STATE OF WASHINGTON – KING COUNTY

--ss.

262604 No.
CITY OF SEATTLE,CLERKS OFFICE

Affidavit of Publication

The undersigned, on oath states that he is an authorized representative of The Daily Journal of Commerce, a daily newspaper, which newspaper is a legal newspaper of general circulation and it is now and has been for more than six months prior to the date of publication hereinafter referred to, published in the English language continuously as a daily newspaper in Seattle, King County, Washington, and it is now and during all of said time was printed in an office maintained at the aforesaid place of publication of this newspaper. The Daily Journal of Commerce was on the 12th day of June, 1941, approved as a legal newspaper by the Superior Court of King County.

The notice in the exact form annexed, was published in regular issues of The Daily Journal of Commerce, which was regularly distributed to its subscribers during the below stated period. The annexed notice, a

CT:123430 ORDINANCE

was published on

11/04/10

The amount of the fee charged for the foregoing publication is the sum of $43,266.40, which amount has been paid in full.

Subscribed and sworn to before me on

11/04/10

Notary public for the State of Washington,
residing in Seattle

JENNIFER A. PATZER
NOTARY PUBLIC
STATE OF WASHINGTON
COMMISSION EXPIRES OCTOBER 24, 2013

SEATTLE CITY NOTICES

ORDINANCE 123430

AN ORDINANCE relating to energy efficiency and energy conservation; amending Section 22.700.010 of the Seattle Municipal Code; enacting a new Seattle Energy Code by adopting by reference the 2009 Washington State Energy Code, with certain amendments applicable to no residential spaces and revisions to administrative and procedural provisions; repealing Sections 2-10 of Ordinance 122530; and providing for a deferred effective date for such repeal and for application of the new Seattle Energy Code to residential spaces.

WHEREAS, the Washington State Building Code Council has adopted the 2009 Washington Energy Code, has deferred its effective date to October 29, 2010, and has proposed a further deferral of its effective date; NOW, THEREFORE,

BE IT ORDAINED BY THE CITY OF SEATTLE AS FOLLOWS:

Section 1. Section 22.700.010 of the Seattle Municipal Code is amended as follows:

22.700.010 ((~~Adoption of the 2006 Washington State Energy Code and local amendments~~)) Seattle Energy Code.

A. The ((2006)) 2009 Washington State Energy Code (WAC 51-11), which is filed with the City Clerk in C.F. ((308938)311044, and the amendments thereto adopted by Council Bill ((116033 that incorporate)) 116967, which are the Seattle Amendments, are hereby adopted and by this reference made a part of this subtitle((~~and constitute the Washington State Energy Code with Seattle amendments~~)). The Seattle Amendments include amendments to Reference Standard 29 and add Reference Standards 35 and 36. The 2009 Washington State Energy Code, with all Seattle Amendments, constitutes the Seattle Energy Code for all purposes other than application to residential spaces.

B. For purposes of this Section 22.700.010:

1. Prior to the effective date of the 2009 Washington State Energy Code, "residential spaces" are defined as spaces within the definition of "Group R" occupancy in Chapter 3 of the 2006 Seattle Building Code, as adopted by Ordinance 122528, or within the exception in Section 101.2 of that code, and

2. Effective upon the date when the 2009 Washington State Energy Code takes effect, "residential spaces" are defined as set forth in Chapter 2 of the 2009 Washington State Energy Code under "RESIDENTIAL".

C. Effective upon the date when the 2009 Washington State Energy Code takes effect, the 2009 Washington State Energy Code, with the Seattle Amendments only to Chapter 1 and to Sections 1144 and 1162 of Chapter 11, and the provisions for procedure, administration and enforcement described in Section 1105 of the Seattle Amendments, shall constitute the Seattle Energy Code for residential spaces, to the extent that the provisions thereof apply to residential spaces. Until the effective date of the 2009 Washington State Energy Code, the 2006 Washington State Energy Code, as filed in C.F. 308938, and the amendments thereto adopted by Ordinance 122530, constitute the Seattle Energy Code for residential spaces, except as provided in Section 101.1.2 of the Seattle Amendments regarding procedure, administration and enforcement provisions.

D. It is the City's intent that the Seattle Energy Code constitute part of a local building code, and that any provisions that would be superseded by federal standards but for the application of 42 USC Section 6316(b)(2)(B) or of any other exception to federal preemption shall be applicable to the full extent authorized by any such exception. Any other provision notwithstanding, any requirement of the Seattle Energy Code shall be applicable at any time only to the maximum extent that its application is not prohibited by United States law as then in effect. If any provision of the Seattle Amendments shall be determined to be invalid or unenforceable for any reason, and if the such invalidity or unenforceability would otherwise result in application of any standard below that required by the Washington State Energy Code as then in effect, then the standard of the Washington State Energy Code as then in effect shall apply unless such application is prohibited by applicable federal law.

Section 2. The following sections or subsections of Chapter 1 of the 2009 Washington State Energy Code are amended, and new subsections are added, as follows:

SECTION 101 — SCOPE AND GENERAL REQUIREMENTS

101.1 Title and Applicability

101.1.1 Title: This Code, including provisions of the 2009 Washington Energy Code as they apply without Seattle Amendments, may be referred to as the "Seattle Energy Code" or the "2009 Seattle Energy Code". References herein to "this Code" mean the entire Seattle Energy Code or the provisions thereof that are applicable to the type of structure or space involved, as the context may require.

Chapters 1 through 10 of this Code, as they apply to single-family residential spaces, shall be known as the "((~~Washington State~~)) Seattle Single-Family Residential Energy Code" and may be cited as such. Any reference to the "Seattle Energy Code" in the Seattle Municipal Code or any Seattle ordinance, to the extent applicable to those spaces, shall include the Seattle Single-Family Residential Energy Code. ((~~It and will be referred to herein as "this Code."~~))

101.1.2 Applicability to Single-Family Residential Spaces: Until the effective date of the 2009 Washington State Energy Code, the 2006 Washington State Energy Code, as filed in Seattle City Clerk's File 308938, and the amendments thereto adopted by Ordinance 122550, constitute the Seattle Energy Code for single-family residential spaces. Effective upon the date when the 2009 Washington State Energy Code takes effect, Chapters 1 through 10 of the 2009 Washington State Energy Code, with the Seattle Amendments only to Chapter 1, constitute the Seattle Energy Code for single-family residential spaces.

EXCEPTION: Sections 1133, 1140, 1141, 1141.2, 1144, and 1162 of Chapter 11 of this Code, which relate to procedure, administration and enforcement, including Seattle Amendments to those sections, and the procedural provisions in all chapters, apply to all spaces and occupancies both before and after the effective date of the 2009 Washington State Energy Code.

101.2 Purpose and Intent: The purpose of the Seattle Single-Family Residential Energy Code((this Code)) is to provide minimum standards for new or altered buildings and structures or portions thereof to achieve efficient use and conservation of energy.

The purpose of the Seattle Single-Family Residential Energy Code((this Code)) is not to create or otherwise establish or designate any particular class or group of persons who will or should be especially protected or benefited by its terms((~~the terms of this Code~~)). It is intended that these provisions provide flexibility to permit the use of innovative approaches and techniques to achieve efficient use and conservation of energy. These provisions are structured to permit compliance with the intent of the Seattle Single-Family Residential Energy Code((~~This Code~~)) by any one of the following three paths of design:

1. A systems analysis approach for the entire building and its energy-using sub-systems which may utilize renewable energy sources; Chapters 4 and 9.
2. A component performance approach for various building elements and mechanical systems and components, Chapters 5 and 9.
3. A prescriptive requirements approach; Chapters 6 and 9.

Compliance with any one of these approaches meets the intent of the Seattle Single-Family Residential Energy Code((~~this Code~~)). The Seattle Single-Family Residential Energy Code((~~This Code~~)) is not intended to abridge any safety or health requirements required under any other applicable codes or ordinances. The provisions of the Seattle Single-Family Residential Energy Code((~~this Code~~)) do not consider the efficiency of various energy forms as they are delivered to the building envelope. A determination of delivered energy efficiencies in conjunction with the Seattle Single-Family Residential Energy Code((~~this Code~~)) will provide the most efficient use of available energy in new building construction.

101.3 Scope: The Seattle Single-Family Residential Energy Code((~~This Code~~)) sets forth, among other things, minimum requirements for the design of new buildings and structures that provide facilities or shelter for residential occupancies by regulating their exterior envelopes and the selection of their mechanical systems, domestic water systems, electrical distribution and illuminating systems, and equipment for efficient use and conservation of energy. Buildings that are subject to the Seattle Single-Family Residential Energy Code shall be designed to comply with the requirements of((~~this~~)) Chapter 4, 5 or 6 of this Code and the additional energy efficiency requirements included in Chapter 9 of this Code.

Spaces within the scope of Section R101.2 of the ((~~International~~))Seattle Residential Code shall comply with Chapters 1 through 10 of this Code. All other spaces, including other Group R Occupancies, shall comply with Chapters 11 through 16((~~20~~)) of this Code as specified in Section 1105. Chapter 2 (Definitions), Chapter 3 (Design Conditions), Chapter 7 (Standards) and Chapter 10 (Default heat loss coefficients) are applicable to all building types.

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105.2.1 Required Inspections: The building official, upon notification, shall make the following inspection in addition to those inspections required in ((~~Section 109.3 of the International~~))the Seattle Building Code or Seattle Residential Code:

1. **Wall Insulation Inspection:** To be made after all wall insulation and air vapor retarder sheet or film materials are in place, but before any wall covering is placed.

***

SECTION 106 — VIOLATIONS AND PENALTIES

It shall be unlawful for any person, firm, or corporation to erect or construct any building, or remodel or rehabilitate any existing building or structure in the ((~~state~~))city of Seattle, or allow the same to be done, contrary to or in violation of any of the provisions of this Code. Other violations are set forth in Section 1144 of this Code. Provisions for notices, enforcement proceedings and penalties specified in Section 103 of the Seattle Building Code apply to violations of this Code, as set forth in Section 1144 of this Code.

***

SECTION 107 LIABILITY

Nothing contained in this Code is intended to be nor shall be construed to create or form the basis for any liability on the part of ((~~any city, its officers~~))the City of Seattle or its officers, employees or agents for any injury or damage resulting from the failure of a building to conform to the provisions of this Code.

***

SECTION 108 — CONFLICTS WITH OTHER CODES

In addition to the requirements of this Code, all occupancies shall conform to the provisions included in the Seattle Building Code or Seattle Residential Code, as applicable, and other applicable codes((~~State Building Code (Chapter 19.27 RCW)~~)). In case of conflicts among Codes enumerated in RCW 19.27.031 subsections (1), (2), (3) and (6) and this Code, the earlier named Code shall govern over those following. In the case of conflict between the duct sealing and insulation requirements of this Code and the duct insulation requirements of Sections 603 and 604 of the ((~~State~~))Seattle Mechanical Code (((~~Chapter 51-52 WAC~~)), the duct insulation requirements of this Code((~~once, or where applicable, a~~ local jurisdiction's energy code)) shall govern.

Where, in any specific case, different sections of this Code specify different materials, methods of construction or other requirements, the most restrictive shall govern. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall be applicable. ((~~Where in this Code reference is made to the appendix, the provisions in the appendix shall not apply unless specifically adopted.~~))

***

Section 3. The following subsections of Section 201 of Chapter 2 of the 2009 Washington State Energy Code are amended, and new subsections are added to that Section, as follows:

SECTION 201 – GENERAL DEFINITIONS

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ADDITION: See the ((~~Washington State~~))Seattle Building Code.

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AHRI STANDARD 1160: AHRI's Standard 1160, Performance Rating of Heat Pump Pool Heaters, 2008.

***

AMCA: Air Movement and Control Association.

AMCA STANDARD 500: AMCA's Standard 500, Laboratory Methods of Testing Dampers for Rating, 1997.

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ASHRAE STANDARD 127: ASHRAE's Standard 127, Method of Testing for Rating Computer and Data Processing Room Unitary Air Conditioners, 2007.

***

BUILDING, EXISTING: An existing structure, as defined in the Seattle Building Code. (See **Existing Structure** in the ((~~Washington State~~))Seattle Building Code.)

BUILDING ENTRANCE: Any doorway, set of doors (including elevator doors such as in parking garages), turnstile, vestibule, or other form of portal that is ordinarily used to gain access to the building by its users and occupants. Where buildings have separate one-way doors to enter and to leave, this also includes any doors ordinarily used to leave the building.

***

BUILDING OFFICIAL: The ((~~official authorized to act in behalf of a jurisdiction code enforcement agency or its~~)) Director of the Seattle Department of Planning and Development, or his or her authorized representative.

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COMPUTER ROOM: a room whose primary function is to house electronic equipment for the processing and storage of electronic data and that has a design electronic data equipment power density exceeding 20 watts/ft^2 of conditioned floor area (215 watts/m^2).

***

CONTINUOUS INSULATION (c.i.): Insulation that is continuous across all structural members without thermal bridges other than fasteners (i.e. screws and nails) and service openings. It is installed on the interior or exterior or is integral to any opaque surface of the building envelope. For the purposes of this definition of continuous insulation, only screws and nails are considered fasteners. Insulation installed between metal studs, girts, z-channels, shelf angles, or insulation with penetrations by brick ties and offset brackets, or any other similar framing is not considered continuous insulation, regardless of whether the metal is continuous or occasionally discontinuous or has thermal break material. (See Section 1332 for documentation of U-factors for assemblies that include metal other than screws and nails.)

Informative Note: Even small slips degrade the performance of insulation. For mass walls, Table 5.5-1 contains a prescriptive compliance option for mass walls with 1-inch clips. This corresponds with the category of "1 in Metal Clips at 24 in. on center horizontally and 16 in. vertically" in Table 10-5B(3), Default U-factor for Concrete and Masonry. However, note that this is not considered continuous insulation. There is a separate listing in Table 10-5B(3) for insulation that qualifies as continuous insulation.

Metal studs, girts or any other repetitive continuous metal framing can decrease the effective R-value of insulation by more than 50%. However, occasional continuous metal framing members such as shelf angles are also significant thermal bridges around the insulation. Discontinuous metal elements, such as metal cliff brackets and hat bar, still have thermal bridging effects. Calculations on a steel cliff system utilizing a hat bracket showed that the brackets mounted at 24 inches on center vertically and 16 inches on center horizontally decreased the effective R-value of the assembly by 23% and the brackets mounted at 48 inches on center vertically and 16 inches on center horizontally decreased the effective R-value of the assembly by 14%. Even isolated discontinuous metal elements such as brick ties have a thermal impact that is too large to be ignored.

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DAYLIGHTED ZONE:

a. **Under skylights**((~~overhead glazing~~)): The area under a skylight((~~overhead glazing~~)) whose horizontal dimension, in each direction, is equal to the skylight's((~~overhead glazing~~)) dimension in that direction plus either 70 percent of the floor to ceiling height or the dimension to a ceiling height opaque partition or to a partition which is more than 50% opaque, or one-half the distance to an adjacent skylight((~~overhead~~)) or vertical fenestration((~~glazing~~)), whichever is least.

b. **At vertical fenestration**((~~glazing~~)): The area adjacent to vertical fenestration ((~~glazing~~)) which receives daylighting from the glazing. For purposes of this definition and unless more detailed daylighting analysis is provided, the primary daylighted zone depth extends into the space a distance equal to the window head height and the secondary daylighted zone extends from the edge of the primary zone to a distance equal to two times the window head height, or to the nearest ceiling height opaque partition or to a partition which is more than 50% opaque, whichever is least((~~less~~)). The daylighting zone width is assumed to be the width of the window plus either two feet on each side (or the lesser distance to an opaque partition) or one-half the distance to adjacent skylights((~~overhead~~)) or vertical fenestration((~~glazing~~)), whichever is least.

c. **In parking garages:** the area within 20 feet of any portion of a perimeter wall that has a net opening to wall ratio of at least 40% and no exterior obstructions within 20 feet.

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DOMESTIC WATER SYSTEM: Supply of hot water and cold water for domestic, ((~~or~~)) commercial, or industrial purposes, including commercial and industrial processes, other than comfort heating and cooling.

Informative Note: As indicated in Section 1120, the Energy Code applies to industrial facilities, as well as commercial and industrial processes. Thus, the domestic water requirements apply to industrial facilities, as well as systems and equipment used in commercial and industrial processes.

***

DPD: the Seattle Department of Planning and Development and any successor department responsible for administration of this Code.

DWELLING UNIT: See the ((~~Washington State~~))Seattle Building Code.

DYNAMIC GLAZING: any fenestration product that has the fully reversible ability to change its performance properties, including U-factor, SHGC, or VT.

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EAST: (See **Orientation.**)

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ENERGY STAR PROGRAM REQUIREMENTS FOR COMMERCIAL DISHWASHERS: Energy Star Program Requirements for Commercial Dishwashers, Version 1.1, October 15, 2007.

ENERGY STAR PROGRAM REQUIREMENTS FOR COMMERCIAL FRYERS: Energy Star Program Requirements for Commercial Fryers, Version 1.0, August 15, 2003.

ENERGY STAR PROGRAM REQUIREMENTS FOR COMMERCIAL STEAM COOKERS: Energy Star Program Requirements for Commercial Steam Cookers, Version 1.0, August 1, 2003.

ENERGY STAR PROGRAM REQUIREMENTS FOR HOT FOOD HOLDING CABINETS: Energy Star Program Requirements for Hot Food Holding Cabinets, Version 1.0, August 15, 2003.

***

FENESTRATION AREA: Total area of the fenestration measured using the rough opening and including the glazing, sash and frame. For doors where the daylight opening area is less than 50 percent of the door area, the fenestration area is the daylight opening area. For all other doors, the fenestration area is the door area.

***

GEOTHERMAL ENERGY: heat extracted from the Earth's interior and used to produce electricity or mechanical power or provide thermal energy for space buildings, water, or processes. Geothermal energy does not include systems that use energy independent of the geothermal source to raise the temperature of the extracted heat, such as heat pumps.

***

GLAZING: For residential spaces, ((~~All~~))all areas, including the frames, in the shell of a conditioned space that let in natural light including windows, clerestories, skylights, sliding or swinging glass doors and glass block walls. For other spaces, that portion of the fenestration that lets in natural light. (See **Fenestration.**)

Informative Note: The terminology used for single-family residential in Chapters 3-10 differs from that used for other spaces in Chapters 2 and 11-26. For single-family residential, the term "glazing" is used to apply to the overall product including the frame. However, for other spaces (nonresidential and multifamily residential), the term "fenestration" is used for the overall product including the frame, and "glazing" means only the portion of the product that lets in natural light.

***

GUEST ROOM: See the ((Washington State))Seattle Building Code.

***

INDIRECTLY CONDITIONED SPACE: an enclosed space within a building that is not a heated or cooled space, whose area weighted heat transfer coefficient to heated or cooled spaces exceeds that to the outdoors or to unconditioned spaces; or through which air from heated or cooled spaces is transferred at a rate exceeding three air changes per hour. Enclosed corridors between conditioned spaces shall be considered as indirectly conditioned space. Unless demonstrated otherwise, all portions of elevator shafts and stair enclosures located in the interior of the building are considered indirectly conditioned space, including those portions of elevator shafts and stair enclosures that extend above the roof and those portions that extend down below the floor into the parking garage. (See **Conditioned Space, Heated Space, Cooled Space,** and **Unconditioned Space.**)

Informative Note: For elevator shafts and stair enclosures, unless the space they enclose is demonstrated not to be conditioned space, the walls and roofs of elevator shafts and stair enclosures that extend above the roof are subject to the building envelope requirements for conditioned space, and the walls of elevator shafts and stair enclosures that extend down below the floor into the parking garage are subject to the building envelope requirements for conditioned space.

***

INTERNATIONAL BUILDING CODE (IBC): (See ((Washington State))Seattle Building Code.)

INTERNATIONAL MECHANICAL CODE (IMC): (See ((Washington State Building))Seattle Mechanical Code.)

INTEGRATED ENERGY EFFICIENCY RATIO (IEER): a single-number figure of merit expressing cooling part-load EER efficiency for commercial unitary air-conditioning and heat pump equipment on the basis of weighted operation at various load capacities for the equipment.

***

MECHANICAL SYSTEM: equipment and components that provide heating, cooling, and ventilation for any purpose, including commercial and industrial processes, other than domestic water systems.

Informative Note: As indicated in Section 1120, the Energy Code applies to industrial facilities, as well as commercial and industrial processes. Thus, the "mechanical system requirements apply to industrial facilities, as well as systems and equipment used in commercial and industrial processes.

***

NOMINAL R-VALUE: the thermal resistance of insulation alone as determined in accordance with the U.S. Federal Trade Commission R-value rule (CFR Title 16, Part 460) in units of hr·ft²·°F/Btu at a mean temperature of 75°F. Nominal R-value refers to the thermal resistance of the added insulation in framing cavities or insulated sheathing only and does not include the thermal resistance of other building materials or air films.

Procedure Requirement: For products not labeled in accordance with the FTC rule, the R-value is to be determined by a report from the ICC Evaluation Service (ICC-ES).

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NORTH: (See **Orientation.**)

***

OCCUPANCY: See the ((Washington State))Seattle Building Code.

***

ON-SITE RENEWABLE ((ENERGY))ELECTRIC POWER SYSTEM: a photovoltaic, solar thermal, geothermal energy, ((and))or wind system((s)), used to generate electrical power and located on the building site. (See **Geothermal Energy.**)

ON-SITE RENEWABLE ENERGY SYSTEM: an on-site renewable electric power system or on-site renewable thermal energy system. (See **On-Site Renewable Electric Power System** and **On-Site Renewable Thermal Energy System.**)

ON-SITE RENEWABLE THERMAL ENERGY SYSTEM: a solar water-heating, geothermal energy, ground-source heat pump, or groundwater-source heat pump system, used to generate thermal energy and located on the building site. (See **Geothermal Energy.**)

***

ORIENTATION:

East: oriented less than 45 degrees of true east.

North: oriented less than or equal to 45 degrees of true north.

South: oriented less than or equal to 45 degrees of true south.

West: oriented less than 45 degrees of true west.

***

PERSON: Any individual, receiver, administrator, executor, assignee, trustee in bankruptcy, trust, estate, firm, partnership, joint venture, club, company, joint stock company, business trust, municipal or quasi-municipal corporation, state or instrumentality thereof, political subdivision of the State of Washington, corporation, limited liability company, association, society or any group of individuals acting as a unit, whether mutual, cooperative, fraternal, nonprofit or otherwise, and the United States or any instrumentality thereof.

***

READILY ACCESSIBLE: See the ((Washington State))Seattle Mechanical Code.

***

RESIDENTIAL: The following two categories comprise all residential spaces for the purposes of this Code:

a. Single-family: All spaces within the scope of Section R101.2 of the ((International))Seattle Residential Code.

b. Multifamily:

i. All Group R Occupancy not falling under the scope of Section 101.2 of the ((International))Seattle Residential Code including, but not limited to, dwelling units, hotel/motel guest rooms, dormitories, fraternity/sorority houses, hostels, prisons, and fire stations;

ii. All sleeping areas in Group I Occupancy including, but not limited to, assisted living facilities, nursing homes, patient rooms in hospitals, prisons, and fire stations; and

iii. All sleeping areas in other occupancies including, but not limited to, fire stations.

***

SENSIBLE COOLING PANEL: a panel designed for sensible cooling of an indoor space through heat transfer to the thermally effective panel surfaces from the occupants and/or indoor space by thermal radiation and natural convection.

SENSIBLE HEATING PANEL: a panel designed for sensible heating of an indoor space through heat transfer from the thermally effective panel surfaces to the occupants and/or indoor space by thermal radiation and natural convection.

***

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

Informative Note: As indicated in Section 1120, the Energy Code applies to industrial facilities, as well as commercial and industrial processes. Thus, the service water heating requirements apply to industrial facilities, as well as systems and equipment used in commercial and industrial processes.

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SOUTH: (See **Orientation.**)

***

STORY: (See the Seattle Building Code.)

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THERMALLY EFFECTIVE PANEL SURFACE: any exterior surface of a panel that is intended to transfer heat between the panel and the occupants and/or the indoor space.

THERMALLY INEFFECTIVE PANEL SURFACE: any exterior surface of a panel that is not intended to transfer heat between the panel and the occupants and/or the indoor space.

***

VISIBLE TRANSMITTANCE (VT): The ratio of visible radiation entering the space through the fenestration product to the incident visible radiation, determined as the spectral transmittance of the total fenestration system, weighted by the photopic response of the eye and integrated into a single dimensionless value.

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WEST: (See **Orientation.**)

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Section 4. The following sections or subsections of Chapter 3 of the 2009 Washington State Energy Code are amended as follows:

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TABLE 3-1

OUTDOOR DESIGN TEMPERATURES

Location	Outdoor Design Temp Heating (°F)	Outdoor Design Temp Cooling (°F)	Location	Outdoor Design Temp Heating (°F)	Outdoor Design Temp Cooling (°F)	Location	Outdoor Design Temp Heating (°F)	Outdoor Design Temp Cooling (°F)
Aberdeen 2E NWS	25	83	Ephrata AP	26	96	Republic	15	88
Arlington	27	82	Everett 2 NW	9	92	Ritzville	8	91
Auburn	24	90	Fairchild AFB	19	90	Roche Harbor	23	81
Bellingham	23	84	Forks 1 E	23	85	Seattle Boeing Field	17	83
Bellingham 2 N	19	78	Friday Harbor	8	83	Shelton	6	89
Bothell	17	93	Glacier 2 SE	22	101	Sedro Woolley	10	90
Bremerton	23	83	Long Beach 3 NNE	28	97	Seattle Sand Point	24	82 dry 69 wb
Burlington	19	87	Longview	24	97	Seattle Sea-Tac AP	24	83
Carlsborg	21	87	Lower Elwha	14	98	Sedro Woolley	10	88
Cashmere 2E	29	97	Mazama	2	100	Stevens Pass	8	77
Castle Rock	21	94	Metaline Falls	-1	89	Snoqualmie Pass	10	80
Centralia 1 NW	9	94	Newhalem	19	89	Spokane AP	6	92
Chehalis AP	2	92	Newport	3	92	Spokane CO	10	89
Concrete	19	85	Northport	2	92	Stampede Pass	7	76
Conconully 1 NNW	6	103	Oak Harbor	16	94	Stehekin 3 NW	12	88
Cougar 3 E	25	93	Odessa	7	100	Stevens	8	77
Darrington AP	14	89	Olga 2 SE	24	71	Tacoma CO	29	82
Darrington RS	13	85	Olympia AP	17	85	Tatoosh Island	31	63
Davenport	5	93	Omak 2 NW	3	90	Toledo AP	17	84
Diamond Lake	24	83	Oroville	5	92	Vancouver	22	83
Ellensburg AP	2	93	Othello	9	98	Vashon Island	28	78
Elma	24	88	Packwood	16	90	Walla Walla AP	6	96
Eglon 4 AP	7	97	Pasco	5	95	Waterville	1	88
Everett Paine AFB	21	79	Pleasant View	16	98	Wellpinit	1	93
Forks 1 E	23	84	Pomeroy	7	95	Wenatchee CO	16	92
Glacier 2S	15	82	Port Angeles	28	75	Whidbey Island	21	71
Glenoma (Kearney)	18	89	Port Townsend	29	76	Whitman Harbor	26	84
Goldendale	7	97	Prosser	12	93	Wilson Creek	3	96
Grays River Hatchery	28	86	Puyallup	19	86	Winthrop 1 WSW	-12	91
Greenwater	14	84	Quillayute 2 SW	23	85	Yakima AP	11	94
Grotto	21	91	Quinault RS	25	84			

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SECTION 303 — MECHANICAL VENTILATION

For single-family residential spaces, the((The)) minimum requirements for ventilation shall comply with Section M1508 of the ((Washington State Residential Code (WAC 51-51))) Seattle Residential Code. For other spaces, see Section 1302.

Section 5. The following sections or subsections of Chapter 5 of the 2009 Washington State Energy Code are amended as follows:

***

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

The U-factors for typical construction assemblies are included in Chapter 10. These values shall be used for all calculations. Where proposed construction assemblies are not represented in Chapter 10, values shall be calculated in accordance with Chapters 16 through 18 and 25 through 27 in Standard RS-1 listed in Chapter 7, using the framing factors listed in Chapter 10 where applicable.

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

1. Results of laboratory measurements according to acceptable methods of test.
2. Standard RS-1, listed in Chapter 7, where the metal framing is bonded on one or both sides to a metal skin or covering.
3. The zone method as provided in Chapter 27 of Standard RS-1, listed in Chapter 7.
4. Results of parallel path correction factors for effective framing/cavity R-values as provided in Table 10-5A: Effective R-Values for Metal Framing and Cavity Only for metal stud walls and roof/ceilings.

Informative Note: Effective framing/cavity R-values are provided in Table 10-5A(C).

***

502.1.4.1 General: All insulating materials shall comply with Sections 2603 and/or 719 of the ((International))Seattle Building Code. Substantial contact of the insulation with the surface being insulated is required. All insulation materials shall be installed according to the manufacturer's instructions to achieve proper densities and maintain uniform R-values and shall be installed in a manner which will permit inspection of the manufacturer's R-value identification mark. To the maximum extent possible, insulation shall extend over the full component area to the intended R-value.

