



**RULE-MAKING ORDER**  
(RCW 34.05.360)

**CR-103** (10/1/89)

Agency: Washington State Building Code Council

- Permanent Rule  
 Emergency Rule

(1) Date of adoption: November 8, 1991

(2) Purpose:  
To correct typographical errors and omissions and to assign the equations and tables of the code their own section numbers.

(3) Citation of existing rules affected by this order:  
Repealed:  
Amended: 51-11-0502, 0503, 0504, 0525 - 0542, 0608, 0625 - 0631, and 1000  
Suspended:

(4) Authority for adoption:  
Statute: 19.27A  
Other Authority:

(5.1) **PERMANENT RULE ONLY**  
Pursuant to notice filed as WSR 91-16-111 on August 7, 1991 (date).  
Describe any changes other than editing from proposed to adopted version:

(5.2) **EMERGENCY RULE ONLY**  
Pursuant to RCW 34.05.350 the agency for good cause finds:  
 (a) That immediate adoption, amendment, or repeal of a rule is necessary for the preservation of the public health, safety, or general welfare, and that observing the time requirements of notice and opportunity to comment upon adoption of a permanent rule would be contrary to the public interest.  
 (b) That state or federal law or federal rule or a federal deadline for state receipt of federal funds requires immediate adoption of a rule.

Reasons for this finding:

(5.3) Any other findings required by other provisions of law as precondition to adoption or effectiveness of rule?  
 Yes  No If yes, explain:

(6) Effective date of rule:

<b>Permanent Rules</b>	<b>Emergency Rules</b>
<input type="checkbox"/> 31 days after filing	<input type="checkbox"/> Immediately
<input type="checkbox"/> Other (specify) <u>7/1/92</u> *	<input type="checkbox"/> Later (specify) _____

\*(If less than 31 days after filing, specific finding in 5.3 under RCW 34.05.380(3) is required)

**CODE REVISER USE ONLY**  
CODE REVISER'S OFFICE  
STATE OF WASHINGTON  
FILED

DEC 19 1991

TIME: 4:43  
WSR: 92-01-140

NAME (TYPE OR PRINT)  
Gene J. Colin

SIGNATURE

TITLE: Chair DATE: 11/8/91

AMENDATORY SECTION (Amending WSR 91-01-112, filed 12/19/90, effective 7/1/91)

## WAC 51-11-0502 BUILDING ENVELOPE REQUIREMENTS.

## 502.1 General:

502.1.1: The stated U- or F-value of any component assembly, listed in Table 5-1 or 5-2, such as roof/ceiling, opaque wall or opaque floor may be increased and the U-value for other components decreased, provided that the total heat gain or loss for the entire building envelope does not exceed the total resulting from compliance to the U-values specified in this Section.

The U-values for typical construction assemblies are included in Chapter 10. These values shall be used for all calculations. Where proposed construction assemblies are not represented in Chapter 10, values shall be calculated in accordance with Chapters 19-27 in RS-1 listed in Chapter 7, using the framing factors listed in Chapter 10 where applicable.

For envelope assemblies containing metal framing, the U-value shall be determined by one of the following methods:

1. Results of laboratory or field measurements.
2. Standard RS-25, listed in Chapter 7, where the metal framing is bonded on one or both sides to a metal skin or covering.
3. The zone method as provided in Chapter 22 of RS-1, listed in Chapter 7.
4. Effective framing/cavity R-values as provided from the following table for metal stud walls:

WALL FRAMING	CAVITY INSULATION	
	R-11	R-19
2 x 4 @ 16" o.c.	5.50	-
2 x 4 @ 24" o.c.	6.60	-
2 x 6 @ 16" o.c.	-	7.6 0
2 x 6 @ 24" o.c.	-	8.5 5

502.1.2: For consideration of thermal mass effects, see section 402.4.

502.1.3: When return air ceiling plenums are employed, the roof/ceiling assembly shall:

- a. For thermal transmittance purposes, not include the ceiling proper nor the plenum space as part of the assembly; and
- b. For gross area purposes, be based upon the interior face of the upper plenum surface.

## 502.1.4 Insulation:

502.1.4.1 General: All insulating materials shall comply with sections 1712 and/or 1713 of the Uniform Building Code. Substantial contact of the insulation with the surface being insulated is required. All insulation materials shall be installed according to the manufacturer's instructions to achieve proper densities, and maintain uniform R-values. To the maximum extent possible, insulation shall extend over the full component area to the intended R-value.

502.1.4.2 Insulation Materials: All insulation materials including facings such as vapor barriers or breather papers installed within floor/ceiling assemblies, roof/ceiling assemblies, walls, crawl spaces, or attics shall have a flame spread rating of less than twenty-five and a smoke density not to exceed four hundred fifty when tested in accordance with UBC Standard 42-1.

EXCEPTIONS:

1. Foam plastic insulation shall comply with section 1712 of the Uniform Building Code.

2. When such materials are installed in concealed spaces of Types III, IV, and V construction, the flame spread and smoke developed limitations do not apply to facing, provided that the facing is installed in substantial contact with the unexposed surface of the ceiling, floor, or wall finish.

3. Cellulose insulation shall comply with section 1713 of the Uniform Building Code.

502.1.4.3 Clearances: Where required, insulation shall be installed with clearances according to manufacturers specifications. Insulation shall be installed so that required ventilation is unobstructed. For blown or poured loose fill insulation clearances shall be maintained through installation of a permanent retainer.

502.1.4.4 Access Hatches and Doors: Access doors from conditioned spaces to unconditioned spaces (e.g., attics and crawl spaces) shall be weatherstripped and insulated to a level equivalent to the insulation on the surrounding surfaces. Access shall be provided to all equipment which prevents damaging or compressing the insulation. A wood framed or equivalent baffle or retainer must be provided when loose fill insulation is installed, the purpose of which is to prevent the loose fill insulation from spilling into the living space when the attic access is opened, and to provide a permanent means of maintaining the installed R-value of the loose fill insulation.

502.1.4.5 Roof/Ceiling Insulation: Open-blown or poured loose-fill insulation may be used in attic spaces where the slope of the ceiling is not more than three feet in twelve and there is at least thirty inches of clear distance from the top of the bottom chord of the truss or ceiling joist to the underside of the sheathing at the roof ridge. When eave vents are installed, baffling of the vent openings shall be provided so as to deflect the incoming air above the surface of the insulation. Baffles shall be, rigid material, resistant to wind driven moisture. Requirements for baffles for ceiling insulation shall meet the Uniform Building Code section 3205(c) for minimum ventilation requirements. When feasible, the baffles shall be installed from the top of the outside of the exterior wall, extending inward, to a point six inches vertically above the height of noncompressed insulation, and twelve inches vertically above loose fill insulation.

502.1.4.6 Wall Insulation: Insulation installed in exterior walls shall comply with the provisions of this section. All wall insulation shall fill the entire cavity. Exterior wall cavities isolated during framing shall be fully insulated to the levels of the surrounding walls. All faced insulation shall be face stapled to avoid compression.

502.1.4.7 Floor Insulation: Floor insulation shall be installed in a permanent manner in substantial contact with the surface being insulated. Insulation supports shall be installed so spacing is no more than twenty-four inches on center. Foundation vents shall be placed so that the top of the vent is below the lower surface of the floor insulation.



Exception: Insulation may be omitted from floor areas over heated basements, heated garages, or underfloor areas used as HVAC supply plenums. See Uniform Mechanical Code section 1008 for under-floor supply plenum requirements. When foundation walls are insulated, the insulation shall be attached in a permanent manner. The insulation shall not block the airflow through foundation vents when installed. When foundation vents are not placed so that the top of the vent is below the lower surface of the floor insulation, a permanently attached baffle shall be installed at an angle of thirty degrees from horizontal, to divert air flow below the lower surface of the floor insulation.

502.1.4.8 Slab-On-Grade: Slab-on-grade insulation, installed inside the foundation wall, shall extend downward from the top of the slab for a minimum distance of twenty-four inches or downward and then horizontally beneath the slab for a minimum combined distance of twenty-four inches. Insulation installed outside the foundation shall extend downward to a minimum of twenty-four inches or to the frostline. Above grade insulation shall be protected.

EXCEPTION: For monolithic slabs, the insulation shall extend downward from the top of the slab to the bottom of the footing.

502.1.4.9 Radiant Slabs: The entire area of a radiant slab shall be thermally isolated from the soil, with a minimum of R-10 insulation. The insulation shall be an approved product for its intended use. If a soil-gas control system is present below the radiant slab, which results in increased convective flow below the radiant slab, the radiant slab shall be thermally isolated from the sub-slab gravel layer.

#### 502.1.4.10 Below-Grade Walls:

a. Below grade exterior wall insulation used on the exterior (cold) side of the wall shall extend from the top of the below-grade wall to the top of the footing and shall be approved for below-grade use. Above grade insulation shall be protected.

b. Insulation used on the interior (warm) side of the wall shall extend from the top of the below-grade wall to the below-grade floor level.

502.1.5 Glazing and Door U-Values: For Group R Occupancy, glazing and door U-values shall be determined in accordance with section 502.1.5.1. For other occupancies, glazing and door U-values shall be determined in accordance with either section 502.1.5.1 or 502.1.5.2.

502.1.5.1 Standard Procedure for Determination of Glazing and Door U-Values: U-values for glazing and doors, including all fire doors, shall be the tested U-values for thermal transmittance due to conduction resulting from either the AAMA 1503.1-88 test procedure or the ASTM C236-87 or C976-82 test procedures, provided that testing shall be conducted under established winter horizontal heat flow test conditions using fifteen mile per hour wind speed directed perpendicular to the exterior surface of the glazing as specified under AAMA 1503.1-88.

AAMA 1503.1-88 testing, shall be conducted by a laboratory accredited by AAMA to perform that test. ASTM C236-87 or C976-82 testing shall be conducted by an independent laboratory accredited by a nationally recognized accreditation program, independent of that laboratory. All tested U-values reported for listing by the state building code council after January 1, 1991, shall include certification by the manufacturer of gas content in the sealed insulated glass unit used for testing and in the production unit.

Product samples tested shall be production line units or representative of units as purchased by the consumer or contractor. Product sample sizes tested shall be in accordance with AAMA 1503.1-88, except that skylights shall be tested with a nominal two foot by four foot size, or a nominal four foot by four foot size. The installation of the test sample shall be in accordance with AAMA 1503.1-88, section 8.4. All testing performed after January 1, 1991, shall not include screens. All glazing and doors shall be identified with a label that states an overall product U-value that is no less than the actual tested U-value. The labeled U-value shall be used in all calculations to determine compliance with this Code. Sealed insulating glass shall conform to, or be in test for, ASTM E-774-81 level A.

#### EXCEPTIONS:

1. The exterior frame dimensions of the product sample size tested shall not deviate by more than three inches from the height and width specified, except that skylights are allowed to be tested in the closest production line size to that specified above.

2. Passive air inlets are not required to be part of the tested assembly.

3. Products tested prior to December 31, 1990, to AAMA 1503.1-80, ASTM C236-80 or C976-82 which are not in compliance with the test size requirement above, and which are in compliance with the product sample sizes in AAMA 1503.1-80, shall be acceptable until December 31, 1994.

4. Untested glazing and doors shall be assigned the default U-values listed in Chapter 10. The default values for the opaque portions of doors shall be those listed in Chapter 10, provided that the U-value listed for a door with a thermal break shall only be allowed if both the door and the frame have a thermal break.

5. The U-value of an insulated glazing product which has a 'grille pattern' installed between the glazing layers shall be deemed equal to the U-value of an insulated glazing product which is tested without a 'grille pattern' in between glazing layers, provided a minimum one-eighth inch air space exists between the 'grille pattern' and both glass lites.

6. For a glazing product which is manufactured with an alternative 'low-e coating' than the 'low-e coating' of the tested glazing product, the U-value shall be deemed equal provided that the alternative 'low-e coating' material has an equal or lower rated emissivity.

7. U-factors, either tested or simulated, labeled and certified in accordance with the National Fenestration Rating Council's (NFRC) procedure 100-91 are acceptable if based on model size AA.

502.1.5.2 Alternate Glazing and Door U-Values for Other Than Group R Occupancy: Glazing U-values for other than Group R Occupancy are also allowed to be taken from Table 13 of Chapter 27 of RS-1 listed in Chapter 7 or calculated in accordance with the procedures of Chapter 27 of RS-1 listed in Chapter 7 and door U-values are also allowed to be taken from Table 6 in Chapter 22 of RS-1 listed in Chapter 7.

#### 502.1.6 Moisture Control:

502.1.6.1: Vapor retarders shall be installed on the warm side (in winter) of insulation as specified in the following cases.

EXCEPTION: Vapor retarder installed with not more than one-third of the nominal R-value between it and the conditioned space.

502.1.6.2 Floors: Floors separating conditioned space from unconditioned space shall have a vapor retarder installed. The vapor retarder shall have a one perm dry cup rating or less (i.e., four mil. polyethylene or kraft faced material).

502.1.6.3: Roof/ceiling assemblies where the ventilation space above the insulation is less than an average of twelve inches shall be provided with a vapor retarder. Faced batt insulation where used as a vapor retarder shall be face stapled. Single rafter joist vaulted ceiling cavaties shall be of sufficient depth to allow a minimum one inch vented air space above the insulation.

502.1.6.4: Vapor retarders shall not be required in roof/ceiling assemblies where the ventilation space above the insulation averages twelve inches or greater.

502.1.6.5: Vapor retarders shall not be required where all of the insulation is installed between the roof membrane and the structural roof deck.

502.1.6.6 Wall Insulation: Walls separating conditioned space from unconditioned space shall have a vapor retarder installed. Faced batt insulation shall be face stapled.

502.1.6.7 Ground Cover: A ground cover of six mil (0.006 inch thick) black polyethylene or approved equal shall be laid over the ground within crawl spaces. The ground cover shall be overlapped twelve inches minimum at the joints and shall extend to the foundation wall.

EXCEPTION: The ground cover may be omitted in crawl spaces if the crawl space has a concrete slab floor with a minimum thickness of three and one-half inches.

## 502.2 Thermal Criteria for Group R Occupancy:

502.2.1: The proposed UA as calculated using Equations 2 and 3 shall not exceed the Target UA as calculated using Equation 1. For the purpose of determining equivalent thermal performance, the glazing area for the target UA shall be calculated using figures in Table 5-1, and all the glazing shall be located in the wall area. The opaque door area shall be the same in the target UA and the proposed UA.

502.2.2 Space Heat Type: The following two categories comprise all space heating types:

1. Electric Resistance: Space heating systems which include baseboard units, radiant units, and forced air units as either the primary or secondary heating system.

EXCEPTION: Electric resistance systems for which the total electric heat capacity in each individual dwelling unit does not exceed the greater of: 1) One thousand watts per dwelling unit, or; 2) One watt per square foot of the gross floor area.

2. Other: All gas, wood, oil, and propane space heating systems, unless electric resistance is used as a secondary heating system, and all heat pump space heating systems. (See EXCEPTIONS, Electric Resistance, section 502.2.2 above.)

## 502.3 Thermal Performance Criteria For Other Than Group R Occupancies.

502.3.1: The overall thermal transmittance value ( $U_o$ ) of the gross area of elements of the exterior building envelope of all buildings other than low-rise residential buildings shall not exceed the values given in Tables 5-2. Equations 2, 4 and 5 shall be used to



determine acceptable combinations of building components and thermal properties to meet this requirement for heating.  $U_o$  and  $U_w$  are specified in units of:

$$\frac{\text{Btu}}{\text{hr.} \cdot \text{ft}^2 \cdot ^\circ\text{F}}$$

502.3.2 Slab on Grade Floors: For slab on grade floors the thermal resistance of the insulation around the perimeter of the floor shall not be less than the value given in Table 5-2.

