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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.
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 (corrugated) and thick blue bar (bar) indicate insulation.

BEFORE YOU BUILD

DESIGN PHASE

Timeline
The design phase of planning can positively impact a project’s timeline. The timeline on page three outlines essential project milestones.

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 recommended 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.

EPS REQUIREMENT

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 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

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.

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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

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 second 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 meet program requirements
- Carbon monoxide alarms installed as required
- Zonal pressure relief meets program requirements

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.

### FOUNDATIONS & SLABS

- Rigid foam insulation acts as a thermal break and vapor barrier when seams are taped or sealed
- Perimeter insulation tapered at top edge if needed for carpet nailing strips
- Exterior foundation insulation with durable flashing
- Rigid foam insulation under slab

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 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.

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.

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 online at www.energytrust.org/epsfieldguide.

**Fig. 3: Modified corner allowing full insulation**

**Fig. 4: Insulated header**

**Fig. 5: Exterior rigid insulation with rainscreen**

**Fig. 6: Staggered double stud wall**

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

- Blower door testing
  - All homes must have a final blower door test performed by an Energy Trust approved verifier.
  - Testing shall follow certification testing protocol or diagnostic equipment manufacturer instructions.

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

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.

**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.

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

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

EPS REQUIREMENT

- Insulation dams must be installed at all edges of attic insulation.
- Weatherstripping or gaskets must be installed around attic 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. 9: Insulation dam installed at side of wall

Insulation dam must be installed at all edges of attic insulation.

Fig. 10: ICAT rated fixture installed in attic

Insulation Contact Air Tight (ICAT) rated fixture installed in attic.
Fig. 9: Attic hatch air sealing and insulation
Plywood or rigid insulation dam to secure attic insulation
Insulation is secured and matches ceiling R-Value
Weatherstripping or gasket
Hatch cover constructed of plywood or drywall over plywood

Fig. 10: Insulation Contact Air Tight (ICAT) rated fixture
Airtight wire connection from junction box
Seal gap between drywall and light fixture housing using caulk and/or manufacturer provided gasket
ICAT rated recessed light

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
Housewrap
Flashing tape
Seal casing to interior of jamb
Exterior water management not shown for clarity

Fig. 16: Air sealing at common wall
Unit A
Unit B
Sheathing may run continuously across property line
Seal seams at property line and exterior boundary with elastomeric caulk or mastic paste

Fig. 17: Air-sealed interior soffit
An air barrier must be aligned with the thermal barrier
Seal seams and penetrations in rigid air barrier

**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.

**EPS REQUIREMENT**
- Window air sealing (see fig. 15)
- Air sealing at common wall (see fig. 16)
- Air-sealed interior soffit (see fig. 17)
Fire-rated sealant can be used to seal small gaps around many penetrations.

**Code-required air gap around flue/chimney**

Metal flashing or duct collar sealed with fire-rated caulk.

**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.

**Note:**

*For an example animation of insulating knee walls, visit [www.insider.energytrust.org/programs/eps-new-construction/training](http://www.insider.energytrust.org/programs/eps-new-construction/training).*
Sheathing on backside of skylight walls must meet all smoke and flame spread requirements

Install rigid air barrier to both sides of vertical insulation

Insulate skylight walls if bottom chord of truss is insulated

Fig. 22: Insulating skylight shafts

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

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

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

Fig. 25: Proper floor insulation installation

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.

Fig. 23: Proper floor insulation installation

Fig. 24: Raised-heel trusses

Fig. 25: Correct insulation around wiring in exterior wall

Slit insulation
- OR -
Notch bottom of studs for electrical wires (see code for notch size)

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.

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-VALUES PER INCH 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>

Information courtesy of: www.energy.gov/energsaver/weatherize/insulation/types-insulation
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. 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**
- 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 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 ≥ 60% 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
- Ducts that are tested before air handler is installed shall be ≤ 4% of the conditioned area
- PTCS Ducts inside Specifications must be met to qualify home as “ducts inside”  
  - If duct and heating system qualify as PTCS Ducts Inside, a visual inspection of the duct system may replace duct testing requirements

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.
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% 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

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.
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 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

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.

