

Top 10 Best Practices for Today's Homebuilder

Oregon version including related 2021 Oregon Residential Energy Code info

1. Design for Efficiency

- *Good:* Continuous thermal boundary
- *Better:* Add right sizing design & systems
- *Best:* Add optimization with energy modeling

2. Superior Air Sealing

- *Good* (code requirement): Air sealing with basic caulking and foaming
- *Better* (code additional measure 8): Fully continuous air barrier + blower door test with advanced caulking and foaming
- *Best:* Exterior sheathing sealed with fluid applied, taped or glued sheathing

3. High Performance Wall Systems

- *Good:* Intermediate or advanced framing with blown-in insulation
- *Better* (code additional measure 3): Single plate with staggered studs + blown insulation (\leq R-27) or 2x6 with exterior continuous insulation.
- *Best:* R-27 + Insulated sheathing or double stud with blown-in insulation

4. High R-Value Ceilings

- *Good* (code requirement): Standard truss with R-21 high density fiberglass batts or rigid insulation inserts + 1" vent channel at eaves
- *Better* (code additional measure 4): Raised heel truss, parallel chord cantilevered truss
- *Best:* True vaulted ceiling (I-joist) or insulated roof above attic

5. Windows

- *Good* (code requirement): Proper U-Value and Solar Heat Gain Coefficient (SHGC) for applications
- *Better* (code additional measure 7): Window design avoiding too much glazing
- *Best* (code additional measure 4): Daylighting + high performance low U-value

6. Ducts and Distribution

- *Good* (code requirement): Seal ducts with mastic
- *Better:* Seal ducts with mastic and test
- *Best* (code requirement): Ducts inside or ductless HVAC system

7. Fresh Air Ventilation

- *Good:* Exhaust only
- *Better* (code requirement): Supply + exhaust with ECM blower motor
- *Best* (code additional measure 8): Heat Recovery Ventilator (HRV) or Energy Recovery Ventilator (ERV)

8. Lighting and Appliances

- *Good:* High-efficacy bulbs in all permanent fixtures (*code requirement*) and Energy Star appliances
- *Better:* Add heat pump dryer
- *Best:* Add induction cooktop

9. Mechanical Systems

- *Good* (code additional measure 1): High-efficiency ducted heat pump or condensing gas furnace
- *Better* (code additional measure 1 & 5): Ductless heat pump or highest efficiency condensing gas furnace or inverter driven ducted heat pump
- *Best* (code additional measure 2): Add heat pump water heater or condensing tankless gas water heater

10. Solar Energy

- *Good:* PV Solar and Electric Vehicle (EV) ready
- *Better:* Zero Energy (or ZE Ready)
- *Best:* Positive Energy with EV

2021 ORSC - Residential Energy Code Prescriptive Path Requirements related to Top 10 Best Practices for Today's Homebuilder

TABLE N1101.1(1)
PRESCRIPTIVE ENVELOPE REQUIREMENTS^a

BUILDING COMPONENT	STANDARD BASE CASE		LOG HOMES ONLY	
	Required Performance	Equiv. Value ^b	Required Performance	Equiv. Value ^b
Wall insulation—above grade	U-0.059 ^c	R-21 Intermediate ^c	Note d	Note d
Wall insulation—below grade ^e	C-0.063	R-15 <u>c.i.</u> /R-21	C-0.063	R-15/R-21
Flat ceilings ^f	U-0.021	R-49	U-0.020	R-49 A ^h
Vaulted ceilings ^g	U-0.033	R-30 Rafter or R-30A ^{g, h} Scissor Truss	U-0.027	R-38A ^h
Underfloors	U-0.033	R-30	U-0.033	R-30
Slab-edge perimeter ^m	F-0.520	R-15	F-0.520	R-15
Heated slab interior ⁱ	n/a	R-10	n/a	R-10
Windows ^j	<u>U-0.27</u>	<u>U-0.27</u>	<u>U-0.27</u>	<u>U-0.27</u>
Skylights	U-0.50	U-0.50	U-0.50	U-0.50
Exterior doors ^k	U-0.20	U-0.20	U-0.54	U-0.54
Exterior doors with > 2.5 ft ² glazing ^l	U-0.40	U-0.40	U-0.40	U-0.40

For SI: 1 inch = 25.4 mm, 1 square foot = 0.0929 m², 1 degree = 0.0175 rad, n/a = not applicable.

