

FORM OF ORDER AND TRANSMITTAL BY BOARD, COMMISSION, OR COUNCIL

State of Washington

State Building Code Council

(name of governing body)

(agency name, if applicable)

Resolution No. 86-17

Administrative Order No.

(1) Be it resolved by the State Building Code Council acting at Eagle's Club, 1510-9th Street, Wenatchee, 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. WSR 86.16.071 filed with the code reviser on August 6, 1986. These rules shall take effect: [X] 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 34.04.026 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 19.27A.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 RCW 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.

APPROVED AND ADOPTED September 12, 1986

STATE OF WASHINGTON FILED

SEP 23 1986

By Lynn A. Carmichael

Chair

Title

CODE REVISER'S OFFICE WSR 86.20.024

AMENDATORY SECTION (Amending Order 86-04, filed 5/13/86)

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 according to the definition of heated space in chapter 2, 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 for space conditioning 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. All alterations and repairs to buildings or portions thereof originally constructed subject to the requirements of this 1986 Code shall conform to the provisions of this Code without exception. For all other existing buildings, initial tenant alterations shall comply with the new construction requirements of this Code. Other alterations and repairs may be made to existing buildings and moved 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.

EXCEPTIONS:

1. Untested storm windows may be installed over existing glazing, however, where glass and sash are being replaced in low-rise residential buildings, class 75 glazing shall be installed where there is an electric resistance space heating system and class 90 glazing shall be installed where there is any other space heating system.
2. 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.))~~

EXCEPTION: For low-rise residential buildings not initially subject to the requirements of this Code, replacement heat pumps shall meet class 2 efficiencies specified in Table 6-3 and replacement central combustion heating equipment shall be equipped with spark ignition. All other replacement combustion heating equipment including horizontal furnaces shall have a minimum AFUE of .65.

- 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 Sections 425 and 426. Other remodels or replacements of lighting systems which are part of a substantial remodel shall comply with Sections 425 and 426. 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.-4-48))~~ Sections 425 and 426. For all other remodels or replacements which affect the lighting system of less than an entire floor those parts of systems which are altered or replaced shall comply with the switching requirements of Section 425 and, unless they comply with the lighting power budgets of Section 426 shall either maintain or reduce the watts per square foot of installed lighting.
- E. Change From Unheated to Heated Space. Changes from unheated to heated space for buildings, structures or portions thereof shall be permitted if the building, structure or portion thereof is brought into compliance with the building envelope requirements as per Section 102(b)3 of this Code, but in no case, less than those building envelope requirements in effect at the time of the initial construction of the building.

The Building Official may approve designs of alterations or repairs which do not fully conform with all of the requirements of this Code 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 51-12-201 SECTION 201. A.

ACCESSIBLE (as applied to Equipment). Allowing close approach, not guarded by locked doors, elevation or other effective means. (See READILY ACCESSIBLE.)

AIR CONDITIONING. The process of treating air so as to control simultaneously its temperature, humidity, cleanliness and distribution to meet requirements of the conditioned space.

AIR TRANSPORT FACTOR. The ratio of the rate of useful sensible heat removal from the conditioned space to the energy input to the supply and return fan motor(s), expressed in consistent units and under the designated operating conditions.

ANNUAL FUEL UTILIZATION EFFICIENCY (AFUE). The amount of energy delivered to the dwelling in the form of useable heat, as a percentage of the total energy input of the fuel consumed. AFUE refers to a performance rating required under the provision of the National Energy Policy and Conservation Act (NECPA), Pub. L95-619. AFUE's taken from the "Energy Guide" published by the Gas Appliance Manufacturers' Association (GAMA) meet this definition. When unlisted in GAMA directory, AFUE ratings for furnaces installed in nonweatherized unconditioned areas, such as garages and unheated basements, may be taken from the AFUE rating for installation within a conditioned space. In no case, except where specifically tested and listed for application in nonweatherized locations, shall credit for compliance be given for the use of vent dampers with furnaces installed in nonweatherized unconditioned spaces. AFUE's apply to all central residential sized furnaces (inputs of less than 225,000 Btu/h).

ASHRAE. American Society of Heating, Refrigeration, and Air Conditioning Engineers, Inc.

AUTOMATIC. Self-acting, operating by its own mechanism when actuated by some impersonal influence, as for example, a change in current strength, pressure, temperature or mechanical configuration.

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

WAC 51-12-304 SECTION 304. DESIGN PARAMETERS.

The following design parameters shall be used for calculations required under this Code.

- (a) Indoor design temperature shall be 70°F maximum for heating and 78°F minimum for cooling.
- (b) Indoor design relative humidity for heating shall not exceed 30 percent.
- (c) The heating or cooling outdoor design temperatures shall be selected from 0.6 percent column for winter and 0.5 percent column for summer from the Puget Sound Chapter of ASHRAE publication "Recommended Outdoor Design Temperatures, Washington State, ASHRAE." (See also Washington State Energy Code Manual.)