The thickness of roof/ceiling insulation that is either blown in or spray-applied shall be identified by inches of thickness, density and R-value markers installed at least one for every 300 square feet (28 m2) throughout the attic and/or ceiling space. In attics, the markers shall be affixed to the trusses or joists and marked with the minimum initial installed thickness with numbers a minimum 1.0 inch (25 mm) in height. Each marker shall face the attic access. The thickness of installed attic insulation shall meet or exceed the minimum initial installed thickness shown by the marker.

502.1.4.2 Insulation Materials: All insulation materials including facings such as vapor barriers or breather papers installed within floor/ceiling assemblies, roof/ceiling assemblies, walls, crawl spaces, or attics shall have a flame spread rating of less than 25 and a smoke density not to exceed 450 when tested in accordance with ASTM E84-07.

EXCEPTIONS:

1. Foam plastic insulation shall comply with Section 2603 of the ((International))Seattle Building Code.
2. Where such materials are installed in concealed spaces of Types III, IV and V construction, the flame spread and smoke developed limitations do not apply to facing, provided that the facing is installed in substantial contact with the unexposed surface of the ceiling, floor or wall finish.
3. Cellulose insulation shall comply with Section 719 of the ((International))Seattle Building Code.

***

502.1.4.5 Roof/Ceiling Insulation: Where two or more layers of rigid board insulation are used in a roof assembly, the vertical joints between each layer shall be staggered. Open-blown or poured loose fill insulation may be used in attic spaces where the slope of the ceiling is not more than 3 in. in 12 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 sheathing at the roof ridge. When eave vents are installed, baffling of the vent openings shall be provided so as to deflect the incoming air above the surface of the insulation. Baffles shall be rigid material, resistant to wind driven moisture. Requirements for baffles for ceiling insulation shall meet the ((International))Seattle Building Code Section 1203.2 for minimum ventilation requirements. Where feasible, the baffles shall be installed from the top of the outside of the exterior wall, extending inward, to a point 6 inches vertically above the height of noncompressed insulation, and 12 inches vertically above loose fill insulation.

***

502.2.1 UA Calculations: The proposed UA as calculated using Equations 2 and 3 shall not exceed the target UA as calculated using Equation 1. For the purpose of determining equivalent thermal performance, the glazing area for the target UA shall be calculated using values in Table 5-1. The opaque door area shall be the same in the target UA and the proposed UA. When showing compliance with Table 9-1 using options 3a, 3b or 3c, the proposed design shall be less than the target UA by the fraction noted in the table.

EXCEPTION: Log and solid timber walls that have a minimum average thickness of 3.5" and solid log space heat type effective electric resistance are exempt from wall target UA and proposed UA calculations.

Procedural Requirement: The plans shall contain a glazing and opaque door schedule.

The glazing schedule shall include all vertical glazing and overhead glazing (windows, sliding and swinging glass doors and glazed roll-up doors, glass block, plastic panels, clerestories, skylights, etc.), as well as all opaque doors.

For all projects, the glazing and opaque door schedule shall include the manufacturer and model number for all products regardless of U-factor.

The glazing and opaque door schedules shall include the product type, size, number of each type, the U-factor and whether the U-factor is NFRC-certified or default.

If the product is claimed to be NFRC-certified, the NFRC Certified Products Directory (CPD) number shall be provided. A specification sheet that states "determined in accordance with NFRC 100" does not suffice.

If a default U-factor from Chapter 10 is used for unrated products in lieu of NFRC certification, the glazing and opaque door schedule shall include a description of the key energy efficiency features that are necessary to achieve that default U-factor (indicating whether the glazing product is fixed or operable, frame material type, thermal break description, number of glazing layers, emissivity of low-e coatings, gas width, gas fill, spacer type, etc.).

***

503.10.3 Sealing: All ducts, air handlers, filter boxes, and building cavities used as ducts shall be sealed. Joints and seams shall comply with Section M1601.3 of the ((International)) Seattle Residential Code or Section 603.9 of the ((International)) Seattle Mechanical Code. Duct tightness testing shall be conducted to verify that the ducts are sealed. A signed affidavit documenting the test results shall be provided to the jurisdiction having authority by the testing agent. When required by the building official, the test shall be conducted in the presence of department staff. Duct tightness shall be verified by either of the following:

1. Post-construction test: Leakage to outdoors shall be less than or equal to 6 cfm per 100 square feet of conditioned floor area or a total leakage less than or equal to 8 cfm per 100 square feet of conditioned floor area when tested at a pressure differential of 0.1 inches w.g. (25 Pascals) across the entire system, including the manufacturer's air handler enclosure. All register boots shall be taped or otherwise sealed during the test.
2. Rough-in test: Total leakage shall be less than or equal to 6 cfm per 100 square feet of conditioned floor area when tested at a pressure differential of 0.1 inches w.g. (25 Pascals) across the roughed-in system, including the manufacturer's air handler enclosure. All register boots shall be taped or otherwise sealed during the test. If the air handler is not installed at the time of the test, total leakage shall be less than or equal to 4 cfm per 100 square feet of conditioned floor area.

EXCEPTIONS:

1. Duct tightness test is not required if the air handler and all ducts are located within conditioned space.
2. Duct tightness test is not required if the furnace is a direct vent type combustion appliance installed in an unconditioned space. A maximum of six feet of connected ductwork in the unconditioned space is allowed. All additional supply and return ducts shall be within the conditioned space. Ducts outside the conditioned space shall be sealed with a mastic type duct sealant and installed on the exterior of R-8 insulation for above grade ducts and R-5 water resistant insulation when under a slab or earth.

503.10.4 Dampers: Requirements for automatic or manual dampers are found in Chapter 15 of the ((Washington State Mechanical Code (WAC 51-52))) Seattle Residential Code.

***

Section 6. The following section of Chapter 6 of the 2009 Washington State Energy Code is amended as follows:

***

602.7.2 Glazing U-Factor: The total glazing area as defined in Chapter 2 shall have an area weighted average U-factor not to exceed that specified in Table 6-1 or 6-2. U-factors for glazing shall be determined in accordance with Section 502.1.5. These areas and U-factors shall also include any doors using the exception of Section 602.6.

If the U-factors for all vertical and overhead glazing products are below the appropriate U-factor specified, then no calculations are required. If compliance is to be achieved through an area weighted calculation, then the areas and U-factors shall be included in the plans submitted with a building permit application.

EXCEPTION: Double glazed garden windows with a wood or vinyl frame shall be exempt from the U-factor calculations but shall have its area included and shall be included in the percentage of the total glazing area allowed for in Table 6-1 or 6-2. The variance area (before trip-ing) a lower for the total of all garden windows is one percent of the floor area or 20 square feet, whichever is less.

Procedural Requirement: The plans shall contain a glazing and opaque door schedule.

The glazing schedule shall include all vertical glazing and overhead glazing (windows, sliding and swinging glass doors and glazed roll-up doors, glass block, plastic panels, clerestories, skylights, etc.), as well as all opaque doors.

For all projects, the glazing and opaque door schedule shall include the manufacturer and model number for all products regardless of U-factor.

The glazing and opaque door schedules shall include the product type, size, number of each type, the U-factor and whether the U-factor is NFRC-certified or default.

If the product is claimed to be NFRC-certified, the NFRC Certified Products Directory (CPD) number shall be provided. A specification sheet that states "determined in accordance with NFRC 100" does not suffice.

If a default U-factor from Chapter 10 is used for unrated products in lieu of NFRC certification, the glazing and opaque door schedule shall include a description of the key energy efficiency features that are necessary to achieve that default U-factor (indicating whether the glazing product is fixed or operable, frame material type, thermal break description, number of glazing layers, emissivity of low-e coatings, gas width, gas fill, spacer type, etc.).

***

Section 7. The following section of Chapter 7 of the 2009 Washington State Energy Code is amended as follows:

***

701 Scope. The following standards shall apply to Chapters 1 through 10((20)). The standards and portions thereof, which are referred to in various parts of this Code ((shall be part of the Washington State Energy Code and)) are hereby declared to be a part of this Code.

CODE STANDARD NO.	TITLE AND SOURCE
RS-1	((2005))2009 ASHRAE Fundamentals Handbook.
RS-2	Super Good Cents Technical Reference (Builder's Field Guide)
RS-3:	(Reserved.)
RS-4	ASHRAE Standard 55-2004 Thermal Environmental Conditions for Human Occupancy.
RS-5	2006 ASHRAE Refrigeration Handbook.
RS-6	(Reserved.)
RS-7	SMACNA, HVAC Duct Construction Standards, Metal and Flexible, 2005.
RS-8:	(Reserved.)
RS-9	ASHRAE/IESNA Standard 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential Buildings.
RS-10	2008 ASHRAE Systems and Equipment Handbook.
RS-11	2007 ASHRAE HVAC Applications Handbook.
RS-12 - RS-28:	(Reserved.)
RS-29	Nonresidential Building Design by Systems Analysis (included in exemption of this Code).
RS-30	Title 10, Code of Federal Regulations (CFR), Part 430 (March 14, 1989).
RS-31	National Fenestration Rating Council (NFRC) Standard 100-2004.
RS-32	Seattle EnvStd ((2006)) 2009.*
RS-33	Duct Testing Standard for New and Existing Construction, Washington State University Extension Energy Program Publication #WSUEEP 09-008.
RS-34	Optional Acceptance Requirements for Nonresidential Buildings, SBCC 2009.
RS-35	Advanced Criteria for Other Programs (included in Seattle Amendments).
RS-36	Illustrative Goals for the 2030 Challenge in Seattle (included in Seattle Amendments).

*The Director of DPD is authorized to develop and accept the next 2009 version of the Seattle EnvStd software, which in substance will consist of Seattle EnvStd 2009 with a baseline created to correspond with Table 13-1 of this Code and having a preliminary WTSHGC rating of 1.50 for vertical fenestration and skylights with glazing made of glass and 1.45 for skylights with glazing made of plastics. The 2009 version shall constitute RS-32 from and after the effective date of the ordinance in which it is adopted by the Director. Prior to that date, references in this Code to the RS-32 option are not effective.

ACCREDITED AUTHORITATIVE AGENCIES

AHRI refers to the Air-Conditioning, Heating and Refrigeration Institute, ((1301 N. Fairfax Dr., Suite 425)) 2111 Wilson Blvd, Suite 500, Arlington, VA 22203
Phone (703) 524-8800 fax (703) 528-3816, internet ((www.ari.org)) www.ahrinet.org

ANSI refers to the American National Standards Institute, Inc., 11 West 42nd Street, New York, NY 10036
Phone (212) 642-4900 fax (212) 398-0023, internet www.ansi.org

ASHRAE refers to the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., 1791 Tullie Circle, N.E., Atlanta, GA 30329
Phone (404) 636-8400 fax (404) 321-5478, internet www.ashrae.org

ASTM refers to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959
Phone (610) 832-9585 fax (610) 832-9555, internet www.astm.org

CTI refers to the Cooling Tower Institute, 530 Wells Fargo Drive, Suite 218, Houston, TX 77090
Phone (281) 583-4087 fax (281) 537-1721, internet www.cti.org

IESNA refers to the Illuminating Engineering Society of North America, 120 Wall Street Floor 17, New York, NY 10005-4001
Phone (212) 248-5000 fax (212) 248-5017, internet www.iesna.org

NFRC refers to the National Fenestration Rating Council, Inc., 8484 Georgia Avenue, Suite 320, Silver Spring, Maryland 20910
Phone (301) 589-1776 fax (301) 589-3884, internet www.nfrc.org

SBCC refers to the Washington State Building Code Council, P.O. Box 42525, Olympia, WA 98504-2525
Phone 360-725-2900 fax 360-586-9383, internet www.sbcc.wa.gov

SMACNA refers to the Sheet Metal and Air Conditioning Contractors National Association, Inc., 4201 Lafayette Center Drive, P.O. Box 221230, Chantilly, VA 20153-1230
Phone (703) 803-2980 fax (703) 803-3732, internet www.smacna.org

WSU refers to the Washington State University Extension Energy Program, 905 Plum Street S.E., Building 40, P.O. Box 43165, Olympia, WA 98504-3166
Phone 360-956-2000 fax 360-956-2217, internet www.energy.wsu.edu

Section 8. The following section of Chapter 9 of the 2009 Washington State Energy Code is amended as follows:

***

901 Additional Residential Energy Efficiency Requirements. Dwelling units permitted under this Code shall comply with all provisions of Chapter 5 of this Code and develop one credit from Table 9-1.

EXCEPTION: Buildings complying using Chapter 6 Building Design by Systems Analysis shall meet this provision of this section by demonstrating that the proposed building energy use is 16 percent less than the target building energy use.

Informative Note: Per "option" 7, all dwelling units exceeding 5000 square feet of gross floor area are assigned a negative 1.0 points and therefore need to achieve a positive 2.0 points in other options in order to comply.

TABLE 9-1

ENERGY CREDITS (DEBITS)

OPTION	DESCRIPTION	CREDIT(S)
1a	HIGH EFFICIENCY HVAC EQUIPMENT 1: Gas, propane or oil-fired furnace or boiler with minimum AFUE of 92%, or Air-source heat pump with minimum HSPF of 9.5, [Procedural Requirement: To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency. It is recommended that projects apply for a mechanical permit prior to the building permit application and paste a copy of the mechanical permit on the building permit drawings.]	1.0

OPTION	DESCRIPTION	CREDIT(S)
1b	HIGH EFFICIENCY HVAC EQUIPMENT 2: Ground-loop ground source heat pump, with a minimum COP of 3.3. [Procedural Requirement: To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency. It is recommended that projects apply for a mechanical permit prior to the building permit application and paste a copy of the mechanical permit on the building permit drawings.]	2.0

OPTION	DESCRIPTION	CREDIT(S)
1c	HIGH EFFICIENCY HVAC EQUIPMENT 3: DUCTLESS SPLIT SYSTEM HEAT PUMPS, ZONAL CONTROLS In zone where the primary space heating system is zonal electric heating, a ductless heat pump system will be installed and provide heating to at least one room of the housing unit. [Procedural Requirement: To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency. It is recommended that projects apply for an electrical permit prior to the building permit application and paste a copy of the electrical permit on the building permit drawings.]	1.0

OPTION	DESCRIPTION	CREDIT(S)
2	HIGH EFFICIENCY HVAC DISTRIBUTION SYSTEM: All heating and cooling system components installed inside the conditioned space. All combustion equipment shall be direct vent or sealed combustion. Heating system components in conditioned crawl spaces is not permitted under this option. Electric resistance heat is not permitted under this option. Direct combustion heating equipment with AFUE less than 80% is not permitted under this option. [Procedural Requirement: To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency. It is recommended that projects apply for a mechanical permit prior to the building permit application and paste a copy of the mechanical permit on the building permit drawings.]	1.0

OPTION	DESCRIPTION	CREDIT(S)
3a	EFFICIENT BUILDING ENVELOPE 1: Prescriptive compliance is based on Table 6-1, Option III with the following modifications: Window U = 0.28 floor R-38, slab on grade R-10 full, below grade slab R-10 2ft. or Component performance compliance: Reduce the Target UA from Table 6-1 by 5%, as determined using EQUATION 1. [Procedural Requirement: To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall show the location and R-value of all insulation. For glazing U-factors: - For Prescriptive compliance, see prescriptive requirement under Section 602.7.2. - For Component performance compliance, see procedural requirement under Section 502.2...]	0.5

OPTION	DESCRIPTION	CREDIT(S)
3b	EFFICIENT BUILDING ENVELOPE 2: Prescriptive compliance is based on Table 6-1, Option III with the following modifications: Window U = 0.65 or less, R-21 plus R-4 and R-28 floor, slab on grade R-10 full, below grade slab R-10 2ft, and R-5 plus R-5 below grade basement walls. or Component performance compliance: Reduce the Target UA from Table 6-1 by 15%, as determined using EQUATION 1. [Procedural Requirement: To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall show the location and R-value of all insulation. For glazing U-factor: - For Prescriptive compliance, see procedural requirement under Section 602.7.2. - For Component performance compliance, see procedural requirement under Section 502.2...]	1.0

OPTION	DESCRIPTION	CREDIT(S)
4	HIGH EFFICIENCY HVAC EQUIPMENT 4: Gas, propane or oil-fired furnace or boiler with minimum AFUE of 92%, or Air-source heat pump with minimum HSPF of 9.5, [Procedural Requirement: To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency. It is recommended that projects apply for a mechanical permit prior to the building permit application and paste a copy of the mechanical permit on the building permit drawings.]	1.0

OPTION	DESCRIPTION	CREDIT(S)
3a	SUPEREFFICIENT BUILDING ENVELOPE.A:	2.0

Prescriptive compliance based on Table 6-1, Option III with the following modifications: Window U = 0.32 and wall R-21 plus R-12 and R-38 floor slab on grade R-10 4ft], below grade slab R-10 full and R-21 plus R-12 below grade basement walls and R-49 advanced ceiling and vault.

or

Component performance compliance: Reduce the Target UA from Table 5.1 by 50%, as determined using EQUACION ..

[Procedural Requirement: To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall show the location and R-value of all insulation.

For glazing U-factors

- for prescriptive compliance, see procedural requirement under Section 602.7.2.

- for Component performance compliance, see procedural requirement under Section 602.7.1

OPTION	DESCRIPTION	CREDIT(S)
4a	AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION:	2.5

Envelope leakage reduced to SLA of 0.00020 building envelope tightness shall be considered acceptable when tested air leakage is less than specific leakage rate of 0.00020 when tested with a blower door at a pressure difference of 50 PA. Testing shall occur after rough in and after installation of penetrations of the building envelope, including penetrations for utilities, plumbing, electrical, ventilation, and combustion appliances.

and

All whole house ventilation requirements as determined by Section M1508 of the ((Washington State)) Seattle Residential Code shall be met with a heat recovery ventilation system in accordance with Section M1508.7 of that Code.

[Procedural Requirement: To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the maximum tested building air leakage and shall show the heat recovery ventilation system.]

OPTION	DESCRIPTION	CREDIT(S)
4b	ADDITIONAL AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION:	1.0

Envelope leakage reduced to SLA of 0.00015 building envelope tightness shall be considered acceptable when tested air leakage is less than specific leakage rate of 0.00015 when tested with a blower door at a pressure difference of 50 PA. Testing shall occur after rough in and after installation of penetrations of the building envelope, including penetrations for utilities, plumbing, electrical, ventilation, and combustion appliances.

and

All whole house ventilation requirements as determined by Section M1508 of the ((Washington State)) Seattle Residential Code shall be met with a heat recovery ventilation system in accordance with Section M1508.7 of that Code.

[Procedural Requirement: To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the maximum tested building air leakage and shall show the heat recovery ventilation system.]

OPTION	DESCRIPTION	CREDIT(S)
5a	EFFICIENT WATER HEATING:	2.5

Water heating system shall include one of the following:

Gas, propane or oil water heater with a minimum EF of 0.62

or

Electric Water Heater with a minimum EF of 0.93.

and for both cases

All showerhead and kitchen sink faucets installed in the house shall meet the standard 2.75 GPM or less. All other lavatory faucets shall be rated at 1.0 GPM or less.[8]

[Procedural Requirement: To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the water heater equipment type and the minimum equipment efficiency and, for solar water heating systems, the calculation of the minimum energy savings.

It is recommended that projects apply for a plumbing permit prior to the building permit application and post a copy of the plumbing permit on the building permit drawings.]

OPTION	DESCRIPTION	CREDIT(S)
5b	HIGH EFFICIENCY WATER HEATING:	1.5

Water heating system shall include one of the following:

Gas, propane or oil water heater with a minimum EF of 0.82.

or

Solar water heating supplementing a minimum standard water heater. Solar water heating shall provide a rated minimum savings of 85 therms or 2000 kWh based on the Solar Rating and Certification Corporation (SRCC) Annual Performance of OG-300 Certified Solar Water Heating Systems.

or

Electric heat pump water heater with a minimum EF of 2.0.

[Procedural Requirement: To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the water heater equipment type and the minimum equipment efficiency and, for solar water heating systems, the calculation of the minimum energy savings.

It is recommended that projects apply for a plumbing permit prior to the building permit application and post a copy of the plumbing permit on the building permit drawings.]

OPTION	DESCRIPTION	CREDIT(S)
6	SMALL DWELLING UNIT.:	1.0

Dwelling units less than 1500 square feet in floor area with less than 200 square feet of window – door area. Additions to existing building that are less than 750 square feet of heated floor area.

[Procedural Requirement: To qualify to claim this credit, the building permit drawings shall specify the option being selected, and shall include a calculation of the window [and door] area.]

OPTION	DESCRIPTION	CREDIT(S)
7	LARGE DWELLING UNIT.[1]	1.0

Dwelling units exceeding 5000 square feet of floor area shall be assessed a deficiency for purposes of complying with Section 401 of this Code.

OPTION	DESCRIPTION	CREDIT(S)
8	RENEWABLE ELECTRIC ENERGY:	0.5

For each 1200 kWh of electrical generation provided annually by on-site wind or solar equipment a 0.5 credit shall be allowed, up to 2 credits. Generation shall be calculated as follows.

For solar electric systems, the design shall be demonstrated to meet this requirement using the National Renewable Energy Laboratory calculator PVWATTs. Documentation noting solar access shall be included on the plans.

For wind generator projects designs shall document annual power generation based on the following factors:

The wind turbine power curve, average annual wind speed at the site, the energy distribution of the wind speed at the site and height of the tower.

[Procedural Requirement: To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall show the photovoltaic or wind turbine equipment type, provide documentation of solar or wind access and include a calculation of the minimum annual energy power production.

It is recommended that projects apply for an electrical permit prior to the building permit application and post a copy of the electrical permit on the building permit drawings.]

Footnotes:

1. Interior Door Tenant Control. Doors included as Option 3 of Table 9-1 shall be passed wholly within the heated envelope of the housing unit. The perimeter shall be inspected and rectified to receive the doors associated with this option.

EXCEPTION: Doors complying with this section may have up to 5% of the total linear feet of ducts located in the exterior cavities or buffer spaces of the dwelling. If this exception is used the doors will be tested to the following standards:

Post-construction test: Leakage to outdoors shall be less than or equal to 1 CFM per 100 ft² of conditioned floor area when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. All registers boots shall be taped or otherwise sealed during the test.

3. Plumbing Fixtures Flow Ratings. Low flow plumbing fixtures (water closets and urinals) and fittings (faucets and showerheads) shall comply with the following requirements:

(a) Residential lavatory (bathroom) faucets: Maximum flow rate - 2.5 L/min (1.5 gpm/6 psi) when tested in accordance with ASME A112.18.1/CSA B125.1.

(b) Residential kitchen faucets: Maximum flow rate - 6.6 L/min (1.75 gpm/6 psi) when tested in accordance with ASME A112.18.1/CSA B125.1.

(c) Residential showerheads: Maximum flow rate - 6.6 L/min (1.75 gpm/6 psi) when tested in accordance with ASME A112.18.1/CSA B125.1.

***

Section 9. The following sections or subsections of Chapter 10 of the 2009 Washington State Energy Code are amended, and new sections are added to that Chapter, as follows:

***

SECTION 1001 — GENERAL

1001.1 Scope: The following defaults shall apply to Chapters 1 through 16((40)). This chapter includes tables of seasonal average heat loss coefficients for specified nominal insulation. The heat loss coefficients may also be used for heating system sizing.

1001.2 Description: These coefficients were developed primarily from data and procedures from Standard RS-1, and taken specifically from Standard RS-2, listed in Chapter 7.

Coefficients not contained in this chapter may be computed using the procedures listed in these references if the assumptions in the following sections and Standard RS-2, listed in Chapter 7, are used, along with data from the sources referenced above.

1001.3 ((Air Films: Default R-values used for air films shall be as follows:

R Value Condition

0.17 All exterior surfaces

~~0.61~~ Interior horizontal surfaces, heat-flow-up

~~0.92~~ Interior horizontal surfaces, heat flow-down

~~0.68~~ Interior vertical surfaces)) Reserved.

1001.4 Compression of Insulation: Insulation which is compressed shall be rated in accordance with Table 10-A or reduction in value may be calculated in accordance with the procedures in Standard RS-1, listed in Chapter 7.

1001.5 Building Materials: Default R-values used for building materials shall be as shown in Table 10-B.

***

TABLE 10-A

R-VALUE OF FIBERGLASS BATTS COMPRESSED WITHIN VARIOUS DEPTH CAVITIES

Insulation R-Values at Standard Thickness

Insulation R-Value at Standard Thickness													
Rated R-Value		R-82	R-71	R-60	R-49	R-38	R-30	R-25	R-22	R-21	R-19	R-15	R-13	R-11
Standard Thickness, in.		26.0	22.5	19.0	15.5	13	9.5	7.25	6.5	5.5	6	3.5	3.5	3.5
Nominal Lumber size, in.	Actual Depth of Cavity, in.	Effective Insulation R-Values when Installed in a Confined Cavity												
Truss	36.0	82						—						
Truss	22.5	—	71	—	—	—	—	—						
Truss	15.0	—	—	60	—	—	—	—	—	—	—	—	—	—
Truss	5.5				49				—	—	—	—	—	—
Truss	12.0					38		—						
2 x 12	11.25	—	—	—	—	37		—						
2 x 10	9.25	—	—	—	—	30	30	—	—	—	—	—	—	—
2 x 8	7.25					27	26	25	22	21	19			—
2 x 6	5.5							21	20	21	18			
2 x 4	3.5	—	—	—	—	—	—	—	14	—	13	15	13	11
	2.5				—	—	—	—	—	—	—	—	9.8	—
	1.5							—					6.2	6

***

TABLE 10-B DEFAULT R-VALUES FOR BUILDING MATERIALS

Material	Nominal Size (in.)	Actual Size (in.)	R-Value (Heat Capacity[3])
Air cavity (ventilated), between media, studs at 16 inches on center[1]	-	-	2.20
Air cavity (unventilated), with all other depths and framing materials[1]	-	-	0.91
Air film, exterior surfaces[2]	-	-	0.17
Air film, interior horizontal surfaces, heat flow up[2]	-	-	0.61
Air film, interior horizontal surfaces, heat flow down[2]	-	-	0.92
Air film, interior vertical surfaces[2]	-	-	0.68
Brick at R-0.12/in. (face brick, 75% solid/65% core area, 130 lbs/ft³)	4	3.5	0.42 (3.9)
Carpet and rubber pad	-	-	1.23
Concrete at R-0.06/in. (sand/gravel/stone, 144 lbs/ft³)	-	2	0.13 (HC-4.8)
	-	4	0.25 (HC-9.6)
	-	6	0.38 (HC-14.4)
	-	8	0.50 (HC-19.2)
	-	10	0.63 (HC-24.0)
	-	12	0.75 (HC-28.8)
Concrete masonry units, solid grouted, lightweight (95 lbs/ft³)	6	-	0.80 (HC-11.4)
Concrete masonry units, solid grouted, normal weight (135 lbs/ft³)	6		0.97 (HC-13.2)
Concrete masonry units, partly grouted, lightweight (95 lbs/ft³)	6	-	1.33 (HC-8.2)
Concrete masonry units, partly grouted, normal weight (135 lbs/ft³)	6	-	0.82 (HC-9.2)
Concrete masonry units, solid grouted, lightweight (95 lbs/ft³)	8	-	1.05 (HC-15.5)
Concrete masonry units, solid grouted, normal weight (135 lbs/ft³)	8	-	0.69 (HC-17.5)
Concrete masonry units, partly grouted, lightweight (95 lbs/ft³)	8		1.64 (HC 9.6)
Concrete masonry units, partly grouted, normal weight (135 lbs/ft³)	8	-	0.98 (HC-12.8)

Material	Nominal Size (in.)	Actual Size (in.)	R-Value (Heat Capacity[3])
Concrete masonry units, solid grouted, lightweight (95 lbs/ft³)	10	-	1.30 (HC-19.7)
Concrete masonry units, solid grouted, normal weight (135 lbs/ft³)	10	-	0.87 (HC-23.6)
Concrete masonry units, partly grouted, lightweight (95 lbs/ft³)	10		1.67 (HC-11.5)
Concrete masonry units, partly grouted, normal weight (135 lbs/ft³)	10	-	1.11 (HC-14.8)
Concrete masonry units, solid grouted, lightweight (95 lbs/ft³)	12	-	1.53 (HC-23.3)
Concrete masonry units, solid grouted, normal weight (135 lbs/ft³)	12	-	1.06 (HC-27.2)
Concrete masonry units, partly grouted, lightweight (95 lbs/ft³)	12	-	1.75 (HC-14.2)
Concrete masonry units, partly grouted, normal weight (135 lbs/ft³)	2	-	1.23 (HC-17.5)
Flooring, wood subfloor	-	0.75	0.94
Gypsum board	-	0.5	0.45
	-	0.625	0.56
Metal deck	-	-	0
Roofing, built-up	-	0.375	0.33
Sheathing, vegetable fiber board, 0.78 in.		0.78	2.06
Soil at R-0.1/in.		12	1.25
Steel, mild		-	0.00 (HC 807
Stucco	-	0.75	0.08

[1] Air cavities, within exterior assemblies, that are open to the exterior are assigned an R-value of 0.

[2] The R-values for air films do not apply to air cavities within an assembly.

[3] For heat capacity for concrete and concrete masonry materials with densities other than the values listed in Table 10-B, see Tables A3.1B and A3.1C in RS-9.

