EPS
FIELD GUIDE

ADVANCING EFFICIENT HOMEBUILDING: VERSION 4.1

EnergyTrust of Oregon

CONTENTS

BUILDING WITH ENERGY TRUST

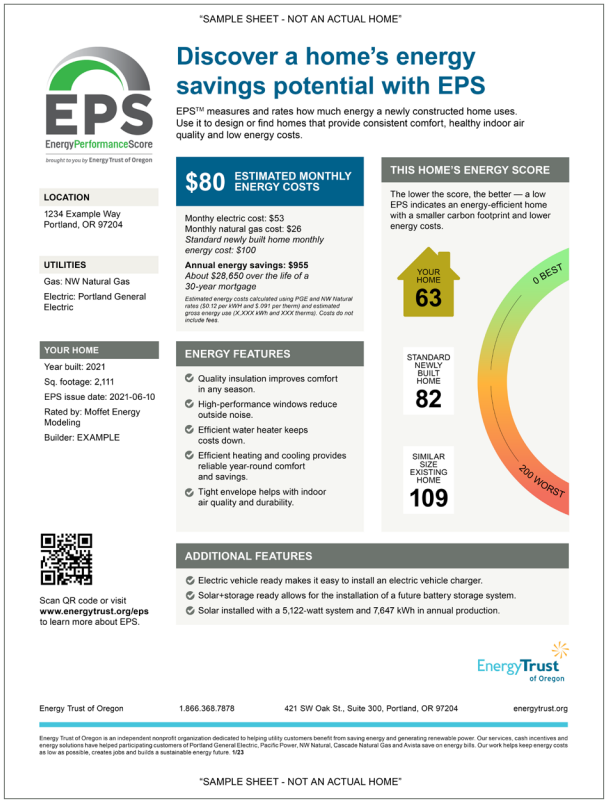
Energy Trust of Oregon works with designers, homebuilders and contractors throughout Oregon and southwest Washington to build energy-efficient homes. EPS,℠ brought to you by Energy Trust, is an energy performance score that estimates a home's energy consumption, energy costs and electricity generated from installed solar.

EPS homes offer superior efficiency, comfort and durability. Builders who meet Energy Trust requirements are eligible to receive incentives and access marketing materials to help promote their EPS homes.

To receive an EPS, homes in Oregon must be served by Portland General Electric, Pacific Power, NW Natural, Cascade Natural Gas or Avista. In Washington, homes must be served by NW Natural.

This EPS Field Guide will help you understand the systems and components that go into building high-performance EPS homes. This includes a full explanation of EPS requirements, along with recommended practices to improve your scores. If you are participating in other home certification programs, make sure you meet any additional requirements as necessary for those programs.

You can learn more about EPS at **www.energytrust.org/epsforallies**.



"SAMPLE SHEET - NOT AN ACTUAL HOME"

EPS EnergyPerformanceScore
brought to you by Energy Trust of Oregon

Discover a home's energy savings potential with EPS

EPS℠ measures and rates how much energy a newly constructed home uses. Use it to design or find homes that provide consistent comfort, healthy indoor air quality and low energy costs.

LOCATION
1234 Example Way
Portland, OR 97204

UTILITIES
Gas: NW Natural Gas
Electric: Portland General Electric

YOUR HOME
Year built: 2021
Sq. footage: 2,111
EPS issue date: 2021-06-10
Rated by: Moffet Energy Modeling
Builder: EXAMPLE

$80 ESTIMATED MONTHLY ENERGY COSTS

Monthy electric cost: $53
Monthly natural gas cost: $26
Standard newly built home monthly energy cost: $100

Annual energy savings: $955
About $28,650 over the life of a 30-year mortgage

Estimated energy costs calculated using PGE and NW Natural rates ($0.12 per kWH and $.091 per therm) and estimated gross energy use (X,XXX kWh and XXX therms). Costs do not include fees.

ENERGY FEATURES
- Quality insulation improves comfort in any season.
- High-performance windows reduce outside noise.
- Efficient water heater keeps costs down.
- Efficient heating and cooling provides reliable year-round comfort and savings.
- Tight envelope helps with indoor air quality and durability.

THIS HOME'S ENERGY SCORE

The lower the score, the better — a low EPS indicates an energy-efficient home with a smaller carbon footprint and lower energy costs.

YOUR HOME 63
STANDARD NEWLY BUILT HOME 82
SIMILAR SIZE EXISTING HOME 109
0 BEST
200 WORST

Scan QR code or visit **www.energytrust.org/eps** to learn more about EPS.

ADDITIONAL FEATURES
- Electric vehicle ready makes it easy to install an electric vehicle charger.
- Solar+storage ready allows for the installation of a future battery storage system.
- Solar installed with a 5,122-watt system and 7,647 kWh in annual production.

EnergyTrust of Oregon

Energy Trust of Oregon 1.866.368.7878 421 SW Oak St., Suite 300, Portland, OR 97204 energytrust.org

Energy Trust of Oregon is an independent nonprofit organization dedicated to helping utility customers benefit from saving energy and generating renewable power. Our services, cash incentives and energy solutions have helped participating customers of Portland General Electric, Pacific Power, NW Natural, Cascade Natural Gas and Avista save on energy bills. Our work helps keep energy costs as low as possible, creates jobs and builds a sustainable energy future. 123

"SAMPLE SHEET - NOT AN ACTUAL HOME"

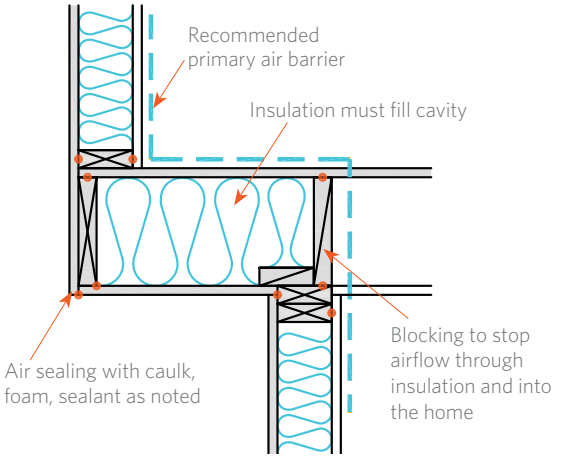
BEFORE YOU BUILD

Throughout this guide, each of the following systems and supporting components is noted as a **requirement**. In order to receive an EPS on a home, you must meet local code and program requirements, and build it at least 10% more efficient than a typical newly built home in Oregon and 5% more efficient than a typical newly built home in Washington.

NOTES ON DRAWINGS WITHIN THIS GUIDE

Throughout the guide, drawings are used to illustrate the recommended practices that meet Energy Trust requirements and recommendations. In all drawings, the blue dashed line (— — —) indicates the location of the recommended primary air barrier. The red dots (• • •) indicate points where air sealing (using caulks, foams, some construction adhesives, gaskets or equivalent materials) will help meet the air tightness recommendations, and the blue corrugated line (ᔓᔓᔓ) and thick blue bar (▬) indicate insulation.

Fig. X: Example



DESIGN PHASE

Timeline

The design phase of planning can positively impact a project's timeline. The timeline on page 3 outlines essential project milestones.

Efficiency in plans

Homes should be designed and constructed to minimize heat loss and heat gain. Clear communication before, during and after the design phase is essential to ensure that the details discussed in this guide are included in plans and carried out during construction by contractors. The design stage is also the best time to schedule an Early Design Assistance meeting with the program.

Conditioned spaces

Any space that is intentionally heated during the winter is identified as a conditioned space. Areas that are not intentionally heated, such as vented crawlspaces, vented attics and garages, are examples of unconditioned spaces. **These details should be shown on drawings and specifications** and explained to all contractors.

Glazing

In most cases, reducing the glazing area will reduce the amount of energy needed to heat and cool a home. If properly implemented, site selection, window orientation and shading can promote the use of passive solar for keeping the home warm in the winter and prevent overheating in the summer.

Other subcontractors

All subcontractors delivering products or services that are related to program requirements or recommended practices should be given a copy of this guide. It is recommended that the subcontractor bid and scope of work include efficiency requirements to facilitate ownership of efficiency components.

To obtain additional printed copies, contact your verifier, or call the trade ally coordinator at **1.877.283.0698**. To download a copy, visit **www.energytrust.org/epsfieldguide**.

TYPICAL TIMELINE

Builder/verifier becomes trade ally	**Optional:** Builder's team participates in an early design assistance meeting	Builder submits construction drawings to verifier	Verifier creates preliminary model	Builder utilizes air barrier/air sealing checklist	Schedule and perform rough inspection (after insulation, before drywall)	Complete construction of home	Schedule and perform final inspection and testing	Receive incentives

VERIFICATION

EPS REQUIREMENT

☐ **Verification site visits**

- Verifiers must perform a site visit at rough-in and a site visit when construction is completed

Verifiers and site visits

Verifiers guide you through the process of energy-efficient building and inspect homes to ensure that they meet program requirements. Your verifier is the key point of contact for all program questions. While verifiers are official Energy Trust trade allies, they operate as independent businesses and set their own fees. Verifiers visit each site at least twice during the building process. See the Resources section in the back of this guide for more information on selecting a verifier.

The ***first*** (rough) site visit occurs immediately after wall insulation, but before drywall. The verifier will confirm the following items:

- Intermediate and/or advanced framing techniques have been implemented
- Wall insulation meets program requirements
- Compliance with EPS New Construction Air Barrier and Air Sealing Checklist
- Ductwork is installed and sealed to meet program requirements
- Duct leakage testing if system is complete
- Mechanical ventilation is installed
- Window NFRC U-Factors are documented
- Solar ready, solar + storage ready, and EV ready infrastructure is installed and labeled, if applicable

The ***second*** (final) site visit occurs when the house is complete. The verifier will confirm, or perform, the following items:

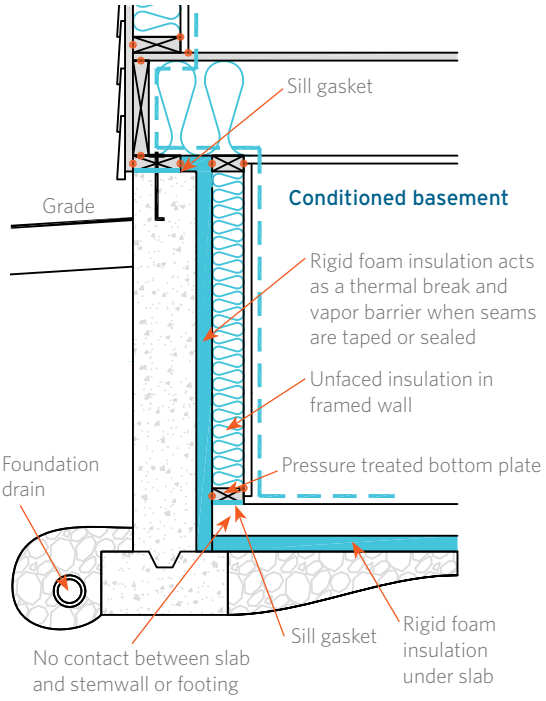
- Blower door testing
- Duct leakage testing if not tested during first site visit
- Record equipment and appliance model numbers
- Energy-efficient lighting meets or exceeds code requirements
- Attic and under-floor insulation meet program requirements
- Mechanical ventilation airflow and settings are set by the mechanical contractor or verifier to meet program requirements
- Carbon monoxide alarms installed as required
- Zonal pressure relief meets program requirements

Additional site visits may be helpful to assist builders and subcontractors with achieving program requirements. Verifiers may charge for re-inspections or additional site visits.

