



## How to Do Residential Thermal Performance Calculations Using Table N1104.1(2)

*This pamphlet is one in a series that describes residential energy conservation requirements of the Oregon Residential Specialty Code and the Structural Specialty Code for Group R buildings three stories and less in height. Other pamphlets in this series may be obtained from Oregon Dept of Energy at [www.oregon.gov/energy/](http://www.oregon.gov/energy/) or local building departments or from Oregon Building Codes Division.*

Homes may comply with residential energy code through a prescriptive path (Table N1104.1(1)) or thermal performance calculations using Table N1104.1(2). The seven prescriptive paths represent different packages of measures that achieve similar performance. Prescriptive Path 1 is the “Base Path.” Paths 2 through 7 and 10 are thermal equivalents of Path 1.

Other combinations of measures may be used if thermal performance calculations show that the combination achieves the performance standard of the Base Path. Thermal performance calculations take more time, but have several advantages over prescriptive paths:

**Trade-offs can save money.** Thermal performance calculations allow “credit” for exceeding requirements. For example, builders often use more efficient windows than prescriptive paths require. Thermal performance calculations allow trading of improved window performance for lower conservation levels elsewhere in the building. Overall building performance still meets the Base Path. Prescriptive paths don’t allow credit for exceeding requirements.

**Flexibility.** When no prescriptive path seems to work for a particular project, thermal performance calculations may be used to customize the conservation package for the job.

### **Untested windows, doors and skylights may be used.**

In general, prescriptive paths require use of tested products. Builders who want to use certain products that are not yet tested can use thermal performance calculations to demonstrate code compliance. Certain untested products are assigned conservative default U-factors (rates of heat transfer per square foot). Other parts of the package are adjusted to compensate for conservative performance estimates of untested components.

Thermal performance calculations should be submitted on a copy of Table N1104.1(2), shown in this pamphlet. Use of a standard format expedites review of the calculations by the code official.

### **How Table 13-B works**

In a thermal performance calculation, a component U-factor is multiplied by total area (A) of the component in square feet. The result of this calculation is the “UA.” The UA indicates rate of heat transfer through total component area. Totalling rates of heat transfer for listed building components gives a “UA total,” or a heat transfer rate for all items that affect code compliance.

In Table N1104.1(2), building heat loss is first calculated as if the building was built using measures in the Base Path (Prescriptive Path 1). On the Table N1104.1(2) worksheet this is called “Base Path 1.” The heat loss total is called “Code UA.” Next, the UA is calculated for alternate conservation measures under consideration by the builder or designer. On the worksheet this is called the “Proposed Alternate.” The heat loss rate is called “Proposed UA.”

If Proposed UA is equal to or less than Code UA, proposed measures meet energy code performance

**TABLE N1104.1(2)  
RESIDENTIAL THERMAL PERFORMANCE CALCULATIONS**

BUILDING COMPONENTS <sup>b</sup>	Base Path 1 <sup>a</sup>			Proposed alternative			
	Areas <sup>c</sup>	U-factor	Areas x U	R-value <sup>d</sup>	Areas <sup>c</sup>	U-factor <sup>e</sup>	Areas x U
Flat ceilings		0.031					
Vaulted ceilings <sup>f</sup>		0.033					
Conventional wood-framed walls		0.060					
Windows <sup>g</sup>							
A. If glazing area is greater than 13 percent of heated space floor area	Take-off area	0.40					
B. If glazing is less than 13 percent of heated space floor area and trade-off is desired	13% of floor area	0.40					
Skylights		0.50					
Exterior doors		0.20					
Underfloor		0.032					
Slab edge		(perimeter ft. =) F=0.52 <sup>h</sup>					
	<b>CODE UA =</b>			<b>Proposed UA<sup>i</sup> =</b>			