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1005.3 Component Description: Default coefficients for the following types of walls are listed: Single-stud walls, strap walls, double-stud walls, log walls, stress-skin panels, metal stud walls, and metal building walls.

Single-Stud Wall, Tables 10-5(1) through 10-5(8): Assumes either 2x4 or 2x6 studs framed on sixteen or twenty-four inch centers. Headers are solid for 2x4 walls and double 2x for 2x6 walls, with either batt-air or rigid-board insulation in the remaining space.

Strap Wall, Table 10-5(9): Assumes 2x6 studs framed on sixteen or twenty-four inch centers. 2x3 or 2x4 strapping is run horizontally along the interior surface of the wall to provide additional space for insulation.

Double-Stud Wall, Tables 10-5(10) and 10-5(11): Assumes an exterior structural wall and a separate interior, nonstructural wall. Insulation is placed in both wall cavities and in the space between the 2 walls. Stud spacing is assumed to be on 24 inch centers for both walls.

Log Wall, Table 10-5(12).

Stress-Skin Panel, Table 10-5(13).

Metal Stud Wall, Overall Assembly U-Factors, Table 10-5A(1): Assumes metal studs spaced on 16- or 24- inch centers with insulation installed to fill wall cavities. Continuous rigid board insulation is applied without creating uninsulated voids in the wall assembly.

Metal Stud Wall, Effective R-Values for Metal Framing and Cavity Only, Table 10-5A(2): These values may be used for the metal-framing/cavity layers in walls with metal studs spaced on 16- or 24-inch centers with insulation installed to fill wall cavities in lieu of using the zone method provided in Chapter 25 of Standard RS-1 listed in Chapter 7.

Metal Building Wall, Table 10-5A(3): A wall whose structure consists of metal spanning panels supported by steel structural members (does not include spandrel glass or metal panels in curtain wall systems). These values may be used for assemblies where the average girt spacing is at least 52 in. The first nominal R-value is for insulation compressed between metal wall panels and the steel structure. ((~~For double layer installations, the nominal rated R-value of insulation is for insulation installed from the inside, covering the girts. For continuous insulation (e.g., insulation boards) it is assumed that the insulation boards are~~)) For assemblies with continuous insulation, the continuous insulation is installed on the outside or inside of the girts, uncompressed and uninterrupted by the framing members. Insulation exposed to the conditioned space, ((or)) including a semi-heated space, shall have a facing, and all insulation seams shall be continuously sealed ((to provide a continuous air barrier)). U-factors for metal building wall assemblies with average girt spacing less than 52 in. shall be determined in accordance with Section A5.2 of RS-9.

Concrete and Masonry Walls, Table 10-5B(1) Single-Family and Multifamily Residential.

Peripheral Edges of Intermediate Concrete Floors, Table 10-5B(2) Single-Family and Multifamily Residential, and Nonresidential.

Concrete and Masonry Walls, Table 10-5B(3) Nonresidential.

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Metal Stud Walls: The nominal R-values in Table 10-5A may be used for purposes of calculating metal stud wall section U-factors in lieu of the ASHRAE zone calculation method as provided in Chapter 27 of Standard RS-1.

TABLE 10-5A

DEFAULT U-FACTORS FOR OVERALL ASSEMBLY METAL STUD WALLS, EFFECTIVE R-VALUES FOR METAL FRAMING AND CAVITY ONLY, AND DEFAULT METAL BUILDING U-FACTORS

TABLE 10-5A(1)

Overall Assembly U-Factors for Metal Stud Walls

Metal Framing	R-Value of Continuous Foam Board Insulation	R-Value of Foam Board Insulation with ≤ 0.04% Metal Penetrations	R-Value of Foam Board Insulation with > 0.04% and ≤ 0.08% Metal Penetrations	Cavity Insulation R-0	R-11 (4" nom)	R-13 (4" nom)	R-15 (4" nom)	R-19 (6" nom)	R-21 (6" nom)	R-25 (8" nom)
16" o.c.	R-0 (none)	R-0 (none)	R-0 (none)	U-0.352	U-0.132	U-0.124	U-0.118	U-0.109	U-0.106	U-0.102
	R-1	R-1.5	R-1.5	U-0.260	U-0.117	U-0.111	U-0.106	U-0.099	U-0.096	U-0.092
	R-2	R-2.5	R-3.0	U-0.207	U-0.105	U-0.100	U-0.095	U-0.090	U-0.087	U-0.084
	R-3	R-3.8	R-4.5	U-0.171	U-0.095	U-0.091	U-0.087	U-0.082	U-0.080	U-0.078
	R-4	R-5.0	R-6.0	U-0.146	U-0.087	U-0.083	U-0.080	U-0.076	U-0.074	U-0.072
	R-5	R-6.3	R-7.5	U-0.128	U-0.080	U-0.077	U-0.074	U-0.071	U-0.069	U-0.067
	R-6	R-7.5	R-9.0	U-0.113	U-0.074	U-0.071	U-0.069	U-0.066	U-0.065	U-0.063
	R-7	R-8.8	R-10.5	U-0.102	U-0.069	U-0.066	U-0.065	U-0.062	U-0.061	U-0.059
	R-8	R-10.0	R-12.0	U-0.092	U-0.064	U-0.062	U-0.061	U-0.058	U-0.057	U-0.056
	R-9	R-11.3	R-13.5	U-0.084	U-0.060	U-0.059	U-0.057	U-0.055	U-0.054	U-0.053
	R-10	R-12.5	R-15.0	U-0.077	U-0.057	U-0.055	U-0.054	U-0.052	U-0.051	U-0.050
	R-11	R-13.8	R-16.5	U-0.072	U-0.054	U-0.052	U-0.051	U-0.050	U-0.049	U-0.048
	R-12	R-15.0	R-18.0	U-0.067	U-0.051	U-0.050	U-0.049	U-0.047	U-0.047	U-0.045
	R-13	R-16.3	R-19.5	U-0.063	U-0.049	U-0.048	U-0.047	U-0.045	U-0.045	U-0.044
	R-14	R-17.5	R-21.0	U-0.059	U-0.046	U-0.045	U-0.045	U-0.043	U-0.043	U-0.042
	R-15	R-18.8	R-22.5	U-0.056	U-0.044	U-0.043	U-0.043	U-0.041	U-0.041	U-0.040
	R-20	R-25.0	R-30.0	U-0.044	U-0.036	U-0.036	U-0.035	U-0.034	U-0.034	U-0.034
24" o.c.	R-0 (none)	R-0 (none)	R-0 (none)	U-0.338	U-0.116	U-0.108	U-0.102	U-0.094	U-0.090	U-0.086
	R-1	R-1.3	R-1.5	U-0.253	U-0.104	U-0.098	U-0.092	U-0.086	U-0.083	U-0.079
	R-2	R-2.5	R-3.0	U-0.202	U-0.094	U-0.089	U-0.084	U-0.079	U-0.077	U-0.073
	R-3	R-3.8	R-4.5	U-0.168	U-0.086	U-0.082	U-0.078	U-0.073	U-0.071	U-0.068
	R-4	R-5.0	R-6.0	U-0.144	U-0.079	U-0.075	U-0.072	U-0.068	U-0.066	U-0.064
	R-5	R-6.3	R-7.5	U-0.126	U-0.073	U-0.070	U-0.067	U-0.064	U-0.062	U-0.060
	R-6	R-7.5	R-9.0	U-0.112	U-0.068	U-0.066	U-0.063	U-0.060	U-0.059	U-0.057
	R-7	R-8.8	R-10.5	U-0.100	U-0.064	U-0.062	U-0.059	U-0.057	U-0.055	U-0.054
	R-8	R-10.0	R-12.0	U-0.091	U-0.060	U-0.058	U-0.056	U-0.054	U-0.052	U-0.051
	R-9	R-11.3	R-13.5	U-0.084	U-0.057	U-0.055	U-0.053	U-0.051	U-0.050	U-0.048
	R-10	R-12.5	R-15.0	U-0.077	U-0.054	U-0.052	U-0.050	U-0.048	U-0.048	U-0.046
	R-11	R-13.8	R-16.5	U-0.072	U-0.051	U-0.049	U-0.048	U-0.046	U-0.045	U-0.044
	R-12	R-15.0	R-18.0	U-0.067	U-0.048	U-0.047	U-0.046	U-0.044	U-0.043	U-0.042
	R-13	R-16.3	R-19.5	U-0.063	U-0.046	U-0.045	U-0.044	U-0.042	U-0.042	U-0.041
	R-14	R-17.5	R-21.0	U-0.059	U-0.044	U-0.043	U-0.042	U-0.041	U-0.040	U-0.039
	R-15	R-18.8	R-22.5	U-0.056	U-0.042	U-0.041	U-0.040	U-0.039	U-0.038	U-0.038
	R-20	R-25.0	R-30.0	U-0.044	U-0.035	U-0.034	U-0.034	U-0.033	U-0.032	U-0.032

TABLE 10-5A(2)

Effective R-Values for Metal Framing and Cavity Only

	Cavity: Nominal Depth, Inches	Cavity: Actual Depth, Inches	Insulation: Nominal R-Value	Effective R-Value 16" O.C.	Effective R-Value 24" O.C.
Air Cavity	Any	Any	R-0.91 (air)	0.79	0.91
	4	3-1/2	R-11	5.5	6.6
	4	3-1/2	R-13	6.0	7.2
	4	3-1/2	R-15	6.4	7.8
Wall	6	5-1/2	R-19	7.1	8.6
	6	5-1/2	R-21	7.4	9.0
	8	7-1/4	R-25	7.8	9.6
Roof		Insulation is uncompressed	R-11	5.5	6.1
			R-19	7.0	9.1
			R-30	9.3	11.4

TABLE 10-5A(3)

Default Metal Building Wall U-Factors

Overall U-Factor for Assembly of Base Wall Plus Continuous Insulation (Uninterrupted by Framing) — Rated R-Value of Continuous Insulation

Insulation System	Rated R-Value of Insulation	Overall U-Factor for Entire Base Wall Assembly	R-5.6	R-9.6	R-13	R-15.8	R-19 ~~(R-19.5)~~	R-22.1	R-25 ~~(R-26)~~	R-32 ~~(R-32.5)~~	R-38 ~~(R-39)~~
Single Layer of Mineral Fiber	None	1.180	0.136	0.094	0.072	0.060	0.050 ~~((0.049))~~	0.044	0.039 ~~((0.036))~~	0.030	0.026 ~~((0.025))~~
	R-10	0.186	0.087	0.060	0.054	0.047	0.041 ~~((0.040))~~	0.036	0.033 ~~((0.032))~~	0.027 ~~((0.026))~~	0.023
	R-11	0.185	0.084	0.066	0.054	0.047	0.041 ((0.040))	0.036	0.035 ~~((0.032))~~	0.027 ~~((0.026))~~	0.025
	R-13	0.162	0.079	0.061	0.052	0.048	0.040 ((0.039))	0.035	0.032 ((0.031))	0.026	0.023 ((0.022))
	R-16	0.155	0.077	0.062	0.051	0.045	0.039	0.035	0.032 ((0.031))	0.026	0.022
	R-19	0.147	0.075	0.060	0.050	0.044	0.039 ((0.038))	0.035	0.031 ((0.030))	0.026 ((0.025))	0.022

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Concrete Masonry Walls: The nominal R-values in Table 10-5B may be used for purposes of calculating concrete masonry wall section U-factors in lieu of the ASHRAE isothermal planes calculation method as provided in Chapter 27 of Standard RS-1.

TABLE 10-5B(1)

SINGLE-FAMILY AND MULTIFAMILY RESIDENTIAL:

DEFAULT U-FACTORS FOR CONCRETE AND MASONRY WALLS

TABLE 10-5B(1a) Single-Family and Multifamily Residential:

8" Concrete Masonry

WALL DESCRIPTION	CORE TREATMENT: Partial Grout with Ungrouted Cores: Empty	Loose-fill insulated: Perlite	Loose-fill insulated: Vermiculite	Solid Grout
Exposed Block, Both Sides	0.40	0.23	0.24	0.43
R-5 Interior Insulation, Wood Furring	0.14	0.11	0.12	0.15
R-6 Interior Insulation, Wood Furring	0.14	0.11	0.11	0.14
R-10.5 Interior Insulation, Wood Furring	0.11	0.09	0.09	0.11
R-8 Interior Insulation, Metal Clips	0.11	0.09	0.09	0.11
R-6 Exterior Insulation	0.12	0.10	0.10	0.12
R-10 Exterior Insulation	0.08	0.07	0.07	0.08
R-9.5 Rigid Polystyrene Integral Insulation, Two Webbed Block	0.11	0.09	0.09	0.12

TABLE 10-5B(1b) Single-Family and Multifamily Residential:

12" Concrete Masonry

WALL DESCRIPTION	CORE TREATMENT: Partial Grout with Ungrouted Cores: Empty	Loose-fill insulated: Perlite	Loose-fill insulated: Vermiculite	Solid Grout
Exposed Block, Both Sides	0.35	0.17	0.18	0.33
R-5 Interior Insulation, Wood Furring	0.14	0.10	0.10	0.15
R-6 Interior Insulation, Wood Furring	0.15	0.09	0.10	0.13
R-10.5 Interior Insulation, Wood Furring	0.11	0.08	0.08	0.10
R-8 Interior Insulation, Metal Clips	0.10	0.08	0.08	0.09
R-6 Exterior Insulation	0.11	0.09	0.09	0.11
R-10 Exterior Insulation	0.08	0.05	0.06	0.08
R-9.5 Rigid Polystyrene Integral Insulation, Two Webbed Block	0.11	0.08	0.09	0.12

TABLE 10-5B(1c) Single-Family and Multifamily Residential:

8" Clay Brick

WALL DESCRIPTION	CORE TREATMENT: Partial Grout with Ungrouted Cores: Empty	Loose-fill insulated: Perlite	Loose-fill insulated: Vermiculite	Solid Grout
Exposed Block, Both Sides	0.50	0.31	0.33	0.56
R-5 Interior Insulation, Wood Furring	0.15	0.13	0.13	0.16
R-6 Interior Insulation, Wood Furring	0.15	0.12	0.12	0.15
R-10.5 Interior Insulation, Wood Furring	0.13	0.10	0.10	0.12
R-8 Interior Insulation, Metal Clips	0.11	0.10	0.10	0.11
R-6 Exterior Insulation	0.12	[illegible]	[illegible]	0.13
R-10 Exterior Insulation	0.08	0.08	0.08	0.09

TABLE 10-5B(1d) Single-Family and Multifamily Residential:

6" Concrete Poured or Precast

WALL DESCRIPTION	CORE TREATMENT: Partial Grout with Ungrouted Cores: Empty	Loose-fill insulated: Perlite	Loose-fill insulated: Vermiculite	Solid Grout
Exposed Concrete, Both Sides	NA	NA	NA	0.61
R-5 Interior Insulation, Wood Furring	NA	NA	NA	0.16
R-6 Interior Insulation, Wood Furring	NA	NA	NA	0.15
R-10.5 Interior Insulation, Wood Furring	NA	NA	NA	0.13
R-8 Interior Insulation, Metal Clips	NA	NA	NA	0.12
R-6 Exterior Insulation	NA	NA	NA	0.13
R-10 Exterior Insulation	NA	NA	NA	0.09

Notes for Default Table 10-5B(1)

1. Grouted cores at 40" x 48" on center vertically and horizontally in partial grouted walls.
2. Interior insulation values include 1/2" gypsum board on the inner surface.
3. Furring and stud spacing is 16" on center. Insulation is assumed to fill furring space and is not compressed.
4. Intermediate values may be interpolated using this table. Values not contained in this table may be computed using the procedures listed in Standard RS-1.

TABLE 10-5B(2) Single-Family and Multifamily Residential, and Nonresidential:

Default U-Factors for Peripheral Edges of Intermediate Concrete Floors

SLAB EDGE TREATMENT	AVERAGE THICKNESS OF WALL ABOVE AND BELOW: 6 inches	8 inches	10 inches	12 inches
Exposed Concrete	0.816	0.741	0.678	0.625
R-5 Exterior Insulation	0.161	0.157	0.154	0.152
R-6 Exterior Insulation	0.138	0.136	0.134	0.133
R-7 Exterior Insulation	0.122	0.120	0.118	0.116
R-8 Exterior Insulation	0.108	0.107	0.106	0.104
R-9 Exterior Insulation	0.098	0.097	0.095	0.094
R-10 Exterior Insulation	0.089	0.088	0.087	0.086
R-11 Exterior Insulation	0.082	0.081	0.080	0.079
R-12 Exterior Insulation	0.075	0.075	0.074	0.074
R-13 Exterior Insulation	0.070	0.070	0.069	0.068
R-14 Exterior Insulation	0.066	0.065	0.065	0.064
R-15 Exterior Insulation	0.062	0.061	0.061	0.060
R-16 Exterior Insulation	0.058	0.058	0.057	0.057
R-17 Exterior Insulation	0.055	0.054	0.054	0.054
R-18 Exterior Insulation	0.053	0.052	0.051	0.051
R-19 Exterior Insulation	0.049	0.049	0.049	0.049
R-20 Exterior Insulation	0.047	0.047	0.047	0.046
R-21 Exterior Insulation	0.045	0.045	0.044	0.044
R-22 Exterior Insulation	0.043	0.043	0.043	0.042
R-23 Exterior Insulation	0.041	0.041	0.041	0.041
R-24 Exterior Insulation	0.040	0.039	0.039	0.039
R-25 Exterior Insulation	0.038	0.038	0.038	0.038

TABLE 10-5B(3) Nonresidential:

Default U-Factors for Concrete and Masonry Walls

Framing Type and Depth	Rated R-Value of Insulation Alone	Assembly U-Factors for Solid Concrete Walls	Assembly U-Factors for Concrete Block Walls: Solid Grouted	Assembly U-Factors for Concrete Block Walls: Partially Grouted (cores uninsulated except where specified)
Base Wall only				
No Framing	R-0	U-0.740	U-0.580	U-0.480
	Ungrouted Cores Filled with Loose-Fill Insulation	N.A.	N.A.	U-0.350
Continuous Wood Framing				
0.75 in.	R-3.0	U-0.247	U-0.225	U-0.210
1.5 in.	R-6.0	U-0.160	U-0.151	U-0.143
2.0 in.	R-10.0	U-0.116	U-0.111	U-0.107
3.5 in.	R-11.0	U-0.094	U-0.091	U-0.088
3.5 in.	R-13.0	U-0.085	U-0.082	U-0.080
3.5 in.	R-15.0	U-0.079	U-0.077	U-0.075
5.5 in.	R-19.0	U-0.060	U-0.059	U-0.058
5.5 in.	R-21.0	U-0.057	U-0.055	U-0.054
Continuous Metal Framing at 24 in. on center horizontally				
1.0 in.	R-[illegible]	U-0.411	U-0.359	U-0.328
1.0 in.	R-3.8	U-0.325	U-0.280	U-0.263

Framing Type and Depth	Rated R-Value of Insulation Alone	Assembly U-Factors for Solid Concrete Walls	Assembly U-Factors for Concrete Block Walls: Solid Grouted	Assembly U-Factors for Concrete Block Walls: Partially Grouted (cores uninsulated except where specified)
1.0 in.	R-5.0	U-0.314	U-0.281	U-0.255
1.0 in.	R-6.5	U-0.305	U-0.271	U-0.249
1.5 in.	R-11.0	U-0.267	U-0.242	U-0.223
2.0 in.	R-7.6	U-0.230	U-0.212	U-0.197
2.0 in.	R-10.0	U-0.219	U-0.202	U-0.188
2.0 in.	R-12.0	U-0.210	U-0.195	U-0.182
3.0 in.	R-11.4	U-0.178	U-0.167	U-0.157
3.0 in.	R-15.0	U-0.168	U-0.158	U-0.149
3.0 in.	R-19.0	U-0.161	U-0.152	U-0.144
3.5 in.	R-11.0	U-0.168	U-0.158	U-0.149
3.5 in.	R-13.0	U-0.161	U-0.152	U-0.144
3.5 in.	R-15.0	U-0.155	U-0.147	U-0.140
4.5 in.	R-17.1	U-0.133	U-0.126	U-0.121
4.5 in.	R-22.5	U-0.124	U-0.119	U-0.114
4.5 in.	R-25.2	U-0.122	U-0.115	U-0.112
5.0 in.	R-19.0	U-0.122	U-0.117	U-0.112
5.0 in.	R-25.0	U-0.115	U-0.110	U-0.106
5.0 in.	R-28.0	U-0.112	U-0.107	U-0.103

Framing Type and Depth	Rated R-Value of Insulation Alone	Assembly U-Factors for Solid Concrete Walls	Assembly U-Factors for Concrete Block Walls: Solid Grouted	Assembly U-Factors for Concrete Block Walls: Partially Grouted (cores uninsulated except where specified)

5.0 in.	R- 22.0	U- 0.108	U- 0.105	U- 0.101
5.5 in.	R- 19.0	U- 0.113	U- 0.110	U- 0.109
5.5 in.	R- 20.9	U- 0.107	U- 0.105	U- 0.105
5.5 in.	R- 21.0	U- 0.113	U- 0.109	U- 0.105
5.5 in.	R- 27.5	U- 0.096	U- 0.092	U- 0.089
5.5 in.	R- 30.8	U- 0.091	U- 0.089	U- 0.086
6.0 in.	R- 22.0	U- 0.106	U- 0.102	U- 0.098
6.0 in.	R- 30.0	U- 0.095	U- 0.093	U- 0.092
6.0 in.	R- 33.6	U- 0.056	U- 0.093	U- 0.090
6.5 in.	R- 24.7	U- 0.099	U- 0.096	U- 0.092
7.0 in.	R- 26.6	U- 0.092	U- 0.090	U- 0.087
7.5 in.	R- 28.5	U- 0.088	U- 0.086	U- 0.082
8.0 in.	R- 38.4	U- 0.083	U- 0.081	U- 0.079

1" Metal Clips at 24 in. on center horizontally and 16 in. vertically

(also, where allowed by Section 1332, for assemblies with a ratio of metal penetration area/gross wall area of ≤0.0004 (≤0.04% of the mass wall area))

1.0 in.	R- 5.3	U- 0.210	U- 0.155	U- 0.132
1.5 in.	R- 7.9	U- 0.181	U- 0.173	U- 0.155

Framing Type and Depth	Rated R-Value of Insulation Alone	Assembly U-Factors for Solid Concrete Walls	Assembly U-Factors for Concrete Block Walls: Solid Grouted	Assembly U-Factors for Concrete Block Walls: Partially Grouted (cores uninsulated except where specified)
1.0 in.	R- 5.6	U- 0.174	U- 0.163	U- 0.154
1.5 in.	R- 8.2	U- 0.160	U- 0.151	U- 0.143
1.5 in.	R- 8.5	U- 0.158	U- 0.171	U- 0.135
1.5 in.	R- 8.4	U- 0.129	U- 0.123	U- 0.118
2.0 in.	R- 7.6	U- 0.129	U- 0.123	U- 0.115
2.0 in.	R- 13.0	U- 0.117	U- 0.108	U- 0.102
2.0 in.	R- 11.2	U- 0.103	U- 0.098	U- 0.095
2.5 in.	R- 9.5	U- 0.109	U- 0.104	U- 0.101
2.5 in.	R- 12.5	U- 0.092	U- 0.089	U- 0.086
3.5 in.	R- 14.0	U- 0.086	U- 0.083	U- 0.080
3.5 in.	R- 11.4	U- 0.091	U- 0.089	U- 0.088
3.5 in.	R- 15.1	U- 0.078	U- 0.076	U- 0.074
3.5 in.	R- 15.3	U- 0.073	U- 0.071	U- 0.069
3.5 in.	R- 15.3	U- 0.082	U- 0.080	U- 0.077
3.5 in.	R- 17.1	U- 0.069	U- 0.067	U- 0.065
3.5 in.	R- 19.6	U- 0.063	U- 0.062	U- 0.061
4.0 in.	R- 15.2	U- 0.073	U- 0.071	U- 0.070
4.0 in.	R- 20.6	U- 0.063	U- 0.060	U- 0.058

Framing Type and Depth	Rated R-Value of Insulation Alone	Assembly U-Factors for Solid Concrete Walls	Assembly U-Factors for Concrete Block Walls: Solid Grouted	Assembly U-Factors for Concrete Block Walls: Partially Grouted (cores uninsulated except where specified)
4.0 in.	R- 22.6	U- 0.057	U- 0.056	U- 0.054
5.5 in.	R- 23.0	U- 0.046	U- 0.046	U- 0.045
6.3 in.	R- 33.6	U- 0.039	U- 0.039	U- 0.038
7.0 in.	R- 39.2	U- 0.034	U- 0.034	U- 0.033
8.0 in.	R- 44.8	U- 0.030	U- 0.030	U- 0.029
9.0 in.	R- 50.4	U- 0.027	U- 0.027	U- 0.026
10.0 in.	R- 56.0	U- 0.024	U- 0.024	U- 0.024
11.5 in.	R- 61.6	U- 0.022	U- 0.022	U- 0.022
Continuous Insulation Uninterrupted by Framing				
No Framing	R- 13.0	U- 0.142	U- 0.067	U- 0.024
	R- 21.0	U- 0.098	U- 0.065	U- 0.045
	R- 33.0	U- 0.058	U- 0.042	U- 0.032
	R- 45.0	U- 0.042	U- 0.032	U- 0.025
	R- 57.0	U- 0.033	U- 0.026	U- 0.021
No Framing	R- 14.0	U- 0.068	U- 0.059	U- 0.026
	R- 17.0	U- 0.059	U- 0.052	U- 0.025
	R- 19.0	U- 0.053	U- 0.048	U- 0.024
	R- 21.0	U- 0.048	U- 0.044	U- 0.023
	R- 24.0	U- 0.042	U- 0.039	U- 0.022
No Framing	R- 19.0	U- 0.053	U- 0.048	U- 0.024
	R- 21.0	U- 0.048	U- 0.044	U- 0.023
	R- 24.0	U- 0.042	U- 0.039	U- 0.022
	R- 27.0	U- 0.038	U- 0.035	U- 0.021
	R- 30.0	U- 0.034	U- 0.032	U- 0.020
No Framing	R- 21.0	U- 0.048	U- 0.044	U- 0.023
	R- 24.0	U- 0.042	U- 0.039	U- 0.022
	R- 27.0	U- 0.038	U- 0.035	U- 0.021
	R- 30.0	U- 0.034	U- 0.032	U- 0.020
	R- 33.0	U- 0.031	U- 0.029	U- 0.019
No Framing	R- 24.0	U- 0.042	U- 0.039	U- 0.022
	R- 27.0	U- 0.038	U- 0.035	U- 0.021
	R- 30.0	U- 0.034	U- 0.032	U- 0.020
	R- 33.0	U- 0.031	U- 0.029	U- 0.019
	R- 36.0	U- 0.028	U- 0.027	U- 0.018

Framing Type and Depth	Rated R-Value of Insulation Alone	Assembly U-Factors for Solid Concrete Walls	Assembly U-Factors for Concrete Block Walls: Solid Grouted	Assembly U-Factors for Concrete Block Walls: Partially Grouted (cores uninsulated except where specified)
No Framing	R- 13.0	U- 0.142	U- 0.067	U- 0.024
	R- 21.0	U- 0.098	U- 0.065	U- 0.045
	R- 33.0	U- 0.058	U- 0.042	U- 0.032
	R- 45.0	U- 0.042	U- 0.032	U- 0.025
	R- 57.0	U- 0.033	U- 0.026	U- 0.021
No Framing	R- 14.0	U- 0.068	U- 0.059	U- 0.026
	R- 17.0	U- 0.059	U- 0.052	U- 0.025
	R- 19.0	U- 0.053	U- 0.048	U- 0.024
	R- 21.0	U- 0.048	U- 0.044	U- 0.023
	R- 24.0	U- 0.042	U- 0.039	U- 0.022
No Framing	R- 19.0	U- 0.053	U- 0.048	U- 0.024
	R- 21.0	U- 0.048	U- 0.044	U- 0.023
	R- 24.0	U- 0.042	U- 0.039	U- 0.022
	R- 27.0	U- 0.038	U- 0.035	U- 0.021
	R- 30.0	U- 0.034	U- 0.032	U- 0.020
No Framing	R- 21.0	U- 0.048	U- 0.044	U- 0.023
	R- 24.0	U- 0.042	U- 0.039	U- 0.022
	R- 27.0	U- 0.038	U- 0.035	U- 0.021
	R- 30.0	U- 0.034	U- 0.032	U- 0.020
	R- 33.0	U- 0.031	U- 0.029	U- 0.019
No Framing	R- 24.0	U- 0.042	U- 0.039	U- 0.022
	R- 27.0	U- 0.038	U- 0.035	U- 0.021
	R- 30.0	U- 0.034	U- 0.032	U- 0.020
	R- 33.0	U- 0.031	U- 0.029	U- 0.019
	R- 36.0	U- 0.028	U- 0.027	U- 0.018

