

State of Washington

State Building Code Council

(name of governing body)

(agency name, if applicable)

Resolution No. _____

Administrative Order No. 86-04

(1) Be it resolved by the State Building Code Council, acting at Angle Lake Fire Hall 2929 South 200 Street, Seattle, Washington, (place)

that it does adopt the annexed rules relating to: Adoption of amendments to the Washington State Energy Code Chapter 51-12 WAC

(2) ALTERNATIVE A. Use only for Adoption of Permanent Rules.

This action is taken pursuant to Notice No. 86-06-058 filed with the code reviser on March 5, 1986. These rules shall take effect: thirty days after they are filed with the code reviser pursuant to RCW 34.04.040(2). at a later date, such date being _____

(2) ALTERNATIVE B. Use only for Adoption of Emergency Rules.

We, _____, find that an emergency exists and that this order is necessary for the preservation of the public health, safety, or general welfare and that observance of the requirements of notice and opportunity to present views on the proposed action would be contrary to public interest. A statement of the facts constituting the emergency is:

These rules are therefore adopted as emergency rules to take effect upon filing with the code reviser.

(3) Pursuant to the requirements of RCW 34.04.026¹ that "every agency shall incorporate the most specific, but in no case omit all, of the following language alternatives when adopting or amending rules" fill in statement (a), (b), or (c) as appropriate:

(a) This rule is promulgated pursuant to RCW 19.27 A. 020 and is intended to administratively implement that statute.

(b) This rule is promulgated pursuant to RCW 19.27A which directs that the

State Building Code Council

(agency)

has authority to implement the provisions of

19.27A

(name of act or RCW citation)

(c) This rule is promulgated under the general rule-making authority of the

(agency)

as authorized in RCW _____

(4) The undersigned hereby declares that the agency has complied with the provisions of the Open Public Meetings Act (chapter 42.30 RCW), the Administrative Procedure Act (chapter 34.04 RCW), and the State Register Act (chapter 34.08 RCW) in the adoption of these rules.

(5) This order, after being first recorded in the order register of this governing body, is herewith transmitted to the Code Reviser for filing pursuant to chapter 34.04 RCW and chapter 1-12 WAC.

STATE OF WASHINGTON APPROVED AND ADOPTED April 18, 19 86 FILED

MAY 13 1986

By [Signature] Chair, State Building Code Council Title

CODE REVISER'S OFFICE

WVSR 86-11-013

AMENDATORY SECTION (Amending Order 85-14, filed 11/26/85)

WAC 51-12-102 SECTION 102. SCOPE.

This Code sets forth minimum requirements for the design of new buildings and structures that provide facilities or shelter for public assembly, educational, business, mercantile, institutional, storage and residential occupancies, as well as those portions of factory and industrial occupancies designed primarily for human occupancy by regulating their exterior envelopes and the selection of their HVAC, service water heating, electrical distribution and illuminating systems and equipment for effective use of energy.

Buildings shall be designed to comply with the requirements of either Chapter 4, 5, or 6 of this Code.

(a) Exempt Buildings. Buildings and structures or portions thereof meeting any of the following criteria shall be exempt from the building envelope requirements of Sections 402 to 405 inclusive, and Sections 601 and 605, but shall comply with all other requirements for building mechanical systems, service water heating and lighting systems.

1. Buildings and structures or portions thereof whose peak design rate of energy usage is less than three and four tenths (3.4) Btu/h per square foot or one point zero (1.0) watt per square foot of floor area for all purposes.
2. Buildings and structures or portions thereof which are neither heated nor cooled by a depletable energy source, including buildings heated with wood with installed back-up or supplemental heating utilizing a depletable energy source provided that: the depletable energy use complies with the requirements of exemption (1).

(b) Application to Existing Buildings.

1. Additions to Existing Buildings. Additions to existing buildings or structures may be made to such buildings or structures without making the entire building or structure comply, provided that the new additions shall conform to the provisions of this Code.
2. Historic Buildings. The Building Official may modify the specific requirements of this Code for historic buildings and require in lieu thereof alternate requirements which will result in a reasonable degree of energy efficiency. This modification may be allowed for those buildings which have been specifically designated as historically significant by the state or local governing body, or listed in "The National Register of Historic Places" or which have been determined to be eligible for listing.
3. Alterations and Repairs. Initial tenant alterations shall comply with the new construction requirements of this Code. Other alterations and repairs may be made to existing buildings without making the entire building comply with all of the requirements of this Code for new buildings, provided the following requirements are met:
 - A. Building Envelope. The result of the alterations or repairs (1) improves the energy efficiency of the building and (2) complies with the overall average thermal transmittance values of the gross area of the elements of the exterior building envelope in Table 4-2, 4-3, or 4-4 of Chapter 4 or the nominal R values in Tables 6-1 or 6-5 and U values in Table 6-2 or glazing requirements in Table 6-5 of Chapter 6. Where the structural elements of the altered portions of roof/ceiling, wall or floor are not being replaced, these elements shall be deemed to comply with this Code if all existing framing cavities which are exposed during construction are

- filled to the full depth with batt insulation or insulation having an equivalent nominal R value while, for roof/ceilings, maintaining the required space for ventilation. Existing roof/ceilings, walls and floors without framing cavities need not be insulated.
- B. Building Mechanical Systems. Those parts of systems which are altered or replaced shall comply with this Code. Heating equipment efficiencies for low-rise residential occupancy buildings shall comply with the minimum efficiency requirements of Table 6-4.
- C. Service Water Heating. Those parts of systems which are altered or replaced shall comply with Section 420.
- D. Lighting. Those parts of systems which are altered or replaced in buildings initially constructed subject to the requirements of this Code shall comply with Section 425. Other remodels or replacements of lighting systems which are part of a substantial remodel shall comply with Section 425. In addition, other remodels or replacements which affect the lighting system of an entire floor shall comply with the lighting power budgets specified in Table No. 4-18.

