Energy Trust of Oregon works with designers, homebuilders and contractors throughout Oregon and southwest Washington to build energy-efficient new homes. EPS™, brought to you by Energy Trust, is an energy performance score that estimates a home’s energy consumption, energy costs and carbon footprint.

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 built within Energy Trust territory in the service areas of Portland General Electric, Pacific Power, NW Natural, Cascade Natural Gas or Avista. In Washington, newly built gas-heated homes served by NW Natural can qualify for EPS, and incentives are also available for participating builders.

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 best practices and recommendations 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.
BEFORE YOU BUILD

EPS Requirements
Throughout this guide, each of the following systems and supporting components is noted in red as a requirement. In order to receive an EPS on a home, you must meet local code requirements and complete the following, when applicable. * Additional details can be found in the corresponding section of the guide:

☐ Compliance with EPS New Construction Air Barrier and Air Sealing Checklist
☐ Blower Door infiltration testing
☐ Insulation and framing inspections
☐ Windows tested and rated by National Fenestration Rating Council, NFRC
☐ Duct sealing and testing
☐ Non-ducted gas heating equipment requirements for primary space heat
☐ Heat pump commissioning
☐ Installation of zonal pressure relief
☐ Carbon monoxide alarms
☐ Installation and verification of whole-home mechanical ventilation system
☐ Spot ventilation in full baths
☐ Qualified heat pump water heaters
☐ Verification and labeling of solar ready equipment

*Compliance with EPS requirements does not imply local code requirements, manufacturer instructions or engineering documentation have been met. When overlapping requirements exist, the more stringent requirement shall apply.

DESIGN PHASE

Efficiency in plans
Homes should be designed and constructed to minimize heat loss during cold weather. Clear communication before, during and after the design phase is essential to ensure that the best practice techniques discussed in this guide are included in plans and carried out during construction by contractors.

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 solar heat and prevent overheating in the summer.

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.

Other subcontractors
All subcontractors delivering products or services that are related to program requirements or best 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.
Online training

Energy Trust offers free online training modules covering EPS best practices and other energy-efficient topics at www.energytrust.org/onlinetraining.

NOTES ON DRAWINGS WITHIN THIS GUIDE

Throughout the guide, drawings are used to illustrate the best 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 (::<>) and thick blue bar (——) indicate insulation.

Fig. X: Example

VERIFICATION

VERIFICATION REQUIREMENT:

☐ Verification site visits
  • Verifiers must perform a site visit at rough-in and a site visit when construction is completed

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

• Infiltration testing
• Duct leakage testing if not tested during first site visit
• Gather 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 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.

The first 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 infrastructure is installed and labeled, if applicable

Before You Build
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.

**Notes:**
- 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. 1:** Insulated slab and foundation wall

**Fig. 2:** Slab insulation options
FRAMING

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 techniques

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.

Fig. 3: Modified corner allowing full insulation (requirement)

Fig. 4: Insulated header in 2x6 wall (requirement)

Fig. 5: Exterior rigid insulation with rainscreen

Fig. 6: Staggered double stud wall

Improved wall systems

Installing exterior rigid insulation between studs and siding 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, thermal bridges are broken and isolated within the insulation.

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

R-10 - R-20 rigid foam insulation under slab

Fig. 3: Modified corner allowing full insulation (requirement)

Fig. 4: Insulated header in 2x6 wall (requirement)

Fig. 5: Exterior rigid insulation with rainscreen

Fig. 6: Staggered double stud wall

Plywood/OSB or 2x gussets at all openings

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.

Structural sheathing with building wrap

Rigid foam insulation with seams taped or sealed

Batten and air gap

Exterior siding

Note: Exterior foam increases interior wall temperatures, thereby reducing the possibility of condensation inside the wall itself.
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, formerly the EPS Field Checklist, may be used in lieu of the Air Barrier and Air Sealing Checklist.

The Air Barrier and Air Sealing Checklist is available from your verifier and can also be found online at www.energytrust.org/epsfieldguide.