- a. As allowed in Section N1104.1, thermal performance of a component may be adjusted provided that overall heat loss does not exceed the total resulting from conformance to the required U-factor standards. Calculations to document equivalent heat loss shall be performed using the procedure and approved U-factors contained in Table N1104.1(1).
- b. R-values used in this table are nominal for the insulation only in standard wood-framed construction and not for the entire assembly.
- c. Wall insulation requirements apply to all exterior wood-framed, concrete or masonry walls that are above grade. This includes cripple walls and rim joist areas. Nominal compliance with R-21 insulation and Intermediate Framing (N1104.5.2) with insulated headers.
- d. The wall component shall be a minimum solid log or timber wall thickness of 3.5 inches.
- e. Below-grade wood, concrete or masonry walls include all walls that are below grade and do not include those portions of such wall that extend more than 24 inches above grade. R-21 for insulation in framed cavity; R-15 continuous insulation.
- f. Insulation levels for ceilings that have limited attic/rafter depth such as dormers, bay windows or similar architectural features totaling not more than 150 square feet in area may be reduced to not less than R-21. When reduced, the cavity shall be filled (except for required ventilation spaces). R-49 insulation installed to minimum 6-inches depth at top plate at exterior of structure to achieve U-factor.
- g. Vaulted ceiling surface area exceeding 50 percent of the total heated space floor area shall have a U-factor no greater than U-0.026 (equivalent to R-38 rafter or scissor truss with R-38 advanced framing).
- h. A = Advanced frame construction. See Section N1104.6.
- i. Heated slab interior applies to concrete slab floors (both on and below grade) that incorporate a radiant heating system within the slab. Insulation shall be installed underneath the entire slab.
- j. Sliding glass doors shall comply with window performance requirements. Windows exempt from testing in accordance with Section NF1111.2, Item 3 shall comply with window performance requirements if constructed with thermal break aluminum or wood, or vinyl, or fiberglass frames and double-pane glazing with low-emissivity coatings of 0.10 or less. Buildings designed to incorporate passive solar elements may include glazing with a U-factor greater than 0.35 by using Table N1104.1(1) to demonstrate equivalence to building thermal envelope requirements.
- k. A maximum of 28 square feet of exterior door area per dwelling unit can have a U-factor of 0.54 or less.
- l. Glazing that is either double pane with low-e coating on one surface, or triple pane shall be deemed to comply with this requirement.
- m. Minimum 24-inch horizontal or vertical below-grade.

2021 ORSC - All conditioned spaces within residential buildings must comply with 1 measure from Table N1101.1(2)

**TABLE N1101.1(2)
ADDITIONAL MEASURES**

1	<p>HIGH EFFICIENCY HVAC SYSTEM^a</p> <p>a. Gas-fired furnace or boiler AFUE 94 percent, or b. Air source heat pump HSPF 10.0/14.0 SEER cooling, or c. Ground source heat pump COP 3.5 or Energy Star rated</p>
2	<p>HIGH EFFICIENCY WATER HEATING SYSTEM</p> <p>a. Natural gas/propane water heater with minimum UEF 0.90, or b. Electric heat pump water heater with minimum 2.0 COP, or c. Natural gas/propane tankless/instantaneous heater with minimum 0.80 UEF and Drain Water Heat Recovery Unit installed on minimum of one shower/tub-shower</p>
3	<p>WALL INSULATION UPGRADE</p> <p>Exterior walls—U-0.045/R-21 conventional framing with R-5.0 continuous insulation</p>
4	<p>ADVANCED ENVELOPE</p> <p>Windows—U-0.21 (Area weighted average), and Flat ceiling^b—U-0.017/R-60, and Framed floors—U-0.026/R-38 or slab edge insulation to F-0.48 or less (R-10 for 48"; R-15 for 36" or R-5 fully insulated slab)</p>
5	<p>DUCTLESS HEAT PUMP</p> <p>For dwelling units with all-electric heat provide: Ductless heat pump of minimum HSPF 10 in primary zone replaces zonal electric heat sources, and Programmable thermostat for all heaters in bedrooms</p>
6	<p>HIGH EFFICIENCY THERMAL ENVELOPE UA^c</p> <p>Proposed UA is 8 percent lower than the code UA</p>
7	<p>GLAZING AREA</p> <p>Glazing area, measured as the total of framed openings is less than 12 percent of conditioned floor area</p>
8	<p>3 ACH AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION</p> <p>Achieve a maximum of 3.0 ACH50 whole-house air leakage when third-party tested and provide a whole-house ventilation system including heat recovery with a minimum sensible heat recovery efficiency of not less than 66 percent.</p>

For SI: 1 square foot = 0.093 m², 1 watt per square foot = 10.8 W/m².

- a. Appliances located within the building thermal envelope shall have sealed combustion air installed. Combustion air shall be ducted directly from the outdoors.
- b. The maximum vaulted ceiling surface area shall not be greater than 50 percent of the total heated space floor area unless vaulted area has a U-factor no greater than U-0.026.
- c. In accordance with Table N1104.1(1), the Proposed UA total of the Proposed Alternative Design shall be a minimum of 8 percent less than the Code UA total of the Standard Base Case.