The Building Official may approve designs of alterations or repairs which do not fully conform with all of the requirements of this Code (~~where~~) when in his/her opinion full conformance is physically impossible and/or economically impractical and: (1) the alteration or repair improves the energy efficiency of the building; or (2) the alteration or repair is energy efficient and is necessary for the health, safety, and welfare of the general public.

AMENDATORY SECTION (Amending Order 85-14, filed 11/26/85)

WAC 51-12-404 SECTION 404. THERMAL PERFORMANCE CRITERIA FOR ALL OTHER OCCUPANCIES.

((1)) Criteria.

((1.1))

- (a) The overall average 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 4-3 and 4-4. Equations 1 and 2 shall be used to determine acceptable combinations of building components and thermal properties to meet this requirement for heating. U values for windows used to calculate total wall U_o shall be determined in accordance with accepted engineering practice. U_o and U_w are specified in units of

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

((1.2))

- (b) Floors over unheated spaces shall not exceed the U_o value given in Table 4-3 and 4-4.

((1.3))

(c) 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 4-3 and 4-4.

Insulation installed inside the foundation shall extend downward from the top of the slab for a minimum distance of 24 inches, or downward to the bottom of the slab; then horizontally beneath the slab for a minimum total distance of 24 inches. Insulation installed outside the foundation shall extend downward 12 inches below grade or frostline or to the top of the footing.

(4-)
(d) Alternative Wall Allowance for Low-rise Nonresidential Occupancies.

(A-)
1. For nonresidential occupancy buildings, 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 4-4 provided that at least one of the following criteria is also met:

(i-)
A. 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 non-occupancy, or

(ii-)
B. The primary source of heating for the building shall be one or more heat pumps meeting the provisions of Section 411(b) or gas or oil combustion heating equipment with a minimum combustion efficiency of 85 percent for central heating plants and 80 percent for room and space heaters. This efficiency shall be determined in accordance with the provisions of Section 411(c).

Provided further: that if both criteria are met, the maximum allowed value for average thermal transmittance (U_o) of the exterior walls used in Table 4-4 may be increased by 0.05 in determining compliance with the provisions of the code.

(B-)
2. For walls with a wall weight of at least 30 lbs. per sq. ft. (provided that walls constructed of hollow masonry units have cores filled with either grout, concrete, or with an insulating material with thermal resistance per inch (R) of at least 2.25 sq. ft./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 25 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 5°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.

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

Where:

U = the thermal transmittance of the assembly

r_o = outside air film resistance,

r_o = .17 for all exterior surfaces in winter

r_o = .25 for all exterior surfaces in summer

r_i = inside air film resistance,

r_i = .61 for interior horizontal surfaces, heat flow up

r_i = .92 for interior horizontal surfaces, heat flow down

r_i = .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

X = the thickness of the material

EQUATION 2

$$U_o = \frac{U_w A_w + U_g A_g + U_d A_d \dots \dots \dots}{A}$$

Where:

U_o = the average or combined transmittance of the gross exterior wall, floor or roof/ceiling assembly area (except slabs on grade).

A = the gross exterior wall, floor or roof/ceiling assembly area.

U_w = the thermal transmittance of the components of the opaque wall, floor or roof/ceiling assembly area.

A_w = opaque wall, floor or roof/ceiling assembly area.

U_g = the thermal transmittance of the glazing (window or skylight) area.

A_g = glazing area.

U_d = the thermal transmittance of the door, or similar opening.

A_d = door area.

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:

$$UW_1AW_1 + UW_2AW_2 + UW_3AW_3 + \dots \text{etc.}$$

AMENDATORY SECTION (Amending Order 85-14, filed 11/26/85)

WAC 51-12-411 SECTION 411. HVAC EQUIPMENT PERFORMANCE REQUIREMENTS.