**EPS REQUIREMENT:**

- Compliance with EPS New Construction Air Barrier and Air Sealing Checklist
  - Based on performance and verifier discretion, experienced builders who consistently achieve final infiltration rates ≤ 0.4 ACH50 may fulfill this requirement by completing the Air Barrier section only
  - Fibrous insulation and housewraps do not qualify as air barrier materials

Air leakage can occur at locations between conditioned and unconditioned spaces where incomplete air barriers exist, or at unsealed connections between air barrier materials. Air barrier materials should consist of rigid materials (plywood, oriented strand board, gypsum wall board or lumber) or semi-rigid materials (sheet metal, foam board or treated cardboard) that do not allow air to flow through. Fibrous insulation and housewrap products do not qualify as 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.

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When second-story floor joists cross over a wall between the garage and a conditioned space, the space between the joists must be blocked and sealed.

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

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.

Tip: 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 seal sealing material can be installed at the top plate before the drywall is installed.

Seal top plate penetrations
Seal drywall to framing with caulk, sill sealer or gasket material
No need to seal drywall penetrations in interior walls
Sealing exterior leaks eliminates interior leaks

Fig. 9: Attic hatch air sealing and insulation (requirement)

Requirement: Insulation dams must be installed at all edges of attic insulation and attic accesses must be insulated.

Requirement: Weatherstripping or gaskets must be installed around attic access covers and recessed lighting.

Insulation is secured and matches ceiling R-Value
Weatherstripping or gasket
Hatch cover constructed of plywood or drywall over plywood
Plywood or rigid insulation dams to secure attic insulation

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.

Tip: 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 seal sealing material can be installed at the top plate before the drywall is installed.

Seal gap between drywall and light fixture housing using caulk and/or manufacturer provided gasket

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

ICAT rated recessed light
Airtight wire connection from junction box

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

Tip: Air seal rough openings, gaps and other penetrations through the attic prior to installing insulation and finish work.
AIR SEALING

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.

Fig. 15: Window air sealing (requirement)

- Housewrap
- Flashing tape
- Seal casing to interior of jamb

Fig. 16: Air sealing at common wall (requirement)

- Exterior water management not shown for clarity
- Seal seams at property line and exterior boundary with elastomeric caulk or mastic paste

Unit A

Unit B

Sheathing may run continuously across property line
Seal seams and penetrations in rigid air barrier. Fire-rated sealant can be used to seal small gaps around many penetrations. Fig. 18: Air-sealed flue (requirement)

An air barrier must be aligned with the thermal barrier. 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.

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. Fully insulate cavity.

Fig. 17: Air-sealed interior soffit (requirement)

Fig. 19: Air-sealed fireplace (requirement)

Fig. 20: Air sealing behind tub/shower (requirement)
Furr ceiling down to allow for full insulation and code-required air space above baffle.

Rigid sealed air barrier to meet flame spread/smoke requirements.

Do not compress insulation.

Block top and bottom of walls with approved material.

Unconditioned attic space.

Baffle.

Fig. 21: Air sealing and insulating kneewalls and attic rooms (requirement)

Fig. 22: Insulating skylight shafts (requirement)

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.

Install rigid air barrier to both sides of vertical insulation.

Sheathing on backside of skylight walls must meet all smoke and flame spread requirements.

Insulate skylight walls if bottom chord of truss is insulated.

Unconditioned attic space.

Baffle.

Baffle.

Note: TRADE ALL Y HOTLINE 1.877.283.0698

energytrust.org/epsfieldguide
**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
  - 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 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

All 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 rims between floors are insulated before final framing makes them inaccessible and so contractors do not have to walk through blown attic insulation after it has been installed.

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-heel trusses should be used to maximize the performance of ceiling insulation at attic perimeters.

Raised-heel trusses allow more insulation to be installed at the exterior edge of the ceiling than standard trusses.

Batt insulation above garages and exterior cantilevers requires a full air barrier on the underside of insulation.

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

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**Fig. 23:** Proper floor insulation installation (requirement)

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

**Fig. 24:** Raised-heel trusses

Raised-heel trusses allow more insulation to be installed at the exterior edge of the ceiling than standard trusses.