- <sup>a</sup> Base path 1 represents Prescriptive Compliance Path 1 from Table N1104.1(1).
- <sup>b</sup> Performance trade-offs are limited to those listed in column 1. Heat plant efficiency, duct insulation levels, passive and active solar heating, and similar measures may not be considered in this method of calculation.
- <sup>c</sup> Areas from plan take-offs. All areas must be the same for both Path 1 and Proposed Alternate, except for window areas allowed in footnote g below. The vaulted ceiling area for Base Path 1 must be the actual area from the plan take-off not to exceed 50 percent of the heated space floor area. Any areas in excess of 50 percent for Base Path 1 must be entered at U-0.031 (R-38) with "Flat Ceilings" area. The skylight area for Base Path 1 must be the actual area from the plan take-off, not to exceed 2 percent of the heated space floor area. Any areas in excess of 2 percent for Base Path 1 must be entered at 0.40, with "Windows" area. A maximum of 28 square feet (2.6 m<sup>2</sup>) of exterior door area per dwelling unit can have a U-factor of 0.54 or less and shall not be included in calculations. Default U-factor for an unglazed wood door is 0.54.
- <sup>d</sup> Minimum Component Requirements: Walls R-15; Floors R-21; Flat Ceilings R-38; Vaults R-21; Below-Grade Wood, Concrete or Masonry Walls R-15; Slab Edge R-10; Duct Insulation R-8. R-values used in this table are nominal, for the insulation only and not for the entire assembly. Window and skylight U-factors shall not exceed 0.65 (CL65). Door U-factors shall not exceed 0.54 (Nominal R-2). The wall component for Path 9 shall be a minimum solid log or timber wall thickness of 3.5 inches (88.9 mm).
- <sup>e</sup> U-factors for wood frame ceilings, walls and floor assemblies shall be as specified in Table N1104.1(3). U-factors for other assemblies, which include brick or other masonry, stucco, etc., shall be calculated using standard ASHRAE procedures.
- <sup>f</sup> Vaulted area, unless insulated to R-38, may not exceed 50 percent of the total heated space floor area.
- <sup>g</sup> Component U-factors trade-offs may be made against window area in detached single family dwellings or rowhouses when window area is less than 13 percent of heated space floor area. The base window area in this case shall be set at 13 percent of the heated space floor area.
- <sup>h</sup> F=The heat loss coefficient, BTU/hr./ft.<sup>2</sup>/°F. per foot (w/m<sup>3</sup>-k) of perimeter.
- <sup>i</sup> Proposed UA must be less than or equal to Code UA.

standards. If the Proposed Alternate doesn't initially qualify, the builder or designer improves conservation levels in one or more building components until it does

The process starts with determining areas (in square feet) of each building component. Then Code UA and Proposed UA are calculated using guidelines in this pamphlet and in footnote c to Table N1104.1(2). The U-factor column for Base Path 1 on Table N1104.1(2) worksheet lists U-factors for calculating Code UA. Proposed Alternative U-values are listed in Table N1104.1(3) Approved Default U-Factors that follows Table N1104.1(2) that is reproduced on pages 7-8 of this pamphlet.

### Minimum component requirements

Thermal performance calculations allow trading of lower energy performance of one component for higher energy performance of another. However, the Proposed Alternative must at least meet the minimum component requirement listed in footnote d to Table N1104.1(2). U-factors for minimum component R-values are specified in Table N1104.1(2) "Approved Default U-Factors" that follows Table N1104.1(2).

### Prescriptive Path 1 area limits apply to Table N1104.1(2) calculations

Prescriptive Path 1 contains component limitations: R-30 vaulted ceilings are limited to 50 percent of heated space floor area and skylights (U-0.41 to U-0.50) are limited to 2 percent of heated floor space. These component limits must be observed when calculating Base Path 1 in Table N1104.1(2). A maximum of 28 square feet of exterior door area per dwelling unit can have a U-factor of 0.54 or less and shall not be included in calculations; Footnote c in Table N1104.1(2) and this pamphlet explain how component area limits are modeled in Base Path 1 calculation. Example calculation worksheets are on pages 9-11 of this pamphlet.

### Calculating component areas

The first step in using Table N1104.1(2) is to find actual areas of each component:

#### Flat ceilings

Area equals length times width. Use outside dimensions and round to the nearest whole square foot. Deduct skylight area and use "net ceiling area."

*Minimum component requirement is R-38, or U-0.031.*

#### Vaulted ceilings

Area equals length times width of the ceiling surface. Measure vault length along the slope to the peak. Deduct skylight area and use "net vault area."

*Minimum component requirement is R-21, or U-0.047.*

**R-30 vault area limit in Base Path calculation:** For Base Path 1, enter area of the R-30 vault, not to exceed 50 percent of heated floor space. Include excess vault area with "Flat Ceilings." For Proposed Alternate, enter actual area of vaulted ceiling under "Vaulted Ceilings." If there are two or more vaulted ceilings with different U-values, enter each vaulted ceiling UA on separate lines for the Proposed Alternate calculation.

#### Opaque (solid) walls

Area equals length times height, using outside dimensions and rounding to the nearest whole square foot. For triangular walls at vaults and gable ends, area equals base times height divided by two.

**Account for all walls that divide heated and unheated spaces.** Remember to include walls between house and garage, vault end walls, skylight wells, pony walls, knee walls, and stairway walls that may divide heated and unheated spaces. Subtract area of windows and exterior doors from total opaque wall area. Use this "net wall area" for the performance calculation.

