July 9, 1980

Introduced by: SCOTT BLAIR

Attachment in "Attachment Items"

Proposed No.: 80-742

ORDINANCE NO. 5027

AN ORDINANCE relating to the King County Building Code; amending Ordinance 4753 Section 3, and repealing Ordinance 4753 Section 9, the King County Energy Code.

BE IT ORDAINED BY THE COUNCIL OF KING COUNTY:

SECTION 1. Ordinance 4753, Section 3, is hereby amended as follows:

SUPPLEMENTS ADOPTED, the King County supplements to the adopted 1976 editions of the Uniform Building Code, and Uniform Code for the Abatement of Dangerous Buildings, are adopted as part of the Code. "Chapter 53" Thermal Performance (Insulation)" of the "Official King County Supplement to the 1976 Uniform Building Code" ((~~is~~)) and the "King County Energy Code dated March 3, 1980 are hereby repealed ((~~, effective July 1, 1980~~)) and the King County Energy Code dated July 7, 1980 attached to this amendatory ordinance is hereby adopted ((~~, effective July 1, 1980~~)) as part of the code; as such they constitute county regulation for any activity subject to the code.

SECTION 2. Ordinance 4753, Section 9 is hereby repealed.

INTRODUCED AND READ for the first time this 23rd day of June, 1980.

PASSED this 4th day of August, 1980.

KING COUNTY COUNCIL
KING COUNTY, WASHINGTON

Bill Reams
Chairman

ATTEST:

Dorothy M. Owens
DEPUTY Clerk of the Council

APPROVED this 8th day of August, 1980.

King County Executive

Ord 5027

KING COUNTY ENERGY CODE

Attachment to Substitute Ordinance #80-742

July 7, 1980

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for the design of exterior envelopes, heating, ventilating and air conditioning systems (HVAC), service water heating, electrical distribution and illuminating systems and equipment to achieve more efficient use of energy. This Chapter is intended to supplement the provisions of the Uniform Mechanical Code and the remainder of the Uniform Building Code, and in case of conflict between this Chapter and any of those codes, the provisions of this Chapter shall apply.

(b) Exempt Buildings

1. Buildings and structures or portions thereof whose peak design rate of energy use is less than one (1) watt per square foot or three and four tenths (3.4) Btu/hour per square foot of floor area for all purposes.

2. Buildings which are neither heated nor cooled.

Subsection 5301.03 Application to Existing Buildings. (a) Additions, Alterations, and Repairs to Existing Buildings. Additions, alterations and repairs may be made to existing buildings or structures without making the entire building or structure comply with all of the requirements of this Chapter for new buildings or structures. Additions, alterations and repairs shall be made to comply with this Chapter to the extent that it is deemed practical and effective by the building official in meeting the intent of this Chapter.

Existing buildings that are substantially remodeled or rehabilitated (see definitions) shall conform to the provisions of this Code.

(b) Historic Buildings and Structures. The Building Official may modify the specific requirements of this Chapter as it applies to buildings and structures designated as landmarks and require in lieu thereof alternate requirements which, in his opinion, will result in a reasonable degree of energy conservation.

(c) Change of Occupancy or Use. Any change in the occupancy or use of an existing unheated or uncooled building, structure or portion of a building to a use or occupancy which requires environmental conditions for human occupancy shall not be permitted unless the building, structure or portion of the building complies with this Chapter.

Subsection 5301.04 Materials and Equipment. (a) All materials and equipment used to comply with this Chapter shall be identified in order to show compliance with this Chapter.

(b) Alternative Systems, Materials, Methods of Construction and Design. The provisions of this Chapter are not intended to prevent the use of any material, method of construction or design not specifically prescribed by this Chapter, provided any such alternate has been approved by the Building Official.

(d) Inspections. All buildings constructed under the provisions of this Chapter are subject to a final inspection for compliance with this Chapter. The building official has the authority to establish rules and procedures for accepting affidavits of substantial compliance with this Chapter in lieu of inspections.

CLERESTORY. A window placed high in a wall or projecting from a roof plane to admit daylight into the interior of a building.

COEFFICIENT OF PERFORMANCE (COP). See Subsection 5304.11 for various definitions of COP.

COMFORT ENVELOPE. The area on a psychometric chart enclosing all those conditions described in ASHRAE Standard 55-74 "Thermal Environmental Conditions for Human Occupancy."

CONDITIONED FLOOR AREA. The horizontal projection of that portion of interior space which is contained within exterior walls and which is conditioned directly or indirectly by an energy-using system.

Subsection 5302.04 D

DEGREE DAY, HEATING. A unit, based upon temperature difference and time, used in estimating fuel consumption and specifying nominal heating load of a building in winter. For any one day, when the mean temperature is less than 65°F, there exist as many Degree Days as there are Fahrenheit degrees difference in temperature between the mean temperature for the day and 65°F.

DRY-BULB TEMPERATURE (DB). The temperature of gas or mixture of gases indicated by an accurate thermometer after correction for radiation.

Subsection 5302.05 E

ECONOMIZER CYCLE. A control sequence of a fan system that modulates the amount of outside air for the purpose of space cooling without using mechanical cooling.