502.3.3 Alternative Wall Allowance for Other Than Group R Occupancies: For other than Group R Occupancies, three stories or less, the maximum allowed value for average thermal transmittance ( $U_o$ ) of the exterior walls may be increased to the values given in Table 5-2 BUILDINGS OVER THREE CONDITIONED STORIES provided that at least one of the following criteria is also met:

1. Mechanical supply of outside air and mechanical exhaust of building air shall be automatically shut off and the duct closed for at least eight hours per day during hours of nonoccupancy, or

2. The primary source of heating for the building shall be one or more heat pumps meeting the provisions of section 503.4.2 or gas or oil combustion heating equipment with a minimum combustion efficiency of eighty-five percent for central heating plants and eighty percent for room and space heaters. This efficiency shall be determined in accordance with the provisions of section 503.4.3.

PROVIDED FURTHER: That if both criteria are met, the maximum allowed value for thermal transmittance ( $U_o$ ) of the exterior walls used in Table 5-2 may be increased by 0.05 in determining compliance with the provisions of the Code.

For walls with a wall weight of at least thirty lbs. per ft<sup>2</sup> (provided that walls constructed of hollow masonry units have cores filled with either grout, concrete, or with an insulating material with resistance per inch (R) of at least 2.25 ft<sup>2</sup>/hr.-°F/Btu) the calculated thermal resistance of the wall sections measured face to face on wall units which are exposed to inside air temperatures, not including the thermal resistance of air films or additional exterior wall elements may be increased by twenty-five percent in determining compliance with the provisions of the code provided that:

Heating and cooling set-point temperatures in the conditioned spaces or zones of the building shall be separated by at least five degrees F. The temperature control shall be designed to prevent new energy from being used to heat the space above the heating set-point temperature or cool the space below the cooling set-point temperature.

#### 502.4 Air Leakage for All Occupancies:

502.4.1: The requirements of this section shall apply to all buildings and structures, or portions thereof, and only to those locations separating outdoor ambient conditions from interior spaces that are heated or mechanically cooled.

502.4.2: Exterior doors and windows shall be designed to limit air leakage into or from the building envelope. Site-constructed doors and windows shall be sealed in accordance with Section 502.4.3.

#### 502.4.3:

a. Exterior joints around windows and door frames, openings between walls and foundation, between walls and roof and wall panels; openings at penetrations of utility services through walls, floors, and roofs; and all other openings in the building envelope for all occupancies and all other openings in between units in R-1 occupancy

shall be sealed, caulked, gasketed, or weatherstripped to limit air leakage.

b. All exterior doors or doors serving as access to an enclosed unheated area shall be weatherstripped to limit leakage around their perimeter when in a closed position.

c. Site built windows are exempt from testing but shall be made tight fitting. Fixed lights shall have glass retained by stops with sealant or caulking all around. Operating sash shall have weatherstripping working against overlapping trim, and a closer/latch which will hold the sash closed. The window frame to framing crack shall be made tight with caulking, overlapping membrane, or other approved technique.

d. Openings that are required to be fire resistive are exempt from this section.

502.4.4 Recessed Lighting Fixtures: When installed in the building envelope, recessed lighting fixtures shall meet one of the following requirements:

1. Type IC rated, manufactured with no penetrations between the inside of the recessed fixture and ceiling cavity and sealed or gasketed to prevent air leakage into the unconditioned space.

2. Type IC (~~or non-IE~~) rated, installed inside a sealed box constructed from a minimum one-half inch thick gypsum wall board, or constructed from a preformed polymeric vapor barrier, or other air tight assembly manufactured for this purpose (~~while maintaining required clearances of not less than one-half inch from combustible material and not less than three inches from insulation material~~).

3. Type IC rated, certified under ASTM E283 to have no more than 2.0 cfm air movement from the conditioned space to the ceiling cavity. The lighting fixture shall be tested at seventy-five Pascals or 1.57 lbs/ft<sup>2</sup> pressure difference and have a label attached, showing compliance.



## EQUATION 1 -- GROUP R OCCUPANCY

## TARGET UA

$$UA_T = U_W A_W + U_{BGW} A_{BGW} + U_G A_G + U_F A_F + U_{RC} A_{RC} + U_{CC} A_{CC} + U_D A_D + F_S P_S$$

## Where:

- $UA_T$  = the target combined thermal transmittance of the gross exterior wall, floor, and roof/ceiling assembly area.
- $U_W$  = the thermal transmittance value of the opaque above grade wall area found in Table 5-1.
- $A_W$  = opaque above grade wall area.
- $U_{BGW}$  = the thermal transmittance value of the below grade opaque wall area found in Table 5-1.
- $A_{BGW}$  = opaque below grade wall area.
- $U_G$  = the thermal transmittance value of the glazing area found in Table 5-1.
- $A_G$  = .15 (total floor area of the conditioned space).
- $U_F$  = the thermal transmittance value of the floor area found in Table 5-1.
- $A_F$  = floor area over unconditioned space.
- $U_{RC}$  = the thermal transmittance value of the roof/ceiling area found in Table 5-1.
- $A_{RC}$  = roof/ceiling area.
- $U_{CC}$  = the thermal transmittance value of the cathedral ceiling area found in Table 5-1.
- $A_{CC}$  = cathedral ceiling area.
- $U_D$  = the thermal transmittance value of the opaque door area found in table 5-1.
- $A_D$  = opaque door area.
- $F_S$  = concrete slab component F-value found in Table 5-1.
- $P_S$  = Lineal ft. of concrete slab perimeter.

## EQUATION 2 -- ALL OCCUPANCIES

$$U = \frac{1}{r_o + R_1 + R_2 \dots r_i}$$

**Where:**

U = the thermal transmittance of the assembly.

$r_o$  = outside air film resistance.

$r_o$  = .17 for all exterior surfaces.

$r_i$  = inside air film resistance.

$r_i$  = 0.61 for interior horizontal surfaces, heat flow up.

$r_i$  = 0.92 for interior horizontal surfaces, heat flow down.

$r_i$  = 0.68 for interior vertical surfaces.

$R = \frac{1}{C} = \frac{X}{K}$  = measure of the resistance to the passage of heat for each element.

C = conductance, the heat flow through a specific material of specific thickness.

K = insulation value of a material per inch.

X = the thickness of the material in inches.

## EQUATION 3 -- GROUP R OCCUPANCY

## PROPOSED UA

$$UA = U_W A_W + U_{BGW} A_{BGW} + U_G A_G + U_F A_F + U_{RC} A_{RC} + U_{CC} A_{CC} + U_D A_D + F_S P_S$$

**Where:**

- UA = the combined thermal transmittance of the gross exterior wall, floor, and roof/ceiling assembly area.
- $U_W$  = the thermal transmittance of the opaque wall area.
- $U_{BGW}$  = the thermal transmittance value of the below grade opaque wall area.
- $A_{BGW}$  = opaque below grade wall area.
- $A_W$  = opaque wall area.
- $U_G$  = the thermal transmittance of the glazing (window or skylight) area.
- $A_G$  = glazing area, including windows in exterior doors.
- $U_F$  = the thermal transmittance of the floor area.
- $A_F$  = floor area over unconditioned space.
- $U_{RC}$  = the thermal transmittance of the roof/ceiling area.
- $A_{RC}$  = roof/ceiling area.
- $U_{CC}$  = the thermal transmittance of the cathedral ceiling area.
- $A_{CC}$  = cathedral ceiling area.
- $U_D$  = the thermal transmittance value of the opaque door area.
- $A_D$  = opaque door area.
- $F_S$  = concrete slab component f-factor.
- $P_S$  = lineal ft. of concrete slab perimeter.

**NOTE:** Where more than one type of wall, window, roof/ceiling, door, and skylight is used, the U and A terms for those items shall be expanded into sub-elements as:

$$U_{W1} A_{W1} + U_{W2} A_{W2} + U_{W3} A_{W3} + \dots \text{etc.}$$

## EQUATION 4 -- OTHER THAN GROUP R OCCUPANCY

TARGET  $U_o$ 

$$U_o = \frac{U_w A_w + U_f A_f + U_c A_c + F_s P_s}{A_w + A_f + A_c + P_s}$$

## Where:

- $U_o$  = the target combined thermal transmittance of the gross exterior wall, floor, and roof/ceiling assembly area.
- $U_w$  = the thermal transmittance value of the opaque above grade wall area found in Table 5-2.
- $A_w$  = opaque above grade wall area.
- $U_f$  = the thermal transmittance value of the floor area found in Table 5-2.
- $A_f$  = floor area over unconditioned space.
- $U_c$  = the thermal transmittance value of the ceiling area found in Table 5-2.
- $A_c$  = ceiling area.
- $F_s$  = concrete slab component F-value found in Table 5-2.
- $P_s$  = lineal ft. of concrete slab perimeter



## EQUATION 5 -- OTHER THAN GROUP R OCCUPANCY

PROPOSED  $U_o$ 

$$U_o = \frac{U_W A_W + U_{BGW} A_{BGW} + U_G A_G + U_F A_F + U_{RC} A_{RC} + U_{CC} A_{CC} + U_D A_D + F_S P_S}{A_W + A_{BGW} + A_G + A_F + A_{RC} + A_{CC} + A_D + P_S}$$

## Where:

- $U_o$  = the combined thermal transmittance of the gross exterior wall, floor, and roof/ceiling assembly area.
- $U_W$  = the thermal transmittance of the opaque wall area.
- $U_{BGW}$  = the thermal transmittance value of the below grade opaque wall area.
- $A_{BGW}$  = opaque below grade wall area.
- $A_W$  = opaque wall area.
- $U_G$  = the thermal transmittance of the glazing (window or skylight) area.
- $A_G$  = glazing area, including windows in exterior doors.
- $U_F$  = the thermal transmittance of the floor area.
- $A_F$  = floor area over unconditioned space.
- $U_{RC}$  = the thermal transmittance of the roof/ceiling area.
- $A_{RC}$  = roof/ceiling area.
- $U_{CC}$  = the thermal transmittance of the cathedral ceiling area.
- $A_{CC}$  = cathedral ceiling area.
- $U_D$  = thermal transmittance value of opaque door area.
- $A_D$  = opaque door area.
- $F_S$  = concrete slab component F-factor.
- $P_S$  = lineal ft. of concrete slab perimeter.

**NOTE:** Where more than one type of wall, window, roof/ceiling, door, and skylight is used, the U and A terms for those items shall be expanded into sub-elements as:

$$U_{W1} A_{W1} + U_{W2} A_{W2} + U_{W3} A_{W3} + \dots \text{etc.}$$

AMENDATORY SECTION (Amending WSR 91-01-112, filed 12/19/90, effective 7/1/91)

WAC 51-11-0503 BUILDING MECHANICAL SYSTEMS.

503.1 General: This section covers the determination of design requirements, system and component performance, control requirements, insulating systems and duct construction.

EXCEPTION: Special applications, including but not limited to hospitals, laboratories, thermally sensitive equipment, and computer rooms may be exempted from the requirements of this section when approved by the building official.

503.2 Calculations of Heating and Cooling Loads, and System Sizing Limits: The design parameters specified in Chapter 3 shall apply for all computations.

503.2.1 Calculation Procedures: Heating and cooling design loads for the purpose of sizing HVAC systems are required and shall be calculated in accordance with accepted engineering practice, including infiltration and ventilation.

503.2.2 Space Heating and Space Cooling System Sizing Limits: Building mechanical systems for all buildings which provide space heating and/or space cooling shall be sized no greater than one hundred fifty percent of the heating and cooling design loads as calculated above.

EXCEPTIONS: The following limited exemptions from the sizing limit shall be allowed, however, in all cases heating and/or cooling design load calculations shall be submitted.

1. For equipment which provides both heating and cooling in one package unit, including heat pumps with electric heating and cooling and gas-pack units with gas heating and electric cooling, compliance need only be demonstrated for either the space heating or space cooling system size.

2. Natural gas- or oil-fired space heating equipment whose total rated space heating output in any one dwelling unit is fifty-six thousand Btu/h or less may exceed the one hundred fifty percent sizing limit provided that the installed equipment has an annual fuel utilization efficiency (AFUE) of not less than the sum of seventy-eight percent plus one percent for every five thousand Btu/h that the space heating equipment output exceeds the design heating load of the dwelling unit.

3. Stand-by equipment may be installed if controls and other devices are provided which allow redundant equipment to operate only when the primary equipment is not operating.

503.3 Simultaneous Heating and Cooling: Each temperature control zone shall include thermostatic controls installed and operated to sequence the use of heating and cooling energy to satisfy the thermal and/or humidity requirement of the zone. Controls shall prevent reheating (heating air that is cooler than system mixed air), recooling (cooling air that is warmer than the system mixed air), mixing or simultaneous supply of warm air (warmer than system return air mixed air) and cold air (cooler than system mixed air), or other simultaneous operation of heating and cooling systems to one zone.

For the purposes of this section, system mixed air is defined as system return air mixed with the minimum ventilation air requirement by section 303.

EXCEPTIONS:

1. Variable air volume systems designed to reduce the air supply to each zone during periods of occupancy to the larger of the following:

a. Thirty percent or less of the peak supply volume.

b. The minimum allowed to meet ventilation requirements of section 303.

c. 0.5 cfm/ft<sup>2</sup> of zone conditioned area before reheating, recooling or mixing takes place. Consideration shall be given to supply air temperature reset control.

2. The energy for reheating, or providing warm air in mixing systems, is provided entirely from recovered energy that would otherwise be wasted, or from renewable energy sources. In addition, the system shall comply with section 503.7 without exception.

3. Areas where specific humidity levels are required to satisfy process needs.

4. Where special pressurization relationships or cross-contamination requirements are such that variable air volume systems are impractical, supply air temperatures shall be reset by representative building load or outside air temperature.

503.4 HVAC Equipment Performance Requirements:

503.4.1 Equipment Components:

503.4.1.1: The requirements of this section apply to equipment and mechanical component performance for heating, ventilating and air-conditioning systems. Equipment efficiency levels are specified. Data furnished by the equipment supplier or certified under a nationally recognized certification program or rating procedure shall be used to satisfy these requirements. Equipment efficiencies shall be based on the standard rating conditions in Tables 5-4, 5-5 or 5-6 as appropriate.

503.4.1.2: Where components from more than one manufacturer are assembled into systems regulated under this section, compliance for each component shall be as specified in sections 503.4.2 through 503.4.6 of this Code.

503.4.2: HVAC System Heating Equipment Heat Pump-heating Mode. Heat pumps whose energy input is entirely electric shall have a coefficient of performance (COP) heating, not less than the values in Table 5-7. Heat Pumps with supplementary backup heat other than electricity shall meet the requirements of Table 5-7.

503.4.2.1: These requirements apply to, but are not limited to, unitary (central) heat pumps (air source and water source) in the heating mode, water source (hydronic) heat pumps as used in multiple-unit hydronic HVAC systems, and heat pumps in the packaged terminal air-conditioner in the heating mode.

503.4.2.3 Supplementary Heater: The heat pump shall be installed with a control to prevent supplementary backup heater operation when the operating load can be met by the heat pump compression cycle alone.

503.4.2.4 Heat Pump Controls: Requirements for heat pump controls are listed in section 503.8.3.5 of this Code.

503.4.3 HVAC System Combustion Equipment: For Group R Occupancy, all gas, oil, and propane central heating systems shall have a minimum AFUE of 0.78\*. All other Group R Occupancy heating equipment fueled by gas, oil, or propane shall be equipped with an intermittent ignition device, or shall comply with the efficiencies as required in the 1987 National Appliances Energy Conservation Act (Public Law 100-12). For all Other Occupancies, all gas and oil-fired central heating plants shall have a minimum combustion efficiency of not less than that shown in Table 5-3.

\* HVAC Heating system efficiency trade-offs shall be made using Chapters 4 or 6 of this Code.

503.4.4 Packaged and Unitary HVAC System Equipment, Electrically Operated, Cooling Mode: HVAC system equipment as listed below, whose energy input in the cooling mode is entirely electric, shall have an energy efficiency ratio (EER) or a seasonal energy efficiency ratio (SEER) cooling not less than values in Table 5-8.

503.4.4.1: These requirements apply to, but are not limited to, unitary (central) and packaged terminal heat pumps (air source and water source); packaged terminal air conditioners.