- (a) The requirement of this section applies to equipment and component performance for heating, ventilating and air-conditioning systems. Where equipment efficiency levels are specified, approved 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 shown in Tables 4-9, 4-10 and 4-11.
- (b) HVAC-System Heating Equipment Heat Pumps--Heating Mode: Heat pumps whose energy input is entirely electric shall have a Coefficient of Performance (COP heating, as defined herein) not less than the values shown in Table 4-12.
1. These requirements apply to, but are not limited to, unitary heat pumps (air source and water source) in the heating mode and to heat pumps in the packaged terminal air-conditioner and room air-conditioner forms in the heating mode. Field assembled unitary heat pumps, consisting of one or more components, shall comply with this section.
 2. Coefficient of Performance (COP) Heating: The ratio of the rate of net heat output to the rate of total energy input, expressed in consistent units and under designated rating conditions.
The rate of net heat output shall be defined as the change in the total heat content of the air entering and leaving the equipment (not including supplementary heat).
Total energy input shall be determined by combining the energy inputs to all elements, except supplementary heaters, of the heat pump, including, but not limited to, compressor(s), pump(s), supply-air fan(s), return-air fan(s), outdoor-air fan(s), cooling-tower fan(s), and the HVAC-system equipment control circuit.
 3. Supplementary Heater: The heat pump shall be installed with a control to prevent supplementary heater operation when the heating load can be met by the heat pump alone. Supplementary heater operation is permitted during transient periods, such as start-ups, following room thermostat set-point advance, and during defrost, when the outdoor air temperature is below 55°F.
A two-stage thermostat, which controls the supplementary heat on its second stage, with outdoor air control, shall be accepted as meeting this requirement. 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. Supplementary heat may be derived from any source of electric resistance heating or combustion heating.

- (c) HVAC-System-Combustion Heating Equipment: All commercial gas and oil-fired central heating plants shall show a minimum combustion efficiency of not less than those shown in Table 4-5.
All residential gas, oil, and propane central heating systems must have a minimum AFUE of .74. All other residential heating equipment fueled by gas, oil, or propane must be equipped with an intermittent ignition device.
- (d) Mechanical Ventilation. Each mechanical ventilation system (supply and/or exhaust) shall be equipped with a readily accessible or automatic means for either shut-off or volume reduction and shut-off when ventilation is not required.
- (e) 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 show a Coefficient of Performance (COP) cooling as defined herein not less than values shown in Table 4-13.
1. These requirements apply to, but are not limited to unitary cooling equipment (air-cooled, water-cooled and evaporatively-cooled); the cooling mode of unitary and packaged heat pumps (air source and water source); packaged terminal air-conditioners; and room air-conditioners.
EXCEPTION: These requirements do not apply to equipment used for refrigerated food or florists' and nurseries' coolers.
 2. Coefficient of Performance (COP) Cooling: The ratio of the rate of net heat removal to the rate of total energy input, expressed in consistent units and under designated rating conditions.
The rate of net heat removal shall be defined as the change in the total heat contents of the air entering and leaving the equipment (without reheat).
Total energy input shall be determined by combining the energy inputs to all elements of the equipment, including but not limited to compressor(s), pump(s), supply-air fan(s), return-air fan(s), condenser-air fan(s), cooling-tower fan(s), circulating water pump(s), and the HVAC-system equipment control circuit.
- (f) Applied HVAC-system components, electrically operated cooling-mode. HVAC-system components, as listed in Table 4-14 whose energy input is entirely electric, shall show a Coefficient of Performance (COP) cooling, as defined herein, and not less than the values shown in Table 4-14.
1. Coefficient of Performance (COP) Cooling. The ratio of the rate of net heat removal to the rate of total energy input, expressed in consistent units and under designated rating conditions.
 2. The rate of net heat removal is defined as the difference in total heat contents of the water or refrigerant entering and leaving the component.
 3. Total energy input shall be determined by combining the energy inputs to all elements and accessories of the component, including but not limited to, compressor(s), internal circulating pump(s), condenser-air fan(s), evaporative-condenser cooling water pump(s), purge, and the HVAC-system component control circuit.
- (g) HVAC-system equipment--heat operated cooling mode. Efficiency limitation equipment: Heat operated cooling equipment shall show a (COP) cooling not less than the values shown in Table 4-15. These requirements apply to, but are not limited to, absorption equipment, engine driven equipment, and turbine driven equipment.
- (h) Fireplaces. Fireplaces shall be provided with:
1. Tightly fitting flue dampers, operated with a readily accessible manual or approved automatic control.

EXCEPTION: Fireplaces with gas logs installed in accordance with UMC 803 shall be equipped with tightly fitting glass or metal doors.

2. An outside source for combustion air. The duct shall be at least six square inches in area, and shall be provided with a readily operable damper.

AMENDATORY SECTION (Amending Order 85-14, filed 11/26/85)

WAC 51-12-426 SECTION 426. 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 426.

(a) 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.

(b) 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 No. 4-18.

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 30 percent shall be allowed for any single space up to 400 square feet and enclosed by ceiling height partitions; classrooms, conference rooms, computer rooms, storage areas, corridors, or waiting rooms.
- B. For daylighting controls, energy savings of 30 percent for continuous dimming and 20 percent for stepped controls shall be allowed for any daylit space.

- C. For lumen maintenance controls, energy savings of 10 percent shall be allowed for any space.
 - D. For daylighting controls with occupant-sensing devices, energy savings of 44 percent shall be allowed for any single space up to 400 square feet within daylit spaces, and enclosed by ceiling height partitions.
 - E. For occupant-sensing devices with lumen maintenance controls, energy savings of 37 percent shall be allowed for any single space up to 400 square feet and enclosed by ceiling height partitions.
2. 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.

(c) 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 square foot of area. Lighting for signs that are not an integral part of the building shall be exempted from inclusion in these calculations.

