# SUMMARY OF
# 2009 SEATTLE ENERGY CODE PROPOSAL

While the first comprehensive Seattle Energy Code took effect in February 1980, Seattle has had residential insulation requirements since 1974 and the first furnace sizing and duct insulation requirements took effect in 1927. Seattle has regularly updated its Energy Code to incorporate changes in technology and to improve implementation. Resolution 30280 also provides direction for Seattle Energy Code updates. This document provides a summary of the latest regular update.

Washington State updates its codes on a three-year cycle, following publication of new versions of the model codes by the International Code Council (ICC). The Washington State Building Code Council (WSBCC) adopted the 2009 Washington State Energy Code (WSEC) on 20 November 2009 and specified an effective date of 1 July 2010. Consequently, soon after adoption of the 2009 WSEC, Seattle began the process to update the Seattle Energy Code. Through a four-month public review process earlier this year, recommendations were refined and then endorsed by DPD's Construction Code Advisory Board. The energy savings estimate for the 2009 Seattle Energy Code for one building type is slightly less than 20% compared to ASHRAE/IESNA Standard 90.1-2007, the latest published version of the national energy standard for all buildings except low-rise residential buildings.

Then, in June 2010, the WSBCC voted to delay the effective date of the 2009 WSEC until no sooner than 29 October 2010, with a preferred new effective date of 1 January 2011. There was no change in the text of the 2009 WSEC that the WSBCC had previously adopted on 20 November 2009. The WSBCC website indicates that public hearings will be held on 10 September 2010 and 24 September 2010 regarding a possible new effective date for the 2009 WSEC, and that a decision will be made on 15 October 2010. This date could be anytime from as early as 29 October 2010 (the end of the current WSBCC emergency rule) to as late as 1 April 2011.

DPD held additional public meetings to discuss the delayed implementation of the 2009 WSEC and to review options. Public comment recommended that Seattle continue on its previous path with a 2009 Seattle Energy Code that was based on amendments to the 2009 WSEC. CCAB unanimously endorsed the DPD recommendations at their meeting on 15 July 2010 and recommended that the 2009 Seattle Energy Code update move ahead with the 2009 updates to the other Seattle construction codes. As a result of the WSBCC action and given Washington State statutory limitations on amendments of the provisions for residential buildings in the WSEC, the proposed ordinance for the 2009 Seattle Energy Code would have the provisions for residential spaces in the 2006 WSEC remain in effect until the new effective date of the 2009 WSEC, while the provisions in the 2009 Seattle Energy Code for other spaces would take effect 30 days after the ordinance is passed and signed by the Mayor, with a transition period when an applicant could opt to comply with the 2006 Seattle Energy Code, until the earlier of 60 days after the 2009 Seattle Building Code takes effect or when the 2009 WSEC takes effect.

## Goals for this Update Cycle

Seattle amendments to the 2009 Washington State Energy Code (WSEC) are proposed:

- to achieve the energy savings specified in Resolution 30280,
- to incorporate addenda for the next version of ASHRAE/IESNA Standard 90.1,
- to incorporate ASHRAE/USGBC/IESNA Standard 189.1, and
- to improve implementation of existing amendments.

Resolution 30280 (Section 1.B.i) directs DPD and Seattle City Light to "propose to the City Council…amendments to the Seattle Energy Code…to achieve up to 20% enhanced energy efficiency beyond the current version of ASHRAE/IESNA Standard 90.1". The 2006 Seattle Energy Code achieved approximately 20% energy savings compared to ASHRAE/IESNA Standard 90.1-2004. However, since that time, ASHRAE/IESNA Standard 90.1-2007 has been published and it contains significant energy efficiency improvements. In addition, over 100 addenda have been proposed for incorporation into the next version of Standard 90.1, nationally-vetted ideas for our consideration. In December 2009, ASHRAE/USGBC/IESNA Standard 189.1, High-Performance Green Buildings Except Low-Rise Residential Buildings, was published, providing criteria for all aspects of green buildings.

## Public Review Process

Beginning in January 2010, DPD distributed draft proposals for the 2009 Seattle Energy Code (2009 WSEC with Seattle amendments). During the February to July 2010 time period, DPD held 15 public meetings to review proposals:

8 February 2010: envelope (13, 10, 11) & on-site renewable energy systems (16)
9 February 2010: lighting (15, 11) & metering (12)
11 February 2010: mechanical (14)
16 February 2010: envelope (13, 10, 11) & on-site renewable energy systems (16)
18 February 2010: mechanical (14)
22 February 2010: building envelope air leakage
23 February 2010: lighting (15, 11) & metering (12)
25 February 2010: RS-29 & initial wrap-up (includes building envelope, mechanical, lighting, metering, and on-site renewable energy)
1 March 2010: original written comment deadline
2 March 2010: review of initial written comments
29 March 2010: revised deadline for written comments
15 April 2010: overview of revised draft & lighting (15, 11)
19 April 2010: envelope (13, 10, 11, 2), mechanical (14), on-site renewable energy systems (16) & metering (12)
27 April 2010: RS-29, Appendix A/B, & carryover
27 April 2010: written comment deadline for revised draft
28 April 2010: review of written comments on revised draft
6 May 2010: CCAB review and discussion of staff recommendations and of written public comments on staff recommendations, two major issues identified, CCAB members make recommendations for a number of minor changes

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(City staff prepare revised draft responding to comments on minor issues)
20 May 2010: CCAB recommends two modifications to the staff recommendations for two major issues and then votes unanimous endorsement
(City staff accept recommended modifications, with some editorial changes)
21 June 2010: review of proposal for draft amendments to 2006 SEC
5 July 2010: written comment deadline for proposal for draft amendments to 2006 SEC
6 July 2010: review of written comments on proposal for draft amendments to 2006 SEC.
15 July 2010: CCAB review and discussion of staff recommendations and of written public comments on staff recommendations, CCAB recommends one minor change
CCAB supports moving ahead with an updated Seattle Energy Code with amendments to the 2009 WSEC (as opposed to further amendments to the 2006 Code)
CCAB then votes unanimous endorsement of the revised staff recommendations for the 2009 Seattle Energy Code
(City staff accept editorial change)

In addition, presentations were made to professional organizations:
11 February 2010 – AACE Seattle (Association for the Advancement of Cost Engineering)
17 February 2010 – AIA Seattle Chapter (American Institute of Architects)
22 February 2010 – NAIOP (National Association of Office and Industrial Parks)
22 April 2010 – Seattle Chamber of Commerce
26 April 2010 – ASHRAE Puget Sound Chapter (American Society of Heating, Refrigerating, and Air-Conditioning Engineers)
17 June 2010 – Electric League of the Pacific Northwest
17 June 2010 – Seattle Building Envelope Enclosure Council

DPD staff made a number of revisions in response to issues raised. The most significant changes were to not include requirements for window orientation and shading in the prescriptive compliance option, to not require that all buildings demonstrate a certain level of airtightness through testing, and to reduce the amount of nonrenewable energy to be supplied onsite. Additional modifications were made to other sections based on comments received and were included in the version reviewed by CCAB. CCAB recommended two key revisions: the development of an updated version of the EnvStd building envelope trade-off software; and an allowance for less energy-efficient operable windows provided that the windows were interlocked with the cooling system and had a high visible-light transmittance for daylighting. CCAB unanimously endorsed the DPD recommendations with these two revisions at their meeting on 20 May 2010.

When the WSBCC decided on 11 June 2010 to delay the initial implementation date for the 2009 WSEC, Seattle DPD considered the option of bringing forward a 2009 Seattle Energy Code that was based on amendments to the 2006 Seattle Energy Code (rather than amendments to the 2009 WSEC). However, public comment recommended that Seattle continue on its previous path with a 2009 Seattle Energy Code that was based on amendments to the 2009 WSEC. CCAB unanimously endorsed the DPD recommendations at their meeting on 15 July 2010.

DPD expresses its gratitude for all of those who participated in this process. Their efforts will result in a Seattle Energy Code that is more workable for all.

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## Energy Efficiency

A preliminary analysis of the proposed 2009 Seattle Energy Code for an office building estimates an energy savings that is more than 15% but less than 20% on a total building energy consumption basis compared to ASHRAE/IESNA Standard 90.1-2007. For any particular building, energy savings will vary depending on the use of the building, hours of operation, building envelope materials, size and orientation of windows, mechanical system types, process loads, etc.

If additional energy savings were desired for the 2009 Seattle Energy Code so as to achieve the 20% energy savings compared to ASHRAE/IESNA Standard 90.1-2007, requiring tested compliance with maximum building air leakage rates would be a logical step. While energy analysis models (and practical experience) show that building air leakage rates can have a significant impact on building energy consumption, past Energy Codes have neglected this arena. However, Energy Codes are beginning to correct this omission. The 2009 WSEC will require tested compliance with maximum building air leakage rates for single-family residential buildings. This is understandable as there is a broad data set of tested results for these small buildings. The 2009 WSEC will also require building air leakage testing for larger buildings, but will not require compliance with specific values as less building air leakage testing has been done for large buildings. During the adoption process for the 2009 WSEC, the intent expressed was to use the next three years to develop additional information through testing of these larger buildings, and then to establish criteria in the 2012 WSEC. When tested compliance with maximum building air leakage rates was discussed as a possible requirement during the public review meetings for the 2009 Seattle Energy Code, concerns were expressed about the uncertainty of the performance of current buildings. Consequently, based on the public review, at this point it is not recommended that nonresidential buildings be required to demonstrate tested compliance with maximum building air leakage rates.

## Code Language Proposals

Consistent with the current Seattle Energy Code, the plan is for the 2009 Seattle Energy Code (the update to be adopted this summer and effective this fall) to consist of the 2009 Washington State Energy Code (WSEC) with Seattle amendments to the provisions for nonresidential spaces. This document only contains the proposed Seattle amendments to the 2009 Washington State Energy Code. As is the case with the current Seattle Energy Code, there are no proposed Seattle amendments to the provisions for residential spaces in the Washington State Energy Code, other than administrative provisions and citing of Seattle codes and procedural requirements. (Please note, however, that the Washington State Building Code Council, WSBCC, did adopt significant revisions to the provisions for residential spaces that are contained in the 2009 WSEC. These changes have been published in the Washington State Register WSR 10-03-115 and can be viewed at the WSBCC website at: http://sbcc.wa.gov/Page.aspx?nid=138 .)

All of the Seattle amendments are summarized below in section number order and include:

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- **Section number and title.**
- *Discussion:* This contains a summary of the issues and the source of the language if it has been taken from another document, such as ASHRAE/IESNA Standard 90.1-2007. (Standard 90.1 is cited in the 1992 National Energy Policy Act as the basis for Energy Codes in all 50 states. Previous versions of the Seattle Energy Code have drawn substantially from this document and its predecessors.)
  - "No Seattle changes (retain existing Seattle amendment)" indicates that the 2009 Seattle amendment is the same as an existing 2006 Seattle amendment, or revised only to reflect partial adoption into the 2009 Washington State Energy Code.
- *Proposal:* This contains the proposed text. All strikethroughs and underlines show changes from the 2009 Washington State Energy Code.
  - Changes to Seattle amendments or new Seattle amendments are shown by a bar in the margin. (Changes to tables are shown by a bar in the margin next to the table title. Changes are not indicated to notes in boxed text or brackets).

## EXISTING SEATTLE AMENDMENTS TO BE RETAINED – NO CHANGES

The Seattle amendments to the following sections and tables are proposed to be retained with no changes:

| | |
|---|---|
| 1001 | General. |
| 1311.6 | Radiant Floors. |
| 1402 | Mechanical Ventilation. |
| 1411.2 | Rating Conditions. |
| 1413.5 | Economizer Heating System Impact. |
| 1414.2 | Insulation. |
| 1513.1 | Local Control and Accessibility. |

## EXISTING SEATTLE AMENDMENTS TO BE RETAINED – MINOR CHANGES

The Seattle amendments to the following sections were partially adopted into the 2009 Washington State Energy Code and are modified to reflect that partial adoption:

| | |
|---|---|
| 1431.2 | System Sizing Limits. |

## EXISTING SEATTLE AMENDMENTS NO LONGER NEEDED – STATE ADOPTION

The previous Seattle amendments to the following sections have been incorporated into the 2009 Washington State Energy Code and so are no longer needed:

| | |
|---|---|
| 1005.1 | Above-Grade Walls, General. |
| Table 10-5 | Default U-Factors for Above-Grade Walls |
| 1007.1 | Ceilings, General. |

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1310.2 Semi-Heated Spaces.
1314.1 Building Envelope Sealing.
1314.5 Loading Dock Weatherseals.
1411.5 Heating Systems in Unenclosed Spaces.
1421 System type.
1422 Controls.
1423 Economizers.
1440 Service Water Heating.
1454 Pool Covers and Insulation.
1512 Exempt Lighting.

## PROPOSED AMENDMENTS

Amendments are proposed for the following:

- 101.1 Title and Applicability: Clarify applicability to and transition for single-family residential spaces.
- 101.2 Purpose and Intent: Clarify that purpose is for single-family residential spaces.
- 101.3 Scope: Clarify the scope for single-family residential spaces and other spaces.
- 105.2.1 Required Inspections: Revise reference to cite Seattle code.
- 106 Violations and Penalties: Companion change to Section 1144.
- 107 Liability: Revise reference to cite City of Seattle.
- 108 Conflicts with Other Codes: Revise references to cite Seattle codes.
- Chapter 2 Definitions: (1) add definition of computer room per addendum bu to ASHRAE/IESNA Standard 90.1-2007 (companion change to Chapter 14); (2) add definition of daylighted zone in parking garages per addendum cz to ASHRAE/IESNA Standard 90.1-2007 (companion change to Chapter 15); (3) add definition of dynamic glazing per addendum cl to ASHRAE/IESNA Standard 90.1-2007 (companion change to Chapter 13); (4) add definition for integrated energy efficiency ratio per addendum s to ASHRAE/IESNA Standard 90.1-2007 (companion change to Chapter 14); (5) add definitions for types of on-site renewable energy systems (with a modification to include ground-source and groundwater-source heat pumps), and geothermal energy, per ASHRAE/USGBC/IESNA Standard 189.1-2009 (companion change to Chapter 16); (6) add definition for orientations (companion change to Chapter 13); (7) add definitions of sensible cooling panel, sensible heating panel, thermally effective panel surface, and thermally ineffective panel surface per addendum ae to ASHRAE/IESNA Standard 90.1-2007 (companion change to Chapter 14); (8) add definition of visible transmittance per addendum bm to ASHRAE/IESNA Standard 90.1-2007; (9) clarify definition of building entrance to specifically mention elevator doors and one-way exit doors; (10) clarify definition of glazing as it applies to other than residential spaces, and add definition for fenestration area to parallel the glazing area definition used for residential spaces; (11) clarify definition of indirectly conditioned space to specifically address elevator shafts

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and stair enclosures; (12) clarify definition of mechanical system to specifically mention industrial facilities and processes; (13) retain existing note about nominal R-value and existing definition of person; (14) add cross-references to the Building Code for the definition of existing building and story; and (15) change definitions to refer to the Seattle codes.

- Table 3-1 Outdoor Design Temperatures: Specify Seattle design conditions for consistency with Section 1431.2.
- 303 Mechanical Ventilation: (1) Revise reference to cite Seattle codes; (2) provide cross-reference to mechanical ventilation requirements for other spaces.
- 502.1.1 Building Envelope, General: Add note to provide information.
- 502.1.4.1 Building Envelope, General: Revise reference to cite Seattle code.
- 502.1.4.2 Insulation Materials: Revise reference to cite Seattle code.
- 502.1.4.5 Roof/Ceiling Insulation: Revise reference to cite Seattle code.
- 502.2.1 UA Calculations: Add note to highlight DPD procedural requirement.
- 503.10.3 Sealing: Revise reference to cite Seattle code.
- 503.10.4 Dampers: Revise reference to cite Seattle code.
- 602.7.2 Glazing U-Factor: Add note to highlight DPD procedural requirement.
- Chapter 7 Standards: (1) Update Seattle EnvStd to 2009 version; (2) add cross-references to RS-35 (advanced criteria) and RS-36 (2030 Challenge) that are included at the end.
- 901 Additional Residential Energy Efficiency Requirements: (1) Provide informative note; (2) add notes to highlight DPD procedural requirement; and (3) revise references to cite Seattle code.
- Table 10-A R-Value of Fiberglass Batts Compressed within Various Depth Cavities: Expand options to include R-25 which fits in nominal 2 x 8 framing.
- Table 10-B Default R-Values for Building Materials: Retain existing Seattle amendment, but revise information for brick to reflect typical face brick and add footnote with reference for other heat capacities.
- 1005.3 Component Description: Revise descriptions for metal building walls for consistency with addendum bb to ASHRAE/IESNA Standard 90.1-2007.
- Table 10-5A U-Factors for Overall Assembly Metal Stud Walls, Effective R-Values for Metal Framing and Cavity Only, and Default Metal Building U-Factors: Expand default options for metal stud walls in Table 10-5A(1); revise and expand default options for metal building walls in Table 10-5A(3) for consistency with addendum bb to ASHRAE/IESNA Standard 90.1-2007.
- Table 10-5B Default U-Factors for Concrete and Masonry Walls: (1) Table 10-5B(1) retain existing Seattle numbering for tables; (2) Table 10-5B(2): expand default options for peripheral edges of intermediate concrete floors; (3) Table 10-5B(3): retain existing

Seattle amendment with default options for mass walls and revise for consistency with addendum bb to ASHRAE/IESNA Standard 90.1-2007.

- 1006 Default U-Factors for Fenestration, Glazing, and Doors: Revise terminology for consistency with 2009 WSEC.
- Table 10-6 Default U-Factors for Vertical Fenestration, Skylights, and Opaque Doors: Clarify default U-factors for revolving doors and vestibules.
- 1007.2 Component Description: Revise descriptions for metal building roofs for consistency with addendum bb to ASHRAE/IESNA Standard 90.1-2007.
- Table 10-7F Default U-Factors for Metal Building Roofs: Revise and expand default options for metal building roofs in Table 10-7F for consistency with addendum bb to ASHRAE/IESNA Standard 90.1-2007.
- Table 10-7G Assembly U-Factors for Roofs with Insulation Entirely Above Deck (Uninterrupted by Framing): Expand default options for roofs with insulation entirely above deck.
- 1009.1 Mass, General: Add cross-reference to Table 10-B for brick, concrete, and concrete masonry used in other than single-family residential projects.
- 1100 Title: Clarify that the requirements apply to multifamily residential spaces.
- 1105 Applicability to Multifamily Residential Spaces: Specify transition for multifamily residential spaces.
- 1110 Purpose and Intent: Clarify that the requirements apply to all buildings, systems, and processes.
- 1120 Scope: More explicitly state the application to commercial and industrial processes.
- 1132.1 Building Envelope: Clarify application of vestibule requirements to existing buildings.
- 1132.2 Mechanical Systems: Add specification that mechanical system alterations are not to decrease the energy efficiency of the building.
- 1132.3 Lighting and Motors: (1) Expand application of requirements for lighting alterations per addendum av to ASHRAE/IESNA Standard 90.1, (2) add specification that lighting system alterations are not to decrease the energy efficiency of the building.
- 1133 Change of Occupancy or Use or Space Conditioning: (1) Explicitly cite changes of space conditioning in the title; (2) retain existing Seattle amendment, with minor change to delete heating equipment capacity.
- 1135 Commissioning: Delete HVAC limitations, thereby retaining application of commissioning requirements to all buildings per existing Seattle Energy Code requirements.
- 1141.2 Details: Companion change to Table 13-1.

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- 1141.4 Systems Analysis Approach for the Entire Building: Companion change to RS-29 Section 1.2.
- 1143.2 Required Inspections: Revise reference to cite Seattle code.
- 1144 Violations and Penalties: Revise to reflect current procedures.
- 1150 Conflicts with Other Codes: Clarify applicability.
- 1162 Liability: Revise to reflect current procedures.
- Table 11-1 Economizer Compliance Options for Mechanical Alterations: Retain existing Seattle amendments, with minor companion change for consistency with Chapter 14.
- Chapter 12 Energy Metering and Energy Consumption Management: Revise (1) to be no less stringent that ASHRAE/USGBC/IESNA Standard 189.1-2009, (2) to clarify intent.
- Figure 13A Building Envelope Compliance Options: Modify to add new sections.
- 1310.1 Conditioned Spaces: Companion change to Section 1335.
- 1310.3 Cold Storage and Refrigerated Spaces: (1) Revise to be no less stringent than changes to Table 13-1, and (2) add assembly U-factors for Target UA compliance option.
- 1311.5 Slab-on-Grade Floor: Revise to correspond with Section 502.1.4.8 of the 2009 WSEC.
- 1312 Fenestration and Doors: Revise terminology for consistency.
- 1312.2 Solar Heat Gain Coefficient and Visible Transmittance: (1) Retain existing Seattle amendments; (2) add exception 3 for dynamic glazing for SHGC per addendum cl to ASHRAE/IESNA Standard 90.1-2007.
- 1313.2 Roof/Ceiling Assemblies: Revise reference to cite Seattle code.
- 1314.2 Fenestration and Doors: Clarify meaning of field fabricated per ASHRAE Standard 90.1-2007, Section 5.4.3.2 interpretation.
- 1314.6 Continuous Air Barrier: Revise (1) to apply requirement for building air leakage testing to all buildings; (2) to specify confidence interval; (3) to more carefully specify test pressures and ranges; and (4) to add another reference to the informative note.
- 1314.7 Vestibules: Retain existing Seattle amendment, but (1) provide exemptions for semi-heated spaces and for elevator lobbies in parking garages; and (2) add informative note to clarify intent.
- 1321 Prescriptive Building Envelope Option, General: Clarify that compliance is to be done separately for nonresidential and residential spaces for consistency with ASHRAE/IESNA Standard 90.1-2007, Section 5.2.1.
- 1322 Opaque Envelope: (1) Add descriptions of alternate compliance options for assemblies with thermal bridges; (2) add cross-reference to Section 1332 for calculation of U-factors for assemblies with metal framing; (3) retain existing Seattle exception, but

modify to correspond with changes to Table 13-1; and (4) add procedural note to clarify application to elevator shafts and stairwells.

- 1323 Fenestration: Revise as follows: (1) Section 1323: add statement of intent for fenestration orientation, retain existing Seattle amendment for the Seattle Land Use Code, incorporate parking lot attendant booths into exception (previously in Section 1301), add allowance for revolving doors and vestibules, revise visible transmittance criteria; (2) Section 1323.1: retain limits on the area of below-grade walls included in the fenestration area calculation from the 2006 WSEC; (3) Section 1323.3: add option for shading credit for open louvers and non-opaque overhangs per ASHRAE/IESNA Standard 90.1-2007, Section 5.5.4.4.1; and (4) Section 1323.4: add criteria for minimum visible transmittance for projects with fenestration areas over 30% of the gross wall area.
- 1331 Component Performance Building Envelope Option, General: Revise as follows: (1) clarify that compliance is to be done separately for nonresidential and residential spaces for consistency with ASHRAE/IESNA Standard 90.1-2007, Section 5.2.1, and as has been required for previous versions of the Seattle and Washington State Energy Codes); (2) update reference to Seattle EnvStd (companion change to Sections 1322 and 1323 and Table 13-1); and (3) retain existing Seattle amendment allowing prescriptive compliance for street-level retail.
- 1332 Component U-Factors: Add alternate for determining U-factor for envelope assemblies containing metal framing.
- 1333 UA Calculations: Retain existing Seattle amendment, and add a procedural note.
- 1334 Solar Heat Gain Coefficient Rate Calculations: Clarify that the baseline for trade-offs is SHGC without the projection factors.
- 1335 Visible Transmittance Calculations: Add procedure for visible transmittance trade-offs (companion change to Table 13-1).
- Equations 13-1 Target UA, 13-2 Proposed UA, 13-3 Target SHGCA, 13-4 Proposed SHGCA: Revise terminology for consistency.
- Equations 13-5 Target VTA & 13-6 Proposed VTA: Companion change to Section 1335.
- Table 13-1 Building Envelope Requirements: Revise opaque envelope and fenestration requirements to achieve greater energy efficiency using the criteria from ASHRAE/IESNA Standard 90.1-2007 and addenda, and ASHRAE/USGBC/IESNA Standard 189.1-2009: (1) Roofs: revise so that the U-factor criteria is comparable for all classes of roofs; (2) Walls above grade: revise so that the U-factor criteria is comparable for all classes of walls but with mass walls slightly higher, revise insulation for metal building walls per ASHRAE/USGBC/IESNA Standard 189.1-2009, revise insulation for other walls per addendum bb to ASHRAE/IESNA Standard 90.1, provide alternate compliance options for otherwise continuous insulation with limited isolated metal penetrations; (3) Walls below grade: revise to be no less stringent than the 2006 SEC; (4) Floors over unconditioned space: revise insulation for wood-framed floors per addendum bb to ASHRAE/IESNA Standard 90.1; (5) Slab-on-grade floors: revise insulation for unheated slab floors per addendum bb to ASHRAE/IESNA Standard 90.1; (6) Opaque doors: require insulated doors per new default values in Table 10-6C; (7)

Vertical fenestration: set maximum baseline prescriptive fenestration area at 30% of the wall area per addendum bb to ASHRAE/IESNA Standard 90.1; revise U-factor for nonmetal framing per ASHRAE/USGBC/IESNA Standard 189.1-2009 and to match 2010 Energy Star criteria, revise U-factor for metal framing by comparable amount, add alternate U-factor criteria for revolving doors and vestibules, and retain existing 2006 SEC SHGC criteria; and require additional improvements for prescriptive fenestration area in excess of the 30% of the wall area allowed by addendum bb to ASHRAE/IESNA Standard 90.1; require 5-7% further improvement in fenestration U-factor and SHGC criteria and establish minimum VT criteria for 30-40% fenestration area; allow higher U-factor for a limited area of operable vertical fenestration with metal framing; (8) Skylights: revise U-factor for skylights without curb per ASHRAE/USGBC/IESNA Standard 189.1-2009, revise U-factor for skylights with curb to match 2010 Energy Star criteria, revise SHGC for all per ASHRAE/USGBC/IESNA Standard 189.1-2009; require 5-10% further improvement in fenestration U-factor and SHGC criteria for 30-40% fenestration area.

- Figure 14A Mechanical Systems Compliance Path: Modify to add new sections.
- 1410 General Requirements: Companion change to Sections 1470 and 1475.
- 1411 Mechanical Equipment Performance Requirements: Clarify that the requirements apply to all mechanical systems.
- 1411.1 General: (1) Add requirement for minimum efficiency for computer room equipment covered by ASHRAE Standard 127 as listed in Table 14-1A(2) per addendum bu of ASHRAE/IESNA Standard 90.1-2007; (2) Add requirement for minimum efficiency for variable refrigerant flow systems covered by AHRI Standard 1230 as listed in Tables 14-1A(3) and 14-1A(4) per addendum cp of ASHRAE/IESNA Standard 90.1-2007; (3) retain existing Seattle amendment, modified so that condenser water return requirements apply to all cooling towers with chilled water systems with an exception for replacement towers where there are space constraints; (4) retain existing Seattle amendment, modified so that single-pass cooling is only allowed for icemakers and use of medical equipment during an emergency.
- 1411.4 Electric Heating and Cooling Equipment: Retain existing Seattle amendment, but modify to address cooling only equipment with electric heat in the main supply duct.
- 1412.4 Setback and Shut-Off: Retain existing Seattle amendment, and add note clarifying application of exception for relief dampers per ASHRAE Standard 90.1-2007, Section 6.5.1.1.5.
- 1412.5 Heat Pump Controls: Revise to correspond with Section 503.8.3.5 of the 2009 WSEC.
- 1412.8 Demand Control Ventilation: (1) Change reference to Seattle Mechanical Code; (2) Modify to achieve further fan energy savings, and associated heating and cooling energy savings, in laboratory spaces.
- 1412.9 Enclosed Loading Dock, Parking Garage, and Motor Vehicle Repair Garage Exhaust Ventilation System Control: Modify for consistency with the Seattle Mechanical Code and to achieve further fan energy savings.

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- 1412.10 Single Zone Variable-Air-Volume Controls: Add requirement for variable speed drive for single-zone systems per addendum n to ASHRAE/IESNA Standard 90.1-2007.
- 1413.1 Operation: Clarify definition of design supply air per ASHRAE Standard 90.1-2007 User's Manual, page 6-67.
- 1413.3 Integrated Operation: Delete exceptions per addendum cy to ASHRAE/IESNA Standard 90.1-2007.
- 1414.1 Duct Sealing and Testing: (1) Require testing of ductwork located outdoors per addendum cq to ASHRAE/IESNA Standard 90.1-2007, (2) require testing of most sections of high-pressure duct work.
- 1415.2 Radiant Systems: Add requirement for insulating the back side of radiant heating systems per addendum ae to ASHRAE/IESNA Standard 90.1-2007, and also apply requirements to radiant cooling systems.
- 1416 Commissioning and Completion Requirements: (1) Retain application of commissioning requirements to all buildings; (2) add metering system to the list of equipment to be commissioned.
- Figure 14B Commissioning Compliance Checklist: Revise reference to cite Seattle code.
- 1431.3 Hydronic System Design: Add requirement for hydronic system piping design per addendum af and cc to ASHRAE/IESNA Standard 90.1-2007.
- 1432.2 Systems Temperature Reset Controls: Require variable speed pump control at same threshold as Section 1438.
- 1433 Economizers: (1) Clarify that requirements also apply to redundant equipment; (2) Exception 1: clarify treatment of redundant units in calculations; clarify meaning of initial tenant improvement; add option b for very high efficiency equipment with improvement per addendum cy to ASHRAE/IESNA Standard 90.1-2007; and retain existing Seattle note about limits to use of the exception; (3) Exception 2: retain capacity limits from existing Seattle amendment; (4) Exception 3: add chilled floors as an option, clarify the DOAS systems that accompany chilled floor, chilled beam, and chilled ceiling space cooling systems must still comply with the air economizer requirements; (5) Exception 7: retain existing Seattle amendment; (6) Exception 8: clarify that the capacity ratings are based on the outside unit; (7) Exception 9: clarify that the text reference is to air economizers, limit Option 9a to 54,000 Btuh, require dedicated waterside economizer for Options 9b and 9c; (8) Exception 10: clarify that heat recovery is required for all units, and that spaces with large internal loads are limited to 20% of the floor area to qualify for this exception.
- 1435 Simultaneous heating and cooling: (1) Clarify that simultaneous heating and cooling is prohibited for ground-coupled systems regardless of whether they actually use ground water; (2) Exception 2, clarify the reset requirements in Section 1432.2 are always applicable; (3) Exception 4, revise to indicate that this exception is not applicable to computer rooms per addendum bu to ASHRAE/IESNA Standard 90.1-2007.

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- 1436 Energy Recovery: (1) Revise title for consistency with ASHRAE/IESNA Standard 90.1; (2) add informative note to clarify that the heat recovery requirements are applicable to industrial facilities and processes.
- 1436.1 Fan Systems: (1) Require energy recovery, rather than heat recovery alone (companion change to Section 1436); (2) delete exception for laboratory VAV systems; (3) add note to clarify heat recovery effectiveness criteria for Seattle; and (4) add cross-reference to additional laboratory requirements in Section 1439.2.
- 1436.2 Condensate Systems: Clarify applicable systems for condensate recovery.
- 1436.3 Heat Recovery for Service Water Heating: Add note indicating typical systems to which heat recovery is applicable.
- 1436.4 Condenser Heat Recovery: Clarify the basis for the calculations and the minimum heat recovery required.
- 1437 Electric Motor Efficiency: (1) Require electronically-commutated motors for fans in fan-coil units; and (2) add informative note to clarify that the motor efficiency requirements are applicable to industrial facilities and processes.
- 1438 System Criteria: (1) Change threshold to 5 hp; (2) clarify that the requirements are applicable to parking garage ventilation fans; (3) retain existing Seattle note; (4) add cross-reference to requirements in elevator code; and (5) revise exception for greater consistency with addendum u to ASHRAE/IESNA Standard 90.1-2007.
- 1439.2 Laboratory Exhaust Systems: Add cross-reference to additional laboratory requirements in Section 1436.1.
- 1444 Conservation of Water and Pumping Energy: Establish requirements for all service water pressure booster systems per addendum cv to ASHRAE/IESNA Standard 90.1-2007.
- 1452 Pool Water Heaters: (1) Retain existing Seattle amendment; and (2) update environmental conditions and rating standard per addendum y to ASHRAE/IESNA Standard 90.1-2007.
- 1470 Compressed Air and Vacuum Pumps: Add requirements for air compressors.
- 1475 Commercial Food Service: Add requirements for commercial food service equipment to be Energy Star per Section 7.4.7.3 of ASHRAE/USGBC/IESNA Standard 189.1-2009.
- Table 14-1A(1) Unitary Air Conditioners and Condensing Units, Electrically Operated, Minimum Efficiency Requirements: Revise EER and IEER values and establish separate criteria for water-cooled and evaporatively-cooled units per addendum co to ASHRAE/IESNA Standard 90.1-2007.
- Table 14-1A(2) Air Conditioners and Condensing Units Serving Computer Rooms, Minimum Efficiency Requirements: Establish requirements for computer room equipment subject to ASHRAE Standard 127 per addendum bu to ASHRAE/IESNA Standard 90.1-2007.

