floor and wall with caulk. Tape and mud unfinished drywall
Doors	Weather-strip doors and install door sweeps or shoes to create an effective air seal

Effective air sealing requires a blower door “test-in” and “test-out” in order to gain an understanding of air sealing effectiveness. Sealing of air leaks can save significant energy, reduce drafts and limit unwanted air exchange to unconditioned spaces. However, after sealing infiltrations, combustion safety testing must be performed for all natural-draft gas heating appliances.

ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual

Copies of required Department of Commerce Combustion and Diagnostic forms can be found on the [CNGC website](#). The last line of *Baseline Conditions & House Tightness* listing the Total CFM₅₀ of the Diagnostic Test Report is required for the CNGC Air Sealing rebate.

Figure 40: AS 1.1 Diagnostic Test Report

Page 1 of 2

Department of Commerce		Diagnostic Test Report		
Innovation is in our nature.		Pre	In-Progress	Post
Technician:	Date:	1/10/14	1/10/14	1/10/14
Pre/Blower Door				
I. Client Interview Performed? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No				
II. Pollution Source Survey Completed? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No				
III. Contaminants Present that would either prohibit blower door test completely, or require pressurization test? <input type="checkbox"/> NONE				
CALCULATIONS				
1 Calculated total square footage of heated area	2638 ft ²			
2 Calculated volume of conditioned space	21,104 ft ³			
3 BAS based on number of occupants (#occ 2 x 16cfm x n)	660			
4 BAS based on number of bedrooms (#bedrooms x 15cfm + 16 x n)	1650			
5 BAS based on volume of conditioned space (volume x 0.35 x n/60)	2308			
6 Calculated BAS = highest number of lines 3, 4, and 5	2708			
BASELINE CONDITIONS & HOUSE TIGHTNESS - Blower door				
7 Primary heat source fuel type (example: nat. gas, electric, propane, wood)	NAT. GAS	Was gas	Not gas	
8 Windspeed MPH	0.5	0.5	0.5	
9 Outside temperature °F	40°	52°	52°	
10 Blower door location	FRONT	Front	Front	
11 Baseline without blower door on in pa (stack-effect)	-0.5	-0.5	-0.5	
12 Blower door configuration: O=open fan A=ring A B=ring B LF=low flow ring	B	B	B	
13 Total CFM50	1032 Actual 2450 >	1915	1795	
ZONAL PRESSURES - Blower door				
ATTIC	WRT house	45.0	—	47.0
CRAWLSPACE	WRT house	—	—	—
GARAGE	WRT house	—	—	—
OTHER:	WRT house	—	—	—
OTHER:	WRT house	—	—	—
OTHER:	WRT house	—	—	—
15 Location of existing ducts: A=inside B=outside C=inside/outside				
16 Duct Pressure Test - Blower door				
17 Room Pressure - HVAC fan only				
17	Location	S/ Supply	Room Pressure: Room WRT Main body	Pre
		R/Return	Room Pressure: Room WRT Main body	Post
a.				
b.				
c.				
d.				
e.				
f.	Duct	Duct	Duct	Duct
g.				
h.				
i.				
j.				
k.				
l.				
TESTING AIRHANDLER (HVAC) EFFECTS: HVAC fan only				
18 Dominant Duct Leak Test: Main Body WRT outside (all interior doors open)	NA	—	—	—
19 All Doors Closed Effect: Main Body WRT outside (all interior doors closed)	NA	—	—	—
20 Duct location after Wx and Repairs: A=inside B=outside C=inside/outside	Duct	Duct	Duct	Duct
21 Electric furnace heat rise test (supply F-return F) acceptable range >40° to <70°	NA	—	—	—
22 Return house to pre test conditions (Check box when done)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
EXHAUST FAN TESTING (ACTUAL CFM)				
a. UPSTAIRS BATH	74	76	—	—
b. DOWNSTAIRS BATH	72	72	—	—
c. —	—	—	—	—
NOTES/DOCUMENTATION:				

Revised April 2011
 In progress: CFM50 After Attic Air Seal and Weatherization Program Exhibit

Attic blow.

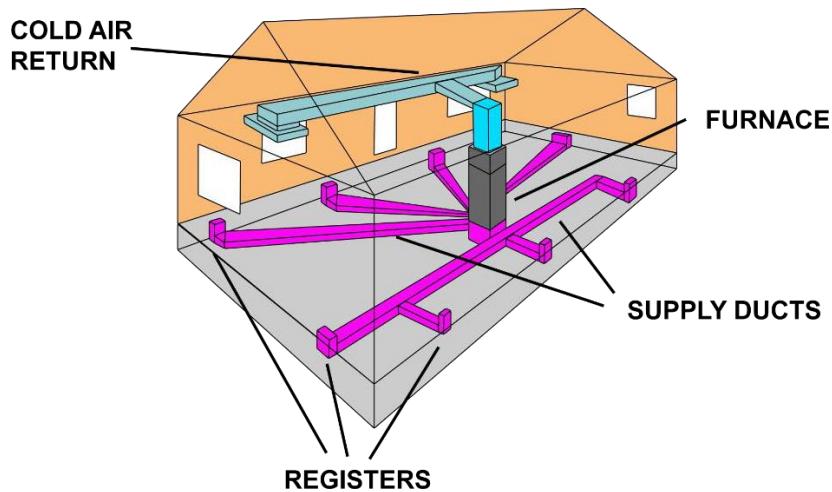
Post: CFM50 After BD guided Air Seal.

Duct Sealing

DU 1.0 – Ducts in Unconditioned Space:

CNGC requires at least 30% of the supply ducts to be accessible and located in unconditioned space to qualify for an incentive. **Exception:** Where high operating pressure leaks are located in an unconditioned space, the system shall be eligible for duct sealing, even if less than 30% of the supply ducts are in unconditioned space. A high operating pressure leak is defined as any leak occurring on the main trunk line within 15 feet of the furnace, especially those at the furnace or plenum connection.

Figure 41: DU 1.0 - House Duct System



For new duct systems, the entire duct system is considered to be accessible.

Ducts in basements are considered to be in conditioned space; while vented crawlspaces, attics with floor insulation, and unheated garages are considered unconditioned.

The inner liner on manufactured home crossover ducts is considered accessible.