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

WAC 51-12-402 SECTION 402. OVERALL THERMAL PERFORMANCE AND BUILDING ENVELOPE REQUIREMENTS.

- (a) The stated U_o value of any one element of a building, such as roof/ceiling, wall or floor, may be increased and the U_o value for other components decreased provided that the overall heat gain or loss for the entire building envelope does not exceed the total resulting from the conformance to the stated U_o values.
- (b) Where return air ceiling plenums are employed, the roof/ceiling assembly area shall:
1. For thermal transmittance purposes, not include the ceiling proper nor the plenum space as part of the assembly; and
 2. For gross area purposes, be based upon the interior face of the upper plenum surface.
- (c) U_o values listed in Tables 4-2, 4-3, and 4-4 refer to component assembly only. Credit for buffering from adjacent unheated spaces is not allowed when calculating U_o values.
- (d) Exemption for Passive Solar features.
Glazing areas which meet all of the following criteria may be exempted from the U_o calculations. Exempted glazing shall not be included in the gross wall area.
1. For buildings that have Electric Resistance heating systems, the glazing area must have a tested thermal transmittance (U) value of less than .61. For Other heating systems, the glazing area need not be tested, but must be double glazed. (See Section 403(e).)
 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 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 buildings 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. 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).

(e) Insulation.

1. General: Thermal and acoustical insulation located on or within floor/ceiling and roof/ceiling assemblies, crawl spaces, walls, partitions, and insulation on pipes and tubing shall comply with this section. Duct insulation shall conform to Section 416 and Table 4-16.
EXCEPTIONS:
 - A. Roof insulation shall comply with Section 3204 of the Uniform Building Code.
 - B. Roof insulation in vaulted ceilings over 3 in 12 shall conform with Section 3204 of the Uniform Building Code.
 - C. Exposed deck ceiling insulation shall conform with Section 3204 of the Uniform Building Code.
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 not to exceed 25 and a smoke density not to exceed 450 when tested in accordance with UBC Standard No. 42-1.
EXCEPTIONS:
 - A. Foam plastic insulation shall comply with Section 1717 of the Uniform Building Code.
 - B. 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.
 - C. Cellulose insulation shall conform to Section 1713 of the Uniform Building Code.
3. Ventilation: Enclosed joist or rafter spaces formed where ceilings are applied directly to the underside 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.

(f) Moisture Control.

1. Vapor retarders shall be installed on the warm side (in winter) of insulation as specified in the following cases:
 - A. 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 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.
 - B. Roof/ceilings.
 - i. 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.
 - ii. Vapor retarders shall not be required in roof/ceiling assemblies where the ventilation space above the insulation averages twelve (12) inches or greater.

- iii. Vapor retarders shall not be required where all of the insulation is installed between the roof membrane and the structural roof deck.
- iv. Vapor retarders with a 1.0 or less dry cup perm rating polyethylene or an approved equal 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.

C. 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 to the foundation wall.

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.

AMENDATORY SECTION (Amending Order 86-04, filed 5/13/86)

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 R Values

Heat Type	Climatic Zone	Roofs	Cathedral	Walls	Floors	Slab ¹
		Ceilings	Ceilings	(Includes Glazing)		on Grade
		Uo	Uo	Uo	Uo	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 Uo Values and
Minimum Allowed R Values

Zone	Ceilings	Walls (Includes Glazing)	Floors	Slab ¹ on Grade
				Installed R Value
				<u>Uo</u>
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 Uo Values and
Minimum Allowed R Values

Zone	Ceilings	Walls (Includes Glazing)	Floors	Slab ¹ on Grade
	<u>Uo</u>	<u>Uo</u>	<u>Uo</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	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	°F	Air Source		Type	Water Source
		db	wb		
Air entering equipment	70	70 db	70 db		70 db
Outdoor unit ambient	47	43 wb	17 db/ 15 wb		--
Entering water temperature	60	--	--		60
Water flow rate	--	--	--		as used in cooling mode

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

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

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

Source and Outdoor Temperature (°F)	Minimum COP	Minimum HSPF
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

Component	Type	Condensing Means					
		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		
Compressor & condenser units 65,000							

Component	Type	Air		Condensing Means		Evap.	
		EER	COP	EER	COP	EER	COP
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		Climate Zone	Insulation Types Heating Only
	Mechanically Cooled			
On roof or on exterior of building	C, V ² and W		I	C and W
	D, V ² and W		II	D and W

Duct Location	Insulation Types		
	Mechanically Cooled	Climate Zone	Insulation Types Heating Only
Attics, garages and crawl spaces, in walls ¹ , within floor-ceiling spaces ¹	B and V ²	I	B
	C and V ²	II	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: Minimum densities and out-of-package thicknesses.

- 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-((6))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-((8))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-((12))10
- 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 temperature 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	1.1
	Stage lighting	Exempt
	Assembly w/o stage: other than B and E	1.1
B	Gasoline service station	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 86-04, filed 5/13/86)

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 (3) 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 permeating 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 UEC). Ceiling insulation may be tapered or compressed at the perimeter to permit proper venting.