FOUNDATIONS & SLABS

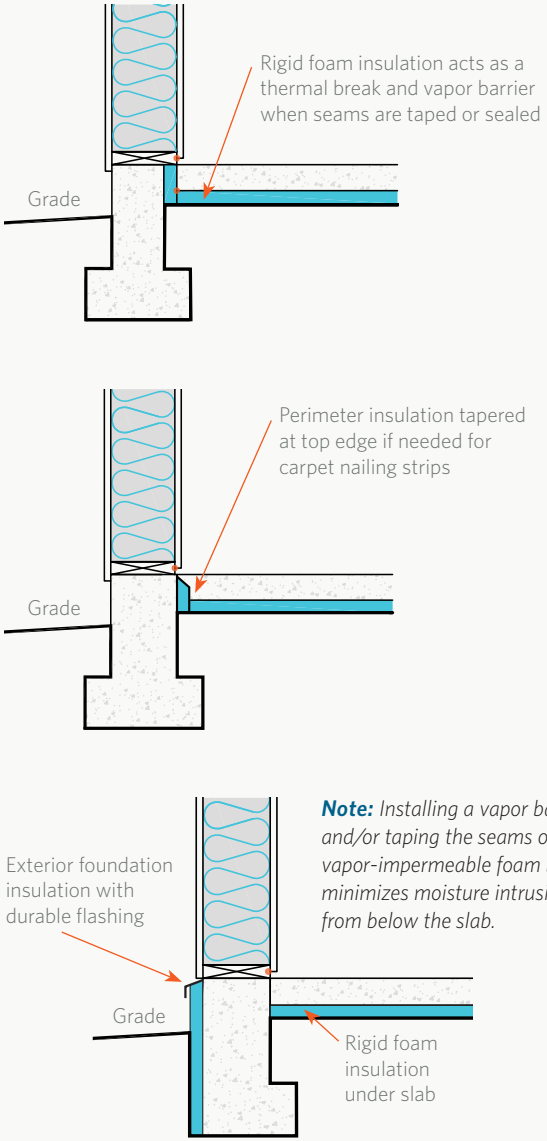
Foundations and slabs are sites of substantial heat loss and possible condensation during cold weather. Slabs and foundation walls between conditioned and unconditioned spaces must be properly insulated in order to minimize these effects.

Fig. 1: Insulated slab and foundation wall



Note: *Foundations and slabs should be designed to minimize moisture intrusion. Materials in contact with concrete should be able to withstand moisture. Using closed-cell foam on the foundation wall, such as the taped foam board in this detail, provides a thermal break as well as a vapor barrier when properly installed and sealed.*

Fig. 2: Slab insulation options



Note: *Installing a vapor barrier and/or taping the seams of vapor-impermeable foam board minimizes moisture intrusion from below the slab.*

FRAMING

EPS REQUIREMENT

- ☐ **Modified corner allowing full insulation (see fig. 3)**
- ☐ **Insulated header (see fig. 4)**

Walls

Walls are the largest source of heat loss in most new homes due to their size, the amount of framing materials and potential air leakage. Incorporating air sealing, reducing thermal bridging and increasing insulation can enhance wall performance and help improve a home's EPS.

Framing technique & thermal bridging

Framing members that connect the interior drywall to the exterior sheathing allow heat to quickly pass around insulation. This is referred to as thermal bridging, which reduces the insulation properties of walls. Intermediate framing techniques, such as modified corners and insulated headers above windows and doors, allow for increased levels of insulation in walls and reduced thermal bridging. Installing studs 24" on center is a common first step toward advanced framing and can help improve the thermal performance of walls.

Improved wall systems

Installing exterior rigid insulation provides additional insulation and breaks thermal bridges to the exterior. Building staggered double stud walls increases wall thickness and the amount of insulation within the wall. By staggering stud layout, or building an advanced wall system, thermal bridges are broken and isolated within the insulation.

Fig. 3: Modified corner allowing full insulation

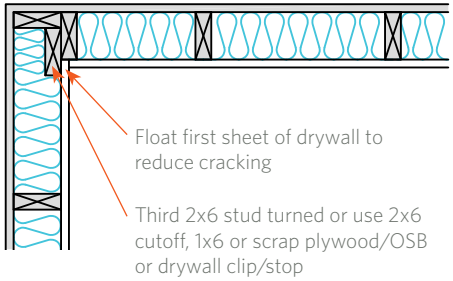
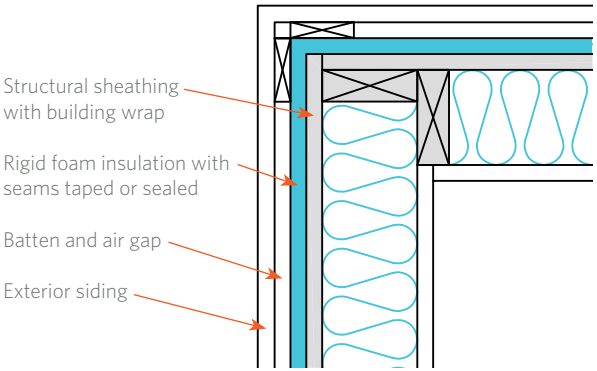


Fig. 4: Insulated header

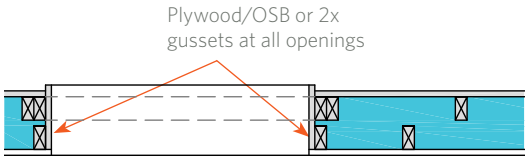
Rigid insulation can be installed on the exterior, the interior or between header framing members to create a thermal break.

Fig. 5: Exterior rigid insulation with rainscreen



Note: *Exterior foam increases interior wall temperatures, thereby reducing the possibility of condensation inside the wall itself.*

Fig. 6: Staggered double stud wall



Interior studs may be placed at 24" on center independent of exterior studs and as convenient for interior wall sheathing

Note: *Staggered double stud wall with blown-in insulation reduces thermal bridging.*

AIR SEALING

EPS REQUIREMENT

☐ **Compliance with EPS New Construction Air Barrier and Air Sealing Checklist**

This checklist will help identify areas requiring special attention to air sealing, framing practices and insulation installation. For builders pursuing ENERGY STAR® Home certification, compliance with the Rater Field Checklist may be used in lieu of the Air Barrier and Air Sealing Checklist. If one section of the checklist is more stringent than the other, the more stringent one should be followed.

The Air Barrier and Air Sealing Checklist is available from your verifier and can also be found on the Energy Trust INSIDER website at: **www.insider.energytrust.org/programs/eps-new-construction/forms-and-resources**.

EPS REQUIREMENT

☐ **Blower door testing**

- All homes must have a final blower door test performed by an Energy Trust approved verifier
- Testing shall follow program-approved certification testing protocol

Air leakage can occur at locations between conditioned and unconditioned spaces where incomplete air barriers exist, or at unsealed connections between air barrier materials. In addition to increased heating and cooling costs, uncontrolled air leakage can cause occupant discomfort and drive moisture through envelope penetrations. Plumbing, electrical and mechanical penetrations as well as framed bypasses should be sealed to minimize air leakage between conditioned and unconditioned spaces.

Air barrier materials should consist of rigid materials (drywall, oriented strand board, duct board or any other stiff product that may support the load of insulation while serving as a durable air barrieror semi-rigid materials (sheet metal, foam board or treated cardboard) that do not allow air to flow through. **Fibrous insulation, foil scrim kraft (FSK) and housewrap products do not qualify as air barrier materials.**

Fig. 7: Foam sill sealer installed at top plate

Foam sill sealer installed at the top plate to minimize air leakage to and from the attic.

Note: *Air sealing materials such as spray foam, caulk and adhesives can be used to reduce air leakage at penetrations, seams and transitions between air barrier materials.*

Recommended practice: *Air can flow through interior partitions to and from unconditioned spaces. Seal the top plate to the ceiling drywall from the attic with silicone caulk, latex caulk or expanding foam BEFORE insulation is installed. Alternatively, a gasket, caulk, foam or other sill sealing material can be installed at the top plate before the drywall is installed.*

EPS REQUIREMENT

- ☐ **Insulation dams must be installed at all edges of attic insulation**
- ☐ **Weatherstripping or gaskets must be installed around attic and crawlspace access hatch and recessed lighting**
  - Attic hatch air sealing and insulation matches ceiling R-Value (see fig. 9)
  - Insulation Contact Air Tight (ICAT) rated fixture (see fig. 10)