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.

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 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 found here: www.energytrust.org/fireplace

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.

Fig. 38: Mini-split heat pump head
**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.

**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.

**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 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

*See page 35 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. 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.

Ventilation controller settings
Modern 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.

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EPS REQUIREMENT

- Ventilation system verification
  - When accessible, airflow must be measured to +/- 15 CFM or +/- 15% 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
  - Sound 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

energytrust.org/epsfieldguide
**Mechanical Ventilation Systems**

Optional:
- Operate exhaust fan at the same time as blower
- Provide wall switch for on/off application

Supply air with mixed fresh air distributed throughout the house
- Motorized damper opens for ventilation cycle
- Insulated fresh air duct connects to return duct near the air handler
- Control set to operate fan and damper to meet ventilation requirements

**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 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**
- **Spot ventilation in full baths**
  - Ventilated 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
  - Exhaust ducts vented to outside (see fig. 43)

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.

**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.

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**Fig. 41: Fresh air intake tied to HVAC**

**Fig. 42: Heat/energy recovery ventilator**

**Fig. 43: Exhaust ducts vented to outside**
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/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
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 homes pursuing solar in addition to EPS, reference these offerings.

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

Inverter
Home electrical panel
Utility meter
Utility grid

DC in
AC out

Solar electric panel (PV)
SOLAR READY

SOLAR READY REQUIREMENTS

- In order to receive Energy Trust solar electric 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.

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

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.

- Ensure the area reserved for the solar electric system has minimal obstruction and shading while meeting installation requirements
- 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. You must also 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: 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
For more information on adding solar to your new home construction project, or to contact a qualified solar trade ally: www.energytrust.org/solarbid
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
RESNET: www.resnet.us

Performance Tested Comfort Systems, PTCS
Duct sealing and testing, follow protocol for existing home/new ducts: www.bpa.gov/EE/sectors/residential/documents/BPA_PTCS_duct_sealing_spec.pdf
Ducts Inside: https://nwcouncil.app.box.com/s/lqbsfwd9s1ldqagqqrcdtms09kf3sn

Qualified products
Direct-vent fireplaces: www.energytrust.org/fireplace
NEEA’s advanced water heating specification qualified products list: www.neea.org/advancedwaterheaterspec

EBS Requirement

☐ 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 ≤ 0.6 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 certification testing protocol or diagnostic equipment manufacturer instructions

☐ Example 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 access covers and recessed lighting
  • Air sealing behind tub/shower (see fig. 20)

☐ 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 require a full air barrier on the underside of insulation

Qualified products
Direct-vent fireplaces: www.energytrust.org/fireplace
NEEA’s advanced water heating specification qualified products list: www.neea.org/advancedwaterheaterspec

• 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. 11)
• Air sealing at common wall (see fig. 12)
• Air-sealed interior soffit (see fig. 21)
• Air-sealed flue (see fig. 38)
• 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)
- Ducts must be in direct contact with the subfloor, except where truss members interfere
- A minimum R-9 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
- PTCS Ducts Inside Specifications must be met to qualify home as "ducts inside"
- 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 required to be sealed combustion or direct vent, located in the mail 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.energystar.gov/fireplace

**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 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 provide fresh air to the home at the following rates:
  - Oregon: Ventilation CFM/(Bedrooms+3) x 7.5 + (0.01 x Conditioned Area)
  - Washington: Whole-House Ventilation CFA/(Bedrooms+1) x 15

**Ventilation system verification**
- When accessible, airflow must be measured to +/- 15 CFM or +/- 15% 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 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

**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
- Duct may not be installed within exterior wall cavities or a garage ceiling unless > 60% 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

**Ventilation CFM=(Bedrooms+1) x 15
5.0
1.25
7.5
20
80**
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. 1/20