EFFICIENCY, OVERALL SYSTEM. The ratio of the useful energy (at the point of use) to the thermal energy input for a designated time period, expressed in percent.

ENERGY. The capacity for doing work, taking a number of forms which may be transformed from one into another, such as thermal (heat), mechanical (work), electrical; in customary units, measured in kilowatt-hours (kwh) or British thermal units (Btu).

ENERGY EFFICIENCY RATIO (EER). The ratio of net cooling capacity in Btu/h to total rate of electric input in watts under designated operating conditions. When SI units are used this becomes equal to COP. (See COP).

ENERGY, NEW. (See NEW ENERGY).

ENERGY, RECOVERED. (See RECOVERED ENERGY).

EXTERIOR ENVELOPE. (See BUILDING ENVELOPE).

HEATED SPACE. Space, within a building, which is provided with a positive heat supply to maintain air temperature of 50°F (10°C) or higher.

HUMIDSTAT. An instrument which measures changes in humidity and controls a device(s) for maintaining a desired humidity.

HVAC. Heating, ventilating and air conditioning.

HVAC SYSTEM. A system that provides either collectively or individually the processes of comfort heating, ventilating, and/or air conditioning within or associated with a building.

Subsection 5302.09 I

INFILTRATION. The uncontrolled inward air leakage through cracks and interstices in any building element and around windows and doors of a building, caused by the pressure effects of wind and-or the effect of differences in the indoor and outdoor air density.

Subsection 5302.10 J (Reserved)

Subsection 5302.11 K (Reserved)

Subsection 5302.12 L

LUMINAIRE. A complete lighting unit consisting of a lamp or lamps together with the parts designated to distribute the light, to position and protect the lamps, and to connect the lamps to power supply.

Subsection 5302.13 M

MANUAL. Capable of being operated by personal intervention.

Subsection 5302.14 N

NEW ENERGY. Energy, other than recovered energy, utilized for the purpose of heating or cooling.

NON-DEPLETABLE ENERGY SOURCES. Sources of energy (excluding minerals) derived from incoming solar radiation, including lighting and photosynthetic processes; from phenomena resulting therefrom including wind, waves and tides, lake or pond thermal differences; and energy derived from the internal heat of the earth, including nocturnal thermal exchanges. Neither natural gas, oil, coal, nor any utility-supplied electricity shall be considered a non-depletable energy source.

Subsection 5302.15 O

OPAQUE AREAS. All exposed areas of a building envelope which enclose conditioned space, except openings for windows, skylights, doors and building service systems.

RESIDENTIAL BUILDINGS, LOW RISE. A building not exceeding three stories in height and containing solely one or more dwelling units.

RESTAURANT. A building or portion of a building principally used for the retail preparation and service of food or beverages.

ROOF ELEMENT. A roof element shall be considered as all components of the roof/ceiling envelope through which heat flows, thereby creating a building transmission heat loss or gain, where such assembly is exposed to outdoor air and encloses a heated or mechanically cooled space.

ROOF AREA, GROSS AREA OF. The gross area of a roof element consists of the total interior surface of such element, including skylights exposed to the heated or mechanically cooled space.

ROOM AIR CONDITIONER. An encased assembly designed as a unit primarily for mounting in a window or through a wall, or as a console. It is designed primarily to provide free delivery of conditioned air to an enclosed space, room or zone. It includes a prime source of refrigeration for cooling and dehumidification and means for circulating and cleaning air, and may include means for ventilating and heating.

Subsection 5302.19 S

SEQUENCE. A consecutive series of operations.

SERVICE SYSTEMS. All energy-using systems in a building that are operated to provide services for the occupants or processes housed therein, including HVAC, service water heating, illumination, transportation, cooking or food preparation, laundering or similar functions.

SERVICE WATER HEATING. Supply of hot water for domestic or commercial purposes other than comfort heating.

SERVICE WATER HEATING DEMAND. The maximum design rate of energy withdrawal from a service water heating system in a designated period of time (usually an hour or a day).

SHADING COEFFICIENT (SC). The ratio of the solar heat gain through a glazing system to that of an unshaded single-pane of double strength window glass under the same set of conditions.

SHALL. Where shall is used in specific provision, that provision is mandatory.

SHOULD. Not mandatory but desireable as good practice.

SKYLIGHT. A clear or translucent panel or shape set in the plane of a roof to admit daylight into the interior of a building.

SLAB ON GRADE (In a Heated Space). Any slab including internally heated slabs poured in contact with the ground and which the top of the finished slab is less than 12 inches below the final elevation of the nearest exterior grade.

U VALUE. See THERMAL TRANSMITTANCE.

UNHEATED SLAB. A slab on grade heated only by delivery of heat from a system above floor level.

UNITARY COOLING AND HEATING EQUIPMENT. One or more factory-made assemblies which normally include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function as well. Where such equipment is provided in more than one assembly, the separate assemblies shall be designed to be used together.