TABLE 4-1
Classification of Building Occupancies

	All Group R Occupancy Space	Other than Group R Occupancy Space
Three conditioned stories and less	Table 4-2	Table 4-3
More than three conditioned stories	Table 4-4	Table 4-4

TABLE 4-2
Low-rise Residential Buildings
Maximum Allowed Uo Values
and Minimum Allowed E Values

Heat Type	Climatic Zone	Roofs	Cathedral	Walls	Floors	Slab ¹
		Ceilings	Ceilings	(Includes Glazing)		on Grade
		<u>U_o</u>	<u>U_o</u>	<u>U_o</u>	<u>U_o</u>	Installed R Value
Electric Resistance	I	0.026	0.035	0.144	0.055	8
Other	I	0.035	0.035	0.203	0.055	8
Electric Resistance	II	0.026	0.035	0.144	0.043	10
Other	II	0.035	0.035	0.203	0.055	10

¹Insulation shall be water-resistant material manufactured for this use.

TABLE 4-3

Nonresidential Occupancies
Buildings 3 Stories or Less
Maximum Allowed U_o Values and
Minimum Allowed R Values

Zone	Ceilings	Walls	Floors	Slab ¹
		(Includes Glazing)		on Grade
		<u>U_o</u>	<u>U_o</u>	Installed R Value
I	0.035	0.25	0.05	8
II	0.035	0.20	0.05	10

¹Insulation shall be water-resistant material manufactured for this use.

TABLE 4-4

All Occupancies
Buildings over 3 Stories
Maximum Allowed U_o Values and
Minimum Allowed R Values

Zone	Ceilings	Walls (Includes Glazing)	Floors	Slab ¹ on Grade
	<u>U_o</u>	<u>U_o</u>	<u>U_o</u>	<u>Installed R Value</u>
I	0.08	0.30	0.08	8
II	0.06	0.25	0.08	10

¹Insulation shall be water-resistant material manufactured for this use.

TABLE 4-5

Nonresidential 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 Furnaces and Boilers
	Percent ¹	Percent ²
Forced-air furnaces and low-pressure steam or hot-water boilers	74	75
Gravity central furnaces	69	-
All other vented heating equipment	69	-

¹Combustion 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.

²Combustion 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 4-6
(Reserved)

TABLE 4-7
(Reserved)

TABLE 4-8
Allowable Air Infiltration Rates

Windows	Residential Doors		Commercial Doors
(cfm per lineal foot of operable sash crack)	cfm per sq. ft. of door area		cfm per lin. ft. of crack
	sliding glass	entrance	swinging, sliding, revolving
0.5	0.5	1.00	11.0

TABLE 4-9
HVAC System Heating Equipment (Heat Pumps)
Standard Rating Conditions

Conditions		Type		
		Air Source		Water Source
Air entering equipment	°F	70 db	70 db	70 db
Outdoor unit ambient	°F	47 db/ 43 wb	17 db/ 15 wb	--
Entering water temperature	°F	--	--	60
Water flow rate		--	--	as used in cooling mode

TABLE 4-10
HVAC System Equipment
Standard Rating Conditions -- Cooling

		Temperatures			
		DB	WB	Inlet	Outlet
Air Entering Equipment	°F	80	67	--	--
Condenser Ambient (Air Cooled)	°F	95	75	--	--

	°F	Temperatures			
		DB	WB	Inlet	Outlet
Condenser Water (Water Cooled)		--	--	85	95

Standard ratings are at sea level.

Note: db = dry bulb
wb = wet bulb

TABLE 4-11
Applied HVAC System Components
Standard Rating Conditions -- Cooling

Item		Centrifugal or Self-Contained Reciprocating Water-Chiller	Condenserless Reciprocating Water-Chiller
Leaving chilled Water temperature	°F	44	44
Entering chilled Water temperature	°F	54	54
Leaving condenser Water temperature	°F	95	--
Entering water temp.	°F	85	--
Fouling factor, water			
Non-ferrous tubes	*	0.0005	0.0005
Steel tubes	*	0.0010	0.0010
Fouling factor, Refrigerant	*	0.0000	0.0000
((Condenser-ambient Air-or-evap.--cooled-----°F-----95-db/75-wb-----			
Compressor-Water-cooled saturated--(or-evap- cooled)-----°F-----105			
Discharge--Air-cooled-----°F-----120 temp.))			
Condenser ambient Air or evap. cooled	°F	95 dB/75 wb	--
Compressor Water cooled Saturated (or evap. Discharge cooled)	°F	--	105
Temperature ----- Air cooled	°F	--	120

Standard ratings are at sea level.
* h ft² F/Btu.

TABLE 4-12
 HVAC-System Heating Equipment (Heat Pumps)
 Minimum COP & HSPF for Heat Pumps, Heating Mode

Source and Outdoor Temperature (°F)	Minimum COP	Minimum HSPF
Air source -- 47 dB/43 WB	2.7	
Air source -- 17 dB/15 WB	1.8	
Air source		6.35
Water source -- 60 entering	3.0	
Ground source	3.0	

TABLE 4-13
 Minimum EER and COP-Cooling for
 Electrically Driven HVAC System Equipment-Cooling¹

Standard Rating Capacity	Air Cooled		Evaporative or Water Cooled	
	EER	COP	EER	COP
Under 65,000 Btu/hr (19,050 watts)	7.8	2.28	8.8	2.58
65,000 Btu/hr (19,060 watts) and over	8.2	2.4	9.2	2.69

¹The U.S. Department of Energy has established required test procedures for single-phase, air-cooled, residential central air conditioners under 19 KW (65,000 Btu/h) capacity, which have been incorporated into ARI Standard 210-79. EER and COP values in Table 4-13 are based on Test A of DOE Test Procedures.