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- Tables 14-1A(3) and 14-1A(4) Electrically Operated Variable Refrigerant Flow Air Conditioners, Minimum Efficiency Requirements, and Air-to-Air and Applied Heat Pumps, Minimum Efficiency Requirements: Establish requirements for variable refrigerant flow air conditioners per addendum cp to ASHRAE/IESNA Standard 90.1-2007.
- Table 14-1B Unitary and Applied Heat Pumps, Electrically Operated, Minimum Efficiency Requirements: Add minimum efficiencies for water-to-water heat pumps per addendum bg to ASHRAE/IESNA Standard 90.1-2007.
- Table 14-1C Water Chilling Packages, Minimum Efficiency Requirements: (1) Retain existing Seattle minimum efficiencies for chillers; (2) add minimum efficiencies for heat recovery chillers.
- Table 14-1D Packaged Terminal Air Conditioners, Packaged Terminal Heat Pumps, Room Air Conditioners, and Room Air Conditioner Heat Pumps, Electrically Operated, Minimum Efficiency Requirements: Revise minimum efficiencies for PTAC and PTHP units per addendum bw to ASHRAE/IESNA Standard 90.1-2007.
- Table 14-1G Performance Requirements for Heat Rejection Equipment: Provide higher equipment efficiency tables per addendum to ASHRAE /IESNA Standard 90.1-2007.
- Table 14-3 Piping System Design Maximum Flow Rate in GPM: Add requirement for hydronic system piping design per addendum af and cc to ASHRAE/IESNA Standard 90.1-2007 (companion change to Section 1431.3).
- Table 14-6 Minimum Pipe Insulation Thickness: Revise requirements for pipe insulation for heating and hot water systems per addendum bi to ASHRAE/IESNA Standard 90.1-2007.
- 1510 General Requirements: Retain existing Seattle amendment requiring that parking garage lighting be calculated separately (formerly in Section 1531).
- 1511 Electric Motors: Add informative note to clarify that the motor efficiency requirements are applicable to industrial facilities and processes.
- 1513.3 Daylight Zone Control: (1) Include parking garages; (2) add minor clarifications to the exception that separate circuiting is required for all daylight zones, and restaurants are treated like retail.
- 1513.5 Automatic Shut-Off Controls, Interior: Provide more direction on shut-off during off-hours per addendum cd to ASHRAE/IESNA Standard 90.1-2007.
- 1513.6 Automatic Shut-Off Controls, Interior: Revise as follows: (1) Section 1513.6: clarify that lighting with dual functionality be equipped with automatic lighting controls to shut off lights during unoccupied hours per addendum cu to ASHRAE/IESNA Standard 90.1-2007; (2) Section 1513.6: expand use of occupancy sensor controls per addenda x (storage spaces), and bp, to ASHRAE/IESNA Standard 90.1-2007; (3) Section 1513.6: require reduction in lighting power for lighting often on for 24-hours when spaces are unoccupied per addenda cf (stairwells) to ASHRAE/IESNA Standard 90.1-2007; (4) Section 1513.6: require reduction in lighting power for parking garages per addenda cz to ASHRAE/IESNA Standard 90.1-2007; (5) Section 1513.6.1: require

manual ON for occupancy sensors to eliminate unnecessary lighting consumption per addenda aa to ASHRAE/IESNA Standard 90.1-2007; and (6) Section 1513.6.2: change automatic control zone maximum to 2,500 $ft^2$ per Section 9.4.1.2 of Standard 90.1-2007.

- 1521 Prescriptive Interior Lighting Requirements: Revise to correspond with changes to Section 1531.
- 1531 Interior Lighting Power Allowance: (1) Retain existing Seattle amendment requiring that parking garage lighting be calculated separately (formerly in Section 1532); (2) add informative note with reference back to trading limitations in Section 1510.
- 1532 Exterior Lighting Power Allowance: (1) Retain existing Seattle light pollution criteria; (2) add limits in Table 15-2B for signs.
- 1540 Transformers: Revise criteria for transformers per addendum o of ASHRAE/IESNA Standard 90.1-2007.
- Table 15-1 Unit Lighting Power Allowance: (1) Revise lighting power allowances to achieve greater energy efficiency per addendum by to ASHRAE/IESNA Standard 90.1-2007; (2) add aircraft maintenance and pharmacies; (3) delete footnotes that are not referenced in the table (and therefore are not applicable).
- Table 15-2A Exterior Lighting Zones & Table 15-2B Lighting Power Densities for Building Exteriors: (1) Revise to merge the two highest lighting categories into zone 3; (2) editorial change to display all values to the same number of decimal places.
- Table 15-3 Minimum Nominal Efficiency Levels for NEMA Class I Low Voltage Dry-Type Distribution Transformers: Revise criteria for transformers per addendum o of ASHRAE/IESNA Standard 90.1-2007 (companion change to Section 1540).
- Chapter 16 On-Site Renewable Energy Systems: Add requirements for on-site renewable energy systems from ASHRAE/USGBC/IESNA Standard 189.1-2009, format for installed capacity from Section 7.4.1.1, but with much less-stringent criteria - only 1/12 as stringent with minimum annual energy production equivalent of 500 Btu/$ft^2$ of gross conditioned floor area (instead of minimum annual energy production equivalent of 6,000 Btu/$ft^2$ of gross conditioned floor area); requirement does not take effect until DPD develops Director's Rule with alternate means of compliance.
- RS-29 Nonresidential and Multifamily Residential Building Design by Systems Analysis: (1) Modify title to specifically include multifamily residential buildings; and (2) revise reference to cite Seattle code.
- RS-29, 1.1 General: Revise to reference Seattle Energy Code.
- RS-29, 1.2 Performance Rating: (1) Revise for consistency with other changes (companion change to Chapters 12 and 14); (2) carry over existing criteria from Director's Rule 27-2005.
- RS-29, 1.3 Trade-Off Limits: Revise for consistency with other changes (companion change to Chapter 16).

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- RS-29, 1.4 Documentation Requirements: Carry over existing criteria from Director's Rule 27-2005.
- RS-29, 2.3 Climatic Data: Carry over existing criteria from Director's Rule 27-2005.
- RS-29, 2.4 Energy Conversion: Companion change to Chapter 16.
- RS-29, 2.5 Exceptional Calculation Methods: Revise criteria for exceptional calculation method per addendum r of ASHRAE/IESNA Standard 90.1-2007.
- RS-29, 3.1 Building Performance Calculations: (1) Carry over existing criteria from Director's Rule 27-2005; (2) clarify that the baseline building must comply with the prescriptive requirements.
- RS-29, 3.1.2.2 Equipment Capacities: Revise so that the proposed design does not provide less comfort than the standard design through more hours of unmet loads.
- RS-29, 3.1.2.9 System Fan Power: Revise criteria for fans systems per addendum ca of ASHRAE/IESNA Standard 90.1-2007.
- RS-29, Table 3-1 Modeling Requirements for Calculating Proposed and Baseline Building Performance: Revise for greater consistency with Chapters 11-16 as follows: (1) In 3, Space Use Classification: eliminate extra text that is not applicable; (2) In 5, Building Envelope: provide guidance on modeling air leakage, require that uninsulated components be separately modeled; (3) In 6, Lighting: clarify that interior and exterior lighting cannot be traded.
- RS-29, Table 3.3 Schedules: Revise for consistency with other requirements such as for occupancy sensors within conditioned spaces and within parking garages (companion change to Chapter 15).
- RS-29, 5 Reporting Format: Carry over existing criteria from Director's Rule 27-2005.
- RS-35, Advanced Criteria for Other Programs: Carry over existing criteria from Director's Rule 27-2005.
- RS-36, Illustrative Goals for the 2030 Challenge in Seattle: Provide illustrative goals for the 2030 Challenge in Seattle.

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# CHAPTER 1
# ADMINISTRATION AND ENFORCEMENT

## 101.1 Title and Applicability.

*Discussion:* Clarify applicability to and transition for single-family residential spaces.
*Proposal:* Amend 2009 WSEC as follows -

**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. ((~~; 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 122530, 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, 1141.1, 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 requirements in all chapters, apply to all spaces and occupancies both before and after effectiveness of the 2009 Washington State Energy Code.

## 101.2 Purpose and Intent.

*Discussion:* Clarify that purpose is for single-family residential spaces.
*Proposal:* Amend 2009 WSEC as follows -

**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

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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.**

*Discussion:* Clarify the scope for single-family residential spaces and other spaces.
*Proposal:* Amend 2009 WSEC as follows -

**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((~~either~~)) 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.

**105.2.1 Required Inspections.**

*Discussion:* Revise reference to cite Seattle codes.
*Proposal:* Amend 2009 WSEC as follows -

**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:

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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.

**106 Violations and Penalties.**

*Discussion:* Companion change to Section 1144.
*Proposal:* Amend 2009 WSEC as follows -

**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.

**107 Liability.**

*Discussion:* Revise reference to cite City of Seattle.
*Proposal:* Amend 2009 WSEC as follows -

**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 or county~~))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.

**108 Conflicts with Other Codes.**

*Discussion:* Revise references to cite Seattle codes.
*Proposal:* Amend 2009 WSEC as follows -

**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 (4) and this Code, an 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((~~code, 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

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is a conflict between a general requirement and a specific requirement, the specific requirement shall be applicable. ((~~Wherever in this Code reference is made to the appendix, the provisions in the appendix shall not apply unless specifically adopted.~~))

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# CHAPTER 2
# DEFINITIONS

## 201.1 Application of Terms.

*Discussion:* Revise as follows:

(1) add definition of computer room per addendum bu to ASHRAE/IESNA Standard 90.1-2007 (companion change to Chapter 14);
(2) add definition of daylighted zone in parking garages per addendum cz to ASHRAE/IESNA Standard 90.1-2007 (companion change to Chapter 15);
(3) add definition of dynamic glazing per addendum cl to ASHRAE/IESNA Standard 90.1-2007 (companion change to Chapter 13);
(4) add definition for integrated energy efficiency ratio per addendum s to ASHRAE/IESNA Standard 90.1-2007 (companion change to Chapter 14);
(5) add definitions for types of on-site renewable energy systems (with a modification to include ground-source and groundwater-source heat pumps), and geothermal energy, per ASHRAE/USGBC/IESNA Standard 189.1-2009 (companion change to Chapter 16);
(6) add definition for orientations (companion change to Chapter 13);
(7) add definitions of sensible cooling panel, sensible heating panel, thermally effective panel surface, and thermally ineffective panel surface per addendum ae to ASHRAE/IESNA Standard 90.1-2007 (companion change to Chapter 14);
(8) add definition of visible transmittance per addendum bm to ASHRAE/IESNA Standard 90.1-2007;
(9) clarify definition of building entrance to specifically mention elevator doors and one-way exit doors;
(10) clarify definition of glazing as it applies to other than residential spaces, and add definition for fenestration area to parallel the glazing area definition used for residential spaces;
(11) clarify definition of indirectly conditioned space to specifically address elevator shafts and stair enclosures;
(12) clarify definition of mechanical system to specifically mention industrial facilities and processes;
(13) retain existing note about nominal R-value and existing definition of person;
(14) add cross-references to the Building Code for the definition of existing building and story; and
(15) change definitions to refer to the Seattle codes.

*Proposal:* Amend 2009 WSEC as follows -

**Section 201.1 Application of Terms:** For the purposes of this Code, certain abbreviations, terms, phrases, words and their derivatives, shall be as set forth in this chapter. Where terms are not defined, they shall have their ordinary accepted meanings within the context with which they are used. In the event there is a question about the definition of a term, the definitions for terms in the codes enumerated in RCW 19.27.031 and the edition of Webster's dictionary referenced therein shall be considered as the sources for providing ordinarily accepted meanings.

**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.

…

**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.

…

**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, z-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 determination of U-factors for assemblies that include metal other than screws and nails.)

Informative Note: Even small clips degrade the performance of insulation. For mass walls, Table 13-1 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, z-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 stand-off brackets are better, but still are a thermal bridging element. Calculations on a stand-off system utilizing 6-inch brackets 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 25% 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.

…

**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.

…

**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.

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**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

…

**EAST:** (See **Orientation**.)

…

**ENERGY STAR PROGRAM REQUIREMENTS FOR COMMERCIAL DISHWASHERS:** Energy Star Program Requirements for Commercial Dishwashers, Version 1.1, October 11, 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 heating 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 1-10) differs from that used for other spaces (in Chapters 2 and 10-16). 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.

…

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**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 $h \cdot ft^2 \cdot °F/Btu$ 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.

Procedural 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).

…

**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.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

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.

…

**SOUTH:** (See **Orientation**.)

…

**STORY:** (See the Seattle Building Code.)

…

**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.

…

**WEST:** (See **Orientation**.)

**…**

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

# CHAPTER 3
# DESIGN CONDITIONS

## Table 3-1 Outdoor Design Temperatures.

*Discussion:* Specify Seattle design conditions for consistency with Section 1431.2.
*Proposal:* Amend 2009 WSEC as follows -

### 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 20 NNE | 25 | 83 | Hoquiam AP | 26 | 79 | Rainier, Longmire | 15 | 85 |
| Anacortes | 24 | 72 | Inchelium 2 NW | 0 | 92 | Paradise RS | 8 | 71 |
| Anatone | -4 | 89 | John Day Dam | 19 | 100 | Raymond | 28 | 81 |
| Auburn | 25 | 84 | Kent | 21 | 85 | Redmond | 17 | 83 |
| Battleground | 19 | 91 | Kirkland | 17 | 83 | Republic | -9 | 87 |
| Bellevue | 24 | 83 | La Grande | 23 | 88 | Richland | 11 | 101 |
| Bellingham 2 N | 19 | 78 | Leavenworth | -3 | 93 | Ritzville | 6 | 99 |
| Blaine | 17 | 73 | Little Goose Dam | 22 | 101 | Satus Pass | 10 | 90 |
| Bremerton | 29 | 83 | Long Beach 3 NNE | 25 | 77 | Seattle | 24 | 82 db/ 66 wb |
| Burlington | 19 | 77 | Longview | 24 | 87 | Seattle: Sea-Tac AP | 24 | 83 |
| Chehalis | 21 | 87 | Lower Granite Dam | 14 | 98 | Sedro Woolley 1 E | 19 | 78 |
| Chelan | 10 | 89 | Lower Monument Dam | 18 | 103 | Sequim | 23 | 78 |
| Cheney | 4 | 94 | Marysville | 23 | 79 | Shelton | 23 | 85 |
| Chesaw | -11 | 81 | Metaline Falls | -1 | 89 | Smyrna | 8 | 102 |
| Clarkston | 10 | 94 | Methow 2 W | 1 | 89 | Snohomish | 21 | 81 |
| Cle Elum | 1 | 91 | Nespelem 2 S | -4 | 93 | Snoqualmie Pass | 6 | 80 |
| Colfax 1 NW | 2 | 94 | Newhalem | 19 | 89 | Spokane AP | 4 | 92 |
| Colville AP | -2 | 92 | Newport | -5 | 92 | Spokane CO | 10 | 96 |
| Concrete | 19 | 83 | Northport | 2 | 92 | Stampede Pass | 7 | 76 |
| Connell 4 NNW | 6 | 100 | Oak Harbor | 16 | 74 | Stehekin 3 NW | 12 | 85 |
| Cougar 5 E | 25 | 93 | Odessa | 7 | 100 | Stevens Pass | 6 | 77 |
| Dallesport AP | 14 | 99 | Olga 2 SE | 24 | 71 | Tacoma CO | 29 | 82 |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

| 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) |
|---|---|---|---|---|---|---|---|---|
| Darrington RS | 13 | 85 | Olympia, AP | 17 | 85 | Tatoosh Island | 31 | 63 |
| Davenport | 5 | 92 | Omak 2 NW | 3 | 90 | Toledo AP | 17 | 84 |
| Edmonds | 24 | 82 | Oroville | 5 | 93 | Vancouver | 22 | 88 |
| Ellensburg AP | 2 | 90 | Othello | 9 | 98 | Vashon Island | 28 | 78 |
| Elma | 24 | 88 | Packwood | 16 | 90 | Walla Walla AP | 6 | 96 |
| Ephrata AP | 7 | 97 | Plain | -3 | 89 | Waterville | 1 | 88 |
| Everett Paine AFB | 21 | 79 | Pleasant View | 16 | 98 | Wellpinit | 1 | 93 |
| Forks 1 E | 23 | 81 | Pomeroy | 3 | 95 | Wenatchee CO | 10 | 92 |
| Glacier RS | 13 | 82 | Port Angeles | 28 | 75 | Whidbey Island | 11 | 71 |
| Glenoma (Kosmos) | 18 | 89 | Port Townsend | 25 | 76 | Willapa Harbor | 26 | 81 |
| Goldendale | 7 | 94 | Prosser | 12 | 97 | Wilson Creek | 3 | 96 |
| Grays River Hatchery | 24 | 86 | Puyallup | 19 | 86 | Winthrop 1 WSW | -12 | 91 |
| Greenwater | 1.4 | 84 | Quilcene 2 SW | 23 | 83 | Yakima AP | 11 | 94 |
| Grotto | 21 | 84 | Quinault RS | 25 | 84 | | | |

## 303 Mechanical Ventilation.

*Discussion:* (1) Revise reference to cite Seattle codes; (2) provide cross-reference to mechanical ventilation requirements for other spaces.

*Proposal:* Amend 2009 WSEC as follows -

### 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 1402.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

# CHAPTER 5
# BUILDING DESIGN BY COMPONENT PERFORMANCE APPROACH

## 502.1.1 Building Envelope, General.

*Discussion:* Add note to provide information.
*Proposal:* Amend 2009 WSEC 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(2).

## 502.1.4.1 Building Envelope, General.

*Discussion:* Revise reference to cite Seattle code.
*Proposal:* Amend 2009 WSEC as follows -

**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.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

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) through 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.

*Discussion:* Revise reference to cite Seattle code.
*Proposal:* Amend 2009 WSEC as follows -

**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 E84-01.

**EXCEPTIONS:**

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

### 502.1.4.5 Roof/Ceiling Insulation.

*Discussion:* Revise reference to cite Seattle code.
*Proposal:* Amend 2009 WSEC as follows -

**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 feet 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. When 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.

*Discussion:* Add note to highlight DPD procedural requirement.
*Proposal:* Amend 2009 WSEC as follows -

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

**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 with space heat type other than 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, gap width, gas fill, spacer type, etc.).

**503.10.3 Sealing.**

*Discussion:* Revise reference to cite Seattle code.
*Proposal:* Amend 2009 WSEC as follows -

**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 nondirect 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 insulated on the exterior with R-8 insulation for above grade ducts and R-5 water resistant insulation when within a slab or earth.

### 503.10.4 Dampers.

*Discussion:* Revise reference to cite Seattle code.
*Proposal:* Amend 2009 WSEC as follows -

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

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

# CHAPTER 6
# BUILDING DESIGN BY PRESCRIPTIVE REQUIREMENTS APPROACH

## 602.7.2 Glazing U-Factor.

*Discussion:* Add note to highlight DPD procedural requirement.
*Proposal:* Amend 2009 WSEC 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 tripled and shall be included in the percentage of the total glazing area as allowed for in Table 6-1 or 6-2. The maximum area (before tripling) allowed 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, gap width, gas fill, spacer type, etc.).

# CHAPTER 7
# STANDARDS

**701 Scope.**

*Discussion:* (1) Update Seattle EnvStd to 2009 version; (2) add cross-references to RS-35 (advanced criteria) and RS-36 (2030 Challenge) that are included at the end.
*Proposal:* Amend 2009 WSEC as follows -

**701 Scope.** The following standards shall apply to Chapters 1 through 16((~~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 compilation of this Code). |
| RS-30 | Title 10, Code of Federal Regulations (CFR), Part 430 (March 14, 1988). |
| 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. |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

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 adopt by rule a 2009 version of the Seattle EnvStd software, which in substance shall consist of Seattle EnvStd 2006 with a baseline updated to correspond with Table 13-1 of this Code and having a minimum VT/SHGC ratio of 1.50 for vertical fenestration and skylights with glazing made of glass and 1.42 for skylights with glazing made of plastic. That 2009 version shall constitute RS-32 from and after the effective date of the rule adopting it. 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, ((~~4301 N. Fairfax Dr., Suite 425~~)) 2111 Wilson Blvd, Suite 500, Arlington, VA 22201 ((~~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 360-725-2990 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 #3, P.O. Box 43165, Olympia, WA 98506-3166
Phone 360-956-2000 fax 360-956-2217, internet www.energy.wsu.edu

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

# CHAPTER 9
# ADDITIONAL SINGLE-FAMILY RESIDENTIAL ENERGY EFFICIENCY REQUIREMENTS

## 901 Additional Residential Energy Efficiency Requirements.

*Discussion:* (1) Provide informative note; (2) add notes to highlight DPD procedural requirement; and (3) revise references to cite Seattle code.

*Proposal:* Amend 2009 WSEC 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 4 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:<br>Gas, propane or oil-fired furnace or boiler with minimum AFUE of 92%,<br>**or**<br>Air-source heat pump with minimum HSPF of 8.5.<br><br>[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.<br>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 |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

| OPTION | DESCRIPTION | CREDIT(S) |
|---|---|---|
| 1b | HIGH EFFICIENCY HVAC EQUIPMENT 2:<br>Closed-loop ground source heat pump;<br>with a minimum COP of 3.3.<br><br>[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.<br>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 |
| 1c | HIGH EFFICIENCY HVAC EQUIPMENT 3:<br>DUCTLESS SPLIT SYSTEM HEAT PUMPS, ZONAL CONTROL:<br>In home where the primary space heating system is zonal electric heating, a ductless heat pump system shall be installed and provide heating to at least one zone of the housing unit.<br><br>[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.<br>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 |
| 2 | HIGH EFFICIENCY HVAC DISTRIBUTION SYSTEM:[1]<br>All heating and cooling system components installed inside the conditioned space. All combustion equipment shall be direct vent or sealed combustion.<br>Locating system components in conditioned crawl spaces is not permitted under this option.<br>Electric resistance heat is not permitted under this option.<br>Direct combustion heating equipment with AFUE less than 80% is not permitted under this option.<br><br>[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 shall show the location of the heating and cooling equipment and all the ductwork.<br>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 |

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| OPTION | DESCRIPTION | CREDIT(S) |
|---|---|---|
| 3a | EFFICIENT BUILDING ENVELOPE 1:<br><br>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 full.<br><br>**or**<br><br>Component performance compliance: Reduce the Target UA from Table 5-1 by 5%, as determined using EQUATION 1.[1]<br><br>[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.<br>For glazing U-factors<br>- for Prescriptive compliance, see procedural requirement under Section 602.7.2.<br>- for Component performance compliance, see procedural requirement under Section 502.2.1.] | 0.5 |
| 3b | EFFICIENT BUILDING ENVELOPE 2:<br><br>Prescriptive compliance is based on Table 6-1, Option III with the following modifications: Window U = 0.25 and wall R-21 plus R-4 and R-38 floor, slab on grade R-10 full, below grade slab R-10 full, and R-21 plus R-5 below grade basement walls.<br><br>**or**<br><br>Component performance compliance: Reduce the Target UA from Table 5.1 by 15%, as determined using EQUATION 1.[1]<br><br>[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.<br>For glazing U-factors<br>- for Prescriptive compliance, see procedural requirement under Section 602.7.2.<br>- for Component performance compliance, see procedural requirement under Section 502.2.1.] | 1.0 |
| 3c | SUPER-EFFICIENT BUILDING ENVELOPE 3:<br><br>Prescriptive compliance is based on Table 6-1, Option III with the following modifications: Window U = 0.22 and wall R-21 plus R-12 and R-38 floor, slab on grade R-10 full, below grade slab R-10 full and R-21 plus R-12 below grade basement walls and R-49 advanced ceiling and vault.<br><br>**or**<br><br>Component performance compliance: Reduce the Target UA from Table 5.1 by 30%, as determined using EQUATION 1.[1]<br><br>[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.<br>For glazing U-factors<br>- for Prescriptive compliance, see procedural requirement under Section 602.7.2.<br>- for Component performance compliance, see procedural requirement under Section 502.2.1.] | 2.0 |

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| OPTION | DESCRIPTION | CREDIT(S) |
|---|---|---|
| 4a | AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION:<br><br>Envelope leakage reduced to SLA of 0.00020 building envelope tightness shall be considered acceptable when tested air leakage is less than specific leakage area 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.<br><br>**and**<br><br>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.<br><br>[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.] | 0.5 |
| 4b | ADDITIONAL AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION:<br><br>Envelope leakage reduced to SLA of 0.00015 building envelope tightness shall be considered acceptable when tested air leakage is less than specific leakage area 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.<br><br>**and**<br><br>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.<br><br>[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.] | 1.0 |
| 5a | EFFICIENT WATER HEATING:[1]<br><br>Water heating system shall include one of the following:<br><br>Gas, propane or oil water heater with a minimum EF of 0.62.<br><br>**or**<br><br>Electric Water Heater with a minimum EF of .93.<br><br>**and for both cases**<br><br>All showerhead and kitchen sink faucets installed in the house shall meet be rated at 1.75 GPM or less. All other lavatory faucets shall be rated at 1.0 GPM or less.[2]<br><br>[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 shall specify the maximum flow rates for all showerheads, kitchen sink faucets, and other lavatory faucets.<br>It is recommended that projects apply for a plumbing permit prior to the building permit application and paste a copy of the plumbing permit on the building permit drawings.] | 0.5 |

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| OPTION | DESCRIPTION | CREDIT(S) |
|---|---|---|
| 5b | HIGH EFFICIENCY WATER HEATING:[1]<br>Water heating system shall include one of the following:<br>Gas, propane or oil water heater with a minimum EF of 0.82.<br>**or**<br>Solar water heating supplementing a minimum standard water heater. Solar water heating will 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.<br>**or**<br>Electric heat pump water heater with a minimum EF of 2.0.<br>[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.<br>It is recommended that projects apply for a plumbing permit prior to the building permit application and paste a copy of the plumbing permit on the building permit drawings.] | 1.5 |
| 6 | SMALL DWELLING UNIT 1:[1]<br>Dwelling units less than 1500 square feet in floor area with less than 300 square feet of window + door area. Additions to existing building that are less than 750 square feet of heated floor area.<br>[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 gross floor area and a calculation of the window plus door area.] | 1.0 |
| 7 | LARGE DWELLING UNIT 1:[1]<br>Dwelling units exceeding 5000 square feet of floor area shall be assessed a deduction for purposes of complying with Section 901 of this Code. | -1.0 |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

| OPTION | DESCRIPTION | CREDIT(S) |
|---|---|---|
| 8 | RENEWABLE ELECTRIC ENERGY:<br><br>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 3 credits. Generation shall be calculated as follows:<br><br>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.<br><br>For wind generation projects designs shall document annual power generation based on the following factors:<br><br>The wind turbine power curve; average annual wind speed at the site; frequency distribution of the wind speed at the site and height of the tower.<br><br>[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 and wind access, and include a calculation of the minimum annual energy power production.<br>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.] | 0.5 |

**Footnotes:**

1. Interior Duct Placement: Ducts included as Option 2 of Table 9-1 shall be placed wholly within the heated envelope of the housing unit. The placement shall be inspected and certified to receive the credits associated with this option.

   **EXCEPTION:** Ducts 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 ducts will be tested to the following standards:

   Post-construction test: Leakage to outdoors shall be less than or equal to 1 CFM per 100 $ft^2$ 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 register boots shall be taped or otherwise sealed during the test.

2. 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 bathroom lavatory sink faucets: Maximum flow rate - 3.8 L/min (1.0 gal/min) 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 gal/min) when tested in accordance with ASME A112.18.1/CSA B125.1.

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

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

# CHAPTER 10
# DEFAULT HEAT LOSS COEFFICIENTS

## Section 1001 General.

*Discussion:* No Seattle changes (retain existing Seattle amendment).
*Proposal:* Amend 2009 WSEC as follows -

**SECTION 1001 — GENERAL**

**1001.1 Scope:** The following defaults shall apply to Chapters 1 through 16((~~20~~)). 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.

*Discussion:* Expand options to include R-25 which fits in nominal 2 x 8 framing.
*Proposal:* Amend 2009 WSEC as follows -

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

**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** | | **82** | **71** | **60** | **49** | **38** | **30** | **25** | **22** | **21** | **19** | **15** | **13** | **11** |
| **Standard Thickness, in.** | | **26.0** | **22.5** | **19.0** | **15.5** | **12** | **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 | 26.0 | 82 | — | — | — | — | — | — | — | — | — | — | — | — |
| Truss | 22.5 | — | 71 | — | — | — | — | — | — | — | — | — | — | — |
| Truss | 19.0 | — | — | 60 | — | — | — | — | — | — | — | — | — | — |
| Truss | 15.5 | — | — | — | 49 | — | — | — | — | — | — | — | — | — |
| Truss | 12.0 | — | — | — | — | 38 | — | — | — | — | — | — | — | — |
| 2 x 12 | 11.25 | — | — | — | — | 37 | — | — | — | — | — | — | — | — |
| 2 x 10 | 9.25 | — | — | — | — | 32 | 30 | — | — | — | — | — | — | — |
| 2 x 8 | 7.25 | — | — | — | — | 27 | 26 | 25 | 22 | 21 | 19 | — | — | — |
| 2 x 6 | 5.5 | — | — | — | — | — | 21 | 20 | 20 | 21 | 18 | — | — | — |
| 2 x 4 | 3.5 | — | — | — | — | — | — | — | 14 | — | 13 | 15 | 13 | 11 |
| | 2.5 | — | — | — | — | — | — | — | — | — | — | — | 9.8 | — |
| | 1.5 | — | — | — | — | — | — | — | — | — | — | — | 6.3 | 6 |

**Table 10-B Default R-Values for Building Materials.**

*Discussion:* Retain existing Seattle amendment, but revise information for brick to reflect typical face brick and add footnote with reference for other heat capacities.
*Proposal:* Amend 2009 WSEC as follows –

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

## TABLE 10-B DEFAULT R-VALUES FOR BUILDING MATERIALS

| Material | Nominal Size (in.) | Actual Size (in.) | R-Value (Heat Capacity[3]) |
|---|---|---|---|
| Air cavity (unventilated), between metal studs at 16 inches on center[1] | - | - | 0.79 |
| Air cavity (unventilated), 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/25% core area, 130 lbs/ft$^3$) | 4 | 3.5 | 0.32 (5.9) |
| Carpet and rubber pad | - | - | 1.23 |
| Concrete at R-0.0625/in., heavyweight (144 lbs/ft$^3$) | - | 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/ft$^3$) | 6 | - | 0.80 (HC-11.4) |
| Concrete masonry units, solid grouted, normal weight (135 lbs/ft$^3$) | 6 | - | 0.51 (HC-13.2) |
| Concrete masonry units, partly grouted, lightweight (95 lbs/ft$^3$) | 6 | - | 1.33 (HC-6.7) |
| Concrete masonry units, partly grouted, normal weight (135 lbs/ft$^3$) | 6 | - | 0.82 (HC-9.0) |
| Concrete masonry units, solid grouted, lightweight (95 lbs/ft$^3$) | 8 | - | 1.05 (HC-15.5) |
| Concrete masonry units, solid grouted, normal weight (135 lbs/ft$^3$) | 8 | - | 0.69 (HC-17.9) |
| Concrete masonry units, partly grouted, lightweight (95 lbs/ft$^3$) | 8 | - | 1.44 (HC-9.6) |
| Concrete masonry units, partly grouted, normal weight (135 lbs/ft$^3$) | 8 | - | 0.98 (HC-12.0) |
| Concrete masonry units, solid grouted, lightweight (95 lbs/ft$^3$) | 10 | - | 1.30 (HC-19.7) |
| Concrete masonry units, solid grouted, normal weight (135 lbs/ft$^3$) | 10 | - | 0.87 (HC-22.6) |
| Concrete masonry units, partly grouted, lightweight (95 lbs/ft$^3$) | 10 | - | 1.61 (HC-11.9) |
| Concrete masonry units, partly grouted, normal weight (135 lbs/ft$^3$) | 10 | - | 1.11 (HC-14.8) |
| Concrete masonry units, solid grouted, lightweight (95 lbs/ft$^3$) | 12 | - | 1.53 (HC-23.9) |
| Concrete masonry units, solid grouted, normal weight (135 lbs/ft$^3$) | 12 | - | 1.06 (HC-27.2) |
| Concrete masonry units, partly grouted, lightweight (95 lbs/ft$^3$) | 12 | - | 1.75 (HC-14.2) |
| Concrete masonry units, partly grouted, normal weight (135 lbs/ft$^3$) | 12 | - | 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-0.104/in. | - | 12 | 1.25 |

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| Material | Nominal Size (in.) | Actual Size (in.) | R-Value (Heat Capacity[3]) |
|---|---|---|---|
| Steel, mild | | 1 | 0.0031807 |
| Stucco | - | 0.75 | 0.08 |

[1] Air cavities, within building assemblies, that are open to outside air 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.