UNITARY HEAT PUMP. One or more factory-made assemblies which normally include an indoor conditioning coil, compressor(s) and outdoor coil or refrigerant-to-water heat exchanger, including means to provide both heating and cooling functions. It is designed to provide the functions of air-circulating, air cleaning, cooling and heating with controlled temperature, and dehumidifying, and may optionally include the function of humidifying. When such equipment is provided in more than one assembly, the separate assemblies shall be designed to be used together.

Subsection 5302.22 V

VENTILATION AIR. That portion of supply air which comes from outside (outdoors) plus any recirculated air that has been treated to maintain the desired quality of air within a designated space. (See ASHRAE Standard 62-73).

Subsection 5302.23 W X Y Z

WET-BULB TEMPERATURE. Thermodynamic wet-bulb temperature is the temperature at which liquid or solid water, by evaporating into air, can bring the air to saturation adiabatically at the same temperature. Wet-bulb temperature (without qualification) is the temperature indicated by a wet-bulb psychrometer constructed and used according to specifications.

ZONE. A space or group of spaces within a building with heating and/or cooling requirements sufficiently similar so that comfort conditions can be maintained throughout by a single controlling device.

(a) OUTDOOR DESIGN TEMPERATURE

Station	SUMMER Design Dry Bulb 0.5%	SUMMER Design Wet Bulb 0.5%	WINTER 0.6%
Auburn	84	67	25
Bellevue	83	67	24
Bothell	83	66	17
Clyde Hill	83	67	24
Des Moines	83	67	25
Enumclaw	83	66	26
Fircrest	82	66	29
Issaquah	83	67	23
Kent	85	66	21
Kirkland	83	67	17
Medina	83	67	24
Mercer Island	83	66	25
Normandy Park	83	65	24
Redmond	83	67	17
Renton	83	67	24
Seattle-Boeing	83	66	25
City Office	82	66	30
Jackson Park	82	66	25
Maple Leaf	82	66	23
U of W	84	67	26
Sea-Tac Airport	83	65	24
Snoqualmie Falls	83	66	22
Snoqualmie Pass	80	62	6
Tukwila	83	67	24
Vashon Island	78	62	28

(b) Indoor design temperature shall be 70°F. for heating and 78°F. for cooling, except where the building official approves a higher indoor design temperature for health or safety reasons for a specific building.

(c) Indoor design relative humidity for heating shall not exceed 30 percent. For cooling, new energy shall not be used to control relative humidity in the range between 30 percent and 70 percent.

Subsection 5303.05 Ventilation. The ventilation air quantities specified in Chapter 11B of the King County Mechanical Code shall be used for design. The required outdoor air quantities shall be used as the basis for calculating the heating and cooling design loads.

SECTION 5304 -- BUILDING DESIGN BY COMPONENT PERFORMANCE APPROACH

(Standard Design)

Subsection 5304.00. General. This section establishes design criteria in terms of the thermal performance of the various components of a building.

A building that is designed to be both heated and cooled shall meet the more stringent of the heating or cooling requirements as provided in this chapter when requirements differ.

Subsection 5304.01. (Reserved)

Subsection 5304.02. Overall Thermal Performances.

(a) The stated U value of any one element of a building, such as roof/ceiling, wall or floor, may be increased and the U 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 values.

(b) Where return air ceiling plenums are employed, the roof-ceiling assembly 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) General insulation and vapor barriers shall be installed in accordance with sound building practices.

Subsection 5304.03. Thermal Performance Criteria for Low-Rise Residential Buildings. Criteria for Residential Buildings three (3) stories or less in height: Group R - Division 3 - detached one and two family dwellings; Group R - Division 1 - All other residential buildings three stories or less.

(a) Heating and Cooling Criteria.

1. The overall average thermal transmittance value of the gross area of the elements of the exterior building envelope of a low rise residential building shall not exceed the value given in Table 4-1. Equations 1 and 2 in Subsection 5304.04 shall be used to determine acceptable combinations of building components and thermal properties to meet this requirement. Steady state U_w values for opaque wall sections may be corrected by multiplying by the appropriate M factor before the calculation of the U_o in Equation 2. U_o and U_w are specified in units of $\frac{\text{Btu}}{\text{hr. sq. ft. }^{\circ}\text{F}}$.

4. Windows and doors and air leakage: (See Subsection 5304.05).

(b) Exemption for Passive Solar Features.

For passive solar credit glazing areas which meet all of the following criteria may be exempted from the U_o calculations:

1. The glazing area must have a thermal transmittance (U) value of not greater than .65.

2. Glazing must be oriented within 30^o of due South. If it is mounted other than vertically, it must be tilted at least 30° up from the horizontal to face south.

3. The glazing must be clear. (Transmission coefficient numerically greater than or equal to .80 for the glazing itself).

4. The glazing must receive direct solar exposure for 50% of the hours between 9:00 a.m. and 3:00 p.m. on December 21.

5. The glazing must receive direct solar exposure for 85% of the hours between 9:00 a.m. and 3:00 p.m. on March 21.

6. For each square foot of glazing, the building must contain a heat storage capacity equivalent to 150 Btu's/ Day, located inside the insulated shell of the structure, and not covered with insulation materials such as carpet yielding an R value of 1.0 or greater.