*Minimum component requirement is R-15, or U-0.080.*

## Windows

For rectangular windows, area equals width times height. Since window U-factors include heat loss through the frame, use rough opening dimensions to calculate window area. Round to the nearest whole square foot. For whole circles, area equals  $\pi$  (3.14) times radius squared ( $A = \pi r^2$ ). For half-round windows, figure whole circle area and divide by two. For triangular windows, area equals base times height divided by two.

Deduct window area from gross wall area. **Window line A:** If window areas for the building exceeds 13 percent of the “heated space floor area,” use actual window area in the window heat loss calculation for both Base Path 1 and Proposed Alternative.

**Window line B (for detached single-family dwellings only):** If window area is less than 13 percent of heated space floor area, use 13 percent of heated space floor area as window area for Base Path 1. Use actual window area (less than 13 percent) for the Proposed Alternative. This gives a qualification advantage to detached single-family dwellings with reduced glazing area.

*Minimum component requirement is U-0.65, or a class 65 window ó typically a double-glazed window with a thermally-improved metal frame.*

For site-assembled windows, use default U-factors from Table NF1111.4(1).

**1 percent unique glazing exemption:** Glazing area equal to 1 percent of heated space floor area may be exempt from meeting window U-factor standards if it is a “unique architectural glazing feature.” That includes door sidelights, stained glass, glass contained in a door, garden windows and other decorative glass. Skylights and conventional window configurations that include but are not limited to horizontal sliders, double-hung and picture windows are not eligible as unique architectural features. Do not include unique exempted glazing in thermal performance calculations. A note accompanying

calculations should indicate which windows were exempted and exempted window area.

## Skylights

Area equals rough opening dimension: length times width. Deduct skylight area from gross flat or vaulted ceiling area.

**Minimum component requirement is U-0.65.** If skylights are untested, use window default U-factors.

**2 percent skylight area limit in the Base Path calculation:** For Base Path 1 actual skylight area, up to 2 percent of the heated space floor area is entered as “Skylight” (U-0.50). If actual area exceeds 2 percent of heated space floor area, enter excess area under “Window” (U-0.40). Excessive skylight area entered as window may bump the window area total above 13 percent and preclude use of the line B window trade-off.

For the Proposed Alternative, enter actual skylight area using the tested U-factor or appropriate default U-factor. If skylights have different U-factors, calculate each skylight UA separately.

## Exterior doors

Area equals width times height of the rough opening. Include sidelights with windows.

### Exempt door - unglazed doors, untested or tested:

For Base Path 1 door area, up to 28 square feet exterior door area per dwelling unit can have a U-factor of 0.54 or less and shall not be included in calculations. Enter all other door area(s) as “Exterior Doors” (U-0.20).

For the Proposed Alternative, enter door area as “Exterior Doors” using the tested door U-factor or the default factor (U-0.54). If an untested 1-3/4- inch foam core door with a thermal break is used, use a U-0.20 default factor for the Proposed Alternative.

**1 percent unique glazing exemption for doors with less than 2.5 ft<sup>2</sup> glazing:** If the 1 percent unique glazing exemption is taken, note excluded glazing area on the Table N1104.1(1) worksheet, but do not include it in Base Path 1 or Proposed Alternative calculations. Use net door area: total door area minus exempted glazing area.

In Base Path 1, enter square footage of net door area under “Exterior Doors” (U-0.20). If excess glazing area remains, use the base case window default factor (U-0.40).

For Proposed Alternate opaque door area, use U-0.54 or the 1-3/4-inch foam core door with thermal break default value (U-0.20) or NFRC-tested U-factor and enter under “Exterior Doors.” The glazing exemption “removes” the glass from the door. Thus, tested U-factors are no longer valid. If excess glazing area remains after the exemption, use default glazing U-factors.

**No glazing exemption available for doors with less than 2.5 ft<sup>2</sup> glazing:** Enter excess opaque area under “Exterior Doors” (U-0.20). Enter excess glazing as “Window” (U-0.40) in the Base Case. In the Proposed Alternative, use default U-factor if not a tested door assembly.

**Tested doors:** Use actual net door area and tested U-factor for the Proposed Alternate.

**Untested doors:** Use actual net door area and U-0.54 or the 1-3/4-inch foam core door with thermal break default factor (U-0.20) for the Proposed Alternate.

**1 percent unique glazing exemption for doors with more than 2.5 ft<sup>2</sup> glazing:** If the 1 percent unique glazing exemption is taken, note excluded glazing area on the Table N1104.1(2) worksheet, but do not include it in Base Path 1 or Proposed Alternative calculations. Use net door area: total door area minus exempted glazed area.