**1005.3 Component Description.**

*Discussion:* Revise descriptions for metal building walls for consistency with addendum bb to ASHRAE/IESNA Standard 90.1-2007.

*Proposal:* Amend 2009 WSEC as follows -

**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 dead-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 second 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 A9.2 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.**

## Table 10-5A U-Factors for Overall Assembly Metal Stud Walls, Effective R-Values for Metal Framing and Cavity Only, and Default Metal Building U-Factors.

*Discussion:* Expand default options for metal stud walls in Table 10-5A(1); revise and expand default options for metal building walls in Table 10-5A(3) for consistency with addendum bb to ASHRAE/IESNA Standard 90.1-2007.

*Proposal:* Amend 2009 WSEC as follows -

**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-1.3 | R-1.5 | U-0.260 | U-0.117 | U-0.111 | U-0.106 | U-0.099 | U-0.096 | U-0.092 |

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| 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) |
| | R-2 | R-2.5 | R-3.0 | U-0.207 | U-0.105 | U-0.100 | U-0.096 | 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-0.078 | 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-0.046 |
| | 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- | U- | U- | U- | U- | U- | U- |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

| 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) |
| | | | | 0.112 | 0.068 | 0.066 | 0.063 | 0.060 | 0.059 | 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 | | Insulation | | |
|---|---|---|---|---|---|
| | Nominal Depth, Inches | Actual Depth, Inches | Nominal R-Value | Effective R-Value | |
| | | | | 16" O.C. | 24" O.C. |
| **Air Cavity** | Any | Any | R-0.91 (air) | 0.79 | 0.91 |
| **Wall** | 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 |
| | 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 |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

**TABLE 10-5A(3)**
**Default Metal Building Wall U-Factors**

| Insul-ation System | Rated R-Value of Insulation | Overall U-Factor for Entire Base Wall Assembly | Overall U-Factor for Assembly of Base Wall Plus Continuous Insulation (Uninterrupted by Framing) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Rated R-Value of Continuous Insulation | | | | | | | | |
| | | | R-6.5 | R-9.8 | 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 ((~~0.037~~)) | 0.030 | 0.026 ((~~0.025~~)) |
| | R-10 | 0.186 | 0.084 | 0.066 | 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 | 0.033 ((~~0.032~~)) | 0.027 ((~~0.026~~)) | 0.023 |
| | R-13 | 0.162 | 0.079 | 0.063 | 0.052 | 0.046 | 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 |

## Table 10-5B Default U-Factors for Concrete and Masonry Walls.

*Discussion:* (1) Table 10-5B(1): retain existing Seattle numbering for tables; (2) Table 10-5B(2): expand default options for peripheral edges of intermediate concrete floors; (3) Table 10-5B(3): retain existing Seattle amendment with default options for mass walls and revise for consistency with addendum bb to ASHRAE/IESNA Standard 90.1-2007.

*Proposal:* Amend 2009 WSEC as follows -

**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 | | | Solid Grout |
| | Empty | Loose-fill insulated | | |
| | | Perlite | Vermiculite | |
| 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 |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

| WALL DESCRIPTION | CORE TREATMENT | | | |
|---|---|---|---|---|
| | Partial Grout with Ungrouted Cores | | | Solid Grout |
| | Empty | Loose-fill insulated | | |
| | | Perlite | Vermiculite | |
| 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 | | | Solid Grout |
| | Empty | Loose-fill insulated | | |
| | | Perlite | Vermiculite | |
| Exposed Block, Both Sides | 0.35 | 0.17 | 0.18 | 0.33 |
| R-5 Interior Insulation, Wood Furring | 0.14 | 0.10 | 0.10 | 0.13 |
| R-6 Interior Insulation, Wood Furring | 0.13 | 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 | 0.06 | 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 | | | Solid Grout |
| | Empty | Loose-fill insulated | | |
| | | Perlite | Vermiculite | |
| Exposed Block, Both Sides | 0.50 | 0.31 | 0.32 | 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 | 0.12 | 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 | 0.11 | 0.11 | 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 | | | Solid Grout |
| | Empty | Loose-fill insulated | | |
| | | Perlite | Vermiculite | |
| 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 | 0.12 |
| 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 | 0.132 |
| 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 | 0.076 | 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 | 0.052 | 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 |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

**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- 0.226 | 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- 0.083 | 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- 0.0 | U- 0.414 | U- 0.359 | U- 0.318 |
| 1.0 in. | R- 3.8 | U- 0.325 | U- 0.290 | U- 0.263 |
| 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- 0.274 | U- 0.249 |
| 1.5 in. | R- 11.0 | U- 0.267 | U- 0.243 | 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- 13.0 | 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- 0.116 | 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 |
| 5.0 in. | R- 32.0 | U- 0.109 | U- 0.105 | U- 0.101 |
| 5.5 in. | R- 19.0 | U- 0.118 | U- 0.113 | U- 0.109 |
| 5.5 in. | R- 20.9 | U- 0.114 | U- 0.109 | 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- 0.106 | U- 0.102 | U- 0.099 |
| 5.5 in. | R- 30.8 | U- 0.104 | U- 0.100 | U- 0.096 |
| 6.0 in. | R- 22.8 | U- 0.106 | U- 0.102 | U- 0.098 |
| 6.0 in. | R- 30.0 | U- 0.099 | U- 0.095 | U- 0.092 |
| 6.0 in. | R- 33.6 | U- 0.096 | 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- 0.093 | U- 0.090 | U- 0.087 |
| 7.5 in. | R- 28.5 | U- 0.088 | U- 0.085 | U- 0.083 |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

| 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) |
|---|---|---|---|---|
| | | | | |
| 8.0 in. | R- 30.4 | U- 0.083 | U- 0.081 | U- 0.079 |
| **1 in 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/ mass wall area of <0.0004 (<0.04% of the mass wall area)[5]** | | | | |
| 1.0 in. | R- 3.8 | U- 0.210 | U- 0.195 | U- 0.182 |
| 1.0 in. | R- 5.0 | U- 0.184 | U- 0.172 | U- 0.162 |
| 1.0 in. | R- 5.6 | U- 0.174 | U- 0.163 | U- 0.154 |
| 1.5 in. | R- 5.7 | U- 0.160 | U- 0.151 | U- 0.143 |
| 1.5 in. | R- 7.5 | U- 0.138 | U- 0.131 | U- 0.125 |
| 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- 0.118 |
| 2.0 in. | R- 10.0 | U- 0.110 | U- 0.106 | U- 0.102 |
| 2.0 in. | R- 11.2 | U- 0.103 | U- 0.099 | U- 0.096 |
| 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 |
| 2.5 in. | R- 14.0 | U- 0.086 | U- 0.083 | U- 0.080 |
| 3.0 in. | R- 11.4 | U- 0.094 | U- 0.090 | U- 0.088 |
| 3.0 in. | R- 15.0 | U- 0.078 | U- 0.076 | U- 0.074 |
| 3.0 in. | R- 16.8 | U- 0.073 | U- 0.071 | U- 0.069 |
| 3.5 in. | R- 13.3 | U- 0.082 | U- 0.080 | U- 0.077 |
| 3.5 in. | R- 17.5 | U- 0.069 | U- 0.067 | U- 0.065 |
| 3.5 in. | R- 19.6 | U- 0.064 | 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- 20.0 | U- 0.061 | U- 0.060 | U- 0.058 |
| 4.0 in. | R- 22.4 | U- 0.057 | U- 0.056 | U- 0.054 |
| 5.0 in. | R- 28.0 | U- 0.046 | U- 0.046 | U- 0.045 |
| 6.0 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 |
| 11.0 in. | R- 61.6 | U- 0.022 | U- 0.022 | U- 0.022 |
| **Continuous Insulation Uninterrupted by Framing** | | | | |
| No Framing | R- 1.0 | U- 0.425 | U- 0.367 | U- 0.324 |
| | R- 2.0 | U- 0.298 | U- 0.269 | U- 0.245 |
| | R- 3.0 | U- 0.230 | U- 0.212 | U- 0.197 |
| | R- 4.0 | U- 0.187 | U- 0.175 | U- 0.164 |
| | R- 5.0 | U- 0.157 | U- 0.149 | U- 0.141 |
| No Framing | R- 6.0 | U- 0.136 | U- 0.129 | U- 0.124 |
| | R- 7.0 | U- 0.120 | U- 0.115 | U- 0.110 |
| | R- 8.0 | U- 0.107 | U- 0.103 | U- 0.099 |
| | R- 9.0 | U- 0.097 | U- 0.093 | U- 0.090 |
| | R- 10.0 | U- 0.088 | U- 0.085 | U- 0.083 |
| No Framing | R- 11.0 | U- 0.081 | U- 0.079 | U- 0.076 |
| | R- 12.0 | U- 0.075 | U- 0.073 | U- 0.071 |
| | R- 13.0 | U- 0.070 | U- 0.068 | U- 0.066 |
| | R- 14.0 | U- 0.065 | U- 0.064 | U- 0.062 |
| | R- 15.0 | U- 0.061 | U- 0.060 | U- 0.059 |
| No Framing | R- 16.0 | U- 0.058 | U- 0.056 | U- 0.055 |
| | R- 17.0 | U- 0.054 | U- 0.053 | U- 0.052 |
| | R- 18.0 | U- 0.052 | U- 0.051 | U- 0.050 |
| | R- 19.0 | U- 0.049 | U- 0.048 | U- 0.047 |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

| 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- 20.0 | U- 0.047 | U- 0.046 | U- 0.045 |
| No Framing | R- 21.0 | U- 0.045 | U- 0.044 | U- 0.043 |
| | R- 22.0 | U- 0.043 | U- 0.042 | U- 0.042 |
| | R- 23.0 | U- 0.041 | U- 0.040 | U- 0.040 |
| | R- 24.0 | U- 0.039 | U- 0.039 | U- 0.038 |
| | R- 25.0 | U- 0.038 | U- 0.037 | U- 0.037 |
| No Framing | R- 30.0 | U- 0.032 | U- 0.032 | U- 0.031 |
| | R- 35.0 | U- 0.028 | U- 0.027 | U- 0.027 |
| | R- 40.0 | U- 0.024 | U- 0.024 | U- 0.024 |
| | R- 45.0 | U- 0.022 | U- 0.021 | U- 0.021 |
| | R- 50.0 | U- 0.019 | U- 0.019 | U- 0.019 |
| | R- 55.0 | U- 0.018 | U- 0.018 | U- 0.018 |
| | R- 60.0 | U- 0.016 | U- 0.016 | U- 0.016 |
| **Brick cavity wall with continuous insulation** | | | | |
| No Framing | R- 0.0 | U- 0.337 | U- 0.299 | U- 0.270 |
| No Framing | R- 3.8 | U- 0.148 | U- 0.140 | U- 0.133 |
| No Framing | R- 5.0 | U- 0.125 | U- 0.120 | U- 0.115 |
| No Framing | R- 6.5 | U- 0.106 | U- 0.102 | U- 0.098 |
| No Framing | R- 7.6 | U- 0.095 | U- 0.091 | U- 0.088 |
| No Framing | R- 10.0 | U- 0.077 | U- 0.075 | U- 0.073 |
| No Framing | R- 10.5 | U- 0.079 | U- 0.077 | U- 0.075 |
| No Framing | R- 11.4 | U- 0.070 | U- 0.068 | U- 0.066 |
| No Framing | R- 15.0 | U- 0.056 | U- 0.055 | U- 0.053 |
| 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- 22.5 | U- 0.041 | U- 0.040 | U- 0.039 |
| No Framing | R- 28.5 | U- 0.033 | U- 0.032 | U- 0.032 |
| **Continuous Insulation Uninterrupted by Framing with Stucco and Continuous Metal Framing at 24 in. on center horizontally** | | | | |
| 1.0 in. | R- 0.0 + R-19 c.i. | U- 0.047 | U- 0.046 | U- 0.045 |
| 1.0 in. | R- 3.8 + R-19 c.i. | U- 0.045 | U- 0.044 | U- 0.044 |
| 1.0 in. | R- 5.0 + R-19 c.i. | U- 0.045 | U- 0.044 | U- 0.043 |
| 1.0 in. | R- 6.5 + R-19 c.i. | U- 0.045 | U- 0.044 | U- 0.043 |
| 1.5 in. | R- 11.0 + R-19 c.i. | U- 0.044 | U- 0.043 | U- 0.043 |
| 2.0 in. | R- 7.6 + R-19 c.i. | U- 0.043 | U- 0.042 | U- 0.041 |
| 2.0 in. | R- 10.0 + R-19 c.i. | U- 0.042 | U- 0.041 | U- 0.041 |
| 2.0 in. | R- 13.0 + R-19 c.i. | U- 0.042 | U- 0.041 | U- 0.041 |
| 3.0 in. | R- 11.4 + R-19 c.i. | U- 0.041 | U- 0.040 | U- 0.039 |
| 3.0 in. | R- 15.0 + R-19 c.i. | U- 0.040 | U- 0.039 | U- 0.039 |
| 3.0 in. | R- 19.0 + R-19 c.i. | U- 0.040 | U- 0.039 | U- 0.038 |
| 3.5 in. | R- 11.0 + R-19 c.i. | U- 0.040 | U- 0.039 | U- 0.039 |
| 3.5 in. | R- 13.0 + R-19 c.i. | U- 0.040 | U- 0.039 | U- 0.038 |
| 5.0 in. | R- 19.0 + R-19 c.i. | U- 0.037 | U- 0.036 | U- 0.036 |
| 5.0 in. | R- 25.0 + R-19 c.i. | U- 0.036 | U- 0.035 | U- 0.035 |
| 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)**

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

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 column.
   – For metal studs and z-furring, use the continuous-metal-framing category.
   – For discontinuous metal clips 1 inch square or smaller, 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 stand-alone walls in multi-layer 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 also includes R-0.45 for 0.5 in. gypsum board. U-factors are provided for the following configurations:
   (a) Concrete wall: 8-in. normal weight concrete wall with a density of 145 lb/ft$^3$.
   (b) Solid grouted concrete block wall: 8-in. medium weight ASTM C90 concrete block with a density of 115 lb/ft$^3$ and solid grouted cores.
   (c) Partially grouted concrete block wall: 8-in. medium weight ASTM C90 concrete block with a density of 115 lb/ft$^3$ having reinforcing steel every 32 in. vertically and every 48 in. horizontally, with cores grouted in those areas only. Other cores are filled with insulating material only if there is no other insulation.
3. For walls with insulation contained in a framing layer, the U-factors in Table 10-5B(3) assume contact (and thermal bridging) between the mass wall and other framing. For wall assemblies with multiple layers where the wood or metal framing layer does not contact the concrete or masonry layer (i.e. walls with an airspace between the stud wall layer and the mass wall layer), 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 layer (e.g. a nominal four-inch metal stud containing insulation that is nominally six inches thick and therefore 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 A3.1 and Tables A3.1A to A3.1D, or Section A9.4. 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.

## 1006 Default U-Factors for Fenestration, Glazing, and Doors.

*Discussion:* Revise terminology for consistency with 2009 WSEC.
*Proposal:* Amend 2009 WSEC as follows -

### 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.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

**Table 10-6 Other than Single-Family Residential: Default U-Factors for Vertical Fenestration, Skylights, and Opaque Doors.**

*Discussion:* Clarify default U-factors for revolving doors and vestibules.
*Proposal:* Amend 2009 WSEC as follows -

**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 (see below for revolving doors & vestibules)[b] | 1.45 | 1.45 | 1.45 |
| Double | 0.90 | 0.85 | 0.75 |
| 1/2 Inch Air, Fixed/Operable | 0.75/0.90 | 0.70/0.84 | 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 | 0.55 | 0.50 |
| 1/2 Inch Air, Fixed/Operable | 0.55/0.66 | 0.50/0.60 | 0.45/0.54 |
| 1/2 Inch Air, Low-e$^{(0.20)}$, Fixed/Operable | 0.50/0.60 | 0.45/0.54 | 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 (3-wing or 4-wing) and size of the rough opening for the revolving door.

ii. Vestibules shall use the default U-factor for 4-wing revolving doors in Table 10-6C that corresponds most closely to the size of the rough opening for the vestibule.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

| ((~~Overhead Glazing~~))Skylights: Sloped Glazing (Including Frame) | | | |
|---|---|---|---|
| | U-Factor | | |
| | **Any Frame** | **Aluminum W/Thermal Break** | **Vinyl/Wood/ Fiberglass Frame** |
| Single | 1.74 | 1.74 | 1.74 |
| Double | 1.08 | 1.02 | 0.90 |
| 1/2 Inch Air, Fixed | 0.90 | 0.84 | 0.72 |
| 1/2 Inch Air, Low-e$^{(0.40)}$, Fixed | 0.84 | 0.72 | 0.60 |
| 1/2 Inch Air, Low-e$^{(0.10)}$, Fixed | 0.78 | 0.66 | 0.54 |
| 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 | 0.66 | 0.60 | 0.54 |
| 1/2 Inch Air, Low-e $^{(0.20)}$, Fixed | 0.60 | 0.54 | 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 |

## 1007.2 Component Description.

*Discussion:* Revise descriptions for metal building roofs for consistency with addendum bb to ASHRAE/IESNA Standard 90.1-2007.

*Proposal:* Amend 2009 WSEC as follows -

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

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

**Ceilings Below a Vented Attic:** Attic insulation is assumed to be blown-in, loose-fill fiberglass with a K-value of 2.6 $h \cdot ft^2 \cdot °F/Btu$ per inch. Full bag count for specified R-value is assumed in all cases. Ceiling dimensions for flat ceiling calculations are forty-five by thirty 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 | .031 |
| 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 0.016.

**Vaulted Ceilings:** Insulation is assumed to be fiberglass batts installed in roof joist cavities. In the vented case, at least 1.5-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 502.1.6.3 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.

## Table 10-7F Default U-Factors for Metal Building Roofs.

*Discussion:* Revise and expand default options for metal building roofs in Table 10-7F for consistency with addendum bb to ASHRAE/IESNA Standard 90.1-2007.

*Proposal:* Amend 2009 WSEC as follows -

**TABLE 10-7F**
**Default U-Factors for Metal Building Roofs**

| Insul-ation 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-15.8 | R-19 ((~~R-19.5~~)) | R-22.1 | R-25 ((~~R-26~~)) | R-32 ((~~R-32.5~~)) | R-38 ((~~R-39~~)) |
| **Standing Seam Roofs with Thermal Spacer Blocks [a,b]** | | | | | | | | | | | |
| Single Layer | None | 1.280 | 0.137 | 0.095 | 0.073 | 0.060 | 0.051 ((~~0.049~~)) | 0.044 | 0.039 ((~~0.037~~)) | 0.031 ((~~0.030~~)) | 0.026 ((~~0.025~~)) |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

| Insul-ation 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-15.8 | R-19 ((~~R-19.5~~)) | R-22.1 | R-25 ((~~R-26~~)) | R-32 ((~~R-32.5~~)) | R-38 ((~~R-39~~)) |
| | R-10 | 0.115 | 0.066 | 0.054 | 0.046 | 0.041 | 0.036 ((~~0.035~~)) | 0.032 | 0.030 ((~~0.029~~)) | 0.025 ((~~0.024~~)) | 0.021 |
| | R-11 | 0.107 | 0.063 | 0.052 | 0.045 | 0.040 | 0.035 | 0.032 | 0.029 ((~~0.028~~)) | 0.024 | 0.021 |
| | R-13 | 0.101 | 0.061 | 0.051 | 0.044 | 0.039 | 0.035 ((~~0.034~~)) | 0.031 | 0.029 ((~~0.028~~)) | 0.024 | 0.021 ((~~0.020~~)) |
| | R-16 | 0.096 | 0.059 | 0.049 | 0.043 | 0.038 | 0.034 ((~~0.033~~)) | 0.031 | 0.028 ((~~0.027~~)) | 0.024 ((~~0.023~~)) | 0.021 ((~~0.020~~)) |
| | R-19 | 0.082 | 0.053 | 0.045 | 0.040 | 0.036 | 0.032 ((~~0.038~~)) | 0.029 | 0.027 ((~~0.026~~)) | 0.023 ((~~0.022~~)) | 0.020 |
| Double Layer | R-10 + R-10 | 0.088 | 0.056 | 0.047 | 0.041 | 0.037 | 0.033 ((~~0.032~~)) | 0.030 | 0.028 ((~~0.027~~)) | 0.023 | 0.020 |
| | R-10 + R-11 | 0.086 | 0.055 | 0.047 | 0.041 | 0.036 | 0.033 ((~~0.032~~)) | 0.030 | 0.027 | 0.023 | 0.020 |
| | R-11 + R-11 | 0.085 | 0.055 | 0.046 | 0.040 | 0.036 | 0.033 ((~~0.032~~)) | 0.030 | 0.027 ((~~0.026~~)) | 0.023 | 0.020 |
| | R-10 + R-13 | 0.084 | 0.054 | 0.046 | 0.040 | 0.036 | 0.032 | 0.029 | 0.027 ((~~0.026~~)) | 0.023 | 0.020 |
| | R-11 + R-13 | 0.082 | 0.053 | 0.045 | 0.040 | 0.036 | 0.032 | 0.029 | 0.027 ((~~0.026~~)) | 0.023 ((~~0.022~~)) | 0.020 |
| | R-13 + R-13 | 0.075 | 0.050 | 0.043 | 0.038 | 0.034 | 0.031 ((~~0.030~~)) | 0.028 | 0.026 ((~~0.025~~)) | 0.022 | 0.019 |
| | R-10 + R-19 | 0.074 | 0.050 | 0.043 | 0.038 | 0.034 | 0.031 ((~~0.030~~)) | 0.028 | 0.026 ((~~0.025~~)) | 0.022 | 0.019 |
| | R-11 + R-19 | 0.072 | 0.049 | 0.042 | 0.037 | 0.034 | 0.030 | 0.028 | 0.026 ((~~0.025~~)) | 0.022 | 0.019 |
| | R-13 + R-19 | 0.068 | 0.047 | 0.041 | 0.036 | 0.033 | 0.030 ((~~0.029~~)) | 0.027 | 0.025 | 0.021 | 0.019 |
| | R-16 + R-19 | 0.065 | 0.046 | 0.040 | 0.035 | 0.032 | 0.029 | 0.027 | 0.025 ((~~0.024~~)) | 0.021 | 0.019 ((~~0.018~~)) |
| | R-19 + R-19 | 0.060 | 0.043 | 0.038 | 0.034 | 0.031 | 0.028 | 0.026 | 0.024 ((~~0.023~~)) | 0.021 ((~~0.020~~)) | 0.018 |
| Liner System | R-19 + R-11 | 0.035 | | | | | | | | | |
| | R-25 + R-11 | 0.031 | | | | | | | | | |
| | R-30 + R-11 | 0.029 | | | | | | | | | |
| | R-25 + R-11 + R-11 | 0.026 | | | | | | | | | |
| | R-30 + R-11 + R-11 | 0.024 | | | | | | | | | |
| **Filled Cavity with Thermal Spacer Blocks [c]** | | | | | | | | | | | |
| | R-10 + R-19 | 0.041 | 0.032 | 0.029 | 0.027 | 0.025 | 0.023 | 0.022 | 0.020 | 0.018 | 0.016 |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

| Insul-ation 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-15.8 | R-19 ((~~R-19.5~~)) | R-22.1 | R-25 ((~~R-26~~)) | R-32 ((~~R-32.5~~)) | R-38 ((~~R-39~~)) |
| | | ((~~0.057~~)) | ((~~0.042~~)) | | ((~~0.033~~)) | | ((0.027)) | | ((~~0.023~~)) | ((~~0.020~~)) | ((~~0.018~~)) |
| **Standing Seam Roofs without Thermal Spacer Blocks** | | | | | | | | | | | |
| Liner System | R-19 + R-11 | 0.040 | | | | | | | | | |
| **Thru-Fastened Roofs without Thermal Spacer Blocks** | | | | | | | | | | | |
| | R-10 | 0.184 | 0.084 | 0.066 | 0.054 | 0.047 | 0.041 | 0.036 | 0.033 | 0.027 | 0.023 |
| | R-11 | 0.182 | 0.083 | 0.065 | 0.054 | 0.047 | 0.041 | 0.036 | 0.033 | 0.027 | 0.023 |
| | R-13 | 0.174 | 0.082 | 0.064 | 0.053 | 0.046 | 0.040 | 0.036 | 0.033 | 0.026 | 0.023 |
| | R-16 | 0.157 | 0.078 | 0.062 | 0.052 | 0.045 | 0.039 | 0.035 | 0.032 | 0.026 | 0.023 |
| | R-19 | 0.151 | 0.076 | 0.061 | 0.051 | 0.045 | 0.039 | 0.035 | 0.032 | 0.026 | 0.022 |
| Liner System | R-19 + R-11 | 0.044 | | | | | | | | | |

(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.

## Table 10-7G Assembly U-Factors for Roofs with Insulation Entirely Above Deck (Uninterrupted by Framing).

*Discussion:* Expand default options for roofs with insulation entirely above deck.
*Proposal:* Amend 2009 WSEC as follows -

**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-0 | Not allowed | U-1.282 |
| R-1 | Not allowed | U-0.562 |
| R-2 | Not allowed | U-0.360 |
| R-3 | Not allowed | U-0.265 |
| R-4 | Not allowed | U-0.209 |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

| **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-0.173 |
| R-6 | R-7 | U-0.147 |
| R-7 | R-8 | U-0.129 |
| R-8 | R-9 | U-0.114 |
| R-9 | R-10 | U-0.102 |
| R-10 | R-12 | U-0.093 |
| R-11 | R-13 | U-0.085 |
| R-12 | 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-31 | U-0.046 |
| R-22 | R-33 | U-0.044 |
| R-23 | R-35 | 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-43 | U-0.036 |
| R-28 | R-46 | U-0.035 |
| R-29 | R-48 | U-0.034 |
| R-30 | R-50 | U-0.032 |
| R-31 | R-52 | U-0.031 |
| R-32 | R-54 | U-0.031 |
| R-33 | R-56 | U-0.030 |
| R-34 | R-59 | 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-73 | U-0.025 |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

| 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-41 | R-75 | 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-96 | U-0.020 |
| R-50 | R-99 | U-0.020 |
| R-55 | R-112 | U-0.018 |
| R-60 | R-126 | U-0.016 |

**1009.1 Mass, General.**

*Discussion:* Add cross-reference to Table 10-B for brick, concrete, and concrete masonry used in other than single-family residential projects.

*Proposal:* Amend 2009 WSEC as follows -

**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:

Ln(R-value) x (-.221) .+ 0.5

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.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

# CHAPTER 11
# ADMINISTRATION AND ENFORCEMENT

## 1100 Title.

*Discussion:* Clarify that the requirements apply to multifamily residential spaces.
*Proposal:* Amend 2009 WSEC 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."~~))

## 1105 Applicability to Multifamily Residential Spaces.

*Discussion:* Specify transition for multifamily residential spaces.
*Proposal:* Amend 2009 WSEC as follows -

**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 1133, 1140, 1141.1, 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 requirements in all chapters, apply to all spaces and occupancies both before and after effectiveness 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 no spaces in Group I occupancy are classified as "residential," therefore all Seattle Amendments to sections relevant to those spaces apply to all such spaces.

## 1110 Purpose and Intent.

*Discussion:* Clarify that the requirements apply to all buildings, systems, and processes.

*Proposal:* Amend 2009 WSEC as follows -

**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.

## 1120 Scope.

*Discussion:* More explicitly state the application to commercial and industrial processes.
*Proposal:* Amend 2009 WSEC as follows -

**SECTION 1120 — SCOPE**

This Code sets forth minimum requirements for the design and commissioning 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.

*Discussion:* Clarify application of vestibule requirements to existing buildings.
*Proposal:* Amend 2009 WSEC as follows -

**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:**

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

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 roof/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 floors without framing cavities, provided that any new cavities added to existing walls and floors 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.

*Discussion:* Add specification that mechanical system alterations are not to decrease the energy efficiency of the building.

Chapter 14 contains requirements for mechanical systems that are applicable to all projects, new buildings as well as alterations to existing buildings. Chapter 11 provides some alternates for existing buildings. Alterations that comply with Chapter 14 do not need to comply with the provisions in Chapter 11. Thus, while alterations of the mechanical systems are not allowed to decrease the energy efficiency under Chapter 11, mechanical systems which are more efficient than required by Chapter 14 of the current code are allowed to decrease energy efficiency as long as the mechanical system still complies with Chapter 14 after the mechanical system alteration is completed.

*Proposal:* Amend 2009 WSEC as follows -

**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 only 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-29 analysis.

2. Alternate designs that are not in full compliance with this Code may be approved when 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.**

*Discussion:* (1) Expand application of requirements for lighting alterations per addendum av to ASHRAE/IESNA Standard 90.1, (2) add specification that lighting system alterations are not to decrease the energy efficiency of the building.

Chapter 15 contains requirements for lighting, motors, and transformers that are applicable to all projects, new buildings as well as alterations to existing buildings. Chapter 11 provides some alternates for existing buildings. Alterations that comply with Chapter 15 do not need to comply with the provisions in Chapter 11. Thus, while alterations of the lighting systems are not allowed to decrease the energy efficiency under Chapter 11, lighting systems which are more efficient than required by Chapter 15 of the current code are allowed to decrease energy efficiency as long as the lighting system still complies with Chapter 15 after the lighting system alteration is completed.

*Proposal:* Amend 2009 WSEC as follows -

**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 tenant improvements, alterations or repairs where ((~~60~~)) 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 $ft^2$ 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.**

*Discussion:* (1) Explicitly cite changes of space conditioning in the title; (2) retain existing Seattle amendment, with minor change to delete heating equipment capacity.
*Proposal:* Amend 2009 WSEC as follows -

**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.**

*Discussion:* Delete HVAC limitations, thereby retaining application of commissioning requirements to all buildings per existing Seattle Energy Code requirements.
*Proposal:* Amend 2009 WSEC as follows -

**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 40 tons or more~~)).

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

**1141.2 Details.**

*Discussion:* Companion change to Table 13-1.
*Proposal:* Amend 2009 WSEC as follows -

**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.**

*Discussion:* Companion change to RS-29 Section 1.2.
*Proposal:* Amend 2009 WSEC as follows -

**1141.4 Systems Analysis Approach for the Entire Building:** In lieu of using Chapters 12 through 16((~~20~~)), 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 1.2 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.**

*Discussion:* Revise reference to cite Seattle code.
*Proposal:* Amend 2009 WSEC as follows -

**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.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

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.**

*Discussion:* Revise to reflect current procedures.
*Proposal:* Amend 2009 WSEC as follows -

**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, commend, 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 that 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.**

*Discussion:* Clarify applicability.
*Proposal:* Amend 2009 WSEC as follows -

**1150 Conflicts with Other Codes.** In case of conflicts among Codes enumerated in RCW 19.27.031 subsections (1), (2), (3) 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**.