**Fig. 25:** Correct insulation around wiring in exterior wall (requirement)

Slit insulation

-OR-

Notch bottom of studs for electrical wires (see code for notch size)
**R-VALUES FOR COMMON INSULATION**

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

**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**

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

**Images:**

- 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 bats are not aligned and have many compressions.
- Fig. 29: Insulation is friction-fit, has no gaps or cracks, and fills the cavity.
EFS 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.

EFS REQUIREMENT:

- Duct sealing and testing
  - Ducts must be sealed with mastic paste and tested following Performance Tested Comfort Systems®, PTCS, specifications for existing home/new ducts
  - 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
  - Mini-split heat pump ducts must be sealed and ducts installed in an unconditioned space must also be insulated; duct testing is required if more than 5 percent of duct length is outside of conditioned space
  - Ducts may not be installed within exterior wall cavities unless ≥ 60 percent of the R-Value of the wall assembly is installed between the exterior wall surface and the duct
  - Building cavities may not be used to transport air
  - Ducts that are tested before air handler is installed shall be ≤ 4 percent of the conditioned area
  - PTCS Ducts Inside Specifications must be met to qualify home as “ducts inside” for modeling purposes
    - If duct and heating system qualify as PTCS Ducts Inside, a visual inspection of the duct system may replace duct testing requirements

Duct design, installation, sealing and insulation is critical to heating system performance. Without proper sealing and insulation, up to 20 percent 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. Ducts should be installed with minimal turns and flexible ducting should be pulled tight and fully extended.

Reference the Resources section for links to PTCS duct specifications.
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.

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, duct systems must meet the PTCS Ducts Inside Single Family Homes Specifications. Requirements include, but are not limited to, the following:

- Heating equipment and at least 95 percent of total duct length must be located inside the air/thermal barriers
- 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
**HEATING & COOLING SYSTEMS**

**Fig. 33:** Strategies to bring ducts inside

- Insulate to the same level as attic
- Create air barrier within attic using a rigid air barrier and sealant
- Duct in conditioned space
- Create air barrier before building soffit within conditioned space

**Notes:**
- Ducts in joists between conditioned and unconditioned spaces are not considered to be in the conditioned space unless properly air sealed and insulated to the same level as the surrounding assembly.

**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.
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.

**EPS REQUIREMENT:**
- **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 must be currently listed on the qualified models list found here: www.energytrust.org/epsfieldguide

**Heat pump commissioning**

To ensure optimal performance, heat pump installers must follow either PTCS or CheckMe! commissioning specifications for sizing, controls, airflow and refrigerant charge. Installers do not have to be certified by either PTCS or CheckMe! to meet this EPS requirement. Mini-split heat pumps are exempt from commissioning requirements.

**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:**
- **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

**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
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.

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.
MECHANICAL VENTILATION SYSTEMS

EPS REQUIREMENT:
- Installation and verification of whole-house mechanical ventilation system*
  - Ventilation system must provide fresh air to the home at the following rates:
    - Oregon: Ventilation CFM = (Bedrooms + 1) x 7.5 + (0.01 x Conditioned Area)
    - Washington: Whole-House Ventilation Rate: CFM = (Bedrooms + 1) x 15

A tightly constructed house with reliable whole-house mechanical ventilation will have improved comfort and indoor air quality. Mechanical ventilation can be provided using exhaust systems, supply systems or HRV/ERV systems.

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 flow hood, flow grid, anemometer or other equivalent tools. Please refer to RESNET Standard 380 and manufacturer instructions for guidance on mechanical ventilation testing tools and procedures. If the ventilation system is inaccessible, airflow testing is not required.

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 exhaust systems
One of the most simple and common ventilation strategies is to use a whole-house exhaust system. Often installed in centrally located bathrooms, these exhaust fans pull stale air from the house and exhaust it outside, while fresh air is pulled into the building through passive vents or other openings in the building shell. Exhaust systems can be a single fan or several in different locations, like bathrooms or laundry rooms. When installed in bathrooms they are often connected to booster controls that increase exhaust rates when turned on. These small fans run continuously or on an intermittent schedule throughout the day. To ensure they are not disconnected by the homeowner it’s important that they meet the program requirements for sound, 1.0 sone or less.