**Tested doors:** Exclude 2.5 ft<sup>2</sup> of exempted area from calculations. Enter excess opaque area under “Exterior Doors” (U-0.20) in the Base Path. Enter glazed area in excess of 2.5 ft<sup>2</sup> as “Window” (U-0.40).

For Proposed Alternative, use U-0.54 or the 1-3/4-inch foam core door with thermal break default value (U-0.20) for net opaque door area.

**Untested doors:** Exclude 2.5 ft<sup>2</sup> of exempted area from calculations. Enter glazed area in excess of 2.5 ft<sup>2</sup> as “Window” U-0.40) in Base Path 1. Enter excess opaque door area under “Exterior Doors” (U-0.20). Excess glazed area must be included as windows and may preclude use of the line B window trade-off.

For Proposed Alternative, use U-0.54 or the 1-3/4-inch foam core door with thermal break default value (U-0.20) for net opaque door area. Enter net glazed area under “Window” using default window U-values (0.60 or 0.65).

**No glazing exemption for doors with more than 2.5 ft<sup>2</sup> glazing:**

**Tested doors:** For Base Path 1, enter net door area under “Exterior Door” (U-0.20). Enter glazed area in excess of 2.5 ft<sup>2</sup> as “Window” (U-0.40).

For Proposed Alternative, enter actual door area as “Exterior Door” using NFRC tested U-factor.

**Untested doors:** For Base Path 1, enter net door area under “Exterior Door” (U-0.20) in Base Path. Enter glazed area in excess of 2.5 ft<sup>2</sup> as “Window” (U-0.40).

For Proposed Alternative opaque door area, use U-0.54 or the 1-3/4-inch foam core door with thermal break default value (U-0.20) and enter under “Exterior Doors.” Use window default factors for glazed door area in excess of 2.5 ft<sup>2</sup>.

Deduct entire door area from gross wall area.

## Underfloor

Underfloor area is floor area that divides heated from unheated spaces. Examples include floors above unheated crawl spaces or unheated basements, cantilevered floors, and floors above unheated garages.

Underfloor area called for in the calculation may be different from total “heated space floor area” of the

home. Heated space floor area in a two-story home includes the area of both the first and second floors because both are heated. But in many homes, only the first floor divides heated from unheated space, so only first floor area is used as underfloor area for the calculation.

*The minimum component requirement for underfloor area is R-21, or U-0.035.*

Deduct entire door area from gross wall area. Minimum component requirement for the main entry door is U-0.54.

### **Other exterior doors**

Area equals width times height of rough opening. Deduct other door area from gross wall area.

*Minimum component requirement is U-0.54. An unglazed, untested wood door has a default U-factor of 0.54.*

### **Underfloor**

Underfloor area is floor area that divides heated from unheated spaces. Examples include floors above unheated crawl spaces or unheated basements, cantilevered floors, and floors above unheated garages.

Underfloor area called for in the calculation may be different from total “heated space floor area” of the home. Heated space floor area in a two-story home includes the area of both the first and second floors because both are heated. But in many homes, only the first floor divides heated from unheated space, so only first floor area is used as underfloor area for the calculation.

*The minimum component requirement for underfloor area is R-21, or U-0.035.*

### **Slab edge (in linear feet of perimeter)**

To calculate slab heat loss, first determine linear footage of the slab perimeter. Slab edge losses pertain to on-grade slabs only, which are part of the heated space floor area.

*Minimum component requirement is R-10, or F-0.54.*

### **Slab edge (in linear feet of perimeter)**

To calculate slab heat loss, first determine linear footage of the slab perimeter. Slab edge losses pertain to on-grade slabs only, which are part of the heated space floor area.

*Minimum component requirement is R-10, or F-0.54.*

### **Basement walls**

Basement walls are not included in Table N1104.1(2) calculations because the minimum component requirement is R-15. The basement wall insulation requirement includes insulation at the rim joist.

### **Air infiltration**

Air infiltration is not included in Table N1104.1(2) thermal performance calculations.

### **Footnote b**

Footnote b indicates that performance trade-offs are limited to building components listed in Table N1104.1(2). Furnace efficiency, duct insulation and passive and active solar heating are not considered in thermal performance calculations.