*Discussion:* Revise to reflect current procedures.
*Proposal:* Amend 2009 WSEC as follows -

**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 of 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.

**Table 11-1 Economizer Compliance Options for Mechanical Alterations.**

*Discussion:* Retain existing Seattle amendments, with minor companion change for consistency with Chapter 14.

*Proposal:* Amend 2009 WSEC as follows -

**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]<br>Economizer: 1433[2] | Efficiency: min.[1]<br>Economizer: 1433[2,3] | Efficiency: min.[1]<br>Economizer: 1433[2,3] | Efficiency: min.[1]<br>Economizer: 1433[2,4] |
| 2. Split Systems | Efficiency: min.[1]<br>Economizer: 1433[2] | Efficiency: + 10/5%[5]<br>Economizer: shall not decrease existing economizer capability | Only for new units < 54,000 Btuh replacing unit installed prior to 1991 (one of two):<br>Efficiency: + 10/5%[5]<br>Economizer: 50%[6]<br>For units > 54,000 Btuh or any units installed after 1991:<br>Option A | Efficiency: min.[1]<br>Economizer: 1433[2,4] |
| 2a. Equipment within the scope of ASHRAE Std 127 | Efficiency: min.[1]<br>Economizer: 1433[2] | Efficiency: min.[1]<br>Economizer: 1433[2] | Efficiency: min.[1]<br>Economizer: 1433[2] | Efficiency: min.[1]<br>Economizer: 1433[2] |
| 3. Water Source Heat Pump | Efficiency: min.[1]<br>Economizer: 1433[2] | (two of three):<br>Efficiency: + 10/5%[5]<br>Flow control valve[7]<br>Economizer: 50%[6] | (three of three):<br>Efficiency: + 10/5%[5]<br>Flow control valve[7]<br>Economizer: 50%[6]<br>(except for certain pre-1991 systems[8]) | Efficiency: min.[1]<br>Economizer: 1433[2,4]<br>(except for certain pre-1991 systems[8]) |
| 4. Hydronic Economizer using Air-Cooled Heat Rejection Equipment (Dry Cooler) | Efficiency: min.[1]<br>Economizer: 1433[2] | Efficiency: + 10/5%[5]<br>Economizer: shall not decrease existing economizer capacity | Option A | Efficiency: min.[1]<br>Economizer: 1433[2,4] |

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| | **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** |
| 4a. Hydronic Economizer using equipment within the scope of ASHRAE Std 127 | Efficiency: min.[1]<br>Economizer: 1433[2] | Efficiency: min.[1]<br>Economizer: 1433[2] | Efficiency: min.[1]<br>Economizer: 1433[2] | Efficiency: min.[1]<br>Economizer: 1433[2] |
| 5. Air-Handling Unit (including fan coil units) where the system has an air-cooled chiller | Efficiency: min.[1]<br>Economizer: 1433[2] | Economizer: 1433[2] for equipment installed outdoors or in a mechanical room adjacent to the outdoors, otherwise shall not decrease existing economizer capacity | Option A (except for certain pre-1991 systems[8]) | Option A (except for certain pre-1991 systems[8]) |
| 6. Air- Handling Unit (including fan coil units) and Water-cooled Process Equipment, where the system has a water-cooled chiller[10] | Efficiency: min.[1]<br>Economizer: 1433[2] | Economizer: 1433[2] for equipment installed outdoors or in a mechanical room adjacent to the outdoors, otherwise shall not decrease existing economizer capacity | Option A (except for certain pre-1991 systems[8] and certain 1991-2009 ((~~2004~~)) systems[9].) | Efficiency: min.[1]<br>Economizer: 1433[2,4] (except for certain pre-1991 systems[8] and certain 1991-2009 ((~~2004~~)) systems[9]) |
| 7. Cooling Tower | Efficiency: min.[1]<br>Economizer: 1433[2] | No requirements | Option A | Option A |
| 8. Air-Cooled Chiller | Efficiency: min.[1]<br>Economizer: 1433[2] | Efficiency: + 5%[11]<br>Economizer: shall not decrease existing economizer capacity | Efficiency (two of two):<br>(1) + 10%[12] and<br>(2) multistage<br>Economizer: shall not decrease existing economizer capacity | Efficiency: min.1<br>Economizer: 1433[2,4] |
| 9. Water-Cooled Chiller | Efficiency: min.[1]<br>Economizer: 1433[2] | Efficiency (one of two):<br>(1) + 10%[13]or<br>(2) plate frame heat exchanger[15]<br>Economizer: shall not decrease existing economizer capacity | Efficiency (two of two):<br>(1) + 15%[14] and<br>(2) plate-frame heat exchanger[15]<br>Economizer: shall not decrease existing economizer capacity | Efficiency: min.[1]<br>Economizer: 1433[2,4] |
| 10. Boiler | Efficiency: min.[1]<br>Economizer: 1433[2] | Efficiency: + 8%[16]<br>Economizer: shall not decrease existing economizer capacity | Efficiency: + 8%[16]<br>Economizer: shall not decrease existing economizer capacity | Efficiency: min.[1]<br>Economizer: 1433[2,4] |

1. Minimum equipment efficiency shall comply with Section 1411.1 and Tables 14-1A through G((~~M~~)).
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.

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3. All equipment replaced in an existing building shall have air economizer complying with Sections 1413 and 1433 unless both the individual unit size and the total capacity of units without air 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 1433 unless both the individual unit size and the total capacity of units without air 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 Btuh, 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 Btuh 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 unit 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 this unit, the outside air supply system shall be capable of providing this additional outside air and equipped with economizer control.
7. Have flow control valve to eliminate flow through the heat pumps that are not in operation with variable speed pumping control complying with Section 1432.2.2 for that heat pump.
   – When the total capacity of all units with flow control valves exceeds 15% 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 capacity-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 x values in Tables 14-1A and 14-1B)).
8. Systems installed prior to 1991 without fully utilized capacity are allowed to comply with Option B, provided that the individual unit cooling capacity does not exceed 90,000 Btuh.
9. Economizer not required for systems installed with water economizer plate and frame 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 coil load does not exceed the existing or added capacity of the heat exchangers.
10. For water-cooled process equipment where the manufacturers specifications require colder temperatures than available with waterside economizer, that portion of the load 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 multistage with a minimum of two compressors.
13. The water-cooled chiller shall have an ((~~NPLV~~)) IPLV efficiency that is at least 10% lower((~~a minimum of 10% 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 NPLV efficiency that is at least 10% lower than the adjusted maximum NPLV rating in kW/ton defined in paragraph 1411.2.1 (1.10 x NPLV).
14. The water-cooled chiller shall have an ((~~NPLV~~)) IPLV efficiency that is at least 15% lower ((~~a minimum of 15% 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 defined in paragraph 1411.2.1 (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 20% of the chiller capacity at standard AHRI rating conditions.
16. The replacement boiler shall have an efficiency that is a minimum of 8% higher than the value in Table 14-1F (1.08 x value in Table 14-1F), except for electric boilers.

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# CHAPTER 12
# ENERGY METERING AND ENERGY CONSUMPTION MANAGEMENT

## Chapter 12 Energy Metering and Energy Consumption Management.

*Discussion:* Revise (1) to be no less stringent that ASHRAE/USGBC/IESNA Standard 189.1-2009, (2) to clarify intent.

*Proposal:* Amend 2009 WSEC 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 $ft^2$ 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 1202.1through 1202.5 is measured through the use of installed submeters or other methods approved as equivalent by the building official.
2. Up to 5% 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 150kVA 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 1416.

((~~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 stream, that exceeds the thresholds listed in Table 12-1. Utility company service entrance/interval meters are allowed to be used provided that they are configured for automatic meter reading (AMR) capability.~~

~~Master 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 subsystem in accordance with Table 12-2.~~))

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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 multicell 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. nonresidential 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 that system or equipment in accordance with Section 1202((~~1201~~)) except that a data acquisition system shall not be required for buildings less than 50,000 $ft^2$.

**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, updated 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.

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**FIGURE 12A**
**ENERGY SOURCE AND SEPARATE END-USE SUBMETERING**

| Energy Source | Separate End-use Submetering |
|---|---|
| Electrical service | HVAC, Lighting, Plugs, Process, Miscellaneous Energy used in the project |
| Gas and steam service | HVAC, Process, Miscellaneous Energy used in the project |
| On-site renewable electric power | Electrical energy supplied to the project |
| Geothermal | 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 temperature 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~~ | ~~> 300 kW (1,000,000 Btu/h)~~ |
| ~~Geothermal~~ | ~~> 300 kW (1,000,000 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 |
|---|---|
| Chillers/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) |
| Exhaust fan systems | > 15 kW (20 hp) |
| Make-up air fan systems | > 15 kW (20 hp) |

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| Component | Submetering Threshold |
|---|---|
| Pump systems | > 15 kW (20 hp) |
| Cooling tower systems | > 15 kW (20 hp) |
| Boilers, furnaces and other heating equipment systems | > 300 kW (1,000,000 Btu/h) heating capacity |
| General lighting circuits | > 15 kVA |
| Miscellaneous electric loads | > 15 kVA |

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# CHAPTER 13
# BUILDING ENVELOPE

## Figure 13A Building Envelope Compliance Options.

*Discussion:* Modify to add new sections.
*Proposal:* Amend 2009 WSEC as follows –

### 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 |

## 1310.1 Conditioned Spaces.

*Discussion:* Companion change to Section 1335.
*Proposal:* Amend 2009 WSEC as follows -

**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 1141.4.

## 1310.3 Cold Storage and Refrigerated Spaces.

*Discussion:* (1) Revise to be no less stringent than changes to Table 13-1, and (2) add assembly U-factors for Target UA compliance option.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

*Proposal:* Amend 2009 WSEC as follows -

**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-ft$^2$ (2 tons per 100 ft$^2$).
2. Controlled atmosphere storage exterior floor and partition wall insulation.

**TABLE 13-3**
**REFRIGERATED WAREHOUSE INSULATION**

| SPACE | SURFACE | ASSEMBLY MAXIMUM U-FACTOR (Btu/h·ft$^2$·°F) | INSULATION MINIMUM R-VALUE (h·ft$^2$·°F/Btu) |
|---|---|---|---|
| Frozen Storage Spaces (28°F or below) and Cold Storage Spaces (28-45°F) | ((~~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-38 ((~~R-36~~)) |
| | ((~~Interior Partition~~[‡])) | | ((~~R-28~~)) |
| ((~~Cold Storage Spaces (28-45°F)~~)) | ((~~Exterior Roof/Ceiling~~)) | | ((~~R-28~~)) |
| | ((~~Exterior Wall~~)) | | ((~~R-28~~)) |
| | ((~~Interior Partition~~[‡])) | | ((~~R-19~~)) |

((~~[‡] Interior partitions include any wall, floor, or ceiling that divides frozen storage spaces or cold storage spaces from each other, conditioned spaces, unconditioned spaces, or semi-conditioned spaces.~~))

**1311.5 Slab-On-Grade Floor.**

*Discussion:* Revise to correspond with Section 502.1.4.8 of the 2009 WSEC.
*Proposal:* Amend 2009 WSEC as follows -

**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.~~

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

**1311.6 Radiant Floors.**

*Discussion:* No Seattle changes (retain existing Seattle amendment).
*Proposal:* Amend 2009 WSEC as follows -

**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, t~~)) 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 Fenestration and Doors.**

*Discussion:* Revise terminology for consistency.
*Proposal:* Amend 2009 WSEC as follows -

**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 Nonresidential~~)) Model Size in Table 4-3 of RS-31. 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 Visible Transmittance.**

*Discussion:* (1) Retain existing Seattle amendments; (2) add exception 3 for dynamic glazing for SHGC per addendum cl to ASHRAE/IESNA Standard 90.1-2007.
*Proposal:* Amend 2009 WSEC as follows -

**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-1 or from the manufacturer's ((~~test~~)) data using a spectral data file determined in accordance with NFRC 300.

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2. For the purposes of 1323, Exception 1, visible transmittance for the center of the glazing assembly shall be taken from Chapter 15 of Standard RS-1 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. Though the SHGC for the frame is not zero (the ASHRAE Handbook of Fundamentals indicates that the SHGC can range from 0.11-0.14 for metal frames and from 0.02 to 0.07 for wood/vinyl/ fiberglass frames), the SHGC for the frame is invariably lower than that for the glass. Consequently, an NFRC-certified SHGC will generally be lower.

Conversely, the VT for the center-of-glass overstates 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.

## 1313.2 Roof/Ceiling Assemblies.

*Discussion:* Revise reference to cite Seattle code.
*Proposal:* Amend 2009 WSEC as follows -

**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 membrane 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 unvented 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 unvented attic assembly.

    3. Where wood shingles or shakes are used, a minimum ¼ 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-permeable insulation installed directly below the structural 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.

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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.

### 1314.2 Fenestration and Doors.

*Discussion:* Clarify meaning of field fabricated per ASHRAE Standard 90.1-2007, Section 5.4.3.2 interpretation.

*Proposal:* Amend 2009 WSEC as follows -

**1314.2 ((~~Glazing~~))<u>Fenestration</u> 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~~))<u>fenestration</u>, 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.

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. Openings that are required to be fire resistant.
2. Field-fabricated fenestration and doors that are weather-stripped or sealed in accordance with Section 1314.1. <u>A field-fabricated fenestration product is a fenestration product including a glazed exterior door whose frame is made at the construction site of standard dimensional lumber or other materials that were not previously cut, or otherwise formed with the specific intention of being used to fabricate a fenestration product or exterior door. Field-fabricated does not include curtain walls.</u>
3. For garage doors, air leakage determined by test at standard test conditions in accordance with ANSI/DASMA 105 shall be an acceptable alternate for compliance with air leakage requirements.
4. Units without air leakage ratings produced by small business that are weatherstripped or sealed in accordance with Section 1314.1.

### 1314.6 Continuous Air Barrier.

*Discussion:* Revise (1) to apply requirement for building air leakage testing to all buildings; (2) to specify confidence interval; (3) to more carefully specify test pressures and ranges; and (4) to add another reference to the informative note.

*Proposal:* Amend 2009 WSEC as follows -

**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 detailing 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 ((~~opaque~~)) 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 ((~~10~~)) 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 to 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 determine air leakage pathways: ASTM E 1186-03 Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

**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 0.16-0.25 cfm/ft$^2$. Their experience is that few buildings have to be sealed and re-tested 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 Colin Genge, ASHRAE Journal, April 2009, pages 50-60, and "Protocol for Field Testing of Tall Buildings to Determine Envelope Air Leakage Rate" by William Bahnfleth, Grenville Yuill, and Brian Lee, ASHRAE Transactions 1999, V. 105, Pt. 2.

**1314.7 Vestibules.**

*Discussion:* Retain existing Seattle amendment, but
(1) provide exemptions for semiheated spaces and for elevator lobbies in parking garages; and
(2) add informative note to clarify intent.

*Proposal:* Amend 2009 WSEC as follows -

**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 elevators have an enclosed lobby at each level of the garage.

Informative Note: Building entrances are defined as the means ordinarily used to gain access to the building, so this does not include the handicapped 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.

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

## 1321 Prescriptive Building Envelope Option, General.

*Discussion:* Clarify that compliance is to be done separately for nonresidential and residential spaces for consistency with ASHRAE/IESNA Standard 90.1-2007, Section 5.2.1.

*Proposal:* Amend 2009 WSEC as follows -

**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.

## 1322 Opaque Envelope.

*Discussion:* (1) Add descriptions of alternate compliance options for assemblies with thermal bridges; (2) add cross-reference to Section 1332 for calculation of U-factors for assemblies with metal framing; (3) retain existing Seattle exception, but modify to correspond with changes to Table 13-1; and (4) add procedural note to clarify application to elevator shafts and stairwells.

*Proposal:* Amend 2009 WSEC as follows -

**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.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

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 in 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 cross-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 10.

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-5 (but not including area within 6 inches of each roof drain), and

b. the area-weighted average insulation is R-68 (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 Table 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 area ratios:

- 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 one 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 at the perimeter edge of an intermediate 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 one of the alternate nominal R-value compliance options.

As the overall opaque wall area is the basis of the calculation, every wall assembly must comply 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 area 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 the insulation requirements in the alternate nominal R-value compliance option as the areas of those infill walls were included in the calculation of the metal penetration area ratio.

There also are additional fin effects where the metal contacts 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.

## 1323 Fenestration.

*Discussion:* Revise as follows:

(1) Section 1323: add statement of intent for fenestration orientation, retain existing Seattle amendment for the Seattle Land Use Code, incorporate parking lot attendant booths into exception (previously in Section 1301), add allowance for revolving doors and vestibules, revise visible transmittance criteria;

(2) Section 1323.1: retain limits on the area of below-grade walls included in the fenestration area calculation from the 2006 WSEC;

(3) Section 1323.3: add option for shading credit for open louvers and non-opaque overhangs per ASHRAE/IESNA Standard 90.1-2007, Section 5.5.4.4.1; and

(4) Section 1323.4: add criteria for minimum visible transmittance for projects with fenestration areas over 30% of the gross wall area.

*Proposal:* Amend 2009 WSEC as follows -

**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 ((~~glazing~~)) 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 nonmetal frame or a metal frame having a thermal break (as defined in footnote 2 to Table 10-6B; 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 1312.2, 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 sections of the building envelope and these values shall not be averaged with any others for compliance purposes. The 75% area may be exceeded on the street level, if the additional glass area is provided from allowances from other areas of the building.

2. Fenestration with single ((~~Single~~)) glazing for security purposes and in vestibules and revolving doors shall be included in the percentage of the total ((~~glazing~~))fenestration area, U-factor calculation 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.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

**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 ((~~all 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-0.10 above that required in Tables 13-1 and 13-2. When this exception is utilized, separate calculations shall be performed for this vertical fenestration and these 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 consisting of open louvers shall be considered to provide shading, provided that no sun penetrates the louvers during the peak sun angle on June 21. For demonstrating compliance for vertical fenestration shaded by partially opaque permanent projections (e.g., framing with glass or perforated metal) 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 North-oriented) | SHGC Multiplier (North-Oriented) |
|---|---|---|
| 0 - 0.10 | 1.00 | 1.00 |
| <0.10 - 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 | 0.81 |
| <0.60 - 0.70 | 0.56 | 0.78 |
| <0.70 - 0.80 | 0.51 | 0.76 |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

| Projection Factor | SHGC Multiplier (All Orientations except North-oriented) | SHGC Multiplier (North-Oriented) |
|---|---|---|
| <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 consistent units. (See Figure 13B.)

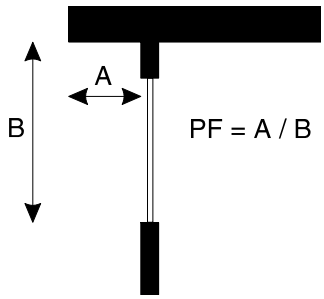


Figure 13B

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-0.35 maximum.

As a simple example, if the proposed building had vertical fenestration only on the south side of the building and all the fenestration had an NFRC-certified SHGC-0.45, 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 tip of the overhang were a distance B of six feet, then the projection factor (PF) would be = A/B = 2 ft/6 ft = 0.33.

From the table to Exception 3 above, the multiplier is 0.74 for a 0.33 PF for south-oriented windows. For compliance purposes, SHGC-0.45 x 0.74 multiplier = 0.33 adjusted SHGC. Therefore, the vertical fenestration in 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.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

**1331 Component Performance Building Envelope Option, General.**

*Discussion:* Revise as follows:
(1) clarify that compliance is to be done separately for nonresidential and residential spaces for consistency with ASHRAE/IESNA Standard 90.1-2007, Section 5.2.1, and as has been required for previous versions of the Seattle and Washington State Energy Codes);
(2) update reference to Seattle EnvStd (companion change to Sections 1322 and 1323 and Table 13-1); and
(3) retain existing Seattle amendment allowing prescriptive compliance for street-level retail.

*Proposal:* Amend 2009 WSEC as follows -

**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 RS-32 for Climate Zone 1 except

a. for buildings using footnote 2 to Table 13-1 ((~~containing attic 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 to Section 1323.

**1332 Component U-Factors.**

*Discussion:* Add alternate for determining U-factor for envelope assemblies containing metal framing.

*Proposal:* Amend 2009 WSEC as follows -

**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 cross-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 cross-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(1).

**1333 UA Calculations.**

*Discussion:* Retain existing Seattle amendment, and add a procedural note.
*Proposal:* Amend 2009 WSEC as follows -

**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 indirectly 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, skylights, etc.), as well as all opaque doors (swinging metal egress 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.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

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) 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 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 that default U-factor (indicating 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.**

*Discussion:* Clarify that the baseline for trade-offs is SHGC without the projection factors.
*Proposal:* Amend 2009 WSEC as follows -

**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.**

*Discussion:* Add procedure for visible transmittance trade-offs (companion change to Table 13-1).
*Proposal:* Amend 2009 WSEC as follows -

**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.

**Equations 13-1 Target UA, 13-2 Proposed UA, 13-3 Target SHGCA, 13-4 Proposed SHGCA.**

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

*Discussion:* Revise terminology for consistency.
*Proposal:* Amend 2009 WSEC as follows -

## EQUATION 13-1
## Target $UA_t$

$UA_t$ = $U_{radt}A_{radt} + U_{mrt}A_{mrt} + U_{rst}A_{rst} + U_{ort}A_{ort} + U_{ogcort}A_{ogcort} + U_{ogort}A_{ogort} + U_{mwt}A_{mwt} + U_{mbwt}A_{mbwt} + U_{sfwt}A_{sfwt} + U_{wt}A_{wt} + U_{vgt}A_{vgt} + U_{vgmt}A_{vgmt} + U_{vgdt}A_{vgdt} + U_{dt}A_{dt} + U_{fmt}A_{fmt} + U_{fst}A_{fst} + U_{ft}A_{ft} + F_{st}P_{st} + F_{rst}P_{rst}$

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

Where:

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

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

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

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

$U_{ogcort}$ = 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.

$U_{ogort}$ = 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.

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

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

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

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

$U_{vgt}$ = 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.

$U_{vgmt}$ = 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.

$U_{vgdt}$ = 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.

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

$U_{fst}$ = 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.

$F_{st}$ = The F-factor for slab-on-grade floors found in Table 13-1 or 13-2.

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

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

$A_{dt}$ = The proposed opaque door area, $A_d$.

$A_{fmt}$ = The proposed mass floor over unconditioned space area, $A_{fm}$.

$A_{fst}$ = The proposed steel joist floor over unconditioned space area, $A_{fs}$.

$A_{ft}$ = The proposed wood framed and other floor over unconditioned space area, $A_f$.

$P_{st}$ = The proposed lineal feet of slab-on-grade floor perimeter, $P_s$.

$P_{rst}$ = The proposed lineal feet of radiant slab floor perimeter, $P_{rs}$.

**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:

$A_{radt}$ = The proposed roof area with insulation entirely above deck, $A_{rad}$.

$A_{mrt}$ = The proposed roof area for metal building, $A_{mr}$.

$A_{rst}$ = The proposed single rafter roof area, $A_{rs}$.

$A_{ort}$ = The proposed attic and other roof area, $A_{or}$.

$A_{ogcort}$ = The proposed ((~~overhead glazing~~))skylight area with curbs, $A_{ogcor}$.

$A_{ogort}$ = The proposed ((~~overhead glazing~~))skylight area without curbs, $A_{ogor}$.

$A_{mwt}$ = The proposed opaque mass wall area, $A_{mw}$.

$A_{mbwt}$ = The proposed opaque metal building wall area, $A_{mbw}$.

$A_{sfwt}$ = The proposed opaque steel framed wall area, $A_{sfw}$.

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

$A_{vgt}$ = The proposed vertical ((~~glazing~~))fenestration area with nonmetal framing, $A_{vg}$.

$A_{vgmt}$ = The proposed vertical ((~~glazing~~))fenestration area with metal framing, $A_{vgm}$.

$A_{vgdt}$ = The proposed entrance door area, $A_{vgd}$.

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~~))skylight 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 $UA_p$

$$UA_p = U_{rad}A_{rad} + U_{mr}A_{mr} + U_{rs}A_{rs} + U_{ra}A_{ra} + U_{ogc}A_{ogc} + U_{og}A_{og} + U_{mw}A_{mw} + U_{mbw}A_{mbw} + U_{sfw}A_{sfw} + U_{wfow}A_{wfow} + U_dA_d + U_{vg}A_{vg} + U_{vgm}A_{vgm} + U_{vgd}A_{vgd} + U_{fm}A_{fm} + U_{fs}A_{fs} + U_{fwo}A_{fwo} + F_sP_s + F_{sr}P_{sr}$$

Where:

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

$U_{rad}$ = The thermal transmittance of the roof area where the insulation is entirely above roof deck.

$A_{rad}$ = Opaque roof area where the insulation is entirely above roof deck.

$U_{mr}$ = The thermal transmittance of the metal building roof area.

$A_{mr}$ = Opaque metal building roof area.

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

$A_{rs}$ = Opaque single rafter roof area.

$U_{ra}$ = The thermal transmittance of the roof over attic and other roof area.

$A_{ra}$ = Opaque roof over attic and other roof area.

$U_{ogc}$ = The thermal transmittance for the ((~~overhead glazing~~))skylights with curbs.

$A_{ogc}$ = ((~~Overhead glazing~~))Skylights area with curbs.

$U_{og}$ = The thermal transmittance for the ((~~overhead glazing~~))skylights without curbs.

$A_{og}$ = ((~~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).

$U_{sfw}$ = The thermal transmittance of the opaque steel framed wall area.

$A_{sfw}$ = Opaque steel framed wall area (not including opaque doors).

$U_{wfow}$ = The thermal transmittance of the opaque wood framed and other wall area.

$A_{wfow}$ = Opaque wood framed and other wall area (not including opaque doors).

$U_{vg}$ = The thermal transmittance of the vertical ((~~glazing~~))fenestration area with nonmetal framing.

$A_{vg}$ = Vertical ((~~glazing~~))fenestration area with nonmetal framing.

$U_{vgmf}$ = The thermal transmittance of the vertical ((~~glazing~~))fenestration area with metal framing.

$A_{vgmf}$ = Vertical ((~~glazing~~))fenestration area with metal framing.

$U_{vgd}$ = The thermal transmittance of the vertical ((~~glazing~~))fenestration area for entrance doors.

$A_{vgd}$ = Vertical ((~~glazing~~))fenestration area for entrance doors.

$U_d$ = 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.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

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

$U_{fwo}$ = The thermal transmittance of the wood framed and other floor over unconditioned space area.

$A_{fwo}$ = Wood framed and other floor area over unconditioned space.

$F_s$ = Slab-on-grade floor component F-factor.

$P_s$ = Lineal feet of slab-on-grade floor perimeter.

$F_{sr}$ = Radiant floor component F-factor.

$P_{sr}$ = Lineal feet of radiant floor perimeter.

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

$$U_{mw1}A_{mw1} + U_{mw2}A_{mw2} + U_{sfw1}A_{sfw1} + \ldots\text{etc.}$$

## EQUATION 13-3
## Target $SHGCA_t$

$$SHGCA_t = \frac{SHGC_t\,(A_{ogcort} + A_{ogort} + A_{vgt} + A_{vgmt} + A_{vgdt})}{((\cancel{SHGC_t\,(A_{ograt} + A_{ogort} + A_{vgt})}))}$$

Where:

$SHGCA_t$ = 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

$A_{ogcort}$, $A_{ogort}$, $A_{vgt}$, $A_{vgmt}$, and $A_{vgdt}$ ((~~$A_{ograt}$, $A_{ogort}$, and $A_{vgt}$~~))are defined under Equation 13-1.

## EQUATION 13-4
## Proposed $SHGCA_p$

$$SHGCA_p = SHGC_{og}A_{og} + SHGC_{vg}A_{vg}$$

Where:

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

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

$A_{og}$ = The ((~~overhead glazing~~))skylight area.

$SHGC_{vg}$ = The solar heat gain coefficient of the vertical fenestration((~~glazing~~)).

$A_{vg}$ = The vertical ((~~glazing~~))fenestration area.

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**Equations 13-5 Target VTA & 13-6 Proposed VTA.**

*Discussion:* Companion change to Section 1335.
*Proposal:* Amend 2009 WSEC as follows -

**EQUATION 13-5**
**Target $VTA_t$**

$VTA_t = VT_t A_{vgt}$

Where:

$VTA_t$ = The target combined visible transmittance of the target fenestration area.

$VT_t$ = 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 $A_{vgt}$ is defined under Equation 13-1.

**EQUATION 13-6**
**Proposed $VTA_p$**

$VTA_p = VT_{vg} A_{vg}$

Where:

$VTA_t$ = The combined proposed visible transmittance of the proposed fenestration area.

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

$A_{vg}$ = The vertical fenestration area.

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**Table 13-1 Building Envelope Requirements.**

*Discussion:* Revise opaque envelope and fenestration requirements to achieve greater energy efficiency using the criteria from ASHRAE/IESNA Standard 90.1-2007 and addenda, and ASHRAE/USGBC/IESNA Standard 189.1-2009.

(1) Roofs: revise so that the U-factor criteria is comparable for all classes of roofs;

(2) Walls above grade: revise so that the U-factor criteria is comparable for all classes of walls but with mass walls slightly higher, revise insulation for metal building walls per ASHRAE/USGBC/IESNA Standard 189.1-2009, revise insulation for other walls per addendum bb to ASHRAE/IESNA Standard 90.1, provide alternate compliance options for otherwise continuous insulation with limited isolated metal penetrations;

(3) Walls below grade: revise to be no less stringent than the 2006 SEC;

(4) Floors over unconditioned space: revise insulation for wood-framed floors per addendum bb to ASHRAE/IESNA Standard 90.1;

(5) Slab-on-grade floors: revise insulation for unheated slab floors per addendum bb to ASHRAE/IESNA Standard 90.1;

(6) Opaque doors: require insulated doors per new default values in Table 10-6C;

(7) Vertical fenestration: set maximum baseline prescriptive fenestration area at 30% of the wall area per addendum bb to ASHRAE/IESNA Standard 90.1; revise U-factor for nonmetal framing per ASHRAE/USGBC/IESNA Standard 189.1-2009 and to match 2010 Energy Star criteria, revise U-factor for metal framing by comparable amount, add alternate U-factor criteria for revolving doors and vestibules, and retain existing 2006 SEC SHGC criteria; and require additional improvements for prescriptive fenestration area in excess of the 30% of the wall area allowed by addendum bb to ASHRAE/IESNA Standard 90.1; require 5-7% further improvement in fenestration U-factor and SHGC criteria and establish minimum VT criteria for 30-40% fenestration area; allow higher U-factor for a limited area of operable vertical fenestration with metal framing; and

(8) Skylights: revise U-factor for skylights without curb per ASHRAE/USGBC/IESNA Standard 189.1-2009, revise U-factor for skylights with curb to match 2010 Energy Star criteria, revise SHGC for all per ASHRAE/USGBC/IESNA Standard 189.1-2009; require 5-10% further improvement in fenestration U-factor and SHGC criteria for 30-40% fenestration area.

For opaque roofs and walls, the U-factor criteria are proposed to be roughly comparable for all classes of construction for equal energy. The mass wall U-criteria is slightly less stringent due to the thermal mass benefits. (Note, however, that the mass benefits are relatively minor in our cloudy climate as there is only a 10-degree winter temperature difference between day and night in Seattle, compared to a 40-degree temperature difference in some portions of the Southwest. Thus, there is relatively little additional heat to be stored during the day to offset loads at night.) The below-grade wall criteria are less due to the buffering effects of the soil.

For opaque walls, alternate compliance options are provided for otherwise continuous insulation with limited isolated metal penetrations. While metal studs, z-girts or any other repetitive continuous metal framing members can decrease the effective R-value of insulation by more than 50%, occasional continuous metal framing members such as shelf angles are also significant thermal bridges around the insulation. Discontinuous metal elements, such as stand-off brackets are better, but still are a thermal bridging element. Calculations on a stand-off system utilizing 6-inch brackets 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 25% 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.