EXCEPTION: These requirements do not apply to equipment used for refrigerated food or florists' and nurseries' coolers.

503.4.5 Applied HVAC System Components, Electrically Operated, Cooling Mode: HVAC System components, as listed in Table 5-9, whose energy input is entirely electric, shall have an energy efficiency ratio (EER) or a Coefficient of Performance (COP) cooling not less than the values in Table 5-9.

503.4.6 HVAC System Equipment - Heat Operated, Cooling Mode, Efficiency Limitation, Equipment: Heat-operated cooling equipment shall have a COP cooling not less than the values in Table 5-10.

503.5 Transport Energy:

503.5.1 All-air Systems: The air transport factor for each all-air system shall be not less than 5.5. The factor shall be based on design system air flow for constant volume systems. The factor for variable air volume systems may be based on average conditions of operation. Energy for transfer of air through heat recovery devices shall not be included in determining the factor; however, such energy shall be included in the evaluation of the effectiveness of the heat recovery system.

$$\text{Air Transport Factor} = \frac{\text{Space Sensible Heat Removal*}}{\text{Supply + Return Fan(s) Power Input*}}$$

\*Expressed in Btu/h or watts

503.5.2 Other Systems: Air and water, all-water and unitary systems employing chilled, hot, dual-temperature or condenser water transport systems to space terminals shall not require greater transport energy (including central and terminal fan power and pump power) than an equivalent all-air system providing the same space sensible heat removal and having an air transport factor not less than 5.5.

503.6 Balancing: The HVAC system design shall provide a means for balancing air and water systems. Balancing the system shall include, but not be limited to, dampers, temperature and pressure test connections and balancing valves.



503.7 Cooling with Outdoor Air (Economizer Cycle): Each fan system shall be designed to use up to and including one hundred percent of the fan system capacity for cooling with outdoor air automatically whenever its use will result in lower usage of new energy. Activation of economizer cycle shall be controlled by sensing outdoor air enthalpy or outdoor air dry-bulb temperature alone or alternate means approved by the building official.

EXCEPTIONS: Cooling with outdoor air is not required under any one or more of the following conditions:

1. The fan system capacity is less than three thousand five hundred cfm or total cooling capacity is less than ninety thousand Btu/h.
2. The quality of the outdoor air is so poor as to require extensive treatment of the air and approval by the building official.
3. The need for humidification or dehumidification requires the use of more energy than is conserved by the outdoor air cooling on an annual basis.
4. The use of outdoor air cooling may affect the operation of other systems so as to increase the overall energy consumption of the building.
5. When energy recovered from an internal/external zone heat recovery system exceeds the energy conserved by outdoor air cooling on an annual basis.
6. When all space cooling is accomplished by a circulating liquid which transfers space heat directly or indirectly to a heat rejection device such as a cooling tower without use of a refrigeration system.
7. When the use of one hundred percent outside air will cause coil frosting, controls may be added to reduce the quantity of outside air. However, the intent of this exception is to use one hundred percent air in lieu of mechanical cooling when less energy usage will result and this exception applies only to direct expansion systems when the compressor is running.

#### 503.8 Controls:

503.8.1 Temperature Control: Each system shall be provided with at least one adjustable thermostat for the regulation of temperature. Each thermostat shall be capable of being set by adjustment or selection of sensors as follows:

503.8.1.1: When used to control heating only: Fifty-five degrees to seventy-five degrees F.

503.8.1.2: When used to control cooling only: Seventy degrees to eighty-five degrees F.

503.8.1.3: When used to control both heating and cooling, it shall be capable of being set from fifty-five degrees to eighty-five degrees F and shall be capable of operating the system heating and cooling in sequence. The thermostat and/or control system shall have an adjustable deadband of not less than ten degrees F.

503.8.2 Humidity Control: If a system is equipped with a means for adding moisture to maintain specific selected relative humidities in space or zones, a humidistat shall be provided. Humidistats shall be capable of being set to prevent new energy from being used to produce space-relative humidity above thirty percent.

EXCEPTION: Special occupancies requiring different relative humidities may be permitted when approved by the building official.

### 503.8.3 Zoning for Temperature Control:

503.8.3.1 One- and Two-Family Dwellings: At least one thermostat for regulation of space temperature shall be provided for each separate system. In addition, a readily accessible manual or automatic means shall be provided to partially restrict or shut off the heating and/or cooling input to each zone or floor.

503.8.3.2 Multifamily Dwellings: For multifamily dwellings, each individual dwelling unit shall have at least one thermostat for regulation of space temperature. A readily accessible manual or automatic means shall be provided to partially restrict or shut off the heating and/or cooling input to each room. Spaces other than living units shall meet the requirements of 503.8.3.3.

503.8.3.3 Other Types of Buildings or Occupancies: At least one thermostat for regulation of space temperature shall be provided for:

1. Each separate system.

2. Each separate zone as defined in Chapter 2. As a minimum, each floor of a building shall be considered as a separate zone. In a multistory building where the perimeter system offsets only the transmission losses of the exterior wall, an entire side of uniform exposure may be zoned separately. A readily accessible manual or automatic means shall be provided to partially restrict or shut off the heating and/or cooling input to each floor.

### 503.8.3.4 Control Setback and Shut-off:

1. Residential Occupancy Groups. One- and Two-Family and Multifamily dwellings--The thermostat required in section 503.8.3.1 or section 503.8.3.2, or an alternate means such as a switch or clock, shall provide a readily accessible, manual or automatic means for reducing the energy required for heating and cooling during the periods of non-use or reduced need, such as, but not limited to unoccupied periods and sleeping hours. Lowering thermostat set points to reduce energy consumption of heating systems shall not cause energy to be expended to reach the reduced setting.

2. Other Buildings and Occupancies. Each HVAC system shall be equipped with a readily accessible, automatic means of shutting off or reducing the energy used for HVAC during periods of non-use or alternate uses of the building spaces or zones served by the system. The following are examples that meet this requirement:

a. Manually adjustable automatic timing devices.

b. Automatic control systems.

503.8.3.5 Heat Pump Controls: Programmable thermostats are required for all heat pump systems. The cut-on temperature for the compression heating shall be higher than the cut-on temperature for the supplementary heat, and the cut-off temperature for the compression heating shall be higher than the cut-off temperature for the supplementary heat. Heat pump thermostats will be capable of providing at least two programmable setback periods per day. The automatic setback thermostat shall have the capability of limiting the use of supplemental heat during the warm-up period.

503.9 Air Handling Duct System Insulation: Ducts, plenums and enclosures installed in or on buildings shall be thermally insulated per Table 5-11.

EXCEPTIONS: Duct insulation (except where required to prevent condensation) is not required in any of the following cases:

1. When the heat gain or loss of the ducts, without insulation, will not increase the energy requirements of the building.
2. Within the HVAC equipment.
3. Exhaust air ducts.
4. Supply or return air ducts installed in unvented crawl spaces with insulated walls, basements, or cellars in one- and two-family dwellings.

503.10 Duct Construction: All duct work shall be constructed in accordance with Standards RS-15, RS-16, RS-17, RS-18, RS-19 or RS-20, as applicable, and the Uniform Mechanical Code.

503.10.1: High-pressure and medium-pressure ducts shall be leak tested in accordance with the applicable standards in Chapter 7 of this Code with the rate of air leakage not to exceed the maximum rate specified in that standard.

503.10.2: When low-pressure supply air ducts are located outside of the conditioned space, all HVAC ductwork seams and joints, both longitudinal and transverse, shall be taped and sealed with products approved by the building official only. Ductwork joints shall be mechanically fastened with a minimum of three fasteners per joint for a cylindrical duct. Use Table 5-11 for duct insulation requirements.

503.10.3: Requirements for Automatic or manual dampers are found in the Washington State Ventilation and Indoor Air Quality Code.

503.11 Piping Insulation: All piping installed to serve buildings (and within) shall be thermally insulated in accordance with Table 5-12. For service hot water systems see section 504.7. If water pipes are outside of conditioned space then the pipe insulation requirement shall be R-3 minimum for non-recirculating hot and cold water pipes. For recirculating service hot and cold water pipes use Table 5-12 for pipe sizes and temperatures.

EXCEPTIONS: Piping insulation is not required ((in--any--of--the following-cases:

1--Piping-installed)) within unitary HVAC equipment.

((2--When--the--heat--loss--and/or--heat--gain--of--the--piping--without insulation--does--not--increase--the--energy--requirements--of--the--building or--is--used--as--a--component--of--a--designed--heating--system))

503.11.1 Other Insulation Thickness: Insulation thickness in Table 5-12 is based on insulation having thermal resistance in the range of 4.0 to 4.6 per inch of thickness on a flat surface at a mean temperature of seventy-five degrees F. Minimum insulation thickness shall be increased for materials having R-values less than 4.0 per inch, or may be reduced for materials having R-values greater than 4.6 per inch.

a. For materials with thermal resistance greater than  $R = 4.6$  per inch, the minimum insulation thickness may be reduced as follows:

$$\frac{4.6 \times (\text{Table 5-12 Thickness})}{\text{Actual Resistance}} = \text{New Minimum Thickness}$$

b. For materials with thermal resistance less than  $R = 4.0$  per inch, the minimum insulation thickness shall be increased as follows:

$$\frac{4.0 \times (\text{Table 5-10 Thickness})}{\text{Actual Resistance}} = \text{New Minimum Thickness}$$



c. Additional insulation with vapor barriers shall be provided to prevent condensation where required by the building official.

AMENDATORY SECTION (Amending WSR 91-01-112, filed 12/19/90, effective 7/1/91)

WAC 51-11-0504 SERVICE WATER HEATING.

504.1 Scope: The purpose of this section is to provide criteria for design and equipment selection that will produce energy savings when applied to service water heating.

504.2 Water Heaters, Storage Tanks and Boilers:

504.2.1 Performance Efficiency: All Storage water heaters shall meet the requirements of the 1987 National Appliance Energy Conservation Act and be so labeled. All electric water heaters in unheated spaces or on concrete floors shall be placed on an incompressible, insulated surface with a minimum thermal resistance of R-10.

504.2.2 Insulation: Heat loss from unfired hot-water storage tanks shall be limited to a maximum of 9.6 Btu/hr/ft<sup>2</sup> of external tank surface area. The design ambient temperature shall be no higher than sixty-five degrees F.

504.2.3 Combination Service Water Heating/Space Heating Boilers: Service water heating equipment shall not be dependent on year round operation of space heating boilers.

EXCEPTIONS:

1. Systems with service/space heating boilers having a standby loss Btu/h less than:

$$(13.3 \text{ pmd} + 400) / n$$

determined by the fixture count method where:

pmd = probably maximum demand in gallons/hour as determined in accordance with Chapter 37 of Standard RS-11.

n = fraction of year when outdoor daily mean temperature exceeds 64.9° F.

The standby loss is to be determined for a test period of twenty-four-hour duration while maintaining a boiler water temperature of ninety degrees F above an ambient of sixty degrees F and a five foot stack on appliance.

2. For systems where the use of a single heating unit will lead to energy savings, such unit shall be utilized.

504.3 Automatic Controls: Service water heating systems shall be equipped with automatic temperature controls capable of adjustment from the lowest to the highest acceptable temperature settings for the intended use. Temperature setting range shall be set to one hundred twenty degrees F or forty-nine degrees C.

504.4 Shutdown: A separate switch shall be provided to permit turning off the energy supplied to electric service water heating systems. A separate valve shall be provided to permit turning off the



energy supplied to the main burner(s) of all other types of service water heater systems.

#### 504.5 Swimming Pools:

504.5.1: All pool heaters shall be equipped with readily accessible ON/OFF switch to allow shutting off the operation of the heater without adjusting the thermostat setting. Controls shall be provided to allow the water temperature to be regulated from the maximum design temperature down to sixty-five degrees F.

504.5.2 Pool Covers: Heated swimming pools shall be equipped with a pool cover, approved by the building official.

504.6 Pump Operation: Circulating hot water systems shall be controlled so that the circulation pump(s) can be conveniently turned off, automatically or manually, when the hot water system is not in operation.

504.7 Pipe Insulation: For recirculating and non-recirculating systems, piping shall be thermally insulated in accordance with section 503.11 and Table 5-12.

#### 504.8 Conservation of Hot Water:

504.8.1 Showers and Lavatories: Showers and lavatories used for other than safety reasons shall be equipped with flow control devices or specially manufactured showerheads or aerators to limit the total water flow rate (~~(to a maximum of three gallons per minute per shower head or faucet)~~) as set forth in chapter 51-26 WAC, as measured with both hot and cold faucets turned on to their maximum flow.

#### 504.8.2 Lavatories in Restrooms of Public Facilities:

504.8.2.1: Lavatories in restrooms of public facilities shall be equipped with a metering valve designed to close by spring or water pressure when left unattended (self-closing) and limit the flow (~~(of water to a maximum of 2.5 gallons per minute)~~) rate as set forth in chapter 51-26 WAC.

EXCEPTION: Separate lavatories for physically handicapped persons shall not be equipped with self-closing valves.

504.8.2.2: Lavatories in restrooms of public facilities shall be equipped with devices which limit the outlet temperature to a maximum of one hundred ten degrees F.

AMENDATORY SECTION (Amending WSR 91-01-112, filed 12/19/90, effective 7/1/91)

#### WAC 51-11-0505 ELECTRICAL POWER AND LIGHTING.

505.1 General: Electrical distribution and lighting systems shall be designed for efficient distribution and use of electrical energy from the service entrance to and at the points of use as provided herein.

505.2 Lighting Switching: Switching for building lighting systems shall be designed and installed to permit efficient use of energy and to permit maximum flexibility in the use of the installed lighting. The following mandatory requirements represent the minimum lighting controls to be installed in any building. Additional controls should be provided where deemed appropriate and where the

installation of such controls can significantly reduce energy consumption.

a. All lighting controls, except automatic controls or those for special purpose applications which require trained operators or those which would pose a safety problem or a security hazard, shall be installed so as to be readily accessible to personnel occupying or using the lighting space.

b. The maximum lighting power that may be controlled from a single switch or automatic control shall not exceed that provided by a twenty ampere circuit loaded to no more than eighty percent. A master control may be installed provided the individual switches retain their capability to function independently.

c. All lighted spaces enclosed by walls or ceiling height partitions and with floor area less than four hundred square feet shall be provided an individual lighting control or an occupant-sensing automatic control.

d. All lighted spaces with floor area greater than four hundred square feet shall be provided with controls to permit reducing the lighting by not more than one half or occupant-sensing automatic controls.

e. All building areas greater than two hundred square feet where natural lighting is available shall be provided with individual controls or daylight- or occupant-sensing automatic controls which permit control of lights independent of general area lighting. Either individual controls shall be provided for each row of luminaires parallel to a window wall or controls shall be provided to reduce the lighting in at least two steps to not more than one-half and to completely off in the natural lighting area. For office and school occupancies, at a minimum, lighting serving a zone within twelve feet of a window wall or the zone between an interior wall and the window wall of less than twelve feet shall comply with this provision. For retail occupancies, at least the row of luminaires nearest the window shall comply with this provision.

f. All display, exhibition, or specialty lighting shall be controlled independently of general area lighting.

g. All exterior building lighting including facade lighting, parking lots, driveways, walkways shall be furnished with automatic controls to reduce or turn off all lights during periods of non-use or daylight hours, except those required for safety and security. Sign lights shall be exempt from this provision.

**505.3 Lighting Power Budget:** A lighting power budget is the upper limit of the power to be available to provide the lighting needs in accordance with the criteria and calculation procedure specified herein.

The lighting power budget for a building shall be the sum of the power limits computed for all lighted interior and exterior spaces and shall be determined in accordance with the procedures specified in this section.

**EXCEPTION:** One- and two-family detached dwellings and the dwelling portion of multifamily buildings are exempt from the requirements of section 505.3.

**505.3.1 Budget Development:** The installed lighting wattage for the building project shall not exceed the budget level calculated in this section. The budget wattage level shall be the sum of the interior budget calculated and the exterior budget. Lighting wattage includes lamp and ballast wattage.