The belly of manufactured homes is considered accessible.

DU 1.1 – Duct Insulation/Asbestos

The presence of insulation alone shall not be considered a barrier to accessibility unless the contractor suspects asbestos may be present. If at any time asbestos is suspected to be present, the contractor shall stop work immediately and notify the homeowner that the site requires professional assessment before duct sealing work can be done.

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DU 1.1 – Duct Repair

All accessible portions of the duct system shall be repaired and mechanically fastened, where needed.

Substandard sections of duct—such as rusted, crushed, disconnected or sections otherwise ineffective—shall be repaired or replaced before duct sealing is performed.

When there are large gaps in sheet metal or duct connections, repairs shall be made using sheet metal, sheet metal screws, and/or mastic with mesh-reinforcing tape. Gaps greater than $\frac{1}{4}$ inch shall be reinforced using mesh-reinforcing tape before applying mastic.

All metal ducts shall be secured using at least three sheet metal screws at each connection and an attempt be made to have them be equally distributed around the ducts.

All flexible ducts shall be joined to a section of rigid duct of matching diameter, including locations where two separate sections of flex duct meet. Both the inner and outer lining shall be tightly fastened using a compression strap tightened with a tool designed for that purpose. Tape may remain as long as a compression strap is installed to maintain a permanent connection.

In manufactured homes with two or more sections, defective or missing cross-over ducts shall be repaired or replaced.

DU 1.2 – Duct Support

To minimize sagging, all accessible portions of the duct system shall be supported with durable supports.

To minimize the possibility of disconnection, flexible ducts shall be supported every 4 feet (and within 3 feet of each connection) to a rigid duct, with straps that are each not less than $1\frac{1}{2}$ inches wide each and that do not restrict airflow.

Figure 42: DU 1.6 Correctly supported ducts



Ducts shall be supported above the ground. When contact with the ground is unavoidable, a minimum of R-4 closed-cell rigid insulation shall be placed between the duct and the ground. The duct shall not come in contact with standing water.

**ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual**

DU 1.3 – Duct Sealing and Acceptable Materials

Duct sealing may involve temporarily removing old insulation and covering all accessible seams and joints with UL-181 rated Mastic.

Figure 43: DU 1.7 Leaky duct showing dirty insulation where sealing is missing

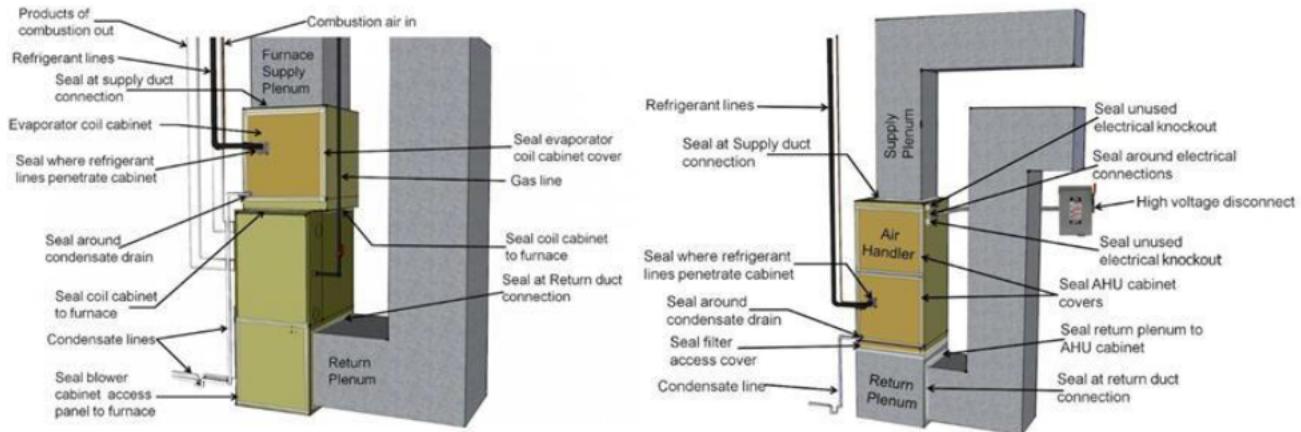


All accessible portions of the duct that require sealing shall be exposed and sealed with approved materials. The following targets for prescriptive duct sealing are listed in order of priority:

1. Plenum
2. Plenum-to-takeoff connections
3. Remove existing loose tape before applying mastic
4. Branch Ts, Ys and Ls
5. Add three screws to each duct connection
6. Duct-to-duct connections
7. Gores on adjustable elbows
8. Finger/dovetail joints
9. Boots
10. Boot-to-floor, boot-to-wall and boot-to-ceiling connections
11. Air-handler cabinet to return

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Figure 44: AS 1.1 Sealing locations on furnace cabinets

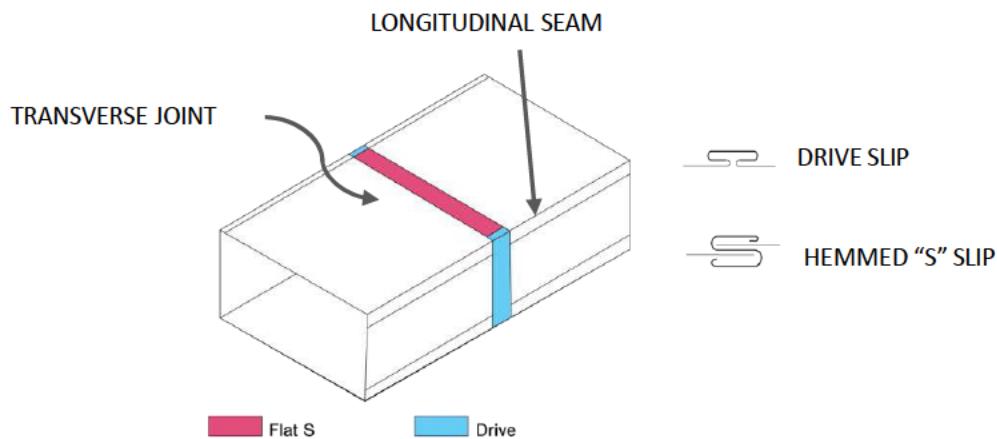


Loose tape shall be removed from rigid metal ducts prior to sealing. Secured tape that remains must be completely covered with mastic which shall extend at least $\frac{1}{2}$ inch beyond the tape edge on either side and be at least $\frac{1}{8}$ inch thick.