For opaque doors, the revised U-factors are based on the expanded default values in Table 10-6C. The Table 10-6C values allow compliance for opaque doors without NFRC certification having mineral wool or polyurethane insulation. (Note that the opaque doors with honeycomb kraft paper as the core insulation do not comply.)

For vertical fenestration area, data used to generate the U.S. Department of Energy's (DOE) Benchmark buildings (used to calculate the energy impacts of changes to ASHRAE/IESNA Standard 90.1, as required by the federal Energy Policy Act - EPAct) shows that the weighted-average fenestration area for the overall nonresidential sector is approximately 25% of the gross wall area. Addendum bb to Standard 90.1-2007 sets 30% as the maximum fenestration area for the prescriptive compliance option. This 30% value allows fenestration areas that are 1/5 larger (25% + 5%) than the overall weighted-average. This 30% value also accommodates good daylighting design as the optimum fenestration area in terms of total energy performance, including daylighting, ranges from 15-30% of the gross wall area. Above 30% fenestration area, there are limited additional energy benefits from reduced lighting energy consumption due to daylighting, but increasing space heating energy consumption for off-hours and morning warmup and increasing cooling energy consumption during the day. To achieve a true 40% fenestration prescriptive option with a UA equivalent to the 30% option would require fenestration U-factor and SHGC improvements of 20-25%. However, here the 40% prescriptive compliance option is not based on equal UA to the 30% option, only a 5-7% improvement in U-factor and SHGC is required, but minimum VT criteria are established to ensure that the larger fenestration area will provide more daylight.

For vertical fenestration U-factor, U-0.30 maximum is the current (2010) Energy Star requirement for windows. The federal 2009 American Recovery and Reinvestment Act (ARRA) sets U-0.30 maximum and SHGC 0.30 maximum as the criteria for incentives for windows. Most major window manufacturers either have products that qualify for these programs or are developing products that will. For products with frames of fiberglass, vinyl, or wood, the U-0.30 can be achieved by double-glazed products with good low-emissivity coatings (and perhaps with argon gas and low-conductance spacers). For products with metal frame having a thermal break, U-0.30 has been achieved in a previous large Seattle high-rise project with a curtain wall having double-glazing, argon gas, a low-conductance spacer, and TWO low-e coatings: a very-good softcoat (sputter) low-e on surface 2 inside the sealed glass unit, and a good hard-coat (pyrolytic) low-e on surface 4 which is exposed to the room. (Also, note that a local well-established skylight manufacturer has advertised that they have a skylight that meets the U-0.30/SHGC-0.30 criteria.) The draft ICC International Green Construction Code (IGCC) sets a value of U-0.28 maximum for fenestration in Seattle's climate.

For vertical fenestration U-factor, an option has been added to allow a higher U-factor for a limited area of operable vertical fenestration with metal framing, provided that the operable windows are tied into an HVAC energy management system to notify building occupants of acceptable time periods (based on outdoor air temperatures) when the operable fenestration may be manually opened for natural ventilation and that disable HVAC operation at the

perimeter zones when outdoor air conditions for natural ventilation are met. This type of system is already being used in some new Seattle buildings.

For vertical fenestration SHGC, the SHGC-0.35 is from the existing 2006 SEC.

From a larger viewpoint, a rough rule-of-thumb for achieving net-zero energy buildings in the Pacific Northwest is a 75% reduction in building loads (such as heat loss and heat gain through the building envelope), with the remaining 25% of the energy consumption being provided by on-site renewable energy production. For further information about low-energy building envelope design, see "High-Rise Igloos" by Joseph Lstiburek, ASHRAE Journal, April 2009, pages 62-66 (with examples of building envelope design having continuous insulation without thermal penetrations) and "Sustainability in Cold Climates" by Shahrokh Farzam and Giuliano Todesco, ASHRAE Journal, January 2010, pages 20-28.

*Proposal:* Amend 2009 WSEC as follows -

## TABLE 13-1
## BUILDING ENVELOPE REQUIREMENTS FOR CLIMATE ZONE 1

| | Nonresidential | | Residential, Other than Single-Family | |
|---|---|---|---|---|
| **Opaque Elements** | **Assembly Max. U-factor** | **Insulation Min. R-Value** | **Assembly Max. U-factor** | **Insulation Min. R-Value** |
| **Roofs** | | | | |
| Insulation entirely above deck | U-0.026 ((~~U-0.034~~)) | R-38 c.i. ((~~R-30 c.i.~~)) | U-0.031 | R-38 c.i. |
| Metal building | U-0.027 ((~~U-0.031~~)) | R-25 + R-11 + R-11 Ls | U-0.031 | R-25 + R-11 Ls |
| Single-rafter | U-0.027 | R-38 | U-0.027 | R-38 |
| Attic and other | U-0.027 | R-38 adv or R-49 | U-0.027 | R-38 adv or R-49 |
| **Walls, Above Grade** | | | | |
| Mass ((~~[1]~~)) (includes peripheral edges of intermediate floor slabs and columns) | U-0.057 for exterior and integral insulation<br><br>U-0.056 for interior insulation<br><br>((~~U-0.150~~)) | Exterior and integral insulation:<br>a. R-16 c.i.<br>b. R-20 insulation with < 0.04% cross-sectional area of metal penetrations per Section 1322.<br>c. R-24 insulation with > 0.04% and < 0.08% cross-sectional area of metal penetrations per Section 1322.<br><br>Interior insulation:<br>d. R-13 cavity insulation + R-6 c.i. wood studs; or<br>e. R-13 cavity insulation + R-10 c.i. metal studs; or<br>f. R-22.4 insulation held solely by 1-in metal clips.<br>((~~R-5.7 c.i.~~)) | U-0.090 | R-11.4 c.i. |
| Metal building | U-0.052 ((~~U-0.064~~)) | R-13 + R-13 c.i. ((~~R-13 + R-7.5 c.i.~~)) | U-0.057 | R-19 + R-8.5 c.i. |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

| | Nonresidential | | Residential, Other than Single-Family | |
|---|---|---|---|---|
| **Opaque Elements** | **Assembly Max. U-factor** | **Insulation Min. R-Value** | **Assembly Max. U-factor** | **Insulation Min. R-Value** |
| Steel framed | U-0.055 ((~~U-0.064~~)) | a. R-13 cavity + R-10 c.i.<br>b. R-13 cavity + R-12.5 insulation with < 0.04% cross-sectional area of metal penetrations per Section 1322.<br>c. R-13 cavity + R-15 insulation with > 0.04% and < 0.08% cross-sectional area of metal penetrations per Section 1322.<br>((~~R-13 + R-7.5 c.i.~~)) | U-0.057 | R-19 + R-8.5 c.i. |
| Wood framed and other | U-0.051 ((~~U-0.057~~)) | a. R-13 cavity + R-7.5 c.i.<br>b. R-13 cavity + R-9.4 insulation with < 0.04% cross-sectional area of metal penetrations per Section 1322.<br>c. R-13 cavity + R-11.3 insulation with > 0.04% and < 0.08% cross-sectional area of metal penetrations per Section 1322.<br>((~~R-21~~)) | U-0.057 | R-13 + R-6 c.i. |
| **Walls, Below Grade** | | | | |
| Below grade wall | U-0.070 | Exterior insulation:<br>a. R-10 c.i.<br>Interior insulation:<br>b. R-19 cavity insulation wood studs; or<br>c. R-13 cavity insulation + R-6 c.i. metal studs; or<br>d. R-16.8 insulation held solely by 1-in metal clips.<br>((~~Same as above grade~~)) | | Same as above grade |
| **Floors** | | | | |
| Mass | U-0.029 | R-30 c.i. | U-0.029 | R-30 c.i. |
| Steel joist | U-0.029 | R-38 cavity + R-4 c.i. | U-0.029 | R-38 + R-4 c.i. |
| Wood framed and other | U-0.025 ((~~U-0.029~~)) | R-38 cavity ((~~R-30~~)) | U-0.029 | 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-10 for 24 in. (with thermal break) |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

| | Nonresidential | | Residential, Other than Single-Family | |
|---|---|---|---|---|
| **Opaque Elements** | **Assembly Max. U-factor** | **Insulation Min. R-Value** | **Assembly Max. U-factor** | **Insulation Min. R-Value** |
| Heated | F-0.360 | R-10 c.i. (with thermal break) | F-0.360 | R-10 c.i. (with thermal break) |
| **Opaque Doors** | | | | |
| Swinging | U-0.470 ((~~U-0.600~~)) | | U-0.400 | |
| Nonswinging | U-0.390 ((~~U-0.600~~)) | | U-0.400 | |
| | | | | |
| **Fenestration ((~~0-40% of Wall~~))** | **Assembly Max. U-Factor** **NFRC-certified or per 1006** | **Assembly Max. SHGC** **NFRC-certified or per 1312.1** | **Assembly Max. U-Factor** **NFRC-certified or per 1006** | **Assembly Max. SHGC** **NFRC-certified or 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-0.30 ((~~U-0.32~~)) | For all frame types: ((~~SHGC-0.40~~)) SHGC-0.35 all OR SHGC-0.45 all PLUS permanent PF>0.50 on west, south and east | U-0.32 | |
| Metal framing: Fixed/operable | U-0.38 [2] ((~~U-0.40~~)) | | U-0.40 | |
| Entrance doors (revolving doors & vestibules) | U-0.60 (U-0.65) | | U-0.60 | |
| **Skylights** | | | | |
| Without curb (i.e., sloped glazing) | U-0.45 ((~~U-0.50~~)) | SHGC-0.32 all[1] ((~~SHGC-0.35 all~~)) | U-0.50 | SHGC-0.35 all |
| With curb (i.e., individual unit skylights) | U-0.55 ((~~U-0.60~~)) | | U-0.60 | |
| **Fenestration** | **Assembly Max. U-Factor** **NFRC-certified or per 1006** | **Assembly Max. SHGC & Min. VT** **NFRC-certified or per 1312.1** | **Assembly Max. U-Factor** **NFRC-certified or per 1006** | **Assembly Max. SHGC** **NFRC-certified or per 1312.1** |
| **Total fenestration (vertical and overhead) area relative to the gross exterior wall area: > 30.0 and <40.0% of wall** | | | | |

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| | Nonresidential | | Residential, Other than Single-Family | |
|---|---|---|---|---|
| **Opaque Elements** | **Assembly Max. U-factor** | **Insulation Min. R-Value** | **Assembly Max. U-factor** | **Insulation Min. R-Value** |
| **Vertical Fenestration** | | | | |
| Nonmetal framing: All | U-0.28 | For all frame types: | U-0.32 | |
| Metal framing: Fixed/operable | U-0.38 [2] | SHGC-0.33 all AND minimum VT-0.51 all<br>OR | U-0.40 | |
| Entrance doors (revolving doors & vestibules) | U-0.60 (U-0.65) | SHGC-0.45 all PLUS permanent PF>0.50 on west, south and east AND minimum VT-0.51 all | U-0.60 | |
| **Skylights** | | | | |
| Without curb (i.e., sloped glazing) | U-0.40 | SHGC-0.30 all[1] | U-0.50 | SHGC-0.35 all |
| With curb (i.e., individual unit skylights) | U-0.50 | | U-0.60 | |

c.i. = continuous insulation, Ls = liner system (see definitions). Also see requirements in Section 1332 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.

   ((~~Nonresidential walls may be ASTM C90 concrete block walls, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with material having a maximum thermal conductivity of 0.44 Btu·in/h·ft$^2$·°F.~~))

2. In nonresidential spaces, up to 10% of the actual vertical fenestration with metal framing is allowed to be operable fenestration with an area-weighted-average assembly maximum U-Factor (NFRC-certified or default per Section 1006) 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 that notifies building occupants of acceptable time periods (based on outdoor air temperatures) when the operable fenestration may be manually opened for natural ventilation and that disables HVAC operation at the perimeter zones when outdoor air conditions for natural ventilation are met. If approved by the building official, other similar control strategies are allowed to be used where they are shown to reduce the HVAC perimeter zone 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 RS-29 or RS-32 compliance options.

   This footnote is allowed to be used for the Component Performance compliance option in Sections 1330 through 1335 provided that 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.

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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 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, plastic panels, clerestories, skylights, etc.), as well as all opaque doors (swinging metal egress 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) 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 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 that default U-factor (indicating 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.

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# CHAPTER 14
# MECHANICAL SYSTEMS

**Figure 14A Mechanical Systems Compliance Path.**

*Discussion:* Modify to add new sections.
*Proposal:* Amend 2009 WSEC as follows –

## 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 Pumping Energy | X | X | X |
| 1445 | Heat Recovery for Domestic Water Systems | X | X | X |
| 1446 | Domestic Hot Water Meters | 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 | Evaporators | X | X | X |
| 1464 | Condensers | X | X | X |

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| Section Number | Subject | Simple Systems Path | Complex Systems Path | Systems Analysis Option |
|---|---|---|---|---|
| 1465 | Compressors | X | X | X |
| 1470 | Compressed Air and Vacuum Air | X | X | X |
| 1475 | Commercial Food Service | X | X | X |

**1402 Mechanical Ventilation.**

*Discussion:* No Seattle changes (retain existing Seattle amendment).
*Proposal:* Amend 2009 WSEC as follows -

**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.**

*Discussion:* Companion change to Sections 1470 and 1475.
*Proposal:* Amend 2009 WSEC as follows -

**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 (Packed 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 Mechanical Equipment Performance Requirements.**

*Discussion:* Clarify that the requirements apply to all mechanical systems.
*Proposal:* Amend 2009 WSEC as follows -

**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.**

*Discussion:*
(1) Add requirement for minimum efficiency for computer room equipment covered by

ASHRAE Standard 127 as listed in Table 14-1A(2) per addendum bu of ASHRAE/IESNA Standard 90.1-2007;
(2) Add requirement for minimum efficiency for variable refrigerant flow systems covered by AHRI Standard 1230 as listed in Tables 14-1A(3) and 14-1A(4) per addendum cp of ASHRAE/IESNA Standard 90.1-2007;
(3) retain existing Seattle amendment, modified so that condenser water return requirements apply to all cooling towers with chilled water systems with an exception for replacement towers where there are space constraints;
(4) retain existing Seattle amendment, modified so that single-pass cooling is only allowed for icemakers and use of medical equipment during an emergency.

*Proposal:* Amend 2009 WSEC as follows -

**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 through14-1G, 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 100 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 tower of 86°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.**

*Discussion:* No Seattle changes (retain existing Seattle amendment).
*Proposal:* Amend 2009 WSEC as follows -

**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: 1 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 | = | $DT_{std}$ + LIFT |
| $DT_{std}$ | = | (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 chilled water temperature (°F) |

**1411.4 Electric Heating and Cooling Equipment.**

*Discussion:* Retain existing Seattle amendment, but modify to address cooling only equipment with electric heat in the main supply duct.

*Proposal:* Amend 2009 WSEC as follows -

**1411.4 Packaged <u>and Split System</u> Electric Heating and Cooling Equipment:**

Packaged <u>and split system</u> electric equipment providing both heating and cooling<u>, and cooling only equipment with electric heat in the main supply duct before VAV boxes, in each case</u> with a total cooling capacity greater than 20,000 Btu/h<u>,</u> shall be a heat pump.

**EXCEPTION:** Unstaffed equipment shelters or cabinets used solely for personal wireless service facilities.

<u>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.</u>

**1412.4 Setback and Shut-Off**

*Discussion:* Retain existing Seattle amendment, and add note clarifying application of exception for relief dampers per ASHRAE Standard 90.1-2007, Section 6.5.1.1.5.

*Proposal:* Amend 2009 WSEC as follows -

**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 at the same temperature setpoint.
2. Equipment with full load demands of 2 Kw (6,826 Btu/h) or less may be controlled by readily accessible manual off-hour controls.

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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 30 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 no 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 systems with a design outdoor air intake or exhaust capacity of 300 cfm or less((~~equipment with less than cfm 5,000 cfm total supply flow when in buildings less than 3 stories in height~~)).
4. Type 1 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/ft$^2$ of damper area at 1.0 in w.g.

(b) Nonmotorized dampers: 20 cfm/ft$^2$ of damper area at 1.0 in w.g., except that for nonmotorized dampers smaller than 24 inches in either dimension: 40 cfm/ft$^2$ 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.

**1412.5 Heat Pump Controls.**

*Discussion:* Revise to correspond with Section 503.8.3.5 of the 2009 WSEC.
*Proposal:* Amend 2009 WSEC as follows -

**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 compressing 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.**

*Discussion:* (1) Change reference to Seattle Mechanical Code; (2) Modify to achieve further fan energy savings, and associated heating and cooling energy savings, in laboratory spaces.
*Proposal:* Amend 2009 WSEC as follows -

**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 $ft^2$, have an occupant density for ventilation of greater than 25 people per 1000 $ft^2$ of floor area (based on the Default 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 1000 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, Parking Garage, and Motor Vehicle Repair Garage Exhaust Ventilation System Control.**

*Discussion:* Modify for consistency with the Seattle Mechanical Code and to achieve further fan energy savings.
*Proposal:* Amend 2009 WSEC as follows -

**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 occupants 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.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

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. ((~~Garages 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 3000 cfm, are permitted to use occupant sensors or time clocks with a manual over-ride 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.

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**EXCEPTIONS:**

1. Enclosed parking garages or motor vehicle repair garages having a total design capacity less than 6,000 cfm are permitted to use either of the following:

   a. An automatic 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 routinely closed to vehicle traffic the garage ventilation system can be shut down during periods when the garage is not scheduled to be open provided that the all of the following conditions are met:

   a. 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 routinely closed to vehicle traffic are defined as commercial parking structures that have posted closed hours including commercial garages that have irregular hours due to events. Enclosed parking garages that serve multifamily 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 routinely closed to vehicle traffic.

((~~be activated by gas sensors.~~

~~**EXCEPTION:** A parking garage ventilation system having a total design capacity under 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 shutdown during periods when the garage is closed provided there is a manual override switch for garage employees to enable the system after 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.

*Discussion:* Add requirement for variable speed drive for single-zone systems per addendum n to ASHRAE/IESNA Standard 90.1-2007.

*Proposal:* Amend 2009 WSEC as follows -

**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

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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.

**1413.1 Operation.**

*Discussion:* Clarify definition of design supply air per ASHRAE Standard 90.1-2007 User's Manual, page 6-67.

*Proposal:* Amend 2009 WSEC as follows -

**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 source. 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-29 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 lacking 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.

**1413.3 Integrated Operation.**

*Discussion:* Delete exceptions per addendum cy to ASHRAE/IESNA Standard 90.1-2007, ASHRAE's rationale being that with advanced controls for economizers it is now possible to eliminate the exception.

*Proposal:* Amend 2009 WSEC as follows -

**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:~~

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

~~1. Individual, direct expansion units that have a rated capacity less than 65,000 Btu/h and use nonintegrated economizer controls that preclude simultaneous operation of the economizer and mechanical cooling.~~

~~2. Water-cooled water chillers with waterside economizer.~~))

### 1413.5 Economizer Heating System Impact.

*Discussion:* No Seattle changes (retain existing Seattle amendment).
*Proposal:* Amend 2009 WSEC as follows -

**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 the heating is allowed by Section 1435.

Informative Note: Single-fan/dual-duct systems and multizone systems do not comply with this requirement. This is because economizer operation lowers the temperature of the air entering the hot deck heating coil, 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 (it would make 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 (particularly if the system has a variable speed drive), offsetting the energy lost due to increased reheat energy.

See the discussion and diagrams in the ASHRAE Standard 90.1-2007 User's Manual, Section 6.5.1.4, page 6-52.

### 1414.1 Duct Sealing and Testing.

*Discussion:* (1) Require testing of ductwork located outdoors per addendum cq to ASHRAE/IESNA Standard 90.1-2007, (2) require testing of most sections of high-pressure duct work.
*Proposal:* Amend 2009 WSEC as follows -

**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 these 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.**

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

*Discussion:* No Seattle changes (retain existing Seattle amendment).
*Proposal:* Amend 2009 WSEC as follows -

**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 zone that serves that zone.

**1415.2 Radiant Systems.**

*Discussion:* Add requirement for insulating the back side of radiant heating systems per addendum ae to ASHRAE/IESNA Standard 90.1-2007, and also apply requirements to radiant cooling systems.
*Proposal:* Amend 2009 WSEC as follows -

**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.**

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

*Discussion:* (1) Retain application of commissioning requirements to all buildings;
(2) add metering system to the list of equipment to be commissioned.
*Proposal:* Amend 2009 WSEC as follows -

**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 compliance with this section and Section 1513.7 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 10 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.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

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 1513.7 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.

**1416.3.4.2 Record Documents.** Construction documents shall be updated to convey a record of the alterations to the original design. Such updates shall include updated mechanical, electrical and control drawings red-lined, or redrawn if specified, that show all changes to size, type and location of components, equipment and assemblies.

**1416.3.4.3 Systems Operation Training.** Training of the maintenance staff for each equipment type and or system shall include as a minimum:

1. Review of systems documentation.
2. Hands-on demonstration of all normal maintenance procedures, normal operating modes, and all emergency shutdown and start-up procedures.
3. Training completion report.

**1416.3.5 Commissioning Report.** The commissioning report shall be completed and provided to the owner. The commissioning report shall include:

1. Completed Functional Test forms including measurable criteria for test acceptance.
2. Issues log of corrected and uncorrected deficiencies with the anticipated date of correction.
3. Deferred tests, which cannot be performed at the time of report preparation, with anticipated date of completion.
4. Record of progress and completion of operator training.
5. Completed Commissioning Compliance form.

**1416.4 Commissioning Compliance Form.** A commissioning compliance checklist shall be submitted to the building official upon substantial completion of the work included in each permit((~~building~~)). The checklist shall be completed and signed by the building owner or owner's representative. The building official may require that the Commissioning Compliance form components be submitted to verify compliance with Sections 1416 and 1513.8 requirements. Completion of the Commissioning Compliance Checklist (Figure 14B) is deemed to satisfy this requirement.

**Figure 14B Commissioning Compliance Checklist.**

*Discussion:* Revise reference to cite Seattle code.
*Proposal:* Amend 2009 WSEC as follows –

**FIGURE 14B**

**COMMISSIONING COMPLIANCE CHECKLIST**

| | |
|---|---|
| **Project Information** | **Project Name:**<br>**Project Address:**<br>**Commissioning Authority:** |
| **Commissioning Plan (Section 1416.3.1)** | ❑ **Commissioning Plan was used during construction and included items below**<br>● A written schedule including Systems Testing and Balancing, Functional Testing, and Supporting Documentation.<br>● Roles and Responsibilities of the commissioning team.<br>● Functional Test procedures and forms. |
| | |
| **Systems Balancing (Section 1416.3.2)** | ❑ **Systems Balancing has been completed**<br>● Air and Hydronic systems are proportionately balanced in a manner to first minimize throttling losses.<br>● Test ports are provided on each pump for measuring pressure across the pump. |

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| | |
|---|---|
| **Project Information** | **Project Name:**<br>**Project Address:**<br>**Commissioning Authority:** |
| | |
| **Functional Testing (Section 1416.3.3)** | ❑ **HVAC Systems Functional Testing has been completed** (Section 1416.3.3)<br>HVAC systems have been tested to ensure that equipment, components, and subsystems are installed, calibrated, adjusted and operate in accordance with approved plans and specifications.<br>❑ **HVAC Controls Functional Testing has been completed** (Section 1416.3.3)<br>HVAC controls have been tested to ensure that control devices are calibrated, adjusted and operate properly. Sequences of operation have been functionally tested to ensure they operate in accordance with approved plans and specifications.<br>❑ **Lighting Controls Functional Testing has been completed** (Section 1513.7)<br>Lighting controls have been tested to ensure that control devices, components, equipment, and systems are calibrated, adjusted and operate in accordance with approved plans and specifications. |
| | |
| **Supporting Documents (Section 1416.3.4)** | ❑ **Systems documentation, record documents and training have been completed or are scheduled.**<br>● System documentation has been provided to the owner or scheduled date:_____<br>● Record documents have been submitted to owner or scheduled date:_____<br>● Training has been completed or scheduled date:_____ |
| | |
| **Commissioning Report (Section 1416.3.5)** | ❑ **Commissioning Report submitted to Owner and includes items below.**<br>● Completed Functional Tests documentation.<br>● Deficiencies found during testing required by this section which have not been corrected at the time of report preparation and the anticipated date of correction.<br>● Deferred tests, which cannot be performed at the time of report preparation due to climatic conditions or other circumstances beyond control of Commissioning Authority. |
| | |
| **Certification** | ❑ I hereby certify that all requirements for commissioning have been completed in accordance with the ((~~Washington State~~))Seattle Energy Code, including all items above.<br>_____<br>Building Owner or Owner's Representative Date |

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**1431.2 System Sizing Limits.**

*Discussion:* No Seattle changes (retain existing Seattle amendment).
*Proposal:* Amend 2009 WSEC as follows -

**1431.2 System Sizing Limits:** Heating and cooling design loads for the purpose of sizing systems shall be determined in accordance with one of the procedures described in Chapter 29 of Standard RS-1 listed in Chapter 7 or an equivalent computation procedure. For interior temperatures, 70°F shall be used for heating and 75°F for cooling, except where different values are specified in the Washington Administrative Code (WAC). For exterior temperatures, 24°F shall be used for heating and 82°F dry bulb and 66°F for wet bulb for cooling.

Building mechanical systems for all buildings which provide space heating and/or space cooling shall be sized no greater than 150 percent of the design load as calculated above, except that cooling towers shall comply with the sizing requirements in Section 1411.1. No additional safety factor is allowed.

For buildings with a total equipment cooling capacity of 300 tons and above, the equipment shall comply with one of the following:

1. No one unit shall have a cooling capacity of more than 2/3 of the total installed cooling equipment capacity;
2. The equipment shall have a variable speed drive; or
3. The equipment shall have multiple compressors.

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

1. For a single piece of equipment which has both heating and cooling capability, only one function, either the heating or the cooling, need meet the requirements of this section. Capacity for the other function shall be, within available equipment options, the smallest size necessary to meet the load.
2. Stand-by equipment may be installed if controls and devices are provided which allow redundant equipment to operate automatically only when the primary equipment is not operating.
3. Multiple units of the same equipment type, such as multiple chillers and boilers, with combined capacities exceeding the design load, or a single unit that is capable of modulating to a part-load capacity of 50 percent of the load or less, may be specified to operate concurrently only if controls are provided that sequence or otherwise optimally control the operation of each unit based on load.
4. Installed space heating equipment output that does not exceed 10 Btu/h per square foot of gross conditioned floor area and installed space cooling equipment output that does not exceed 15 Btu/h per square foot of gross conditioned floor area. No additional safety factor is allowed.

**1431.3 Hydronic System Design.**

*Discussion:* Add requirement for hydronic system piping design per addendum af and cc to ASHRAE/IESNA Standard 90.1-2007.
*Proposal:* Amend 2009 WSEC as follows -

**1431.3 Hydronic System Design:** All chilled water and condenser water piping shall be designed such that the design flow rate in each pipe segment shall not exceed the values listed in Table 14-3 for the appropriate total annual hours of operation. Pipe size selections for systems that operate under variable flow conditions (e.g. modulating 2-way control valves at

coils) and that contain variable speed pump motors are allowed to be made from the "Variable Flow/Variable Speed" columns. All others shall be made from the "Other" columns. (Note: The flow rates listed here do not consider noise or erosion. Lower flow rates are often recommended for noise sensitive locations.)

**EXCEPTION:** Design flow rates exceeding the values in Table 14-3 are allowed in specific sections of pipe if the pipe in question is not in the critical circuit at design conditions and is not predicted to be in the critical circuit during more than 30% of operating hours.

**1432.2 Systems Temperature Reset Controls.**

*Discussion:* Require variable speed pump control at same threshold as Section 1438.
*Proposal:* Amend 2009 WSEC as follows -

**1432.2 Systems Temperature Reset Controls**

**1432.2.1 Air Systems for Multiple Zones:** Systems supplying heated or cooled air to multiple zones shall include controls which automatically reset supply air temperatures by representative building loads. Temperature shall be reset by at least 25 percent of the design supply-air-to-room-air temperature difference. Interior zones without an exterior wall load impact and high occupancy areas (per Section 1412.8) shall have maximum airflow sized to meet typical cooling loads with the higher reset air temperature.

**EXCEPTIONS:**

1. Where specified humidity levels are required to satisfy process needs, such as computer rooms or museums.
2. Systems that prevent reheating, recooling, or mixing of heated and cooled air supply.
3. 75 percent of the energy for reheating is from site-recovered or site solar energy sources.
4. Zones with peak supply air quantities of 300 cfm or less.
5. Dedicated outdoor air systems less than 5,000 cfm with separate thermal controls.

**1432.2.2 Hydronic Systems:** Systems with a design capacity of 300,000 Btu/h or greater supplying heated or mechanically refrigerated water shall include controls which automatically reset supply water temperatures by representative building loads or by outside air temperature. Temperature shall be reset by at least 25 percent of the design supply-to-return water temperature differences.

**EXCEPTIONS:**

1. Steam boilers.
2. Systems that provide heating with 100°F or lower supply temperature (e.g., water source heat pump loops).

To limit the heat loss from the heat rejection device (cooling tower), for hydronic heat pumps connected to a common heat pump water loop with central devices for heat rejection (e.g., cooling tower):

a. If a closed-circuit tower (fluid cooler) is used, either an automatic valve shall be installed to bypass all but a minimal flow of water around the tower (for freeze protection), or low leakage positive closure dampers shall be provided.

b. If an open-circuit tower is used directly in the heat pump loop, an automatic valve shall be installed to bypass all heat pump water flow around the tower.

c. If an open-circuit tower is used in conjunction with a separate heat exchanger to isolate the tower from the heat pump loop, then heat loss shall be controlled by shutting down the circulation pump on the cooling tower loop.

For hydronic heat pumps connected to a common heat pump water loop with central devices for heat rejection (e.g., cooling tower) and having a total pump system power 5 hp and greater ((~~exceeding 10 hp~~)), each hydronic heat pump shall have:

a. A two-position two-way (but not three-way) valve, or

b. A variable head pressure two-way (water regulating) control valve or pump.

For the purposes of this section, pump system power is the sum of the nominal power demand (i.e., nameplate horsepower at nominal motor efficiency) of motors of all pumps that are required to operate at design conditions to supply fluid from the heating or cooling source to all heat transfer devices (e.g., coils, heat exchanger) and return it to the source. This converts the system into a variable flow system and, as such, the primary circulation pumps shall comply with the variable flow requirements in Section 1438.

**1433 Economizers.**

*Discussion:* (1) Clarify that requirements also apply to redundant equipment;
(2) Exception 1: clarify treatment of redundant units in calculations; clarify meaning of initial tenant improvement; add option b for very high efficiency equipment with improvement per addendum cy to ASHRAE/IESNA Standard 90.1-2007; and retain existing Seattle note about limits to use of the exception;
(3) Exception 2: retain capacity limits from existing Seattle amendment;
(4) Exception 3: add chilled floors as an option, clarify the DOAS systems that accompany chilled floor, chilled beam, and chilled ceiling space cooling systems must still comply with the air economizer requirements;
(5) Exception 7: retain existing Seattle amendment;
(6) Exception 8: clarify that the capacity ratings are based on the outside unit;
(7) Exception 9: clarify that the text reference is to air economizers, limit Option 9a to 54,000 Btuh, require dedicated waterside economizer for Options 9b and 9c;
(8) Exception 10: clarify that heat recovery is required for all units, and that spaces with large internal loads are limited to 20% of the floor area to qualify for this exception.

*Proposal:* Amend 2009 WSEC as follows -

**1433 Economizers.** Air economizers meeting the requirements of Section 1413 shall be provided on all ((~~new~~)) systems including those serving computer server rooms, electronic equipment, radio equipment, telephone switchgear, medical and laboratory equipment, and also on redundant equipment.