Air sealing requirements.

N1104.8 Air leakage. The building thermal envelope shall be constructed to limit air leakage in accordance with this section.

N1104.8.1 Air barriers. A continuous air barrier shall be installed and fully aligned with the building thermal envelope on every vertical portion of air-permeable insulation and on the warm side of horizontal, air-permeable insulation. Air-permeable insulation shall not be used as a sealing material.

Exception: Unvented attics, continuous insulation walls and similar conditions where an impermeable insulation layer forms an air barrier.

N1104.8.2 Sealing required. Exterior joints around window and door frames, between wall cavities and window or door frames, between walls and foundation, between walls and roof, between wall panels, at penetrations or utility services through walls, floors and roofs and all other openings in the exterior envelope shall be sealed in a manner approved by the *building official*.

Sealing for the purpose of creating a continuous air barrier shall be in accordance with the applicable requirements of Table N1104.8, or the dwelling shall be tested to demonstrate a blower door result not less than 4.0 ACH50.

N1104.8.2.1 Top plate sealing. At all walls in contact with vented attics, the wall covering (gypsum board or other) shall be sealed to the top plate with caulk, sealant, gasket or other approved material.

N1104.9 Moisture control. To ensure the effectiveness of insulation materials and reduce the hazard of decay and other degradation due to condensation within the structure, moisture-control measures shall be included in all buildings and structures or portions thereof regulated by this chapter.

N1104.9.1 Vapor retarders. Vapor retarders shall be installed in accordance with Section R318.

N1104.9.2 Ground cover. A ground cover shall be installed in the crawl space for both new and existing buildings when insulation is installed. Ground cover shall be installed in accordance with Chapter 4.

TABLE N1104.8
AIR BARRIER INSTALLATION AND AIR SEALING REQUIREMENTS

COMPONENT	AIR BARRIER CRITERIA
General requirements	A continuous air barrier shall be installed in alignment with the building thermal envelope. Breaks or joints in the air barrier shall be sealed.
Ceiling/attic	The air barrier in any dropped ceiling or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop-down stairs, or knee wall doors to unconditioned attic spaces shall be gasketed and sealed.
Walls	The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of interior walls shall be sealed between wall cavities and windows or door frames. All penetrations or utility services through the top and bottom plates shall be sealed. Knee walls shall be sealed.
Windows, skylights and doors	The space between framing and skylights, and the jambs of windows and doors shall be sealed.
Rim/band joists	Rim/band joists shall be a part of the thermal envelope and have a continuous air barrier.
Floors Including cantilevered floors and floors above garages	The air barrier shall be installed at any exposed edge of insulation.
Crawl space walls	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.
Shafts, penetrations	Duct shafts, utility penetrations and flue shafts opening to exterior or unconditioned space shall be sealed.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be sealed to the finished surface.
Shower/tub on exterior walls	The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.
HVAC register boots	HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.

SECTION N1105 HEATING, VENTILATING AND AIR-CONDITIONING SYSTEMS

N1105.1 General. This section provides minimum requirements for heating, ventilating and air-conditioning systems.

N1105.2 Insulation of ducts. All new duct systems or new portions of duct systems exposed to unconditioned spaces, and buried ductwork within insulation that meets the exception to Section N1105.3, shall be insulated to minimum R-8.

Exceptions:

1. The replacement or addition of a furnace, air conditioner or heat pump shall not require existing ducts to be insulated to current code.
2. Exhaust and intake ductwork.

N1105.3 Installation of ducts. All new duct systems and air handling equipment and appliances shall be located fully within the building thermal envelope.

Exceptions:

1. Ventilation intake ductwork and exhaust ductwork.
2. Up to 5 percent of the length of an HVAC system ductwork shall be permitted to be located outside of the thermal envelope.
3. Ducts deeply buried in insulation in accordance all of the following:
 - 3.1. Insulation shall be installed to fill gaps and voids between the duct and the ceiling, and a minimum of R-19 insulation shall be installed above the duct between the duct and unconditioned attic.
 - 3.2. Insulation depth marker flags shall be installed on the ducts every 10 feet (3048 mm) or as approved by the building official.

Joists, seams and connections.

M1601.4.1 Joints, seams and connections. Longitudinal and transverse joints, seams and connections in metallic and nonmetallic ducts shall be constructed as specified in SMACNA HVAC *Duct Construction Standards—Metal and Flexible* and NAIMA *Fibrous Glass Duct Construction Standards*. Joints, longitudinal and transverse seams, and connections in ductwork shall be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, liquid sealants or tapes. Tape shall not be used to seal metal ductwork or be used as the only sealing method between metal duct and flexible or fibrous duct. Tape is permitted to be used with metal duct at connections to equipment requiring future replacement. Tapes and mastics used to seal fibrous glass ductwork shall be *listed* and *labeled* in accordance with UL 181A and shall be marked “181A-P” for pressure-sensitive tape, “181 A-M” for mastic or “181 A-H” for heat-sensitive tape.