505.3.2 Building Interiors: The interior lighting budget shall be calculated by multiplying the gross conditioned floor area, in square feet, by the appropriate unit power budget, in watts per square foot, specified in Table 5-13.

For special conditions when approved by the building official, calculation based on Illuminating Engineering Society Unit Power Density or similar nationally recognized standards may be used.

The lighting power budget shall be based on the primary occupancy for which the space within the building is intended. If multiple occupancies are intended, the lighting power budget for each type of occupancy shall be separately calculated and summed to obtain the lighting budget for the interior spaces of the building. If a common circulation area serves multiple occupancies or multiple retail spaces, the lighting power budget for the common circulation area shall be the weighted average of the lighting power budgets for all other areas on that floor. In cases where a lighting plan for only a portion of a building is submitted, the interior lighting budget shall be based on the gross floor area covered by the plan.

EXCEPTIONS:

1. Where the following automatic lighting controls are installed, for calculations used to determine code compliance, the installed lighting wattage may be reduced by the following percentages:

a. For occupant-sensing devices, energy savings of thirty percent shall be allowed for any single space up to four hundred ft<sup>2</sup> and enclosed by ceiling height partitions; classrooms, conference rooms, computer rooms, storage areas, corridors, or waiting rooms.

b. For daylighting controls, energy savings of thirty percent for continuous dimming and twenty percent for stepped controls shall be allowed for any daylit space.

c. For lumen maintenance controls, energy savings of ten percent shall be allowed for any space.

d. For daylighting controls with occupant-sensing devices, energy savings of forty-four percent shall be allowed for any single space up to four hundred ft<sup>2</sup> within daylit spaces, and enclosed by ceiling height partitions.

e. For occupant-sensing devices with lumen maintenance controls, energy savings of thirty-seven percent shall be allowed for any single space up to four hundred ft<sup>2</sup> and enclosed by ceiling height partitions.

505.3.2.1: Lighting for the following applications shall be exempted from inclusion in the calculation of lighting power budgets:

A. Stage lighting, entertainment, or audiovisual presentations where the lighting is an essential technical element for the function performed.

B. Lighting for medical and dental tasks.

C. Lighting in areas specifically designed for visually handicapped people.

D. For restaurant occupancies, lighting for kitchens and food preparation areas.

505.3.4 Building Exteriors: The exterior lighting budget shall be calculated by multiplying the building perimeter in feet by 7.5 watts per foot. Lighting for parking structures shall be calculated

at 0.3 watts per gross square foot of parking area. An allowance for outdoor surface parking and circulation lighting may be added at 0.05 watts per ft<sup>2</sup> of area. Lighting for signs that are not an integral part of the building shall be exempted from inclusion in these calculations.



TABLE 5-1 TARGET COMPONENT VALUES FOR GROUP R OCCUPANCY

Climate Zone→	Electric Resistance		Other Fuels	
	1	2	1	2
<u>Component</u>				
Glazing % Floor Area	15%	15%	15%	15%
Glazing U-Factor	U = 0.400	U = 0.400	U = 0.650	U = 0.600
Doors	U = 0.200 (R = 5)	U = 0.200 (R = 5)	U = 0.400 (R = 2.5)	U = 0.400 (R = 2.5)
Ceilings:				
Attic	U = 0.031 (R = 38)	U = 0.031 (R = 38)	U = 0.036 (R = 30)	U = 0.031 (R = 38)
Single Rafter/ Joist Vaulted	U = 0.034 (R = 30)	U = 0.034 (R = 30)	U = 0.034 (R = 30)	U = 0.034 (R = 30)
Walls	U = 0.058 (R = 19A)	U = 0.044 (R = 19+5A)	U = 0.062 (R = 19)	U = 0.062 (R = 19+5)
Floors	U = 0.029 (R = 30)	U = 0.029 (R = 30)	U = 0.041 (R = 19)	U = 0.029 (R = 30)
Slab on Grade Slab R-Value	F = 0.54 (R = 10)	F = 0.54 (R = 10)	F = 0.54 (R = 10)	F = 0.54 (R = 10)
<u>Below Grade Interior</u>				
Wall R-Value	(R = 19)	(R = 19)	(R = 19)	(R = 19)
2' Depth: Walls Slab	U = 0.043 F = .69	U = 0.043 F = .69	U = 0.043 F = .69	U = 0.043 F = .69
3.5' Depth: Walls Slab	U = 0.041 F = 0.64	U = 0.041 F = 0.64	U = 0.041 F = 0.64	U = 0.041 F = 0.64
7' Depth: Walls Slab	U = 0.037 F = 0.57	U = 0.037 F = 0.57	U = 0.037 F = 0.57	U = 0.037 F = 0.57
<u>Below Grade Exterior</u>				
Wall R-Value	(R = 10)	(R = 12)	(R = 10)	(R = 12)
2' Depth: Walls Slab	U = 0.070 F = 0.60	U = 0.061 F = 0.60	U = 0.070 F = 0.60	U = 0.061 F = 0.60
3.5' Depth: Walls Slab	U = 0.064 F = 0.57	U = 0.057 F = 0.57	U = 0.064 F = 0.57	U = 0.057 F = 0.57
7' Depth: Walls Slab	U = 0.056 F = 0.42	U = 0.050 F = 0.42	U = 0.056 F = 0.42	U = 0.050 F = 0.42

TABLE 5-2

COMPONENT REQUIREMENTS FOR OTHER  
THAN GROUP R OCCUPANCIES

BUILDINGS OF THREE CONDITIONED STORIES OR LESS					
Zone	Ceilings	Walls (Includes Glazing)	Floors	Slab on Grade <sup>1</sup>	
	$U_o$	$U_o$	$U_o$	Installed R-Value	Installed F-Value
I.	0.035	0.25	0.05	7	0.56
II.	0.035	0.20	0.05	10	0.54

<sup>1</sup> Insulation shall be water-resistant material manufactured for this use.

BUILDINGS OVER THREE CONDITIONED STORIES					
Zone	Ceilings	Walls (Includes Glazing)	Floors	Slab on Grade <sup>1</sup>	
	$U_o$	$U_o$	$U_o$	Installed R-Value	Installed F-Value
I.	0.08	0.30	0.08	7	0.56
II.	0.06	0.25	0.08	10	0.54

<sup>1</sup> Insulation shall be water-resistant material manufactured for this use.

TABLE 5-3

OTHER THAN GROUP R OCCUPANCY HVAC SYSTEM  
HEATING EQUIPMENT - GAS- AND OIL-FIRED  
MINIMUM STEADY STATE COMBUSTION EFFICIENCY

Types of Equipment	Furnaces of Capacity of 225,000 Btu/h and less Boilers of Capacities of 300,000 Btu/h and less	All Other Commercial/ Industrial Furnace and Boilers
	Percent <sup>1</sup>	Percent <sup>2</sup>
Forced-air furnaces and low-pressure steam or hot-water boilers	74	75
Gravity central furnaces	69	-
All other vented heating equipment	69	-

<sup>1</sup> Combustion efficiency for furnaces of capacities of 225,000 Btu/h and less and boilers of capacities of 300,000 Btu/h and less shall be tested in accordance with the applicable U.S. Department of Energy furnace test procedures.

<sup>2</sup> Combustion efficiency of commercial/industrial furnaces and boilers is defined as 100 percent minus stack losses in percent of heat input.

Stack losses are:

Loss due to sensible heat in dry flue gas.

Loss due to incomplete combustion.

Loss due to sensible and latent heat in moisture formed by combustion of hydrogen in the fuel.

TABLE 5-4 HVAC SYSTEM HEATING EQUIPMENT (HEAT PUMPS)  
ELECTRICALLY OPERATED STANDARD RATING CONDITIONS

CONDITIONS	TYPE		
	AIR SOURCE	WATER SOURCE	
Air entering equipment °F	70°F(dry bulb)	70°F(dry bulb)	70°F(dry bulb)
Outdoor unit ambient °F	47°F(dry bulb) /43°F(wet bulb)	17°F(dry bulb) /15°F(wet bulb)	-----
Entering water temp. °F	-----	-----	60°F
Water flow rate	-----	-----	As used in cooling

Standard ratings are at sea level.

TABLE 5-5 HVAC SYSTEM EQUIPMENT, ELECTRICALLY DRIVEN  
STANDARD RATING CONDITIONS--COOLING

		TEMPERATURES			
		DRY BULB	WET BULB	INLET	OUTLET
Air entering equipment	°F	80°	67°	-----	-----
Condenser ambient (air cooled)	°F	95°	75°	-----	-----
Condenser water (water cooled)	°F	---	---	85°	95°

Standard ratings are at sea level.



TABLE 5-6 APPLIED HVAC SYSTEM COMPONENTS ELECTRICALLY DRIVEN  
STANDARD RATING CONDITIONS -- COOLING

ITEM	CENTRIFUGAL OR SELF-CONTAINED RECIPROCATING WATER CHILLER	CONDENSERLESS RECIPROCATING WATER-CHILLER
Water Temperature, °F		
Leaving chilled	44°	44°
Entering chilled	54°	54°
Leaving condenser	95°	--
Entering	85°	--
Fouling Factor, Water		
Nonferrous tubes	0.0005*	0.0005
Steel tubes	0.0010*	0.0010
Refrigerant	0.0000*	0.0000
Condenser Ambient (air/evap. cooled) °F	95°F (dry bulb) /75°F (wet bulb)	--
Compressor saturated discharge temperature		
Water cooled (evap. cooled) °F	--	105°
Air cooled °F	--	120°

Standard ratings at sea level.

\* hr·ft<sup>2</sup>·°F/Btu

TABLE 5-7 MINIMUM HEAT PUMP EFFICIENCIES, HEATING MODE<sup>1</sup>

SOURCE	MINIMUM COP	MINIMUM HSPF
Air Source:		
Split System	3.0 <sup>2</sup>	6.8
Single Package System	3.0 <sup>2</sup>	6.6
Water Source	3.8 <sup>3</sup>	---
Ground Water Source	3.0 <sup>4</sup>	---

<sup>1</sup> When tested at the standard rating specified in Table 5-4.

<sup>2</sup> When tested @ 47°F(dry bulb)/43°F(wet bulb)

<sup>3</sup> @ 70°F entering

<sup>4</sup> @ 50°F entering

TABLE 5-8 MINIMUM EFFICIENCY FOR ELECTRIC HVAC EQUIPMENT, COOLING

STANDARD RATING CAPACITY	<u>AIR COOLED</u>		<u>EVAP/WATER COOLED</u>
	SEER	EER	EER
Under 65,000 Btu/hr. ( 19,050 watts )			
A. Split System	10.0	---	---
B. Single Package	9.7	---	9.3 <sup>1</sup>
65,000 Btu/hr. and over	----	8.9 <sup>2</sup>	10.5 <sup>1</sup>

<sup>1</sup> @ 80°F dry bulb / 67°F wet bulb

<sup>2</sup> @ 95°F dry bulb

TABLE 5-9 MINIMUM EFFICIENCY FOR ELECTRIC HVAC COMPONENTS<sup>1,2</sup>

		WATER CHILLING PACKAGES					
		CONDENSING MEANS					
TYPE OF COMPONENT	COMPRESSOR TYPE	AIR		WATER		EVAPORATIVE	
		EER	COP	EER	COP	EER	COP
Condenser Included	Centrifugal or rotary	8.00	2.34	13.80	4.04	--	--
	Reciprocating	8.40	2.36	12.00	3.51	--	--
	Condenserless Reciproc.	9.90	2.90	12.00	3.51	--	--
Compressor and condenser units 65,000 Btu/hr (19,000 watts) and over <sup>2</sup>	Positive displacement	9.50	2.78	12.50	3.66	12.50	3.66
		HYDRONIC HEAT PUMPS					
Water source under 65,000 Btu/hr (19,000 watts)	Centrifugal or rotary			9.00	2.64		
Water source 65,000 Btu/hr (19,000 watts) and over	Centrifugal or rotary			9.40	2.75		

<sup>1</sup> When tested at the standard rating conditions specified in Table 5-6.

<sup>2</sup> Ratings in accordance with Standard RS-14 as applicable.

TABLE 5-10 HVAC-SYSTEM HEAT OPERATED COOLING EQUIPMENT

HEAT SOURCE	MINIMUM COP
Direct Fired ( gas, oil )	0.48
Indirect Fired ( steam, hot water )	0.68
Minimum COP =	$\frac{\text{Net Cooling Output}}{\text{Total heat input}^1}$

<sup>1</sup> electrical auxiliary inputs excluded



TABLE 5-11

## INSULATION OF DUCTS

DUCT LOCATION	CLIMATE ZONE	INSULATION TYPES MECHANICALLY COOLED	INSULATION TYPES HEATING ONLY	GROUP R OCCUPANCY HEATING OR COOLING DUCTS
On roof or on exterior of building	I	C, V <sup>2</sup> and W	C and W	E and W
	II	D, V <sup>2</sup> and W	D and W	D and W
Attic, garage, crawl space, in walls <sup>1</sup> , in floor/ceiling <sup>1</sup>	I	B and V <sup>2</sup>	B	E
	II	C and V <sup>2</sup>	C	E
Within the conditioned space or in heated basements		None Required	None Required	None Required
In cement slab or in ground		A	B	B

Note: Where ducts are used for both heating and cooling, the minimum insulation shall be as required for the most restrictive condition.

<sup>1</sup> Insulation may be omitted on that portion of a duct which is located within a wall or floor-ceiling space where both sides of this space are exposed to conditioned air and where this space is not ventilated or otherwise exposed to unconditioned air.

<sup>2</sup> Vapor barriers shall be installed on conditioned air supply ducts in geographic areas where the average of the July, August, and September mean dewpoint temperature exceeds 60°F.

**INSULATION TYPES:** Minimum densities and out-of-package thickness.

- A. 0.5-inch 1.5 to 2 lb/cu. ft. duct liner, mineral or glass fiber blanket or equivalent to provide an installed total thermal resistance of at least R-2.
- B. 2-inch 0.60 lb/cu. ft. mineral or glass fiber blanket 1.5-inch 1.5 to 2 lb/cu. ft. duct liner, mineral or glass fiber blanket. 1.5-inch 3 to 7 lb/cu. ft. mineral or glass fiber board or equivalent to provide an installed total thermal resistance of at least R-5.
- C. 3-inch 0.60 lb/cu. ft. mineral or glass fiber blanket 2-inch 1.5 to 2 lb/cu. ft. duct liner, mineral or glass fiber blanket. 2-inch 3 to 7 lb/cu. ft. mineral or glass fiber board or equivalent to provide an installed total thermal resistance of at least R-7.
- D. 4-inch 0.60 lb/cu. ft. mineral or glass fiber blanket 3-inch 1.5 to 2 lb/cu. ft. duct liner, mineral or glass fiber blanket. 3-inch 3 to 7 lb/cu. ft. mineral or glass fiber board or equivalent to provide an installed total thermal resistance of at least R-10.
- E. 3.5 inch 0.60 lb/cu.ft. mineral or glass fiber blanket, 2.5 inch 1.5 to 2 lb/cu. ft. duct liner, mineral or glass fiber board or equivalent to provide an installed total thermal resistance of at least R-8.
- V. Vapor barrier, with perm rating not greater than 0.5 perm, all joints sealed.
- W. Approved weatherproof barrier.

INSULATION THICKNESS FOR GIVEN PIPE DIAMETERS<sup>1</sup>

PIPING SYSTEM	FLUID TEMP RANGE (°F)	LESS THAN 12 FOOT PIPE RUN <sup>2</sup> UP TO 2"	INSULATION THICKNESS FOR GIVEN PIPE DIAMETERS <sup>1</sup>			
			1" AND LESS	GREATER THAN 1" TO 2"	GREATER THAN 2" TO 4"	GREATER THAN 4" TO 6" AND LARGER
<b>HEATING &amp; HOT WATER SYSTEMS</b>						
Steam & Hot Water Pressure/temperature						
High	306°F ↔ 450°F	1.5"	2.5"	2.5"	3.0"	3.5"
Medium	251°F ↔ 305°F	1.5"	2.0"	2.5"	3.0"	3.0"
Low	201°F ↔ 250°F	1.0"	1.5"	1.5"	2.0"	2.0"
All Other	100°F ↔ 200°F	0.5"	1.0"	1.0"	1.5"	1.5"
Steam Condensate (for feed water)	Any	1.0"	1.0"	1.5"	2.0"	2.0"
<b>COOLING SYSTEMS</b>						
Chilled Water	40°F ↔ 55°F	0.5"	0.5"	0.75"	1.0"	1.0"
Refrigerant/brine	Below 40°F	1.0"	1.0"	1.5"	1.5"	1.5"

<sup>1</sup> For piping exposed to ambient air, increase thickness by 0.5".