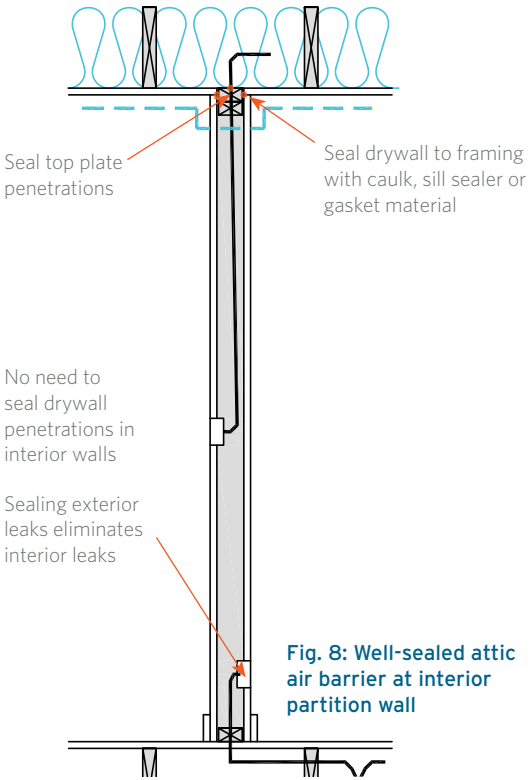


Fig. 8: Well-sealed attic air barrier at interior partition wall

Fig. 9: Attic hatch air sealing and insulation

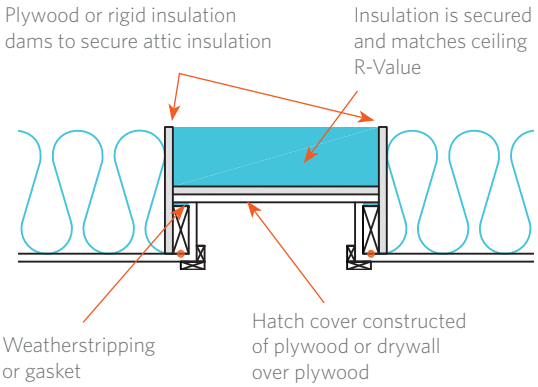
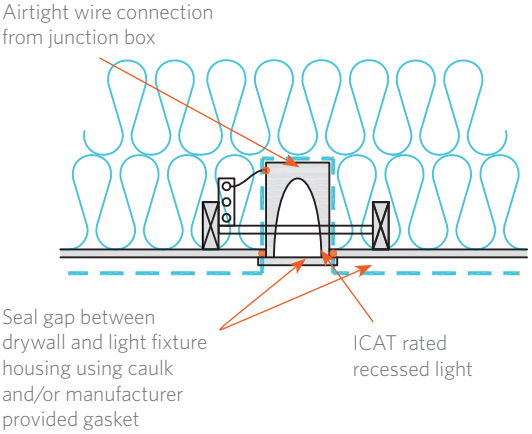


Fig. 10: Insulation Contact Air Tight (ICAT) rated fixture



Note: *While penetrations must be air sealed, junction boxes should be accessible for repairs and inspections.*

Recommended practice: *Air seal rough openings, gaps and other penetrations through the attic prior to installing insulation and finish work. For more details, reference the EPS New Construction Air Sealing Quick Reference Guide, found on the Energy Trust Insider website:* ***www.insider.energytrust.org/programs/eps-new-construction/forms-and-resources***.

Fig. 11: Penetrations around duct using fibrous insulation do not seal the attic against air movement to the chase.

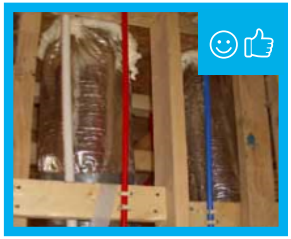


Fig. 12: All penetrations properly sealed with a rated air barrier.

Fig. 13: Top plate is not air sealed, connecting attic air to interior wall.

Fig. 14: Top plate to drywall connection is sealed with all gaps and cracks covered.

EPS REQUIREMENT

- ☐ Window air sealing (see fig. 15)
- ☐ Air sealing at common wall (see fig. 16)
- ☐ Air-sealed interior soffit (see fig. 17)

Fig. 15: Window air sealing

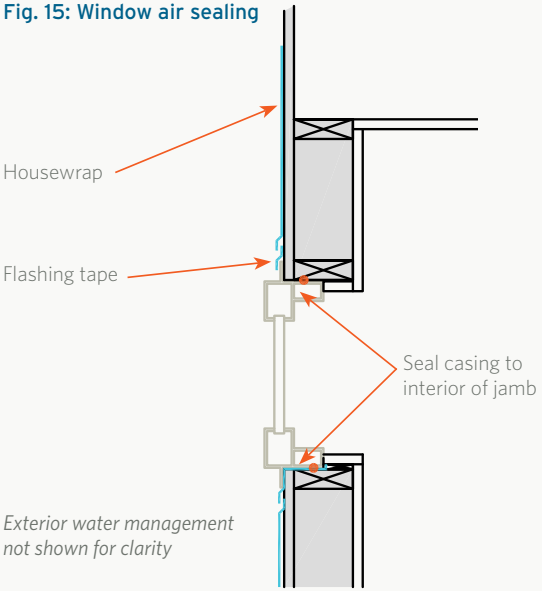


Fig. 16: Air sealing at common wall

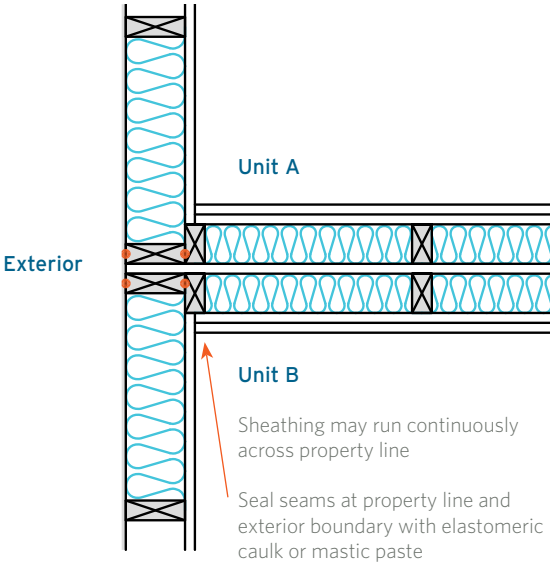
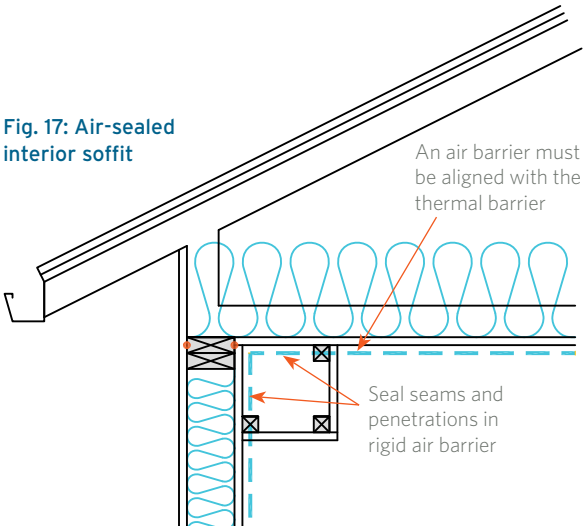


Fig. 17: Air-sealed interior soffit



EPS REQUIREMENT

- ☐ **Air-sealed flue (see fig. 18)**
- ☐ **Air-sealed fireplace (see fig. 19)**
- ☐ **Air sealing behind tub/shower (see fig. 20)**

Fully insulate walls and sheath interior surface of exterior walls before installing tubs, showers or fireplaces. Extra attention may be needed to ensure flue and gas line penetrations are properly blocked and sealed at the air barrier/walls behind fireplaces.

Install tubs/showers on interior walls, when possible, to avoid the complications associated with air sealing and insulating at exterior walls. Block and seal plumbing penetrations. Check with your local jurisdiction for approved rigid air barrier materials allowed in confined, enclosed spaces.

Fig. 18: Air-sealed flue

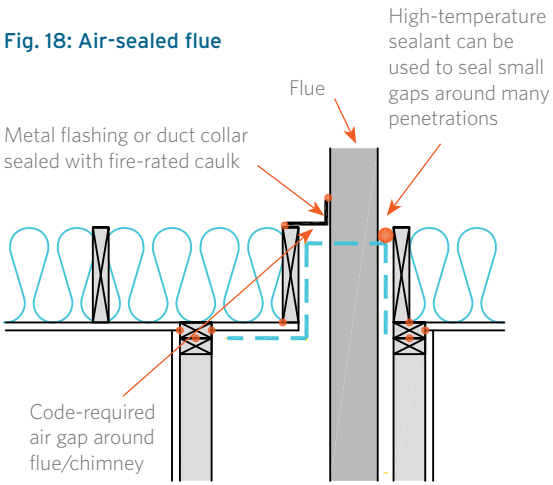
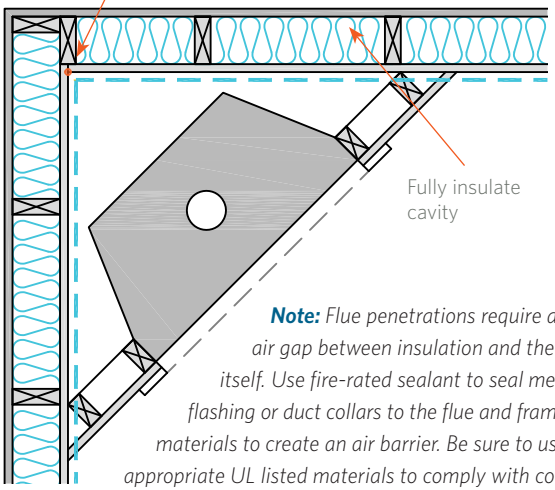


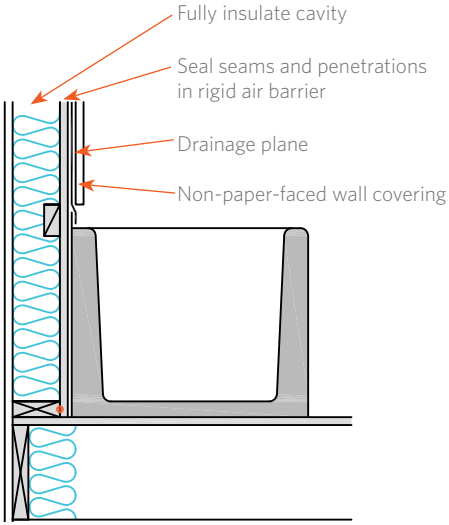
Fig. 19: Air-sealed fireplace

Seal seams and penetrations in rigid air barrier



Note: *Flue penetrations require an air gap between insulation and the flue itself. Use fire-rated sealant to seal metal flashing or duct collars to the flue and framing materials to create an air barrier. Be sure to use the appropriate UL listed materials to comply with code.*