TABLE N1104.1(3)— APPROVED DEFAULT U-FACTORS

FLAT CEILINGSA			EXTERIOR WALLSA			
Insulation	Type	U-Factor	Insulation	Insulation Sheathing	Framing	U-Factor
R-38	Conventional framing	0.031	R-15	0	Conventional framing	0.080
R-38	=>8/12 roof pitch	0.028	R-15	0	Intermediate framing <sup>b</sup>	0.075
R-38	Advance framing <sup>c</sup>	0.026	R-19	0	Conventional framing <sup>b</sup>	0.065
R-49	Conventional framing	0.025	R-19	0	Intermediate framing <sup>b</sup>	0.063
R-49	=>8/12 roof pitch	0.024	R-19	0	Advance framing <sup>d</sup>	0.061
R-49	Advance framing <sup>c</sup>	0.020				
VAULTED CEILINGSA						
Insulation	Type	U-Factor	R-21	0	Conventional framing	0.060
R-21	Rafter framings	0.047	R-21	0	Intermediate framing <sup>b</sup>	0.058
R-30	Rafter framing	0.033	R-21	0	Advance framing <sup>d</sup>	0.055
R-38	Rafter framing	0.027				
R-21	Scissors truss	0.055	R-11	3.5 <sup>e</sup>	Conventional framing	0.069
R-30	Scissors truss	0.046	R-11	5 <sup>e</sup>	Conventional framing	0.063
R-38	Scissors truss	0.042	R-11	7 <sup>e</sup>	Conventional framing	0.055
R-49	Scissors truss	0.039	R-11	3.5 <sup>e</sup>	Advance framing <sup>d</sup>	0.067
			R-11	5 <sup>e</sup>	Advance framing <sup>d</sup>	0.061
R-30	Advance scissors truss <sup>c</sup>	0.032	R-11	7 <sup>e</sup>	Advance framing <sup>d</sup>	0.054
R-38	Advance scissors truss <sup>c</sup>	0.026				
R-49	Advance scissors truss <sup>c</sup>	0.020	R-13	3.5 <sup>e</sup>	Conventional framing	0.064
			R-13	5 <sup>e</sup>	Conventional framing	0.058
EPS FOAM CORE PANEL VAULTED CEILINGSA			R-13	7 <sup>e</sup>	Conventional framing	0.052
Insulation	Type	U-Factor	R-13	3.5 <sup>e</sup>	Advance framing <sup>d</sup>	0.062
R-29	8-1/4" EPS foam core panel	0.037	R-13	5 <sup>e</sup>	Advance framing <sup>d</sup>	0.056
R-37	10-1/4" EPS foam core panel	0.030	R-13	7 <sup>e</sup>	Advance framing <sup>d</sup>	0.050
R-44	12-1/4" EPS foam core panel	0.025				
FLOORSA			R-15	3.5 <sup>e</sup>	Conventional framing	0.060
Insulation	Type	U-Factor	R-15	5 <sup>e</sup>	Conventional framing	0.055
R-21	Underfloor	0.035	R-15	7 <sup>e</sup>	Conventional framing	0.049
R-25	Underfloor	0.032	R-15	3.5 <sup>e</sup>	Advance framing <sup>d</sup>	0.057
R-30	Underfloor	0.028	R-15	5 <sup>e</sup>	Advance framing <sup>d</sup>	0.052
			R-15	7 <sup>e</sup>	Advance framing <sup>d</sup>	0.047
SLAB-ON-GRADE						
Insulation	Type	F-Factor <sup>f</sup>	R-19	3.5 <sup>e</sup>	Conventional framing	0.052
R-10	Slab edge	0.54	R-19	5 <sup>e</sup>	Conventional framing	0.047
R-15	Slab edge	0.52	R-19	7 <sup>e</sup>	Conventional framing	0.043
EPS FOAM CORE PANEL EXTERIOR WALLS			R-19	3.5 <sup>e</sup>	Advance framing <sup>d</sup>	0.049
Insulation	Type	U-Factor	R-19	5 <sup>e</sup>	Advance framing <sup>d</sup>	0.045
R-14.88	4-1/2" EPS foam core panel	0.065	R-19	7 <sup>e</sup>	Advance framing <sup>d</sup>	0.041
R-22.58	6-1/4" EPS foam core panel	0.045				
R-29.31	8-1/4" EPS foam core panel	0.035	R-21	3.5 <sup>e</sup>	Conventional framing	0.048
			R-21	5 <sup>e</sup>	Conventional framing	0.044
			R-21	7 <sup>e</sup>	Conventional framing	0.040
			R-21	3.5 <sup>e</sup>	Advance framing <sup>d</sup>	0.044
			R-21	5 <sup>e</sup>	Advance framing <sup>d</sup>	0.042
			R-21	7 <sup>e</sup>	Advance framing <sup>d</sup>	0.038