<sup>2</sup> Pipe runouts not exceeding 12 feet in length to individual units, with a pipe diameter of less than 2 inches.

\* Column headings for pipe diameters amended 5/30/90.

TABLE 5-13

LIGHTING POWER BUDGET<sup>1</sup>

<u>GROUP OCCUPANCY</u>	<u>DESCRIPTION</u>	<u>LIGHTING POWER BUDGET<sup>3</sup> (Watts/ft<sup>2</sup>)</u>
A	Assembly w/stage	1.1
	Stage lighting	Exempt
B	Assembly w/o stage; other than B and E	1.1
	Gasoline service station	1.7
	Storage garages	0.3
	Office buildings	1.7
	Wholesale stores	2.0
	Police and fire stations	1.7
	Retail stores:	
	less than 6000 ft <sup>2</sup>	4.0
	6000 to 20,000 ft <sup>2</sup>	3.0
	over 20,000 ft <sup>2</sup>	2.0
	Drinking and dining establishments	1.85
	Food preparation task light	Exempt
	Aircraft hangars - storage	0.7
	Process plants <sup>4</sup>	1.0
	Factories and work shops <sup>4</sup>	1.7
Storage structures	0.7	
E	Schools and daycare centers	1.7
	Audio-visual presentation lighting	Exempt
H	Storage structures	0.7
	Handling areas	1.7
	Paint shops	2.5
	Auto repair shops	1.7
	Aircraft repair hangars	1.7
I	Institutions	1.7
	Administrative support areas	1.7
	Diagnostic, treatment, food service task lighting	Exempt
R	Dwelling units	Exempt
	Food preparation task lighting	Exempt

<sup>1</sup> Watts/ft<sup>2</sup> of room may be increased by two percent per foot of height above 20 feet.

<sup>2</sup> Emergency exit lighting is exempt from interior lighting budget.

<sup>3</sup> Lighting that is part of machines or equipment is exempt from this budget.

NEW SECTION

WAC 51-11-0525 EQUATION 1--GROUP R OCCUPANCY.

**EQUATION 1 -- GROUP R OCCUPANCY****TARGET UA**

$$UA_T = U_W A_W + U_{BGW} A_{BGW} + U_G A_G + U_F A_F + U_{RC} A_{RC} + U_{CC} A_{CC} + U_D A_D + F_S P_S$$

**Where:**

- $UA_T$  = the target combined thermal transmittance of the gross exterior wall, floor, and roof/ceiling assembly area.
- $U_W$  = the thermal transmittance value of the opaque above grade wall area found in Table 5-1.
- $A_W$  = opaque above grade wall area.
- $U_{BGW}$  = the thermal transmittance value of the below grade opaque wall area found in Table 5-1.
- $A_{BGW}$  = opaque below grade wall area.
- $U_G$  = the thermal transmittance value of the glazing area found in Table 5-1.
- $A_G$  = .15 (total floor area of the conditioned space).
- $U_F$  = the thermal transmittance value of the floor area found in Table 5-1.
- $A_F$  = floor area over unconditioned space.
- $U_{RC}$  = the thermal transmittance value of the roof/ceiling area found in Table 5-1.
- $A_{RC}$  = roof/ceiling area.
- $U_{CC}$  = the thermal transmittance value of the cathedral ceiling area found in Table 5-1.
- $A_{CC}$  = cathedral ceiling area.
- $U_D$  = the thermal transmittance value of the opaque door area found in table 5-1.
- $A_D$  = opaque door area.
- $F_S$  = concrete slab component F-value found in Table 5-1.
- $P_S$  = Lineal ft. of concrete slab perimeter.



NEW SECTION

WAC 51-11-0526 EQUATION 2--ALL OCCUPANCIES.

## EQUATION 2 -- ALL OCCUPANCIES

$$U = \frac{1}{r_o + R_1 + R_2 \dots r_i}$$

**Where:**

U = the thermal transmittance of the assembly.

$r_o$  = outside air film resistance.

$r_o$  = .17 for all exterior surfaces.

$r_i$  = inside air film resistance.

$r_i$  = 0.61 for interior horizontal surfaces, heat flow up.

$r_i$  = 0.92 for interior horizontal surfaces, heat flow down.

$r_i$  = 0.68 for interior vertical surfaces.

$R = \frac{1}{C} = \frac{X}{K}$  = measure of the resistance to the passage of heat for each element.

C = conductance, the heat flow through a specific material of specific thickness.

K = insulation value of a material per inch.

X = the thickness of the material in inches.

NEW SECTION

WAC 51-11-0527 EQUATION 3--GROUP R OCCUPANCY.

## EQUATION 3 -- GROUP R OCCUPANCY

## PROPOSED UA

$$UA = U_W A_W + U_{BGW} A_{BGW} + U_G A_G + U_F A_F + U_{RC} A_{RC} + U_{CC} A_{CC} + U_D A_D + F_S P_S$$

**Where:**

- UA = the combined thermal transmittance of the gross exterior wall, floor, and roof/ceiling assembly area.
- $U_W$  = the thermal transmittance of the opaque wall area.
- $U_{BGW}$  = the thermal transmittance value of the below grade opaque wall area.
- $A_{BGW}$  = opaque below grade wall area.
- $A_W$  = opaque wall area.
- $U_G$  = the thermal transmittance of the glazing (window or skylight) area.
- $A_G$  = glazing area, including windows in exterior doors.
- $U_F$  = the thermal transmittance of the floor area.
- $A_F$  = floor area over unconditioned space.
- $U_{RC}$  = the thermal transmittance of the roof/ceiling area.
- $A_{RC}$  = roof/ceiling area.
- $U_{CC}$  = the thermal transmittance of the cathedral ceiling area.
- $A_{CC}$  = cathedral ceiling area.
- $U_D$  = the thermal transmittance value of the opaque door area.
- $A_D$  = opaque door area.
- $F_S$  = concrete slab component f-factor.
- $P_S$  = lineal ft. of concrete slab perimeter.

**NOTE:** Where more than one type of wall, window, roof/ceiling, door, and skylight is used, the U and A terms for those items shall be expanded into sub-elements as:

$$U_{W1} A_{W1} + U_{W2} A_{W2} + U_{W3} A_{W3} + \dots \text{etc.}$$

NEW SECTION

WAC 51-11-0528 EQUATION 4--OTHER THAN GROUP R OCCUPANCY.

## EQUATION 4 -- OTHER THAN GROUP R OCCUPANCY

TARGET  $U_o$ 

$$U_o = \frac{U_w A_w + U_f A_f + U_c A_c + F_s P_s}{A_w + A_f + A_c + P_s}$$

**Where:**

- $U_o$  = the target combined thermal transmittance of the gross exterior wall, floor, and roof/ceiling assembly area.
- $U_w$  = the thermal transmittance value of the opaque above grade wall area found in Table 5-2.
- $A_w$  = opaque above grade wall area.
- $U_f$  = the thermal transmittance value of the floor area found in Table 5-2.
- $A_f$  = floor area over unconditioned space.
- $U_c$  = the thermal transmittance value of the ceiling area found in Table 5-2.
- $A_c$  = ceiling area.
- $F_s$  = concrete slab component F-value found in Table 5-2.
- $P_s$  = lineal ft. of concrete slab perimeter

NEW SECTION

WAC 51-11-0529 EQUATION 5--OTHER THAN GROUP R OCCUPANCY.

1991 EDITION

## EQUATION 5 -- OTHER THAN GROUP R OCCUPANCY

PROPOSED  $U_o$ 

$$U_o = \frac{U_W A_W + U_{BGW} A_{BGW} + U_G A_G + U_F A_F + U_{RC} A_{RC} + U_{CC} A_{CC} + U_D A_D + F_S P_S}{A_W + A_{BGW} + A_G + A_F + A_{RC} + A_{CC} + A_D + P_S}$$

Where:

- $U_o$  = the combined thermal transmittance of the gross exterior wall, floor, and roof/ceiling assembly area.
- $U_W$  = the thermal transmittance of the opaque wall area.
- $U_{BGW}$  = the thermal transmittance value of the below grade opaque wall area.
- $A_{BGW}$  = opaque below grade wall area.
- $A_W$  = opaque wall area.
- $U_G$  = the thermal transmittance of the glazing (window or skylight) area.
- $A_G$  = glazing area, including windows in exterior doors.
- $U_F$  = the thermal transmittance of the floor area.
- $A_F$  = floor area over unconditioned space.
- $U_{RC}$  = the thermal transmittance of the roof/ceiling area.
- $A_{RC}$  = roof/ceiling area.
- $U_{CC}$  = the thermal transmittance of the cathedral ceiling area.
- $A_{CC}$  = cathedral ceiling area.
- $U_D$  = thermal transmittance value of opaque door area.
- $A_D$  = opaque door area.
- $F_S$  = concrete slab component F-factor.
- $P_S$  = lineal ft. of concrete slab perimeter.

**NOTE:** Where more than one type of wall, window, roof/ceiling, door, and skylight is used, the U and A terms for those items shall be expanded into sub-elements as:

$$U_{W1} A_{W1} + U_{W2} A_{W2} + U_{W3} A_{W3} + \dots \text{etc.}$$



NEW SECTION

WAC 51-11-0530 TABLE 5-1.

## TARGET COMPONENT VALUES FOR GROUP R OCCUPANCY

Climate Zone→	Electric Resistance		Other Fuels	
	1	2	1	2
<b>Component</b>				
<b>Glazing % Floor Area</b>	15%	15%	15%	15%
<b>Glazing U-Factor</b>	U = 0.400	U = 0.400	U = 0.650	U = 0.600
<b>Doors</b>	U = 0.200 (R = 5)	U = 0.200 (R = 5)	U = 0.400 (R = 2.5)	U = 0.400 (R = 2.5)
<b>Ceilings:</b>				
Attic	U = 0.031 (R = 38)	U = 0.031 (R = 38)	U = 0.036 (R = 30)	U = 0.031 (R = 38)
Single Rafter/ Joist Vaulted	U = 0.034 (R = 30)	U = 0.034 (R = 30)	U = 0.034 (R = 30)	U = 0.034 (R = 30)
<b>Walls</b>	U = 0.058 (R = 19A)	U = 0.044 (R = 19+5A)	U = 0.062 (R = 19)	U = 0.062 (R = 19)
<b>Floors</b>	U = 0.029 (R = 30)	U = 0.029 (R = 30)	U = 0.041 (R = 19)	U = 0.029 (R = 30)
<b>Slab on Grade</b>	F = 0.54	F = 0.54	F = 0.54	F = 0.54
Slab R-Value	(R = 10)	(R = 10)	(R = 10)	(R = 10)
<b><u>Below Grade Interior</u></b>				
Wall R-Value	(R = 19)	(R = 19)	(R = 19)	(R = 19)
2' Depth: Walls	U = 0.043	U = 0.043	U = 0.043	U = 0.043
Slab	F = .69	F = .69	F = .69	F = .69
3.5' Depth: Walls	U = 0.041	U = 0.041	U = 0.041	U = 0.041
Slab	F = 0.64	F = 0.64	F = 0.64	F = 0.64
7' Depth: Walls	U = 0.037	U = 0.037	U = 0.037	U = 0.037
Slab	F = 0.57	F = 0.57	F = 0.57	F = 0.57
<b><u>Below Grade Exterior</u></b>				
Wall R-Value	(R = 10)	(R = 12)	(R = 10)	(R = 12)
2' Depth: Walls	U = 0.070	U = 0.061	U = 0.070	U = 0.061
Slab	F = 0.60	F = 0.60	F = 0.60	F = 0.60
3.5' Depth: Walls	U = 0.064	U = 0.057	U = 0.064	U = 0.057
Slab	F = 0.57	F = 0.57	F = 0.57	F = 0.57
7' Depth: Walls	U = 0.056	U = 0.050	U = 0.056	U = 0.050
Slab	F = 0.42	F = 0.42	F = 0.42	F = 0.42

NEW SECTION

WAC 51-11-0531 TABLE 5-2.

COMPONENT REQUIREMENTS FOR OTHER  
THAN GROUP R OCCUPANCIES

---

BUILDINGS OF THREE CONDITIONED STORIES OR LESS

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Zone	Ceilings	Walls (Includes Glazing)	Floors	Slab on Grade <sup>1</sup>	
	$U_o$	$U_o$	$U_o$	Installed R-Value	Installed F-Value
I.	0.035	0.25	0.05	7	0.56
II.	0.035	0.20	0.05	10	0.54

---

<sup>1</sup> Insulation shall be water-resistant material manufactured for this use.

---

BUILDINGS OVER THREE CONDITIONED STORIES

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Zone	Ceilings	Walls (Includes Glazing)	Floors	Slab on Grade <sup>1</sup>	
	$U_o$	$U_o$	$U_o$	Installed R-Value	Installed F-Value
I.	0.08	0.30	0.08	7	0.56
II.	0.06	0.25	0.08	10	0.54

---

<sup>1</sup> Insulation shall be water-resistant material manufactured for this use.

NEW SECTION

WAC 51-11-0532 TABLE 5-3.

OTHER THAN GROUP R OCCUPANCY HVAC SYSTEM  
HEATING EQUIPMENT - GAS- AND OIL-FIRED  
MINIMUM STEADY STATE COMBUSTION EFFICIENCY

Types of Equipment	Furnaces of Capacity of 225,000 Btu/h and less Boilers of Capacities of 300,000 Btu/h and less	All Other Commercial/ Industrial Furnace and Boilers
	Percent <sup>1</sup>	Percent <sup>2</sup>
Forced-air furnaces and low-pressure steam or hot-water boilers	74	75
Gravity central furnaces	69	-
All other vented heating equipment	69	-

<sup>1</sup> Combustion efficiency for furnaces of capacities of 225,000 Btu/h and less and boilers of capacities of 300,000 Btu/h and less shall be tested in accordance with the applicable U.S. Department of Energy furnace test procedures.

<sup>2</sup> Combustion efficiency of commercial/industrial furnaces and boilers is defined as 100 percent minus stack losses in percent of heat input.

Stack losses are:

Loss due to sensible heat in dry flue gas.

Loss due to incomplete combustion.

Loss due to sensible and latent heat in moisture formed by combustion of hydrogen in the fuel.

NEW SECTION

WAC 51-11-0533 TABLE 5-4.

HVAC SYSTEM HEATING EQUIPMENT (HEAT PUMPS)  
ELECTRICALLY OPERATED STANDARD RATING CONDITIONS

CONDITIONS	TYPE		
	AIR SOURCE		WATER SOURCE
Air entering equipment °F	70°F(dry bulb)	70°F(dry bulb)	70°F(dry bulb)
Outdoor unit ambient °F	47°F(dry bulb) /43°F(wet bulb)	17°F(dry bulb) /15°F(wet bulb)	-----
Entering water temp. °F	-----	-----	60°F
Water flow rate	-----	-----	As used in cooling

Standard ratings are at sea level.



NEW SECTION

WAC 51-11-0534 TABLE 5-5.

HVAC SYSTEM EQUIPMENT, ELECTRICALLY DRIVEN  
STANDARD RATING CONDITIONS--COOLING

		TEMPERATURES			
		DRY BULB	WET BULB	INLET	OUTLET
Air entering equipment	°F	80°	67°	-----	-----
Condenser ambient (air cooled)	°F	95°	75°	-----	-----
Condenser water (water cooled)	°F	---	---	85°	95°

Standard ratings are at sea level.