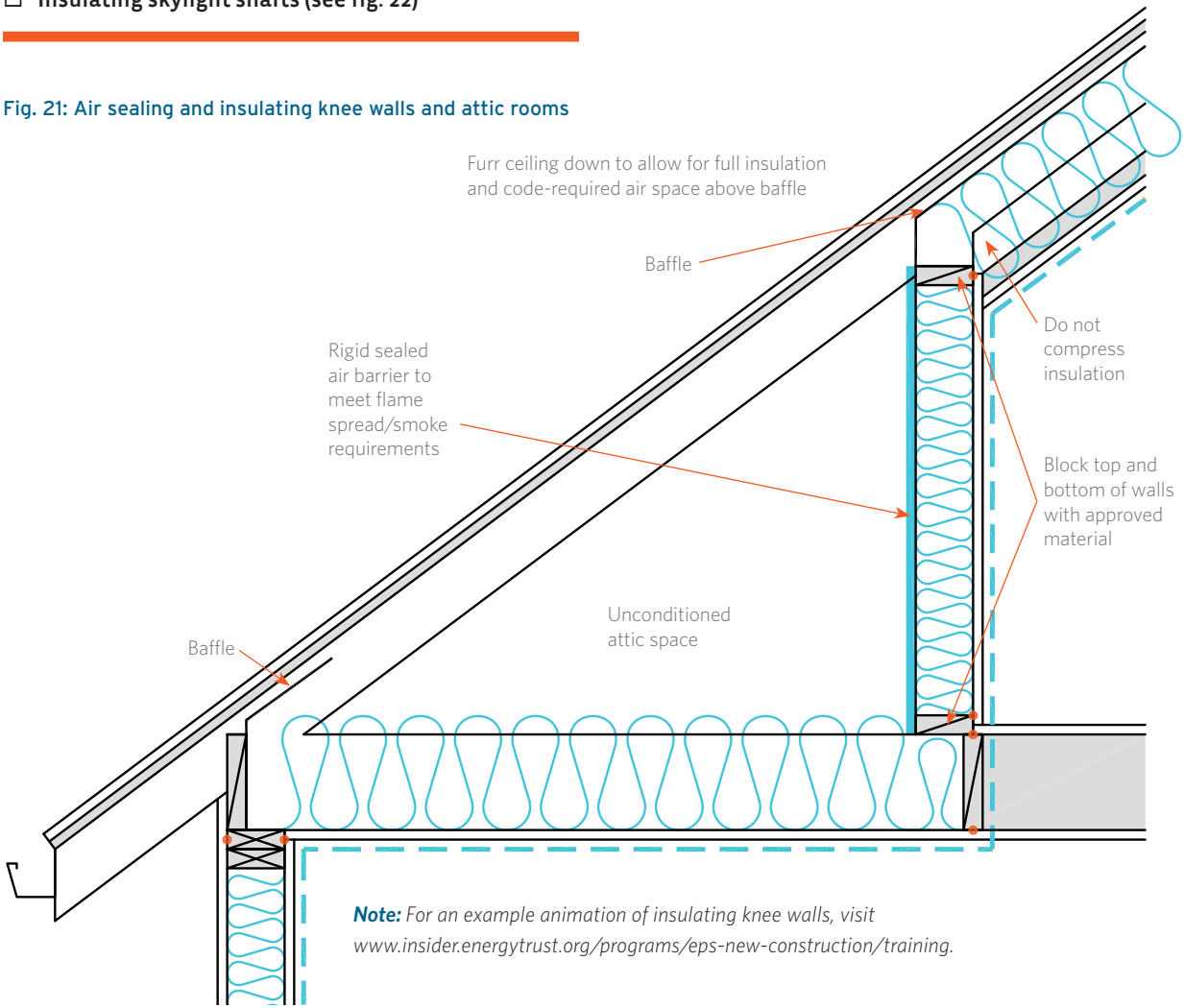
Fig. 20: Air sealing behind tub/shower



EPS REQUIREMENT

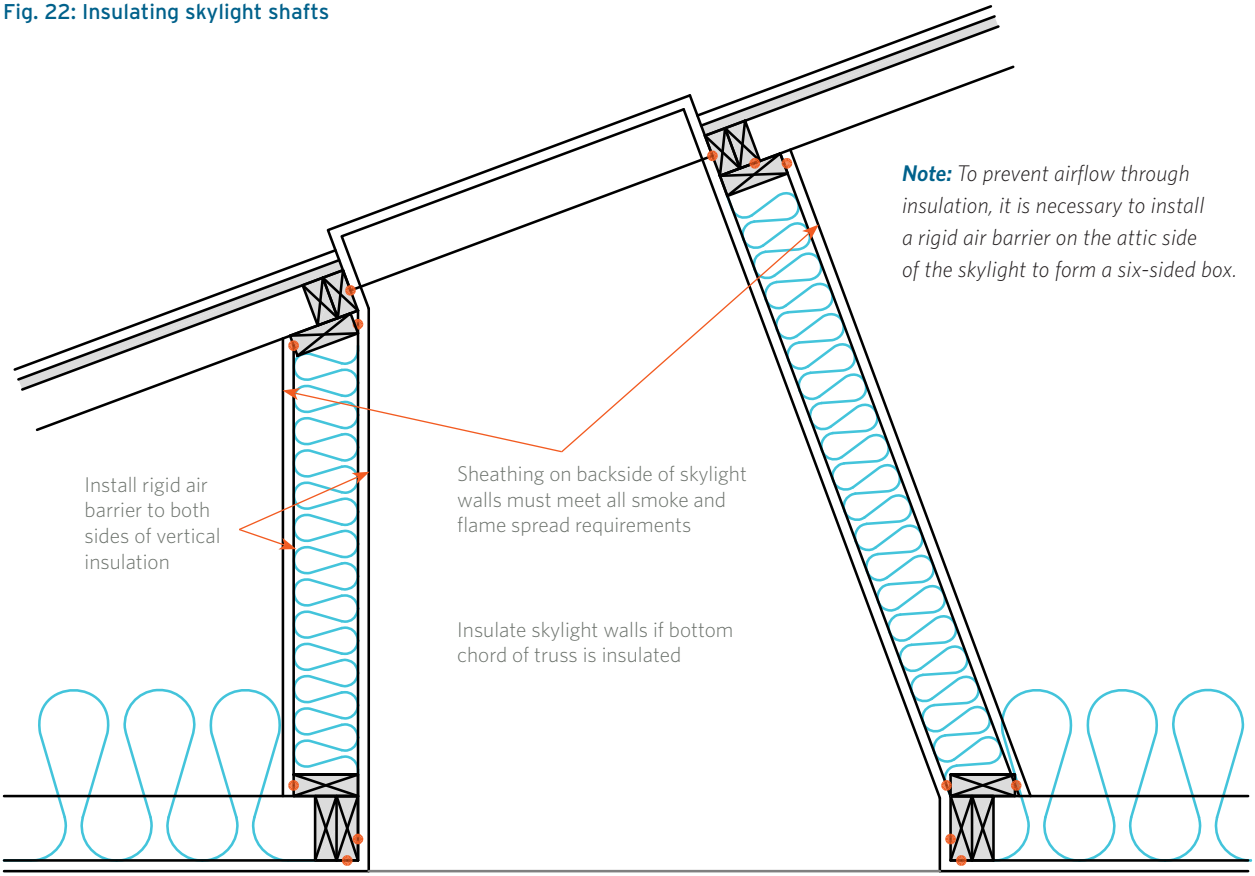
- ☐ **Air sealing and insulating knee walls and attic rooms (see fig. 21)**
- ☐ **Insulating skylight shafts (see fig. 22)**

Fig. 21: Air sealing and insulating knee walls and attic rooms



Note: *For an example animation of insulating knee walls, visit www.insider.energytrust.org/programs/eps-new-construction/training.*

Fig. 22: Insulating skylight shafts



Note: *To prevent airflow through insulation, it is necessary to install a rigid air barrier on the attic side of the skylight to form a six-sided box.*

INSULATION

EPS REQUIREMENT

☐ **Insulation and framing inspections**

- Intermediate framing as defined by local code including, but not limited to: 16" on-center stud spacing, insulated headers, exterior wall intersections and modified, insulated corners
- Thermal barrier insulation must be installed to RESNET® Grade I standards with no gaps, voids, compression or misalignment
- In insulated wall assemblies, insulation must be enclosed and in contact with an air-sealed, rigid air barrier on all sides, creating a six-sided box
- In insulated attics, insulation at vertical edges must have a rigid air barrier, or insulation dam, that extends above the full height of the insulation
- Floor insulation must be in full contact with subfloor above and properly supported (see fig. 23)
  - Floor insulation above garages and exterior cantilevers requires a full air barrier on the underside of insulation
  - Open web floor joists with batt insulation must use batts the same width as the joist spacing and be installed so that the batt expands/extends into the joist webbing
  - When ductwork is installed in open web floor assemblies, spray-applied or loose-fill insulation is required
- Floor insulation installation shall be in contact with subfloor and secured
- Cut or split insulation around wiring in exterior walls (see fig. 25)

All thermal barrier insulation should be installed to the manufacturer's specifications. Building cavities must meet Grade I requirements with no voids, gaps or compression. All insulation must be in contact with the appropriate air barrier to complete the thermal barrier.

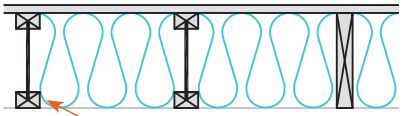
Open web joists require specific attention to assure Grade I insulation and alignment of the thermal barrier and air barrier. For batt insulation in open web floor joists, ensure that a wide batt is installed to extend into the joist webbing. For example: floor joists 24" on center must use 24" batts so that the extra width of the batt expands/extends into joist webbing.

Pay attention to construction sequencing to ensure that rim joists between floors are insulated before final framing makes them inaccessible.

Batt insulation should be cut to fit and placed around electrical boxes, plumbing pipes and mechanical equipment in wall cavities, floor and rafter bays or attic spaces. Blown insulation typically provides easier Grade I compliance with no gaps, compression or misalignment.

Insulation in attics will perform best when installed to full depth without excessive compression. Raised/energy-heel trusses should be used to maximize the performance of ceiling insulation at attic perimeters.