**TABLE N1104.1(3) — APPROVED DEFAULT U-FACTORS**

- <sup>a</sup> *U*-factors are for wood frame construction. *U*-factors for other assemblies, which include steel framing, brick or other masonry, stucco, etc., shall be calculated using standard ASHRAE procedures.
  - <sup>b</sup> Intermediate framing consists of wall studs placed at a minimum 16 inches on-center with insulated headers. Voids in headers shall be insulated with rigid insulation having a minimum R-value of 4 per one-inch (w/m<sup>3</sup>-k) thickness.
  - <sup>c</sup> Advanced framing construction for ceilings as defined in Section 1104.6
  - <sup>d</sup> Advanced framing construction for walls as defined in Section 1104.5.1
  - <sup>e</sup> Insulation sheathing shall be rigid insulation material, installed continuously over entire exterior or interior of wall (excluding partition walls).
  - <sup>f</sup> *F*-Factor is heat loss coefficient in Btu/hr/°F per lineal foot of concrete slab perimeter.
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Footnote e to Table N1104.1(2) states *U*-factors calculated using standard ASHRAE methodology may be used. Consult the Oregon Building Codes Division for information about assumptions used to calculate new component *U*-factors.

**What happens if Proposed UA exceeds Code UA?**

If Proposed UA exceeds Code UA, the building does not comply with energy code. Make changes in proposed *U*-factors until you find a combination of measures equivalent to or less than Code UA.

**Example calculations**

Following are examples of Table N1104.1(2) thermal performance calculations:

In Example 1, the builder is using windows that exceed code standards and wants to do trade-offs with other building components.

In Example 2, window area is less than 13 percent of floor area. The builder is taking advantage of the line B window trade-off.

Example 3 shows how to do calculations for a building that has R-30 vaults in excess of 50 percent of heated floor space.

Example 4 shows how to do calculations for a building that has R-30 vaults in excess of 50 percent of heated floor area and skylights in excess of 2 percent of heated floor space.

Example 5 shows how to do calculations when the exempt door exceeds the 28 square feet limit.

Example 6 shows how to treat untested glazing in thermal performance calculations.



**Example 1**

**Builder trades window performance against other measures**

$$\frac{\text{Heated Floor Area} \quad \text{Window Area} \quad 327}{\text{Slab} \quad 674 \quad \text{Floor Area} \quad 2301} = 14$$

$$\frac{\text{Crawl} \quad 1672}{\text{Total} \quad 2301 \text{ Ft}^2}$$

More efficient windows make it possible to decrease vault, wall, floor, and slab R-values. A less efficient skylight (0.60) may also be used.

**TABLE N1104.1(2)  
RESIDENTIAL THERMAL PERFORMANCE CALCULATIONS**

BUILDING COMPONENTS <sup>b</sup>	Base Path 1 <sup>a</sup>			Proposed alternative			
	Areas <sup>c</sup>	U-factor	Areas x U	R-value <sup>d</sup>	Areas <sup>c</sup>	U-factor <sup>e</sup>	Areas x U
Flat ceilings	1965	0.031	60.91	R-38	1965	0.031	60.91
Vaulted ceilings <sup>f</sup>	407	0.033	13.43	R-21	407	0.047	19.13
Conventional wood-framed walls	1754	0.060	105.24	R-19 std	1754	0.065	114.01
Windows <sup>g</sup>							
A. If glazing area is greater than 13 percent of heated space floor area	Take-off area 327	0.40	130.5	–	327	0.32	104.64
B. If glazing is less than 13 percent of heated space floor area and trade-off is desired	13% of floor area	0.40	–	–	–	–	–
Skylights	16	0.50	8.0	–	16	0.60	9.6
Exterior doors	17	0.20	3.4	Insul	17	0.19	3.23
Underfloor	1627	0.032	52.06	R-21	1627	0.035	56.95
Slab edge	117'	(perimeter ft. =) F=0.52 <sup>h</sup>	60.84	R-10	117'	0.54	63.18
	<b>CODE UA =</b>		<b>434.6</b>		<b>Proposed UA<sup>i</sup> =</b>		<b>431.65</b>

**Example 2**

**Line B window trade off**

$$\frac{\text{Window Area} \quad 276}{\text{Floor Area} \quad 2301} = 12\% \text{ Therefore use Windows line B}$$

Base Path Wall Area: 2118 Gross Wall – (299 Windows + 37 Doors) = 1782 Ft<sup>2</sup>

Proposed Alternative Wall Area:

$$2118 - (276 \text{ Windows} + 37 \text{ Doors}) = 1805 \text{ Ft}^2$$

Reducing window area to 13 percent or less gives the Proposed Alternate a compliance advantage over Base Path 1