Non-flex duct joints, connections and seams shall be sealed with UL-181 listed mastic. The application of mastic shall be done according to manufacturer specifications.

Take offs and crimped fitted joints shall be mechanically secured with screws and sealed with mastic. Non-leaking seams such as S-slip, drive slip and "Snappys" are exempt from being sealed with mastic.

Figure 45: AS 1.1.2 Crimped fitted joints to connect duct sections end to end



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2024 Weatherization & HVAC Specification Manual**

On the air handler, only foil or mastic HVAC tape labeled as meeting UL-181 standards may be used.

Figure 46: DU 1.3 Duct Insulation and Duct Seal



Cloth-backed duct tape shall not be used to seal, secure, or fasten ducts.

Boots shall be mechanically fastened to the subfloor and properly sealed with UL-181 mastic or UL-181 sealant.

All flexible ducts shall be joined to a section of rigid duct of matching diameter, including locations where two separate sections of flex duct meet. Flexible duct connections shall have the interior and exterior liners secured and air-sealed with nylon straps (Panduit or equivalent) and tightened with a manufacturer-approved tensioning tool. Steel band clamps with worm drive tension adjusters are also acceptable. Tape may remain as long as a compression strap is installed to maintain a permanent connection

The return should be sealed if it is easily accessible and in unconditioned space.

End caps must be made of either sheet metal or a UL-181 approved rigid product.

DU 1.4 – Duct Insulation

Rigid Ducts shall be insulated to R-8 or greater. Flexible ducts shall be R-8 or greater.

**ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual**

Figure 47: DU 1.4.1 Correctly Insulated Exhaust Vent



Duct sealing shall be performed before insulating the ducts. All ducts in unconditioned areas shall be insulated securely. The insulation is attached to the duct system using mechanical fasteners such as, permanent plastic straps, nylon twine or fastening material specified by the insulation manufacturer. Mastic will not effectively hold insulation in place. Special attention shall be paid to elbows and termination areas to ensure complete coverage. Do not insulate over flex ducts or pre-formed fiberglass duct board and remove duct board insulation that is R-2 or less. Insulation shall be secured to ductwork every 12" with rot-proof twine, noncorrosive wire or manufacturer-approved vinyl tape if the insulation is vinyl-backed.

Figure 48: DU 1.4.2 Insulation Covered



Duct insulation installed in basements, garages, storage areas or other human contact areas shall be covered to limit occupant exposure to insulation fibers. Covering shall meet applicable fire codes. Basements that contain HVAC ducts or have a direct access to the interior conditioned space of a home shall be considered conditioned space. Insulation installed on ducts in conditioned space is not eligible.

ENERGY EFFICIENCY INCENTIVE PROGRAM 2024 Weatherization & HVAC Specification Manual

Windows

CNGC rebate program offers rebates for removing single pane windows and replacing them with double pane. Check the CNGC website for current offerings: www.CNGC.com/energy-efficiency

The [U-factor](#) measures heat flow and how well a product prevents conductance or keeps heat from escaping. Existing windows must be single pane which needs to be stated on the invoice along with the make, model, dimensions, and U-value.

CNGC accepts reasonable building material replacements that perform equally. A liquid or film flashing membrane such as FastFlash, Liquid Flash, SIP-SEAL, etc. A crack, joint, and seam filler such as R-Guard or 3M Joint & Seam Filler is acceptable.



WI 1.1 – Existing conditions to be retrofitted.



WI 1.2 – Carefully remove existing trim and try to salvage for use after new window is installed.

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2024 Weatherization & HVAC Specification Manual



WI 1.3.1 – Remove existing window.

WI 1.3.2 – Adjust framing as necessary to make opening square and allow for $\frac{1}{2}$ " of space around window frame.

WI 1.3.3 – If adding a sloped sill, be sure to account for the height of the sloped sill in addition to the $\frac{1}{2}$ " of space on each side of the window casing.



WI 1.4.1 – Apply a Joint & Seam Filler to corners, intersections, and edges of opening.

WI 1.4.2 – Tool into place.



WI 1.5 – Apply FastFlash around inside of opening and extend out as far as possible from opening on face of sheathing.



WI 1.6 – Lift up any existing building paper and continue FastFlash out as far as possible.

ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual



WI 1.7 – When possible, bring FastFlash out over the top of siding for continuous lapping (shown with window installed)



WI 1.8.1 – Use shims to leave a space between the bottom flange and building frame to allow drainage in case of window failure.

WI 1.8.2 – 1/6" to 1/8" horseshoe shims are recommended.



WI 1.9 – Install window in rough opening and fasten per manufacturer specifications.



WI 1.10.1 – Bead and tool joint & seam filler along top window flange to prevent water intrusion.

WI 1.10.2 – Optional (pictured): Apply joint & seam filler to jambs as well, but NEVER to sill.

ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual



WI 1.11 – Install head flashing to protect the trim.

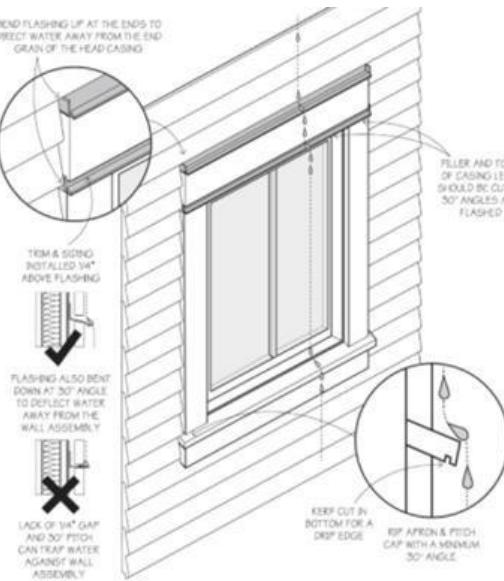


WI 1.12.1 – Complete the window retrofit by fitting trim and caulking around edges where the trim meets the siding on the sides, but NEVER the bottom.