Fig. 23: Proper floor insulation installation



Use synthetic twine, strapping or other rigid material to secure insulation and ensure contact with the subfloor

Fig. 24: Raised/energy-heel trusses

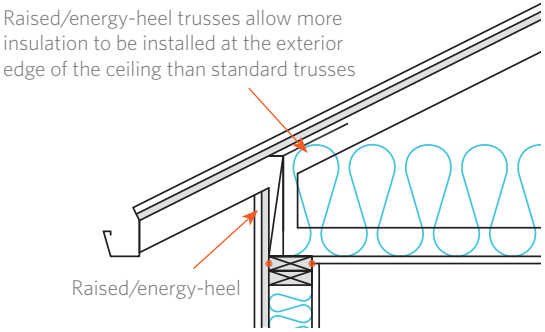


Fig. 25: Correct insulation around wiring in exterior wall

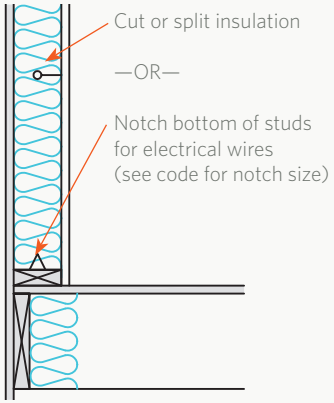


Fig. 26: Insulation has been compressed and has multiple gaps.

Fig. 27: Well-fit insulation, filling the cavity, with no gaps or cracks.

Fig. 28: Insulation batts are not aligned and have many compressions.

Fig. 29: Insulation is friction-fit, has no gaps or cracks, and fills the cavity.

R-Values

Insulation is rated by its resistance to heat transfer, known as the R-Value. The higher the R-Value, the more effective it is at reducing heat transfer and improving occupant comfort.

R-VALUE PER INCH FOR COMMON INSULATION		
Insulation Type	**R-Value per Inch**	**Description**
Batts and Blankets		
Fiberglass	2.6-4.3	Strands of fiberglass bonded together forming a batt or blanket
Mineral wool	3.0-3.6	Batts/board made of steam-blasted rock or glass fibers
Blown, Sprayed or Poured		
Loose-fill cellulose	3.2-3.6	Treated cellulose blown into place at approximately 2 lbs/cu. ft.
Dense-pack cellulose	3.0-3.4	Treated cellulose blown into place at approximately 4 lbs/cu. ft.
Blown-in batt/blanket	3.6-4.4	Proprietary spray-applied fiberglass insulation secured with netting
Blown fiberglass	2.2-2.7	Fiberglass fibers blown into place, density dependent on location
Low-density spray foam	3.5-3.8	Polyurethane foam, sprayed at 0.5 lbs/cu. ft., "open cell foam"
High-density spray foam	6.0-7.0	Polyurethane foam, sprayed at 2.0 lbs/cu. ft., "closed cell foam"
Rigid Board		
Expanded polystyrene (EPS)	3.6-4.2	White polystyrene beads fused into foam board
Extruded polystyrene (XPS)	5.0	Molten polystyrene extruded into smooth, uniform foam sheets
Polyisocyanurate (Polyiso)	5.6-7.6	Closed cell rigid foam, usually faced with foil

Information courtesy of: www.energy.gov/energysaver/weatherize/insulation/types-insulation.

WINDOWS & DOORS

EPS REQUIREMENT

☐ **Windows tested and rated by National Fenestration Rating Council (NFRC)**

- Windows must be tested and rated by the NFRC, and the rating labels must remain on windows until they are documented by a verifier

Windows lose heat more than five times faster than a typical wall assembly rated at R-21. To reduce heat loss in homes, window glazing area should be limited.

Skylights and glass doors (french and sliding doors) must be included in glazing area and average U-Factor calculations. Contact your verifier for guidance on glazing for your projects.

Verifiers will need to collect the U-Factor and Solar Heat Gain Coefficient (SHGC) for all the windows in the home. This is typically done at the first site inspection.

Please leave stickers on windows until they have been recorded or verifiers will request a copy of the purchase order to confirm window values.

Fig. 30: Example NFRC label

HEATING & COOLING SYSTEMS

EPS REQUIREMENT

☐ **Duct sealing and testing**

- All ducts must be sealed with mastic paste
- Flex duct must be fully extended and both interior and exterior sleeves of flex duct must be mechanically fastened using nylon draw-bands and manufacturer approved tensioning tool
- Ducts may not be installed within exterior wall cavities or a garage ceiling unless ≥ $^{2}/_{3}$ of the R-Value of the wall or ceiling assembly is installed between the exterior wall surface and the duct
- When ducts are installed in open web floor assemblies over unconditioned space with the intention to bring "ducts inside," the following also applies:
  - An air barrier must be installed to bring the ducts within the thermal and air barriers of the home
  - Ducts must be in direct contact with the subfloor, except where truss members interfere
  - A minimum R-19 insulation must be installed under all duct runs
- Building cavities may not be used to transport air
- With ducts that are tested before air handler is installed, leakage shall be ≤ 4% of the conditioned area
- If the ducts and equipment are within the continuous thermal and air barriers of the house, the verifier may enter "Leakage to Outside" total value of 80 CFM50 in lieu of testing. Up to 10 ft of the system's ductwork shall be permitted to be located outside of the thermal envelope.

Duct design, installation, sealing and insulation is critical to heating system performance. Without proper sealing and insulation, up to 20% of the heat distributed through a ducted heating system can be lost to the surrounding space through leaks or conducted through insulation. To ensure proper delivery of conditioned air, duct systems should be designed based on the home size, layout, insulation levels and air leakage (manual D). Ducts should be installed with minimal turns and flexible ducting should be pulled tight and fully extended.

HVAC system design, selection and installation

Proper design, selection and installation of a heating and cooling system is essential for an efficient and comfortable home. Information specific to each house, such as conditioned square footage, surface areas and U-Factors, detailed air leakage and ventilation information, equipment efficiency and duct design and leakage should be used to design heating and cooling systems so that equipment is properly sized.

Fig. 31: Rigid duct sealed with mastic paste and flex duct mechanically fastened and tightened with nylon draw-bands

Fig. 32: Nickel-thick mastic

Install ducts inside conditioned space

Homes should be designed to accommodate placement of ducts and heating systems inside conditioned spaces. Homes with central heating and cooling systems should either have return grills in each room or transfer ducts to the main body.

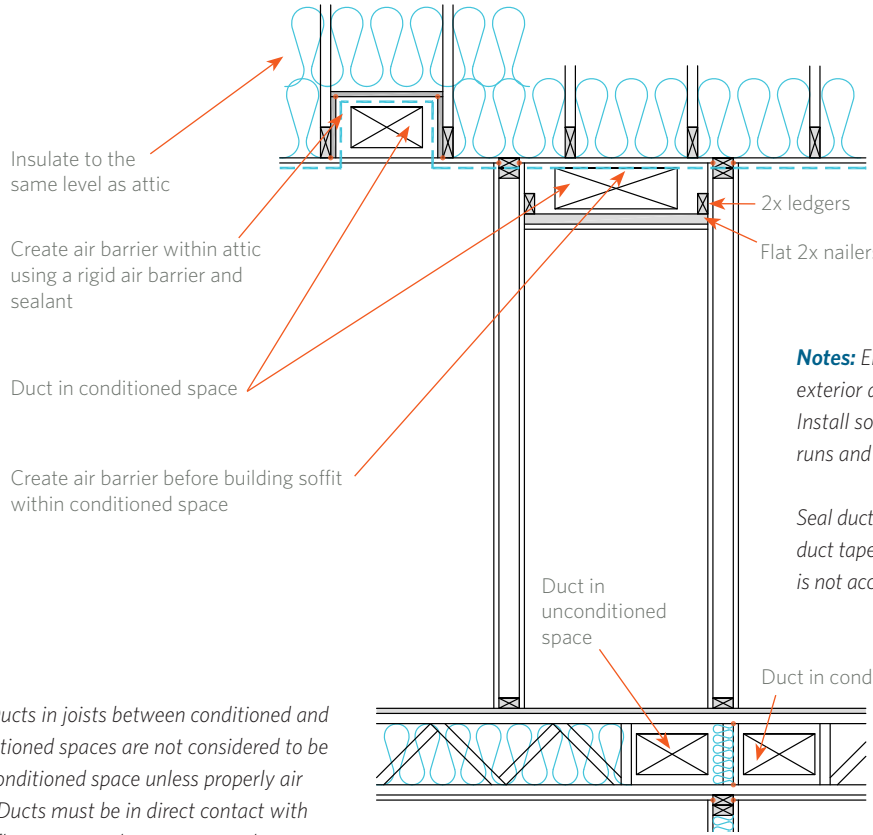
This greatly improves the distribution system efficiency because much less heat is lost.

Before construction begins, plan duct and heating system placement with your designer, HVAC contractor and other trades.

To meet program designation as a ducts-inside home, requirements include, but are not limited to, the following:

- Heating equipment and all ductwork must be located inside the air/thermal barriers. Up to ten linear feet of ductwork can be located outside of the thermal envelope.
- Rim joists between floors must be sealed and verified
- Joints and seams in ductwork must be mechanically fastened, sealed with mastic paste and verified
- Soffits containing ductwork must be sealed and verified
- Chases containing ductwork must be sealed, insulated and verified
- Building cavities may not be used as ductwork
- When ducts are installed in floor systems over unconditioned spaces, the entire floor assembly must be insulated with full-depth, blown-in insulation; batts are not allowed

Fig. 33: Strategies to bring ducts inside



Notes: *Ensure proper sealing of exterior air barriers near duct runs. Install solid air barrier between duct runs and fibrous insulation.*

Seal duct joints with mastic paste; duct tape—or tape of any kind—is not acceptable.

Note: *Ducts in joists between conditioned and unconditioned spaces are not considered to be in the conditioned space unless properly air sealed. Ducts must be in direct contact with the subfloor, except where truss members interfere and a minimum R-19 insulation must be installed under all duct runs.*

Fig. 34: Mechanical seal (Panduit strap or zip tie) is not connecting flexible duct to metal boot.

Fig. 35: Installer is securing the flex duct to the boot with a mechanical fastener to provide a seal.

Fig. 36: Duct sealing mastic was used too thinly and does not fill the holes.

Fig. 37: Mastic is nickel thick and covers both connections and gores to ensure a tight seal.

Duct sealing and testing

Seal all seams, joints, elbows and connections with mastic paste to minimize air leakage. Apply mastic paste to a minimum thickness of a nickel. Pay special attention to connections at the plenum, including start collars and behind air handler cabinets. Mastic paste is not required on blower cabinet service panels that are intended to be removed for unit service.