Framing Type and Depth	Rated R-Value of Insulation Alone	Assembly U-Factors for Solid Concrete Walls	Assembly U-Factors for Concrete Block Walls: Solid Grouted	Assembly U-Factors for Concrete Block Walls: Partially Grouted (cores uninsulated except where specified)
	R- 19.0	U- 0.053	U- 0.048	U- 0.024
	R- 45.0	U- 0.022	U- 0.021	U- 0.021
	R- 57.0	U- 0.019	U- 0.019	U- 0.019
	R- 65.0	U- 0.013	U- 0.013	U- 0.013
	R- 69.0	U- 0.010	U- 0.010	U- 0.010
Brick cavity wall with continuous insulation				
No Framing	R- 5.0	U- 0.337	U- 0.296	U- 0.270
No Framing	R- 8.0	U- 0.148	U- 0.138	U- 0.125
No Framing	R- 9.0	U- 0.135	U- 0.130	U- 0.115
No Framing	R- 9.5	U- 0.130	U- 0.122	U- 0.095
No Framing	R- 7.1	U- 0.095	U- 0.091	U- 0.088
No Framing	R- 10.0	U- 0.127	U- 0.075	U- 0.073
No Framing	R- 10.5	U- 0.079	U- 0.077	U- 0.075
No Framing	R- 11.1	U- 0.073	U- 0.068	U- 0.065
No Framing	R- 13.0	U- 0.066	U- 0.065	U- 0.063
No Framing	R- 16.5	U- 0.054	U- 0.053	U- 0.052
No Framing	R- 19.0	U- 0.046	U- 0.045	U- 0.044
No Framing	R- 22.0	U- 0.041	U- 0.040	U- 0.039
No Framing	R- 25.5	U- 0.035	U- 0.035	U- 0.034
Continuous Insulation Uninterrupted by Framing with Stucco and Continuous Metal Framing at 24 in. on center horizontally				
3.0 in.	R- 0.0 + R-19 c.i.	U- 0.047	U- 0.046	U- 0.045
3.8 in.	R- 3.8 + R-19 c.i.	U- 0.045	U- 0.044	U- 0.044
4.0 in.	R- 5.0 + R-19 c.i.	U- 0.045	U- 0.044	U- 0.043
4.0 in.	R- 5.5 + R-19 c.i.	U- 0.045	U- 0.044	U- 0.043
4.5 in.	R- 7.0 + R-19 c.i.	U- 0.041	U- 0.040	U- 0.040
5.0 in.	R- 7.6 + R-19 c.i.	U- 0.040	U- 0.039	U- 0.038
5.0 in.	R- 10.0 + R-19 c.i.	U- 0.038	U- 0.037	U- 0.036
5.0 in.	R- 13.0 + R-19 c.i.	U- 0.036	U- 0.035	U- 0.035
5.5 in.	R- 13.0 + R-19 c.i.	U- 0.036	U- 0.035	U- 0.034
6.0 in.	R- 13.0 + R-19 c.i.	U- 0.035	U- 0.034	U- 0.033
6.0 in.	R- 15.0 + R-19 c.i.	U- 0.033	U- 0.032	U- 0.032
6.5 in.	R- 15.0 + R-19 c.i.	U- 0.032	U- 0.031	U- 0.031
6.5 in.	R- 17.0 + R-19 c.i.	U- 0.031	U- 0.030	U- 0.030
7.0 in.	R- 17.0 + R-19 c.i.	U- 0.030	U- 0.029	U- 0.029
7.0 in.	R- 19.0 + R-19 c.i.	U- 0.029	U- 0.028	U- 0.028
7.5 in.	R- 19.0 + R-19 c.i.	U- 0.028	U- 0.027	U- 0.027
8.0 in.	R- 19.0 + R-19 c.i.	U- 0.027	U- 0.026	U- 0.026
8.0 in.	R- 21.0 + R-19 c.i.	U- 0.026	U- 0.025	U- 0.025

Framing Type and Depth	Rated R-Value of Insulation Alone	Assembly U-Factors for Solid Concrete Walls	Assembly U-Factors for Concrete Block Walls: Solid Grouted	Assembly U-Factors for Concrete Block Walls: Partially Grouted (cores uninsulated except where specified)
5.0 in.	R- 32.5 + R-19 c.i.	U- 0.035	U- 0.035	U- 0.034
5.5 in.	R- 19.0 + R-19 c.i.	U- 0.036	U- 0.036	U- 0.035
5.5 in.	R- 21.0 + R-19 c.i.	U- 0.035	U- 0.035	U- 0.035

Notes for Default Table 10-5B(3)

1. It is acceptable to use the U-factors in Table 10-5B(3) for all concrete and masonry walls, provided that the grouting is equal to or less than that specified.
   For ungrouted walls, use the partially-grouted solution.
   For metal studs and furring, use the continuous metal framing category.
   For discontinuous metal clips – hat section, z-section or similar, use the metal clip category.
   – For insulation that is attached without any framing members (e.g. glued), use the continuous-insulation-uninterrupted-by-framing category. Continuous insulation may be installed on the interior or exterior of masonry walls, or between steel-stud wall sheathing and cavity masonry walls, or on the interior or exterior of the concrete.
2. For Table 10-5B(3), the U-factor includes R-0.17 for exterior air film and R-0.68 for interior air film – vertical surfaces. For insulated walls, the U-factor includes R-0.45 for 0.5 in. gypsum board. U-factors are provided for the following assemblies:
   (a) Concrete wall: 8-in. normal weight concrete wall with a density of 145 lb/ft³.
   (b) Solid grouted concrete block wall: 8-in. medium weight ASTM C90 concrete block with a density of 115 lb/ft³ and solid grouted cores.
   (c) Partially grouted concrete block wall: 8 in. medium weight ASTM C90 concrete block with a density of 115 lb/ft³ having reinforcing steel every 32 in. vertically and every 48 in. horizontally, with cores grouted in these areas only. Other cores are filled with insulating material only if there is no other insulation.
3. For walls with insulation continuous through framing, apply the U-factors in Table 10-5B(3) assume contact (and thermal bridging) between the mass wall and the framing. For wall assemblies with multiple layers where the wood or metal framing does not contact the concrete or masonry layer (i.e. walls with an airspace between the stud wall liner and the mass wall liner), it is acceptable to use the appropriate wood or metal frame wall default U-factors in Tables 10-5 or 10-5A. Note, it is acceptable to use this approach where the insulation extends beyond the framing and is in contact with the mass wall liner (e.g. a nominal four-inch metal stud containing insulation that is supported by metal hats and the insulation extends two inches beyond the back of the metal stud).
4. Except for wall assemblies qualifying for note 3, if not taken from Table 10-5B(3), mass wall U-factors shall be determined in accordance with RS-9, Appendix A, Section A2.1 and Tables A3.1A to A3.1D, or Section A9.5, if not taken from Table 10-9, heat capacity for mass walls shall be taken from RS-9, Appendix A, Table A3.1B or A3.1C.
5. See Section 1332 for determination of U-factors for assemblies that include metal other than screws and nails.

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SECTION 1006 — DEFAULT U-FACTORS FOR FENESTRATION, GLAZING, AND DOORS

1006.1 Fenestration, Glazing and Doors Without NFRC Certification: Fenestration, glazing, ((Glazing)) and doors that do not have NFRC Certification shall be assigned the following U-factors.

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TABLE 10-6

OTHER THAN SINGLE-FAMILY RESIDENTIAL

DEFAULT U-FACTORS FOR VERTICAL FENESTRATION((GLAZING)),

SKYLIGHTS((OVERHEAD GLAZING)) AND OPAQUE DOORS

Vertical Fenestration((Glazing))			
	U-Factor		
	Any Frame	Aluminum W/Thermal Break[a]	Vinyl/Wood/ Fiberglass Frame
Single	1.45	1.45	1.45
Jams below for revolving doors & vestibules			
Double	0.90	0.85	0.75
1/2 Inch Air, Fixed/Operable	0.75/0.90	0.70/0.81	0.60/0.72
1/2 Inch Air, Low-e[0.40], Fixed/Operable	0.70/0.84	0.60/0.72	0.50/0.60
1/2 Inch Air, Low-e[0.10], Fixed/Operable	0.65/0.78	0.55/0.66	0.45/0.54
1/2 Inch Argon, Low-e[0.10], Fixed/Operable	0.60/0.72	0.50/0.60	0.40/0.48
Triple	0.75	0.65	0.50
1/2 Inch Air, Fixed	0.66	0.60/0.60	0.45/0.54
1/2 Inch Air, Low-e[0.40], Fixed	0.60	0.50/0.60	0.40/0.48
1/2 Inch Air, 2 Low-e[0.10], Fixed/Operable	0.45/0.54	0.35/0.42	0.30/0.36
1/2 Inch Argon, Low-e[0.10], Fixed/Operable	0.40/0.48	0.30/0.36	0.25/0.30

a. The category for aluminum frame with a thermal break is as defined in footnote 7 to Table 10-6A.

b. For revolving doors and vestibules that are fenestration:

i. Revolving doors shall use the default U-factors in Table 10-6C that corresponds most closely to the configuration, R-value, and size of the door opening for the revolving door.

ii. Vestibules shall use the default U-factor for revolving doors in Table 10-6C that corresponds most closely to the size of the rough opening for the vestibule.

((Overhead Glazing)) Skylights: Sloped Glazing (Including Frame)			
	U-Factor		
	Any Frame	Aluminum W/Thermal Break	Vinyl/Wood/ Fiberglass Frame
Single	1.74	1.74	1.47
Double	1.28	1.02	0.90
1/2 Inch Air, Fixed	1.90	0.84	0.72
1/2 Inch Air, Low-e[0.40], Fixed	0.84	0.72	0.62
1/2 Inch Air, Low-e[0.10], Fixed	0.78	0.66	0.57
1/2 Inch Argon, Low-e[0.10], Fixed	0.72	0.60	0.48
Triple	0.90	0.66	0.60
1/2 Inch Air, Fixed	0.96	0.68	0.54
1/2 Inch Air, Low-e[0.40], Fixed	0.68	0.57	0.48
1/2 Inch Air, 2 Low-e[0.10], Fixed	0.54	0.42	0.36
1/2 Inch Argon, 2 Low-e[0.10], Fixed	0.48	0.36	0.30

This default table is applicable to sloped glazing only. (Sloped glazing is a multiple-lite glazed system (similar to a curtain wall) that is mounted at a slope greater than 15° from the vertical plane.) Other ((overhead glazing)) skylights shall use the defaults in Table 10-6E.

Opaque Doors	
	U-Factor
Uninsulated Metal	1.20
Insulated Metal (Including Fire Door and Smoke Vent)	0.60
Wood	0.50
Other Doors	See Table 10-6C

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1007.2 Component Description: The ((four)) types of ceilings are characterized as follows:

Ceilings Below a Vented Attic: Attic insulation is assumed to be blown-in, loose-fill fiberglass with a K-value of 2.6 h-ft²-°F/Btu per inch. Full bag count for specified R-value is assumed in all cases. Ceiling dimensions for flat ceiling calculations are forty-five by forty feet, with a gabled roof having a 4/12 pitch. The attic is assumed to vent naturally at the rate of three air changes per hour through soffit and ridge vents. A void fraction of 0.002 is assumed for all attics with insulation baffles. Standard-framed, unbaffled attics assume a void fraction of 0.008.

Attic framing is either standard or advanced. Standard framing assumes tapering of insulation depth around the perimeter with resultant decrease in thermal resistance. An increased R-value is assumed in the center of the ceiling due to the effect of piling leftover insulation. Advanced framing assumes full and even depth of insulation extending to the outside edge of exterior walls. Advanced framing does not change from the default value.

U-factors for flat ceilings below vented attics with standard framing may be modified with the following table:

	U-Factor for Standard Framing	
Roof Pitch	R-30	R-38
4/12	.036	.030
5/12	.035	.030
6/12	.034	.029
7/12	.034	.029
8/12	.034	.028
9/12	.034	.028
10/12	.033	.028
11/12	.033	.027
12/12	.033	.027

Vented scissors truss attics assume a ceiling pitch of 2/12 with a roof pitch of either 4/12 or 5/12. Unbaffled standard framed scissors truss attics are assumed to have a void fraction of 0.015.

Vaulted Ceilings: Insulation is assumed to be fiberglass batts installed in roof joist cavities. In the vented case, at least .5-inches between the top of the batts and the underside of the roof sheathing is left open for ventilation in each cavity. A ventilation rate of 3.0 air changes per hour is assumed. In the unvented or dense pack case, the ceiling cavity is assumed to be fully packed with insulation, leaving no space for ventilation.

> EXCEPTION: Where spray polyurethane foam meets the requirements of Section 3920.6.2 or 1313.2, the cavity shall be filled to the depth to achieve R-value requirements.

Roof Decks: Rigid insulation is applied to the top of roof decking with no space left for ventilation. Roofing materials are attached directly on top of the insulation. Framing members are often left exposed on the interior side.

Metal Truss Framing: Overall system tested values for the roof/ceiling U_o for metal framed truss assemblies from approved laboratories shall be used, when such data is acceptable to the building official.

Alternatively, the U_o for roof/ceiling assemblies using metal truss framing may be obtained from Tables 10-7A, 10-7B, 10-7C, 10-7D and 10-7E.

Steel Truss Framed Ceiling, Table 10-7A.

Steel Truss Framed Ceiling with R-3 Sheathing, Table 10-7B.

Steel Truss Framed Ceiling with R-5 Sheathing, Table 10-7C.

Steel Truss Framed Ceiling with R-10 Sheathing, Table 10-7D.

Steel Truss Framed Ceiling with R-15 Sheathing, Table 10-7E.

Metal Building Roof, Table 10-7F: The base assembly is a roof where the insulation is compressed when installed beneath metal roof panels attached to the steel structure (purlins). Additional assemblies include continuous insulation, uncompressed and uninterrupted by framing. Insulation exposed to a conditioned space shall have a facing, and all insulation seams shall be continuously sealed.

Single Layer. The rated R-value of insulation is for insulation installed perpendicular to and draped over purlins and then compressed when the metal roof panels are attached. A minimum R-3 (R-0.5) thermal spacer block between the purlins and the metal roof panels is required, unless compliance is shown by the overall assembly U-factor.

Double Layer. The first rated R-value of insulation is for insulation installed perpendicular to and draped over purlins. The second rated R-value of insulation is for unfaced insulation installed above the first layer and parallel to the purlins and then compressed when the metal roof panels are attached. A minimum R-3 (R-0.5) thermal spacer block between the purlins and the metal roof panels is required, unless compliance is shown by the overall assembly U-factor.

Continuous Insulation. For assemblies with continuous insulation, the continuous insulation is installed above or below the purlins, uncompressed and uninterrupted by framing members. ((For continuous insulation (e.g., insulation boards or blankets), it is assumed that the insulation is installed below the purlins and is uninterrupted by framing members. Insulation exposed to the conditioned space or semiheated space shall have a facing, and all insulation seams shall be continuously sealed to provide a continuous air barrier.))

Liner System (Ls). A continuous membrane is installed below the purlins and uninterrupted by framing members. Uncompressed, unfaced insulation rests on top of the membrane between the purlins. For multilayer installations, the last rated R-value of insulation is for unfaced insulation draped over purlins and then compressed when the metal roof panels are attached. A minimum R-3 (R-0.5) thermal spacer block between the purlins and the metal roof panels is required, unless compliance is shown by the overall assembly U-factor.

Filled Cavity. ((The first rated R-value of insulation is for faced insulation installed parallel to the purlins. The second rated R-value of insulation is for unfaced insulation installed above the first layer, parallel to and between the purlins and compressed when the metal roof panels are attached. The facer of the first layer of insulation is of sufficient width to be continuously sealed to the top flange of the purlins and to accommodate the full thickness of the second layer of insulation. A supporting structure retains the bottom of the first layer at the prescribed depth required for the full thickness of the second layer of insulation being installed above it.)) The first rated R-value of insulation represents faced or unfaced insulation installed between the purlins. The second rated R-value of insulation represents unfaced insulation installed above the first layer, perpendicular to the purlins and compressed where the metal roof panels are attached. A supporting structure retains the bottom of the first layer at the prescribed depth required for the full thickness of insulation. A minimum R-5 (R-0.9) thermal spacer block between the purlins and the metal roof panels is required, unless compliance is shown by the overall assembly U-factor.

U-factors for Metal Building Roofs. U-factors for metal building roofs shall be taken from Table 10-7F, provided the average purlin spacing is at least 52 in. and the R-value of the thermal spacer block is greater than or equal to the thermal spacer block R-value indicated in Table 10-7F for the assembly. It is not acceptable to use the U-factors in Table 10-7F if additional insulated sheathing is not continuous. U-factors for metal building roof assemblies with average purlin spacing less than 52 in. shall be determined in accordance with Section A9.2 of RS-9.

Roofs with Insulation Entirely Above Deck (uninterrupted by framing), Table 10-7G: The base assembly is continuous insulation over a structural deck. Added insulation is continuous and uninterrupted by framing. For the insulation, the first column lists the R-value for continuous insulation with a uniform thickness; the second column lists the comparable area-weighted average R-value for continuous insulation provided that the insulation thickness is never less than R-5 (except at roof drains) and that the slope is no greater than 1/4 inch per foot.

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TABLE 10-7F

Default U-Factors for Metal Building Roofs

Insulation System	Rated R-Value of Insulation	Overall U-Factor for Entire Base Roof Assembly	Overall U-Factor for Assembly of Base Roof Plus Continuous Insulation (Uninterrupted by Framing): Rated R-Value of Continuous Insulation								
			R-6.5	R-9.8	R-13	R-15.9	R-19 ((R-19.0))	R-22.1	R-25 ((R-25))	R-32 ((R-32.))	R-38 ((R-38))
Standing Seam Roofs with Thermal Spacer Blocks [a,b]											
Single Layer	None	1.289	0.137	0.095	0.073	0.060	0.051 ((0.050))	0.044	0.039 ((0.038))	0.031 ((0.030))	0.026 ((0.025))
	R-10	0.111	0.096	0.084	0.069	0.061	0.054 ((0.053))	0.047	0.042 ((0.041))	0.035 ((0.034))	0.031
	R-11	0.107	0.093	0.082	0.068	0.060	0.053	0.046	0.041 ((0.040))	0.034	0.030
	R-13	0.101	0.091	0.080	0.066	0.059	0.052	0.045	0.040	0.033	0.029
	R-16	0.096	0.086	0.076	0.063	0.056	0.050 ((0.049))	0.044	0.039 ((0.038))	0.032 ((0.031))	0.028 ((0.027))
	R-19	0.092	0.083	0.073	0.061	0.054	0.048 ((0.047))	0.042	0.037 ((0.036))	0.031 ((0.030))	0.027 ((0.026))
Double Layer	R-10 + R-10	0.088	0.078	0.069	0.058	0.051	0.046 ((0.045))	0.040	0.036 ((0.035))	0.030 ((0.029))	0.026 ((0.025))
	R-10 + R-11	0.086	0.077	0.068	0.057	0.050	0.045 ((0.044))	0.039	0.035 ((0.034))	0.029 ((0.028))	0.025 ((0.024))
	R-11 + R-11	0.085	0.076	0.067	0.056	0.049	0.044 ((0.043))	0.038	0.034 ((0.033))	0.028 ((0.027))	0.025 ((0.024))
	R-11 + R-13	0.084	0.075	0.066	0.055	0.048	0.043 ((0.042))	0.038	0.033 ((0.032))	0.028 ((0.027))	0.024 ((0.023))
	R-11 + R-13	0.082	0.073	0.065	0.054	0.047	0.042 ((0.041))	0.037	0.033 ((0.032))	0.027 ((0.026))	0.024 ((0.023))
	R-13 + R-13	0.081	0.072	0.064	0.053	0.046	0.041 ((0.040))	0.036	0.032 ((0.031))	0.027 ((0.026))	0.023 ((0.022))
	R-11 + R-19	0.078	0.070	0.062	0.051	0.044	0.039 ((0.038))	0.035	0.030 ((0.029))	0.025 ((0.024))	0.022 ((0.021))
	R-13 + R-19	0.076	0.068	0.060	0.050	0.043	0.038 ((0.037))	0.034	0.029 ((0.028))	0.024 ((0.023))	0.021 ((0.020))
	R-16 + R-19	0.074	0.066	0.058	0.048	0.042	0.037 ((0.036))	0.032	0.028 ((0.027))	0.023 ((0.022))	0.020 ((0.019))
	R-19 + R-19	0.072	0.064	0.056	0.047	0.040	0.035 ((0.034))	0.031	0.027 ((0.026))	0.022 ((0.021))	0.019 ((0.018))
Liner System	R-10 + R-11	0.085	0.076	0.067	0.056	0.049	0.044 ((0.043))	0.038	0.034 ((0.033))	0.028 ((0.027))	0.025 ((0.024))
	R-13 + R-13	0.080	0.071	0.063	0.052	0.045	0.040 ((0.039))	0.035	0.031 ((0.030))	0.026 ((0.025))	0.022 ((0.021))
	R-13 + R-19	0.074	0.066	0.058	0.048	0.042	0.037 ((0.036))	0.032	0.028 ((0.027))	0.023 ((0.022))	0.020 ((0.019))
	R-16 + R-19	0.069	0.061	0.054	0.045	0.039	0.034 ((0.033))	0.030	0.026 ((0.025))	0.022 ((0.021))	0.019 ((0.018))
	R-19 + R-19	0.065	0.058	0.051	0.043	0.037	0.032 ((0.031))	0.028	0.024 ((0.023))	0.021 ((0.020))	0.018 ((0.017))
Liner System	R-10 + R-11	0.053									
	R-13 + R-11	0.052									
	R-13 + R-13	0.051									
	R-30 + R-11 + R-11	0.034									
Filled Cavity with Thermal Spacer Blocks [c]											
	R-10 + R-19	0.041 ((0.040))	0.035 ((0.034))	0.028	0.022 ((0.021))	0.020	0.018 ((0.017))	0.016	0.014 ((0.013))	0.010 ((0.009))	0.010 ((0.009))
Standing Seam Roofs without Thermal Spacer Blocks											
Liner System	R-10 + R-11	0.050									
Thru-Fastened Roofs without Thermal Spacer Blocks											
	R-10	0.184	0.104	0.068	0.054	0.042	0.034	0.030	0.026	0.020	0.016
	R-11	0.182	0.103	0.068	0.054	0.042	0.034	0.030	0.026	0.020	0.016
	R-13	0.174	0.098	0.064	0.050	0.040	0.032	0.028	0.025	0.019	0.015
	R-13	0.167	0.094	0.062	0.049	0.039	0.031	0.027	0.024	0.018	0.015
	R-19	0.151	0.086	0.057	0.045	0.036	0.029	0.025	0.022	0.017	0.014
Liner System	R-10 + R-11	0.054									

(Multiple R-values are listed in order from inside)

a. A standing seam roof clip that provides a minimum 1.5 in. distance between the top of the purlins and the underside of the metal roof panels is required.

b. A minimum R-3 thermal spacer block is required.

c. A minimum R-5 thermal spacer block is required.

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TABLE 10-7G

ASSEMBLY U-FACTORS FOR ROOFS WITH INSULATION ENTIRELY ABOVE DECK

(UNINTERRUPTED BY FRAMING)

Rated R-Value of Insulation Alone: Minimum Throughout, Unsloped	Rated R-Value of Insulation Alone: Average (R-5 minimum), Sloped (1/4 inch per foot maximum)	Overall U-Factor for Entire Assembly
R-5	Not allowed	U-0.282
R-11	Not allowed	U-0.062
R-12	Not allowed	U-0.060
R-13	Not allowed	U-0.265
R-14	Not allowed	U-0.209
R-15	Not allowed	U-0.173
R-16	R-7	U-0.147
R-17	R-8	U-0.129
R-18	R-9	U-0.114
R-19	R-10	U-0.102
R-20	R-12	U-0.093
R-21	R-15	U-0.085

Rated R-Value of Insulation Alone: Minimum Throughout, Unsloped	Rated R-Value of Insulation Alone: Average (R-5 minimum), Sloped (1/4 inch per foot maximum)	Overall U-Factor for Entire Assembly
R-13	R-15	U-0.078
R-13	R-16	U-0.073
R-14	R-18	U-0.068
R-15	R-20	U-0.063
R-16	R-22	U-0.060
R-17	R-23	U-0.056
R-18	R-25	U-0.053
R-19	R-27	U-0.051
R-20	R-29	U-0.048
R-21	R-3	U-0.046
R-22	R-30	U-0.044
R-23	R-25	U-0.042
R-24	R-37	U-0.040
R-25	R-39	U-0.039
R-26	R-41	U-0.037
R-27	R-42	U-0.036
R-28	R-46	U-0.035
R-29	R-48	U-0.034
R-30	R-51	U-0.032
R-31	R-52	U-0.031
R-32	R-56	U-0.030

Rated R-Value of Insulation Alone: Minimum Throughout, Unsloped	Rated R-Value of Insulation Alone: Average (R-5 minimum), Sloped (1/4 inch per foot maximum)	Overall U-Factor for Entire Assembly
R-33	R-59	U-0.030
R-34	R-60	U-0.029
R-35	R-61	U-0.028
R-36	R-63	U-0.027
R-37	R-66	U-0.026
R-38	R-68	U-0.026
R-39	R-71	U-0.025
R-40	R-72	U-0.025
R-41	R-73	U-0.024
R-42	R-78	U-0.023
R-43	R-80	U-0.023
R-44	R-83	U-0.022
R-45	R-86	U-0.022
R-46	R-88	U-0.021
R-47	R-90	U-0.021
R-48	R-93	U-0.021
R-49	R-95	U-0.020
R-50	R-99	U-0.020
R-55	R-112	U-0.018
R-60	R-120	U-0.016

***

1009.1 General: Tables 10-9 and 10-10 list default mass values for concrete masonry construction for residential. Calculations are based on standard ASHRAE values for heat-storage capacity as listed in Standard RS-1, Chapter 26. For heat capacity values for brick, concrete, and concrete masonry materials used in other projects, see Table 10-B.

Thermal capacity of furniture is ignored, as is heat storage beyond the first four inches of mass thickness. All mass is assumed to be in direct contact with the conditioned space. Concrete separated from the heated volume by other materials must multiply the listed concrete mass value by the result of the following formula:

$$\text{Ln}(\text{R-value}) \times (-.221) + .5$$

Where:

Ln = Natural log

R-value = R-value of material covering concrete

Note: All default values for covered concrete slabs have been adjusted according to this procedure.

Section 10. The following sections or subsections of Chapter 11 of the 2009 Washington State Energy Code are amended, and new sections are added to that Chapter, as follows.

SECTION 1100 — TITLE

Chapters 11 through 16((20)) of this Code shall be known as the "((Washington State)) Seattle Nonresidential and Multifamily Residential Energy Code" and may be cited as such. Any reference to the "Seattle Energy Code" in the Seattle Municipal Code or any Seattle ordinance, to the extent applicable to those spaces, shall include the Seattle Nonresidential and Multifamily Residential Energy Code. ((, and will be referred to herein as "this Code."))

SECTION 1105 — APPLICABILITY TO MULTIFAMILY RESIDENTIAL SPACES

Until the effective date of the 2009 Washington State Energy Code, the 2006 Washington State Energy Code, as filed in Seattle City Clerk's File 308938, and the amendments thereto adopted by Ordinance 122530, constitute the Seattle Energy Code for multifamily residential spaces. Effective upon the date when the 2009 Washington State Energy Code takes effect, the 2009 Washington State Energy Code, with the Seattle Amendments only to Chapter 1, constitutes the Seattle Energy Code for multifamily residential spaces.

EXCEPTION: Sections 1102, 1103, 1111, 1112, 1114, and 1162 of Chapter 1 of this Code which govern procedure, administration and enforcement, including Seattle Amendments to those sections, and the general requirements in Chapters, apply to all spaces and occupancies both before and after effective date of the 2009 Washington State Energy Code.

For purposes of this Section: (1) Prior to the effective date of the 2009 Washington State Energy Code, "multifamily residential spaces" are defined as spaces within the definition of "Group R" occupancy in Chapter 3 of the 2006 Seattle Building Code and not falling within the scope of Section 101.2 of the 2006 Seattle Residential Code, and (2) effective upon the date when the 2009 Washington State Energy Code takes effect, "multifamily residential spaces" are defined as set forth in Chapter 2 of this Code under "RESIDENTIAL".

Informative Note: Prior to the effective date of the 2009 Washington State Energy Code as spaces in Group I occupancy are classified as "residential," therefore all Seattle Amendments to sections relevant to those spaces apply to all such spaces.

SECTION 1110 — PURPOSE AND INTENT

The purpose of this Code is to provide minimum standards for new or altered buildings and structures or portions thereof, including systems and equipment used for commercial and industrial processes contained therein, to achieve efficient use and conservation of energy. It is intended that these provisions provide flexibility to permit the use of innovative approaches and techniques to achieve efficient use and conservation of energy.

The purpose of this Code is not to create or otherwise establish or designate any particular class or group of persons who will or should be especially protected or benefited by the terms of this Code. This Code is not intended to abridge any safety or health requirements required under any other applicable codes or ordinances.

The provisions of this Code do not consider the efficiency of various energy forms as they are delivered to the building envelope.

Informative Note: As indicated in Section 1120, the Energy Code applies to industrial facilities, as well as commercial and industrial processes. Thus, the purpose and the intent is that requirements apply to industrial facilities, as well as systems and equipment used in commercial and industrial processes.