WI 1.12.2 – Kerf bottom of sill trim with a 3/16" drip edge.

See Figure 49: WI 1.13 for an example of a kerf cut on the underside of a windowsill to prevent rainwater from entering the wall.

Figure 49: WI 1.13 Kerf on a Window



**ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual**

Door

For CNGC rebate submissions, the installer shall enter the door U-factor, model number, and other physical characteristic (size, hand, windows, etc.) on the invoice.



DO 1.1.1 – Router the rough opening to make clean edges for applying liquid flashing.

DO 1.1.2 – Pass over outer edges with sandpaper to get rid of any inconsistencies.

DO 1.1.3 – Rough openings should be 1" larger than door width dimensions and $\frac{1}{2}$ " larger than height.

DO 1.1.4 – Make sure sill is flat and level.

DO 1.1.5 – Make sure opening is square and plumb.



DO 1.2.1 – Apply Joint & Seam Filler to all joints to be covered in FastFlash.

DO 1.2.2 – Ensure that all nails are set, apply Joint & Seam Filler and tool into place.

ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual



DO 1.3 – Tool Joint & Seam Filler.



L-Metal Installation

DO 1.4 – Set L-Metal into bead of Joint & Seam Filler.



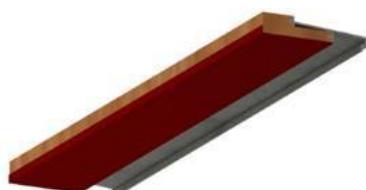
DO 1.5 – Apply another bead of Joint & Seam Filler over L-Metal to form a continuous barrier.



Applying FastFlash

DO 1.6 – Apply FastFlash to sill, extending 9" out from the rough opening to either side.

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2024 Weatherization & HVAC Specification Manual



⑦

DO 1.7 – When installing a wood door threshold, coat the bottom of the threshold with FastFlash. Alternatively, the height of the rough opening can be sized slightly larger and composite shims can be used to elevate the wood threshold off the sill.



⑧

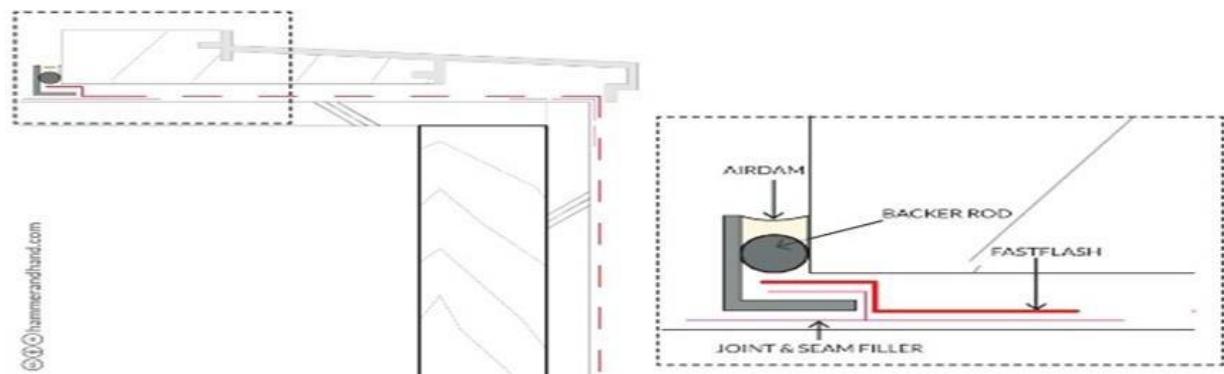
DO 1.8.1 – Install door threshold and sill.

DO 1.8.2 – Fasten accordingly to manufacturer's specifications.



⑨

DO 1.9 – Insert backer rod and sealant between L-Metal and door sill and tool into place.



Note: If the threshold is subject to moisture, the door needs to sit on a resilient shim material.

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2024 Weatherization & HVAC Specification Manual



Interior View

DO 1.10.1 – Insert properly sized backer rod, taking care not to puncture or damage it.

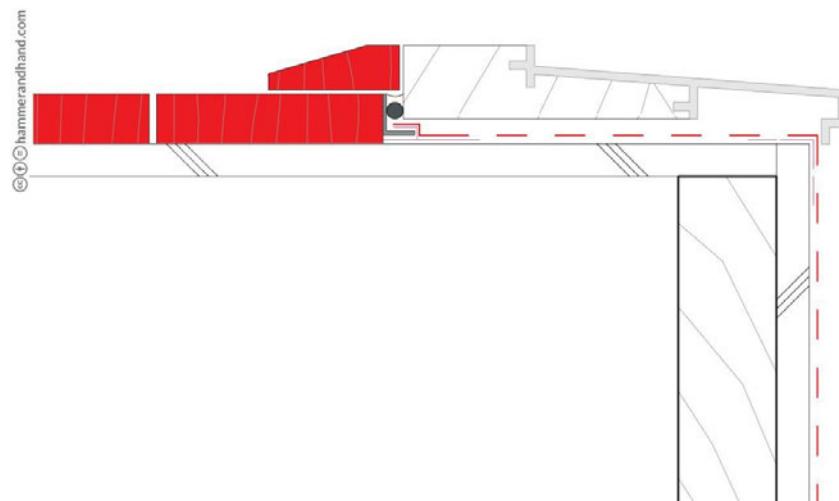
DO 1.10.2 – Make continuous around door frame



DO 1.11 – AirDam over the backer rod and tool the joint.



DO 1.12 – After interior flooring is installed, finish door with trim piece to hide sealant.



ENERGY EFFICIENCY INCENTIVE PROGRAM 2024 Weatherization & HVAC Specification Manual

HVAC

Heating Systems

CNGC recommends heating and cooling systems be sized in accordance with Manual S, Manual D, Manual J, Spec Pro, or another industry-accepted HVAC calculation methodology based on building heating loads. The equipment manufacturer's selection procedures and sizing guidelines should be referenced as part of the HVAC planning and sizing process.

All necessary mechanical and electrical permits should be obtained, and a copy posted on site.