Heat storage capacity shall be calculated by the following procedure:

HS = (WM)(SH)(T)

Where:

HS = Heat Storage Capacity (Btu's/Day)

WM = The weight of the materials (lbs.) inside the insulated shell of the building to a depth yielding a resistance of R-1, except in the case of slab floors where only the slab itself is credited.

SH = Specific Heat of those materials (Btu's/[lb.] [degree F])

T = Temperature flux; 5°F per day will be the maximum allowable for calculation purposes, except that light weight frame construction will be allowed to flux 10°F per day.

Subsection 5304.04 Thermal Performance Criteria for All Other Buildings

3. 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 4-2. The insulation 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.

(b) Cooling Criteria

1. Walls: Any building that is mechanically cooled shall have an overall thermal transfer value (OTTV) for the gross area of exterior walls not exceeding the values shown in Table 4-2 in Btu/h/ft^2. Equation 3 of this subsection shall be used to determine acceptable combinations to meet these requirements.

2. Roof/Ceiling: Any building that is mechanically cooled shall have a combined thermal transmittance value (U value) for roof/ceiling not to exceed that specified in Table 4-2.

EQUATION 1

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

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 all interior horizonal 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

TD_{EQ} = temperature difference value (from table below)

SC = shading coefficient of the fenestration (see definitions)

SF = 136 BTU/hr. $ft.^2$

Δt = temperature difference between exterior and interior design condition °F.

NOTE: Where more than one type of wall is used, the respective terms for those elements shall be expanded into subelements, as: $(U_{w1}A_{w1}TD_{EQ1}) + (U_{w2}A_{w2}TD_{EQ2}) + \ldots$etc.

FACTORS FOR USE WITH EQUATIONS 2 & 3

WALLS

WEIGHT OF CONSTRUCTION Lbs./$Ft.^2$	TD_{EQ} FACTOR	M-FACTOR
0-25	44	1.00
26-40	37	0.96
41-70	30	0.93
71 and above	23	0.90

Subsection 5304.05. Air Leakage for all Buildings. (a) The requirements of this subsection shall apply to all buildings and structures and only to those locations separating outdoor ambient conditions from interior spaces that are heated or mechanically cooled. The requirements of this subsection are not applicable to the separation of interior conditioned spaces from each other.

(b) 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 weather stripped to limit air leakage.

(c) All exterior doors, other than fire-rated doors, shall be designed to limit air leakage around their perimeter when in a closed position and shall meet the following criteria:

1. All doors shall be provided with gasketing or weatherstripping at the head and jamb, including double acting doors.

2. Doors requiring vertical tracks or guides shall use a continuous mounting angle and standard jamb weatherstripping.

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

Subsection 5304.07 Calculations 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 Section 5303 shall apply for all computations.

HVAC equipment for low-rise residential buildings shall be sized no greater than 125% of the design load as calculated above. If the selected manufacturer does not provide equipment in the range of 115% to 125% of the design load, the next size larger than 125% may be used.

Subsection 5304.08 Infiltration. Infiltration for heating and cooling design loads shall be calculated using accepted engineering practice, and Subsection 5304.05.

Subsection 5304.09. Simultaneous Heating and Cooling. Simultaneous heating and cooling by reheating or recooling supply air or by concurrent operation of independent heating and cooling systems serving a common zone shall be restricted as delineated below:

(a) Recovered and non-depletable energy, provided the new energy expended in the recovery process is less than the amount recovered, may be used for control of temperature and humidity.

(b) New energy may be used for control of temperature if minimized as delineated in paragraphs (c) through (g).

(c) Reheat Systems. Systems employing reheat and serving multiple zones shall be provided with control that will automatically reset the system cold air supply to the highest temperature level that will satisfy the individual thermostat or primary zone requiring the coolest air. Single zone reheat systems shall be controlled to sequence heating and cooling. The total installed capacity of all reheat using new energy shall be limited to 15% of the total system design cooling capacity.

(d) Dual Duct and Multi Zone Systems. These systems shall be provided with control that will automatically reset: (1) the cold deck air supply to the highest temperature that will satisfy the zone requiring the coolest air, and (2) the hot deck air supply to the lowest temperature that will satisfy the zone requiring the warmest air.

Primary zone temperature and/or flow volume may be used as the control for this subsection. Primary zone is defined as an area with a single weather exposure and similar thermal loading.

The systems must be provided with heat pumps or recovery devices so that new energy is not required on the hot and cold deck or plenum simultaneously with the exception of limited warm-up periods.

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 degrees 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 gas and oil fired central heating equipment shall show a minimum combustion efficiency of 75 percent at maximum rated output. Gas and oil fired room and space heaters shall show a minimum combustion efficiency of 70 percent at maximum rated output. Combustion efficiency is defined as 100 percent minus stack losses in percent of heat input. Stack losses are:

1. Loss due to sensible heat in dry flue gas
2. Loss due to incomplete combustion
3. Loss due to sensible and latent heat in moisture formed by combustion of hydrogen in the flue.

All central heating plant connecting vents must be equipped with an approved automatic damper when the central heating plant is located in a heated space.