SECTION 1120 — SCOPE

This Code sets forth minimum requirements for the design and construction of new or altered buildings and structures or portions thereof that provide facilities or shelter for public assembly, educational, business, mercantile, institutional, storage, factory, industrial, and multifamily residential occupancies by regulating their exterior envelopes and the selection of their mechanical systems, domestic water systems, electrical distribution and illuminating systems, and equipment for efficient use and conservation of energy, including systems and equipment used for commercial and industrial processes contained therein.

EXCEPTION: The provisions of this Code do not apply to temporary growing structures used solely for the commercial production of horticultural plants including ornamental plants, flowers, vegetables, and fruits.

—Temporary growing structure means a structure that has the sides and roof covered with polyethylene, polyvinyl, or similar flexible synthetic material and is used to provide plants with either frost protection or increased heat retention.

A temporary growing structure is not considered a building for purposes of this Code.

***

1132.1 **Building Envelope:** Alterations or repairs shall comply with Chapter 13, including the nominal R-values and ((glazing)) fenestration requirements in Table 13-1 or 13-2.

EXCEPTIONS:

1. Storm windows installed over existing glazing.
2. Glass replaced in existing sash and frame provided that glazing is of equal or lower U-factor.
3. For solar heat gain coefficient compliance, glazing with a solar heat gain coefficient equal to or lower than that of the other existing glazing.
4. Existing roofs/ceiling, wall or floor cavities exposed during construction provided that these cavities are insulated to full depth with insulation having a minimum nominal value of R-3.0 per inch installed per Sections 1311 and 1313.
5. Existing walls and doors without framing cavities, provided that any new cavities added to existing walls and doors comply with Exception 4.
6. Existing roofs where the roof membrane is being replaced and
   a. The roof sheathing or roof insulation is not exposed, or
   b. If there is existing roof insulation below the deck
7. Replacement of existing doors that separate conditioned space from the exterior shall not require the installation of a vestibule or revolving door, provided that the rough opening and the door size does not change, and provided that any existing vestibule or revolving door that separates a conditioned space from the exterior shall not be removed.

In no case shall the energy efficiency of the building be decreased.

1132.2 **Mechanical Systems:** Those parts of systems which are altered or replaced shall comply with Chapter 14 of this Code. Additions or alterations shall not be made to an existing mechanical system that will cause the existing mechanical system to become out of compliance.

All new systems in existing buildings, including packaged unitary equipment and packaged split systems, shall comply with Chapter 14.

Where mechanical cooling is added to a space that was not previously cooled, the mechanical cooling system shall comply with Sections 1413 and either 1423 or 1433.

EXCEPTIONS: These exceptions can apply to situations where mechanical cooling is added to a space that was not previously cooled.

1. Water-cooled refrigeration equipment provided with a water economizer meeting the requirements of Section 1413 need not comply with 1423 or 1433. This exception shall not be used for RS-20 analysis.
2. Alterations that are not in full compliance with this Code may be approved where the building official determines that existing building or occupancy constraints make full compliance impractical or where full compliance would be economically impractical.

Alterations to existing mechanical cooling systems shall not decrease economizer capacity unless the system complies with Sections 1413 and either 1423 or 1433. In addition, for

existing mechanical cooling systems that do not comply with Sections 1413 and either 1423 or 1433, including both the individual unit size limits and the total building capacity limits on units without economizer, other alterations shall comply with Table 11-1.

When space cooling equipment is replaced, controls shall be installed to provide for integrated operation with economizer in accordance with Section 1413.3.

Existing equipment currently in use may be relocated within the same floor or same tenant space if removed and reinstalled within the same permit.

In no case shall the energy efficiency of the building be decreased.

1132.3 Lighting and Motors: Where the use in a space changes from one use in Table 15-1 to another use in Table 15-1, the installed lighting wattage shall comply with Section 1521 or 1531.

Other lemodel improvements, alterations or repairs where ((600)) 20 percent or more of the fixtures, or of the lamps plus ballasts alone, in a space enclosed by walls or ceiling-height partitions are ((new)) altered, added, or replaced shall comply with Sections 1531 and 1532. (Where this threshold is triggered, the areas of the affected spaces may be combined for lighting code compliance calculations.) Where less than ((60)) 20 percent of the fixtures in a space enclosed by walls or ceiling-height partitions are new, the installed lighting wattage shall be maintained or reduced. Where ((60)) 20 percent or more of the lighting fixtures in a suspended ceiling are new, and the existing insulation is on the suspended ceiling, the roof/ceiling assembly shall be insulated according to the provisions of Chapter 13, Section 1311.2.

Any new lighting control devices shall comply with the requirements of Section 1513. Where new wiring is being installed to serve added fixtures and/or fixtures are being relocated to a new circuit, controls shall comply with Sections 1513.1 through 1513.5 and, as applicable, 1513.8. In addition, office areas less than 300 ft² enclosed by walls or ceiling-height partitions, and all meeting and conference rooms, and all school classrooms, shall be equipped with occupancy sensors that comply with Section 1513.6 and 1513.8. Where a new lighting panel (or a moved lighting panel) with all new raceway and conductor wiring from the panel to the fixtures is being installed, controls shall also comply with the other requirements in Sections 1513.6 through 1513.8.

Where new walls or ceiling-height partitions are added to an existing space and create a new enclosed space, but the lighting fixtures are not being changed, other than being relocated, the new enclosed space shall have controls that comply with Sections 1513.1 through 1513.2, 1513.4, and 1513.6 through 1513.8.

Those motors which are altered or replaced shall comply with Section 1511.

In no case shall the energy efficiency of the building be decreased.

1133 Change of occupancy or use or space conditioning. Changes of occupancy or use or space conditioning shall comply with the following requirements:

a. Any unconditioned space that is altered to become semi-heated, cooled, or fully heated, or any semi-heated space that is altered to become cooled or fully heated space shall be required to be brought into full compliance with this Code. Existing warehouses and repair shops are considered unconditioned space unless they are indicated as conditioned space in DPD records or they were built after 1980 and they comply with the building envelope requirements for conditioned space in effect at the time of construction. (See the Seattle Mechanical Code for requirements for combustion appliances.)

b. Any nonresidential space which is converted to multifamily residential space shall be brought into full compliance with this Code.

c. Any multifamily residential space which is converted to nonresidential space shall be required to comply with all of the provisions of Sections 1130 through 1132 of this Code.

***

1135 Commissioning. Commissioning in compliance with Sections 1416 and 1513.8 shall be required for new systems or modified portions of systems((, with a heating capacity of 600,000 Btu/h or a cooling capacity of 10 tons or more)).

***

1141.2 Details: The plans and specifications shall show in sufficient detail all pertinent data and features of the building and the equipment and systems as herein governed including, but not limited to: design criteria; exterior envelope component materials, U-factors of the envelope systems, R-values of insulating materials; U-factors and solar heat gain coefficients and visible transmittance of fenestration or shading coefficients of glazing; area weighted U-factor calculations; efficiency, economizer, size and type of apparatus and equipment; fan system horsepower; equipment and systems controls; lighting fixture schedule with wattages and controls narrative; commissioning requirements for HVAC equipment, HVAC controls, and lighting controls, and other pertinent data to indicate compliance with the requirements of this Code.

***

1141.4 Systems Analysis Approach for the Entire Building: In lieu of using Chapters 12 through 16((29)), compliance may be demonstrated using the systems analysis option in Standard RS-29. When using systems analysis, the proposed ((~~building~~)) design, as defined in Standard RS-29, shall provide ((~~equal or~~)) better conservation of energy((~~than~~)), to the extent required by Section 1.3 of Standard RS-29 than the ((standard design)) baseline building design, as defined in Standard RS-29, that would comply with this Code without reference to this Section 1141.4. If required by the building official, all energy comparison calculations submitted under the provisions of Standard RS-29 shall be stamped and authenticated by an engineer or architect licensed to practice by the state of Washington.

***

1143.2 Required Inspections: The building official, upon notification, shall make the inspection required in this section, in addition to or as part of those inspections required in Section 109.3 of the ((~~International~~)) Seattle Building Code. Inspections may be conducted by special inspection pursuant to Section 1704 of the ((~~International~~)) Seattle Building Code. Where applicable, inspections shall include at least:

1143.2.1 Envelope

a. Wall Insulation Inspection: To be made after all wall insulation and air vapor retarder sheet or film materials are in place, but before any wall covering is placed.

b. ((Glazing)) Fenestration Inspection: To be made after ((glazing)) fenestration materials are installed in the building.

c. Exterior Roofing Insulation: To be made after the installation of the roof insulation, but before concealment.

d. Slab/Floor Insulation: To be made after the installation of the slab/floor insulation, but before concealment.

1143.2.2 Mechanical

a. Mechanical Equipment Efficiency and Economizer: To be made after all equipment and controls required by this Code are installed and prior to the concealment of such equipment or controls.

b. Mechanical Pipe and Duct Insulation: To be made after all pipe and duct insulation is in place, but before concealment.

1143.2.3 Lighting and Motors

a. Lighting Equipment and Controls: To be made after the installation of all lighting equipment and controls required by this Code, but before concealment of the lighting equipment.

b. Motor Inspections: To be made after installation of all equipment covered by this Code, but before concealment.

***

1144 Violations and Penalties((~~: It shall be a violation of this Code for any person, firm or corporation to erect or construct~~ any building or remodel or rehabilitate any existing building or ~~structure~~ in the state, or allow the same to be done, contrary to any of the provisions of this Code.))

1144.1 Violations: It is a violation of this Code for anyone to:

1. erect, construct, enlarge, repair, move, improve, remove, convert, demolish, equip, occupy, operate, inspect or maintain any building or structure in the City, contrary to or in violation of any of the provisions of this Code;
2. knowingly aid, abet, counsel, encourage, hire, command, induce or otherwise procure another to violate or fail to comply with this Code;
3. use any material or to install any device, appliance or equipment that does not comply with the applicable standards of this Code, or that has not been approved by the building official if their approval is required;
4. violate or fail to comply with any final order issued by the building official pursuant to the provisions of this Code or with any requirements of this Code;
5. remove, mutilate, destroy or conceal any notice or order issued or posted by the building official pursuant to the provisions of this Code, or any notice or order issued or posted by the building official in response to a natural disaster or other emergency; or
6. make or submit any false or misleading statement or information as part of or in connection with any application for any permit or approval under this Code.

1144.2 Notices, Review and Enforcement: The provisions of Section 103 of the Seattle Building Code regarding notices of violation, orders, recording, review, and legal proceedings apply under this Code. Section 103 of the Seattle Building Code, as adopted by SMC Section 22.100.010, is incorporated in this Section by this reference. Nothing in this Section 1144 shall be deemed to limit or preclude any action or proceeding pursuant to the Seattle Building Code or any other ordinance, and nothing in this section shall be deemed to obligate or require the building official to issue a notice of violation prior to the imposition of civil or criminal penalties.

1144.3 Penalties and Remedies: Any person violating or failing to comply with the provisions of this Code or an order of the building official under this Code shall be subject to the same civil and criminal penalties as provided for a violation of the Seattle Building Code under Section 103 of that code. The provisions for additional remedies in Section 103 of the Seattle Building Code apply under this Code.

***

1150 Conflicts with Other Codes. In case of conflicts among Codes enumerated in RCW 19.27.031 subsections (1), (2), (5) and (4) and this Code, the first named Code shall govern. The duct insulation requirements in this Code ((~~or a local jurisdiction's energy code, whichever is more stringent~~)) supersede the requirements in the Mechanical Code.

Informative Note: Additional efficiency standards for electrical energy use may also appear in Seattle City Light service requirements, which should be consulted.

Where, in any specific case, different sections of this Code specify different materials, methods of construction or other requirements, the most restrictive shall govern. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall be applicable.

***

1162 Liability: Nothing contained in this Code is intended to be nor shall be construed to create or form the basis for any liability on the part of ((~~any city or county~~)) the City or its officers, employees or agents for any injury or damage resulting from the failure of a building or any fixture or equipment to conform to the provisions of this Code, or by reason of or in consequence of any inspection, notice, order, certificate, permission or approval authorized or issued or done in connection with the implementation or enforcement of this Code, or by reason of any action or inaction on the part of the City or by its officers or agents related in any manner to the enforcement of this Code. This Code shall not be construed to lessen or relieve the responsibility of any person owning, operating or controlling any building or structure for any damages to persons or property caused by defects, nor shall DPD or the City of Seattle be held to have assumed any such liability by reason of the inspections authorized by this Code or any permits or certificates issued under this Code.

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TABLE 11-1

ECONOMIZER COMPLIANCE OPTIONS FOR MECHANICAL ALTERATIONS

	Option A	Option B (alternate to A)	Option C (alternate to A)	Option D (alternate to A)
Unit Type	Any alteration with new or replacement equipment	Replacement unit of the same type with the same or smaller output capacity	Replacement unit of the same type with a larger output capacity	New equipment added to existing system or replacement unit of a different type
1. Packaged Units	Efficiency: min.[1] Economizer: 1433[2]	Efficiency: min.[1] Economizer: 1433[2]	Efficiency: min.[1] Economizer: 1433[2]	Efficiency: min.[1] Economizer: 1433[2]
2. Split Systems	Efficiency: min.[1] Economizer: 1433[2]	Efficiency: 10.3 EER[3] Economizer: shall not decrease existing economizer capacity	Only for new units ≤ 54,000 Btu/h serving only newly installed section 1991 (one of two): Efficiency: ≥ 10.9 EER[3] Economizer: 1433[2]	Efficiency: min.[1] Economizer: 1433[2]
3. Water Source Heat Pumps	Efficiency: min.[1] Economizer: 1433[2]	Efficiency: 10.3 EER[3] Economizer: shall not decrease existing economizer capacity	(two of three): Efficiency: ≥ 10.9 EER[3] Economizer: shall not decrease existing economizer capacity	(three of three): Efficiency: min.[1] Economizer: 1433[2]
4. Evaporative Condensers	Efficiency: min.[1] Economizer: 1433[2]	Efficiency: 10.3 EER[3] Economizer: shall not decrease existing economizer capacity	Efficiency: ≥ 10.9 EER[3] Economizer: 1433[2]	Efficiency: min.[1] Economizer: 1433[2]
5. Air-Handling Unit (including fan coil units) where the system has a water-cooled chiller	Efficiency: min. Economizer: 1433[2]	Economizer: 1433[2] for equipment located outdoors or in unconditioned areas adjacent to the outdoors, otherwise shall not decrease existing economizer capacity	Option A (except for certain pre-1991 systems[3])	Option A (except for certain pre-1991 systems[3])
6. Air-Handling Unit (including fan coil units) where the system has a water-cooled chiller[4]	Efficiency: min.[1] Economizer: 1433[2]	Economizer: 1433[2] for equipment located outdoors or in unconditioned areas adjacent to the outdoors, otherwise shall not decrease existing economizer capacity	Option A (except for certain pre-1991 systems[3])	Efficiency: min.[1] Economizer: 1433[2,4]
7. Cooling Towers	Efficiency: min.[1] Economizer: 1433[2]	No requirements	Option A	Option A
8. Air-Cooled Chiller	Efficiency: min.[1] Economizer: 1433[2]	Efficiency: 5%[11] Economizer shall not decrease existing economizer capacity	Efficiency (two of two): (1) + 10%[14] and (2) multistage Economizer shall not decrease existing economizer capacity	Efficiency: min.[1] Economizer: 1433[2,4]
9. Water-Cooled Chiller	Efficiency: min.[1] Economizer: 1433[2]	Efficiency (one of two): (1) + 15%[14] and (2) plate-and-frame heat exchanger[5] Economizer: shall not decrease existing economizer capacity	Efficiency (two of two): (1) + 15%[14] and (2) plate-and-frame heat exchanger[5] Economizer: shall not decrease existing economizer capacity	Efficiency: min.[1] Economizer: 1433[2,4]
10. Boiler	Efficiency: min.[1] Economizer: 1433[2]	Efficiency: 1.8%[13] Economizer: shall not decrease existing economizer capacity	Efficiency: 2%[15] Economizer: shall not decrease existing economizer capacity	Efficiency: min.[1] Economizer: 1433[2,4]

1. Minimum equipment efficiency shall comply with Section 1411.1 and Tables 14-1A through 14-1M.
2. System and building shall comply with Section 1433 (including both the individual unit size limits and the total building capacity limits on units without economizer). It is acceptable to comply using one of the exceptions to Section 1433.
3. All equipment replaced in any existing building shall have air economizer complying with Sections 1413 and 1423 unless both the individual unit size and the total capacity of units without an economizer in the building is less than that allowed in Exception 1 to Section 1433.
4. All separate new equipment added to an existing building shall have air economizer complying with Sections 1413 and 1423 unless both the individual unit size and the total capacity of units without an economizer in the building is less than that allowed in Exception 1 to Section 1433.
5. Equipment shall have a capacity-weighted average cooling system efficiency:
   a. for units with a cooling capacity below 54,000 Btu/h, a minimum of 10% greater than the requirements in Tables 14-1A and 14-1B (1.10 x values in Tables 14-1A and 14-1B).
   b. for units with a cooling capacity of 54,000 Btu/h and greater, a minimum of 5% greater than the requirements in Tables 14-1A and 14-1B (1.05 x values in Tables 14-1A and 14-1B).
6. Minimum of 50% air economizer that is ducted in a fully enclosed path directly to every heat pump and in each zone, except that ducts may terminate within 12 inches of the intake to an HVAC unit provided that they are physically fastened so that the outside air duct is directed into the unit intake. If this is an increase in the amount of outside air supplied to the unit, the outside air supply system shall be capable of providing this additional outside air and be provided with economizer control.
7. Have low-end valves to shut intake flow through the heat pumps that are not in operation with variable speed pumping control complying with Section 1432.2.2 for the heat pumps.
   - When the total capacity of all units with flow control valves exceeds 75% of the total system capacity, a variable frequency drive shall be installed on the main loop pump.
   - As an alternate to this requirement, have a space-by-space weighted average cooling system efficiency that is 5% greater than the requirements in note 5 (i.e. a minimum of 15%/10% greater than the requirements in Tables 14-1A and 14-1B (1.15/1.10

as listed in Tables 14-1A and 14-1B).

8. Systems installed prior to 1991 without fully enclosed capacity are allowed to comply with Option B, provided that the individual fan cooling capacity does not exceed 90,000 Btu/h.

9. Economizer not required for systems installed with water economizer cycle and flame heat exchanger complying with previous codes between 1991 and ((June 2004)) the effective date of the 2009 Seattle Energy Code, provided that the total fan cold head does not exceed the cooling installed capacity of the heat exchangers.

10. For water-cooled process equipment where the manufacturer's specifications require cooler temperatures than available with water side economizer, that portion of the cooling is exempt from the economizer requirements.

11. The air-cooled chiller shall have an IPLV efficiency that is a minimum of 5% greater than the IPLV requirements in EER in Table 14-1C (1.05 x IPLV values in EER in Table 14-1C).

12. The air-cooled chiller shall:

a. have an IPLV efficiency that is a minimum of 10% greater than the IPLV requirements in EER in Table 14-1C (1.10 x IPLV values in EER in Table 14-1C); and

b. be multi-stage with a minimum of two compressors.

13. The water-cooled chiller shall have an ((NPLV)) IPLV efficiency that is at least 13% lower ((a minimum of 13% greater)) than the ((NPLV)) IPLV requirements in kW/ton in ((Table 14-1K, Table 14-1L, or Table 14-1M)) Table 14-1C (1.10 x ((NPLV)) IPLV values in kW/ton in ((Table 14-1K, Table 14-1L, or Table 14-1M)) Table 14-1C). Water-cooled centrifugal chillers designed for non-standard conditions shall have an IPLV efficiency that is at least 10% lower than the adjusted maximum NPLV rating in kW/ton derived in paragraph 14-1.2.1 (1.10 x NPLV).

14. The water-cooled chiller shall have an ((NPLV)) IPLV efficiency that is at least 13% lower ((a minimum of 13% greater)) than the ((NPLV)) IPLV requirements in kW/ton in ((Table 14-1K, Table 14-1L, or Table 14-1M)) Table 14-1C (1.15 x ((NPLV)) IPLV values in kW/ton in ((Table 14-1K, Table 14-1L, or Table 14-1M)) Table 14-1C). Water-cooled centrifugal chillers designed for non-standard conditions shall have an NPLV efficiency that is at least 15% lower than the adjusted maximum NPLV rating in kW/ton derived in paragraph 14-1.2.1 (1.15 x NPLV).

15. Economizer cooling shall be provided by adding a plate-frame heat exchanger on the waterside with a capacity that is a minimum of 22% of the chiller capacity at specified AHRI rating conditions.

16. The condensing boiler shall have an efficiency at least the minimum 85% high gas fired annual fuel utilization efficiency value in Table 14-1F (1.06 x value in Table 14-1F), except for electric boilers.

Section 11. The following sections of Chapter 12 of the 2009 Washington State Energy Code are amended, and new sections are added to that Chapter, as follows:

Chapter 12 Energy Metering and Energy Consumption Management

1201 General. All buildings shall comply with Chapter 12. Whole building energy supply sources shall be metered to supply energy consumption data to the building owner to effectively manage energy. The building shall have a totalizing meter for each energy source.

1202 Whole Building Energy Supply Metering. For buildings with a gross conditioned floor area of 20,000 ft² and larger, measurement devices with remote communication capability shall be provided to collect energy use data for each energy supply source to the building including gas, electricity and district steam. The system shall collect energy use data for the total building and separately for each of the end-use categories listed in Sections 1202.1 through 1202.5 and Figure 12A.

Exceptions:

1. Buildings where the total usage of each of the load types described in Sections 1202.1 through 1202.5 is measured through the use of installed submeters or other methods approved as equivalent by the building official.

2. Up to 2% of the total calculated load of each end-use category as defined in Sections 1202.1 through 1202.5, may be excluded from the energy submetering requirements of this chapter.

3. Separate metering is not required for fire pumps, stairwell pressurization fans and associated life-safety systems that operate only during testing or emergency.

4. Health care facilities with loads in excess of 150 kVA may have submetering that measures electrical energy usage in accordance with the normal and essential electrical systems identified in Article 517 of the Seattle Electrical Code.

All measurement devices shall be configured to automatically communicate the energy data to a data acquisition system. At a minimum, measurement devices shall provide daily data. The data acquisition system shall be capable of electronically storing the data, for a minimum of 36 months, from the measurement devices and other sensing devices and creating user reports showing daily, monthly and annual energy consumption. The system shall be commissioned in accordance with Section 1410.6.

((Meters with remote metering capability or automatic meter reading (AMR) capability shall be provided to collect energy use data for each energy supply source to the building including gas, electricity and district steam, that exceeds the thresholds listed in Table 12-1. Utility company service entrance/interval meters are allowed to be used provided they are factory configured for automatic meter reading (AMR) capability.

~~Meter submetering with remote metering capability (including current sensors or flow meters) shall be provided for the systems that exceed the thresholds in Table 12-1 to collect overall totalized energy use data for each calendar year in accordance with Table 12-2.~~))

Metering shall be digital-type meters for the main meter. Current sensors or flow meters are allowed for submetering. ((~~For subsystems with multiple similar units, such as multi-cell cooling towers, only one meter is required for the subsystem.~~)) Existing buildings are allowed to reuse installed existing analog-type utility company service/interval meters.

1202.1 HVAC System Total Energy Use. This category shall include all energy used to provide space heating, space cooling, and ventilation to the building including boilers, chillers, pumps, fans for supply, return, relief, exhaust, and parking garages, etc.

1202.2 Lighting System Total Energy Use. This category shall include all energy used by interior and exterior lighting, but not including plug-in task lighting.

1202.3 Plug Load System Total Energy Use. This category shall include all energy used by plugged in task lighting, appliances, and other equipment and devices.

1202.4 Process Load System Total Energy Use. This category shall include all energy used by any non-building operation load (e.g. non-residential refrigeration and cooking) that accounts for over 2% of the total building connected load. If the total process energy use is less than 2% of the total building connected load, the process energy use is allowed to be included in miscellaneous process energy use.

1202.5 Miscellaneous Total Energy Use. This category shall include energy use other than those specified in Sections 1202.1 through 1202.4 including domestic hot water, elevators and escalators, and swimming pools.

1203 Metering for New or Replacement Systems and Equipment: Where new or replacement systems or equipment is installed in an existing building, metering shall be installed so that that system or equipment is included in the total for the corresponding end-use category in accordance with Section 1202.

Exceptions:

1. Where new or replacement systems or equipment that falls below the threshold in Table 12-2 is installed in an existing building that was not subject to the requirements of this chapter, no additional metering shall be required.

2. Where new or replacement systems or equipment ((is installed)) that exceeds the threshold in ((Table 12-1 or)) Table 12-2 is installed in an existing building that was not subject to the requirements of this chapter, metering shall be installed for the system or equipment in accordance with Section 1202((, only)); except that a data acquisition system shall not be required for buildings less than 50,000 ft².

1204 Energy Display. For each building subject to Section 1202, a permanent, readily accessible and visible display shall be provided in the building accessible by building operation and management. At a minimum the display shall be capable of providing the current energy demand for the whole building, metered for each energy source, as well as the average and peak demands for the previous day and the same day the previous year, and the total energy usage for the previous 12 months.

Exception: For existing buildings where a data acquisition system is not required, compliance with Section 1204 shall not be required.

FIGURE 12A

ENERGY SOURCE AND SEPARATE END-USE SUBMETERING

Energy Source	Separate End-use Submetering
Electric service	HVAC, Lighting, Plugs, Process, Miscellaneous Energy used in Life-cycle
Gas and steam service	HVAC, Process, Miscellaneous Energy used in the project
On-site renewable electric power	Electrical energy supplied to the project
Gas heated	Heat content supplied to the project
On-site renewable thermal energy	Heat content supplied to the project

Informative Note: Metering of on-site renewable thermal energy, such as for solar water heating systems, will typically require measurement of input and output temperatures and, flow to determine the thermal energy.

((~~TABLE 12-1~~

~~ENERGY SOURCE METER THRESHOLDS~~

~~Energy Source~~	~~Main Metering Threshold~~
~~Electrical service~~	~~> 500 kVA~~
~~On-site renewable electric power~~	~~> 10 kVA (peak)~~
~~Gas and steam service~~	~~> 800 kBtu/h (1,000,000 Btu/h)~~
~~Geothermal~~	~~> 800 kW (2,000,000 Btu/h) heating~~
~~On-site renewable thermal energy~~	~~> 10 kW (30,000 Btu/h)~~

))

TABLE 12-2

COMPONENT ENERGY MASTER SUBMETERING THRESHOLDS

Component	Submetering Threshold
Chiller/heat pump systems	> 70 kW (240,000 Btu/h) cooling capacity
Packaged AC unit systems	> 70 kW (240,000 Btu/h) cooling capacity
HVAC fan systems	> 15 kW (20 hp)
Dedicated fan systems	> 15 kW (20 hp)
Make-up air fan systems	> 15 kW (20 hp)
Pump systems	> 15 kW (20 hp)
Cooling tower systems	> 15 kW (20 hp)
Boilers, furnaces and other heating equipment systems	> 200 kW (1,000,000 Btu/h) heating capacity

Component	Submetering Threshold
General lighting circuits	> 15 kVA
Miscellaneous electric loads	> 15 kVA

Section 12. The following sections or subsections of Chapter 13 of the 2009 Washington State Energy Code are amended, and new subsections are added, as follows:

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FIGURE 13A

BUILDING ENVELOPE COMPLIANCE OPTIONS

Section Number	Subject	Prescriptive Option	Component Performance Option	Systems Analysis Option
1310	General Requirements	X	X	X
1311	Insulation	X	X	X
1312	((Glazing))Fenestration and Doors	X	X	X
1313	Moisture Control	X	X	X
1314	Air Leakage	X	X	X
1320	Prescriptive Building Envelope Option	X		
1321	General	X		
1322	Opaque Envelope	X		
1323	((Glazing))Fenestration	X		
1330	Component Performance Building Envelope Option		X	
1331	General		X	
1332	Component U-Factors		X	
1333	UA Calculations		X	
1334	Solar Heat Gain Coefficient		X	
1335	Visible Transmittance		X	
RS-29	Systems Analysis			X

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1310.1 Conditioned Spaces: The building envelope for conditioned spaces shall also comply with one of the following paths:

a. Prescriptive Building Envelope Option Sections 1320 through 1323.

b. Component Performance Building Envelope Option Sections 1330 through ((1334)) 1335.

c. Systems Analysis. See Section 1141.3.

1310.3 Cold Storage and Refrigerated Spaces: Exterior and interior surfaces of frozen storage spaces or cold storage spaces in refrigerated warehouses may comply with either the prescriptive or component performance approach using insulation values in Table 13-3. The remainder of refrigerated warehouse area containing conditioned or semi-conditioned spaces shall comply by using either the prescriptive or component performance approach using Tables 13-1 and 13-2.

EXCEPTIONS:

1. Areas within refrigerated warehouses that are designed solely for the purpose of quick chilling or freezing of products with design cooling capacities of greater than 240 Btu/hr ft² (2 tons per 1000 ft²).