**EXCEPTIONS:**

1. a. Qualifying small equipment: This exception shall not be used for unitary cooling equipment installed outdoors or in a mechanical room adjacent to the outdoors. This exception is allowed to be used for other cooling units and split systems with a total cooling capacity rated in accordance with Section 1411.2 of less than 33,000 Btu/h (hereafter referred to as qualifying small systems) provided that these are high-efficiency cooling equipment with SEER and EER values more than 15% higher than minimum efficiencies listed in Tables 14-1A, 14-1B and 14-1D, in the appropriate size category, using the same test procedures. Equipment shall be listed in the appropriate certification program to qualify for this exception. The total capacity of all qualifying small equipment without economizers shall not exceed 72,000 Btu/h per building, or 5% of its air economizer capacity, whichever is greater. That portion of the equipment serving Group R Occupancy is not

included in determining the total capacity of all units without economizers in a building. Redundant units are not
included in determining the total capacity of all units without economizers in a building ((~~counted in the capacity limitations~~)). This exception shall not be used for the shell-and-core permit or for the initial tenant improvement (i.e. the first time that the space is occupied) or for RS-29 analysis.

b. Qualifying very-small very-high efficiency equipment: This exception shall not be used for unitary cooling equipment installed outdoors or in a mechanical room adjacent to the outdoors. This exception is allowed to be used for other cooling units and split systems with a total cooling capacity rated in accordance with Section 1411.2 of less than or equal to 24,000 Btu/h (hereafter referred to as "qualifying very-small very-high efficiency equipment") provided that these are high-efficiency cooling equipment with SEER and EER values more than 64% higher than minimum efficiencies listed in Tables 14-1A, 14-1B and 14-1D, in the appropriate size category, using the same test procedures. If a unit is rated with an IPLV, IEER or SEER, then to eliminate the required economizer, the minimum cooling efficiency of the HVAC unit shall be increased by the percentage shown. If the HVAC unit is only rated with a full load metric like EER or COP cooling then these shall be increased by the percentage shown. Equipment shall be listed in the appropriate certification program to qualify for this exception. The total capacity of all qualifying very-small very-high efficiency equipment without economizers shall not exceed 24,000 Btu/h per tenant space. This exception shall not be used for the shell-and-core permit or for the initial tenant improvement or for RS-29 analysis.

Informative Note: Exception 1 is only applicable to HVAC equipment that complies with Section 1411.1 and is regulated in Tables 14-1A, 14-1B and 14-1D.

Section 1411.1 requires that "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." As of the date of adoption of this Code, the AHRI program does satisfy those criteria. Therefore, products subject to the AHRI standards must be listed in the AHRI certification program.

In Tables 14-1A, 14-1B, and 14-1D, virtually all of the equipment efficiency ratings are required to be determined in accordance with an AHRI Standard (though some products are rated in accordance with ASHRAE Standard 127). Energy Code compliance is determined at standard conditions (not at project specific conditions). Compliance should be verifiable through the AHRI directory at www.ahridirectory.org. It is not acceptable for a manufacturer to submit its own calculations for AHRI standards.

Consequently, to use exception 1 to Section 1433, a product must both: be within the scope of the specified AHRI standard and be included in the AHRI certification program (except for those products rated in accordance with ASHRAE Standard 127). Certain equipment used in computer server rooms is not within the scope of the standards listed in Tables 14-1A, 14-1B, and 14-1D and is not eligible for certification. Therefore, such equipment does not qualify to use exception 1 to Section 1433 (though it may qualify to use another exception).

Informative Note: The exceptions to Section 1433 generally are not equal-energy alternates to a system with air economizer. For example, the 15% higher efficiency cooling units allowed in Exception 1a do not come close to providing equivalence to air economizer.

However, in response to requests, ASHRAE has calculated the improvement in cooling equipment efficiency necessary to compensate for the lack of outside air cooling capability of an economizer. For western Washington, the cooling equipment efficiency improvement required is 64%. This is the basis for the criteria in Exception 1b. At the time this Code was adopted, it was not known whether there were equipment models on the market that could be shown to meet the criteria in Exception 1b.

2. Chilled water terminal units connected to systems with chilled water generation equipment with IPLV values more than 25% higher than minimum part load efficiencies listed in Table 14-1C, in the appropriate size category, using the same test procedures. Equipment shall be listed in the appropriate certification program to qualify for this exception. The total capacity of all systems without economizers shall not exceed ((~~480,000~~)) 72,000 Btu/h per building, or ((~~20~~)) 5% of its air economizer capacity, whichever is greater. That portion of the equipment serving

Group R Occupancy is not included in determining the total capacity of all units without economizers in a building. This exception shall not be used for the shell-and-core permit or for the initial tenant improvement or for RS-29 analysis.

3. Water-cooled refrigeration equipment ((~~serving chilled beams and chilled ceilings space cooling systems only~~)) which are provided with a water economizer meeting the requirements of Section 1413 and that serve only the following space cooling systems:

   a. chilled floor slabs not covered with other material and having direct exposure to the space,

   b. chilled beams,

   c. chilled ceilings.

   Water economizer capacity per building shall not exceed 500 tons. This exception shall not be used for RS-29 analysis.

Informative Note: This water economizer exception applies to equipment that only serves chilled floor slabs, chilled beams, and chilled ceilings space cooling systems. Chilled floor slabs, chilled beams, and chilled ceilings space cooling systems are often partnered with Direct Outside Air Supply (DOAS) systems. The DOAS system is not included in this exception and must comply with the air economizer requirements, unless it qualifies for one of the other exceptions.

4. Systems for which at least 75% of the annual energy used for mechanical cooling is provided from site-recovery or site-solar energy source.

5. Systems where special outside air filtration and treatment, for the reduction and treatment of unusual outdoor contaminants, makes an air economizer infeasible.

6. Systems with dehumidification that affect other systems so as to increase the overall building energy consumption. New humidification equipment shall comply with Section 1413.4.

7. Systems complying with all of the following criteria:

   a. Consist of multiple water source heat pumps with a total cooling capacity for each water-source heat pump of less than 54,000 Btu/h that are connected to a common water loop;

   b. Have a minimum of 60% air economizer complying with Section 1413 that is ducted in a fully enclosed path directly to every heat pump unit 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;

   c. Have water source heat pumps with an EER at least 15% higher for cooling and, for units serving perimeter zones with heating loads (e.g. zones with exterior walls, roofs, or floors), a COP at least 15% higher for heating than that specified in Section 1411;

   d. Where provided with a dedicated boiler or furnace for that building, have a central boiler or furnace efficiency of 90 percent minimum; and

   e. Provide heat recovery with a minimum 50% heat recovery effectiveness as defined in Section 1436 to preheat the outside air supply.

8. For Group R Occupancy, cooling units installed outdoors or in a mechanical room adjacent to outdoors with a total cooling capacity less than 20,000 Btu/h and other cooling units with a total cooling capacity less than 54,000 Btu/h provided that these are high-efficiency cooling equipment with SEER and EER values more than 15 percent higher than minimum efficiencies listed in Tables 14-1A, 14-1B and 14-1D, in the appropriate size category, using the same test procedures. Equipment shall be listed in the appropriate certification program to qualify for this exception. For split-systems, compliance is based on the cooling capacity of individual fan coil units.

Informative Note: Chillers with fan coil units do not qualify for this exception as chillers are not covered in Tables 14-1A, 14-1B, or 14-1D. Most variable refrigerant flow (VRF) systems are too large and also do not qualify for this exception, as AHRI 1230, the standard for rating the efficiency of VRF systems in Tables 14-1A(3)-(4), bases the capacity on the outside unit size.

9. Equipment used to cool any dedicated server room, electronic equipment room or telecom switch room provided that they completely comply with option 9a, 9b, ((~~or~~)) 9c, 9d, or 9e in the table below. The total capacity of all qualifying systems without economizers shall not exceed 240,000 Btu/h per building or 10 percent of its air economizer capacity, whichever is greater. This exception shall not be used for RS-29 analysis.

10. Variable refrigerant flow (VRF) systems, multiple-zone split-system heat pumps, consisting of multiple, individually metered indoor units with multi-speed fan motors, served on a single common refrigeration circuit with an exterior reverse-cycle heat pump with variable speed compressor(s) and variable speed condenser fan(s). These systems shall also be capable of providing simultaneous heating and cooling operation, where in all zones with VRF units recovered energy from the indoor units operating in one mode can be transferred to one or more indoor units operating in the other mode, and shall serve at least 20 percent internal (no perimeter wall within 12 feet ((.))) and 20 percent perimeter zones (as determined by conditioned floor area) and the outdoor unit shall be at least 65,000 Btu/h in total capacity. Systems utilizing this exception shall have 50 percent heat recovery effectiveness on the outside air. For the purposes of this exception, dedicated server rooms, electronic equipment rooms or telecom switch rooms are not considered perimeter zones and shall not exceed 20% of the floor area served by the VRF system. This exception shall be limited to buildings of 60,000 square feet and less.

Procedural Requirement: The materials submitted with the permit application shall specify the gross conditioned floor area of the building.

11. Medical and laboratory equipment that is directly water-cooled and that is not dependent upon space air temperature.

| | **Equipment Type** | **Higher Equipment Efficiency** | **Part-Load Control** | **Economizer** |
|---|---|---|---|---|
| **Option 9a** | Table 14-1A and Table 14-1B[a] | + 15%[b] | Required over 85,000 Btu/h[c] | None required |
| **Option 9b** | Table 14-1A and Table 14-1B[a] | + 5%[d] | Required over 85,000 Btu/h[c] | Dedicated Waterside economizer |
| **Option 9c** | ASHRAE Standard 127[f] | + ((~~0~~)) 10%[g] | Required over 85,000 Btu/h[c] | Dedicated Waterside economizer |
| **Option 9d** | Table 14-1C[h] | + 25%[i] | Required for all chillers[j] | None required |
| **Option 9e** | Table 14-1C[h] | + 10/15%[k] | Required over 85,000 Btu/h[c] | Dedicated Waterside economizer |

Footnotes to table

a. For a system where all of the cooling equipment is subject to the AHRI standards listed in Tables 14-1A and 14-1B, the system shall comply with all of the following (note that if the system contains any cooling equipment that exceeds the capacity limits in Table 14-1A or 14-1B, or if the system contains any cooling equipment that is not included in Table 14-1A or 14-1B, then the system is not allowed to use this option).

b. The cooling equipment shall have an SEER/EER value and an IEER/IPLV value that each is a minimum of 15 percent greater than the value listed in Tables 14-1A and 14-1B (1.15 x values in Tables 14-1A and 14-1B).

c. For units with a total cooling capacity over 85,000 Btu/h, the system shall utilize part-load capacity control schemes that are able to modulate to a part-load capacity of 50 percent of the load or less that results in the compressor operating at the same or higher EER at part loads than at full load (e.g., minimum of two-stages of compressor unloading such as cylinder unloading, two-stage scrolls, dual tandem scrolls, but hot gas bypass is not credited as a compressor unloading system).

d. The cooling equipment shall have an SEER/EER value and an IEER/IPLV value that each is a minimum of 5 percent greater than the value listed in Tables 14-1A and 14-1B (1.05 x values in Tables 14-1A and 14-1B).

e. The system shall include a water economizer in lieu of air economizer. Water economizers shall be capable of providing the total concurrent cooling load served by the connected terminal equipment lacking 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. The equipment shall
be served by a dedicated condenser water system ((~~unless a nondedicated condenser water system exists that can provide appropriate water temperatures during hours when waterside economizer cooling is available~~)).

f. For a system where all cooling equipment is subject to ASHRAE Standard 127-2007.

g. The cooling equipment subject to the ASHRAE Standard 127-2007 shall have ((~~an EER value and an IPLV~~)) a SCOP value that is ((~~equal or~~)) a minimum of 10 percent greater than the value listed in Tables 14-1A(2) (1.10 x values in Tables 14-1A(2)) ((~~and 14-1B~~)) when determined in accordance with the rating conditions in ASHRAE Standard 127-2007 (i.e., not the rating conditions in AHRI Standard 210/240 or 340/360). ((~~This~~)) Effective January 1, 2012, this information shall be provided by an independent third party.

h. For a system with chillers subject to the AHRI standards listed in Table 14-1C (e.g. a chilled water system with fan coil units).

i. The cooling equipment shall have an full-load EER value and an IPLV value that is a minimum of 25 percent greater than the value listed in Table 14-1C (1.25 x value in Table 14-1C), or a full-load and IPLV kW/ton that is at least 25 percent lower than the value listed in Table 14-1C (0.75 x value in Table 14-1C).

j. For all chillers, the system shall utilize part-load capacity control schemes that are able to modulate to a part-load capacity of 50 percent of the load or less and that result in the compressor operating at the same or higher EER at part loads than at full load (e.g., minimum of two-stages of compressor unloading such as cylinder unloading, two-stage scrolls, dual tandem scrolls, but hot gas bypass is not a qualifying compressor unloading system).

k. For air-cooled chillers, the cooling equipment shall have an IPLV EER value that is a minimum of 10% greater than the IPLV EER value listed in Table 14-1C (1.10 x values in Table 14-1C). For water-cooled chillers, the cooling equipment shall have an IPLV kW/ton that is at least 15% lower than the IPLV kW/ton value listed in Table 14-1C (0.85 x values in Table 14-1C).

Informative Note: Options 9a and 9b are only applicable to HVAC equipment that complies with Section 1411.1 and is regulated in Tables 14-1A and 14-1B.

Section 1411.1 requires that "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." As of the date of adoption of this Code, the AHRI program does satisfy those criteria. Therefore, products subject to the AHRI standards must be listed in the AHRI certification program.

In Tables 14-1A and 14-1B, virtually all of the equipment efficiency ratings are required to be determined in accordance with an AHRI Standard (though some products are rated in accordance with ASHRAE Standard 127). As specified in Section 1411.2, Energy Code compliance is determined at standard conditions (not at project specific conditions). Compliance should be verifiable through the AHRI directory at www.ahridirectory.org. It is not acceptable for a manufacturer to submit its own calculations for AHRI standards.

Equipment used in computer server rooms that is within the scope of ASHRAE Standard 127, Method of Testing for Rating Computer and Data Processing Room Unitary Air Conditioners is also eligible to use exception 9 option 9c to Section 1433.

Informative Note: For hydronic systems over 300,000 Btuh, see Section 1432.2.2.

## 1435 Simultaneous heating and cooling.

*Discussion:* (1) Clarify that simultaneous heating and cooling is prohibited for ground-coupled systems regardless of whether they actually use ground water;
(2) Exception 2, clarify the reset requirements in Section 1432.2 are always applicable;
(3) Exception 4, revise to indicate that this exception is not applicable to computer rooms per addendum bu to ASHRAE/IESNA Standard 90.1-2007.

*Proposal:* Amend 2009 WSEC as follows -

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

**1435 Simultaneous heating and cooling.** Systems which provide heating and cooling simultaneously to a zone are prohibited. Zone thermostatic and humidistatic controls shall be capable of operating in sequence the supply of heating and cooling energy to the zone. Such controls shall prevent:

a. Reheating for temperature control.

b. Recooling for temperature control.

c. Mixing or simultaneous supply of air that has been previously mechanically heated and air that has been previously cooled, either by economizer systems, ((~~ground water~~)) ground-coupled hydronic loops, or by mechanical refrigeration.

d. Other simultaneous operation of heating and cooling systems to the same zone.

e. Reheating for humidity control.

**EXCEPTIONS:**

1. Variable air volume (VAV) systems which, during periods of occupancy are designed and controlled:

   1.1 To reduce the primary air supply to each zone to a minimum air volume when the zone temperature is in a 5°F (3°C) zone temperature dead band after cooling is no longer required and before reheating, recooling or mixing takes place. This minimum volume shall be no greater than the larger of the following:

   1.1.1 Twenty percent of the peak supply volume; or

   1.1.2 The volume of outdoor air required to meet zone ventilation requirements, unless increasing the volume to critical zones (zones with the highest ratio of outside air to total supply air) beyond the minimum ventilation requirements results in a decrease in overall outside air required by the HVAC system. An increase beyond minimum ventilation rates shall not be applied to more than 20 percent of the zones with reheat on any one system excluding zones equipped with ventilation controls for high occupancy areas required by Section 1317.2.2.

   1.2 So the volume of air that is reheated, recooled, or mixed in peak heating demand shall be less than 50 percent of the zone design peak supply rate.

   1.3 So the airflow between dead band and full heating or full cooling shall be modulated.

   1.4 So the control logic of each system shall have means preventing changes in setpoint(s) from inducting simultaneous heating and cooling (including economizer cooling) except for humidity control or zone controls operating as described under exception 1.1.

2. Zones where special pressurization relationships, cross-contamination requirements, or code-required minimum circulation rates are such that variable air volume systems are impractical, such as some areas of hospitals and laboratories. Systems which use this exception and supply heated or cooled air to multiple zones shall include:

   2.1 Controls that automatically reset supply air temperatures by representative building loads or by outside air temperature unless it can be shown that supply air temperature reset increases overall building annual energy costs. In all cases, these controls shall comply with the requirements in Section 1432.2.

   2.2 Variable speed drives for supply, ((~~and~~)) return, and exhaust fans, modulating pressure independent zone dampers on all zones (supply, return, and exhaust fans where applicable), specified occupied and unoccupied or low occupancy airflows, and have controls which reduce airflow in response to changes in occupancy levels.

3. Zones where at least 75% of the energy for reheating or for providing warm air in mixing systems is provided from a site-recovered (including condenser heat) or site solar energy source.

4. Zones where specific humidity levels are required to satisfy process needs, such as ((~~computer rooms,~~)) museums, surgical suites, and buildings with refrigerating systems, such as supermarkets, refrigerated warehouses, and ice arenas. This exception does not apply to computer rooms.

5. Zones with a peak supply air quantity of 300 cfm (142 L/s) or less.

6. Three deck multizone systems that mix economizer-cooled (mixed) air with heated or cooled air where the temperature of the economizer-cooled air is reset based on weighted zone heating and cooling loads and zone

airflow is reduced to a minimum of 20% design airflow or the volume of outdoor air required to meet zone ventilation requirements before mixing is allowed.

**1436 Energy Recovery.**

*Discussion:* (1) Revise title for consistency with ASHRAE/IESNA Standard 90.1; (2) add informative note to clarify that the heat recovery requirements are applicable to industrial facilities and processes.

*Proposal:* Amend 2009 WSEC as follows -

**1436 ((~~Heat~~)) <u>Energy</u> Recovery.**

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

**1436.1 Fan Systems.**

*Discussion:* (1) Require energy recovery, rather than heat recovery alone (companion change to Section 1436); (2) delete exception for laboratory VAV systems; (3) add note to clarify heat recovery effectiveness criteria for Seattle; and (4) add cross-reference to additional laboratory requirements in Section 1439.2.

*Proposal:* Amend 2009 WSEC as follows -

**1436.1 Fan Systems:** Fan systems which have a minimum outdoor air capacity of 5,000 cfm or greater shall have an ((~~heat~~)) energy recovery system that is designed for, and operates during, both the heating and the cooling seasons, with at least 50 percent heat recovery effectiveness. For the purposes of sizing the energy recovery system, the applicant shall submit calculations demonstrating that the system will provide at least 50% heat recovery effectiveness. Fifty percent heat recovery effectiveness shall mean an increase in the outside air supply temperature at design heating conditions of one half the difference between the outdoor design air temperature and 65°F. Provision shall be made to bypass or control the ((~~heat~~)) energy recovery system to permit air economizer operation as required by Section 1433. ((~~Heat~~)) Energy recovery energy may be provided from any site-recovered or site-solar source. Where a single room or space is supplied by multiple units, the aggregate ventilation (cfm) of those units shall be used in applying this requirement. The return/exhaust air stream temperature for heat recovery device selection shall be 70°F.

Informative Note: In Seattle, the outdoor design air temperature is 24°F as specified in Table 3-1. The difference between 24°F and 65°F is 41 degrees. One-half of 41 degrees is 20.5 degrees. Therefore, to provide 50% heat recovery effectiveness in Seattle, the heat recovery system shall raise the outside supply air temperature to a minimum of 44.5°F (24°F + 20.5°F) at the outdoor design conditions.

**EXCEPTIONS:** These exceptions only apply to the particular exhaust subsystems. The remaining cfm of the main supply system is subject to the energy recovery requirements.

1. ((~~Laboratory systems equipped with both variable air volume supply and variable air volume or two-speed exhaust fume hoods provided that an instruction label is placed on the face of the hood that provides the information in Exhibit 14-1.~~)) Reserved.

**((~~Exhibit 14-1~~**

~~INSTRUCTIONS TO OPERATOR~~

~~To be in compliance with the Energy Code, this fume hood is designed to operate as variable air volume (VAV) by adjusting the sash or controller. Maintain sash in the minimum position during use and close totally when the fume hood is not in use.~~

))

2. Systems serving spaces heated to less than 60 degrees F.
3. Systems which can be shown to use as much energy with the addition of heat recovery equipment as without it.
4. Systems exhausting toxic, flammable, paint exhaust or corrosive fumes making the installation of heat recovery equipment impractical.
5. Type I commercial kitchen hoods.
6. Systems that only provide cooling.
7. Cooling only air handling units or air conditioning units where the minimum outdoor air is less than 70 percent of total supply air.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

Laboratory systems shall also comply with Section 1439.2.

**1436.2 Condensate Systems.**

*Discussion:* Clarify applicable systems for condensate recovery.
*Proposal:* Amend 2009 WSEC as follows -

**1436.2 Condensate Systems:** ((~~On-site steam h~~))Heating systems with on-site steam generation shall have condensate water recovery. On-site includes a system that is located within or adjacent to one or more buildings within the boundary of a contiguous area or campus under one ownership and which serves one or more of those buildings.

Buildings using steam generated off-site with steam heating systems which do not have condensate water recovery shall have condensate water recovery.

**1436.3 Heat Recovery for Service Water Heating.**

*Discussion:* Add note indicating typical systems to which heat recovery is applicable.
*Proposal:* Amend 2009 WSEC as follows -

**1436.3 Heat Recovery for Service Water Heating:** Condenser water heat recovery systems shall be installed for heating or preheating of service hot water provided all of the following are true:

a. The facility operates 24 hours a day.

b. The total installed heat rejection capacity of the water-cooled systems exceeds 1,500,000 Btu/h of heat rejection.

c. The capacity of service water heating equipment exceeds 250,000 Btu/h.

The required heat recovery system shall have the capacity to provide the smaller of:

a. 60 percent of the peak heat rejection load at design conditions; or

b. Preheat of the peak service hot water draw to 85°F; or

c. 50 percent of the service water heating load.

**EXCEPTIONS:**

1. Facilities that employ condenser heat recovery for space heating with a heat recovery design exceeding 30 percent of the peak water-cooled condenser load at design conditions.

2. Facilities that provide 60 percent of their service water heating from site solar or site recovered energy or from other sources.

Informative Note: This requirement typically applies to hotels, dormitories, mixed-use retail/residential projects, commercial kitchens, and institutions such as prisons and hospitals according to the ASHRAE/IESNA Standard 90.1 User's Manual, page 6-76.

**1436.4 Condenser Heat Recovery.**

*Discussion:* Clarify the basis for the calculations and the minimum heat recovery required.
*Proposal:* Amend 2009 WSEC as follows -

**1436.4 Condenser Heat Recovery:** Facilities having food service, meat or deli departments and having 500,000 Btu/h or greater of remote refrigeration condensers shall have condenser waste heat recovery from freezers and coolers and shall use the waste heat for service water heating, space heating or for dehumidification reheat. Facilities having a gross conditioned floor area of 40,000 $ft^2$ or greater and 1,000,000 Btu/h or greater of remote refrigeration shall have condenser waste heat recovery from freezers and coolers and shall use the waste heat for service water heating, and either for space heating or for dehumidification reheat for maintaining low space humidity. The required heat recovery system shall have the capacity to provide the smaller of:

a. 60 percent of the peak heat rejection load at design conditions; or

b. 50 percent of the sum of the service water heating load plus space heating load.

**1437 Electric Motor Efficiency.**

*Discussion:* (1) Require electronically-commutated motors for fans in fan-coil units; and (2) add informative note to clarify that the motor efficiency requirements are applicable to industrial facilities and processes.
*Proposal:* Amend 2009 WSEC as follows -

**1437 Electric motor efficiency.** Design A & B squirrel-cage, T-frame induction permanently wired polyphase motors of 1 hp or more having synchronous speeds of 3,600, 1,800 and 1,200 rpm shall have a nominal full-load motor efficiency no less than the corresponding values for energy efficient motors provided in Table 14-4.

**EXCEPTIONS:**

1. Motors used in systems designed to use more than one speed of a multispeed motor.
2. Motors used as a component of the equipment meeting the minimum equipment efficiency requirements of Section 1411 and Tables 14-1A through 14-1G provided that the motor input is included when determining the equipment efficiency.
3. Motors that are an integral part of specialized process equipment.
4. Where the motor is integral to a listed piece of equipment for which no complying motor has been approved.

Fan motors less than 1 hp in series terminal units and in fan-coil units shall be electronically commutated motors, or shall have a minimum motor efficiency of 65% when rated in accordance with NEMA Standard MG-1 at full load rating conditions.

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

**1438 System Criteria.**

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

*Discussion:* (1) Change threshold to 5 hp;
(2) clarify that the requirements are applicable to parking garage ventilation fans;
(3) retain existing Seattle note;
(4) add cross-reference to requirements in elevator code; and
(5) revise exception for greater consistency with addendum u to ASHRAE/IESNA Standard 90.1-2007.

*Proposal:* Amend 2009 WSEC as follows -

**1438 System Criteria.** For fans and pumps ((~~7.5~~)) 5 horsepower and greater including custom and packaged air handlers serving variable air volume fan systems, constant volume fans, parking garage ventilation fans,
heating and cooling hydronic pumping systems, pool and service water pumping systems, domestic water pressure boosting systems, cooling tower fan, and other pumps or fans where variable flows are required, there shall be:

a. Variable speed drives, or

b. Other controls and devices that will result in fan and pump motor demand of no more than 30% of design wattage at 50% of design air volume for fans when static pressure set point equals 1/3 the total design static pressure, and 50% of design water flow for pumps, based on manufacturer's certified test data. Variable inlet vanes, throttling valves (dampers), scroll dampers or bypass circuits shall not be allowed.

Informative Note: At the time this Code was adopted, very few technologies could be shown to meet the criteria in option b.

**EXCEPTION:** Variable speed devices are not required for motors that serve:

1. Fans or pumps in packaged equipment where variable speed drives are not available as a factory option from the equipment manufacturer.
2. Fans or pumps that are required to operate only for emergency fire-life-safety events (e.g., stairwell pressurization fans, elevator pressurization fans, fire pumps, etc.).

See the Seattle Building Code, Section 3016.15, for energy efficiency requirements for ventilation fan systems in elevators.

Informative Note: As indicated in Section 1120, the Energy Code applies to industrial facilities, as well as commercial and industrial processes. Thus, the variable speed drive requirement applies to industrial facilities, as well as systems and equipment used in commercial and industrial processes.

**1438.1 Heat Rejection Equipment:** The requirements of this section apply to heat rejection equipment used in comfort cooling systems such as air-cooled condensers, open cooling towers, closed-circuit cooling towers, and evaporative condensers.

**EXCEPTION:** Heat rejection devices included as an integral part of equipment listed in Tables 14-1A through 14-1D.

Heat rejection equipment shall have a minimum efficiency performance not less than values specified in Table 14-1G. These requirements apply to all propeller, axial fan and centrifugal

fan cooling towers. Table 14-1G specifies requirements for air-cooled condensers that are within rating conditions specified within the table.

**1438.1.1 Variable flow controls:** Cooling tower fans ((~~7.5~~)) 5 hp and greater shall have control devices that vary flow by controlling leaving fluid temperature or condenser temperature/pressure of the heat rejection device.

**1438.1.2 Limitation on centrifugal fan cooling towers:** Open cooling towers with a combined rated capacity of 1,100 gpm and greater at 95°F condenser water return, 85°F condenser water supply and 75°F outdoor wet-bulb temperature shall meet the energy efficiency requirement for axial fan open circuit cooling towers.

> **EXCEPTION:** Open circuit cooling towers that are ducted (inlet or discharge) ((~~or have external sound attenuation~~)) that require((~~s~~)) external static pressure capability or open circuit cooling towers that have external sound attenuation.

**1438.2 Hot gas bypass limitation:** Cooling equipment with direct expansion coils rated at greater than 95,000 Btu/h total cooling capacity shall have a minimum of 2 stages of cooling capacity or capacity modulation other than hot gas bypass that is capable of reducing input and output by at least 50%.

**1438.3 Large volume fan systems:** Single or multiple fan systems serving a zone or adjacent zones without separating walls with total air flow over 10,000 cfm (3,540 L/s) are required to reduce airflow based on space thermostat heating and cooling demand. A variable speed drive shall reduce airflow to a maximum 75% of peak airflow or minimum ventilation air requirement as required by Section 403 of the IMC, whichever is greater.

> **EXCEPTIONS:**
>
> 1. Systems where the function of the supply air is for purposes other than temperature control, such as maintaining specific humidity levels or supplying an exhaust system.
> 2. Dedicated outdoor air supply unit(s) with heat recovery where airflow is equal to the minimum ventilation requirements and other fans cycle off unless heating or cooling is required.
> 3. An area served by multiple units where designated ventilation units have 50% or less of total area airflow and nonventilation unit fans cycle off when heating or cooling is not required.

## 1439.2 Laboratory Exhaust Systems.

*Discussion:* Add cross-reference to additional laboratory requirements in Section 1436.1.
*Proposal:* Amend 2009 WSEC as follows -

**1439.2 Laboratory Exhaust Systems:** Buildings with laboratory exhaust systems having a total exhaust rate greater than 5,000 cfm (2,360 L/s) shall include heat recovery systems to precondition((~~ed~~)) makeup air from laboratory exhaust. The heat recovery system shall be capable of increasing the outside air supply temperature at design heating conditions by 25°F (13.9°C) in Climate Zone 1 and 35°F (19.4°C) in Climate Zone 2. A provision shall be made to bypass or control the heat recovery system to permit air economizer operation as required by Section 1433.

> **EXCEPTIONS:**
>
> 1. Variable air volume laboratory exhaust and room supply systems capable of reducing exhaust and make-up air volume to 50% or less of design values; or

2. Direct make-up (auxiliary) air supply equal to at least 75% of the exhaust rate, heated no warmer than 2°F (1.1°C) below room set point, cooled to no cooler than 3°F (1.7°C) above room set point, no humidification added, and no simultaneous heating and cooling used for dehumidification control; or
3. Combined Energy Reduction Method: VAV exhaust and room supply system capable of reducing exhaust and makeup air volumes and a heat recovery system to precondition makeup air from laboratory exhaust that when combined will produce the same energy reduction as achieved by a heat recovery system with a 50% sensible recovery effectiveness as required above. For calculation purposes, the heat recovery component can be assumed to include the maximum design supply airflow rate at design conditions. The combined energy reduction (QER) shall meet the following:

$$QER \geq QMIN$$

$$QMIN = CFMS \cdot (TR-TO) \cdot 1.1 \cdot 0.6$$

$$QER = CFMS \cdot (TR-TO) \cdot 1.1(A+B)/100$$

Where:

| | | |
|---|---|---|
| QMIN | = | Energy recovery at 60% sensible effectiveness (Btu/h) |
| QER | = | Combined energy reduction (Btu/h) |
| CFMS | = | The maximum design supply airflow rate to conditioned spaces served by the system in cubic feet per minute |
| TR | = | Space return air dry bulb at winter design conditions |
| TO | = | Outdoor air dry bulb at winter design conditions |
| A | = | Percentage that the exhaust and makeup air volumes can be reduced from design conditions |
| B | = | Percentage sensible heat recovery effectiveness |

Laboratory systems shall also comply with Section 1436.1.

**1444 Conservation of Water and Pumping Energy.**

*Discussion:* Establish requirements for all service water pressure booster systems per addendum cv to ASHRAE/IESNA Standard 90.1-2007.

*Proposal:* Amend 2009 WSEC as follows -

**1444 Conservation of Water and Pumping Energy.** Pumps for all domestic water systems shall comply with Section 1438.

In addition, domestic water pressure booster systems shall be designed such that:

a. One or more pressure sensors shall be used to vary pump speed or to start and stop pumps, or for both purposes. Either the sensor(s) shall be located near the critical fixture(s) that determine the pressure required, or logic shall be employed that adjusts the setpoint to simulate operation of remote sensor(s).

b. No device(s) shall be installed for the purpose of reducing the pressure of all of the water supplied by any booster system pump or booster system, except for safety devices.

c. No booster system pumps shall operate when there is no service water flow.