(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-Systems 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 4-5.

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 new heat renewal 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 4-6 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 4-6.

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.

   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.

   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.

(e) Internal/external zone heat recovery or other energy recovery is used, which is more efficient than using outdoor air.

(f) When all space cooling is accomplished by a circulating liquid which transfers space heat directly or indirectly to a heat rejection device such as a cooling tower without the use of a refrigeration system.

Subsection 5304.15. Controls. (a) Temperature Control: Each HVAC system shall be provided with at least one thermostat for the regulation of temperature.

Where used to control both heating and cooling, each thermostat shall be capable of being set from 55-85 degrees F and shall be capable of operating the system heating and cooling in sequence. It shall be adjustable to provide a temperature range of up to 10 degrees F between full heating and full cooling, except as allowed in Subsection 5304.09(g).

(b) Humidity Control. If an HVAC system is equipped with a means for adding moisture to maintain specific selected relative humidities in spaces or zones, a humidistat shall be provided. This device shall be capable of being set to prevent new energy from being used to produce space relative humidity above 30 percent rh. Where a humidistat is used in an HVAC system for controlling moisture removal to maintain specific selected relative humidities in spaces or zones, it shall be capable of being set to prevent new energy from being used to produce a space relative humidity below 60 percent relative humidity.

EXCEPTION: Special occupancies requiring different relative humidities may be permitted by the Building Official.

(c) Zoning for Temperature Control.

1. One and Two-Family Dwellings: 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 and/or cooling input to each zone or floor not controlled by a thermostat.

2. Multi-Family Dwellings: For multi-family dwellings, each individual dwelling unit shall be considered separately and shall meet the above requirements. Spaces other than living units shall meet the requirements of Subsection 5304.15(c)(3).

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

   A. Each separate HVAC system.

Subsection 5304.17. Duct Construction. All duct work shall be constructed, sized and erected in accordance with the King County Mechanical Code.

Subsection 5304.18. Piping Insulation. All piping installed to serve buildings and within buildings shall be thermally insulated in accordance with Table 4-10, except as stated herein, (for service water heating systems, see Subsection 5304.19).

(a) Other Insulation Thickness: Insulation thickness in Table 4-10 is based on insulation having thermal resistance in the range of 4.0 to 4.6 per inch of thickness on a flat surface at a mean temperature of 75°F. Minimum insulation thickness shall be increased for materials having R values less than 4.0 per inch, or may be reduced for materials having R values greater than 4.6 per inch.

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

$$\frac{4.6 \times \text{Table 4-10 thickness}}{\text{Actual R}} = \text{New Minimum Thickness}$$

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

$$\frac{4.0 \times \text{Table 4-10 Thickness}}{\text{Actual R}} = \text{New Minimum Thickness}$$

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

1. Piping installed within unitary HVAC equipment.

2. Piping at temperatures between 55°F and 100°F.

3. When the heat loss and/or heat gain of the piping, without insulation, does not increase the energy requirements of the building.

(c) Additional insulation with vapor barriers shall be provided to prevent condensation where required.

Subsection 5304.19. Service Water Heating. (a) General: Hot water for domestic, sanitary and swimming pool purposes shall be generated and delivered in a manner conducive to saving heat energy.

(b) Scope: The purpose of the following provisions is to provide criteria for design and equipment selection that will produce energy savings when applied to service water heating.

Subsection 5304.20. Water Heaters, Storage Tanks, Boilers, and Piping. (a) Performance Efficiency.

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

3. Swimming Pools:

Heated swimming pools shall be equipped with:

A. Controls which allow water temperature to be regulated from the maximum design temperature down to 65°F;

B. An ON-OFF switch for the pool heater, mounted for easy access to allow shutting off the operation of the heater without adjusting the thermostat setting and to allow restarting without relighting a pilot light; and

C. A pool cover at the surface of the water.

Subsection 5304.21. Pump Operation. Circulating hot water systems shall be arranged so that the circulating pump(s) can be conveniently turned off, automatically or manually, when the hot water system is not in operation.

Subsection 5304.22. Pipe Insulation. For recirculation systems, piping heat loss shall be limited to a maximum of 25 Btu/hr./ft.^{2} of external pipe surface for underground piping. Maximum heat loss shall be determined at a ΔT equal to the maximum water temperature minus a design ambient temperature no higher than 65°F.

Subsection 5304.23. Conservation of Hot Water. (a) Showers: Showers used for other than safety reasons shall be equipped with flow control devices to limit total flow to a maximum of 3 gpm per shower head.

(b) Lavatories in restrooms of public facilities shall be equipped with outlet devices which limit the flow of hot water to a maximum of 0.5 gpm.

Subsection 5304.24. Electrical Power - General. Electrical distribution and lighting systems shall be designed for efficient distribution and use of electrical energy from the service entrance to and at the points of use as provided herein.

Subsection 5304.25. Electrical Distribution. One and two family detached dwellings and the dwelling portion of multi-family buildings are exempt from the requirements of this Subsection.