Whole-house supply systems
Whole-house supply systems are typically used in conjunction with a ducted HVAC system. Fresh outdoor air is drawn in through the cold air return, conditioned and distributed throughout the house. An electronically operated mechanical damper controls when outdoor air is able to enter the system. These systems can be combined with controllers that also activate an exhaust fan inside the house. For optimal performance and comfort, these systems should use controllers that can coordinate providing fresh air with the normal operation of the heating/cooling system and use low fan speeds at other times.

ENERGYTRUST.ORG/EPSTECHGUIDE
TRADE ALLY HOTLINE 1.877.283.0698
energytrust.org/epsfldguide
*See Page 35 for additional requirements concerning your ventilation strategy and verification.

REQUIREMENTS:
- Ventilation system verification
  - When accessible, airflow must be measured to +/- 15 CFM or +/- 15 percent of calculated requirement (whichever is greater)
- 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
- Whole-house exhaust fans
  - Rated for continuous operation
  - Sone rating of 1.0 or less
  - Centrally located
  - 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

34
35
Heat/energy recovery ventilator

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 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 Sensible Recovery Efficiencies, SRE, of 80 percent or higher and fan consumption of 0.75 watts/cfm or less. Refer to manufacturer instructions to properly test and balance airflow.
EPS REQUIREMENT:

Spot ventilation in full baths
- Vented to outside with a dedicated termination
- Rated at 2.0 sones or less
- Tested to provide at least 80 CFM when operated intermittently or 20 CFM continuously

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

Notes:
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.

Fig. 43: Exhaust ducts vented to outside (requirement)

EPS REQUIREMENT:

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/advancedwaterheaterspec

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. Also consider solar water heating systems, which can reduce the demand/load of any water heater.

Lighting and appliances
Using high-efficiency lighting and appliances can reduce a homeowner’s energy consumption. Refer to your local jurisdiction lighting and appliance 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 (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 panel (PV)**
- **Inverter**
- **Home electrical panel**
- **Utility meter**
- **Utility grid**

**Requirement:** In order to receive Energy Trust solar electric incentives, solar projects must be pre-approved by Energy Trust and completed by approved Energy Trust solar trade ally contractors.

**EPS REQUIREMENT:**
- **Proper installation of solar ready equipment**
  - 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

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

**Requirement:** In order to receive Energy Trust solar electric incentives, solar projects must be pre-approved by Energy Trust and completed by approved Energy Trust solar trade ally contractors.

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**

- Non-flexible metal conduit
- Solar ready roof area reserved and included in roof plan or diagram
- Space reserved for future equipment
- Label infrastructure to code and as instructed in the requirements
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 percent Total Solar Resource Fraction, TSRF, or meet prescriptive solar ready installation requirements
- 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.

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 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, and ensure breaker capacity meets system and jurisdiction requirements

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.
**Energy Trust resources**

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

For upcoming trainings: [www.energytrust.org/trainingcalendar](http://www.energytrust.org/trainingcalendar)

For online trainings related to the EPS requirements: [https://insider.energytrust.org/programs/eps-new-construction/training/](https://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](http://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/solarbid](http://www.energytrust.org/solarbid)

For easy access to EPS Field Guide resources: [www.energytrust.org/epsfieldguide](http://www.energytrust.org/epsfieldguide)

**Other resources**

For training, technical and marketing resources from a range of home certification programs, visit NEEA’s Residential New Construction program at: [www.betterbuilt nw.com](http://www.betterbuilt nw.com)

RESNET Standard for ventilation airflow testing: [www.resnet.us](http://www.resnet.us)

Building and energy efficiency information:
- [www.energystar.gov](http://www.energystar.gov)
- [www.oregon.gov/energy](http://www.oregon.gov/energy)
- [www.ahridirectory.org](http://www.ahridirectory.org)


**Performance Tested Comfort Systems, PTCS**

Duct sealing and testing, follow protocol for existing home/new ducts:

Ducts Inside:
- [https://nwncouncil.box.com/s/lqrsfbwd95lqpgqrrdctms09kfsn](https://nwncouncil.box.com/s/lqrsfbwd95lqpgqrrdctms09kfsn)

Heat pump commissioning:

**Qualified products**

Gas fireplaces must be currently listed on Energy Trust’s qualified models list:
- [www.energytrust.org/epsfieldguide](http://www.energytrust.org/epsfieldguide)

NEEA qualified heat pump water heaters:
- [http://neea.org/advancedwaterheaterspec](http://neea.org/advancedwaterheaterspec)

**Referenced standards and forms**

Air Barrier and Air Sealing Checklist:
- [www.energytrust.org/epsfieldguide](http://www.energytrust.org/epsfieldguide)

**RESOURCES**

- [RESNET Standard for ventilation airflow testing](http://www.resnet.us)
- [Building and energy efficiency information](http://www.energystar.gov)
- [2017 Oregon Residential Specialty Code](https://www.oregon.gov/bcd/codes-stand/Pages/adopted-codes.aspx)
- [Air Barrier and Air Sealing Checklist](http://www.energytrust.org/epsfieldguide)

**REFERENCES**

- [RESNET Standard for ventilation airflow testing](http://www.resnet.us)
- [Building and energy efficiency information](http://www.energystar.gov)
- [2017 Oregon Residential Specialty Code](https://www.oregon.gov/bcd/codes-stand/Pages/adopted-codes.aspx)
- [Air Barrier and Air Sealing Checklist](http://www.energytrust.org/epsfieldguide)
EPS Requirements

- Compliance with EPS New Construction Air Barrier and Air Sealing Checklist
  - Based on performance and verifier discretion, experienced builders who consistently achieve final infiltration rates ≤ 4.0 ACH50 may fulfill this requirement by completing the Air Barrier section only
  - Fibrous insulation and housewraps do not qualify as air barrier materials
- Blower Door infiltration 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 certification testing protocol or diagnostic equipment manufacturer instructions
- 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
  - Insulation must be installed to RESNET Grade I standards with no gaps, voids, compression or misalignment
- 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
  - Ducts must be sealed with mastic paste and tested following PTCS specifications for existing home/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
  - Mini-split heat pump ducts must be sealed and when not installed in conditioned space, insulated; duct testing is required if more than 5 percent of duct length is outside of conditioned space
- Heat pump commissioning
  - Heat pump installation must follow PTCS or CheckMe! standards for sizing, controls, airflow and refrigerant charge
- 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 2” door undercut

- Ducts must be sealed with mastic paste and tested following PTCS specifications for existing home/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
- Mini-split heat pump ducts must be sealed and when not installed in conditioned space, insulated; duct testing is required if more than 5 percent of duct length is outside of conditioned space
- Ducts may not be installed within exterior wall cavities unless ≥ 60 percent of the R-Value of the wall assembly is installed between the exterior wall surface and the duct
- Building cavities may not be used to transport air
- PTCS Ducts Inside Specifications must be met to qualify home as "ducts inside" for modeling purposes
  - If duct and heating system qualify as PTCS Ducts Inside, a visual inspection of the duct system may replace duct testing requirements
- 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 must be currently listed on the qualified models list found here: www.energytrust.org/epsfieldguide
- PTCS Ducts Inside Specifications must be met to qualify home as "ducts inside" for modeling purposes
  - If duct and heating system qualify as PTCS Ducts Inside, a visual inspection of the duct system may replace duct testing requirements
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 provide fresh air to the home at the following rates:
  - Oregon: Ventilation CFM= (Bedrooms+1) x 7.5 + (0.01 x Conditioned Area)
  - Washington: Whole-House Ventilation CFM= (Bedrooms+1) x 15

Spot ventilation in full baths
- Vented to outside with a dedicated termination
- Rated at 2.0 sones or less
- Able to provide at least 80 CFM when operated intermittently or 20 CFM continuously

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/advancedwaterheaterspec

Proper installation of solar ready equipment
- Projects must meet Energy Trust Solar Ready Residential Installation Requirements, including solar resource and labels for verifier inspection, and complete the Solar Ready Checklist found here: www.energytrust.org/solarready

*See page 34 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.
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 costs. Our work helps keep energy costs as low as possible, creates jobs and builds a sustainable energy future. Printed on recycled paper that contains post-consumer waste. 1/19