Check for the presence of asbestos-containing materials and confirm abatement of asbestos before continuing work. If a friable asbestos-like substance is found to be present in an area that will be disturbed by work (white tape), it must be tested by a certified professional, and all system components and possible disturbed surrounding areas will be certified free of asbestos by a licensed professional before equipment removal can begin. See Figure 2: [PR 1.1](#)

If suspected mold is found, determine the source and cause, repair issues and remove the suspected mold. Refer to section [PR 1.1](#).

Follow all local codes, or in the absence of local codes, follow the current edition of the National Fuel Gas Code: ANSI Z223.1/NFPA 54 & 70 in the USA or B149.

For rebate eligible improvements and equipment, confirm current CNGC incentives at www.CNGC.com/energy-efficiency.

High-Efficiency Natural Gas Furnace

GF 1.0 – Forced Air Systems.

High efficiency natural gas furnaces are eligible for CNGCC's incentive program. Include the make, model number, serial number, and AFUE rating on the invoice for rebate submissions.

Figure 50: GF 1.0 Direct Vent Condensing Furnace



ENERGY EFFICIENCY INCENTIVE PROGRAM 2024 Weatherization & HVAC Specification Manual

GF 1.1 – Installation

CNGC recommends the following for best practices.

Remove existing furnace and inspect the condition of vent connection pipe and chimney. Parts of the venting system may have deteriorated over time. Chimney problems can be expensive to repair and may help justify installing new heating equipment that can't use the existing chimney.

Install furnace to manufacture specs.

Check the combustion chamber for cracks

Check the physical integrity of the heat exchanger. Furnace heat exchangers mix combustion gases with house air when they leak—an important safety reason to have them inspected.

Check that all connections are tight between ducts, boots, plenums and air handler.

Check fuel input and flame characteristics; adjust if necessary. Test for carbon monoxide (CO) leakage and remedy if found.

Adjust the controls on the furnace to provide optimum air temperature settings for both efficiency and comfort. Adjust blower control and supply-air temperature

Conduct a combustion efficiency and combustion safety test after installation to ensure equipment is drafting properly and running correctly. Install new CO detector if necessary.

Educate the customer on operation, thermostat, and maintenance for peak energy efficiency and comfort. Explain the location of the condensate line, as well as prevention or action if the condensate drain line freezes.

GF 1.2 – Condensate lines

Install the condensate drain line to an interior drain at a $\frac{1}{4}$ " slope or install a pump. To minimize the risk of freezing during prolonged cold spells, one of the following methods of terminating condensate drainage pipe should be adopted.

1. Connect to an internal drain connection such as a kitchen or bathroom waste pipe.
2. Install a condensate pump to the internal drain connection such as the examples above.
3. Install or connect to an external drain connection or in unheated internal areas (which also run the risk of freezing).

If in an area likely to freeze, a secondary condensate drain path planned specifically for freezing temperatures should be properly designed in a manner that allows condensate capture or an appropriate drainage alternative when the exterior outlet is obscured. Also, see [Figure 52: BO 1.0](#).

**ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual**

Figure 51: GF 1.2 Ice Dam at Condensate Termination



GF 1.3 – Installation in Attic

CNGC does not recommend furnace installation in attics. If it is unavoidable, a code compliant walkway and service platform will be installed in attics, if not present.

Sequence of system operation will be verified in accordance with the design documents, and the manufacturer's installation, operation, and maintenance manuals

GF 1.4 – Installation in Crawlspace

CNGC does not recommend furnace installation in crawlspaces.

If suspected mold or asbestos is found, refer to section [PR 1.1](#).

ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual

High-Efficiency Condensing Boiler

BO 1.0 – Boilers

CNGC incentivizes High Efficiency Boilers with condensing flue gases in a second heat exchanger. CNGC recommends the following for installation best practices.

Install boiler to manufacture specifications ensuring piping, venting, draining and flue gas test ports are accessible for maintenance and proper clearance is granted. Minimum 12" from ventilation opening, min 48" from an opening into the house.

Securely mount boiler to wall or ceiling if necessary, maintaining proper clearances.

Install vent/flue dampers. To prevent exhaust and intake air from mixing, maintain a safe distance between the air inlet and flue terminal; a minimum of 3 ft. (21)

If necessary, install the horizontal flue pipe with approximately a 3-degree slope (6 cm/m) towards the boiler. Route the horizontal air supply with a 3-degree slope towards the outside – install the air inlet with wind protection.

Adjust the carbon dioxide output to meet current required standards and international residential code. Slide separator fully onto coupling then push the next balanced flue pipe into the coupling of the separator and secure.

Test the pressure-relief valve and test high-limit control.

Inappropriate installation or using unsuitable components or assemblies may lead to a risk of poisoning or explosion.

Inspect pressure tank, which should be filled with air, to verify that it's not filled with water. Check entire system for leaks

Clean the heat exchanger.

Check that the condensate line drains correctly at a $\frac{1}{4}$ " slope or install a pump. To minimize the risk of freezing during prolonged very cold spells, one of the following methods of terminating condensate drainage pipe should be adopted.

1. Connect to an internal drain connection such as a kitchen or bathroom waste pipe.
2. Install a condensate pump to the internal drain connection such as the examples above.
3. Install or connect to an external drain connection or in unheated internal areas (which also run the risk of freezing).

If in an area likely to freeze, a secondary condensate drain path planned specifically for freezing temperatures should be properly designed in a manner that allows condensate capture or an appropriate drainage alternative when the exterior outlet is obscured. Also, see Figure 51: [GF 1.2](#).

**ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual**

Figure 52: BO 1.0 Secondary condensate drain



Educate customer on how to use the boiler, thermostat settings and energy-saving options. Install CO detector if necessary. Explain the location of the condensate line, as well as prevention or action if the condensate drain line freezes.

BO 1.1 – Radiant Hydronic Heating

Installer shall enter values for make, model, serial number, and AFUE of the equipment installed in the home. Where hydronic systems use a radiant slab for distribution, ensure the unit is sized appropriately.