NEW SECTION

WAC 51-11-0535 TABLE 5-6.

APPLIED HVAC SYSTEM COMPONENTS ELECTRICALLY DRIVEN  
STANDARD RATING CONDITIONS -- COOLING

ITEM	CENTRIFUGAL OR SELF-CONTAINED RECIPROCATING WATER CHILLER	CONDENSERLESS RECIPROCATING WATER-CHILLER
<b>Water Temperature, °F</b>		
Leaving chilled	44°	44°
Entering chilled	54°	54°
Leaving condenser	95°	--
Entering	85°	--
<b>Fouling Factor, Water</b>		
Nonferrous tubes	0.0005*	0.0005
Steel tubes	0.0010*	0.0010
Refrigerant	0.0000*	0.0000
<b>Condenser Ambient (air/evap. cooled) °F</b>	95°F (dry bulb) /75°F (wet bulb)	--
<b>Compressor saturated discharge temperature</b>		
Water cooled (evap. cooled) °F	--	105°
Air cooled °F	--	120°

Standard ratings at sea level.

\* hr·ft<sup>2</sup>·°F/Btu

NEW SECTION

WAC 51-11-0536 TABLE 5-7.

TABLE 5-6.

MINIMUM HEAT PUMP EFFICIENCIES, HEATING MODE<sup>1</sup>

SOURCE	MINIMUM COP	MINIMUM HSPF
Air Source:		
Split System	3.0 <sup>2</sup>	6.8
Single Package System	3.0 <sup>2</sup>	6.6
Water Source	3.8 <sup>3</sup>	---
Ground Water Source	3.0 <sup>4</sup>	---

<sup>1</sup> When tested at the standard rating specified in Table 5-4.

<sup>2</sup> When tested @ 47°F(dry bulb)/43°F(wet bulb)

<sup>3</sup> @ 70°F entering

<sup>4</sup> @ 50°F entering

NEW SECTION

WAC 51-11-0537 TABLE 5-8.

MINIMUM EFFICIENCY FOR ELECTRIC HVAC EQUIPMENT, COOLING

STANDARD RATING CAPACITY	<u>AIR COOLED</u>		<u>EVAP/WATER COOLED</u>
	SEER	EER	EER
Under 65,000 Btu/hr. ( 19,050 watts )			
A. Split System	10.0	---	---
B. Single Package <sup>3</sup>	9.7	---	9.3 <sup>1</sup>
65,000 Btu/hr. and over	----	8.9 <sup>2</sup>	10.5 <sup>1</sup>

<sup>1</sup> @ 80°F dry bulb / 67°F wet bulb<sup>2</sup> @ 95°F dry bulb<sup>3</sup> Prior to January 1, 1993 a minimum value of 8.0 SEER may be used.

NEW SECTION

WAC 51-11-0538 TABLE 5-9.

**MINIMUM EFFICIENCY FOR ELECTRIC HVAC COMPONENTS<sup>1,2</sup>****WATER CHILLING PACKAGES****CONDENSING MEANS**

TYPE OF COMPONENT	COMPRESSOR TYPE	AIR		WATER		EVAPORATIVE	
		EER	COP	EER	COP	EER	COP
Condenser Included	Centrifugal or rotary	8.00	2.34	13.80	4.04	--	--
	Reciprocating	8.40	2.36	12.00	3.51	--	--
Condenserless	Reciproc.	9.90	2.90	12.00	3.51	--	--
Compressor and condenser units 65,000 Btu/hr (19,000 watts) and over <sup>2</sup>	Positive displacement	9.50	2.78	12.50	3.66	12.50	3.66

**HYDRONIC HEAT PUMPS**

Water source under 65,000 Btu/hr (19,000 watts)	Centrifugal or rotary	9.00	2.64
Water source 65,000 Btu/hr (19,000 watts) and over	Centrifugal or rotary	9.40	2.75

<sup>1</sup> When tested at the standard rating conditions specified in Table 5-6.<sup>2</sup> Ratings in accordance with Standard RS-14 as applicable.



NEW SECTION

WAC 51-11-0539 TABLE 5-10.

## HVAC-SYSTEM HEAT OPERATED COOLING EQUIPMENT

HEAT SOURCE	MINIMUM COP
Direct Fired ( gas, oil )	0.48
Indirect Fired ( steam, hot water )	0.68

Minimum COP =  $\frac{\text{Net Cooling Output}}{\text{Total heat input}^1}$

<sup>1</sup> electrical auxiliary inputs excluded

NEW SECTION

WAC 51-11-0540 TABLE 5-11.

## INSULATION OF DUCTS

DUCT LOCATION	CLIMATE ZONE	INSULATION TYPES MECHANICALLY COOLED	INSULATION TYPES HEATING ONLY	GROUP R OCCUPANCY HEATING OR COOLING DUCTS
On roof or on exterior of building	I	C, V <sup>2</sup> and W	C and W	E and W
	II	D, V <sup>2</sup> and W	D and W	D and W
Attic, garage, crawl space, in walls <sup>1</sup> , in floor/ceiling <sup>1</sup>	I	B and V <sup>2</sup>	B	E
	II	C and V <sup>2</sup>	C	E
Within the conditioned space or in heated basements		None Required	None Required	None Required
In cement slab or in ground		A	B	B

**Note:** Where ducts are used for both heating and cooling, the minimum insulation shall be as required for the most restrictive condition.

<sup>1</sup> Insulation may be omitted on that portion of a duct which is located within a wall or floor-ceiling space where both sides of this space are exposed to conditioned air and where this space is not ventilated or otherwise exposed to unconditioned air.

<sup>2</sup> Vapor barriers shall be installed on conditioned air supply ducts in geographic areas where the average of the July, August, and September mean dewpoint temperature exceeds 60°F.

**INSULATION TYPES:** Minimum densities and out-of-package thickness.

- A. 0.5-inch 1.5 to 2 lb/cu. ft. duct liner, mineral or glass fiber blanket or equivalent to provide an installed total thermal resistance of at least R-2.
- B. 2-inch 0.60 lb/cu. ft. mineral or glass fiber blanket 1.5-inch 1.5 to 2 lb/cu. ft. duct liner, mineral or glass fiber blanket. 1.5-inch 3 to 7 lb/cu. ft. mineral or glass fiber board or equivalent to provide an installed total thermal resistance of at least R-5.
- C. 3-inch 0.60 lb/cu. ft. mineral or glass fiber blanket 2-inch 1.5 to 2 lb/cu. ft. duct liner, mineral or glass fiber blanket. 2-inch 3 to 7 lb/cu. ft. mineral or glass fiber board or equivalent to provide an installed total thermal resistance of at least R-7.
- D. 4-inch 0.60 lb/cu. ft. mineral or glass fiber blanket 3-inch 1.5 to 2 lb/cu. ft. duct liner, mineral or glass fiber blanket. 3-inch 3 to 7 lb/cu. ft. mineral or glass fiber board or equivalent to provide an installed total thermal resistance of at least R-10.
- E. 3.5 inch 0.60 lb/cu.ft. mineral or glass fiber blanket, 2.5 inch 1.5 to 2 lb/cu. ft. duct liner, mineral or glass fiber board or equivalent to provide an installed total thermal resistance of at least R-8.
- V. Vapor barrier, with perm rating not greater than 0.5 perm, all joints sealed.
- W. Approved weatherproof barrier.

NEW SECTION

WAC 51-11-0541 TABLE 5-12.

## MINIMUM PIPE INSULATION REQUIREMENTS\*

INSULATION THICKNESS FOR GIVEN PIPE DIAMETERS<sup>1</sup>GREATER  
THAN 6"  
AND  
LARGERGREATER  
THAN 4"  
TO 6"GREATER  
THAN 2"  
TO 4"GREATER  
THAN 1"  
TO 2"1"  
AND  
LESSLESS THAN  
12 FOOT<sup>2</sup>  
PIPE RUN<sup>2</sup>  
UP TO 2"FLUID TEMP  
RANGE (°F)PIPING SYSTEMHEATING & HOT  
WATER SYSTEMSSteam & Hot Water  
Pressure/temperature

High	306°F to 450°F	1.5"	2.5"	2.5"	3.0"	3.5"	3.5"
Medium	251°F to 305°F	1.5"	2.0"	2.5"	2.5"	3.0"	3.0"
Low	201°F to 250°F	1.0"	1.5"	1.5"	2.0"	2.0"	2.0"
All Other	100°F to 200°F	0.5"	1.0"	1.0"	1.5"	1.5"	1.5"

Steam Condensate  
(for feed water)

Any

1.0"

1.5"

1.0"

1.0"

Any

1.0"

2.0"

COOLING SYSTEMS

Chilled Water

40°F to 55°F

0.5"

0.5"

0.75"

1.0"

1.0"

1.0"

Refrigerant/brine

Below 40°F

1.0"

1.0"

1.5"

1.5"

1.5"

1.5"

<sup>1</sup> For piping exposed to ambient air, increase thickness by 0.5".<sup>2</sup> Pipe runouts not exceeding 12 feet in length to individual units, with a pipe diameter of less than 2 inches.

\* Column headings for pipe diameters amended 5/30/90.

NEW SECTION

WAC 51-11-0542 TABLE 5-13.

TABLE 5-13  
LIGHTING POWER BUDGET<sup>1</sup>

<u>GROUP OCCUPANCY</u>	<u>DESCRIPTION</u>	<u>LIGHTING POWER BUDGET<sup>2</sup> (W/sq. ft.)</u>
A	Assembly w/stage	1.1
	Stage lighting	Exempt
	Assembly w/o stage; other than B & E	1.1
B	Gasoline service station	1.7
	Storage garages	0.3
	Office buildings	1.7
	Wholesale stores	2.0
	Police and fire stations	1.7
	Retail stores:	
	less than 6000 sq. ft.	4.0
	6000 to 20,000 sq. ft.	3.0
	over 20,000 sq. ft.	2.0
	Drinking and dining establishments	1.85
	Food preparation task light	Exempt
	Aircraft hangars - storage	0.7
	Process plants <sup>3</sup>	1.0
Factories and work shops <sup>3</sup>	1.7	
Storage structures	0.7	
E	Schools and daycare centers	1.7
	Audio-visual presentation lighting	Exempt
H	Storage structures	0.7
	Handling areas	1.7
	Paint shops	2.5
	Auto repair shops	1.7
	Aircraft repair hangars	1.7
I	Institutions	1.7
	Administrative support areas	1.7
	Diagnostic, treatment, food service task lighting	Exempt
R	Dwelling units	Exempt
	Food preparation task lighting	Exempt

<sup>1</sup> Watts/ft<sup>2</sup> of room may be increased by two percent per foot of height above 20 feet.

<sup>2</sup> Emergency exit lighting is exempt from interior lighting budget.

<sup>3</sup> Lighting that is part of machines or equipment is exempt from this budget.

AMENDATORY SECTION (Amending WSR 91-01-112, filed 12/19/90, effective 7/1/91)

WAC 51-11-0608 ELECTRICAL POWER AND LIGHTING REQUIREMENTS FOR OTHER THAN GROUP R OCCUPANCIES. All electrical power and lighting systems shall comply with the requirements of section 505.



TABLE 6-1 • PRESCRIPTIVE REQUIREMENTS<sup>1</sup> FOR GROUP R OCCUPANCY  
CLIMATE ZONE 1 • HEATING BY ELECTRIC RESISTANCE

OPTION	GLAZING % FLOOR AREA	GLAZING U-VALUE	DOORS U-VALUE	CEILING <sup>2</sup>	VAULTED CEILING <sup>3</sup>	WALL ABOVE GRADE	WALL, int <sup>4</sup> BELOW GRADE	WALL, ext <sup>4</sup> BELOW GRADE	FLOOR <sup>5</sup>	SLAB <sup>6</sup> ON GRADE
I.	10%	0.46	0.40	R-38	R-30	R-21	R-21	R-10	R-30	R-10
II.	12%	0.43	0.20	R-38	R-30	R-19	R-19	R-10	R-30	R-10
III.	12%	0.40	0.40	R-38	R-30	R-21	R-21	R-10	R-30	R-10
IV.*	15%	0.40	0.20	R-38	R-30	R-19	R-19	R-10	R-30	R-10
V.	18%	0.39	0.20	R-38	R-30	R-21	R-21	R-10	R-30	R-10
VI.	21%	0.36	0.20	R-38	R-30	R-21	R-21	R-10	R-30	R-10
VII. <sup>7</sup>	25%	0.35	0.20	R-38	R-30	R-19+R-5 <sup>8</sup>	R-21	R-10	R-30	R-10
VIII. <sup>7</sup>	30%	0.32	0.20	R-38	R-30	R-19+R-5 <sup>8</sup>	R-21	R-10	R-30	R-10

\* Reference Case • (highlighted in redline)

1 Minimum requirements for each option listed. For example, if a proposed design has a glazing ratio to the conditioned floor area of 19%, it shall comply with all of the requirements of the 21% glazing option (or higher). Proposed designs which cannot meet the specific requirements of a listed option above, may calculate compliance by Chapters 4 or 5 of this Code.

2 Requirement applies to all ceilings except single rafter or joist vaulted ceilings. 'Adv' denotes Advanced Framed Ceiling.

3 Requirement applicable only to single rafter or joist vaulted ceilings.

4 Below grade walls shall be insulated either on the exterior to a minimum level of R-10, or on the interior to the same level as walls above grade. Exterior insulation installed on below grade walls shall be a water resistant material, manufactured for its intended use, and installed according to the manufacturer's specifications. See section 602.2.

5 Floors over crawl spaces or exposed to ambient air conditions.

6 Required slab perimeter insulation shall be a water resistant material, manufactured for its intended use, and installed according to manufacturer's specifications. See section 602.4.

7 These options shall be applicable to buildings less than three stories.

8 This wall insulation requirement denotes R-19 wall cavity insulation plus R-5 foam sheathing.

TABLE 6-2 • PRESCRIPTIVE REQUIREMENTS<sup>1</sup> FOR GROUP R OCCUPANCY  
CLIMATE ZONE 1 • HEATING BY OTHER FUELS

OPTION	HVAC <sup>9</sup> EQUIP. EFFIC.	GLAZING % FLOOR AREA	GLAZING U-VALUE	DOORS U-VALUE	CEILING <sup>2</sup>	VAULTED CEILING <sup>3</sup>	WALL, ABOVE GRADE	WALL <sup>4</sup> •int <sup>4</sup> BELOW GRADE	WALL <sup>4</sup> •ext <sup>4</sup> BELOW GRADE	FLOOR <sup>5</sup>	SLAB <sup>6</sup> ON GRADE
I.	Med.	10%	0.70	0.40	R-30	R-30	R-15	R-15	R-10	R-19	R-10
II.	Med.	12%	0.65	0.40	R-30	R-30	R-15	R-15	R-10	R-19	R-10
III.	High	21%	0.75	0.40	R-30	R-30	R-19	R-19	R-10	R-19	R-10
IV.*	Med.	21%	0.65	0.40	R-30	R-30	R-19	R-19	R-10	R-19	R-10
V.	Low	21%	0.60	0.40	R-30	R-30	R-19	R-19	R-10	R-19	R-10
VI. <sup>7</sup>	Med.	25%	0.50	0.40	R-38	R-30	R-19	R-19	R-10	R-25	R-10
VII. <sup>7</sup>	Med.	30%	0.45	0.40	R-30	R-30	R-19	R-19	R-10	R-25	R-10

\* Reference Case • (highlighted in redline)

- 1 Minimum requirements for each option listed. For example, if a proposed design has a glazing ratio to the conditioned floor area of 10%, it shall comply with all of the requirements of the 21% glazing option (or higher). Proposed designs which cannot meet the specific requirements of a listed option above, may calculate compliance by Chapters 4 or 5 of this Code.
- 2 Requirement applies to all ceilings except single rafter or joist vaulted ceilings. 'Adv' denotes Advanced Framed Ceiling.
- 3 Requirement applicable only to single rafter or joist vaulted ceilings.
- 4 Below grade walls shall be insulated either on the exterior to a minimum level of R-10, or on the interior to the same level as walls above grade. Exterior insulation installed on below grade walls shall be a water resistant material, manufactured for its intended use, and installed according to the manufacturer's specifications. See section 602.2.
- 5 Floors over crawl spaces or exposed to ambient air conditions.
- 6 Required slab perimeter insulation shall be a water resistant material, manufactured for its intended use, and installed according to manufacturer's specifications. See section 602.4.
- 7 These options shall be applicable to buildings less than three stories.
- 8 This wall insulation requirement denotes R-19 wall cavity insulation plus R-5 foam sheathing.
- 9 Minimum HVAC Equipment efficiency requirement. 'Low' denotes an AFUE of 0.74, 'Med.' denotes an AFUE of 0.78. 'High' denotes an AFUE of 0.88.