(a) Power Factor. Utilization equipment, rated greater than 1,000 W and lighting equipment greater than 15W, with an inductive reactance load component, shall have a power factor of not less than 85 percent under rated load conditions. Power factor of less than 85 percent shall be corrected to at least 90 percent under rated load conditions. Power factor corrective devices, installed to comply with this Chapter, shall be switched with the utilization equipment, when a leading power factor would result.

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

EXCEPTIONS: Vacant building space or open unoccupied areas need not meet the provisions of the switching requirements until tenant occupancy is determined.

Subsection 5304.26. Lighting Power Budget. One and two family detached dwellings and the dwelling portion of multi-family buildings are exempt from the requirements of this Subsection

A lighting power budget is the upper limit of the power to be available to provide lighting needs in accordance with the criteria 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.

(a) The installed lighting wattage in the building shall not exceed the budget level calculated in this subsection. The budget wattage level shall be the sum of the interior budget calculated in accordance with subsection (b) and the exterior budget calculated in accordance with subsection (c). Lighting wattage includes lamp and ballast wattage.

(b) The interior lighting budget shall be calculated by multiplying the gross building area, in square feet, by the appropriate unit power budget, in watts per square foot, specified in Table 4-11.

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. 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.

Power required for trickle-charging for battery-powered emergency lighting may be excluded from the interior power budget.

(c) The exterior lighting budget shall be calculated by multiplying the building perimeter in feet by 7.5 watts per foot. An allowance for outdoor parking lighting may be added at 0.05 watts per square foot of parking area.

TABLE 4-5

Minimum EER and COP-Cooling

STANDARD RATING CAPACITY	EER	COP
Under 65,000 BTU/hr. (19,050 watts)	6.8	2.0
65,000 BTU/hr. (19,060 watts) and over	7.5	2.2

See Note following Table 4-6.

TABLE 4-6

Applied HVAC System Components, Electrically Driven Water Chillers, and Compressor and Condenser Units-Minimum EER and COP-Cooling

COMPONENT	CONDENSING MEANS	AIR EER	AIR COP	WATER EER	WATER COP	EVAP. EER	EVAP. COP
Self-contained Water chillers	Centrifugal	7.8	2.3	13.6	4.0		
	Positive Displacement	7.5	2.2	11.6	3.4		
Condenserless Water chillers	Positive Displacement	9.5	2.8	11.6	3.4		
Compressor and Condenser units 65,000 BTU/hr (19,050 watts and over)	Positive Displacement	8.5	2.5	11.9	3.5	11.9	3.5

NOTE: When tested at the standard rating conditions specified in Table 4-8A, 4-8B and 4-8C.

TABLE 4-8B

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	--	--
Condenser Water(Water Cooled)F	--	--	85	95

Standard ratings are at sea level

TABLE 4-8C

Applied HVAC System Components
Standard Rating Conditions--Cooling

ITEM		Centrifugal or Self-Contained Reciprocating Water-Chiller	Condenserless Reciprocating Water-Chiller
Leaving Chilled Water Temp. F		44	44
Entering Chilled Water Temp.F		54	54
Leaving Condenser Water Temp. F		95	--
Entering Water Temp. F		85	--
Fouling Factor, Water Non-Ferrous Tubes *		0.0005	0.0005
Fouling Factor, Water Steel Tubes *		0.0010	0.0010
Fouling Factor, Refrigerant *		0.0000	0.0000
Condenser Ambient (Air or Evap.Cooled) F		95db/75wb	--
Compressor Saturated Discharge Temp.	Water Cooled (or Evap. Cooled) F	--	105
	Air Cooled F	--	120

Standard Ratings are at sea level.
*h ft F/Btu

TABLE 4-10

Minimum Pipe Insulation

PIPING SYSTEM TYPES	FLUID TEMPERATURE RANGE,F	INSULATION THICKNESS IN INCHES FOR PIPE SIZES					
		RUN-OUTS UP TO 2"	1" AND LESS	1-1/4 TO 2"	2-1/2 TO 4"	5" TO 6"	8" AND LARGER
HEATING SYSTEMS							
Steam and Hot Water							
High Pressure/ Temp.	306-450	1-1/2	1-1/2	2	2-1/2	3-1/2	3-1/2
Med.Pressure/ Temp.	251-305	1-1/2	1-1/2	2	2-1/2	3	3
Low Pressure/ Temp.	201-250	1	1	1-1/2	1-1/2	2	2
Low Temp.	120-200	1/2	3/4	1	1	1	1-1/2
Steam Condensate (for Feed Water)	Any	1	1	1	1-1/2	1-1/2	2
COOLING SYSTEMS							
Chilled Water	40-55	1/2	1/2	3/4	1	1	1
Refrigerant, or Brine	Below 40	1	1	1-1/2	1-1/2	1-1/2	1-1/2

SECTION 5305 -- BUILDING DESIGN BY SYSTEMS ANALYSIS AND BUILDING UTILIZING NON-DEPLETABLE ENERGY SOURCES

(Alternate Design)

Subsection 5305.00. General. This section establishes design criteria in terms of total energy use by a building including all of its systems.