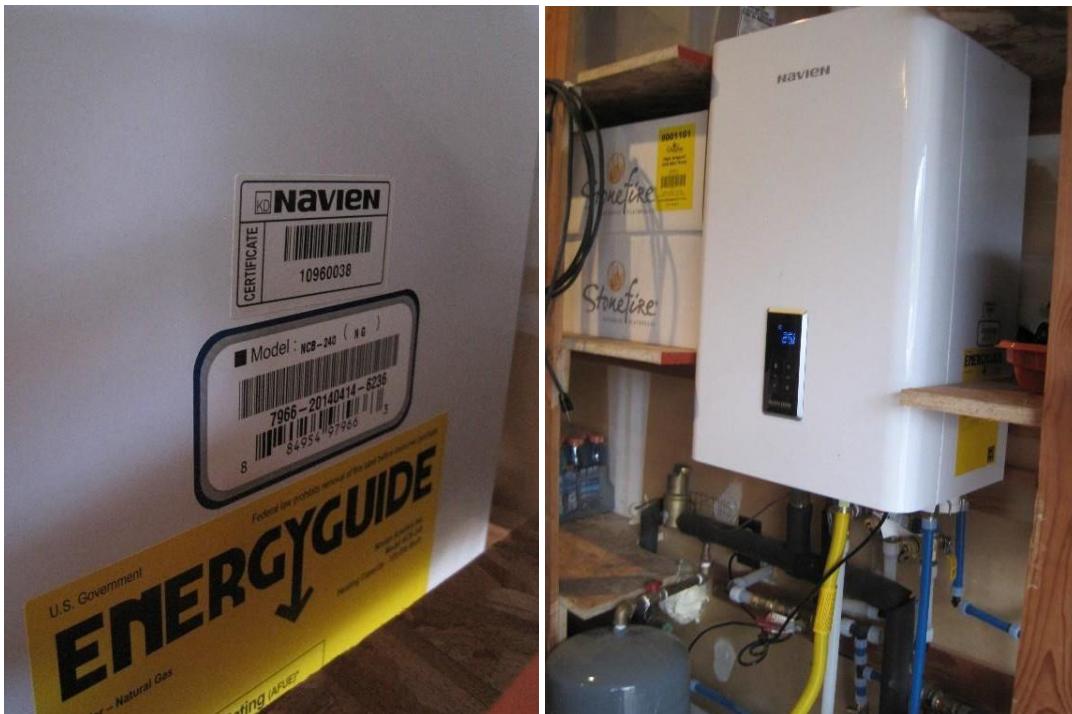
Insulation is essential in reducing heat losses from the boiler, pipes, and valves. Confirm the boiler being installed is well insulated.

ENERGY EFFICIENCY INCENTIVE PROGRAM 2024 Weatherization & HVAC Specification Manual

Combination Residential Space and Water Heat System

CNGC provides rebates for combination space and water heat systems. Include the make, model, serial number and energy rating for the equipment. Refer to best practices in section [BO 1.0](#) as well as the following information:

Figure 53: Navien NCB-240 Combination Space and Water Heat Unit



CO 1.0 – Combination Space and Water Heating

Strainers shall be installed on the boiler water supply side of indirect tank/heat exchanger and on the inlet side of the heating pump in accordance with manufacturer specifications. Scale reducing treatment will be taken into account for areas with hard water.

Equipment will be installed in accordance with the latest international standards or per scope of work, and manufacturer specifications, and will include:

- Boilers
- New indirect tank or heat exchangers and storage tanks
- Pumps
- Controls
- Expansion tanks
- Flow controls
- Insulation

ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual

System will be tested for leaks, operation, and performance, and will be in accordance with manufacturer specifications and confirmed by a contractor.

Water flow through the boiler, pressure, operating amperage, and voltage shall be measured in accordance with the latest ANSI / ACCA Standard 5 or ANSI / ASHRAE Standard 111, and adjusted to meet design requirements

Install the condensate line at a $\frac{1}{4}$ " slope or install a condensate pump for proper drainage. To minimize the risk of freezing during prolonged very cold spells, one of the following methods of terminating condensate drainage pipe should be adopted. See Figures 51: [GF 1.2](#) and 52: [BO 1.0](#).

1. Connect to an internal drain connection such as a kitchen or bathroom waste pipe.
2. Install a condensate pump to the internal drain connection such as the examples above.
3. Install or connect to an external drain connection or in unheated internal areas (which also run the risk of freezing).

Educate the customer on proper operation, maintenance and use to optimize energy efficiency. Leave a commissioning checklist with the appliance and install a CO detector if necessary. Explain the location of the condensate line, as well as prevention or action if the condensate drain line freezes.

ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual

Condensing Natural Gas Tankless Water Heater

TK 1.0 – Tankless Water Heater

CNGC incentivizes high efficiency natural gas tankless water heaters. Contractors should include the make, model, serial number and UEF rating on the invoice for rebate submission. CNGC recommends the following best practices for installation.

The water heater will be installed to manufacturer specs and to the latest international residential code.

Figure 54: TK 1.0 Navien NPE-180



The tankless water heater must be installed in a location where the proper amount of combustible air will always be available to it without obstructions, and water leakage will not damage surrounding areas.

Mount it securely and allow enough clearance for service of lines, components, venting and access to the panel. If installed in a garage, locate where unit will not be damaged by moving vehicles or stored items.

Install the condensate line sloped $\frac{1}{4}$ " per foot away from the unit or install a pump.

Seal all positive pressure vent joints and pipes to prevent leakage.

Route drain line to a nearby floor drain, laundry tub, or condensation pump as the water heater will not work with a blocked condensate line. Do not install the drain line where it could possibly freeze. See Figures 51: [GF 1.2](#) and 52: [BO 1.0](#).

ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual

Educate the owner about proper maintenance and operation for efficiency and safety. Explain the location of the condensate line, as well as prevention or action if the condensate drain line freezes.

TK 1.1 – General rules for venting water heaters are:

1. Place the tankless water heater as close as possible to the vent termination.
2. The vent collar of the water heater must be fastened directly to an unobstructed vent pipe.
3. Do not weld the vent pipe to the water heater's vent collar or cut the vent collar of the unit.
4. The vent must be easily removable from the top of the water heater for normal service and inspection of the unit.
5. The water heater vent must not be connected to any other gas appliance or vent stack except an approved common-venting system.
6. Avoid using an oversized vent pipe or using extremely long runs of the pipe unless it is part of an approved common vent system.
7. For rooftop venting, a rain cap or other form of termination that prevents rainwater from entering into the water heater must be installed.
8. Do not terminate vent into a chimney. If the vent must go through the chimney, the vent must run all the way through the chimney to the outside.