Tapes and mastics used to seal metallic and flexible air ducts and flexible air connectors shall comply with UL 181B and shall be marked “181 B-FX” for pressure-sensitive tape or “181 BM” for mastic. Duct connections to flanges of air distribution system equipment shall be sealed and mechanically fastened.

Mechanical fasteners for use with flexible nonmetallic air ducts shall comply with UL 181B and shall be marked 181B-C. Crimp joints for round metallic ducts shall have a contact lap of not less than 1 inch (25 mm) and shall be mechanically fastened by means of not less than three sheet-metal screws or rivets equally spaced around the joint.

Closure systems used to seal all ductwork shall be installed in accordance with the manufacturers’ instructions.

Exceptions:

1. Spray polyurethane foam shall be permitted to be applied without additional joint seals.
2. Where a duct connection is made that is partially **without access**, three screws or rivets shall be equally spaced on the exposed portion of the joint so as to prevent a hinge effect.
3. For ducts having a static pressure classification of less than 2 inches of water column (500 Pa), additional closure systems shall not be required for continuously welded joints and seams and locking-type joints and seams. **This exception shall not apply to snap-lock and button-lock type joints and seams that are located outside of conditioned spaces.**

M1505.4 Whole-house mechanical ventilation system. *Whole-house mechanical ventilation systems shall be designed in accordance with Sections M1505.4.1 through M1505.4.4.*

M1505.4.1 System design. The *whole-house mechanical ventilation system shall provide balanced ventilation.* Local exhaust or supply fans are permitted to serve as part of such a system. Outdoor air ventilation provided by a supply fan ducted to the return side of an air handler shall be considered as providing supply ventilation for the balanced system.

M1505.4.2 System controls. The *whole-house mechanical ventilation system shall be provided with controls that enable manual override.*

M1505.4.3 Mechanical ventilation rate. The whole-house mechanical ventilation system shall provide outdoor air at a continuous rate as determined in accordance with Table M1505.4.3(1) or Equation 15-1.

Ventilation rate in cubic feet per minute = $(0.01 \times \text{total square foot area of house}) + [7.5 \times (\text{number of bedrooms} + 1)]$

Equation 15-1

Exception: The *whole-house mechanical ventilation system is permitted to operate intermittently where the system has controls that enable operation for not less than 25 percent of each 4-hour segment and the ventilation rate prescribed in Table M1505.4.3(1) is multiplied by the factor determined in accordance with Table M1505.4.3(2).*

**TABLE M1505.4.3(1)
CONTINUOUS WHOLE-HOUSE MECHANICAL VENTILATION SYSTEM AIRFLOW RATE REQUIREMENTS**

DWELLING UNIT FLOOR AREA (square feet)	NUMBER OF BEDROOMS				
	0 – 1	2 – 3	4 – 5	6 – 7	> 7
	Airflow in CFM				
< 1,500	30	45	60	75	90
1,501 – 3,000	45	60	75	90	105
3,001 – 4,500	60	75	90	105	120
4,501 – 6,000	75	90	105	120	135
6,001 – 7,500	90	105	120	135	150
> 7,500	105	120	135	150	165

For SI: 1 square foot = 0.0929 m², 1 cubic foot per minute = 0.0004719 m³/s.

**TABLE M1505.4.3(2)
INTERMITTENT WHOLE-HOUSE MECHANICAL VENTILATION RATE FACTORS^{a, b}**

RUN-TIME PERCENTAGE IN EACH 4-HOUR SEGMENT	25%	33%	50%	66%	75%	100%
Factor ^a	4	3	2	1.5	1.3	1.0

- a. For ventilation system run time values between those given, the factors are permitted to be determined by interpolation.
- b. Extrapolation beyond the table is prohibited.

Lighting efficiency.

SECTION N1107 LIGHTING

N1107.1 General. The provisions of this section apply to lighting equipment, related controls and electric circuits serving all conditioned and unconditioned interior floor space and exterior building facades of all dwelling units and guest rooms within residential buildings and structures, or portions thereof.

N1107.2 High-efficiency interior lighting. All permanently installed lighting fixtures shall be high efficiency light sources.

The building official shall be notified in writing at the final inspection that the permanently installed lighting fixtures have met this requirement.

Exception: Two permanently installed lighting fixtures are not required to be high-efficiency light sources when controlled by a dimmer or automatic control.