EPS REQUIREMENT

- ☐ **Non-ducted gas heating equipment used for primary space heat is required to be sealed combustion or direct vent, located in the main living area and controlled by a programmable thermostat**
  - Gas fireplaces used for primary space heat must be currently listed on the qualified models list

Non-ducted gas heating

Small homes with open floor plans can be comfortably heated with an approved gas fireplace, gas unit heater or hydronic system. Gas fireplaces and gas unit heaters used for primary space heat must be either sealed combustion or direct vented, located in the main living area and controlled by a programmable thermostat. Electric resistance wall heaters can be placed in bedrooms and bathrooms for supplemental spot heating. Unvented combustion heating appliances are not permitted.

EPS REQUIREMENT

☐ **HVAC system sizing and selection**

- The program may request proof of proper equipment sizing or heat pump commissioning documentation. For more information on quality HVAC design and installation, ACCA Standard 5 and RESNET Standard 310 both outline ANSI-approved methodologies to ensure the design and installation of an HVAC system performs as the manufacturer intended.

Fig. 38: Mini-split heat pump head

Heat pump commissioning

To ensure optimal performance, heat pump installers are expected to follow manufacturer's commissioning specifications for sizing, controls, airflow and refrigerant charge. Mini-split heat pumps are exempt from commissioning requirements.

Mini-split heat pumps

Mini-split systems with variable speed compressors, or inverter drives, efficiently heat and cool homes. As with any heating system, mini-split heat pumps should be properly sized for each location using whole-home load calculations from an HVAC contractor. Electric resistance heating is sometimes used to supplement heating demands in rooms isolated from the main heating area.

EPS REQUIREMENT

☐ **Installation of zonal pressure relief**

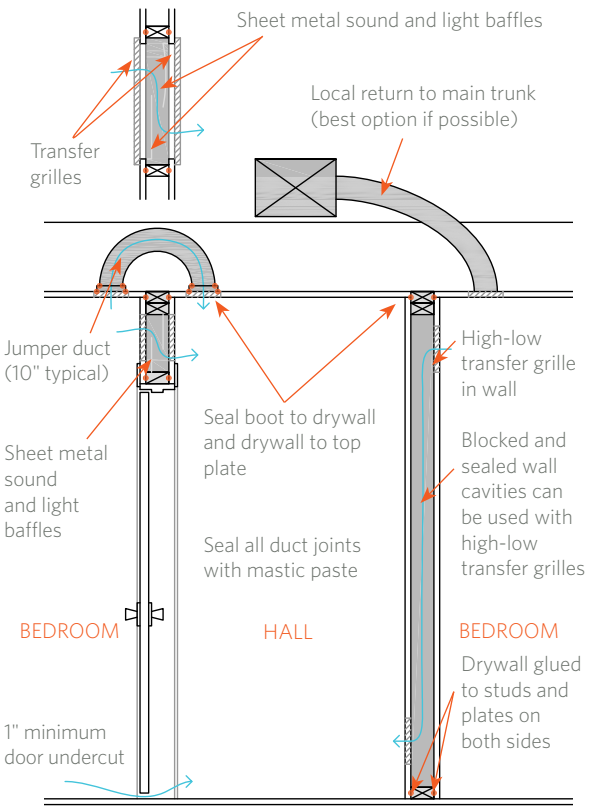
- Bedrooms with multiple supplies require a jumper duct, transfer grille, dedicated return or HRV/ERV duct
- Bedrooms with one supply, but without a return, may fulfill this requirement with a minimum 1" door undercut
- Zonal pressure relief strategies (see fig. 39)

Zonal pressure relief

Closing bedroom doors can restrict air movement between supply and return registers, causing pressure imbalances in homes. This has been proven to increase house air leakage and can negatively affect occupant comfort. Properly designed duct systems will include return air pathways between all supply and return duct registers. Return air pathways may include door undercuts, transfer grilles above doors, high-low transfer grilles, jumper ducts, individual room returns or HRV/ERV ducts.

Zonal pressure relief is required in all homes with ducted heating systems.

Fig. 39: Zonal pressure relief strategies



EPS REQUIREMENT

☐ **Installation of carbon monoxide alarms**

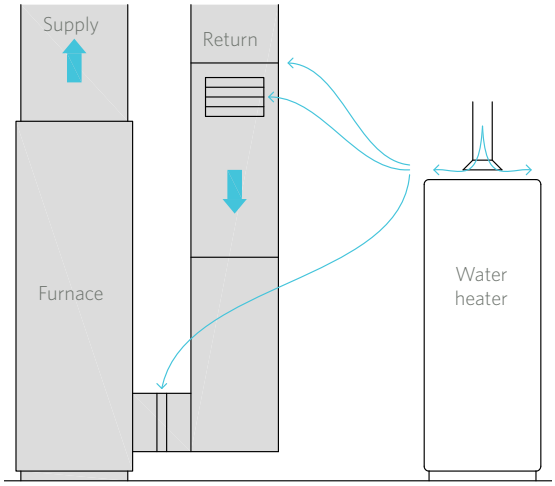
- Carbon monoxide alarms must be installed according to local jurisdiction requirements

Combustion appliance safety

All combustion appliances must be properly vented, operate in a safe manner and have suitable combustion air to meet local building codes and standards. Proper installation, operation and venting of combustion appliances can help ensure safety and that indoor air quality is not compromised.

When combustion appliance zone (CAZ) testing is performed, Energy Trust recommends following procedures provided by local jurisdictions or national industry organizations such as, but not limited to, BPI, RESNET or ACCA.

Fig. 40: Backdrafting scenario



WARNING! *Depressurization from improper installation or duct leakage can cause atmospheric gas water heaters and furnaces to backdraft. Backdrafting appliances can release combustion gases into the air that can potentially be distributed throughout the home. Proper equipment installation, operation and carbon monoxide alarms are critical safety elements.*

MECHANICAL VENTILATION SYSTEMS

EPS REQUIREMENT

☐ **Installation and verification of whole-house mechanical ventilation system***

- Ventilation system must provide continuous fresh air to the home at the following rate:
  - Ventilation CFM = (bedrooms +1) × 7.5 + (0.01 × conditioned area)

*See page 37 for additional requirements concerning your ventilation strategy and verification.

A tightly constructed house with reliable whole-house mechanical ventilation will have improved comfort and indoor air quality. Below are whole-house ventilation guidelines for each state:

- In Oregon, whole-house ventilation shall be balanced.
- In Washington, if the system is not balanced and/or distributed, adjust the whole-house ventilation rate by the following coefficients:

System Type	Distributed	Not Distributed
Balanced	1.0	1.25
Not Balanced	1.25	1.5

Ventilation airflow testing

To ensure that adequate fresh air is being delivered to the home, airflow through the ventilation system must be measured. Depending on the ventilation strategy and design, measurement equipment may be a pitot tube, flow hood, anemometer or other equivalent tools. Please refer to RESNET Standard 380 and manufacturer instructions for guidance on mechanical ventilation testing tools and procedures. Balanced ventilation systems are a combination of exhaust and supply methods providing approximately equal indoor exhaust and outdoor supply air flow.

Ventilation controller settings

Ventilation controllers can operate single fans, multiple fans or combinations of individual fans and heating systems. Controller settings can be based on a number of factors including airflow rates, home size, number of occupants, run times and combinations thereof. In order to ensure that the ventilation system is providing enough fresh air over a 24-hour period, your HVAC contractor or program verifier will need to commission the controller settings after ventilation airflow has been measured. Whole-house mechanical ventilation system shall be provided with controls that enable manual override.

Intermittent ventilation

If a house has an intermittent ventilation system, the whole-house ventilation rates must be as follows:

- In Washington the system must run for at least 50% of each 4-hour segment.
- In Oregon the system must run for at least 25% of each 4-hour segment.
- Verify that the fresh air intake sticker has been placed adjacent to the balanced ventilation control switch.

EPS REQUIREMENT

☐ **Continuous ventilation systems**

- Verify 24-hour operation
- Verify mechanical damper is installed and fully operational

☐ **Intermittent ventilation systems**

- Verify mechanical damper is installed and fully operational
- Verify controller is properly commissioned based on airflow rate, occupancy, home size, cycle times and other applicable settings
- For intermittent ventilation systems, adjust the continuous flow rate to an intermittent rate

☐ **Whole-house exhaust fans must have a Sone rating of 1.0 or less when used for balanced ventilation**

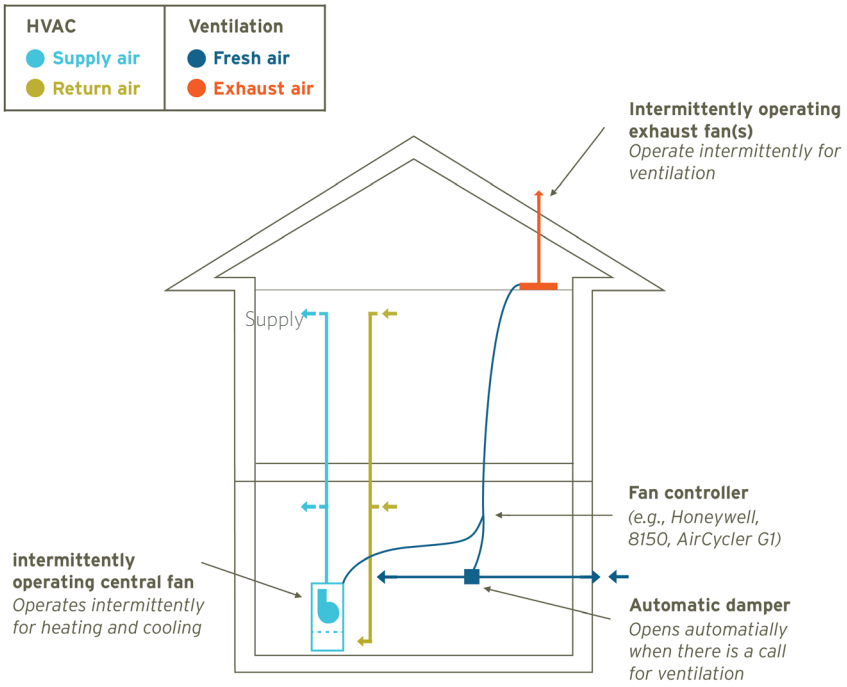
FRESH AIR INTAKE

Your heating and cooling system includes a fresh air intake that should **remain ON** for healthier indoor air.