TABLE 4-14
 Minimum EER and COP for Electrically Driven HVAC-System Components¹

Water Chilling Packages		Condensing Means					
Component	Type	Air	Water		Evap.		
		EER	COP	EER	COP	EER	COP
Condenser included	Centrifugal or rotary	8.00	2.34	13.80	4.04		
Condenser included	Reciprocating	8.40	2.46	12.00	3.51		
Condenserless	Reciprocating	9.90	2.90	12.00	3.51		

Component	Type	Condensing Means					
		Air		Water		Evap.	
		EER	COP	EER	COP	EER	COP
Compressor & condenser units 65,000 Btu/hr (19,050 watts) and over ²	Positive displacement	9.50	2.78	12.50	3.66	12.50	3.66

Hydronic Heat Pumps

Component	Type	EER	COP
Water source under 65,000 Btu/h (19,000 watts)	Centrifugal or rotary	9.00	2.64
Water source 65,000 Btu/h (19,000 watts) and over	Centrifugal or rotary	9.40	2.75

¹When tested at the standard rating conditions specified in Table No. 4-9, 4-10, and 4-11.

²Ratings in accordance with Standard for Positive Displacement Refrigerant Compressor and Condensing Units, ARI Standard 520-74 as applicable. COP based on condensing unit standard rating capacity and energy input to the unit, all at sea level.

TABLE 4-15
HVAC-System Heat-Operated Cooling Equipment

$$\text{Minimum COP} = \frac{\text{Net Cooling Output}}{\text{Total Heat Input (Electrical Auxiliary Inputs Excluded)}}$$

Heat Source	Minimum COP
Direct fired (gas, oil)	0.48
Indirect fired (steam, hot water)	0.68

TABLE 4-16

Insulation of Ducts

Duct Location	Insulation Types Mechanically Cooled	Climate Zone	Insulation Types Heating Only
On roof or on exterior of building	C, V ² and W D, V ² and W	I II	C and W D and W
Attics, garages and crawl spaces, in walls ¹ , within floor-ceiling spaces ¹	B and V ² C and V ²	I II	B C
Within the conditioned space or in basements	None Required		None Required
Cement slab or within ground	A		B

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

¹ 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.

² 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:

- A. 0.5-inch 1.5 to 2 lb/cu. ft. duct liner, mineral or glass fiber blanket or equivalent to provide an installed 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 thermal resistance of at least R-6
- 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 thermal resistance of at least R-8
- 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 thermal resistance of at least R-12
- V. Vapor barrier, with perm rating not greater than 0.5 perm, all joints sealed.
- W. Approved weatherproof barrier.

TABLE 4-17

Minimum Pipe Insulation

Piping System Types	Fluid temper- ature range, °F	Run- outs up to 2" ¹	Insulation Thickness In Inches for Pipe Sizes ²				
			1" and less	1.25" to 2"	2.5" to 4"	5" to 6"	8" and larger
HEATING AND HOT WATER SYSTEMS							
Steam and hot water							
High pressure/ temperature	306-450	1.5	2.5	2.5	3.0	3.5	3.5
Med. pressure/ temperature	251-305	1.5	2.0	2.5	2.5	3.0	3.0
Low pressure/ temperature	201-250	1.0	1.5	1.5	2.0	2.0	2.0
Low temperature	100-200	.5	1.0	1.0	1.5	1.5	1.5
Steam condensate (for feed water)	Any	1.0	1.0	1.5	2.0	2.0	2.0
COOLING SYSTEMS							
Chilled water	40-55	.5	.5	.75	1.0	1.0	1.0
Refrigerant, or brine	Below 40	1.0	1.0	1.5	1.5	1.5	1.5

¹Runouts not exceeding 12 feet in length to individual terminal units.

²For piping exposed to outdoor air, increase thickness by .5 inch.

TABLE 4-18

Interior Lighting Power Budget¹

Group	Occupancy Description	Lighting Power Budget ² (W/sq ft)
A	Assembly w/stage Stage lighting	1.1 Exempt
B	Assembly w/o stage; other than B and E Gasoline service station	1.1 1.7

Group	Occupancy Description	Lighting Power Budget ² (W/sq ft)
	Storage garages	0.3
	Office buildings	1.7
	Wholesale stores	2.0
	Police and fire stations	1.7
	Retail Stores:	
	less than 6000 s.f.	4.0
	6000 to 20,000 s.f.	3.0
	over 20,000 s.f.	2.0
	Drinking and dining establishments	1.85
	Food preparation task light	Exempt
	Aircraft hangars - storage	0.7
	Process plants ³	1.0
	Factories and work shops ³	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

¹Watts/sq. ft. of room may be increased by two percent per foot of height above 20 feet.

²Emergency exit lighting is exempt from interior lighting budget.

³Lighting that is part of machines or equipment is exempt from this budget.