TABLE 6-3 • PRESCRIPTIVE REQUIREMENTS<sup>1</sup> FOR GROUP R OCCUPANCY  
CLIMATE ZONE 2 • HEATING BY ELECTRIC RESISTANCE

OPTION	GLAZING % FLOOR AREA	GLAZING U-VALUE	DOORS U-VALUE	CEILING <sup>2</sup>	VAULTED CEILING <sup>3</sup>	WALL ABOVE GRADE	WALL-int <sup>4</sup> BELOW GRADE	WALL-ext <sup>4</sup> BELOW GRADE	FLOOR <sup>5</sup>	SLAB <sup>6</sup> ON GRADE
I.	10%	0.38	0.20	R-38	R-30	R-21	R-21	R-12	R-30	R-10
II.	12%	0.40	0.20	R-38	R-30	R-19+R-5 <sup>8</sup>	R-21	R-12	R-25	R-10
III.*	15%	0.40	0.20	R-38	R-30	R-19+R-5 <sup>8</sup>	R-21	R-12	R-30	R-10
IV.	18%	0.38	0.20	R-38	R-30	R-19+R-5 <sup>8</sup>	R-21	R-12	R-30	R-10
V. <sup>7</sup>	21%	0.35	0.20	R-38Adv	R-38	R-19+R-5 <sup>8</sup>	R-21	R-12	R-30	R-10
VI. <sup>7</sup>	25%	0.33	0.20	R-49Adv	R-38	R-19+R-5 <sup>8</sup>	R-21	R-12	R-30	R-10
VII. <sup>7</sup>	30%	0.31	0.20	R-60Adv	R-38	R21+R7.5 <sup>9</sup>	R-21	R-12	R-30	R-10

\* Reference Case • (highlighted in redline)

1 Minimum requirements for each option listed. For example, if a proposed design has a glazing ratio to the conditioned floor area of 19%, it shall comply with all of the requirements of the 21% glazing option (or higher). Proposed designs which cannot meet the specific requirements of a listed option above, may calculate compliance by Chapters 4 or 5 of this Code.

2 Requirement applies to all ceilings except single rafter or joist vaulted ceilings. 'Adv' denotes Advanced Framed Ceiling.

3 Requirement applicable only to single rafter or joist vaulted ceilings.

4 Below grade walls shall be insulated either on the exterior to a minimum level of R-10, or on the interior to the same level as walls above grade. Exterior insulation installed on below grade walls shall be a water resistant material, manufactured for its intended use, and installed according to the manufacturer's specifications. See section 602.2.

5 Floors over crawl spaces or exposed to ambient air conditions.

6 Required slab perimeter insulation shall be a water resistant material, manufactured for its intended use, and installed according to manufacturer's specifications. See section 602.4.

7 These options shall be applicable to buildings less than three stories.

8 This wall insulation requirement denotes R-19 wall cavity insulation plus R-5 foam sheathing.

9 This wall insulation requirement denotes R-21 wall cavity insulation plus R-7.5 foam sheathing.

TABLE 6-4 • PRESCRIPTIVE REQUIREMENTS<sup>1</sup> FOR GROUP R OCCUPANCY  
CLIMATE ZONE 2 • HEATING BY OTHER FUELS

OPTION	HVAC <sup>9</sup> EQUIP. EFFIC.	GLAZING % FLOOR AREA	GLAZING U-VALUE	DOORS U-VALUE	CEILING <sup>2</sup>	VAULTED CEILING <sup>3</sup>	WALL ABOVE GRADE	WALL <sup>4</sup> int <sup>4</sup> BELOW GRADE	WALL <sup>4</sup> ext <sup>4</sup> BELOW GRADE	FLOOR <sup>5</sup>	SLAB <sup>6</sup> ON GRADE
I.	Med.	10%	0.70	0.40	R-38	R-30	R-19	R-19	R-12	R-25	R-10
II.	Med.	12%	0.65	0.40	R-38	R-30	R-19	R-19	R-12	R-25	R-10
III.	High	17%	0.65	0.40	R-38	R-30	R-19	R-19	R-12	R-25	R-10
IV.*	Med.	17%	0.60	0.40	R-38	R-30	R-19	R-19	R-12	R-30	R-10
V.	Low	17%	0.50	0.40	R-38	R-30	R-19	R-19	R-12	R-30	R-10
VI.	Med.	21%	0.50	0.40	R-38	R-30	R-19	R-19	R-12	R-30	R-10
VII. <sup>7</sup>	Med.	25%	0.45	0.40	R-38	R-30	R-19	R-19	R-12	R-30	R-10
VIII. <sup>7</sup>	Med.	30%	0.40	0.40	R-38	R-30	R-19	R-19	R-12	R-30	R-10

\* Reference Case \* (highlighted in redline)

1 Minimum requirements for each option listed. For example, if a proposed design has a glazing ratio to the conditioned floor area of 10%, it shall comply with all of the requirements of the 21% glazing option (or higher). Proposed designs which cannot meet the specific requirements of a listed option above, may calculate compliance by Chapters 4 or 5 of this Code.

2 Requirement applies to all ceilings except single rafter or joist vaulted ceilings. 'Adv' denotes Advanced Framed Ceiling.

3 Requirement applicable only to single rafter or joist vaulted ceilings.

4 Below grade walls shall be insulated either on the exterior to a minimum level of R-10, or on the interior to the same level as walls above grade. Exterior insulation installed on below grade walls shall be a water resistant material, manufactured for its intended use, and installed according to the manufacturer's specifications. See section 602.2.

5 floors over crawl spaces or exposed to ambient air conditions.

6 Required slab perimeter insulation shall be a water resistant material, manufactured for its intended use, and installed according to manufacturer's specifications. See section 602.4.

7 These options shall be applicable to buildings less than three stories.

8 This wall insulation requirement denotes R-19 wall cavity insulation plus R-5 foam sheathing.

9 Minimum HVAC Equipment efficiency requirement. 'Low' denotes an AFUE of 0.74. 'Med.' denotes an AFUE of 0.78. 'High' denotes an AFUE of 0.88.

TABLE 6-5

**LOG HOMES PRESCRIPTIVE REQUIREMENTS<sup>1</sup>**  
**HEATING BY ELECTRIC RESISTANCE**

OPTION	AVERAGE <sup>2</sup> LOG THICKNESS	GLAZING % FLOOR AREA	GLAZING U-VALUE	DOORS U-VALUE	CEILING <sup>3</sup>	VAULTED <sup>4</sup> CEILING	FLOOR <sup>5</sup>	SLAB <sup>6</sup> ON GRADE
<b>CLIMATE ZONE 1</b>								
I. <sup>7</sup>	5.5"	15%	0.31	0.14	R-60 Adv	R-38	R-38	R-10
II. <sup>7</sup>	7.5"	15%	0.40	0.20	R-60 Adv	R-38	R-30	R-10
III.*	9.6"	15%	0.40	0.20	R-38	R-30	R-30	R-10
<b>CLIMATE ZONE 2</b>								
IV. <sup>7</sup>	6.7"	15%	0.31	0.14	R-60 Adv	R-38	R-38	R-10
V. <sup>7</sup>	8.7"	15%	0.40	0.14	R-60 Adv	R-38	R-38	R-10
VI. <sup>7</sup>	9.8"	15%	0.40	0.20	R-60 Adv	R-38	R-30	R-10
VII. <sup>7</sup>	10.5"	15%	0.40	0.20	R-49 Adv	R-38	R-30	R-10
VIII.*	13.5"	15%	0.40	0.20	R-38	R-30	R-30	R-10

\* Reference Case \* (highlighted in redline)

<sup>1</sup> For Group R Occupancy use Table 6-5 for only the portion of floor area using log/solid timber walls. Use Tables 6-1 to 6-4 for all other portions of the floor area. Minimum requirements are for each option listed. Interpolations between options is not permitted. Proposed designs which cannot meet the specific requirements of a listed option above, may calculate compliance by Chapters 4 or 5 of this Code.

<sup>2</sup> Required minimum average log thickness.

<sup>3</sup> 'Adv' denotes Advanced Framing. Requirement applies to all ceilings except single rafter joist vaulted ceilings.

<sup>4</sup> Requirement applicable only to single rafter joist vaulted ceilings.

<sup>5</sup> Floors over crawl spaces or exposed to ambient air conditions.

<sup>6</sup> Required slab perimeter insulation shall be water-resistant material, manufactured for its intended use, and installed according to manufacturer's specifications.

<sup>7</sup> These options shall be applicable to buildings less than three stories.



TABLE 6-6

**LOG HOMES PRESCRIPTIVE REQUIREMENTS<sup>1</sup>**  
**HEATING BY OTHER FUELS**

OPTION	AVERAGE <sup>2</sup> LOG THICKNESS	GLAZING % FLOOR AREA	GLAZING U-VALUE	DOORS U-VALUE	CEILING <sup>3</sup>	VAULTED <sup>4</sup> CEILING	FLOOR <sup>5</sup>	SLAB <sup>6</sup> ON GRADE
<b>CLIMATE ZONE 1</b>								
I. <sup>7</sup>	3.5"	21%	0.40	0.39	R-49 Adv	R-38	R-30	R-10
II.	4.4"	21%	0.40	0.40	R-38	R-30	R-19	R-10
III.	5.2"	21%	0.50	0.40	R-38	R-30	R-19	R-10
IV.	6.5"	21%	0.60	0.40	R-38	R-30	R-19	R-10
V.	7.0"	21%	0.60	0.40	R-38	R-30	R-19	R-10
VI.*	8.2"	21%	0.65	0.40	R-38	R-30	R-19	R-10
<b>CLIMATE ZONE 2</b>								
VII. <sup>7</sup>	3.5"	17%	0.31	0.14	R-60 Adv	R-38	R-38	R-10
VIII. <sup>7,8</sup>	3.5"	17%	0.40	0.40	R-60 Adv	R-38	R-30	R-10
IX. <sup>7</sup>	4.6"	17%	0.40	0.40	R-60 Adv	R-38	R-30	R-10
X.	5.4"	17%	0.40	0.40	R-38	R-30	R-30	R-10
XI.	6.8"	17%	0.50	0.40	R-38	R-30	R-30	R-10
XII.*	9.0"	17%	0.60	0.40	R-38	R-30	R-30	R-10

\* Reference Case • (highlighted in redline)

<sup>1</sup> For Group R Occupancy use Table 6-6 for only the portion of floor area using log/solid timber walls. Use Tables 6-1 to 6-4 for all other portions of the floor area. Minimum requirements are for each option listed. Interpolations between options is not permitted. Proposed designs which cannot meet the specific requirements of a listed option above, may calculate compliance by Chapters 4 or 5 of this Code.

<sup>2</sup> Required minimum average log thickness.

<sup>3</sup> 'Adv' denotes Advanced Framing. Requirement applies to all ceilings except single rafter joist vaulted ceilings.

<sup>4</sup> Requirement applicable only to single rafter joist vaulted ceilings.

<sup>5</sup> Floors over crawl spaces or exposed to ambient air conditions.

<sup>6</sup> Required slab perimeter insulation shall be water-resistant material, manufactured for its intended use, and installed according to manufacturer's specifications.

<sup>7</sup> These options shall be applicable to buildings less than three stories.

<sup>8</sup> For this option, minimum HVAC system efficiency is an AFUE of 0.88.

TABLE 6-7 OTHER THAN GROUP R OCCUPANCIES PRESCRIPTIVE REQUIREMENTS

COMPONENT	ZONE I	ZONE II
SPACE CONDITIONING SYSTEM TYPE	ANY	ANY
ROOF/CEILINGS	R-30	R-30
EXTERIOR WALLS	R-11	R-11
FLOORS OVER UNCONDITIONED SPACE	R-11	R-11
BELOW GRADE WALLS	R-4	R-5
SLAB ON GRADE FLOORS <sup>1</sup>	R-7	R-10
GLAZING TYPE	Double <sup>2</sup>	Double <sup>2</sup>
MAXIMUM TOTAL GLAZING AREA (% of Gross Exterior Wall Area)	32%	22%

<sup>1</sup> Insulation shall be a water-resistant material, manufactured for its intended use, and installed to manufacturer's specifications.

<sup>2</sup> 'Double' denotes a minimum air space between glazings of 1/2 inch.

NEW SECTION

WAC 51-11-0625 TABLE 6-1.

TABLE 6-1  
 PRESCRIPTIVE REQUIREMENTS<sup>1</sup> FOR GROUP R OCCUPANCY  
 CLIMATE ZONE 1  
 HEATING BY ELECTRIC RESISTANCE

OPTION	GLAZING % FLOOR AREA	GLAZING U-VALUE	DOORS U-VALUE	CEILING <sup>2</sup>	VAULTED CEILING <sup>3</sup>	WALL ABOVE GRADE	WALL•int <sup>4</sup> BELOW GRADE	WALL•ext <sup>4</sup> BELOW GRADE	FLOOR <sup>5</sup>	SLAB <sup>6</sup> ON GRADE
I.	10%	0.46	0.40	R-38	R-30	R-21	R-21	R-10	R-30	R-10
II.	12%	0.43	0.20	R-38	R-30	R-19	R-19	R-10	R-30	R-10
III.	12%	0.40	0.40	R-38	R-30	R-21	R-21	R-10	R-30	R-10
IV.*	15%	0.40	0.20	R-38	R-30	R-19	R-19	R-10	R-30	R-10
V.	18%	0.39	0.20	R-38	R-30	R-21	R-21	R-10	R-30	R-10
VI.	21%	0.36	0.20	R-38	R-30	R-21	R-21	R-10	R-30	R-10
VII. <sup>7</sup>	25%	0.32 <sup>7</sup>	0.20	R-38	R-30	R-19+R-5 <sup>8</sup>	R-21	R-10	R-30	R-10
VIII. <sup>7</sup>	30%	0.29 <sup>7</sup>	0.20	R-38	R-30	R-19+R-5 <sup>8</sup>	R-21	R-10	R-30	R-10

\* Reference Case

- 1 Minimum requirements for each option listed. For example, if a proposed design has a glazing ratio to the conditioned floor area of 19%, it shall comply with all of the requirements of the 21% glazing option (or higher). Proposed designs which cannot meet the specific requirements of a listed option above, may calculate compliance by Chapters 4 or 5 of this Code.
- 2 Requirement applies to all ceilings except single rafter or joist vaulted ceilings. 'Adv' denotes Advanced Framed Ceiling.
- 3 Requirement applicable only to single rafter or joist vaulted ceilings.
- 4 Below grade walls shall be insulated either on the exterior or on the interior. Exterior insulation installed on below grade walls shall be a water resistant material, manufactured for its intended use, and installed according to the manufacturer's specifications. See section 602.2.
- 5 Floors over crawl spaces or exposed to ambient air conditions.
- 6 Required slab perimeter insulation shall be a water resistant material, manufactured for its intended use, and installed according to manufacturer's specifications. See section 602.4.
- 7 The following options shall be applicable to buildings less than three stories: 0.35 maximum for glazing areas of 25% or less; 0.32 maximum for glazing areas of 30% or less.
- 8 This wall insulation requirement denotes R-19 wall cavity insulation plus R-5 foam sheathing.