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BUILDING COMPONENTS <sup>b</sup>	Base Path 1 <sup>a</sup>			Proposed alternative			
	Areas <sup>c</sup>	U-factor	Areas x U	R-value <sup>d</sup>	Areas <sup>c</sup>	U-factor <sup>e</sup>	Areas x U
Flat ceilings	1965	0.031	60.91	R-38	1965	0.031	60.91
Vaulted ceilings <sup>f</sup>	407	0.033	13.43	R-21	407	0.047	19.13
Conventional wood-framed walls	1754	0.060	105.24	R-21 std	1805	0.060	108.3
Windows <sup>g</sup>							
A. If glazing area is greater than 13 percent of heated space floor area	Take-off area	0.40	–	–	–	–	–
B. If glazing is less than 13 percent of heated space floor area and trade-off is desired	13% of floor area 299	0.40	119.6	–	276	0.40	110.4
Skylights	16	0.50	8.0	–	16	0.60	9.6
Exterior doors	17	0.20	3.4	Insul	17	0.19	3.23
Underfloor	1627	0.032	52.06	R-25	1627	0.032	52.06
Slab edge	117'	(perimeter ft. =) F=0.52 <sup>h</sup>	60.84	R-15	117'	0.52	60.84
	<b>CODE UA =</b>		<b>425.16</b>		<b>Proposed UA<sup>i</sup> =</b>		<b>424.44</b>

**Example 3**

**Home exceeds prescriptive R-30 vault area limit**

*Floor Area = 2301 Flat Ceiling = 857*  
*Vault (Gross) = 1463 Skylights = 16*  
*Allowable Vault  $2301 \times .5 = 1151 \text{ Ft}^2$  (Note max=50% of floor area)*  
*Net Vault = Gross Vault 1463 - Skylights 16 = 1447*  
*Excess Vault as Flat Ceiling: Net Vault 1477 - Allowable Vault 1151 = 296 Vault as Flat Ceiling*

*When R-30 vault area exceeds 50 percent of the floor area, enter vault in excess of 50 percent as flat ceiling for Base Path 1.*

**TABLE N1104.1(2)  
RESIDENTIAL THERMAL PERFORMANCE CALCULATIONS**

BUILDING COMPONENTS <sup>b</sup>	Base Path 1 <sup>a</sup>			Proposed alternative			
	Areas <sup>c</sup>	U-factor	Areas x U	R-value <sup>d</sup>	Areas <sup>c</sup>	U-factor <sup>e</sup>	Areas x U
Flat ceilings	857 = 296	0.031	35.73	R-49 std	857	0.0245	21.43
Vaulted ceilings <sup>f</sup>	1151	0.033	37.98	R-30	1447	0.033	47.75
Conventional wood-framed walls	2447	0.060	146.82	R-19 std	2497	0.065	159.05
Windows <sup>g</sup>							
A. If glazing area is greater than 13 percent of heated space floor area	Take-off area 327	0.40	130.8	-	327	0.34	111.18
B. If glazing is less than 13 percent of heated space floor area and trade-off is desired	13% of floor area	0.40	-	-	-	-	-
Skylights	16	0.50	8.0	-	16	0.60	9.
Exterior doors	17	0.20	3.4	Insul	17	0.19	3.23
Underfloor	1627	0.032	52.06	R-25	1627	0.032	52.06
Slab edge	117'	(perimeter ft. =) F=0.52 <sup>h</sup>	60.84	R-10	117'	0.54	63.18
	CODE UA =		475.64		Proposed UA <sup>i</sup> =		467.48

**Example 4**

**Home exceeds R-30 vault and 2 percent skylight limit**

*Actual Skylight Area: 48 Ft<sup>2</sup> Allowable Skylight Area 2301 x .02 = 46 Ft<sup>2</sup>*  
*1463 Gross Vault - 48 Skylight 1415 Net Value*  
*1415 - 1151 264 Excess Vault Area to Flat Ceiling*  
*48 Actual Skylight - 46 Allowed 2 Ft to Window*

*Enter excess R-30 vault as flat ceiling and excess skylight area as window for Base Path 1.*

**TABLE N1104.1(2)  
RESIDENTIAL THERMAL PERFORMANCE CALCULATIONS**

BUILDING COMPONENTS <sup>b</sup>	Base Path 1 <sup>a</sup>			Proposed alternative			
	Areas <sup>c</sup>	U-factor	Areas x U	R-value <sup>d</sup>	Areas <sup>c</sup>	U-factor <sup>e</sup>	Areas x U
Flat ceilings	857 = 264	0.031	35.73	R-38	857	0.031	26.57
Vaulted ceilings <sup>f</sup>	1151	0.033	37.98	R-30	1447	0.033	46.70
Conventional wood-framed walls	2447	0.060	146.82	R-21 std	2447	0.060	146.82
Windows <sup>g</sup>							
A. If glazing area is greater than 13 percent of heated space floor area	Take-off area 327 + 2	0.40	131.6	-	327	0.39	127.53
B. If glazing is less than 13 percent of heated space floor area and trade-off is desired	13% of floor area	0.40	-	-	-	-	-
Skylights	46	0.50	23.0	-	48	0.50	24.0
Exterior doors	17	0.20	3.4	Insul	17	0.19	3.23
Underfloor	1627	0.032	52.06	R-25	1627	0.032	52.06
Slab edge	117'	(perimeter ft. =) F=0.52 <sup>h</sup>	60.84	R-15	117'	0.52	60.84
	CODE UA =		490.45		Proposed UA <sup>i</sup> =		487.75