2. Controlled atmosphere storage rooms and partition wall insulation.

TABLE 13-3

REFRIGERATED WAREHOUSE INSULATION

SPACE	SURFACE	ASSEMBLY MAXIMUM U-FACTOR (Btu/h-ft²-°F)	INSULATION MINIMUM R-VALUE (h-ft²-°F/Btu)
Frozen Storage Spaces (0°F and below) and Cold Storage Spaces (32°F and below)	((Exterior)) Roof/Ceiling	U-0.027	R-38 ((R-36))
	((Exterior)) Wall	U-0.027	R-38 ((R-36))
	((Exterior)) Floor	U-0.027	R-28 ((R-36))
	((Interior Partition[1]))		((R-28))
((Cold Storage Spaces (32-45°F))	((~~Exterior Roof/Ceiling~~))		((R-28))
	((Exterior Wall))		((R-28))
	((Interior Partition[1]))		((R-19))

((Interior partitions including walls, floors, or ceiling that divides freezer or cooler space, or cold storage space from warm space, or cold storage space from each other, or utility and service spaces.))

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1311.5 Slab-On-Grade Floor: Slab-on-grade insulation shall be placed on the outside of the foundation or on the inside of the foundation wall. The insulation shall extend downward from the top of the slab for a minimum distance of 24 inches or downward to at least the bottom of the slab and then horizontally to the interior or exterior for the total distance of 24 inches. Above grade insulation shall be protected. A 2-inch by 2-inch (maximum) nailer may be placed at the finished floor elevation for attachment of interior finish materials. ((~~Slab-on-grade insulation installed inside the foundation wall shall extend downward from the top of the slab a minimum distance of 24 inches or to the top of the footing, whichever is less. Insulation installed outside the foundation shall extend downward a minimum of 24 inches or to the frost line, whichever is greater. Above grade insulation shall be protected.~~

~~EXCEPTION: For non-slab-on-grade floors, the insulation shall extend from the top of the slab to the bottom of the footing.~~))

1311.6 Radiant Floors (on or below grade): Slab-on-grade insulation shall extend downward from the top of the slab a minimum distance of 36 inches or downward to the top of the footing and horizontal for an aggregate of not less than 36 inches.

((If required by the building official where soil conditions warrant such insulation,)) The entire area of a radiant floor shall be thermally isolated from the soil. Where a soil gas control system is provided below the radiant floor, which results in increased convective flow below the radiant floor, the radiant floor shall be thermally isolated from the sub-floor gravel layer.

1312 ((Glazing))Fenestration and Doors

1312.1 Standard Procedure for Determination of ((Glazing))Fenestration and Door U-Factors: U-factors for ((glazing))fenestration and doors shall be determined, certified and labeled in accordance with Standard RS-31 by a certified independent agency licensed by the National Fenestration Rating Council (NFRC). Compliance shall be based on the ((~~Residential or the Noncontinental~~)) Model Size in Table 4-3 of RS-3 . Product samples used for U-factor determinations shall be production line units or representative of units as purchased by the consumer or contractor. Unlabeled ((glazing))fenestration and doors shall be assigned the default U-factor in Table 10-6.

1312.2 Solar Heat Gain Coefficient and ((Shading Coefficient))Visible Transmittance: Solar Heat Gain Coefficient (SHGC) and Visible Transmittance (VT), shall be determined, certified and labeled in accordance with the National Fenestration Rating Council (NFRC) Standard by a certified, independent agency, licensed by the NFRC.

EXCEPTIONS:

1. Shading coefficients (SC) or solar heat gain coefficient for the center of glass shall be an acceptable alternate for compliance with solar heat gain coefficient requirements. Shading coefficients or solar heat gain coefficient for the center of glass for glazing shall be taken from Chapter 15 of Standard RS-3 or from the manufacturer's (1-10) data using a spectral data file determined in accordance with NFRC 300.

2. For the purposes of 1322, exception 1, visible transmittance for the center of the glazing assembly shall be taken from Chapter 15 of Standard RS-3 or from the manufacturer's data using a spectral data file determined in accordance with NFRC 300.

3. For dynamic glazing, the minimum SHGC shall be used to demonstrate compliance with this section. Dynamic glazing shall be considered separately from other vertical fenestration, and area-weighted averaging with other vertical fenestration that is not dynamic glazing shall not be permitted.

Informative Note: Using the exception for the SHGC for the center of glass does not give the full credit for the overall product (including the frame) that the NFRC certified SHGC does. The center-the SHGC for the frame is zero (the ASHRAE Handbook of Fundamentals indicates that the SHGC can range from 0.11-0.13 for metal frames, and from 0.39 to 0.07 for wood/vinyl/fiberglass frames). The SHGC for the frame is always higher, sometimes much higher, than that for the glass. Consequently, an NFRC-certified SHGC will generally be lower.

Conversely, the VT for the center-of-glass normally exceeds the VT for the overall product (including the frame). The VT for the frame is zero. Consequently, an NFRC-certified VT will always be lower. For this reason, Exception 2 to Section 1312.2 is only applicable to Exception 1 in Section 1323. It is not applicable to other sections.

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1313.2 Roof/Ceiling Assemblies: Roof/ceiling assemblies where the ventilation space above the insulation is less than an average of 12 inches shall be provided with a vapor retarder. (For enclosed attics and enclosed rafter spaces, see Section 1203.2 of the ((International))Seattle Building Code.) Roof/ceiling assemblies without a vented airspace, allowed only where neither the roof deck nor the roof structure are made of wood, shall provide a continuous vapor retarder with taped seams.

EXCEPTIONS:

1. Vapor retarders need not be provided where all of the insulation is installed between the roof sheathing and the structural roof deck.

2. Unvented attic assemblies (spaces between the ceiling joists of the top story and the roof rafters) shall be permitted if all of the following conditions are met:

1. The unventilated attic space is completely contained within the building thermal envelope.
2. No interior vapor retarders are installed on the ceiling side (attic floor) of the unventilated attic assembly.
3. Where wood shingles or shakes are used, a minimum 4 inch (6 mm) vented air space separates the shingles or shakes and the roofing underlayment above the structural sheathing.
4. Any air-impermeable insulation shall be a vapor retarder, or shall have a vapor retarder coating or covering in direct contact with the underside of the insulation.
5. Either items a, b or c shall be met, depending on the air permeability of the insulation directly under the structural roof sheathing.
   a. Air-impermeable insulation only. Insulation shall be applied in direct contact to the underside of the structural roof sheathing.
   b. Air-permeable insulation only. In addition to the air-impermeable insulation installed directly below the sheathing, sheathing, rigid board or sheet insulation shall be installed directly above the structural roof sheathing as specified per WA Climate Zone for condensation control:
      i. Climate Zone 1: R-10 minimum rigid board or air-impermeable insulation R-value
      ii. Climate Zone 2: R-25 minimum rigid board or air-impermeable insulation R-value
   c. Air-impermeable and air-permeable insulation. The air-impermeable insulation shall be applied in direct contact to the underside of the structural roof sheathing as specified per WA Climate Zone for condensation control. The air-permeable insulation shall be installed directly under the air-impermeable insulation.
      i. Climate Zone 1: R-10 minimum rigid board or air-impermeable insulation R-value
      ii. Climate Zone 2: R-25 minimum rigid board or air-impermeable insulation R-value

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1314.2 ((Glazing))Fenestration and Doors: Air leakage for fenestration and doors shall be determined in accordance with NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440 or ASTM E283 as specified below. Air leakage shall be determined by a laboratory accredited by a nationally recognized accreditation organization, such as the National Fenestration Rating Council, and shall be labeled and certified by the manufacturer. Air leakage shall not exceed:

a. 1.0 cfm/ft^2 for glazed swinging entrance doors and revolving doors, tested at a pressure of at least 1.57 pounds per square foot (psf) in accordance with NFRC 400, AAMA/WDMA/CSA 101/I.S.2/A440, or ASTM E283,

b. 0.04 cfm/ft^2 for curtain wall and storefront ((glazing))fenestration, tested at a pressure of at least 1.57 pounds per square foot (psf) in accordance with NFRC 400, AAMA/WDMA/CSA 101/I.S.2/A110, or ASTM E283.

c. 0.2 cfm/ft^2 for all other products when tested at a pressure of at least 1.57 pounds per square foot (psf) in accordance with NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440, or 0.3 cfm/ft^2 when tested at a pressure of at least 6.24 pounds per square foot (psf) in accordance with AAMA/WDMA/CSA 101/I.S/A440.

EXCEPTIONS:

1. Operable doors that are required to be fire resistant.
2. Field-fabricated fenestration and doors that are weatherstripped or sealed in accordance with Section 1314.1.
   A field-fabricated fenestration product is a fenestration product installed in a glazed exterior door where material is added at the construction site to standard dimensional lumber or other materials that were not previously cut or otherwise formed with the specific intention of forming used to fabricate a fenestration product or exterior door. Field-fabricated does not include curtain walls.
3. Fire garage doors, air leakage determined by test at standard test conditions in accordance with ANSI/DASMA 10 shall be an acceptable alternate for compliance with air leakage requirements.
4. Units without air leakage ratings provided they shall be weatherstripped or sealed in accordance with Section 1314.1.

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1314.6 Continuous Air Barrier: For all buildings ((over five stories)), the building envelope shall be designed and constructed with a continuous air barrier to control air leakage into, or out of, the conditioned space. All air barrier components of each envelope assembly shall be clearly identified on construction documents and the joints, interconnections and penetrations of the air barrier components shall be detailed.

Construction documents shall also contain a diagram showing the building's pressure boundary in plan(s) and section(s) and a calculation of the area of the pressure boundary to be considered in the test.

Informative Note: As stated above, the continuous air barrier is intended to control the air leakage into and out of the conditioned space. The definition of conditioned space includes semiheated spaces and indirectly conditioned spaces, so these spaces are included when creating the continuous air barrier and when determining the pressure boundary for conducting the air leakage test. However, unheated spaces are not included when determining the pressure boundary.

The air leakage test is done using calibrated fans. The amount of airflow in cfm (as adjusted for temperature and pressure) at 75 Pa (0.3" w.g.) measured during the test is divided by the area of the building envelope (the pressure boundary) included in the test. Multiplying that building envelope area by 0.4 cfm will provide an indication of how many cfm are needed to perform the test (how many fans or fan capacity).

1314.6.1 Characteristics: The continuous air barrier shall have the following characteristics:

a. The air barrier component of each assembly shall be joined and sealed in a flexible manner to the air barrier component of adjacent assemblies, allowing for the relative movement of these assemblies and components. This requirement shall not be construed to restrict the materials or methods by which the air barrier is achieved.

b. It shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on the air barrier without damage or displacement, and shall transfer the load to the structure. It shall not displace adjacent materials under full load.

c. It shall be installed in accordance with the manufacturer's instructions and in such a manner as to achieve the performance requirements.

1314.6.2 Compliance: Compliance of the continuous air barrier for the ((space)) building envelope shall be demonstrated by testing the completed building and demonstrating that the upper 95% confidence interval for the air leakage rate of the building envelope does not exceed 0.40 cfm/ft^2 at a pressure differential of 0.3 inch w.g. (1.57 psf) as specified below.

a. Whole building testing shall be accomplished in accordance with ASTM E 779 or approved similar test. Tests shall be accomplished using either (1) both pressurization and depressurization or (2) pressurization alone, but not depressurization alone((or depressurization or both)). The building shall not be tested unless it is verified that the continuous air barrier is in place and installed without failures in accordance with installation instructions so that repairs to the continuous air barrier, if needed to comply with the required air leakage rate, can be done in a timely manner. Following are comments referring to ASTM E 779:

b. Under ASTM E 779 it is permissible to test using the building's HVAC system. In buildings with multistory HVAC systems and shafts it is permissible to test using the building's mechanical system using CAN/CGSB-149.15-96 Determination of the Overall Envelope Airtightness of Buildings by the Fan Pressurization Method Using the Building's Air Handling Systems, Canadian General Standards Board, Ottawa.

c. ((In lieu of the fan pressurization method described in ASTM E 779, a tracer gas test of the building air change rate in accordance with ASTM E 741 is also allowed. The tracer gas test shall be run with building HVAC fans off.)) Reserved.

d. Section 8.1 - For purposes of this test, a multizone building shall be configured as a single zone by opening all interior doors, and otherwise connecting the interior spaces as much as possible. It is also allowed to test a smaller section of the building, provided the test area can be isolated from neighboring conditioned zones by balancing the pressure in adjacent conditioned zones to that in the zone being tested. This can be very difficult to do in buildings with multistory shafts and HVAC systems. If a smaller section of the building is tested, provide a drawing showing the zone(s) tested, the pressure boundaries and a diagram of the testing equipment configuration.

e. Section 8.2 - Seal all intentional functional openings such as exhaust and relief louvers, grilles and dryer vents that are not used in the test to introduce air, using plastic sheeting and duct tape or similar materials. All plumbing traps shall be filled with water.

f. Section 8.10 - The test pressure range shall be from ((40)) 25 Pa to 80 Pa((, If approved by the building official, lower test pressures are acceptable)), but the upper limit shall not be less than 50 Pa, and the difference between the upper and lower limit shall not be less than 25 Pa.

g. Section 9.4 - If both pressurization and depressurization are not tested, plot the air leakage against the corrected P for ((either)) pressurization((, or depressurization)).

h. Section 9.6.4 - If the pressure exponent n is less than ((0.5)) 0.45 or greater than ((1)) 0.85, ((corrective work shall be performed on the continuous air barrier and)) the test shall be rerun with additional readings over a longer time interval.

i. Section 10.4 - Report the air leakage rate normalized in cfm/ft^2 at 0.3 inch w.g. (1.57 psf) over the total area of the building envelope air pressure boundary including the lowest floor, any below-grade walls, above-grade walls, and roof (or ceiling) (including windows and skylights) separating the interior conditioned space from the unconditioned environment.

Informative Note: Those familiar with building air leakage testing indicate that there are three critical areas:

- the junctions at the top of the building between interior and exterior walls and the roof;
- the wall areas around the perimeter of the windows (not the windows themselves); and
- brackets and other penetrations used to support exterior features such as awnings and canopies.

For buildings with excessive air leakage, there is a methodology to help pinpoint air leakage pathways: ASTM E 1186-03 Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems.

1314.6.3 Certificate of Occupancy: A final certificate of occupancy shall not be issued for the building, or portion thereof, until such time that the building official determines that the project complies with one of the following:

a. Option 1:
   i. the continuous air barrier has been inspected by a qualified person (such as the designer or a building commissioning agent) who is not associated with the construction company and an inspection report by that person has been submitted to the building official; and
   ii. the building, or portion thereof, has been field tested in accordance with Section 1314.6.2, and the test report for the whole building air leakage testing in accordance with Section 1314.6.2 is provided to DPD and filed with the inspection record for the project.

Informative Note: Option 1 does not require that testing achieve 0.40 cfm/ft^2. The requirement is that the testing be executed in accordance with Section 1314.6.2.

b. Option 2:
   i. the building, or portion thereof, has been field tested in accordance with Section 1314.6.2 and the building air leakage does not exceed that allowed in Section 1314.6.2.

Informative Note: As of 2009, the U.S. Army Corps of Engineers limits air leakage in its facilities to 0.25 cfm/ft^2 for mold prevention and so as to reduce energy use in accordance with the 2005 U.S. Energy Policy Act. Tested buildings have been in the range of 0.15-0.25 cfm/ft^2. Field experience is that few buildings have been tested and required to meet these requirements when buildings are designed and constructed with attention to details.

For further information on comparisons of building envelope air leakage standards and test procedures, see "U.S. Army Corps of Engineers Air Leakage Protocol for Measuring Air Leakage in Buildings", "Controlling Air Leakage in Tall Buildings" by Cody Coryea, ASHRAE Journal, April 2009, pages 50-60, and "Protocol for Field Testing of Tall Buildings to Determine Envelope Air Leakage Rate" by William Babcock, Grenville Pratt, and Brian Lee, ASHRAE Transactions, 1999, V. 105, Pt. 2.

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1314.7 Vestibules. Building entrances that separate conditioned space from the exterior shall be enclosed vestibules, with all doors opening into and out of the vestibule equipped with self-closing devices. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior doors to open at the same time. Interior and exterior doors shall have a minimum distance between them of not less than 7 ft and a maximum distance of not more than 20 ft when in the closed position. The exterior envelope of conditioned vestibules shall comply with the requirements for a conditioned space. Either the interior or exterior envelope of unconditioned vestibules shall comply with the requirements for a conditioned space. The building lobby is not considered a vestibule.

EXCEPTIONS:

1. Building entrances with revolving doors.
2. Doors not intended to be used as a building entrance.
3. Building entrances in buildings that are less than four stories above grade and less than 10,000 ft^2 in area.
4. Doors that open directly from a space that is less than 3,000 ft^2 in area and is separate from the building entrance.
5. Entrances to semi-heated spaces.
6. Elevator doors in parking garages, provided that the elevator lobby on each level of the garage is

Informative Note: Building entrances are defined as the doors customarily used to gain access to the building, so this does not include the doors/entrances/access doors that might be adjacent to a revolving door.

Doors other than for building entrances, such as those leading to service areas, mechanical rooms, electrical equipment rooms, or exits from fire stairways, are not covered by this requirement. There is less traffic through these doors and the vestibule may limit access for large equipment.

Fire-rated lobbies in parking garages also serve to reduce the flow of vehicle exhaust into the building.

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1321 General: This section establishes building envelope design criteria in terms of prescribed requirements for building construction. Compliance shall be calculated separately for the building envelope for nonresidential spaces and for residential spaces.

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1322 Opaque Envelope: Roof/ceilings, opaque exterior walls, opaque doors, floors over unconditioned space, below-grade walls, slab-on-grade floors and radiant floors enclosing conditioned spaces shall be insulated according to Section 1311 and Tables 13-1 or 13-2. Compliance with nominal R-values shall be demonstrated for the thermal resistance of the added insulation in framing cavities and/or insulated sheathing only. Nominal R-values shall not include the thermal transmittance of other building materials or air films.

For walls where the proposed assembly would not be continuous insulation, Table 13-1 contains two alternate nominal R-value compliance options for assemblies with isolated metal penetrations of otherwise continuous insulation. These alternate nominal R-value compliance options are allowed for projects complying with all of the following:

a. The ratio of the cross-sectional area, as measured on the plane of the wall, of metal penetrations of otherwise continuous insulation to the overall opaque wall area is:
   i. less than 0.0004 (less than 0.04%),
   ii. less than 0.0008 (less than 0.08%).
b. The metal penetrations of otherwise continuous insulation are isolated or discontinuous (e.g. brick ties or other discontinuous metal attachments, offset brackets supporting shelf angles that allow insulation to go between the shelf angle and the primary portions of the wall structure). No continuous metal elements (e.g. metal studs, z-girts, z-channels, shelf angles) penetrate the otherwise continuous portion of the insulation.
c. Every wall assembly shall comply with the alternate nominal R-value compliance option, regardless of where the metal penetrations are located. All wall assemblies (e.g. mass, steel-framed, wood-framed) shall comply with the option in Table 13-1 corresponding to the gross-sectional area of metal penetrations as a percentage of the overall opaque wall area.
d. Building permit drawings shall contain details showing the locations and dimensions of all the metal penetrations (e.g. brick ties or other discontinuous metal attachments, offset brackets, etc.) of otherwise continuous insulation. In addition, calculations shall be provided showing the ratio of the cross-sectional area of metal penetrations of otherwise continuous insulation to the overall opaque wall area.

For other cases where the proposed assembly is not continuous insulation, see Section 1332 for determination of U-factors for assemblies that include metal other than screws and nails.

For the U-factor compliance for all envelope components, including metal frame assemblies (used in spaces with electric resistance space heat), compliance shall be demonstrated with the component U-factor for the overall assembly based on the assemblies in Chapter 16.

Area-weighted averaging of the R-value is not allowed. When showing compliance with R-values, the minimum insulation R-value for all areas of the component shall comply with Tables 13-1 and 13-2. When calculating compliance using U-factors, area-weighted averaging is allowed. Where insulation is tapered (e.g. roofs), separate assembly U-factors shall be calculated for each four foot section of tapered insulation.

EXCEPTIONS:

1. Opaque smoke vents are not required to meet insulation requirements.
2. For roofs with rigid continuous insulation on the top of the roof, the insulation R-value may be averaged for compliance with minimum prescriptive R-values only, provided that both:
   a. The minimum insulation is no less than R-28ci but not including, area within 6 inches of each roof drain), and
   b. The area-weighted average insulation is R-60 (in lieu of R-38).

Informative Note: For the application of the building envelope requirements to elevator shafts and stair enclosures, see the definition of Indirectly conditioned space in Chapter 2.

Informative Note: For the definition of continuous insulation, see Chapter 2.

The alternate nominal R-value compliance options provided in Section 1322 and the default U-factors in Chapter 10-5A(1) for assemblies with isolated metal penetrations are intended to offer several simple prescriptive choices in lieu of the complicated calculations required to determine the U-factors of assemblies with metal framing.

While specific calculations need to be done for each project, previous calculations have found the following approximate metal penetration percentages:

Brick ties alone (that penetrate otherwise continuous insulation) may well have a metal penetration area ratio of 0.0002 (0.02% of the overall opaque wall area).

Offset brackets alone (that penetrate otherwise continuous insulation) that project out to support a shelf angle (so that the shelf angle does not penetrate otherwise continuous insulation and the insulation can run between the shelf angle and the structure) could have a metal penetration area ratio of 0.0003 (0.03% of the overall opaque wall area).

When added together, the total metal penetration area ratio of otherwise continuous insulation for a design with only these two metal penetration types is likely to be within the range where it could qualify for use of the alternate nominal R-value compliance options.

On the other hand, shelf angles alone (such as those used to support brick veneer when attached directly to the structure without offset brackets (thereby resulting in the shelf angle penetrating otherwise continuous insulation), such as the rectangular plate of an reinforced concrete floor slab, are likely to have a metal penetration area ratio in the 0.20% range. Consequently, shelf angles will always need to be mounted on offset brackets that allow insulation to go between the shelf angle and the primary portions of the wall structure in order to qualify to use any of the alternate nominal R-value compliance options.

As the overall opaque wall area in the form of metal penetrations in every wall assembly not complying with the alternate nominal R-value compliance option, regardless of where the metal penetrations are located. Thus, even if the offset brackets attached to the mass wall areas were the only metal penetrations (which penetrate otherwise continuous insulation), the infill steel-framed wall or wood-framed wall assemblies would still need to comply with their calculation requirements in the alternate nominal R-value compliance option as the areas of these infill walls were included in the calculation of the metal penetration area ratio.

There also are additional fin effects where the metal connects the surfaces on the outside of the insulation, such as a brick façade, that have not been considered. Metal cladding would certainly further degrade the effective insulation R-value.

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1323 Fenestration ((Glazing)). The intent is that fenestration in building facades be designed for daylighting and vary by orientation to respond to external climatic loads. Fenestration ((Glazing)) shall comply with Section 1312 and Tables 13-1 or 13-2. All glazing shall be, at a minimum, double glazing. In addition, all glazing assemblies shall have at least one low-emissivity coating unless the fenestration((glazing)) assembly has an overall U-factor that complies with the values in Tables 13-1 or 13-2.

EXCEPTIONS:

1. Vertical fenestration ((shaded)) located on the display side of the street level story of a retail occupancy or where there is a street level transparency requirement in the Seattle Land Use Code or in parking lot attendant booths with a gross floor area not exceeding 50 square feet, provided in each case that the fenestration ((glazing))

   a. (i) is double glazed with a minimum 1/2 inch airspace and with a low-e coating having a maximum emittance of e=0.10 in a nominal U frame or a metal frame having a thermal break (as defined in footnote 3 to Table 13-6B); or

      (ii) has an area weighted U-factor of 0.50 or less, except that revolving doors and vestibules are allowed to have an area-weighted U-factor of 0.65 or less.

      (U-factor calculations shall use overall assembly U-factors. When this exception is used, there are no SHGC requirements), and

   b. has:

      (i) a visible transmittance for the overall fenestration assembly including the frame of 0.42, or

      (ii) a visible transmittance, determined according to Section 1512.2, Exception 2, for the center of the glazing assembly of 0.48, and

   c. does not exceed 75 % of the gross exterior wall area of the display side of the street level story measured from the top of the finished floor at street level. However, if the display side of the street level story exceeds 20 feet in height, then this exception may only be used for the first 20 feet of that story.

When this exception is utilized, separate calculations shall be performed for these portions of the building envelope and these values shall not be averaged with any others for compliance purposes. The 75% area may be increased on the street level if the additional glass area is provided from allowances from other areas of the building.

2. Entrances with single ((glazing)) glazing for security purposes and in vestibules and revolving doors shall be included in the percentage of the total ((glazing)) fenestration area, U-factor, calculations and SHGC as allowed in the Tables 13-1 or 13-2. The maximum area allowed for the total of all fenestration with single glazing is 1% of the gross exterior wall area.

1323.1 Area: The percentage of total fenestration area (vertical fenestration and skylights) ((glazing (vertical and overhead) area)) relative to the gross exterior wall area shall not be greater than the appropriate value from Tables 13-1 or 13-2 for the vertical fenestration ((glazing)) U-factor, ((overhead glazing))skylight U-factor, ((and)) vertical fenestration solar heat gain coefficient, skylight solar heat gain coefficient, and, where applicable, vertical fenestration visible transmittance selected. For buildings with below-grade wall area, the gross wall area used to calculate the allowable fenestration area shall not include the portion of below-grade walls that is more than 10 feet below grade.

1323.2 U-Factor: The area-weighted average U-factor of vertical fenestration ((glazing)) shall not be greater than that specified in Tables 13-1 or 13-2 for the appropriate area and solar heat gain coefficient and, where applicable, visible transmittance. The area-weighted average U-factor of skylights((overhead glazing)) shall not be greater than that specified in Tables 13-1 or 13-2 for the appropriate area and solar heat gain coefficient. U-factors for ((glazing)) fenestration shall be determined in accordance with Section 1312.

1323.3 Solar Heat Gain Coefficient: The area-weighted average solar heat gain coefficient of ((glazing)) fenestration shall be calculated separately for vertical fenestration and for skylights and shall not be greater than that specified in Tables 13-1 or 13-2 for the appropriate area and U-factor and, where applicable, visible transmittance.

EXCEPTIONS:

1. Fenestration ((Glazing)) separating conditioned space from semi-heated space or unconditioned space.

2. Vertical fenestration with a north orientation (((glazing which is oriented within 45 degrees of north))) shall be allowed to have a maximum solar heat gain coefficient (SHGC) 0.05 above that required in Tables 13-1 or 13-2. When this exception is utilized, separate calculations shall be performed for the vertical fenestration and those values shall not be averaged with any others for compliance purposes.

3. For demonstrating compliance for vertical fenestration ((glazing)) for the first SHGC option in Tables 13-1 and 13-2 only, the SHGC in the proposed building shall be allowed to be reduced by using the multipliers in the table below for each fenestration ((glazing)) product shaded by permanent projections that will last as long as the building itself. Permanent projections separating air conditioned from unconditioned spaces shall be considered to provide shading provided during peak summer conditions the louvers during the peak summer conditions on June 21. For demonstrating compliance for vertical fenestration shaded by partially opaque permanent projections (e.g., framing with glass or translucent panels) that will last as long as the building itself, the PF shall be reduced by multiplying it by a factor that accounts for the solar transmittance.

Projection Factor	SHGC Multiplier (All Orientations except Northeast-Northwest)	SHGC Multiplier (Northeast-Northwest)
0 - 0.19	1.00	1.00
>0.19 - 0.20	0.91	0.95
>0.20 - 0.30	0.82	0.91
>0.30 - 0.40	0.74	0.87
>0.40 - 0.50	0.67	0.84
>0.50 - 0.60	0.61	0.8
>0.60 - 0.70	0.56	0.78
>0.70 - 0.80	0.51	0.76
>0.80 - 0.90	0.47	0.75
>0.90 - 1.00	0.44	0.73

Projection factor (PF) is the ratio of the horizontal depth of the external shading projection (A) divided by the sum of the height of the fenestration and the distance from the top of the fenestration to the bottom of the farthest point of the external shading projection (B), in same units. (See Figure 13D.)

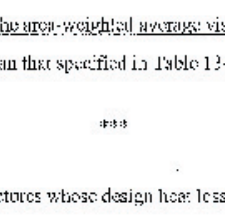

Figure 13D

Informative Note: The projection factor multiplier is used to adjust the SHGC in the proposed design for purposes of Exception 3 above. The SHGC criteria in Table 13-1 do not change.

For example, for a building with a 27% fenestration area, the SHGC required in Table 13-1 for vertical fenestration is SHGC=0.50 maximum.

As a simple example, if the proposed building had vertical fenestration only on the south side of the building, and if the fenestration had an NFRC certified SHGC=0.65, then the fenestration alone would not comply with the maximum SHGC criteria for vertical fenestration. However, if there were an overhang projecting out over the vertical fenestration a distance A of two feet, and the vertical height from the bottom of the window to the bottom of the projection overhang were a distance B of six feet, then the projection factor (PF) would be = A/B = 2.0/6.0 = 0.33.

From the table to Exception 3 above, the multiplier is 0.74 for a 0.50 PF for south oriented windows. For compliance purposes, SHGC 0.65 x 0.74 multiplier = 0.50 allowable SHGC. Therefore, if a vertical fenestration overhang is provided with a PF of 0.33 or greater, the proposed design complies with the SHGC criteria provided this overhang is installed.

Note that for most projects, use of this exception is more complicated. Calculations must be done separately for each window with a different SHGC and with a different overhang A or different height B that changes the projection factor, and for each orientation as north-oriented fenestration has a different multiplier.