AMENDATORY SECTION (Amending Order 85-14, filed 11/26/85)

WAC 51-12-601 SECTION 601. LOW-RISE RESIDENTIAL BUILDING ENVELOPE REQUIREMENTS.

For all components, except for walls, the R values specified in Table 6-1 are for installed insulation material only. R values for construction are defined as any combination of rigid-sheathing, loose fill, or batt insulation that achieves the prescribed R value. Where insulation is installed in a continuous manner and is not interrupted by occasional framing members, its R value may be increased by 20% in determining compliance with the requirements of this table. This allowance does not apply to insulation of slab on grade or walls.

- (a) Walls. The total assembly of opaque exterior wall sections, walls in finished basements, and the interior walls exposed to unheated spaces shall have a thermal resistance R value not less than the values specified in Table 6-1. Total wall assembly R values include values for insulation, sheathing, gypsum-board, air-films, concrete, etc. The following walls shall be considered to meet the R-19 total assembly criteria without additional documentation:

1. 2" x 6" with installed R-19 batt.

2. 2" x 4" with an installed R-13 batt and R-5 insulating sheathing.
3. 2" x 4" with an installed R-11 batt and R-5.4 insulating sheathing.

EXCEPTION: Concrete or masonry foundation walls of unfinished basements that have one foot or less of the wall above grade need not be insulated until finished, provided that:

- A. Any frame walls comply with the requirements of Table 6-1;
- B. The rim-joists are properly insulated;
- C. All walls that are more than an average of one foot above grade are insulated to meet the requirements of Table 6-1.

(b) Roof/ceiling. The roof/ceiling assembly shall have a thermal resistance R value not less than the value specified for the indicated type of construction in Table 6-1.

EXCEPTION: Insulation levels in the case of single rafter or joist vaulted ceilings. These types of ceilings may be insulated to a level of R-30, regardless of space heat type.

(c) Thermal Design Standards for Floors.

1. 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 6-1.

Insulation installed inside the foundation shall extend downward from the top of the slab for a minimum distance of 24 inches; or downward to the bottom of the slab, then horizontally beneath the slab for a minimum total distance of 24 inches. Insulation installed outside the foundation shall extend downward a minimum of 6 inches below grade but not less than to the frostline and need not extend deeper than to the top of the footing.

2. Floor Sections. Floor sections over unheated spaces, such as unheated basements, unheated garages or ventilated crawl spaces, shall be constructed to comply with the required values as specified in Table 6-1.

EXCEPTION: Insulation may be omitted from floor areas over heated basements, heated garages, or under floor areas used as HVAC plenums or where operable foundation vents are used and when foundation walls are insulated. When foundation walls are insulated in accordance with Section 601(a), the insulation shall be attached in a permanent manner.

(d) Thermal Design Standards for Openings.

1. At a minimum, all windows must be double glazed, and are classed according to U values as shown on Table 6-2. Glazing requirements are listed in Table 6-4.
2. At a minimum, all skylights must be double glazed. The area of Class 90 skylights and Class 90 exterior windows sloped more than 30° from the vertical shall be doubled and this area included in the percentage of the total glazing area as allowed for in Table 6-4. Class 75 or Class 60 glazing in skylights or Class 75 or Class 60 windows sloped more than 30° from the vertical need not be doubled.
3. Single glazing for ornamental, security or architectural purposes shall have its area doubled and shall be included in the percentage of the total glazing area as allowed for in Table 6-4. The maximum area (before doubling) allowed for the total of all single glazing is 1% of the floor area.

(e) Air Leakage.

1. Windows and Doors. All windows within a wall and doors shall conform to the air infiltration requirements specified in Section 405. Site built windows shall be constructed to minimize leakage.

EXCEPTION: Openings required to be protected by fire resistive assemblies are exempt from this section.

2. Exterior joints around windows and door frames, openings between walls and foundations, between walls and roof and between wall panels; openings at penetrations of utility services through walls, floors and roofs; and all other such openings in the building envelope shall be sealed, caulked, gasketed, or weatherstripped to limit air leakage.

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

1. Walls separating conditioned space from unconditioned space shall have a vapor retarder installed when thermal insulation is installed. The vapor retarder shall have a one perm dry cup rating or less. Inset stapled batts with a facing with a perm rating less than one may be installed if staples are placed not more than (8) inches on center and gaps between the facing and the framing do not exceed (1/16) of an inch.

2. Roof/ceilings:

- A. Roof/ceiling assemblies where the ventilation space above the insulation is less than an average of twelve (12) inches shall be provided with a vapor retarder having a dry cup perm rating of 1.0 or less.
- B. Vapor retarders shall not be required in roof/ceiling assemblies where the ventilation space above the insulation averages twelve (12) inches or greater.
- C. Vapor retarders shall not be required where all of the insulation is installed between the roof membrane and the structural roof deck.
- D. Vapor retarders with a 1.0 or less dry cup perm rating shall be installed in roof/ceiling assemblies where the insulation is comprised of insulation between the roofing membrane and the structural roof decking and insulation below the structural roof decking.

3. Ground Cover.

A ground cover of 4 mil (0.004 inch thick) polyethylene or approved equal shall be laid over the ground within crawl spaces. The ground cover shall be overlapped twelve (12) inches minimum at joints and shall extend over the top of the footing.