TK 1.2 – General rules for vent terminations:

1. Avoid locating the tankless water heater vent termination near any air intake devices. These fans can pick up the exhaust flue products from the water heater and return them to the building which can create a health hazard.
2. Locate the vent termination so that it cannot be blocked by any debris, at any time. Most codes require that the termination be at least 12 in. (305 mm) above grade, but the installer may determine if it should be higher depending on the job site condition and applicable codes.
3. A proper sidewall termination is recommended when the water heater is vented through a sidewall regarding the clearances from the exhaust termination to the air inlet or opening.

ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual

Natural Gas Fireplace or Hearth

FI 1.0 – Hearths and Fireplaces

CNGC offers rebates for qualified Fireplace and Hearth installations. These systems require combustion venting to the outside of the conditioned space.

For CNGC rebates, invoices should list the make, model, serial number, and efficiency factor of equipment installed.

The most energy-efficient gas fireplaces have many of the following features:

1. A high EnerGuide Fireplace Efficiency (FE) rating as tested to CSA P.4.1-15, found in product brochures or on manufacturers' Web sites. CNGC does not use the steady state rating for energy efficiency.
2. Direct-vent design, where appropriate.
3. An intermittent electronic ignition system or an easy means of turning off and relighting the pilot light.
4. A ceramic glass front.
5. A quiet squirrel-cage-type circulating fan to help transfer convective heat to the room.
6. Secondary heat exchanger.
7. Insulated outer casing to prevent heat loss through the walls to the outside if located on an exterior wall.
8. Good turndown or other means such as ducting to prevent localized overheating.

Figure 55: FI 1.1 Natural Gas Fireplace Insert



ENERGY EFFICIENCY INCENTIVE PROGRAM 2024 Weatherization & HVAC Specification Manual

FI 1.1 – Installation

Fireplace installation should follow manufacturer standards, current regional codes, and it's recommended to include the following:

1. Frame an opening for fireplace, allowing for type of installation (corner, flat wall application) and proper venting.
2. If masonry (optional) will be used, prepare foundation for the masonry load. A lintel is required to support the added weight above the fireplace.
3. Attach nailing flanges to fireplace.
4. Insert fireplace into framing.
5. Install hearth (if applicable).
6. Complete gas line installation.
7. Complete electrical hook-up and install any standard or optional electrical components.
8. Complete venting installation. Seal around collars and outer edge of termination box.
9. Verify all clearance and secure fireplace to flooring through holes located in the outer box bottom and to the framing with nailing flanges.
10. Install facing material, mantel or cabinetry, allowing room for optional full-face doors, if applicable.
11. Install logs, grills and optional decorative doors/faces.
12. Verify proper operation of fireplace and all components. Educate the owner on proper use and maintenance schedule for most energy efficiency.

FI 1.2 – Vent Termination

1. Terminations against vinyl siding must use a vinyl siding protector.
2. DO NOT RECESS TERMINATION KIT INTO OUTSIDE BUILDING MATERIALS - i.e.: brick, stone, siding, etc. If necessary, extend framing so that termination kit will be exposed once building materials are installed.
3. Vent termination must not be located where it will become plugged by snow or other material. The flow of combustion and ventilation air must not be obstructed.
4. Minimum 12" clearance around vent cap

FI 1.3 – Ventless Fireplaces

Cascade Natural Gas does not incentivize or recommend the installation of ventless fireplaces. They are being advertised and sold as 99.9% energy efficient. While they can be highly efficient, they do so by venting all combustion gases into the living space. The risk of Carbon Monoxide poisoning and system failure is currently such that CNGC is not accepting ventless fireplace models in the rebate program.

ENERGY EFFICIENCY INCENTIVE PROGRAM 2024 Weatherization & HVAC Specification Manual

Thermostat

PT 1.0 – Programmable or Smart Thermostat

Programmable Thermostat: 7 day (flexibility)/5+2(workweek/weekend)/5+1+1 day

Smart Thermostat: ENERGY STAR: [Smart Thermostats | ENERGY STAR](#)

https://www.energystar.gov/products/smart_thermostats

Figure 56: PT 1.1 Honeywell Programmable Thermostat



At least one thermostat shall be present or provided for each separate heating and cooling system.

Where the primary heating system is a forced-air furnace, at least one thermostat per dwelling unit shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day. The thermostat shall allow for, at a minimum, a 5-2 programmable schedule (weekdays/weekends) and be capable of providing at least two programmable setback periods per day. This thermostat shall include the capability to set back or temporarily operate the system to maintain zone temperatures down to 55°F (13°C) or up to 85°F (29°C).

The thermostat and/or control system shall have an adjustable dead band of not less than 10°F.

Glossary of Terms

ACH (Air Changes per Hour)

ACH is a measurement of volume flow rate typically used for ventilation. ACH50 is the measure of air infiltration through cracks, holes, and gaps in construction, and reflects the number of times the air volume in a house changes over in one hour when pressurized to 50 pascals. This may also be called the natural ventilation rate of a home and is measured using a blower door test. A house with 1/3 ACH means the interior air equal to the house's full volume changes with the outside air every 3 hours. The lower the number, the tighter the home. Homes that measure less than 1/3 ACH are more efficient, but due to the low turnover of air volume, mechanical ventilation should be installed.

AFUE (Annual Fuel Use Efficiency)

AFUE measures the efficiency of a furnace or boiler. It's a percentage of how much of the energy is converted into useful heat. A 96% efficient furnace loses only 4% of its energy in producing heat for the home, the other 96% gets transferred into the ducts throughout the house. Old systems may run at 65% AFUE, with almost 35% wasted heat.

AHRI (Air Conditioning, Heating, and Refrigeration Institute)

The AHRI provides a directory of certified product performance. It lists the energy efficiency of residential and commercial heating equipment such as furnaces, boilers, and water heaters.

<https://www.ahridirectory.org/Search/SearchHome?ReturnUrl=%2f>

CFM (Cubic Feet per Minute)

CFM is a measurement of volume flow rate typically used for air sealing. CFM50 is the amount of air moving through a building per minute when pressurized to 50 pascals. Using a blower door test, the CFM50 number shows how tight or leaky a building is. When a house is air sealed, the volume of air escaping per minute will be reduced by the CFM50 reduction (initial CFM50 measure less the post CFM50 measure), preserving the heated or cooled air longer inside the building and reducing energy use. The lower the CFM50 number, the tighter the home.