**1452 Pool Water Heaters.**

*Discussion:* (1) retain existing Seattle amendment; and (2) update environmental conditions and rating standard per addendum y to ASHRAE/IESNA Standard 90.1-2007.
*Proposal:* Amend 2009 WSEC as follows -

**1452 Pool Water Heaters:** Pool water heaters using electric resistance heating as the primary source of heat are prohibited for pools over 2,000 gallons. Heat pump pool heaters shall have a minimum COP of 4.0 at 50.0°F db, 44.2°F wb, outdoor air and 80.0°F entering water, determined in accordance with AHRI Standard 1160, Performance Rating of Heat Pump Pool Heaters((~~ASHRAE Standard 146, Method of Testing for Rating Pool Heaters~~)). Other pool heating equipment shall comply with the applicable efficiencies in Tables 14-1A through 14-1G.

**1470 Compressed Air and Vacuum Pumps.**

*Discussion:* Add requirements for air compressors.
*Proposal:* Amend 2009 WSEC as follows -

**1470 Compressed Air and Vacuum Air.**

**EXCEPTIONS:** If used for medical purposes, compressed air and vacuum air are exempt from this section.

**1470.1 Air Compressors (50-150 PSI), General:** Air compressors operating at 50-150 PSI shall comply with the following:

a. All water drains shall be "no loss" drains.

b. Timed unheated desiccant air driers shall not be allowed.

**1470.2 Rotary Screw Air Compressors over 10 hp (50-150 PSI):** Rotary screw air compressors over 10 hp operating at 50-150 PSI shall not rely on modulation control and shall have one of the following:

a. Receiver capacity greater than three gallon per cfm to allow efficient load/unload control,

b. Variable speed drive controlled air compressor, or

c. Multiple air compressors using a smaller trim-air compressor to trim. The trim compressor shall use variable speed drive control, or shall use load/unload control with greater than three gallon receiver capacity per cfm for the trim air compressor.

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

**1475 Commercial Food Service.**

*Discussion:* Add requirements for commercial food service equipment to be Energy Star per Section 7.4.7.3 of ASHRAE/USGBC/IESNA Standard 189.1-2009.

*Proposal:* Amend 2009 WSEC as follows -

**1475 Commercial Food Service.** The following types of equipment within the scope of the applicable Energy Star program shall comply with the energy-efficiency and water-efficiency criteria required to achieve the Energy Star label:

a. Commercial fryers: Energy Star Program Requirements for Commercial Fryers

b. Commercial hot food holding cabinets: Energy Star Program Requirements for Hot Food Holding Cabinets

c. Commercial steam cookers: Energy Star Program Requirements for Commercial Steam Cookers

d. Commercial dishwashers: Energy Star Program Requirements for Commercial Dishwashers

Informative Note: Energy Star requirements are posted on the Energy Star website at: http://www.energystar.gov/index.cfm?c=product_specs.pt_product_specs

**Table 14-1A(1) Unitary Air Conditioners and Condensing Units, Electrically Operated, Minimum Efficiency Requirements.**

*Discussion:* Revise EER and IEER values and establish separate criteria for water-cooled and evaporatively-cooled units per addendum co to ASHRAE/IESNA Standard 90.1-2007.

*Proposal:* Amend 2009 WSEC as follows -

**TABLE 14-1A(1)**
**Unitary Air Conditioners and Condensing Units, Electrically Operated, Minimum Efficiency Requirements**

| Equipment Type | Size Category | Heating Section Type | Sub-Category or Rating Condition | Minimum Efficiency[a] | Test Procedure[b] |
|---|---|---|---|---|---|
| Air conditioners, air-cooled | < 65,000 Btu/h[d] | | Split System and Single Package | 13.0 SEER | AHRI 210/240 |
| | ≥65,000 Btu/h and <135,000 Btu/h | | Split System and Single Package | 11.2 EER[c]<br>11.4 IEER[c] | AHRI 340/360 |
| | ≥135,000 Btu/h and <240,000 Btu/h | | Split System and Single Package | 11.0 EER[c]<br>11.2 IEER[c] | |
| | ≥240,000 Btu/h and < 760,000 Btu/h | | Split System and Single Package | 10.0 EER[c]<br>10.1 IEER[c] | |
| | ≥ 760,000 Btu/h | | Split System and Single Package | 9.7 EER[c]<br>9.8 IEER[c] | |
| Through-the-wall, air-cooled | < 30,000 Btu/h[d] | | Split System and Single Package | 12.0 SEER | AHRI 210/240 |
| Small-duct, high-velocity, air-cooled | < 65,000 Btu/h[d] | | Split System | 10.0 SEER | AHRI 210/240 |
| Air conditioners, water ((~~and evaporatively~~)) cooled | < 65,000 Btu/h | All | Split System and Single Package | 12.1 EER<br>12.3 IEER | AHRI 210/240 |
| | ≥65,000 Btu/h and <135,000 Btu/h | Electric Resistance (or None) | Split System and Single Package | 11.5 EER (before 6/1/2011)<br>12.1 EER (as of 6/1/2011)<br>11.7 IEER (before 6/1/2011)<br>12.3 IEER (as of 6/1/2011) | AHRI 340/360 |
| | | All other | Split System and Single Package | 11.3 EER (before 6/1/2011)<br>11.9 EER (as of 6/1/2011)<br>11.5 IEER (before 6/1/2011)<br>12.1 IEER (as of 6/1/2011) | |
| | ≥135,000 Btu/h and <240,000 Btu/h | Electric Resistance (or None) | Split System and Single Package | 11.0 EER (before 6/1/2011)<br>12.5 EER (as of 6/1/2011)<br>11.2 IEER (before 6/1/2011)<br>12.7 IERR (as of 6/1/2011) | |
| | | All other | Split System and Single Package | 10.8 EER (before 6/1/2011)<br>12.3 EER (as of 6/1/2011)<br>11.0 IEER (before 6/1/2011)<br>12.5 IEER (as of 6/1/2011) | |
| | ≥240,000 Btu/h and < 760,000 Btu/h | Electric Resistance (or None) | Split System and Single Package | 11.0 EER (before 6/1/2011)<br>12.4 EER (as of 6/1/2011)<br>11.1 IEER (before 6/1/2011)<br>12.6 IEER (as of 6/1/2011) | |
| | | All other | Split System and Single Package | 10.8 EER (before 6/1/2011)<br>12.2 EER (as of 6/1/2011)<br>10.9 IEER (before 6/1/2011)<br>12.4 IEER (as of 6/1/2011) | |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

| Equipment Type | Size Category | Heating Section Type | Sub-Category or Rating Condition | Minimum Efficiency[a] | Test Procedure[b] |
|---|---|---|---|---|---|
| | | | | | |
| | ≥ 760,000 Btu/h | Electric Resistance (or None) | Split System and Single Package | 11.0 EER (before 6/1/2011)<br>12.2 EER (as of 6/1/2011)<br>11.1 IEER (before 6/1/2011)<br>12.4 IEER (as of 6/1/2011) | |
| | | All other | Split System and Single Package | 10.8 EER (before 6/1/2011)<br>12.0 EER (as of 6/1/2011)<br>10.9 IEER (before 6/1/2011)<br>12.2 IEER (as of 6/1/2011) | |
| Air conditioners, evaporatively cooled | < 65,000 Btu/h | All | Split System and Single Package | 12.1 EER<br>12.3 IEER | AHRI 210/240 |
| | ≥65,000 Btu/h and <135,000 Btu/h | Electric Resistance (or None) | Split System and Single Package | 11.5 EER (before 6/1/2011)<br>12.1 EER (as of 6/1/2011)<br>11.7 IEER (before 6/1/2011)<br>12.3 IEER (as of 6/1/2011) | AHRI 340/360 |
| | | All other | Split System and Single Package | 11.3 EER (before 6/1/2011)<br>11.9 EER (as of 6/1/2011)<br>11.5 IEER (before 6/1/2011)<br>12.1 IEER (as of 6/1/2011) | |
| | ≥135,000 Btu/h and <240,000 Btu/h | Electric Resistance (or None) | Split System and Single Package | 11.0 EER (before 6/1/2011)<br>12.0 EER (as of 6/1/2011)<br>11.2 IEER (before 6/1/2011)<br>12.2 IERR (as of 6/1/2011) | |
| | | All other | Split System and Single Package | 10.8 EER (before 6/1/2011)<br>11.8 EER (as of 6/1/2011)<br>11.0 IEER (before 6/1/2011)<br>12.0 IEER (as of 6/1/2011) | |
| | ≥240,000 Btu/h and < 760,000 Btu/h | Electric Resistance (or None) | Split System and Single Package | 11.0 EER (before 6/1/2011)<br>11.9 EER (as of 6/1/2011)<br>11.1 IEER (before 6/1/2011)<br>12.1 IEER (as of 6/1/2011) | |
| | | All other | Split System and Single Package | 10.8 EER (before 6/1/2011)<br>12.2 EER (as of 6/1/2011)<br>10.9 IEER (before 6/1/2011)<br>11.9 IEER (as of 6/1/2011) | |
| | ≥ 760,000 Btu/h | Electric Resistance (or None | Split System and Single Package | 11.0 EER (before 6/1/2011)<br>11.7 EER (as of 6/1/2011)<br>11.1 IEER (before 6/1/2011)<br>11.9 IEER (as of 6/1/2011) | |
| | | All other | Split System and Single Package | 10.8 EER (before 6/1/2011)<br>11.5 EER (as of 6/1/2011)<br>10.9 IEER (before 6/1/2011)<br>11.7 IEER (as of 6/1/2011) | |
| Condensing units, air cooled | ≥ 135,000 Btu/h | - | | 10.1 EER (before 6/1/2011)<br>10.5 EER (as of 6/1/2011)<br>((~~11.2 IPLV~~))<br>11.4 IEER (before 6/1/2011)<br>11.8 IEER (as of 6/1/2011) | AHRI 365 |
| Condensing units, water ((~~or evaporatively~~)) cooled | ≥ 135,000 Btu/h | - | | 13.1 EER (before 6/1/2011)<br>13.5 EER (as of 6/1/2011)<br>((~~13.1 IPLV~~))<br>13.6 IEER (before 6/1/2011)<br>14.0 IEER (as of 6/1/2011) | |
| Condensing units, evaporatively cooled | ≥ 135,000 Btu/h | - | | 13.1 EER (before 6/1/2011)<br>13.5 EER (as of 6/1/2011)<br>((~~13.1 IPLV~~))<br>13.6 IEER (before 6/1/2011)<br>14.0 IEER (as of 6/1/2011) | |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

a Reserved.

b IPLVs are only applicable to equipment with capacity modulation.

c Deduct 0.2 from the required EERs and IEERs for units with a heating section other than electric resistance heat.

d Applies to all units, including single-phase and three-phase. For single-phase air-cooled air-conditioners < 65,000 Btu/h, SEER values are those set by NAECA.

e Reserved.

## Table 14-1A(2) Air Conditioners and Condensing Units Serving Computer Rooms, Minimum Efficiency Requirements.

*Discussion:* Establish requirements for computer room equipment subject to ASHRAE Standard 127 per addendum bu to ASHRAE/IESNA Standard 90.1-2007.

*Proposal:* Amend 2009 WSEC as follows -

**TABLE 14-1A(2)**
**Air Conditioners and Condensing Units Serving Computers Rooms**
**Minimum Efficiency Requirements**

| Equipment Type | Net Sensible Cooling Capacity[a] | Minimum SCOP-127[b] Efficiency Downflow units / Upflow units | Test Procedure |
|---|---|---|---|
| Air conditioners, air cooled | <65,000 Btu/h (<19 kW) | 2.20 / 2.09 | ANSI / ASHRAE 127 |
| | >= 65,000 Btu/h and < 240,000 Btu/h (>=19kW and < 70 kW) | 2.10 / 1.99 | |
| | >= 240,000 Btu/h (>= 70 kW) | 1.90 / 1.79 | |
| Air conditioners, water cooled | <65,000 Btu/h (<19 kW) | 2.60 / 2.49 | ANSI / ASHRAE 127 |
| | >= 65,000 Btu/h and < 240,000 Btu/h (>=19kW and < 70 kW) | 2.50 / 2.39 | |
| | >= 240,000 Btu/h (>= 70 kW) | 2.40 /2.29 | |
| Air conditioners, water cooled with fluid economizer | <65,000 Btu/h (<19 kW) | 2.55 /2.44 | ANSI / ASHRAE 127 |
| | >= 65,000 Btu/h and < 240,000 Btu/h (>=19kW and < 70 kW) | 2.45 / 2.34 | |
| | >= 240,000 Btu/h (>= 70 kW) | 2.35 / 2.24 | |
| Air conditioners, glycol cooled (rated at 40% propylene glycol) | <65,000 Btu/h (<19 kW) | 2.50 / 2.39 | ANSI / ASHRAE 127 |
| | >= 65,000 Btu/h and < 240,000 Btu/h (>=19kW and < 70 kW) | 2.15 / 2.04 | |
| | >= 240,000 Btu/h (>= 70 kW) | 2.10 / 1.99 | |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

| Equipment Type | Net Sensible Cooling Capacity[a] | Minimum SCOP-127[b] Efficiency Downflow units / Upflow units | Test Procedure |
|---|---|---|---|
| Air conditioners, glycol cooled (rated at 40% propylene glycol) with fluid economizer | <65,000 Btu/h (<19 kW) | 2.45 / 2.34 | ANSI / ASHRAE 127 |
| | >= 65,000 Btu/h and < 240,000 Btu/h (>=19kW and < 70 kW) | 2.10 / 1.99 | |
| | >= 240,000 Btu/h (>= 70 kW) | 2.05 / 1.94 | |

a. Net sensible cooling capacity: The total gross cooling capacity less the latent cooling less the energy to the air movement system. (Total Gross – latent – Fan Power)

b. Sensible coefficient of performance (SCOP-127): a ratio calculated by dividing the net sensible cooling capacity in watts by the total power input in watts (excluding re-heaters and humidifiers) at conditions defined in ASHRAE Standard 127. The net sensible cooling capacity is the gross sensible capacity minus the energy dissipated into the cooled space by the fan system.

**Tables 14-1A(3) and 14-1A(4) Electrically Operated Variable Refrigerant Flow Air Conditioners, Minimum Efficiency Requirements, and Air-to-Air and Applied Heat Pumps, Minimum Efficiency Requirements.**

*Discussion:* Establish requirements for variable refrigerant flow air conditioners per addendum cp to ASHRAE/IESNA Standard 90.1-2007.

*Proposal:* Amend 2009 WSEC as follows -

**TABLE 14-1A(3)**
**Electrically Operated Variable Refrigerant Flow Air Conditioners**
**Minimum Efficiency Requirements**

| Equipment Type | Size Category | Heating Section Type | Sub-Category or Rating Condition | Minimum Efficiency | Test Procedure |
|---|---|---|---|---|---|
| VRF Air Conditioners, Air Cooled | <65,000 Btu/h | All | VRF Multi-split System | 13.0 SEER | AHRI 1230 |
| | ≥65,000 Btu/h and <135,000 Btu/h | Electric Resistance (or none) | VRF Multi-split System | 11.2 EER<br>12.5 IEER<br>13.1 IEER (as of 7/1/2012) | |
| | ≥135,000 Btu/h and <240,000 Btu/h | Electric Resistance (or none) | VRF Multi-split System | 11.0 EER<br>12.3 IEER<br>12.9 IEER (as of 7/1/2012) | |
| | ≥240,000 Btu/h | Electric Resistance (or none) | VRF Multi-split System | 10.0 EER<br>11.1 IEER<br>11.6 IEER (as of 7/1/2012) | |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

## TABLE 14-1A(4)
## Electrically Operated Variable Refrigerant Flow Air-to-Air and Applied Heat Pumps Minimum Efficiency Requirements

| Equipment Type | Size Category | Heating Section Type | Sub-Category or Rating Condition | Minimum Efficiency | Test Procedure |
|---|---|---|---|---|---|
| VRF Air Cooled, (cooling mode) | <65,000 Btu/h | All | VRF Multi-split System | 13.0 SEER | AHRI 1230 |
| | ≥65,000 Btu/h and <135,000 Btu/h | Electric Resistance (or none) | VRF Multi-split System | 11.0 EER<br>12.3 IEER<br>12.9 IEER (as of 7/1/2012) | |
| | ≥65,000 Btu/h and <135,000 Btu/h | Electric Resistance (or none) | VRF Multi-split System with Heat Recovery | 10.8 EER<br>12.1 IEER<br>12.7 IEER (as of 7/1/2012) | |
| | ≥135,000 Btu/h and <240,000 Btu/h | Electric Resistance (or none) | VRF Multi-split System | 10.6 EER<br>11.8 IEER<br>12.3 IEER (as of 7/1/2012) | |
| | ≥135,000 Btu/h and <240,000 Btu/h | Electric Resistance (or none) | VRF Multi-split System with Heat Recovery | 10.4 EER<br>11.6 IEER<br>12.1 IEER (as of 7/1/2012) | |
| | ≥240,000 Btu/h | Electric Resistance (or none) | VRF Multi-split System | 9.5 EER<br>10.6 IEER<br>11.0 IEER (as of 7/1/2012) | |
| | ≥240,000 Btu/h | Electric Resistance (or none) | VRF Multi-split System with Heat Recovery | 9.3 EER<br>10.4 IEER<br>10.8 IEER (as of 7/1/2012) | |
| VRF Water source (cooling mode) | <65,000 Btu/h | All | VRF Multi-split systems 86ºF entering water | 12.0 EER | |
| | <65,000 Btu/h | All | VRF Multi-split systems with Heat Recovery 86ºF entering water | 11.8 EER | |
| | ≥65,000 Btu/h and <135,000 Btu/h | All | VRF Multi-split System 86ºF entering water | 12.0 EER | |
| | ≥65,000 Btu/h and | All | VRF Multi-split | 11.8 EER | |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

| Equipment Type | Size Category | Heating Section Type | Sub-Category or Rating Condition | Minimum Efficiency | Test Procedure |
|---|---|---|---|---|---|
| | <135,000 Btu/h | | System with Heat Recovery 86ºF entering water | | AHRI 1230 |
| | ≥135,000 Btu/h | All | VRF Multi-split System 86ºF entering water | 10.0 EER | |
| | ≥135,000 Btu/h | All | VRF Multi-split System with Heat Recovery 86ºF entering water | 9.8 EER | |
| VRF Groundwater source (cooling mode) | <135,000 Btu/h | All | VRF Multi-split System 59ºF entering water | 16.2 EER | AHRI 1230 |
| | <135,000 Btu/h | All | VRF Multi-split System with Heat Recovery 59ºF entering water | 16.0 EER | |
| | ≥135,000 Btu/h | All | VRF Multi-split System 59ºF entering water | 13.8 EER | |
| | ≥135,000 Btu/h | All | VRF Multi-split System with Heat Recovery 59ºF entering water | 13.6 EER | |
| VRF Ground source (cooling mode) | <135,000 Btu/h | All | VRF Multi-split System 77ºF entering water | 13.4 EER | AHRI 1230 |
| | <135,000 Btu/h | All | VRF Multi-split System with Heat Recovery 77ºF entering water | 13.2 EER | |
| | ≥135,000 Btu/h | All | VRF Multi-split System 77ºF entering water | 11.0 EER | |
| | ≥135,000 Btu/h | All | VRF Multi-split System with Heat Recovery 77ºF entering water | 10.8 EER | |
| VRF Air Cooled (heating mode) | <65,000 Btu/h (cooling capacity) | - - - | VRF Multi-split System | 7.7 HSPF | |
| | ≥65,000 Btu/h and <135,000 Btu/h (cooling capacity) | - - - | VRF Multi-split system 47ºF db/43ºF wb outdoor air | 3.3 COP | |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

| **Equipment Type** | **Size Category** | **Heating Section Type** | **Sub-Category or Rating Condition** | **Minimum Efficiency** | **Test Procedure** |
|---|---|---|---|---|---|
| | | | 17ºF db/15ºF wb outdoor air | 2.25 COP | AHRI 1230 |
| | ≥135,000 Btu/h (cooling capacity) | - - - | VRF Multi-split System 47ºF db/43ºF wb outdoor air | 3.2 COP | |
| | | | 17ºF db/15ºF wb outdoor air | 2.05 COP | |
| VRF Water source (heating mode) | <135,000 Btu/h (cooling capacity) | --- | VRF Multi-split System 68ºF entering water | 4.2 COP | AHRI 1230 |
| | ≥135,000 Btu/h (cooling capacity) | --- | VRF Multi-split System 68ºF entering water | 3.9 COP | |
| VRF Groundwater source (heating mode) | <135,000 Btu/h (cooling capacity) | --- | VRF Multi-split System 50ºF entering water | 3.6 COP | AHRI 1230 |
| | ≥135,000 Btu/h (cooling capacity) | --- | VRF Multi-split System 50ºF entering water | 3.3 COP | |
| VRF Ground source (heating mode) | <135,000 Btu/h (cooling capacity) | --- | VRF Multi-split System 32ºF entering water | 3.1 COP | AHRI 1230 |
| | ≥135,000 Btu/h (cooling capacity) | --- | VRF Multi-split System 32ºF entering water | 2.8 COP | |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

**Table 14-1B Unitary and Applied Heat Pumps, Electrically Operated, Minimum Efficiency Requirements.**

*Discussion:* Add minimum efficiencies for water-to-water heat pumps per addendum bg to ASHRAE/IESNA Standard 90.1-2007.

*Proposal:* Amend 2009 WSEC as follows -

## TABLE 14-1B
## UNITARY AND APPLIED HEAT PUMPS, ELECTRICALLY OPERATED, MINIMUM EFFICIENCY REQUIREMENTS

| Equipment Type | Size Category | Sub-Category or Rating Condition | Minimum Efficiency[b] | Test Procedure[a] |
|---|---|---|---|---|
| **Air Cooled, (Cooling Mode)** | < 65,000 Btu/h[d] | Split System | 13.0 SEER | AHRI 210/240 |
| | | Single Package | 13.0 SEER | |
| | ≥65,000 Btu/h and < 135,000 Btu/h | Split System and Single Package | 11.0 EER[c]<br>11.2 IEER[c] | AHRI 340/360 |
| | ≥135,000 Btu/h and <240,000 Btu/h | Split System and Single Package | 10.6 EER[c]<br>10.7 IEER[c] | |
| | ≥240,000 Btu/h | Split System and Single Package | 9.5 EER[c]<br>9.6 IEER[c] | |
| **Through-the-Wall (Air Cooled, Cooling Mode)** | <30,000 Btu/h[d] | Split System | 12.0 SEER | AHRI 210/240 |
| | | Single Package | 12.0 SEER | |
| **Water-Source (Cooling Mode)** | < 17,000 Btu/h | 86°F Entering Water | 11.2 EER | AHRI/ISO-13256-1 |
| | ≥ 17,000 Btu/h and <65,000 Btu/h | 86°F Entering Water | 12.0 EER | AHRI/ISO-13256-1 |
| | ≥65,000 Btu/h and < 135,000 Btu/h | 86°F Entering Water | 12.0 EER | AHRI/ISO-13256-1 |
| **Groundwater-Source (Cooling Mode)** | < 135,000 Btu/h | 59°F Entering Water | 16.2 EER | AHRI/ISO-13256-1 |
| **Ground Source (Cooling Mode)** | < 135,000 Btu/h | 77°F Entering Water | 13.4 EER | AHRI/ISO-13256-1 |
| **Air Cooled (Heating Mode)** | < 65,000 Btu/h[d] (Cooling Capacity) | Split System | 7.7 HSPF | AHRI 210/240 |
| | | Single Package | 7.7 HSPF | |
| | ≥65,000 Btu/h and < 135,000 Btu/h (Cooling Capacity) | 47°F db/43°F wb Outdoor Air<br>17°F db/15°F wb Outdoor Air | 3.3 COP<br>2.25 COP | |
| | ≥135,000 Btu/h (Cooling Capacity) | 47°F db/43°F wb Outdoor Air<br>17°F db/15°F wb Outdoor Air | 3.2 COP<br>2.05 COP | AHRI 340/360 |
| **Through-the-Wall (Air Cooled, Heating Mode)** | <30,000 Btu/h[d] | Split System | 7.4 HSPF | AHRI 210/240 |
| | | Single Package | 7.4 HSPF | |
| **Water-Source (Heating Mode)** | < 135,000 Btu/h (Cooling Capacity) | 68°F Entering Water | 4.2 COP | AHRI/ISO-13256-1 |
| **Groundwater-Source (Heating Mode)** | < 135,000 Btu/h (Cooling Capacity) | 50°F Entering Water | 3.6 COP | AHRI/ISO-13256-1 |
| **Ground Source (Heating Mode)** | < 135,000 Btu/h (Cooling Capacity) | 32°F Entering Water | 3.1 COP | AHRI/ISO-13256-1 |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

| | | | | |
|---|---|---|---|---|
| **Water-Source Water-to-Water (Cooling Mode)** | < 135,000 Btu/h | 86°F Entering Water | 10.6 EER | AHRI/ISO-13256-2 |
| **Groundwater-Source Water-to-Water (Cooling Mode)** | < 135,000 Btu/h | 59°F Entering Water | 16.3 EER | AHRI/ISO-13256-2 |
| **Ground Source Brine-to-Water (Cooling Mode)** | < 135,000 Btu/h | 77°F Entering Water | 12.1 EER | AHRI/ISO-13256-2 |
| **Water-Source Water-to-Water (Heating Mode)** | < 135,000 Btu/h (Cooling Capacity) | 68°F Entering Water | 4.2 COP | AHRI/ISO-13256-2 |
| **Groundwater-Source Water-to-Water (Heating Mode)** | < 135,000 Btu/h (Cooling Capacity) | 50°F Entering Water | 3.6 COP | AHRI/ISO-13256-2 |
| **Ground Source Brine-to-Water (Heating Mode)** | < 135,000 Btu/h (Cooling Capacity) | 32°F Entering Water | 3.1 COP | AHRI/ISO-13256-2 |

[a] Reserved.
[b] IPLVs and Part load rating conditions are only applicable to equipment with capacity modulation.
[c] Deduct 0.2 from the required EERs and IEERs for units with a heating section other than electric resistance heat.
[d] Applies to all units, including single-phase and three-phase. For single-phase air-cooled heat pumps < 65,000 Btu/h, SEER and HSPF values are those set by NAECA.
[e] Reserved.

## Table 14-1C Water Chilling Packages, Minimum Efficiency Requirements.

*Discussion:* (1) Retain existing Seattle minimum efficiencies for chillers; (2) add minimum efficiencies for heat recovery chillers.
*Proposal:* Amend 2009 WSEC as follows -

### TABLE 14-1C
### WATER CHILLING PACKAGES, MINIMUM EFFICIENCY REQUIREMENTS[a]

| | | | PATH A[b] | | PATH B[b] | | |
|---|---|---|---|---|---|---|---|
| **Equipment Type** | **Size Category** | **Units** | **Full Load** | **IPLV** | **Full Load** | **IPLV** | **Test Procedure[a]** |
| Air-Cooled Chillers[e] | <150 tons | EER | >9.562 | >12.500 | NA[c] | NA[c] | AHRI 550/590-03 |
| | ≥150 tons | EER | >9.562 | >12.750 | NA[c] | NA[c] | |
| Air-Cooled Without Condenser, Electrically Operated[e] | All Capacities | Air-cooled chillers without condensers must be rated with matching condensers and comply with the air-cooled chiller efficiency requirements | | | | | |
| Water-Cooled, Electrically Operated, Reciprocating | All Capacities | Reciprocating units must comply with water cooled positive displacement efficiency requirements | | | | | |
| Water-Cooled, Electrically Operated, Positive Displacement and Heat Recovery Chillers | <75 tons (larger sizes to comply with centrifugal requirements) | kW/ton | <0.780[f] | <0.630 | <0.800[f] | <0.600 | |
| | ((~~≥75 tons and <150 tons~~ | ~~kW/ton~~ | ~~<0.775~~ | ~~<0.615~~ | ~~<0.790~~ | ~~<0.586~~ | |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

| | | | PATH A[b] | | PATH B[b] | | |
|---|---|---|---|---|---|---|---|
| **Equipment Type** | **Size Category** | **Units** | **Full Load** | **IPLV** | **Full Load** | **IPLV** | **Test Procedure[a]** |
| | ~~≥150 tons and <300 tons~~ | ~~kW/ton~~ | ~~<0.680~~ | ~~<0.580~~ | ~~<0.718~~ | ~~<0.540~~ | |
| | ~~≥300 tons~~ | ~~kW/ton~~ | ~~<0.620~~ | ~~<0.540~~ | ~~<0.639~~ | ~~<0.490~~)) | |
| Water-Cooled, Electrically Operated, Centrifugal | <150 tons | kW/ton | <0.634[f] | <0.596 | <0.639[f] | <0.450 | |
| | ≥150 tons and <300 tons | kW/ton | <0.634[f] | <0.596 | <0.639[f] | <0.450 | |
| | ≥300 tons and <600 tons | kW/ton | <0.576[f] | <0.549 | <0.600[f] | <0.400 | |
| | ≥600 tons | kW/ton | <0.570[f] | <0.539 | <0.590[f] | <0.400 | |
| Air-Cooled Absorption Single Effect | All Capacities | COP | >0.600 | NR[d] | NA[c] | NA[c] | AHRI |
| Water-Cooled Absorption Single Effect | All Capacities | COP | >0.700 | NR[d] | NA[c] | NA[c] | 560-92 |
| Absorption Double Effect | All Capacities | COP | >1.000 | >1.050 | NA[c] | NA[c] | |
| Absorption Double Effect Direct Fired | All Capacities | COP | >1.000 | >1.000 | NA[c] | NA[c] | |

[a] The chiller equipment requirements do not apply for chillers used in low temperature applications where the design leaving fluid temperature is <38°F.

[b] Compliance with this standard can be obtained by meeting the minimum requirements of Path A or Path B. However, both the full and IPLV must be met to fulfill the requirements of Path A or Path B.

[c] NA means that this requirement is not applicable and cannot be used for compliance.

[d] NR means that there are no minimum requirements for this category.

[e] Chilled water plants and buildings with more than 500 tons total capacity shall not have more than 100 tons provided by air-cooled chillers.

[f] Full load efficiency requirements do not apply to positive displacement chillers used in condenser water heat recovery systems.

**Table 14-1D Packaged Terminal Air Conditioners, Packaged Terminal Heat Pumps, Room Air Conditioners, and Room Air Conditioner Heat Pumps, Electrically Operated, Minimum Efficiency Requirements.**

*Discussion:* Revise minimum efficiencies for PTAC and PTHP units per addendum bw to ASHRAE/IESNA Standard 90.1-2007.