Subsection 5305.01. Energy Analysis. Compliance with this subsection will require an analysis of annual energy use.

A building designed in accordance with this chapter (the "alternative design building") will comply with this chapter if the annual energy consumption is not greater than that of a building of similar design (a "standard design") whose enclosure elements and energy consuming systems are designed in accordance with Section 5304. The calculated energy consumption of the alternative design shall be subject to a limitation in the improvement credited to any individual building system as outlined in subsection 5305.03.

"Building of similar design" shall mean a building utilizing the same energy sources(s) for the same functions and having equal floor area, environmental requirements, occupancy, climate data and usage schedule. Inputs to the energy analysis relating to occupancy and usage shall correspond to the expected occupancy and usage of the building.

The alternative design shall incorporate the applicable provisions of Subsection 5304.15 (mechanical system controls), Subsection 5304.20(b) (water temperature control), and Subsection 5304.25(c) (lighting switching).

Subsection 5305.02. Design. The standard design, conforming to the criteria of Section 5304 and the proposed alternative design shall be designed on a common basis as specified herein.

The comparison of total energy usage shall be expressed in Btu input per square foot of gross floor area per year for the standard design and the alternative design. Comparison of similar elements, systems or components shall be expressed in dimensions or terms accepted by standard engineering practice.

If the proposed alternative design results in an increase in consumption of one energy source and a decrease in another energy source, even though similar sources are used for similar purposes, the difference in each energy source shall be converted to equivalent energy units for purposes of comparing the total energy used.

Subsection 5305.03. Analysis Procedure. The analysis of the annual energy usage of the standard design and the proposed alternative building and system design shall meet the following criteria:

(a) The building heating/cooling load calculation procedure used for annual energy consumption analysis shall be of sufficient detail to

(e) Mechanical equipment: Design capacity, part load profile.

(f) Building loads: Internal heat generation, lighting, equipment, number of people during occupied and unoccupied periods.

Subsection 5305.05. Documentation. A proposed alternative design submitted under this chapter shall be accompanied by an energy analysis comparision report. The report shall provide sufficient technical detail on the two buildings and their systems and on the data used in and resulting from the comparative analysis to certify that both the analysis and the designs meet the criteria of this chapter.

The documentation shall demonstrate that the analysis used is consistent with accepted techniques and procedures.

EXCEPTION: Proposed alternative designs for single family and two family dwellings and for commercial and industrial structures having the indoor temperature controlled from a single point need not provide the energy usage analysis for a full year. A comparison of energy consumption between the alternative design and the standard design in a manner which follows approved engineering practices and standards, as approved by the Building Official, shall be provided.

Subsection 5305.06. Buildings Utilizing Non-Depletable Energy. (a) Buildings utilizing solar, geothermal, wind or other non-depletable energy sources for all or part of its energy source shall meet the requirements of this chapter, except such non-depletable energy may be excluded from the total annual energy consumption attributed to the alternative design building by this section.

(b) To qualify for this exclusion, such non-depletable energy must be derived from a specific collection, storage and distribution system. The solar energy passing through windows shall also be considered as qualifying if such windows are provided with (1) operable insulating shutters or other devices which, when drawn or closed, shall reduce maximum outward heat flows to those permitted in subsection 5304.02(a) and Subsection 5304.04(a) and, (2) the window areas are shaded or otherwise protected from the direct rays of the sun during periods when cooling is required.

(c) This subsection shall also apply to nocturnal or passive cooling processes in lieu of energy consuming processes.

(d) All other criteria covered in this Section and Section 5304 shall apply to the proposed alternative designs utilizing non-depletable sources of energy.

Subsection 5305.07. Documentation - Buildings Using Non-Depletable Energy Sources. Proposed alternative designs, submitted as requests for exception to the standard design criteria shall be accompanied by an energy analysis, as specified in this Section. The report shall provide sufficient technical detail on the alternative building and system designs and on the data employed in and resulting from the comparative analysis to verify that both the analysis and the designs meet the criteria of Section 5304 and this Section.

SECTION 5306 -- PRESCRIPTIVE REQUIREMENTS APPROACH

Subsection 5306.00. General. (a) This Section establishes design criteria in terms of prescribed requirements for building construction.

(b) The requirements contained in this part are applicable only to buildings less than 5000 square feet in gross floor area or dwelling units of three stories or less in height. Other methods may be used provided a satisfactory design is submitted showing compliance with the performance standards of this chapter.

(c) (Reserved)

(d) Installed insulation having a minimum "R" value as specified in this Section shall be accepted as providing the corresponding required "U" value.

(e) 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.

Subsection 5306.01. Building Envelope Requirements.

(a) Walls. The opaque exterior wall sections and the interior walls exposed to unheated spaces shall have a thermal transmittance "U"-value not to exceed the value specified in Table 6-1.

(b) Roof/Ceiling. The roof/ceiling assembly shall have a thermal transmittance "U" value not to exceed the value specified for the indicated type of construction in Table 6-1.

(c) Thermal Design Standards for Floors.