**Example 5**

**Exterior door exceeds 28 square feet allowance**

*Actual Door is 40 Ft<sup>2</sup>*

*Door Area Qualifying as Exempt 28 Ft<sup>2</sup>*

*Excess Area to Other Door: 40 – 28 = 12 Ft<sup>2</sup>*

*When an exterior door area exceeds 28 square feet and the door is wood, enter excess area as exterior door for Base Path 1.*

**TABLE N1104.1(2)  
RESIDENTIAL THERMAL PERFORMANCE CALCULATIONS**

BUILDING COMPONENTS <sup>b</sup>	Base Path 1 <sup>a</sup>			Proposed alternative			
	Areas <sup>c</sup>	U-factor	Areas x U	R-value <sup>d</sup>	Areas <sup>c</sup>	U-factor <sup>e</sup>	Areas x U
Flat ceilings	1965	0.031	60.91	R-49 std	1965	0.028	49.13
Vaulted ceilings <sup>f</sup>	407	0.033	13.43	R-30	407	0.033	13.43
Conventional wood-framed walls	1734	0.060	104.04	R-21 std	1734	0.060	104.04
Windows <sup>g</sup>							
A. If glazing area is greater than 13 percent of heated space floor area	Take-off area 327	0.40	130.8	–	327	0.40	130.8
B. If glazing is less than 13 percent of heated space floor area and trade-off is desired	13% of floor area	0.40	–	–	–	–	–
Skylights	16	0.50	8.0	–	16	0.50	8.0
Exterior doors	17+12	0.20	5.8	Insul	17	0.20	3.4
				Wood	12	0.54	6.48
Underfloor	1627	0.032	52.06	R-25	1627	0.032	52.06
Slab edge	117'	(perimeter ft. =) F=0.52 <sup>h</sup>	60.84	R-15	117'	0.52	60.84
	<b>CODE UA =</b> 435.88			<b>Proposed UA<sup>i</sup> =</b> 428.18			

**Example 6**

**House with untested door sidelight**

*Untested Sidelite 12 Ft<sup>2</sup>*

*Default U-Value = 0.54 (Wood Frame, 1/2" Air Space, Clear Glass)*

*Use the default U-value for an untested door sidelight for the Proposed Alternate.*

**TABLE N1104.1(2)  
RESIDENTIAL THERMAL PERFORMANCE CALCULATIONS**

BUILDING COMPONENTS <sup>b</sup>	Base Path 1 <sup>a</sup>			Proposed alternative			
	Areas <sup>c</sup>	U-factor	Areas x U	R-value <sup>d</sup>	Areas <sup>c</sup>	U-factor <sup>e</sup>	Areas x U
Flat ceilings	1965	0.031	60.91	R-38	1965	0.031	60.92
Vaulted ceilings <sup>f</sup>	407	0.033	13.43	R-30	407	0.033	13.43
Conventional wood-framed walls	1754	0.060	105.24	R-21A	1754	0.057	99.98
Windows <sup>g</sup>							
A. If glazing area is greater than 13 percent of heated space floor area	Take-off area 327	0.40	130.8	–	315 12	0.40 0.54	126.0 6.48
B. If glazing is less than 13 percent of heated space floor area and trade-off is desired	13% of floor area	0.40	–	–	–	–	–
Skylights	16	0.50	8.0	–	16	0.60	9.6
Exterior doors	17	0.20	3.4	Insul	17	0.19	3.23
Underfloor	1627	0.032	52.06	R-25	1627	0.032	52.06
Slab edge	117'	(perimeter ft. =) F=0.52 <sup>h</sup>	60.84	R-15	117'	0.52	60.84
	<b>CODE UA =</b> 434.68			<b>Proposed UA<sup>i</sup> =</b> 431.11			

Information presented in this publication supports the Oregon Residential Specialty Code, or Chapter 13 of the Oregon Structural Specialty Code. This publication does not include all code requirements. Refer to the code and check with your code official for additional requirements. If information in this publication conflicts with code or your local officials, follow requirements of code and your local officials.

For more information about the residential energy code, call the Building Codes Division at (503)378-4133 or the Oregon Dept of Energy (503)378-4040 in Salem or toll-free, 1-800-221-8035.

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