FE (Fireplace Efficiency)

FE is based on the CSA-P.4 test method and can typically be found on the EnerGuide label of a gas fireplace. CSA (Canadian Standards Association) P.4.1 is a standardized test specifically designed to test the energy efficiency of gas fireplaces and is therefore the trusted rating for rebate programs internationally.

http://oee.nrcan.gc.ca/pml-lmp/index.cfm?action=app.search-recherche&appliance=FIREPLACE_G

GPM (Gallons per Minute)

The water flow rate for faucets, shower heads, and tankless water heaters is measured in gallons per minute.

The flow rates for tankless water heaters are correlated with their efficiency ratings.

HSPF (Heating Season Performance Factor)

HSPF is a ratio of BTU heat output over the heating season to watt-hours of electricity used (BTU/Watt hours). HSPF is typically a rating for electric heat pumps.

ENERGY EFFICIENCY INCENTIVE PROGRAM 2024 Weatherization & HVAC Specification Manual

NFA (Net Free Area)

The Net Free Area is the open area that exists for air to pass through in a building. It is used when calculating venting in an attic or crawlspace. See section [VE 1.0](#).

NFRC (National Fenestration Rating Council)

The National Fenestration Rating Council rates energy performance of windows, doors, and skylights. <http://search.nfrc.org/search/searchdefault.aspx> NFRC ratings are required on new manufactured windows and doors. Look for a certification sticker showing U-value at the upper left. The sticker will also show a solar heat gain coefficient (SHGC) and visible light transmission – a measure of how much daylight comes through. Windows with a low SHGC are good at keeping the home cool when used on the south and west orientation.

R-Value

Measures the resistance to heat loss by restricting heat movement. The higher the number, the better the insulator. $R=1/U$.

SEER (Seasonal Energy Efficiency Ratio)

The SEER rating is the AHRI standard for air conditioning efficiency. The SEER number is the ratio of cooling in BTUs to the energy consumed in watt-hours. The higher the SEER rating, the more energy efficient the unit.

UEF (Uniform Energy Factor)

The Uniform Energy Factor is a standardized rating system from the Department of Energy for all water heaters. UEF is replacing the previous EF rating for efficiency standards of water heaters.

U-Factor

Measures how much a material transmits heat, it is the inverse of an R value. $U=1/R$. U- factors are used to measure the efficiency of windows and doors.

ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual

Quick Reference Guide

(R-values are typical and intended as guides when specific manufacturers' information is unavailable)

Insulation Material	R-Value (per inch)	Description (typical)
Loose-fill fiberglass	2.8	Colors: Pink/white/yellow; Attic, floor, walls
Fiberglass batts (blanket)	3	Pink/yellow; Walls, floor, attic
Cellulose fiber	3.7	Light gray/ recycled paper; Attic
Rockwool	3	Black/gray similar to fiberglass; Floor, attic, wall
Polyethylene foam	3	Black; Pipe
Poly-Iso Rigid foam board	7	Pink/white; Foundation walls
Closed cell spray foam	6	White; Attics, walls, framing
Open-cell spray foam	3.6	White; Attics, walls, framing

Fiberglass Batt Condition Ratings	R-Value (per inch)	Description (typical)
Good Condition	3	No gaps or other imperfections
Fair Condition	2	Gaps over 2.5%, still in contact
Poor Condition	0.7	Gaps over 5%, missing in areas, falling down

Cellulose Loose Fill	R-Values
3 ½ inches	11
6 inches	19
7 inches	25
8 inches	30
10 inches	38
10-12 inches	38
15 inches	49
15-17 inches	49
17-20 inches	60

Fiberglass Loose Fill	R-Values
3 ½ inches	8
5 inches	11
7 inches	15
8 inches	19
10 inches	25
12 inches	30
15 inches	38
19 inches	49
22 inches	60

Wall/Floor Fiberglass Batt Insulation	R-Values
2 x 4 (3.5")	15
2 x 6 (5.5")	19-21
2 x 8 (7.25")	25
2 x 10 (9.5")	30
NA	

ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual

Eave Vents	Attic Ventilation
4 holes NFA = 0.09 sq. ft.	Roof jacks 7 inches diameter NFA = 0.21 sq. ft.
3 holes NFA = 0.07 sq. ft.	Roof jacks 8 inches diameter NFA = 0.28 sq. ft.
1 hole NFA = 0.02 sq. ft.	Roof jacks 9 inches diameter NFA = 0.35 sq. ft.
Small rectangle opening NFA = 0.25 sq. ft.	Roof jacks 12 inches diameter NFA = 0.38 sq. ft.
Large rectangle opening NFA = 0.42 sq. ft.	Gable vent 12 inches x 12 inches NFA = 0.50 sq. ft.
	Gable vent 12 inches x 18 inches NFA = 0.75 sq. ft.
	Gable vent 12 inches x 24 inches NFA = 1.50 sq. ft.

To determine the size of the vent in **Net Free Area (NFA) sq. ft.**, use the following equation:

1. (Length x width) ÷ 144 = Gross opening in sq. ft.
2. Gross opening in sq. ft. divided by the screen factor = sq. ft. NFA

Screen Factor:

The screen factor accounts for the loss in ventilation due to any louvers or screen cloth restricting airflow.

Here is a chart of screen factors:

1/4 or 1/2 mesh per inch without louvers = 1.00	1/4 or 1/2 mesh per inch with rain louvers = 2.00
1/8 mesh per inch without rain louvers = 1.25	1/8 mesh per inch with rain louvers = 2.25
1/16 mesh per inch without rain louvers = 2.00	1/16 mesh per inch with rain louvers = 3.00
For example: 14 ½ X 3" vent with a 1/8" mesh = 0.24 sq. ft. NFA	

Rule of thumb: Half of the opening size = NFA

(Most often, this will be within acceptable limits for gable vents)

ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual

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ENERGY EFFICIENCY INCENTIVE PROGRAM
2024 Weatherization & HVAC Specification Manual

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