1323.4 Visible Transmittance: The area-weighted average visible transmittance of all vertical fenestration shall not be greater than that specified in Table 13-1 for the appropriate area.

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1331 General: Buildings or structures whose design heat loss rate (UA_p) and solar heat gain coefficient rate (SHGC * A_p) are less than or equal to the target heat loss rate (UA_t) and solar heat gain coefficient rate (SHGC * A_t) shall be considered in compliance with this section. The stated U-factor, F-factor or allowable area of any component assembly, listed in Tables 13-1 or 13-2, such as roof/ceiling, opaque wall, opaque door, vertical fenestration, skylight ((glazing)), floor over conditioned space, slab-on-grade floor, radiant floor or opaque floor may be increased and the U-factor or F-factor for other components decreased, provided that the total heat gain or loss for the entire building envelope does not exceed the total resulting from compliance to the U-factors, F-factors or allowable areas specified in this section. Compliance shall be calculated separately for the building envelope for nonresidential spaces and for residential spaces.

EXCEPTIONS:

1. Compliance is also allowed to be shown using Res 22 for Climate Zone 1 except

   a. for buildings using footnote 2 to Table 13-1 ((nonsingle-ply roofs, wood framed walls or vertical fenestration with nonmetal frames or)) and

   b. for Group R occupancies.

2. The prescriptive approach in Section 1323 may be used for that portion of the building envelope that complies with exception 1 in Section 1325.

1332 Component U-factors. The U-factors for typical construction assemblies are included in Chapter 10. These values shall be used for all calculations. Where proposed construction assemblies are not represented in Chapter 10, values shall be calculated in accordance with Chapters 16 through 18 and 25 through 27 in Standard RS-1 listed in Chapter 7, using the framing factors listed in Chapter 10.

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

1. Results of laboratory measurements according to acceptable methods of test.
2. Standard RS-1, listed in Chapter 7, where the metal framing is bonded on one or both sides to a metal skin or covering.
3. The zone method as provided in Chapter 27 of Standard RS-1, listed in Chapter 7.
4. Effective framing/cavity R-values as provided in Table 10-5A(2).
5. Mass wall assemblies having exterior insulation with isolated metal penetrations (such as offset brackets supporting shelf angles that allow insulation to go between the shelf angle and the primary portions of the mass wall structure) where the ratio of the gross-sectional area of metal penetrations of otherwise continuous insulation to the mass wall area only is less than 0.0004 (less than 0.04% of the mass wall area only), it is acceptable to use the U-factors shown in Table 10-5B(3) for assemblies with 1 inch metal clips at 24 inches on center horizontally and 16 inches on center vertically. When this option is used, building permit drawings shall contain a detail showing the offset bracket with the insulation passing between the shelf angle and the primary portions of the mass wall structure. In addition, calculations shall be provided showing the ratio of the gross-sectional area of metal penetrations to the mass wall area.

When 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.

Informative Note: For further information about compliance for assemblies with isolated metal penetrations, see Section 1322 and the default U-factors in Table 10-5A(3).

1333 UA Calculations: The target UA_t and the proposed UA_p shall be calculated using Equations 13-1 and 13-2 and the corresponding areas and U-factors from Table 13-1 or 13-2. For the target UA_t calculation, the ((overhead glazing))skylights shall be located in roof/ceiling area and the remainder of the ((glazing))fenestration allowed per Table 13-1 or 13-2 shall be located in the wall area. Where insulation is tapered, separate assembly U-factors shall be calculated in accordance with Section 1322. (See also the criteria in Section 1331.)

Informative Note: For the application of the building envelope requirements to elevator shafts and stair enclosures, see the definition of the term conditioned space in Chapter 2.

Procedural Requirement: The plans shall contain a fenestration and opaque door schedule.

The fenestration schedule shall include all vertical fenestration and skylights (curtain walls, windows, sliding and swinging glass doors and glazed roll up doors, glass block, plastic panels, clerestories, solariums, etc.), as well as all opaque doors (swinging metal access doors, roll-up warehouse doors, etc.).

For all projects, the fenestration and opaque door schedule shall include the manufacturer and model number for all products regardless of U-factor.

The fenestration and opaque door schedules shall include the product type, size, number of each type, the U-factor and whether the U-factor is NFRC-certified or default.

If the product is claimed to be NFRC-certified, the NFRC Certified Products Directory (CPD) number shall be provided. A simulation report is not acceptable as this does not demonstrate that the product complies with the NFRC rating, labeling, and certification program. Also, a specification sheet that states "determined in accordance with NFRC 100" does not suffice.

For site-built fenestration products (as defined by NFRC 100 ONLY, at the time of building permit application, it is acceptable to provide simulation reports from an NFRC accredited simulation laboratory for each product type that is to be installed in the project. The manufacturer must include the specific frame profiles, glazing options, grids, sills, spacers, etc. that are proposed to be installed in the building. However, the NFRC Label Certificate is required to be provided to the building inspector at the construction site. (AAMA 507 reports, thermal performance matrices, and certificates of compliance are not acceptable.)

If a default U-factor from Chapter 10 is used for unrated products in lieu of NFRC certification, the fenestration and opaque door schedule shall include a description of the key energy efficiency features that are necessary to achieve the listed U-factor (i.e., for curtainwalls, whether the fenestration product is fixed or operable, frame material type, thermal break description, number of glazing layers, emissivity of low-e coatings, gap width, gas fill, spacer, type, etc.).

For fenestration in nonresidential spaces, the fenestration schedule shall also include the solar heat gain coefficient for each product and, where applicable, visible transmittance.

1334 Solar Heat Gain Coefficient Rate Calculations: Solar heat gain coefficient shall comply with Section 1323.3. The target $SHGCA_t$ and the proposed $SHGCA_p$ shall be calculated using Equation 13-3 and 13-4 and the corresponding areas and SHGCs from Table 13-1 or 13-2. The target SHGC is the SHGC from Table 13-1 without the projection factor.

1335 Visible Transmittance Calculations:

Visible transmittance rate shall comply with Section 1323.4. The target VTA_t and the proposed VTA_p shall be calculated using Equations 13-5 and 13-6 and the corresponding areas and VTs from Table 13-1.

Informative Note: There is no visible transmittance requirement or calculations required to show code compliance when the proposed total fenestration (vertical and overhead) area relative to the gross exterior wall area is in the 0-30% category of Table 13-1.

EQUATION 13-1

Target UA_t

$UA_t = U_{rmt}A_{rmt} + U_{rst}A_{rst} + U_{mt}A_{mt} + U_{gt}A_{gt} + U_{ovgt}A_{ovgt} + U_{ovgtA}A_{ovgtA} + U_{ovgtB}A_{ovgtB} + U_{ovgtC}A_{ovgtC} + U_{ovgtD}A_{ovgtD} + U_{wmt}A_{wmt} + U_{wst}A_{wst} + U_{mtw}A_{mtw} + U_{wgt}A_{wgt} + U_{wdt}A_{wdt} + U_{wtA}A_{wtA} + U_{wtB}A_{wtB} + U_{wtC}A_{wtC} + U_{wtD}A_{wtD} + F_tP_t + U_{sdt}I_{sdt}$

Where:

UA_t = The target combined specific heat transfer of the gross roof/ceiling assembly, exterior wall and floor area.

U_{rmt} = The thermal transmittance value for roofs with the insulation entirely above deck found in Table 13-1 or 13-2.

U_{rst} = The thermal transmittance value for metal building roofs found in Table 13-1 or 13-2.

U_{mt} = The thermal transmittance value for single rafter roofs found in Table 13-1 or 13-2.

U_{gt} = The thermal transmittance value for attic and other roofs found in Table 13-1 or 13-2.

U_{ovgtA}, = The thermal transmittance for ((overhead glazing))skylights with curb found in Table 13-1 or 13-2 which corresponds to the proposed total ((glazing))fenestration area as a percent of gross exterior wall area.

U_{ovgtB} = The thermal transmittance for ((overhead glazing))skylights without curb found in Table 13-1 or 13-2 which corresponds to the proposed total ((glazing))fenestration area as a percent of gross exterior wall area.

U_{wmt} = The thermal transmittance value for opaque mass walls found in Table 13-1 or 13-2.

U_{mtw} = The thermal transmittance value for opaque metal building walls found in Table 13-1 or 13-2.

U_{wst} = The thermal transmittance value for opaque steel framed walls found in Table 13-1 or 13-2.

U_{wdt} = The thermal transmittance value for opaque wood framed and other walls found in Table 13-1 or 13-2.

U_{wp} = The thermal transmittance value for vertical fenestration((glazing)) with nonmetal framing found in Table 13-1 or 13-2 which corresponds to the proposed total ((glazing))fenestration area as a percent of gross exterior wall area.

U_{wpmt} = The thermal transmittance value for vertical fenestration((glazing)) with metal framing found in Table 13-1 or 13-2 which corresponds to the proposed total ((glazing))fenestration area as a percent of gross exterior wall area.

U_{wdr} = The thermal transmittance value for entrance doors found in Table 13-1 or 13-2 which corresponds to the proposed total ((glazing))fenestration area as a percent of gross exterior wall area.

U_{dt} = The thermal transmittance value for opaque doors found in Table 13-1 or 13-2.

U_{mt} = The thermal transmittance value for mass floors over unconditioned space found in Table 13-1 or 13-2.

U_{ft} = The thermal transmittance value for steel joist floors over unconditioned space found in Table 13-1 or 13-2.

U_{ft} = The thermal transmittance value for wood framed or other floors over unconditioned space found in Table 13-1 or 13-2.

F_t = The F-factor for slab-on-grade floors found in Table 13-1 or 13-2.

F_{rt} = The F-factor for radiant slab floors found in Table 13-1 or 13-2.

A_{rt} = The proposed opaque roof area, A_r.

A_{mt} = The proposed mass floor over unconditioned space area, A_m.

A_{ft} = The proposed steel joist floor over unconditioned space area, A_f.

A_t = The proposed wood framed and other floor over unconditioned space area, A_t.

P_t = The proposed ((linear)) lineal feet of slab-on-grade floor perimeter, P_t.

P_{rt} = The proposed ((linear)) lineal feet of radiant slab floor perimeter, P_{rt}.

and;

If the total amount of ((glazing))fenestration area as a percent of gross exterior wall area does not exceed the maximum allowed in Table 13-1 or 13-2:

A_{rmt} = The proposed roof area with insulation entirely above deck, A_{rm}.

A_{rst} = The proposed roof area for metal buildings, A_{rm}.

A_{mt} = The proposed single rafter roof area, A_m.

A_{gt} = The proposed attic and other roof area, A_g.

A_{ovgtA} = The proposed ((overhead glazing))skylights area with curbs, A_{ovg}.

A_{ovgtB} = The proposed ((overhead glazing))skylight area without curbs, A_{ovg}.

A_{wmt} = The proposed opaque mass wall area, A_{wm}.

A_{mtw} = The proposed opaque metal building wall area, A_{mtw}.

A_{wst} = The proposed opaque steel framed wall area, A_{ws}.

A_{wdt} = The proposed opaque wood framed and other wall area, A_w.

A_{gn} – The proposed vertical ~~(glazing)~~fenestration area with nonmetal framing, A_{gn}

A_{gm} – The proposed vertical ~~(glazing)~~fenestration area with metal framing, A_{gm}

A_{gpd} – The proposed entrance door area, A_{gpd}

or;

If the total amount of ~~(glazing)~~fenestration area as a percent of gross exterior wall area exceeds the maximum allowed in Table 13-1 or 13-2, the area of each fenestration element shall be reduced in the base envelope design by the same percentage and the net area of each wall type adjusted proportionately by the same percentage so that the total ~~(overhead)~~sky light and vertical fenestration area is exactly equal to the maximum gross wall area allowed in Table 13-1 or 13-2.

EQUATION 13-2

Proposed UA_p

UA_p – $U_{rn}A_{rn} + U_{rm}A_{rm} + U_{rs}A_{rs} - U_{rn}A_{rn} - U_{wn}A_{wn} + U_{cw}A_{cw} - U_{mw}A_{mw} - U_{mbw}A_{mbw} + U_{stw}A_{stw} - U_{wbw}A_{wbw} - U_dA_d + U_{sg}A_{sg} + U_{cgl}A_{cgl} + U_{dn}A_{dn} - U_{fl}A_{fl} - U_{rsc}A_{rsc} + F_2P_2 + F_3P_3$.

Where:

UA_p – The combined proposed specific heat transfer of the gross exterior wall, floor and roof/ceiling assembly area

U_{rsd} – The thermal transmittance of the roof area where the insulation is entirely above roof deck.

A_{rsd} – Opaque roof area where the insulation is entirely above roof deck,

U_{rm} – The thermal transmittance of the metal building roof area,

A_{rm} – Opaque metal building roof area,

U_{rs} – The thermal transmittance of the single rafter roof area.

A_{rs} – Opaque single rafter roof area.

U_{rn} – The thermal transmittance of the roof over attic and other roof area.

A_{rn} – Opaque roof over attic and other roof area.

U_{sgl} – The thermal transmittance for the ~~(overhead glazing)~~skylights with curbs.

A_{sgl} – ~~(Overhead glazing)~~Skylights area with curbs.

U_{sn} – The thermal transmittance for the ~~(overhead glazing)~~skylights without curbs.

A_{sn} – ~~(Overhead glazing)~~Skylights area without curbs.

U_{mw} – The thermal transmittance of the opaque mass wall area.

A_{mw} – Opaque mass wall area (not including opaque doors).

U_{mbw} – The thermal transmittance of the opaque metal building wall area.

A_{mbw} – Opaque metal building wall area (not including opaque doors).

U_{stw} – The thermal transmittance of the opaque steel framed wall area.

A_{stw} – Opaque steel framed wall area (not including opaque doors).

U_{wbw} – The thermal transmittance of the opaque wood framed and other wall areas.

A_{wbw} – Opaque wood framed and other wall area (not including opaque doors).

U_g – The thermal transmittance of the vertical ~~(glazing)~~fenestration area with nonmetal framing

A_g – Vertical ~~(glazing)~~fenestration area with nonmetal framing.

U_{gmf} – The thermal transmittance of the vertical ~~(glazing)~~fenestration area with metal framing.

A_{gmf} – Vertical ~~(glazing)~~fenestration area with metal framing.

U_{gpd} – The thermal transmittance of the vertical ~~(glazing)~~fenestration area for entrance doors.

A_{gpd} – Vertical ~~(glazing)~~fenestration area for entrance doors.

U_f – The thermal transmittance value of the opaque door area

A_d – Opaque door area.

U_{fm} – The thermal transmittance of the mass floor over unconditioned space area.

A_{fm} – Mass floor area over unconditioned space.

U_{fs} – The thermal transmittance of the steel joist floor over unconditioned space area.

A_{fs} – Steel joist floor area over unconditioned space.

U_{fw} – The thermal transmittance of the wood framed and other floor over unconditioned space area.

A_{fw} – Wood framed and other floor area over unconditioned space.

U_s – Slab-on-grade floor component U-factor.

P_2 – ~~((Linear))~~ Lineal feet of slab-on-grade floor perimeter.

F_2 – Radiant floor component F-factor.

P_3 – ~~((Linear))~~ Lineal feet of unheated perimeter.

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

$U_{mw1}A_{mw1} + U_{mw2}A_{mw2} - U_{mw3}A_{mw3} - ...$etc.

EQUATION 13-3

Target $SHGCA_t$

$SHGCA_t$ – $SHGC_t(A_{gpd} + A_{gmf} + A_{gn} + A_{sgl} + A_{sn})$

~~$((SHGC_t A_{g} + A_{gmf} + A_{sgl} + A_{sn}))$~~

Where:

SHGCA – The target combined specific heat gain of the target ~~(glazing)~~fenestration area.

$SHGC_t$ – The solar heat gain coefficient for fenestration~~(glazing)~~ found in Table 13-1 or 13-2 which corresponds to the proposed total ~~(glazing)~~fenestration area as a percent of gross exterior wall area, and

A_{gpd}, A_{gmf}, A_{gn}, A_{sgl} and A_{sn} (A_g, A_{gmf} and A_{sn}) are defined under Equation 13-1.

EQUATION 13-4

Proposed $SHGCA_p$

$SHGCA_p$ – $SHGC_gA_g + SHGC_{sk}A_{sk}$

Where:

$SHGCA_p$ – The combined proposed specific heat gain of the proposed ~~(glazing)~~fenestration area.

$SHGC_{sk}$ – The solar heat gain coefficient of the ~~(overhead glazing)~~skylights.

A_{sk} – The ~~(overhead glazing)~~skylight area.

$SHGC_g$ The solar heat gain coefficient of the vertical fenestration~~(glazing)~~.

A_g The vertical ~~(glazing)~~fenestration area.

EQUATION 13-5

Target VTA_t

VTA_t = VTA_{gd}

Where:

VTA – The target combined visible transmittance of the target fenestration area.

VT_d = The visible transmittance for fenestration found in Table 13-1 which corresponds to the proposed total fenestration area as a percent of gross exterior wall area, and

A_{gd} is defined under Equation 13-1

EQUATION 13-6

Proposed VTA_p

VTA_p = $VT_{gp}A_{gp}$

Where:

VTA_p = The combined proposed visible transmittance of the proposed fenestration area.

VT_{gp} = The visible transmittance of the vertical fenestration.

A_g = The vertical fenestration area.

TABLE 13-1

BUILDING ENVELOPE REQUIREMENTS FOR CLIMATE ZONE 1

Opaque Elements	Nonresidential Assembly Max. U-factor	Nonresidential Insulation Min. R-Value	Residential, Other than Single-Family Assembly Max. U-factor	Residential, Other than Single-Family Insulation Min. R-Value
Roofs				
Insulation entirely above deck	U-0.026 ((U-0.034))	R-38 ci ((R-30 ci))	U-0.031	R-38 ci
Metal building	U-0.027 ((U-0.031))	R-25 + R-11 Ls + R-11 Ls	U-0.035	R-25 + R-11 Ls
Single rafter	U-0.027	R-38	U-0.027	R-38
Attic and other	U-0.029	R-38 adv or R-49	U-0.027	R-38 adv or R-49
Walls, Above Grade				
Mass ([b]) (includes perimeter edges of intermediate floor slabs and solid cores)	U-0.057 for exterior surface thermal insulation ((U-0.064))	Exterior and integral insulation: a. R-16 ci. b. R-21 in solution with ≤ 0.01% area-sectional area of metal penetrations per Section 1322 c. R-24 insulation with ≥ 0.04% and ≤ 0.08% cross-sectional area of metal penetrations per Section 1322. Interior insulation: d. R-13 cavity insulation + R-6 ci. wood studs; or e. R-13 cavity insulation + R-7.5 ci. metal studs; or f. R-22 ci insulation held securely by L in metal strips. ((R-15.2 ci.))	C-0.090	R-17.4 ci.
Metal building	U-0.032 ((U-0.036))	R-13 + R-13 ci. ((R-13+13+7.5 ci.))	U-0.057	R-19 + R-8.5 ci.
Steel framed	U-0.055 ((U-0.061))	a. R-13 cavity + R-10 ci. b. R-13 cavity + R-12.5 insulation with ≤ 0.02% area-sectional area of metal penetrations per Section 1322. c. R-13 cavity + R-20 insulation with ≥ 0.04% and ≤ 0.08% cross-sectional area of metal penetrations per Section 1322. ((R-13 + R-7.5 ci.))	U-0.057	R-19 + R-8.5 ci.
Wood framed and other	U-0.051 ((U-0.057))	a. R-13 cavity + R-7.5 ci. b. R-13 cavity + R-6 insulation with ≤ 0.04% cross-sectional area of metal penetrations per Section 1322. c. R-13 cavity + R-6 ci. metal studs; or d. R-13 insulation held securely by L in metal strips. ((Same as above grade))	U-0.057	R-13 + R-6 ci.
Walls, Below Grade				
Below grade wall	U-0.070	Exterior insulation: a. R-10 ci. Interior insulation: b. R-19 cavity insulation + wood studs; or c. R-13 cavity insulation + R-6 ci. metal studs; or d. R-10.8 insulation held securely by L in metal strips. ((Same as above grade))		Same as above grade
Floors				
Mass	U-0.029	R-30 ci	C-0.029	R-30 ci
Steel joist	U-0.029	R-38 cavity + R-4 ci	C-0.029	R-28 + R-4 ci.
Wood framed and Other	U-0.025 ((U-0.029))	R-28 cavity ((R-30))	U-0.026	R-30
Slab-on-Grade Floors				
Unheated	F-0.520 ((F-0.540))	((R-10)) R-15 for 24 in. (with thermal break)	F-0.540	R-15 for 24 in. (with thermal break)
Heated	F-0.860	R-10 ci. (w/o thermal break)	F-0.860	R-10 ci. (with thermal break)
Opaque Doors				
Swinging	U-0.470 ((U-0.600))		U-0.600	
Nonswinging	U-0.390 ((U-0.500))		U-0.450	

Fenestration (0-40% of Wall)	Assembly Max. U-Factor	Assembly Max. SHGC	Assembly Max. U-Factor	Assembly Max. SHGC
	NFRC-certified or per 1106	NFRC-certified as per 1322.1	NFRC-certified as per 1606	NFRC-certified as per 1312.1
Total fenestration (vertical and overhead) area relative to the gross exterior wall area: 0-30.0 % of wall				
Vertical Fenestration				
Nonmetal framing: All	U-0.33 ((U-0.32))	For all frame types:		U-0.32
Metal framing: Fixed/inoperable	U-0.38 ((U-0.37))	(SHGC-0.45) OR SHGC-0.35 all		U-0.40
Entrance doors (revolving doors & vestibules)	U-0.60 ((U-0.65))	SHGC-0.15 all FU-US permanent PF>0.5ft on west, south and east		U-0.60
Skylights				
Without curb (i.e., sloped glazing)	U-0.65 ((U-0.80))	SHGC-0.32 all ((SHGC-0.35 all))	U-0.55	SHGC-0.35 all
With curb (i.e., individual unit skylights)	U-0.55 ((U-0.60))		U-0.65	
Fenestration	Assembly Max. U-Factor	Assembly Max. SHGC & Min. VT	Assembly Max. U-Factor	Assembly Max. SHGC
	NFRC-certified or per 1106	NFRC-certified or per 1312.1	NFRC-certified or per 1606	NFRC-certified as per 1312.1.
Total fenestration (vertical and overhead) area relative to the gross exterior wall area: >30.0 and ≤40.0% of wall				
Vertical Fenestration				
Nonmetal framing: All	U-0.28	For all frame types:		U-0.32
Metal framing: Fixed/inoperable	U-0.38 ²	SHGC-0.23 all AND minimum VT-0.51 all OR		U-0.40
Entrance doors (revolving doors & vestibules)	U-0.60 ((U-0.65))	SHGC-0.15 all FU-US permanent PF>0.5ft on west, south and east AND minimum VT-0.51 all		U-0.60
Skylights				
Without curb (i.e., sloped glazing)	U-0.60	SHGC-0.30 all.	U-0.50	SHGC-0.35 all
With curb (i.e., individual unit skylights)	U-0.80		U-0.60	

ci – Continuous insulation, Ls – Linear system (see definitions). Also see requirements in Section 1322 for methodology for determining U-factors for assemblies containing metal.

Footnotes:

1 Daylighting with Plastic Skylights. For plastic skylights, the SHGC is allowed to be SHGC-0.65 maximum provided that:

(a) the visible transmittance (VT) is greater than the SHGC and

(b) the skylight area is no greater than 6% of the overhead daylight zone;

~~((Unrelated: Unframed walls may be ASTM C90 concrete block walls, ungrouted or partially grouted, 12 inches or less in center vertically and 48 inches or less in center horizontally, with cores not cross-filled with mortar having a maximum fixture accidental gap of 3/4 inch (6.4 mm).))~~

2 In assembly/unit, values, up to 10% of the total, vertical fenestration with metal framing is allowed to be operable fenestration with a factory-applied average assembly maximum U-Factor (NFRC certified or default, per Section 1606) of U-0.45 provided that:

(a) the total operable fenestration area does not exceed 10% of the total vertical fenestration (actual fixed plus operable) area;

(b) the total fenestration (vertical and overhead) area does not exceed 40% of the gross exterior wall area; and

(c) the building utilizes an HVAC energy management system (EMS) which is capable of accumulating periods (based on outdoor air temperatures) when the operable fenestration may be manually opened for natural ventilation and that disables HVAC operation of the perimeter zone when outdoor air conditions for natural ventilation are met. If approved by the building official, other air flow control strategies are allowed to be used where they are shown to reduce the HVAC peak energy and energy consumption when used in conjunction with natural ventilation from operable fenestration.

This footnote does not apply to fenestration with nonmetal framing. This footnote is not allowed to be used for the R5-22 or R5-22 compliance options.

This note is not permitted to be used for the Component Performance compliance option in Sections 1338 through 1343 unless the Proposed Design complies with (a), (b), and (c).

When this footnote is utilized, separate calculations shall be performed for the operable fenestration and these values shall not be averaged with any others for compliance purposes.

Informative Note: For the application of the exterior envelope requirements to elevator shafts and stair enclosures, see the definition of indirectly conditioned space in Chapter 2.

Informative Note: For further information about compliance for assemblies with isolated metal penetrations, see Section 1322 and the default U-factors in Table 10-5A(1).

Procedural Requirement: The plans shall contain a fenestration and opaque door schedule. The fenestration schedule shall include all vertical fenestration and skylights (curtain walls, windows, sliding and swinging glass doors and glazed roll-up doors, glass block walls, glass panels, clerestories, skylights, etc.), as well as all opaque doors (swinging doors, roll-up doors,

...weatherization doors, etc.).

For all projects, the fenestration and opaque door schedule shall include the manufacturer and model number for all products regardless of U-Factor.

The fenestration and opaque door schedules shall indicate the product type, size, number of each type, the U-factor and whether the U-factor is NFRC-certified or default.

If the product is claimed to be NFRC-certified, the NFRC Certified Products Directory (CPD) number shall be provided. A simulation report is not acceptable as it does not demonstrate that the product complies with the NFRC rating, labeling, and certification programs. Also, a specification sheet that simply states "determined in accordance with NFRC 100" does not suffice.

For site-built fenestration products (as defined by NFRC) ONLY, at the time of building permit application, it is acceptable to provide simulation reports from an NFRC-accredited simulation laboratory for each product type that is to be installed in the project. The simulation must include the specific frame profiles, glazing options, gas fills, spacers, etc. that are proposed to be installed in the building. However, the NFRC label Certificate is required to be provided to the building inspector at the construction site. (AAMA 907 reports, thermal performance matrices, and certificates of compliance are not acceptable.)

If a default U-factor from Chapter 16 is used for rated products in lieu of NFRC certification, the fenestration and opaque door schedule shall include a description of the key energy-efficiency features that are necessary to achieve that default U-factor (indicating whether the fenestration product is fixed or operable, frame material type, thermal break assumption, number of glazing layers, emissivity of low-e coatings, gas/width, gas fill, spacer type, etc.).

For fenestration in nonresidential spaces, the fenestration schedule shall also include the solar heat gain coefficient for each product and, where applicable, visible transmittance.

Section 13. The following sections or subsections of Chapter 14 of the 2009 Washington State Energy Code are amended, and new subsections are added, as follows:

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FIGURE 14A
MECHANICAL SYSTEMS COMPLIANCE PATH

Section Number	Subject	Simple Systems Path	Complex Systems Path	Systems Analysis Option
1410	General Requirements	X	X	X
1411	((HVAC)) Mechanical Equipment Performance Requirements	X	X	X
1412	Controls	X	X	X
1413	Air Economizers	X	X	X
1414	Ducting Systems	X	X	X
1415	Piping Systems	X	X	X
1416	Completion Requirements	X	X	X
1420	Simple Systems (Packaged Unitary Equipment)	X		
1421	System Type	X		
1422	Controls	X		
1423	Economizers	X		
1424	Separate Air Distribution Systems	X		
1430	Complex Systems		X	
1431	System Type		X	
1432	Controls		X	
1433	Economizers		X	
1434	Separate Air Distribution Systems		X	
1435	Simultaneous Heating and Cooling		X	
1436	Heat Energy Recovery		X	
1437	Electric Motor Efficiency		X	
1438	Variable Flow Systems		X	
1439	Exhaust Hoods		X	
RS-29	Systems Analysis			X
1440	Domestic Water Systems	X	X	X
1441	Water Heater Installation	X	X	X
1442	Shut-Off Controls	X	X	X
1443	Pipe Insulation	X	X	X
1444	Conservation of Water and Reception Energy	X	X	X
1445	Heat Recovery for Domestic Water Systems	X	X	X
1446	Domestic Hot Water Mains	X	X	X
1450	Heated Pools	X	X	X
1451	General	X	X	X
1452	Pool Water Heaters	X	X	X
1453	Controls	X	X	X
1454	Pool Covers	X	X	X
1454	Heat Recovery	X	X	X
1460	Cold Storage	X	X	X
1461	Refrigerated Warehouse Heating and Cooling	X	X	X
1462	Underslab Heating	X	X	X
1463	Temperature	X	X	X
1464	Condensers	X	X	X
1465	Compressors	X	X	X
1470	Compressed Air and Vacuum Air	X	X	X
1475	Commercial Food Service	X	X	X

***

1402 **Mechanical Ventilation:** The minimum requirements for ventilation shall comply with the ((Washington State Mechanical Code (WAC 51-52))) Seattle Mechanical Code.