Turn OFF only when outdoor air quality is poor. Don't forget to turn your system back **ON** when outdoor air quality improves.

EnergyTrust of Oregon

Fig. 41: Fresh air intake tied to HVAC



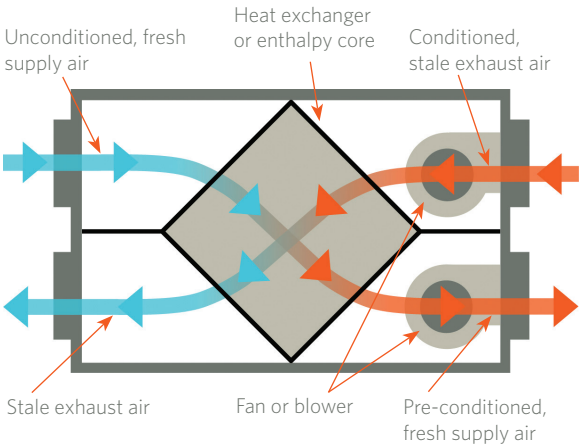
1. Central fan integrated, intermittent + exhaust, without heat recovery

Heat/energy recovery ventilation

HRVs/ERVs simultaneously supply fresh air and exhaust stale air throughout the home. These systems can be used to reduce energy loss from mechanical air exchange by tempering incoming air. They provide balanced ventilation and can minimize pressure imbalances. These systems perform best when installed as independently ducted systems providing fresh air to individual rooms. Some systems can be integrated with heating ducts; however, extra time and design consideration is needed to ensure proper connections, run times, fan settings and airflow.

Spot HRVs/ERVs provide the same sort of balanced ventilation but they do not have a ducted distribution system. These units either exhaust or supply air in

Fig. 42: Heat/energy recovery ventilator



Note: *Whole-house mechanical ventilation systems with supply air capabilities should be designed to provide fresh air to all conditioned areas of the home. Follow manufacturer guidelines on insulating the ductwork.*

a single room/location and can be used to provide ventilation in smaller homes.

For optimal performance, HRV/ERV ducts should be sealed. Ducts in unconditioned spaces and ducts connected to the outside should be insulated to reduce condensation and heat loss. When selecting and designing your systems be sure to properly size the equipment and consult the Home Ventilation Institute to select the most efficient equipment. To get the best performance and efficiency, look for units with Adjusted Sensible Recovery Efficiencies (ASRE) of 80% or higher and fan consumption of 0.75 watts/CFM or less. Refer to manufacturer instructions to properly test and balance airflow.

EPS REQUIREMENT

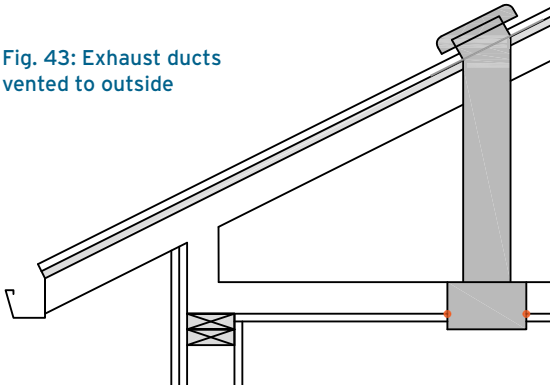
☐ **Exhaust in full baths and laundry rooms**

- Vented to outside with a dedicated termination
- Rated at 2.0 sones or less
- Tested to provide at least 65 CFM when operated intermittently or 20 CFM continuously

Local exhaust

In addition to the whole-house mechanical ventilation strategy, homes must also install code-required local exhaust. Exhaust fans installed in full baths, laundry rooms, and spa facilities must meet program requirements for sound and minimum flow rates.

Fig. 43: Exhaust ducts vented to outside



Recommended practice: *Exhaust duct runs should be short, free of sharp turns, vented to the outside with a dedicated roof vent and insulated to reduce the likelihood of condensation. Flexible ducts should be fully extended and cut to the shortest possible length.*

If exhausting through a sidewall vent, assure that fan outlet is pointed toward the direction the duct will terminate.

WATER HEATING & LIGHTING

EPS REQUIREMENT

☐ **If installing heat pump water heaters**

- Heat pump water heaters must be currently listed on the NEEA Advanced Water Heater Specification Qualified Products List found here: **www.neea.org/img/documents/qualified-products-list.pdf**

Water heater

Tankless, condensing and heat pump water heaters are higher-efficiency alternatives to standard storage water heaters. Be sure to consult manufacturer recommendations and instructions for capacity, installation locations, air supply and other specific equipment requirements.

Lighting

Using high-efficiency lighting can reduce a homeowner's energy consumption. Refer to your local jurisdiction lighting requirements.

The 2017 Oregon Residential Specialty Code requires 100% efficient lighting. LEDs offer the following benefits:

- Dimmable
- Attractive in exposed fixtures
- Wide spectrum of color tones
- Last at least 15 times longer than traditional incandescent bulbs
- More cost-effective over time
- Durable and contain no mercury

SOLAR ELECTRIC SYSTEMS

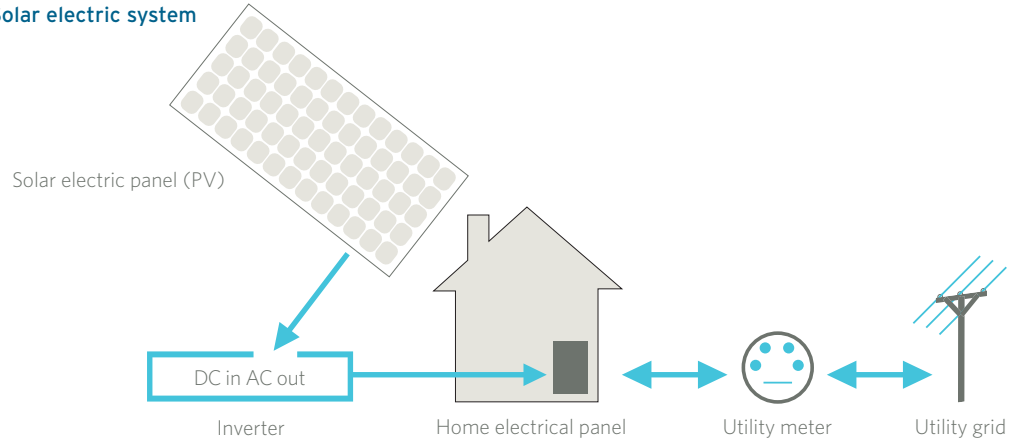
For EPS homes installing solar at the time of construction, in order to qualify for solar incentives the installation must be completed by an approved Energy Trust solar trade ally contractor.

For more information on available incentives, or to find a solar trade ally, go to: **www.energytrust.org/solar**.

Solar electric (photovoltaic or PV)

A solar electric system uses the sun's energy to produce electricity. Depending on the number of solar panels installed, the system can produce a portion or all of the electricity needed by a home, substantially lowering the homeowner's electricity bills.

Fig. 44: Solar electric system



SOLAR READY

SOLAR READY REQUIREMENT

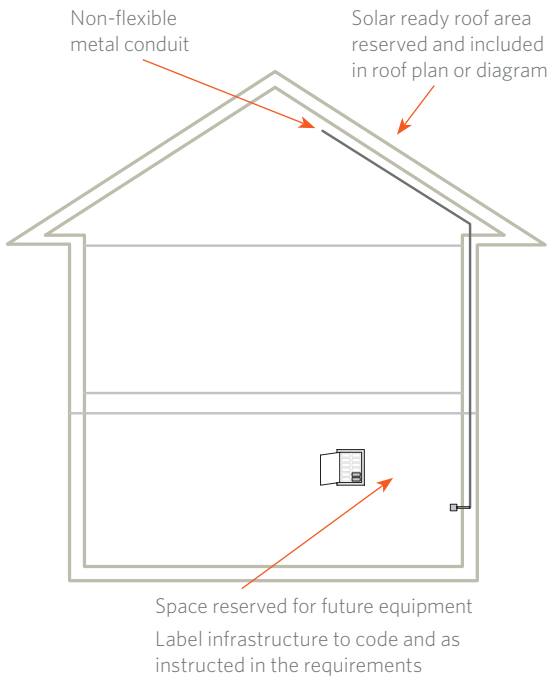
- ☐ **In order to receive Energy Trust solar PV incentives, solar projects must be completed by approved Energy Trust solar trade ally contractors.**
- ☐ **Proper installation of solar ready features**
  - To qualify as solar ready, projects must meet the following requirements:
    - Energy Trust's Solar Ready Residential Installation Requirements*
    - A completed Solar Ready Checklist* must be submitted for the home
    - All equipment must be properly labeled
    - Solar ready roof (see fig. 46)
    - Solar ready electric panel and surrounding area configuration (see fig. 47)

*The installation requirements and checklist can be found at **www.energytrust.org/solarready**.

As an alternative to constructing a solar-equipped home, solar ready infrastructure can be installed to prepare for a future solar electric system. The solar ready installation requirements are designed to ensure that preliminary work done to make a home solar ready is in compliance with Energy Trust's full solar installation requirements and will result in a more attractive and less costly installation in the future.

Incorporate solar ready infrastructure into the design phase to best accommodate solar resource, available roof space and location of conduit.