EXCEPTION: The ground cover may be omitted in unheated crawl spaces if the crawl space has a concrete slab floor with a minimum thickness of 3-1/2 inches.

(g) General Requirements for Loose Fill Insulation. Blown or poured loose fill insulation may be used in attic spaces where the slope of the ceiling is not more than 3 feet in 12 feet and there is at least 30 inches of clear distance from the top of the bottom chord of the truss or ceiling joist to the underside of the roof 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.

(h) Space Heat Type. The following four 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.

EXCEPTIONS: Electric resistance elements which are integral to either heat pump or passive solar heating systems (as defined below), or when the total electric heat capacity in each individual dwelling unit does not exceed the greater of: 1) 1,000 watts per dwelling, or; 2) 1.0 watt per square foot of the gross floor area.

2. Electric, Passive Solar. Electric resistance space heating systems which utilize solar energy to provide a portion of the building's heating load. A Passive Solar System is required to have at least ten (10) percent of the building's gross floor area in glazing that meets the specifications of Section 601(i).
3. Other. Includes all gas, wood (not meeting the provisions of Section 102 (a) 2), oil, propane, and electric heat pump space heating systems, unless electric resistance is used as a secondary heating system. (See EXCEPTIONS, Electric Resistance, Section 601 (h) 1. above.) Nonelectric heat pump heating systems are also included in this category.
4. Other, Passive Solar. Other types of space heating systems which utilize solar energy to provide a portion of the building's heating load. A Passive Solar System is required to have at least ten (10) percent of the building's gross floor area in glazing that meets the specifications of Section 601(i).

(i) Passive Solar Glazing. Glazing areas are required to meet the following criteria in order to be considered Passive Solar Glazing.

1. Glazing areas are required to meet the "Electric, Passive Solar" and "Other, Passive Solar" glazing requirements of Table 6-4.
2. The south glazing shall be oriented within 45 degrees of true south.
3. The glazing shall be mounted at least 60 degrees up from the horizontal.
4. The glazing shall have a transmission coefficient greater than or equal to 0.80 for visible light or greater than or equal to 0.73 for total solar radiation.
5. Documentation shall be provided in the form of a sun chart, a photograph, or approved evidence, demonstrating that the glazing area shall not be shaded for at least 4 hours between 8 a.m. and 4 p.m. standard time on January 21 and March 21.
6. The building shall contain a heat capacity equal to a four inch concrete slab. The heat capacity shall be equivalent to at least 20 Btu/degree F-ft² for each square foot of south glazing when the south glazing area is between 10% and 14% of the building's gross floor area, and at least 45 Btu/degree F-ft² for each square foot of south glazing when the south area glazing exceeds 14 percent of gross floor area. In buildings with south glazing area between 10% and 14% of gross floor area, the heat capacity provided by a four inch concrete slab shall be deemed sufficient. This heat storage capacity shall be located inside the insulated shell of the structure and not covered with insulation materials, such as carpet, which yield an R value of 1.0 or greater. If the storage medium is not within the space containing the south glazing, an approved natural or mechanical means of transferring the heat to the heat storage medium shall be provided. Heat storage capacity shall be calculated using the below equation and/or accepted analytical methods:

HS = $D \times SH \times V$

Where:

HS = Heat Storage. The heat storage capacity available inside the insulated space.

V = Volume of heat storage components.

D = Density of material inside the insulated shell of the building to a depth yielding a thermal resistance of R-1, except in the case of slab floors where only the slab itself is credited. Mass located in conditioned or unconditioned basements without solar glazing shall not be counted (lbs/cu ft).

SH = Specific heat of the material (Btu/lb/°F).

- (j) Ventilation: Enclosed joist or rafter spaces formed where ceilings are applied directly to the under side of roof joists or rafters must have joists or rafters of sufficient size to provide a minimum of one inch clear vented air space above the insulation (see also Section 3205 (c) of UBC). Ceiling insulation may be tapered or compressed at the perimeter to permit proper venting.

AMENDATORY SECTION (Amending Order 85-14, filed 11/26/85)

WAC 51-12-602 SECTION 602. LOW-RISE RESIDENTIAL BUILDING MECHANICAL SYSTEMS.

All HVAC devices, components and their elements shall conform to the requirements of this section.

(a) Heating and Mechanical Cooling Devices.

1. All heating and mechanical cooling devices shall meet the required efficiency factor specified herein or in Tables 4-12, 4-13, 4-14, and 4-15, 6-3, and 6-4, for the specific type of device.
2. Combustion Heating Equipment. All gas and oil-fired heating equipment shall meet the minimum combustion efficiencies as specified in Table 6-4.
3. Fireplaces shall be provided with:
 - A. Tightly fitting flue dampers, operated with a readily accessible manual or approved automatic control.

EXCEPTION: Fireplaces with gas logs installed in accordance with UMC 803 shall be equipped with tightly fitting glass or metal doors.
 - B. An outside source for combustion air. The duct shall be at least six square inches in area, and shall be provided with a readily operable damper.
4. Calculation of Heating and Cooling Loads. Heating and cooling design loads for the purpose of sizing HVAC systems are required and shall be calculated in accordance with accepted engineering practice. The design parameters specified in Chapter 3 shall apply for all computations.