1. Slab on Grade Floors. Slab-on- grade floors shall be provided with insulation having a minimum "R" value of 4.25 in Zone I and 5.40 in Zone V; slabs internally heated or with perimeter heat ducts in the slab shall be provided with insulation having a minimum "R" value of 6.35 in Zone I and 8.00 in Zone V. The insulation shall extend downward from the top of the slab for a minimum distance of 24 inches, or downward to the bottom of the slab the horizontally beneath the slab for a minimum total distance of 24 inches.

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 6-2.

EXCEPTION: Insulation may be omitted from floor over heated basements, heated garages, or under floor areas used as plenums if foundation walls are insulated in accordance with subsection 5306.01(a). The insulation shall be attached in a permanent manner.

(d) Thermal Design Standards for Openings.

1. Special glazing shall be required for all exterior windows, except that 1% of the gross exterior wall area may be single glazed if approved by the building official for decorative, security or unique architectural features. If glazing area exceeds 20% of the gross exterior wall area, for Zone I, or 17% for Zone V, then the calculation procedure of Subsection 5304.03 must be used. The area of skylights and exterior windows sloped more than 30^{o} from the vertical shall be doubled, and this area shall be included in the percentage of the total glazing area allowed.

2. Exemptions for Passive Solar Features.

For credit glazing area which meets the following requirements may be excluded from the glazed area percentage calculation of part 1 of this subsection (d). The requirements establish criteria for solar access during the heating season, resistance to heat loss, and the provision of heat storage capacity within the insulated walls, either as part of a passive solar design or as part of the ordinary building floor, walls, or ceiling.

A. The area must be double-glazed.

B. The glazing must be oriented within 30 degrees of due south.

C. The glazing must be untinted, non-reflecting glass.

D. The glazing must receive direct solar exposure for 50% of the hours between 9:00 a.m. and 3:00 p.m. on December 21.

E. The glazing must receive direct solar exposure for 85% of the hours between 9:00 a.m. and 3:00 p.m. on March 21.

F. For each square foot of exempt glazing, the building must contain a heat storage capacity equivalent to 150 Btu/day, located inside the insulated shell of the structure, and not covered with insulation materials such as carpet yielding an R value of 1.0 or greater. Heat storage capacity is calculated as specified in subsection 5304.03(b)6.

(a) Heating and Mechanical Cooling Devices.

1. All heating and mechanical cooling devices shall meet the required efficiency factor specified herein or in tables 4-4, 4-5, 4-6 and 4-7, for the specific type of device.

2. Combustion Heating Equipment. All gas and oil fired central heating equipment shall show a minimum combustion efficiency of 75 percent at maximum rated output. Gas and oil fired room or space heaters shall show a minimum combustion efficiency of 70 percent at maximum rated output. Combustion efficiency is defined as 100 percent minus stack losses in percent of heat input. Stack losses are:

   A. Loss due to sensible heat in dry flue gas.

   B. Loss due to incomplete combustion.

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

   All central heat plant connecting vents must be equipped with an approved automatic damper when the central heating plant is located in a heated space.

3. Fireplaces. Fireplaces shall be provided with:

   A. Tightly-fitting flue dampers, operated with a readily accessible manual or approved automatic control.

   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 Section 5303 shall apply for all computations.

   HVAC equipment for low-rise residential buildings shall be sized no greater than 125% of the design load as calculated above. If the selected manufacturer does not provide equipment in the range of 115% to 125% of the design load, the next size larger than 125% may be used. All associated ductwork shall be sized to meet minimum airflow requirements as determined by the load calculation.

EXCEPTION: For service water heating systems, see Subsection 5306.03.

Subsection 5306.03. Service Water Heating. Water heating storage tanks, boilers and piping for all water heating systems shall be installed in accordance with the following:

(a) Temperature Controls.

Service water heating systems shall be equipped with automatic temperature controls capable of adjustment from the lowest to the highest acceptable temperature settings for the intended use.

(b) Shut-down.

A separate switch or individual circuit breaker shall be provided to permit turning off the energy supplied to electric service water heating systems. A separate valve shall be provided to permit turning off the energy supplied to the main burner(s) of all other types of service water heating systems.

(c) Swimming Pools

Heated swimming pools shall be equipped with:

1. Controls which allow water temperature to be regulated from the maximum design temperature down to 65°F;

2. An ON-OFF switch for the pool heater, mounted for easy access to allow shutting off the operation of the heater without adjusting the thermostat setting and to allow restarting without relighting a pilot light; and

3. A pool cover at the surface of the water.

(d) Pump Operation.

Circulating hot water systems shall be arranged so that the circulating pump(s) can be conveniently turned off, automatically or manually, when the hot water system is not in operation.

(e) Insulation.

For recirculating systems, piping heat loss shall be limited to a maximum of 25 Btu/hr.ft.^{2} of external pipe surface for above ground piping and a maximum of 35 Btu/hr.ft.^{2} of external pipe surface for underground piping. Maximum heat loss shall be determined at a temperature differential equal to the maximum water temperature minus a design ambient temperature no higher than 65°F.

(f) Showers.

Showers used for other than safety reasons shall be equipped with flow control devices to limit total flow to a maximum of 3 gpm per shower head.