1410 General Requirements. The building mechanical system shall comply with Sections 1411 through 1416, Sections 1440 through 1443, Sections 1450 through 1454, Sections 1470 and 1475, and with one of the following paths:

a. Simple Systems (Packaged Unitary Equipment), Sections 1420 through 1424

b. Complex Systems, Sections 1430 through 1439

c. Systems Analysis. See Section 1141.4

Systems serving cold storage spaces and frozen storage spaces in refrigerated warehouses shall meet the requirements of Sections 1416, 1437, and 1460 through 1465.

1411 **((HVAC)) Mechanical Equipment Performance Requirements.**

Informative Note: As indicated in Section 1120, the Energy Code applies to industrial facilities, as well as commercial and industrial processes. Thus, the equipment efficiency requirements apply to industrial facilities, as well as systems and equipment used in commercial and industrial processes.

1411.1 **General:** Equipment shall have a minimum performance at the specified rating conditions not less than the values shown in Tables 14-1A through 14-1G. Air conditioners primarily serving computer rooms and covered by ASHRAE Standard 127 shall comply with the requirements in Table 14-1A(2). All other air conditioners shall comply with the requirements in Table 14-1A(1). If a nationally recognized certification program exists for a product covered in Tables 14-1A through 14-1G, and it includes provisions for verification and challenge of equipment efficiency ratings, then the product shall be listed in the certification program.

Informative Note: The AHRI certification program is nationally recognized and it does include provisions for verification and challenge of equipment efficiency ratings. Consequently, if equipment is subject to an AHRI Standard, it shall be listed in the AHRI certification program.

For equipment not within the scope of the standards in Table 14-1A through 14-1G, this Code does not contain any minimum efficiency requirements. However, for any claims of efficiency, such as for calculations using the RS-29 compliance option, data shall be furnished by the equipment manufacturer consisting of a complete report from a test performed by an independent laboratory accredited by a nationally recognized accreditation organization.

Gas-fired and oil-fired forced air furnaces with input ratings ≥ 225,000 Btu/h (65 kW) and all unit heaters shall also have an intermittent ignition or interrupted device (IID), and have either mechanical draft (including power venting) or a flue damper. A vent damper is an acceptable alternative to a flue damper for furnaces where combustion air is drawn from the conditioned space. All furnaces with input ratings ≥ 225,000 Btu/h (65 kW), including electric furnaces, that are not located within the conditioned space shall have jacket losses not exceeding 0.75% of the input rating.

Chilled water plants and buildings with more than 500 tons total capacity shall not have more than 150 tons provided by air-cooled chillers.

EXCEPTIONS:

1. Where the designer demonstrates that the water quality at the building site fails to meet manufacturer's specifications for the use of water-cooled equipment.
2. Air-cooled chillers with minimum efficiencies at least 10 percent higher than those listed in Table 14-1C.
3. Replacement of existing equipment.

Cooling towers serving chilled water systems shall be selected to be able to maintain a return condenser water temperature to the lower of 85°F or less at peak design conditions, except for replacement cooling towers of the same or smaller capacity in existing buildings where physical constraints preclude a change from the original design.

Hydronic heat pump and other cooling and refrigeration equipment (e.g. icemakers, walk-in coolers) shall not use domestic water only one time before dumping it to waste (no single pass water cooling systems are allowed). The only exceptions are: replacement of existing icemakers, or use of single pass cooling for medical and dental equipment during power outages and other emergencies.

1411.2 **Rating Conditions:** Cooling equipment shall be rated at AHRI test conditions and procedures when available. If equipment is rated in accordance with an AHRI Standard, it shall be rated at AHRI Standard Rating Conditions, not "design" conditions. Where no applicable procedures exist, data shall be furnished by the equipment manufacturer consisting of a complete report from a test performed by an independent laboratory accredited by a nationally recognized accreditation organization.

1411.2.1 **Water-Cooled Centrifugal Water-Chilling Packages--Nonstandard Conditions:** Water cooled centrifugal water-chilling packages that are not designed for operation at AHRI Standard 550/590 test conditions reflected in Table 14-1C (44°F leaving chilled-water temperature and 85°F entering condenser water temperature with 3 gpm/ton condenser water flow) shall have maximum full-load kW/ton and NPLV ratings adjusted using Equation 14-1.

The adjusted full load and NPLV values are only applicable over the following full-load design ranges:

- Minimum leaving chilled water temperature: 38°F;
- Maximum condenser entering water temperature: 102°F;
- Condenser water flow: 3 to 6 gpm/ton; and
- X ≥ 39 and ≤ 60.

Chillers designed to operate outside of these ranges or applications utilizing fluids or solutions with secondary coolants (e.g., glycol solutions or brines) with a freeze point of 27°F or lower from freeze protection are not covered by this standard.

EQUATION 14-1

Adjusted maximum full-load kW/ton rating = (Full load kW/ton from Table 14-1C)/K_{adj}

Adjusted maximum NPLV rating = (IPLV from Table 14-1C)/K_{adj}

Where:

K_{adj} = $6.174722 - 0.303668(X) + 0.00629466(X)^2 - 0.000045780(X)^3$

X = DT_{adj} / LIFT

DT_{adj} = (24 / (Full load kW/ton from Table 14-1C) x 6.83)/Flow

Flow = Condenser water flow (gpm)/cooling full load capacity (tons)

LIFT = CEWT - CLWT

CEWT = Full load condenser entering water temperature (°F)

CLWT = Full load condenser leaving chiller water temperature (°F)

***

1411.4 **Packaged and Split System Electric Heating and Cooling Equipment:** Packaged and split system electric equipment providing both heating and cooling, and cooling only equipment with electric heat in the main supply duct before VAV boxes, in each case with a total cooling capacity greater than 30,000 Btu/h, shall be a heat pump.

EXCEPTION: Detailed equipment studies or systems used solely for personal wireless service facilities.

Informative Note: This does not apply to VAV systems with terminal reheat, provided that there is no electric heat in the main supply duct. Electric heat is allowed in the terminal units.

***

1412.4 **Setback and Shutoff:** HVAC systems shall be equipped with automatic controls capable of accomplishing a reduction of energy use through control setback or equipment shutdown during periods of nonuse or alternate use of the spaces served by the system. The automatic controls shall:

a. Have a minimum seven day clock and be capable of being set for seven different day types per week.

b. Be capable of retaining programming and time setting during loss of power for a period of at least ten hours, and

c. Include an accessible manual override, or equivalent function (e.g., telephone interface), that allows temporary operation of the system for up to two hours.

EXCEPTIONS:

1. Systems serving areas which require continuous operation to the same temperature setpoint.
2. Equipment with all load demands ≤ 2 kw (6,826 Btu/h) or less may be controlled by readily accessible manual off-hour controls.
3. Systems controlled by an occupant sensor that is capable of shutting the system off when no occupant is sensed for a period of up to 20 minutes.
4. Systems controlled solely by a manually operated timer capable of operating the system for no more than two hours.

For hotel and motel guest rooms, a minimum of one of the following control technologies shall be required in hotels/motels with over 50 guest rooms such that the space temperature would automatically setback (winter) or set up (summer) by not less than 3°C (5°F) when the occupant is not in the room:

1. Controls that are activated by the room occupant via the primary room access method - key, card, deadbolt, etc.
2. Occupancy sensor controls that are activated by the occupant's presence in the room.

1412.4.1 **Dampers:** Outside air intakes, exhaust outlets and relief outlets serving conditioned spaces shall be equipped with motorized dampers which close automatically when the system is off or upon power failure. Return air dampers shall be equipped with motorized dampers. Stair shaft and elevator shaft smoke relief openings shall be equipped with normally open (fails to open upon loss of power) dampers. These dampers shall remain closed until activated by the fire alarm system or other approved smoke detection system.

EXCEPTIONS:

1. Systems serving areas which require continuous operation.
2. Combustion air intakes.
3. Gravity (nonmotorized) relief dampers are acceptable in areas with a design outdoor air intake or exhaust capacity of 300 cfm or less (e.g. damper with less than a 6x6 inch or 6 inch round supply flow when the building is less than 3 stories in height).
4. Type I grease hoods exhaust.

Informative Note: Per RS-9, Section 6.5.1.1.5, relief dampers are part of an air economizer system that prevents overpressurization of the building. Other exhausts are not considered relief and require motorized dampers.

Dampers installed to comply with this section, including dampers integral to HVAC equipment, shall have a maximum leakage rate when tested in accordance with AMCA Standard 500 of:

(a) Motorized dampers: 10 cfm/ft² of damper area at 1.0 in w.g.

(b) Nonmotorized dampers: 20 cfm/ft² of damper area at 1.0 in w.g., except that for nonmotorized dampers smaller than 24 inches in either dimension: 40 cfm/ft² of damper area at 1.0 in w.g.

Drawings shall indicate compliance with this section.

1412.4.1.1 **Damper Controls:** Dampers for outdoor air supply and exhaust shall automatically shut when the systems or spaces served are not in use or during building warm-up, cooldown, and setback. Operation of dampers shall be allowed during ventilation prepurge one hour before expected occupancy and for unoccupied period precooling during the cooling season.

Classrooms, gyms, auditoriums and conference rooms larger than 500 square feet of floor area shall have occupancy sensor control that will either close outside air dampers or turn off serving equipment when the space is unoccupied except where equipped with another means to automatically reduce outside air intake below design rates when spaces are partially occupied.

1412.4.2 **Optimum Start Controls:** Heating and cooling systems with design supply air capacities exceeding 2,000 cfm shall have optimum start controls. Optimum start controls shall be designed to automatically adjust the start time of an HVAC system each day to bring the space to desired occupied temperature levels immediately before scheduled occupancy. The control algorithm shall, as a minimum, be a function of the difference between space temperature and occupied setpoint and the amount of time prior to scheduled occupancy.

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1412.5 **Heat Pump Controls:** ((Unitary air cooled heat pumps shall include microprocessor controls that minimize supplemental heat usage during start up, set-up, and defrost conditions. These controls shall anticipate need for heat and use compression heating as the first stage of heat. Controls shall indicate when supplemental heating is being used through visual means (e.g. LED indicators). Heat pumps equipped with supplementary heaters shall be installed with controls that prevent supplemental heater operation above 40°F.)) Heat pumps with supplementary electric resistance heaters shall have controls complying with the following requirements:

1. Prevent supplementary heater operation when the heating load can be met by the heat pump alone; and
2. The cut-on temperature for compression heating shall be higher than the cut-on temperature for supplementary heating, and the cut-off temperature for compression heating shall be higher than the cut-off temperature for supplementary heating.

All heat pumps installed shall include the capability to lock out the supplementary heat based on outdoor temperature. This control shall have a maximum setting of 40°F. At final inspection, the lock out control shall be set to 32°F or less.

EXCEPTION: The controls may allow supplementary heater operation during defrost.

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1412.8 Demand Control Ventilation.

1412.8.1 **Ventilation Controls for High-Occupancy Areas.** Demand control ventilation (DCV) is required for spaces that are larger than 500 ft², have an occupant density for ventilation of greater than 25 people per 1000 ft² of floor area (based on the Design Occupant Density column of Table 403.3 of the ((Washington State)) Seattle Mechanical Code), and are served by systems with one or more of the following:

a. An air-side economizer,

b. Automatic modulating control of the outdoor air damper, or

c. A design outdoor ventilation airflow of all systems serving the space combined greater than 3000 cfm.

EXCEPTIONS:

1. Systems with energy recovery complying with Section 1436.
2. Spaces with a combined design outdoor airflow less than 1500 cfm.
3. Spaces where the supply airflow rate minus any makeup or outgoing transfer air requirement is less than 1000 cfm.

1412.8.2 **Ventilation Controls for Laboratories.** Demand-based ventilation control, or setback control of ventilation is required for laboratory spaces with a design air change rate greater than or equal to 6 air changes per hour (ACH). The system shall be capable of reducing the ventilation to 3 ACH.

1412.9 **Enclosed Loading Dock, ((and)) Parking Garage, and Motor Vehicle Repair Garage Exhaust Ventilation System Control.** Mechanical ventilation systems for enclosed loading docks, ((and)) parking garages, and motor vehicle repair garages shall be designed to exhaust the airflow rates (maximum and minimum) determined in accordance with the ((State Mechanical Code (chapter 51-52 WAC))) Seattle Mechanical Code Section 404.

((~~Ventilation systems shall be equipped with a control device that operates the system automatically upon detection of vehicle operation or the presence of occupancy by approved automatic detection devices. Each of the following types of controllers shall be capable of shutting off fans or modulating fan speed.~~)) Mechanical ventilation systems shall operate continuously to provide ventilation per Seattle Mechanical Code Section 404.2.

1. Gas sensor controllers shall be arranged to operate automatically upon detection of vehicle operation or the presence of occupants by approved automatic detection devices and shall be equipped with gas sensor systems that modulate the ventilation system by staging fans or varying fan speed to maintain gas concentrations below specified maximum levels ((used to activate the exhaust ventilation system shall stage or modulate fan speed upon detection of specified gas levels)). All equipment used in sensor controlled systems shall be designed for the specific use and installed in accordance with the manufacturer's recommendations. The following are minimum gas sensor system requirements:

   a. ((~~Garage and~~)) In enclosed loading docks, parking garages, and motor vehicle repair garages used predominantly by gasoline-powered vehicles shall be equipped with a controller and a full array of carbon monoxide (CO) sensors set to maintain levels of carbon monoxide below 35 parts per million (ppm). Spacing and location of the sensors shall be installed in accordance with manufacturer recommendations.

   b. In enclosed loading docks, parking garages, and motor vehicle repair garages ((W))where more than 20 percent of the vehicles using the garage or loading dock are powered by nongasoline fuels, the area exposed to nongasoline fueled vehicle exhaust shall be equipped with a controller and fuel-appropriate sensors. The set-point for the nongasoline sensors shall be no less than the standard used by OSHA for eight hour exposure. The controller shall activate the ventilation system when sensor set-point is reached. Spacing and location of the sensors shall be installed in accordance with manufacturer recommendations.

2. Automatic time clocks used to activate the system shall activate the system during occupied periods. The time clock shall be capable of scheduling multiple start and stop times for each day of the week, varying the daily schedule, and retaining programming for a 10-hour period during loss of power.

3. Occupant detection sensors used to activate the system shall detect entry into the parking garage along both the vehicle and pedestrian pathways.

1412.9.1 System Activation Devices for Enclosed Loading Docks. Ventilation systems for enclosed loading docks shall operate continuously and shall be staged or vary fan speed by gas sensors.

EXCEPTION: Enclosed loading docks having a total design capacity less than 21000 cfm are permitted to use occupant sensors or time clocks with a manual override switch. Ready access to the switch shall be provided to persons in the loading dock area. Time clocks shall activate the system during occupied periods and shall be capable of scheduling multiple start and stop times for each day of the week, varying the daily schedule, and retaining programming for 10 hours during loss of power.

((~~be activated by one of the following:~~

1. Gas sensors, or
2. Time clock and a manual over-ride switch located in the dock area that is accessible to persons in the loading dock area.))

1412.9.2 System Activation Devices for Enclosed Parking Garages. Ventilation systems for enclosed parking garages shall operate continuously and shall be staged or vary fan speed by gas sensors.

EXCEPTIONS:

1. Enclosed parking garages for motor vehicle repair garages having a total design capacity less than 6,000 cfm are permitted to use either of the following:
   a. An atmospheric time clock that activates the system during occupied periods that is capable of scheduling multiple start and stop times for each day of the week, varying the daily schedule, and retaining programming for 10 hours during loss of power.
   b. An occupant detection sensor that activates the system when entry into the parking garage along a vehicle or pedestrian pathway is detected.
2. For enclosed parking garages that are normally closed to vehicle traffic the garage ventilation system may be shut down during periods when the garage is not scheduled to be open provided that all of the following conditions are met:
   a. The enclosed parking garage has a total coverage gas detection system;
   b. Gas detection system is continuously active to stage fans or vary fan speed to maintain specified gas concentration levels below specified maximum levels; and
   c. System operates for a minimum of 1 hour after the garage is scheduled to be closed.

For purposes of this section, enclosed parking garages that are normally closed to vehicle traffic are defined as commercial parking structures that have posted closed hours including commercial garages that have longer hours due to events. Enclosed parking garages that serve multi-family residential garages that are open 24 hours per day for 7 days per week, or other similar uses are not considered to be defined as normally closed to vehicle traffic.

((~~be activated by gas sensors:~~

EXCEPTION: A parking garage ventilation system having a total design capacity of over 8,000 cfm may use a time clock or occupant sensors.))

1412.9.3 System Activation Devices for Enclosed Motor Vehicle Repair Garages. Ventilation systems for enclosed motor vehicle repair garages shall operate continuously and shall be staged or vary fan speed by gas sensors.

EXCEPTION: Motor vehicle repair garages are permitted to shut down during periods when the garage is closed provided there is no override switch for running employees to enable the system for hours and the gas detection system is continuously active to stage fans or vary fan speed to maintain specified gas concentration levels below specified maximum levels.

1412.10 Single Zone Variable-Air-Volume Controls. HVAC systems shall have variable airflow controls as follows:

a. Air-handling and fan-coil units with chilled-water cooling coils and supply fans with motors greater than or equal to 5 hp shall have their supply fans controlled by variable-speed drives or electronically-commutated motors. At cooling demands less than or equal to 50%, the supply fan controls shall be able to reduce the airflow to no greater than the larger of the following:
   1. One half of the full fan speed, or
   2. The volume of outdoor air required to meet the ventilation requirements of the Seattle Mechanical Code.

b. Effective January 1, 2012, all air conditioning equipment and air-handling units with direct expansion cooling and a cooling capacity at the rating conditions in the AHRI standard appropriate to the equipment, greater than or equal to 110,000 Btu/h that serve single zones shall have their supply fans controlled by variable speed drives or electronically-commutated motors. At cooling demands less than or equal to 50%, the supply fan controls shall be able to reduce the airflow to no greater than the larger of the following:
   1. Two-thirds of the full fan speed, or
   2. The volume of outdoor air required to meet the ventilation requirements of the Seattle Mechanical Code.

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1413.1 Operation: Air economizers shall be capable of automatically modulating outside and return air dampers to provide 100 percent of the design supply air as outside air to reduce or eliminate the need for mechanical cooling. The design supply air is the total airflow provided through the heating or cooling spaces. Systems shall provide a means to relieve excess outdoor air during air economizer operation to prevent overpressurizing the building. Air economizers shall be used for RS-99 analysis base case for all systems without exceptions in Sections 1413, 1423, or 1433. Water economizers, when allowed by Section 1132.2 exception 1 or Section 1433 exceptions 3 and 9, shall be capable of providing the total concurrent cooling load served by the connected terminal equipment (taking airside economizer, at outside air temperatures of 50°F dry-bulb/45°F wet-bulb and below. For this calculation, all factors including solar and internal load shall be the same as those used for peak load calculations, except for the outside temperatures.

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1413.3 Integrated Operation: The HVAC system and its controls shall allow economizer operation when mechanical cooling is required simultaneously. Air and water economizers shall be capable of providing partial cooling even when additional mechanical cooling is required to meet the remainder of the cooling load.

((~~EXCEPTIONS~~

1. Individual direct expansion units that have a rated capacity less than 65,000 Btu/h and use non-integrated economizer controls that prevent simultaneous operation of the economizer and mechanical cooling.
2. Water cooled water chillers with waterside economizer.))

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1413.5 Economizer Heating System Impact. Any HVAC system that increases the building heating energy use during economizer operation is not allowed (e.g. single-fan/dual-duct systems and multizone systems).

EXCEPTION: Where heating is allowed by Section 1433.

Informative Note: Single-fan/dual-duct systems and multizone systems do not comply with this requirement. This is because economizer operation causes the temperature of the air entering the hot deck heating coil to increase, increasing its energy use. In order to use this type of system, the system must meet one of the economizer exceptions and have neither type of economizer. (Another resolution is to use a dual-fan/dual-duct system, where the hot deck fan supplies only return air or return air plus minimum ventilation air.)

This requirement will not affect three-deck multizone since they cannot work with an air economizer in any case (Outside makes the neutral deck a cold deck).

An exception to this Section 1413.5 is provided for economizers on VAV systems that cause zone level heating to increase due to a reduction in supply air temperature. Reducing supply air temperatures on a cooling-VAV system will reduce fan energy (unfavorable) if the system has a variable speed drive), or (unless the energy is reclaimed) natural energy.

See the discussion and diagrams on the ASHRAE Standard 90.1-2007 User's Manual, Section 6.3.1.4, page 6-52.

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1414.1 Duct Sealing and Testing: Duct work and plenums shall be sealed in accordance with Section 1414.1.1. Additionally, ducts shall be tested in accordance with Sections 1414.1.2 and 1414.1.3 as required.

1414.1.1 Sealing: Duct work which is designed to operate at pressures above 1/2 inch water column static pressure shall be sealed as follows:

1. Static pressure 1/2 inch to 3 inches: Seal all transverse joints and longitudinal seams. Spiral lock seams in round and flat-oval duct work do not require sealing; however, other seams shall be sealed.
2. Static pressure above 3 inches: Seal all transverse joints, longitudinal seams and duct wall penetrations.

For the purposes of this section, longitudinal seams are joints oriented in the direction of airflow. Transverse joints are connections of two duct sections oriented perpendicular to airflow. Duct wall penetrations are openings made by any screw fastener, pipe, rod or wire. All other connections are considered transverse joints, including but not limited to spin-ins, taps and other branch connections, access door frames and jambs, duct connections to equipment.

All low pressure supply and return air systems not located entirely within the conditioned space, including the unconditioned side of enclosed stud bays or joist cavities/spaces used to transport air, shall be securely fastened and sealed. Duct work shall be sealed using welds, gaskets, mastic, or mastic-plus-embedded-fabric tape. Enclosed stud bays or joist cavities/spaces used to transport air shall be sealed using mastic-plus-embedded-fabric tape, or when drywall is used to enclose the air system, drywall mud and tape. Duct tape is not permitted as a sealant on any ducts.

EXCEPTION: Fibrous glass duct systems installed in accordance with Standard UL 181A and flexible duct systems installed in accordance with Standard UL 181B may use tapes listed for those systems.

1414.1.2 Low Pressure Duct Leak Test: All duct systems shall be sealed to a leakage rate not to exceed 6 percent of the fan flow if the duct system:

1. Is connected to a constant volume, single zone, air conditioner, heat pump or furnace; and
2. Serves less than 5,000 square feet of floor area; and
3. Has more than 25 percent duct surface area located in any unconditioned space.

The leakage rate shall be confirmed through field verification and diagnostic testing, in accordance with SMACNA Duct Leakage Test Procedures - 1985.

1414.1.3 High Pressure Duct Leak Test: Duct work that is designed to operate at static pressures in excess of 3 inches water column and all ductwork located outside the building envelope shall be leak-tested in accordance with SMACNA Duct Leakage Test Procedures - 1985. Representative sections totaling no less than ((25)) 75 percent of the total installed duct area for the designated pressure class and all ductwork located outside the building envelope shall be tested. Duct systems with pressure ratings in excess of 3 in. w.c. shall be identified on the drawings. The maximum permitted duct leakage shall be:

$$L_{max} = C_L P^{0.65}$$

Where:

L_{max} = Maximum permitted leakage in cfm/100 ft^2 duct surface area.

C_L = Duct leakage class, cfm/100 ft^2 at 1 in. w.c.

C_L = 6 for rectangular sheet metal, rectangular fibrous, and round flexible ducts

C_L = 3 for round/flat oval sheet metal or fibrous glass ducts.

P = Test pressure, which shall be equal to the design duct pressure class rating in in. w.c.

1414.2 Insulation: Ducts and plenums that are constructed and function as part of the building envelope, by separating interior space from exterior space, shall meet all applicable requirements of Chapter 13. These requirements include insulation installation, moisture control, air leakage, and building envelope insulation levels. ((Unheated equipment rooms with combustion air louvers shall be isolated from the conditioned space by insulating interior surfaces to a minimum of R-11 and any exterior envelope surfaces per Chapter 13)). Outside air ducts serving individual supply air units with less than 2,800 cfm of total supply air capacity shall be insulated to a minimum of R-7 and are not considered building envelope. Other outside air duct runs are considered building envelope until they:

1. connect to the heating or cooling equipment, or
2. are isolated from the exterior with an automatic shut-off damper complying with Section 1412.4.1.

Once outside air ducts meet the above listed requirements, any runs within conditioned space shall comply with Table 14-5 requirements.

Other ducts and plenums shall be thermally insulated per Table 14-5.

EXCEPTIONS:

1. Within the HVAC equipment.
2. Exhaust air ducts not subject to condensation.
3. Exposed ductwork within a space that serves that space.

1415 Piping Systems

1415.1 Insulation: Piping shall be thermally insulated in accordance with Table 14-6.

EXCEPTION: Piping installed within factory HVAC equipment.

Cold water pipes outside the conditioned space shall be insulated in accordance with the Washington State Plumbing Code (WAC 51-56).

1415.2 Radiant Systems.

1415.2.1 Sensible Heating and Sensible Cooling Panel Insulation. All thermally ineffective panel surfaces of sensible heating panels and sensible cooling panels, including U-bends and headers, shall be insulated with a minimum of R-3.5. Adjacent envelope insulation counts toward this requirement.

1415.2.2 Radiant Floor Heating and Radiant Ceiling Cooling. The bottom surfaces of floor structures incorporating radiant heating and the top surfaces of ceiling structures incorporating radiant cooling shall be insulated with a minimum of R-3.5. Adjacent envelope insulation counts toward this requirement.

EXCEPTION: Requirements for heated slab-on-grade floors incorporating radiant heating are in Chapter 13.

1416 Commissioning and Completion Requirements.

1416.1 General. Drawing notes or specifications shall require commissioning and completion requirements in accordance with this section.

1416.2 Commissioning Scope. Commissioning in accordance with this section and Section 1513.((F))8 shall be required for new systems or modified portions of systems((, with a ~~heating capacity of 600k Btu/h~~ or a cooling capacity of 40 tons or more)).

1416.2.1 Buildings which require commissioning shall go through a commissioning process that includes as a minimum:

1. Commissioning plan;
2. Systems testing and balancing;
3. HVAC equipment and HVAC controls functional testing;
4. Supporting documentation in the form of operation and maintenance and record documents;
5. Commissioning report.

1416.3 Commissioning Requirements.

1416.3.1 Commissioning Plan. Commissioning plan shall include:

1. A general description of the commissioning process activities including the systems to be commissioned;
2. The scope of the commissioning process including systems testing and balancing, functional testing, and supporting documentation;
3. Roles and responsibilities of the commissioning team;
4. A schedule of activities including systems testing and balancing, functional testing, and supporting documentation;
5. Functional test procedures and forms.

1416.3.2 Systems Testing and Balancing.

1416.3.2.1 General. All HVAC air and hydronic systems shall be balanced in accordance with generally accepted engineering standards.

1416.3.2.2 Air Systems Balancing. Throttling losses shall be minimized by balancing the systems or adjusting the speed of fans with motors greater than 1 hp.

1416.3.2.3 Hydronic Systems Balancing. Throttling losses shall be minimized by balancing the systems, or trimming the pump impeller or adjusting the pump speed.

EXCEPTIONS: 1. Pumps with pump motors of 5 hp or less.

2. Throttling is an acceptable method of balancing only if the power draw does not exceed that of equivalent system with the impeller trimmed by more than 5 percent.

All hydronic heating or cooling coils with design flow exceeding 20 gpm (76 l/m) shall be equipped with dedicated pressure testing ports to enable testing of pressure drop through the coil. All hydronic heating or cooling systems served by pump(s) exceeding 5 hp (3.7 kW) shall be equipped with accessible pressure testing ports to enable testing supply and return pressure near the end of each major hydronic run.

1416.3.3 Systems, Equipment, and Controls Functional Testing. All HVAC systems, equipment, and controls as well as metering as specified in Chapter 12 and lighting controls as specified in Section 1513.((F))8 shall be tested to ensure that control devices, components, equipment and systems are calibrated, adjusted and operate in accordance with sequences of operation prescribed in the construction documents. Written procedures which clearly describe the individual systematic test procedures, the expected systems' response or acceptance criteria for each procedure, the actual response or findings, and any pertinent discussion. Optional examples of test methods and forms are provided in Reference Standard 34.

1416.3.4 Supporting Documentation. Supporting documentation shall include, as a minimum:

1416.3.4.1 Systems Documentation. Systems documentation shall be in accordance with industry accepted standards and shall include as a minimum:

1. Submittal data stating equipment size and selected options for each piece of equipment.
2. Operation and maintenance manuals for each piece of equipment requiring maintenance, except equipment not furnished as part of the project. Required routine maintenance actions shall be clearly identified.
3. Names and addresses of at least one HVAC service agency.
4. HVAC controls system maintenance and calibration information, including wiring diagrams, schematics, as-built drawings and control sequence descriptions. Desired or field determined set points shall be permanently recorded on control drawings at control devices, or, for digital control systems, in programming comments.
5. Complete written narrative of how each system and piece of equipment is intended to operate including interface with existing equipment or systems (where applicable). Sequence of operation is not acceptable as a narrative for this requirement.