TABLE 6-2  
 PRESCRIPTIVE REQUIREMENTS<sup>1</sup> FOR GROUP R OCCUPANCY  
 CLIMATE ZONE 1  
 HEATING BY OTHER FUELS

OPTION	HVAC <sup>9</sup> EQUIP. EFFIC.	GLAZING % FLOOR AREA	GLAZING U-VALUE	DOORS U-VALUE	CEILING <sup>2</sup>	VAULTED CEILING <sup>3</sup>	WALL, ABOVE GRADE	WALL•int <sup>4</sup> BELOW GRADE	WALL•ext <sup>4</sup> BELOW GRADE	FLOOR <sup>5</sup>	SLAB <sup>6</sup> ON GRADE
I.	Med.	10%	0.70	0.40	R-30	R-30	R-15	R-15	R-10	R-19	R-10
II.	Med.	12%	0.65	0.40	R-30	R-30	R-15	R-15	R-10	R-19	R-10
III.	High	21%	0.75	0.40	R-30	R-30	R-19	R-19	R-10	R-19	R-10
IV.*	Med.	21%	0.65	0.40	R-30	R-30	R-19	R-19	R-10	R-19	R-10
V.	Low	21%	0.60	0.40	R-30	R-30	R-19	R-19	R-10	R-19	R-10
VI. <sup>7</sup>	Med.	25%	0.45 <sup>7</sup>	0.40	R-38	R-30	R-19	R-19	R-10	R-25	R-10
VII. <sup>7</sup>	Med.	30%	0.40 <sup>7</sup>	0.40	R-30	R-30	R-19	R-19	R-10	R-25	R-10

\* Reference Case

- 1 Minimum requirements for each option listed. For example, if a proposed design has a glazing ratio to the conditioned floor area of 19%, it shall comply with all of the requirements of the 21% glazing option (or higher). Proposed designs which cannot meet the specific requirements of a listed option above, may calculate compliance by Chapters 4 or 5 of this Code.
- 2 Requirement applies to all ceilings except single rafter or joist vaulted ceilings. 'Adv' denotes Advanced Framed Ceiling.
- 3 Requirement applicable only to single rafter or joist vaulted ceilings.
- 4 Below grade walls shall be insulated either on the exterior or on the interior. Exterior insulation installed on below grade walls shall be a water resistant material, manufactured for its intended use, and installed according to the manufacturer's specifications. See section 602.2.

5 Floors over crawl spaces or exposed to ambient air conditions.

6 Required slab perimeter insulation shall be a water resistant material, manufactured for its intended use, and installed according to manufacturer's specifications. See section 602.4.

7 The following options shall be applicable to buildings less than three stories: 0.50 maximum for glazing areas of 25% or less; 0.45 maximum for glazing areas of 30% or less.

8 This wall insulation requirement denotes R-19 wall cavity insulation plus R-5 foam sheathing.

9 Minimum HVAC Equipment efficiency requirement for combustion appliances. 'Low' denotes an AFUE of 0.74. 'Med.' denotes an AFUE of 0.78. 'High' denotes an AFUE of 0.88 or greater. Minimum HVAC Equipment efficiency requirement for heat pumps. 'Low' denotes an HSPF of 6.35. 'Med' denotes and HSPF of 6.8. 'High' denotes and HSPF of 7.7. Water and ground source heat pumps shall be considered as medium efficiency and have a minimum COP as required in Table 5-7.

**PRESCRIPTIVE REQUIREMENTS<sup>1</sup> FOR GROUP R OCCUPANCY  
CLIMATE ZONE 2  
HEATING BY ELECTRIC RESISTANCE**

OPTION	GLAZING % FLOOR AREA	GLAZING U-VALUE	DOORS U-VALUE	CEILING <sup>2</sup>	VAULTED CEILING <sup>3</sup>	WALL ABOVE GRADE	WALL•int <sup>4</sup> BELOW GRADE	WALL•ext <sup>4</sup> BELOW GRADE	FLOOR <sup>5</sup>	SLAB <sup>6</sup> ON GRADE
I.	10%	0.38	0.20	R-38	R-30	R-21	R-21	R-12	R-30	R-10
II.	12%	0.40	0.20	R-38	R-30	R-19+R-5 <sup>8</sup>	R-21	R-12	R-25	R-10
III.*	15%	0.40	0.20	R-38	R-30	R-19+R-5 <sup>8</sup>	R-21	R-12	R-30	R-10
IV.	18%	0.38	0.20	R-38	R-30	R-19+R-5 <sup>8</sup>	R-21	R-12	R-30	R-10
V. <sup>7</sup>	21%	0.35	0.20	R-38Adv	R-38	R-19+R-5 <sup>8</sup>	R-21	R-12	R-30	R-10
VI. <sup>7</sup>	25%	0.30 <sup>7</sup>	0.20	R-49Adv	R-38	R-19+R-5 <sup>8</sup>	R-21	R-12	R-30	R-10
VII. <sup>7</sup>	30%	0.28 <sup>7</sup>	0.20	R-60Adv	R-38	R21+R7.5 <sup>9</sup>	R-21	R-12	R-30	R-10

\* Reference Case

1 Minimum requirements for each option listed. For example, if a proposed design has a glazing ratio to the conditioned floor area of 19%, it shall comply with all of the requirements of the 21% glazing option (or higher). Proposed designs which cannot meet the specific requirements of a listed option above, may calculate compliance by Chapters 4 or 5 of this Code.

2 Requirement applies to all ceilings except single rafter or joist vaulted ceilings. 'Adv' denotes Advanced Framed Ceiling.

3 Requirement applicable only to single rafter or joist vaulted ceilings.

4 Below grade walls shall be insulated either on the exterior or on the interior. Exterior insulation installed on below grade walls shall be a water resistant material, manufactured for its intended use, and installed according to the manufacturer's specifications. See section 602.2.

5 Floors over crawl spaces or exposed to ambient air conditions.

6 Required slab perimeter insulation shall be a water resistant material,

7 manufactured for its intended use, and installed according to manufacturer's specifications. See section 602.4.

8 The following options shall be applicable to buildings less than three stories: 0.35 maximum for glazing areas of 25% or less; 0.31 maximum for glazing areas of 30% or less.

9 This wall insulation requirement denotes R-19 wall cavity insulation plus R-5 foam sheathing.

10 This wall insulation requirement denotes R-21 wall cavity insulation plus R-7.5 foam sheathing.



**PRESCRIPTIVE REQUIREMENTS<sup>1</sup> FOR GROUP R OCCUPANCY**  
**CLIMATE ZONE 2**  
**HEATING BY OTHER FUELS**

OPTION	HVAC <sup>9</sup> EQUIP. EFFIC.	GLAZING % FLOOR AREA	GLAZING U-VALUE	DOORS U-VALUE	CEILING <sup>2</sup>	VAULTED CEILING <sup>3</sup>	WALL ABOVE GRADE	WALL•int <sup>4</sup> BELOW GRADE	WALL•ext <sup>4</sup> BELOW GRADE	FLOOR <sup>5</sup>	SLAB <sup>6</sup> ON GRADE
I.	Med.	10%	0.70	0.40	R-38	R-30	R-19	R-19	R-12	R-25	R-10
II.	Med.	12%	0.65	0.40	R-38	R-30	R-19	R-19	R-12	R-25	R-10
III.	High	17%	0.65	0.40	R-38	R-30	R-19	R-19	R-12	R-25	R-10
IV.*	Med.	17%	0.60	0.40	R-38	R-30	R-19	R-19	R-12	R-30	R-10
V.	Low	17%	0.50	0.40	R-38	R-30	R-19	R-19	R-12	R-30	R-10
VI.	Med.	21%	0.50	0.40	R-38	R-30	R-19	R-19	R-12	R-30	R-10
VII.	Med.	25%	0.40 <sup>7</sup>	0.40	R-38	R-30	R-19	R-19	R-12	R-30	R-10
VIII.	Med.	30%	0.35 <sup>7</sup>	0.40	R-38	R-30	R-19	R-19	R-12	R-30	R-10

\* Reference Case

1 Minimum requirements for each option listed. For example, if a proposed design has a glazing ratio to the conditioned floor area of 10%, it shall comply with all of the requirements of the 21% glazing option (or higher). Proposed designs which cannot meet the specific requirements of a listed option above, may calculate compliance by Chapters 4 or 5 of this Code.

2 Requirement applies to all ceilings except single rafter or joist vaulted ceilings. 'Adv' denotes Advanced Framed Ceiling.

3 Requirement applicable only to single rafter or joist vaulted ceilings.

4 Below grade walls shall be insulated either on the exterior or on the interior. Exterior insulation installed on below grade walls shall be a water resistant material, manufactured for its intended use, and installed according to the manufacturer's specifications. See section 602.2.

5 Floors over crawl spaces or exposed to ambient air conditions.

6 Required slab perimeter insulation shall be a water resistant material, manufactured for its intended use, and installed according to manufacturer's specifications. See section 602.4.

7 The following options shall be applicable to buildings less than three stories: 0.45 maximum for glazing areas of 25% or less; 0.40 maximum for glazing areas of 30% or less.

8 This wall insulation requirement denotes R-19 wall cavity insulation plus R-5 foam sheathing.

9 Minimum HVAC Equipment efficiency requirement for combustion appliances. 'Low' denotes an AFUE of 0.74. 'Med.' denotes an AFUE of 0.78. 'High' denotes an AFUE of 0.88 or greater. Minimum HVAC Equipment efficiency requirement for heat pumps. 'Low' denotes an HSPF of 6.35. 'Med' denotes and HSPF of 6.8. 'High' denotes and HSPF of 7.7. Water and ground source heat pumps shall be considered as medium efficiency and have a minimum COP as required in Table 5-7.

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**LOG HOMES PRESCRIPTIVE REQUIREMENTS<sup>1</sup>**  
**HEATING BY ELECTRIC RESISTANCE**

OPTION	AVERAGE <sup>2</sup> LOG THICKNESS	GLAZING % FLOOR AREA	GLAZING U-VALUE	DOORS U-VALUE	CEILING <sup>3</sup>	VAULTED <sup>4</sup> CEILING	FLOOR <sup>5</sup>	SLAB <sup>6</sup> ON GRADE
<b>CLIMATE ZONE 1</b>								
I. <sup>7</sup>	5.5"	15%	0.31	0.14	R-60 Adv	R-38	R-38	R-10
II. <sup>7</sup>	7.5"	15%	0.40	0.20	R-60 Adv	R-38	R-30	R-10
III.*	9.6"	15%	0.40	0.20	R-38	R-30	R-30	R-10
<b>CLIMATE ZONE 2</b>								
IV. <sup>7</sup>	6.7"	15%	0.31	0.14	R-60 Adv	R-38	R-38	R-10
V. <sup>7</sup>	8.7"	15%	0.40	0.14	R-60 Adv	R-38	R-38	R-10
VI. <sup>7</sup>	9.8"	15%	0.40	0.20	R-60 Adv	R-38	R-30	R-10
VII. <sup>7</sup>	10.5"	15%	0.40	0.20	R-49 Adv	R-38	R-30	R-10
VIII.*	13.5"	15%	0.40	0.20	R-38	R-30	R-30	R-10

\* Reference Case

<sup>1</sup> For Group R Occupancy use Table 6-5 for only the portion of floor area using log/solid timber walls. Use Tables 6-1 to 6-4 for all other portions of the floor area. Minimum requirements are for each option listed. Interpolations between options is not permitted. Proposed designs which cannot meet the specific requirements of a listed option above, may calculate compliance by Chapters 4 or 5 of this Code.

<sup>2</sup> Required minimum average log thickness.

<sup>3</sup> 'Adv' denotes Advanced Framing. Requirement applies to all ceilings except single rafter joist vaulted ceilings.

<sup>4</sup> Requirement applicable only to single rafter joist vaulted ceilings.

<sup>5</sup> Floors over crawl spaces or exposed to ambient air conditions.

<sup>6</sup> Required slab perimeter insulation shall be water-resistant material, manufactured for its intended use, and installed according to manufacturer's specifications.

<sup>7</sup> These options shall be applicable to buildings less than three stories.

**NEW SECTION**

WAC 51-11-0630 TABLE 6-6.

**LOG HOMES PRESCRIPTIVE REQUIREMENTS<sup>1</sup>**  
**HEATING BY OTHER FUELS**

OPTION	AVERAGE <sup>2</sup> LOG THICKNESS	GLAZING % FLOOR AREA	GLAZING U-VALUE	DOORS U-VALUE	CEILING <sup>3</sup>	VAULTED <sup>4</sup> CEILING	FLOOR <sup>5</sup>	SLAB <sup>6</sup> ON GRADE
<b>CLIMATE ZONE 1</b>								
I. <sup>7</sup>	3.5"	21%	0.40	0.39	R-49 Adv	R-38	R-30	R-10
II.	4.4"	21%	0.40	0.40	R-38	R-30	R-19	R-10
III.	5.2"	21%	0.50	0.40	R-38	R-30	R-19	R-10
IV.	6.5"	21%	0.60	0.40	R-38	R-30	R-19	R-10
V.	7.0"	21%	0.60	0.40	R-38	R-30	R-19	R-10
VI.*	8.2"	21%	0.65	0.40	R-38	R-30	R-19	R-10
<b>CLIMATE ZONE 2</b>								
VII. <sup>7</sup>	3.5"	17%	0.31	0.14	R-60 Adv	R-38	R-38	R-10
VIII <sup>7,8</sup>	3.5"	17%	0.40	0.40	R-60 Adv	R-38	R-30	R-10
IX. <sup>7</sup>	4.6"	17%	0.40	0.40	R-60 Adv	R-38	R-30	R-10
X.	5.4"	17%	0.40	0.40	R-38	R-30	R-30	R-10
XI.	6.8"	17%	0.50	0.40	R-38	R-30	R-30	R-10
XII.*	9.0"	17%	0.60	0.40	R-38	R-30	R-30	R-10

\* Reference Case

<sup>1</sup> For Group R Occupancy use Table 6-6 for only the portion of floor area using log/solid timber walls. Use Tables 6-1 to 6-4 for all other portions of the floor area. Minimum requirements are for each option listed. Interpolations between options is not permitted. Proposed designs which cannot meet the specific requirements of a listed option above, may calculate compliance by Chapters 4 or 5 of this Code.

<sup>2</sup> Required minimum average log thickness.

<sup>3</sup> 'Adv' denotes Advanced Framing. Requirement applies to all ceilings except single rafter joist vaulted ceilings.

<sup>4</sup> Requirement applicable only to single rafter joist vaulted ceilings.

<sup>5</sup> Floors over crawl spaces or exposed to ambient air conditions.

<sup>6</sup> Required slab perimeter insulation shall be water-resistant material, manufactured for its intended use, and installed according to manufacturer's specifications.

<sup>7</sup> These options shall be applicable to buildings less than three stories.

<sup>8</sup> For this option, minimum HVAC system efficiency is an AFUE of 0.88.

**NEW SECTION**

WAC 51-11-0631 TABLE 6-7.

OTHER THAN GROUP R OCCUPANCIES PRESCRIPTIVE REQUIREMENTS

COMPONENT	ZONE I	ZONE II
SPACE CONDITIONING SYSTEM TYPE	ANY	ANY
ROOF/CEILINGS	R-30	R-30
EXTERIOR WALLS	R-11	R-11
FLOORS OVER UNCONDITIONED SPACE	R-11	R-11
BELOW GRADE WALLS	R-4	R-5
SLAB ON GRADE FLOORS <sup>1</sup>	R-7	R-10
GLAZING TYPE	Double <sup>2</sup>	Double <sup>2</sup>
MAXIMUM TOTAL GLAZING AREA (% of Gross Exterior Wall Area)	32%	22%

<sup>1</sup> Insulation shall be a water-resistant material, manufactured for its intended use, and installed to manufacturer's specifications.

<sup>2</sup> 'Double' denotes a minimum air space between glazings of 1/2 inch.

AMENDATORY SECTION (Amending WSR 91-01-112, filed 12/19/90, effective 7/1/91)

WAC 51-11-1000 CHAPTER 10.

Section 1000 Default heat-loss coefficients ((for-site-built-single-and-multifamily-homes)).