HVAC equipment for low-rise residential buildings shall be sized no greater than 150 percent of the design load as calculated above.

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

- (b) Temperature Control.
Each heating system shall be provided with at least one thermostat for the regulation of temperature. Each thermostat shall be capable of being set as follows:
Where used to control heating only--55-75°;
Where used to control cooling only--70-85°;
Where used to control both heating and cooling, it shall conform to the requirements of Section 415.
- (c) Zoning for Temperature Control.
1. Group R-3 Occupancy
At least one thermostat for regulation of space temperature shall be provided for each separate HVAC system. In addition, a readily accessible manual or automatic means shall be provided to partially restrict or shut off the heating or cooling input to each zone or floor.
EXCEPTION: Nonconditioned basements and garages.
 2. Group R-1 Occupancy.
For multifamily dwellings, each individual dwelling unit shall be considered separately and shall meet the requirements of Section 602. Spaces other than living units shall meet the requirements of section 415 (c) ((4-)) 3.
 3. Control Setback and Shutoff: Group R-1 and R-3.
The thermostat required in (a) and (b) 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 periods of nonuse 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.
 4. Duct Insulation.
All ducts, plenums and enclosures installed in or on buildings shall be thermally insulated and constructed in accordance with Section 416.
 5. Pipe Insulation.
All piping installed to serve buildings or within buildings shall be thermally insulated in accordance with Table 4-17.
EXCEPTION: For service water heating systems, see Section 603.

AMENDATORY SECTION (Amending Order 85-14, filed 11/26/85)

WAC 51-12-608 SECTION 608. ELECTRICAL POWER AND LIGHTING REQUIREMENTS FOR OTHER THAN LOW-RISE RESIDENTIAL BUILDINGS.
All electrical power and lighting systems shall comply with the requirements of Sections 424 to 426, inclusive.

TABLE 6-1

Low-rise Residential Buildings
Minimum (average) Allowed R Values¹

Space Heat Type	Climatic		Roof			Slab on ³
	Zone	Ceilings ²	Decks	Walls	Floors	Grade
Electric Resistance	I	38	38	19	19	8
Electric, Passive Solar	I	30	30	19	19	8
Other	I	30	30	19	19	8
Other, Passive Solar	I	30	30	19	19	8
Electric Resistance	II	38	38	19	25	10
Electric, Passive Solar	II	30	30	19	19	10
Other	II	30	30	19	19	10
Other, Passive Solar	II	30	30	19	19	10

¹R values, except for walls, are for installed insulation material only.

²R-30 in single rafter, joist vaulted ceilings.

³Insulation shall be water-resistant material manufactured for this use.

TABLE 6-2

Low-rise Residential Buildings
Classes of Glazing

Class	U-Value	Window Thermal Testing Requirement ¹
90	.90	Untested
90	Greater than .75	Tested
75	.61 to .75	Tested
60	Less than .61	Tested

¹See DEFINITIONS, Section 223. WINDOW THERMAL TESTING.

TABLE 6-3

Low-rise Residential Buildings
Heat Pump Minimum Efficiencies

Source and Outdoor Temperature (°F)	Class 1		Class 2	
	COP	HSPF	COP	HSPF
Air Source - 47 dB/43 WB ((Air-Source---47-dB/43-WB))	2.7		2.5	
Air source - 17 dB/15 WB	1.8		1.5	
Air Source		6.35		5.60

Source and Outdoor Temperature (°F)	Class 1		Class 2	
	COP	HSPF	COP	HSPF
Water Source - 60 entering	3.0		2.5	
Ground Source	3.0		3.0	

TABLE 6-4

Low-rise Residential Buildings
Glazing and Furnace
Efficiency Requirements

Space Heat Type	Climate Zone	Maximum Percentage of Floor Area in Glazing	Glazing Class	AFUE*	Heat Pump Class
Electric Resistance	I	21%	60	n/a	n/a
Electric, Passive Solar	I	21%	60	n/a	n/a
Other	I	21%	75	.65	2
Other	I	21%	90	.74	1
Other, Passive Solar	I	21%	90	.65	2
Electric Resistance	II	17%	60	n/a	n/a
Electric, Passive Solar	II	17%	60	n/a	n/a
Other	II	17%	75	.65	2
Other	II	17%	90	.74	1
Other, Passive Solar	II	17%	90	.65	2

*AFUE applies only to central heating equipment. All other types of heating equipment fueled by gas, oil, or propane must be equipped with an intermittent ignition device in order to use Class (4) 90 glazing.

TABLE NO. 6-5

All Other than Low-rise Residential Buildings
Component Requirements

Component	Zone I	Zone II
Space Conditioning System Type	Any	Any
Opaque Envelope Minimum Nominal R Value		
Roof/Ceilings	R-30	R-30
Exterior Walls	R-11	R-11
Floors over Unconditioned Space	R-11	R-11
Below Grade Walls ¹	R-4	R-5
Slab on Grade Floors ¹	R-3	R-10

Glazing

Component	Zone I	Zone II
Type	Double	Double
Maximum Total Area (Percent of Gross Exterior Wall)	32%	22%

1 Insulation shall be water-resistant material manufactured for this use.