Fig. 45: Components of a solar ready installation

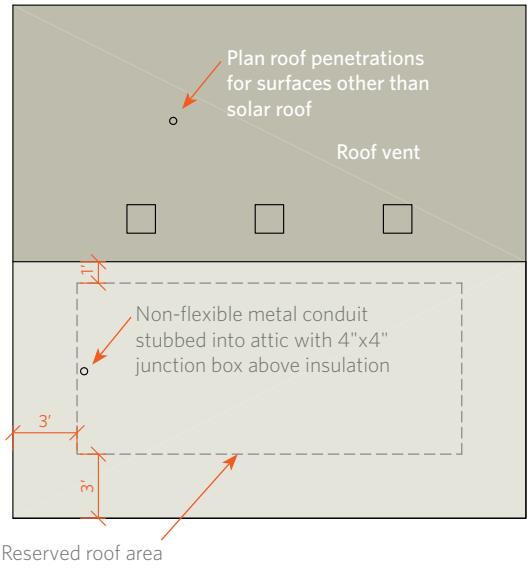


Solar access and roof area

Consult your Energy Trust verifier to find a solar ready installer and ensure that the project site meets the following solar access and location requirements. Requirements include but are not limited to the following:

- Document in a plan set or roof diagram the proposed system location and setbacks as required by code
- Reserved solar roof area must achieve at least 80% Total Solar Resource Fraction (TSRF) or meet prescriptive solar ready installation requirements

Fig. 46: Solar ready roof



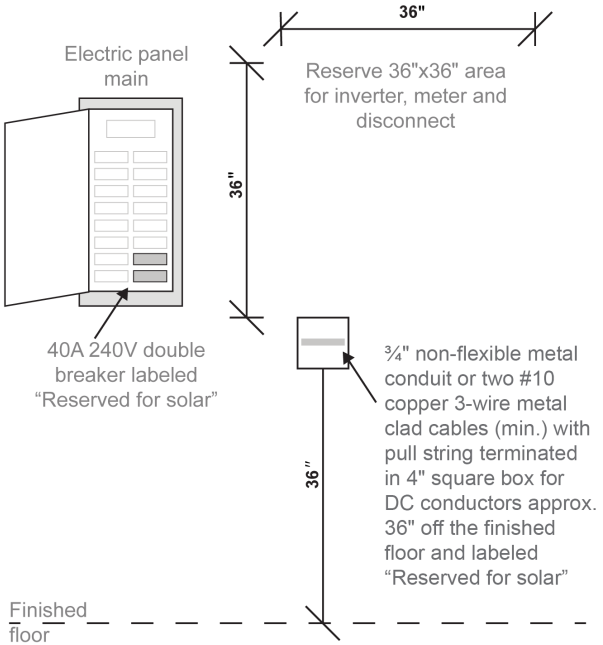
Ensure a minimum 200 sq. ft. roof area is reserved for future solar electric panel system and that it is clear of any roof penetrations or other obstructions

- Ensure the area reserved for the solar electric system has minimal obstruction and shading while meeting installation requirements

Solar ready infrastructure

To meet solar ready requirements and reduce costs associated with the installation of a future solar electric system, electrical conduit and junction boxes must be installed for future solar electric wiring. In addition, space will be needed in and near the electric panel to facilitate the integration of solar energy into the home's electrical system.

Fig. 47: Solar ready electric panel and surrounding area configuration



Solar ready installation requirements include but are not limited to the following:

- Reserve space near the electric panel for a future inverter and balance of system
- Install non-flexible metal conduit or two #10 copper 3-wire metal clad cables from the future system location to the reserved space near the electric panel
- Reserve breaker space inside the electric panel and label the reserved locations. Ensure breaker capacity meets system and jurisdiction requirements

RESOURCES

Energy Trust resources

For more information about EPS New Construction and to find a verifier or technician, visit **www.energytrust.org/epsresources** or contact the trade ally coordinator at **1.877.283.0698**.

For upcoming trainings:
www.energytrust.org/trainingcalendar

For online trainings related to the EPS requirements:
insider.energytrust.org/programs/eps-new-construction/training

For more on solar ready installation and to download a copy of the Solar Ready Residential Installation Requirements or the Solar Ready Checklist:
www.energytrust.org/solarready

For more information on adding solar to your new home construction project, or to contact a qualified solar trade ally: **www.energytrust.org/solar**

For easy access to EPS Field Guide resources:
www.energytrust.org/epsfieldguide

For TA enrollment, Technical Info and Requirements, and Incentive Forms:
insider.energytrust.org/programs/eps-new-construction/forms-and-resources

Other resources

For training, technical and marketing resources from a range of home certification programs, visit NEEA's Residential New Construction program at:
www.betterbuiltnw.com

Building and energy efficiency information:
www.energystar.gov
www.ahridirectory.org

Qualified products

Direct-vent fireplaces:
www.energytrust.org/fireplace

NEEA's advanced water heating specification qualified products list:
www.neea.org/advancedwaterheaterspec

EPS Requirement

☐ **Verification site visits**

- Verifiers must perform a site visit at rough-in and a site visit when construction is completed

☐ **Framing**

- Modified corner allowing full insulation (see fig. 3)
- Insulated header (see fig. 4)

☐ **Compliance with EPS New Construction Air Barrier and Air Sealing Checklist**

- Builders who consistently achieve final infiltration rates ≤ 4.0 ACH50 may fulfill this requirement by complying with the Air Barrier section only
- Fibrous insulation and housewraps do not qualify as air barrier materials

☐ **Blower door testing**

- All homes must have a final blower door infiltration test performed by an Energy Trust approved verifier, HERS Rater, BPI professional or other approved technician
- Testing shall follow program-approved certification testing protocol

☐ **Air sealing**

- Insulation dams must be installed at all edges of attic insulation and attic accesses must be insulated
- Weatherstripping or gaskets must be installed around attic and crawlspace access covers and recessed lighting
- Attic hatch air sealing and insulation matches ceiling R-Value (see fig. 9)
- Insulation Contact Air Tight (ICAT) rated fixture (see fig. 10)
- Window air sealing (see fig. 15)
- Air sealing at common wall (see fig. 16)
- Air-sealed interior soffit (see fig. 17)
- Air-sealed flue (see fig. 18)
- Air-sealed fireplace (see fig. 19)
- Air sealing behind tub/shower (see fig. 20)
- Air sealing and insulating knee walls and attic rooms (see fig. 21)
- Insulating skylight shafts (see fig. 22)

☐ **Insulation and framing inspections**

- Intermediate framing as defined by local code including, but not limited to: 16" on-center stud spacing, insulated headers, exterior wall intersections and modified, insulated corners
- Thermal barrier insulation must be installed to RESNET Grade I standards with no gaps, voids, compression or misalignment
- In insulated wall assemblies, insulation must be enclosed and in contact with an air-sealed, rigid air barrier on all sides, creating a six-sided box
- In insulated attics, insulation at vertical edges must have a rigid air barrier, or insulation dam, that extends above the full height of the insulation
- Floor insulation must be in full contact with subfloor above and properly supported
  - Floor insulation above garages and exterior cantilevers require a full air barrier on the underside of insulation
  - Open web floor joists with batt insulation must use batts the same width as the joist spacing and be installed so that the batt expands/extends into the joist webbing
  - When ductwork is installed in open web floor assemblies, spray-applied or loose-fill insulation is required

- Floor insulation installation shall be in contact with subfloor and secured (see fig. 23)
- Correct insulation around wiring in exterior wall (see fig. 25)

☐ **Windows tested and rated by National Fenestration Rating Council**

- Windows must be tested and rated by the NFRC, and the rating labels must remain on windows until they are documented by a verifier

☐ **Duct sealing and testing**

- All ducts must be sealed with mastic paste and tested following Program Standards and Testing Procedures specifications for new ducts
- Flex duct must be fully extended and both the interior and exterior sleeves of flex duct must be mechanically fastened using nylon draw-bands and manufacturer approved tensioning tool
- Ducts may not be installed within exterior wall cavities or a garage ceiling unless ≥ ⅔ of the R-Value of the wall or ceiling assembly is installed between the exterior wall surface and the duct
- When ducts are installed in open web floor assemblies over unconditioned spaces with the intention to bring "ducts inside," the following also applies:
  - An air barrier must be installed to bring the ducts within the thermal and air barriers of the home
  - Ducts must be in direct contact with the subfloor, except where truss members interfere
  - A minimum R-19 insulation must be installed under all duct runs
- Building cavities may not be used to transport air
- The entire floor assembly must be insulated with full-depth, blown-in insulation; batts are not allowed

☐ **Non-ducted gas heating equipment requirements for primary space heat. Sealed combustion or direct vent, located in the main living area and controlled by a programmable thermostat**

- Gas fireplaces used for primary space heat must be currently listed on the qualified models list found here: **www.energytrust.org/fireplace**

☐ **Heat pump commissioning**

- Heat pump installation must follow PTCS or CheckMe! standards for sizing, controls, airflow and refrigerant charge
- PTCS specifications can be found here: **www.bpa.gov/EE/sectors/residential/documents/ASHP_specifications.pdf**

☐ **Installation of zonal pressure relief**

- Bedrooms with multiple supplies require either a jumper duct, transfer grille, dedicated return or HRV/ERV duct
- Bedrooms with one supply, and without a return, may fulfill this requirement with a minimum 1" door undercut
- Zonal pressure relief strategies (see fig. 39)

☐ **Installation of carbon monoxide alarms**

- Carbon monoxide alarms must be installed according to local jurisdiction requirements

☐ **Installation and verification of whole-house mechanical ventilation system**

- Ventilation system must be balanced and provide continuous fresh air to the home at the following rate:
  - Ventilation CFM = (bedrooms +1) × 7.5 + (0.01 × conditioned area)

☐ **Continuous ventilation systems**

- Verify 24-hour operation

☐ **Intermittent ventilation systems**

- Verify mechanical damper is installed and fully operational
- Verify controller is properly commissioned based on airflow rate, occupancy, home size, cycle times and other applicable settings
- For intermittent ventilation systems, adjust the continuous flow rate to an intermittent rate

☐ **Whole-house exhaust fans**

- Rated for continuous operation
- Sone rating of 1.0 or less
- Operated continuously or intermittently with commissioned controls

☐ **Whole-house supply systems in Washington**

- Whole-house supply systems are only permitted when used with an air handler equipped with an electronically commutated motor

☐ **Spot ventilation in full baths**

- Vented to outside with a dedicated termination
- Rated at 2.0 sones or less
- Must be tested to provide at least 65 CFM when operated intermittently or 20 CFM continuously
- Exhaust ducts vented to outside (see fig. 43).

☐ **If installing heat pump water heaters****

- Heat pump water heaters must be currently listed on the NEEA Advanced Water Heater Specification Qualified Products List found here: **neea.org/img/documents/qualified-products-list.pdf**

☐ **Proper installation of solar ready features**

- To qualify as solar ready, projects must meet the following requirements:
  - Energy Trust's Solar Ready Installation Requirements***
  - A completed Solar Ready Checklist*** must be submitted for the home
  - All equipment must be properly labeled
  - Solar ready roof (see fig. 46)
  - Solar ready electric system (see fig. 47)

* See page 26 of this guide for additional requirements for specific ventilation strategies and verification.

** Incentives for newly built EPS homes in Washington are only available for homes heated with gas provided by NW Natural. Incentive payments are based on gas savings and efficiency improvements. Electric energy savings may be factored into a home's score, but are not eligible for incentive payments.

*** See page 32 for additional requirements.

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