*Proposal:* Amend 2009 WSEC as follows -

**TABLE 14-1D**
**PACKAGED TERMINAL AIR CONDITIONERS,**
**PACKAGED TERMINAL HEAT PUMPS, ROOM AIR CONDITIONERS,**
**AND ROOM AIR CONDITIONER HEAT PUMPS, ELECTRICALLY OPERATED,**
**MINIMUM EFFICIENCY REQUIREMENTS**

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

| Equipment Type | Size Category (Input) | Sub-Category or Rating Condition | Minimum Efficiency[b] | Test Procedure[a] |
|---|---|---|---|---|
| **PTAC (Cooling Mode) Standard Size** | All Capacities | 95°F db Outdoor Air | 12.5 - (0.213 x Cap/1000)[b] EER (before 10/08/2012)<br>13.8 - (0.300 × Cap/1000)[b] EER (as of 10/08/2012) | AHRI 310/380 |
| | | 82°F db Outdoor Air | 14.7 - (0.213 x Cap/1000)[b] EER | |
| **PTAC (Cooling Mode) Nonstandard Size[c]** | All Capacities | 95°F db Outdoor Air | 10.9 - (0.213 x Cap/1000)[b] EER | |
| | | 82°F db Outdoor Air | 13.1 - (0.213 x Cap/1000)[b] EER | |
| **PTHP (Cooling Mode) Standard Size** | All Capacities | 95°F db Outdoor Air | 12.3 - (0.213 x Cap/1000)[b] EER (before 10/08/2012)<br>14.0 - (0.300 × Cap/1000)[b] EER (as of 10/08/2012) | |
| | | 82°F db Outdoor Air | 14.5 - (0.213 x Cap/1000)[b] EER | |
| **PTHP (Cooling Mode) Nonstandard Size[c]** | All Capacities | 95°F db Outdoor Air | 10.8 - (0.213 x Cap/1000)[b] EER | |
| | | 82°F db Outdoor Air | 13.0 - (0.213 x Cap/1000)[b] EER | |
| **PTHP (Heating Mode) Standard Size** | All Capacities | | 3.2 - (0.026 x Cap/1000)[b] COP (before 10/08//2012)<br>3.7 - (0.052 × Cap/1000)[b] COP (as of 10/08/2012) | |
| **PTHP (Heating Mode) Nonstandard Size[c]** | All Capacities | | 2.9 - (0.026 x Cap/1000)[b] COP | |
| **SPVAC (Cooling Mode)** | < 65,000 Btu/h | 95°F db/75°F wb Outdoor Air | 9.0 EER | AHRI 390 |
| | ≥ 65,000 Btu/h and < 135,000 Btu/h | 95°F db/75°F wb Outdoor Air | 8.9 EER | |
| | ≥ 135,000 Btu/h and < 240,000 Btu/h | 95°F db/75°F wb Outdoor Air | 8.6 EER | |
| **SPVHP (Cooling Mode)** | < 65,000 Btu/h | 95°F db/75°F wb Outdoor Air | 9.0 EER | |
| | ≥ 65,000 Btu/h and < 135,000 Btu/h | 95°F db/75°F wb Outdoor Air | 8.9 EER | |
| | ≥ 135,000 Btu/h and < 240,000 Btu/h | 95°F db/75°F wb Outdoor Air | 8.6 EER | |
| **SPVAC (Heating Mode)** | < 65,000 Btu/h | 47°F db/43°F wb Outdoor Air | 3.0 COP | |
| | ≥ 65,000 Btu/h and < 135,000 Btu/h | 47°F db/43°F wb Outdoor Air | 3.0 COP | |
| | ≥ 135,000 Btu/h and < 240,000 Btu/h | 47°F db/43°F wb Outdoor Air | 2.9 COP | |
| **Room Air Conditioners, with Louvered Sides** | < 6,000 Btu/h | | 9.7 EER | ANSI/ AHAM RAC-1 |
| | ≥6,000 Btu/h and < 8,000 Btu/h | | 9.7 EER | |
| | ≥ 8,000 Btu/h and < 14,000 Btu/h | | 9.8 EER | |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

| Equipment Type | Size Category (Input) | Sub-Category or Rating Condition | Minimum Efficiency[b] | Test Procedure[a] |
|---|---|---|---|---|
| | | | | |
| | ≥14,000 Btu/h and < 20,000 Btu/h | | 9.7 EER | |
| | ≥20,000 Btu/h | | 8.5 EER | |
| **Room Air Conditioners, without Louvered Sides** | < 8,000 Btu/h | | 9.0 EER | |
| | ≥8,000 Btu/h and < 20,000 Btu/h | | 8.5 EER | |
| | ≥20,000 Btu/h | | 8.5 EER | |
| **Room Air Conditioner Heat Pumps with Louvered Sides** | < 20,000 Btu/h | | 9.0 EER | |
| | ≥ 20,000 Btu/h | | 8.5 EER | |
| **Room Air Conditioner Heat Pumps without Louvered Sides** | < 14,000 Btu/h | | 8.5 EER | |
| | ≥ 14,000 Btu/h | | 8.0 EER | |
| **Room Air Conditioner, Casement Only** | All Capacities | | 8.7 EER | |
| **Room Air Conditioner, Casement –Slider** | All Capacities | | 9.5 EER | |

[a] Reserved.
[b] Cap means the rated cooling capacity of the product in Btu/h. If the unit's capacity is less than 7000 Btu/h, use 7000 Btu/h in the calculation. If the unit's capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculation.
[c] Nonstandard size units must be factory labeled as follows: "MANUFACTURED FOR NONSTANDARD SIZE APPLICATIONS ONLY; NOT TO BE INSTALLED IN NEW CONSTRUCTION PROJECTS." Nonstandard size efficiencies apply only to units being installed in existing sleeves having an external wall opening of less than 16-in. high or less than 42-in. wide, and having a cross-sectional area less than 670 $in^2$.
[d] Casement room air conditioners are not separate product classes under current minimum efficiency column.
[e] New room air conditioner standards, covered by NAECA became effective October 1, 2000.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

**Table 14-1G Performance Requirements for Heat Rejection Equipment.**

*Discussion:* Provide higher equipment efficiency tables per addendum to ASHRAE /IESNA Standard 90.1-2007.

*Proposal:* Amend 2009 WSEC as follows -

**Table 14-1G**
**Performance Requirements for Heat Rejection Equipment**

| Equipment Type | Total System Heat Rejection Capacity at Rated Conditions | Sub-Category or Rating Condition | Minimum Efficiency[b] | Test Procedure[c] |
|---|---|---|---|---|
| Propeller or Axial Fan, Open Circuit Cooling Towers | All propeller or axial fan; PLUS centrifugal fan > 1100 gpm | 95°F (35°C) Entering Water<br>85°F (29°C) Leaving Water<br>75°F (24°C) wb Outdoor Air | 38.2 gpm/hp<br>(3.23 L/s-kW) | CTI ATC-105 and CTI STD-201 |
| Centrifugal Fan, Open Circuit Cooling Towers[d] | < 1100 gpm (larger sizes to comply with propeller/axial fan requirements) ((~~All~~)) | 95°F (35°C) Entering Water<br>85°F (29°C) Leaving Water<br>75°F (24°C) wb Outdoor Air | 20.0 gpm/hp<br>(1.7 L/s-kW) | CTI ATC-105 and CTI STD-201 |
| Propeller or Axial Fan, Closed Circuit Cooling Towers | All | 102°F (39°C) Entering Water<br>90°F (32°C) Leaving Water<br>75°F (24°C) wb Outdoor Air | 14.0 gpm/hp | CTI ATC-105S and CTI STD-201 |
| Centrifugal Fan, Closed Circuit Cooling Towers | All | 102°F (39°C) Entering Water<br>90°F (32°C) Leaving Water<br>75°F (24°C) wb Outdoor Air | 7.0 gpm/hp | CTI ATC-105S and CTI STD-201 |
| Air Cooled Condensers | All | 125°F (52°C) Condensing Temperature<br>R22 Test Fluid<br>190°F (88°C) Entering Gas Temperature<br>15°F (8°C) Subcooling<br>95°F (35°C) Entering Drybulb | 176,000 Btu/ḥhp<br>69 COP | AHRI 460 |

[a] For purposes of this table, open circuit cooling tower performance is defined as the process water flow rating of tower at thermal rating conditions listed in this table divided by the fan nameplate rated motor power.

[b] For purposes of this table, closed circuit cooling tower performance is defined as the process water flow rating of tower at thermal conditions listed in this table divided by the sum of fan motor nameplate power.

[c] For purposes of this table air-cooled condenser performance is defined as the heat rejected from the refrigerant divided by the fan nameplate rated motor power.

[d] Centrifugal fan open-circuit cooling towers with a combined rated capacity of 1,100 gpm or greater at 95°F condenser water return, 85°F condenser water supply, and 75°F outdoor air wet-bulb temperature shall comply with the energy efficiency requirement for axial fan open-circuit cooling towers listed in Table 14-1G except for those that comply with the exception listed in Section 1438.1.2.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

**Table 14-3 Piping System Design Maximum Flow Rate in GPM.**

*Discussion:* Add requirement for hydronic system piping design per addendum af and cc to ASHRAE/IESNA Standard 90.1-2007 (companion change to Section 1431.3).
*Proposal:* Amend 2009 WSEC as follows -

**TABLE 14-3** ((~~RESERVED~~))
**PIPING SYSTEM DESIGN MAXIMUM FLOW RATE IN GPM[1]**

| - | <=2000 hours/yr | | >2000 and <=4400 hours/year | | > 4400 hours/year | |
|---|---|---|---|---|---|---|
| Pipe Size (in) | Other | Variable Flow/ Variable Speed | Other | Variable Flow/ Variable Speed | Other | Variable Flow/ Variable Speed |
| 2 ½ | 120 | 180 | 85 | 130 | 68 | 110 |
| 3 | 180 | 270 | 140 | 210 | 110 | 170 |
| 4 | 350 | 530 | 260 | 400 | 210 | 320 |
| 5 | 410 | 620 | 310 | 470 | 250 | 370 |
| 6 | 740 | 1100 | 570 | 860 | 440 | 680 |
| 8 | 1200 | 1800 | 900 | 1400 | 700 | 1100 |
| 10 | 1800 | 2700 | 1300 | 2000 | 1000 | 1600 |
| 12 | 2500 | 3800 | 1900 | 2900 | 1500 | 2300 |

1. There are no requirements for pipe sizes smaller than the minimum shown in the table or larger than the maximum shown in the table.

**Table 14-6 Minimum Pipe Insulation Thickness.**

*Discussion:* Revise requirements for pipe insulation for heating and hot water systems per addendum bi to ASHRAE/IESNA Standard 90.1-2007.
*Proposal:* Amend 2009 WSEC as follows -

**TABLE 14-6**
**MINIMUM PIPE INSULATION THICKNESS[1]**

| Fluid Design Operating Temp. Range (°F) | Insulation Conductivity | | Nominal Pipe or Tube Size (in.) | | | | |
|---|---|---|---|---|---|---|---|
| | Conductivity Btu·in./(h·ft$^2$·°F) | Mean Rating Temp. °F | <1 | 1 to <1-1/2 | 1-1/2 to <4 | 4 to <8 | >8 |
| Heating and Hot Water Systems (Steam, Steam Condensate, ((~~and~~)) Hot Water Heating and Domestic Water Systems)[2] | | | | | | | |
| >350 | 0.32-0.34 | 250 | 4.5 ((~~3.0~~)) | 5.0 ((~~3.5~~)) | 5.0 ((~~3.5~~)) | 5.0 ((~~4.5~~)) | 5.0 ((~~4.5~~)) |
| 251-350 | 0.29-0.32 | 200 | 3.0 ((~~2.0~~)) | 4.0 ((~~3.0~~)) | 4.5 ((~~3.5~~)) | 4.5 ((~~3.5~~)) | 4.5 ((~~3.5~~)) |
| 201-250 | 0.27-0.30 | 150 | 2.5 ((~~2.0~~)) | 2.5 ((~~2.0~~)) | 2.5 | 3.0 ((~~2.5~~)) | 3.0 ((~~2.5~~)) |

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

| Fluid Design Operating Temp. Range (°F) | Insulation Conductivity | | Nominal Pipe or Tube Size (in.) | | | | |
|---|---|---|---|---|---|---|---|
| | Conductivity Btu·in./(h·ft$^2$·°F) | Mean Rating Temp. °F | <1 | 1 to <1-1/2 | 1-1/2 to <4 | 4 to <8 | ≥8 |
| 141-200 | 0.25-0.29 | 125 | 1.5 | 1.5 | 2.0 ((~~1.5~~)) | 2.0 | 2.0 |
| 105-140 | 0.22-0.28 | 100 | 1.0 | 1.0 | 1.5 | 1.5 | 1.5 |
| ((~~Domestic and Service Hot Water Systems~~ | | | | | | | |
| ~~105+~~ | ~~0.22-0.28~~ | ~~100~~ | ~~1.0~~ | ~~1.0~~ | ~~1.5~~ | ~~1.5~~ | ~~1.5~~)) |
| Cooling Systems (Chilled Water, Brine, and Refrigerant) | | | | | | | |
| 40-60 | 0.22-0.28 | 100 | 1.0 | 1.0 | 1.5 | 1.5 | 1.5 |
| <40 | 0.22-0.28 | 100 | 1.0 | 1.5 | 1.5 | 1.5 | 2.0 |

[1] For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows:

$T = r\{(1 + t/r)^{K/k} - 1\}$

where

T = minimum insulation thickness (in.),

r = actual outside radius of pipe (in.),

t = insulation thickness listed in this table for applicable fluid temperature and pipe size,

K = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature, Btu·in./(h·ft$^2$·°F); and

k= the upper value of the conductivity range listed in this table for the applicable fluid temperature.

[2] Piping insulation is not required between the control valve and coil on runouts when the control valve is located within 4 feet of the coil and the pipe size is 1 inch or less.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

# CHAPTER 15
# LIGHTING, MOTORS, AND TRANSFORMERS

## 1510 General Requirements.

*Discussion:* Retain existing Seattle amendment requiring that parking garage lighting be calculated separately (formerly in Section 1531).
*Proposal:* Amend 2009 WSEC as follows -

**Section 1510 General Requirements:** Lighting and motors shall comply with Sections 1511 through 1514. Lighting systems shall comply with one of the following paths:

a. Prescriptive Lighting Option:
   Interior Section 1521, or
   Exterior Section 1522.

b. Lighting Power Allowance Option:
   Interior Section 1531, or
   Exterior Section 1532.

c. Systems Analysis. See Section 1141.4.

The compliance path selected for interior and exterior lighting need not be the same. However, interior and exterior lighting cannot be traded. In addition, parking garage lighting cannot be traded with other interior lighting or with exterior lighting. See the Seattle Building Code, Section 3016.15, for energy efficiency requirements for lighting in elevators.

Transformers shall comply with Section 1540.

## 1511 Electric Motors.

*Discussion:* Add informative note to clarify that the motor efficiency requirements are applicable to industrial facilities and processes.
*Proposal:* Amend 2009 WSEC as follows -

**1511 Electric Motors:** All permanently wired polyphase motors of 1 hp or more, which are not part of an HVAC system, shall comply with Section 1437.

**EXCEPTIONS:** 1. Motors that are an integral part of specialized process equipment.

2. Where the motor is integral to a listed piece of equipment for which no complying motor has been approved.

Informative Note: As indicated in Section 1120, the Energy Code applies to industrial facilities, as well as commercial and industrial processes. Thus, the motor efficiency requirements apply to industrial facilities, as well as systems and equipment used in commercial and industrial processes, unless a motor qualifies for one of the exceptions.

## 1513.1 Local Control and Accessibility.

*Discussion:* No Seattle changes (retain existing Seattle amendment).

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

*Proposal:* Amend 2009 WSEC as follows -

**1513.1 Local Control and Accessibility:** Each space, enclosed by walls or ceiling-height partitions, shall be provided with lighting controls located within that space. The lighting controls, whether one or more, shall be capable of turning off all lights within the space. The controls shall be readily accessible, at the point of entry/exit, to personnel occupying or using the space.

**EXCEPTIONS:** The following lighting controls may be centralized in remote locations:

1. Lighting controls for spaces which must be used as a whole.
2. Automatic controls, when provided in addition to manual controls.
3. Controls requiring trained operators.
4. Controls for safety hazards and security.

**1513.3 Daylight Zone Control.**

*Discussion:* (1) Include parking garages;
(2) add minor clarifications to the exception that separate circuiting is required for all daylight zones, and restaurants are treated like retail.

*Proposal:* Amend 2009 WSEC as follows -

**1513.3 Daylight Zone Control:** All daylighted zones, as defined in Chapter 2, both under skylights((~~overhead glazing~~)) and adjacent to vertical fenestration((~~glazing~~)), shall be provided with individual controls, or daylight-or occupant-sensing automatic controls, which control the lights independent of general area lighting.

In all areas with skylights, monitors or other fenestration at or above ceiling level and in all areas with windows and all areas in parking garages with façade openings, all permanent luminaires in the daylighted zone shall be controlled by automatic daylight sensing controls. The primary daylighted zone shall be controlled separately from the secondary daylighted zone.

Automatic daylight sensing controls shall:

a. Be capable of reducing the light output of the controlled luminaires while maintaining a uniform level of illuminance by either:
   1. Continuous dimming to at least 20% light output; or
   2. Step switching of each lamp in individual luminaires (noncontinuous dimming devices shall have adjustable separation (deadband) of on and off points to prevent short cycling) and provide an automatic OFF control, switching alternate luminaires is not permitted except with single lamp luminaires; or
   3. Step dimming by reducing the output of all of the lamps in individual luminaires by at least 50% and provide an automatic OFF control.
b. Control only luminaires within the daylighted area.
c. Incorporate time-delay circuits to prevent cycling of light level changes of less than three minutes.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

Any switching devices installed to override the automatic daylighting control shall comply with the criteria in Section 1513.6.2 items a through e.

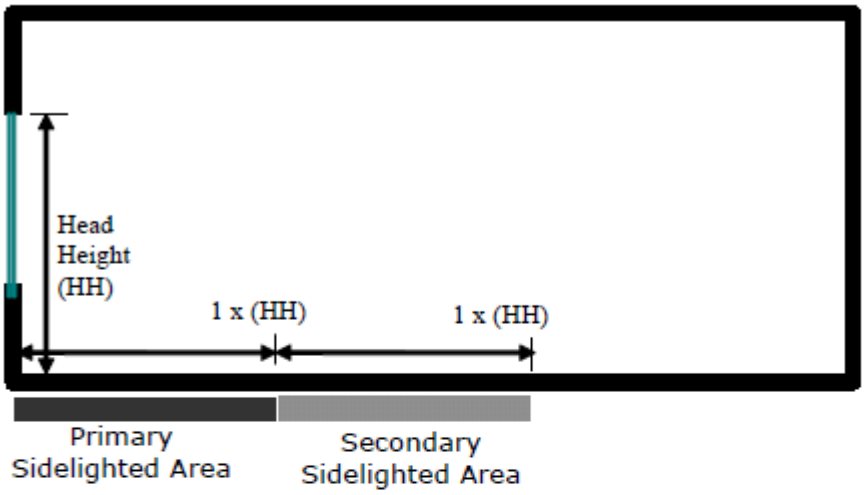
Contiguous daylight zones adjacent to vertical fenestration((~~glazing~~))are allowed to be controlled by a single controlling device serving no more than eight fixtures or 60 linear feet of façade whichever is less provided that they do not include zones facing more than two adjacent cardinal orientations (i.e., north, east, south, west). Daylight zones under skylights((~~overhead glazing~~)) shall be controlled separately from daylight zones adjacent to vertical fenestration((~~glazing~~)).

**EXCEPTION:** The following are exempt from the requirements for automatic daylighting controls in Section 1513.3, if they have separate control of the lights in the daylight zone, which control is independent of general area lighting:

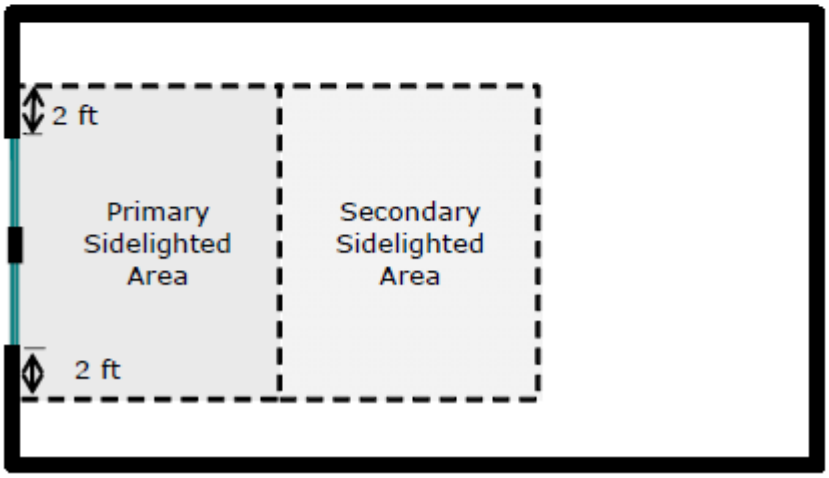
1. Retail and restaurant spaces adjacent to vertical fenestration((~~glazing~~)) (retail and restaurant spaces under skylights ((~~overhead glazing~~)) are not exempt).
2. Lighting exempted by Section 1512.
3. Display, exhibition and specialty lighting complying with Section 1513.4.
4. The following spaces are exempt from the requirements for automatic daylighting controls in Section 1513.3 provided that they have occupancy sensor controls that comply with Section 1513.6.1:
   a. Small spaces in the daylighted zone that are normally unoccupied (such as a storage room with a window or restrooms);
   b. Rooms less than 300 square feet; and
   c. Conference rooms 300 square feet and larger that have a lighting control system with at least four scene options and an occupancy sensor control that complies with Section 1513.6.1.
5. HID lamps with automatic controls that are capable of reducing the power consumption by at least 50%.
6. HID lamps 100 watts or less.

Informative Note: The following graphics from addendum ac to RS-9 provide a visual representation of the primary and secondary daylighting zones adjacent to vertical fenestration.

a) Section View




b) Plan View

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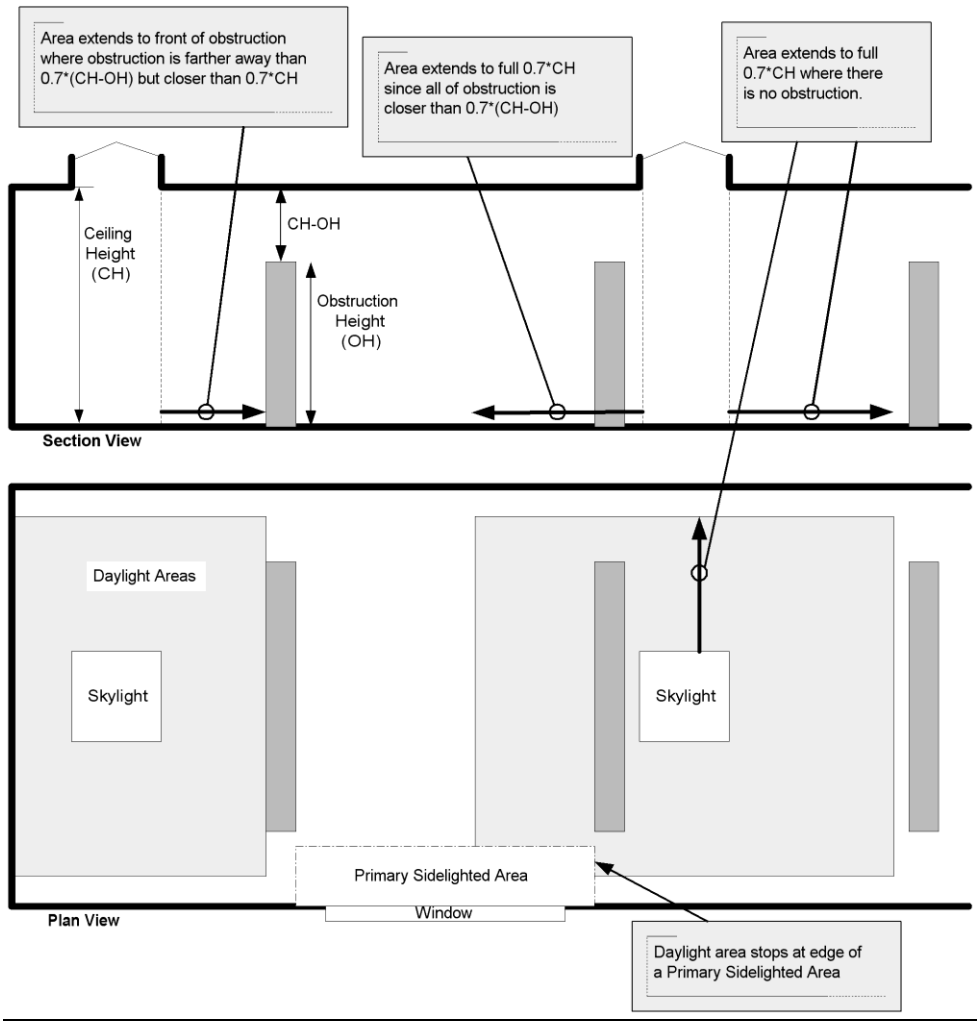
Informative Note: The following graphics from addendum ab to RS-9 provide a visual representation of daylighting zones under skylights and under high vertical fenestration.

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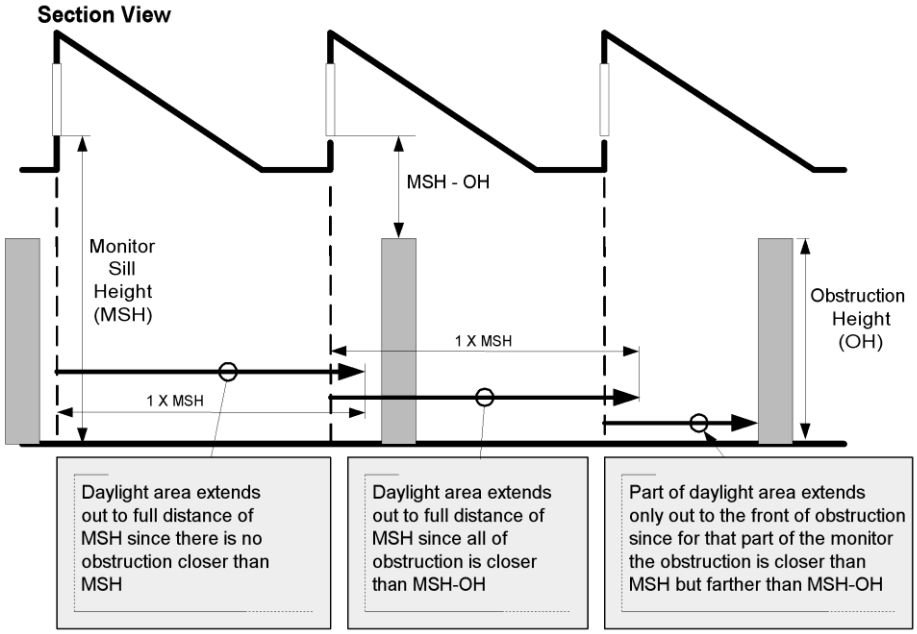


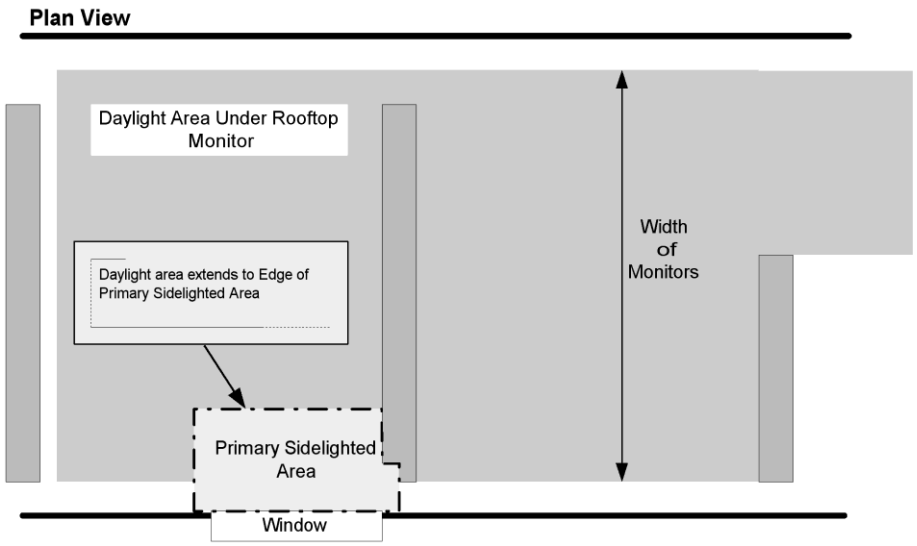


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**1513.5 Automatic Reduction and Shut-Off Controls, Exterior.**

*Discussion:* Provide more direction on shut-off during off-hours per addendum cd to ASHRAE/IESNA Standard 90.1-2007.

*Proposal:* Amend 2009 WSEC as follows -

**1513.5 Automatic Reduction and Shut-off Controls, Exterior:** Lighting for exterior applications not exempted in Section 1512 shall comply with the following requirements:

a. Lighting shall be controlled by a device that automatically turns off the lighting when sufficient daylight is available by either:

   i. A combination of a photosensor and a time switch; or

   ii. An astronomical time switch.

b. All building façade lighting shall be automatically shut off between midnight or business/facility closing, whichever is later, and 6 am or business/facility opening, whichever comes first.

c. Lighting not specified in paragraph b above, including advertising signage, shall be controlled by a device that automatically reduces the connected lighting power, on a system-wide basis, by at least 30% for at least one of the following conditions:

   1. from 12 midnight or one hour after the end of business/facility operations, if any, whichever is later, until 6am or business/facility opening, whichever is earlier; or

   2. during any period when no activity has been detected for a time of no longer than 15 minutes.

**((**~~Lighting for all exterior applications shall have automatic controls capable of turning off exterior lighting when sufficient daylight is available or when the lighting is not required during nighttime hours. Lighting not designated for dusk-to-dawn operation shall be controlled by either:~~

~~a. A combination of a photosensor and a time switch; or~~

~~b. An astronomical time switch.~~

~~Lighting designated for dusk-to-dawn operation shall be controlled by an astronomical time switch or photosensor.~~)) All time switches shall be capable of retaining programming and the time setting during loss of power for a period of at least 10 hours.

**EXCEPTION:** Lighting for covered vehicle entrances or exits from buildings or parking structures where required for safety, security, or eye adaptation.

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**1513.6 Automatic Shut-Off Controls, Interior.**

*Discussion:* Revise as follows:

(1) Section 1513.6: clarify that lighting with dual functionality be equipped with automatic lighting controls to shut off lights during unoccupied hours per addendum cu to ASHRAE/IESNA Standard 90.1-2007;
(2) Section 1513.6: expand use of occupancy sensor controls per addenda x (storage spaces), and bp, to ASHRAE/IESNA Standard 90.1-2007;
(3) Section 1513.6: require reduction in lighting power for lighting often on for 24-hours when spaces are unoccupied per addenda cf (stairwells) to ASHRAE/IESNA Standard 90.1-2007;
(4) Section 1513.6: require reduction in lighting power for parking garages per addenda cz to ASHRAE/IESNA Standard 90.1-2007;
(5) Section 1513.6.1: require manual ON for occupancy sensors to eliminate unnecessary lighting consumption per addenda aa to ASHRAE/IESNA Standard 90.1-2007; and
(6) Section 1513.6.2: change automatic control zone maximum to 2,500 $ft^2$ per Section 9.4.1.2 of Standard 90.1-2007.

*Proposal:* Amend 2009 WSEC as follows -

**1513.6 Automatic Reduction and Shut-Off Controls, Interior:** All buildings shall be equipped with separate automatic controls to shut off the lighting in all spaces during unoccupied hours, including lighting with dual functionality as normal and emergency lighting.

Within these buildings, the following spaces shall be equipped with occupancy sensors that comply with Section 1513.6.1:

a. all office areas less than 300 $ft^2$ enclosed by walls or ceiling-height partitions, and

b. all meeting and conference rooms, and training rooms,

c. all ((~~school~~)) classrooms and lecture halls,

d. all employee lunch and break rooms,

e. all rooms used for document copying and printing,

f. all restrooms,

g. all dressing, locker, and fitting rooms, and

h. warehouse and storage spaces greater than 50 $ft^2$ ((~~shall be equipped with occupancy sensors that comply with Section 1513.6.1~~)).

In addition, lighting in stairwells and parking garages shall have one or more control devices to automatically reduce lighting power in any one controlled zone by at least 50% within 30 minutes of all occupants leaving that controlled zone. Lighting zones for occupancy sensors in parking garages shall be no larger than 3,600 $ft^2$.

For all other spaces not specifically mentioned above, automatic controls may be an occupancy sensor, time switch, or other device capable of automatically shutting off lighting. (For hotel and motel guestrooms, see Section 1513.7.)

**EXCEPTIONS:**

1. Areas that must be continuously illuminated (e.g., 24-hour convenience stores), or illuminated in a manner requiring manual operation of the lighting.

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2. Emergency lighting and means of egress illumination as required by code that are automatically OFF during normal building operation.
3. Switching for industrial or manufacturing process facilities as may be required for production.
4. 24-hour occupancy areas in hospitals and laboratory spaces.
5. Areas in which medical or dental tasks are performed are exempt from the occupancy sensor requirement.
6. Dwelling units.

**1513.6.1 Occupancy Sensors:** Occupancy sensors shall be capable of automatically turning off all the lights in an area, no more than 30 minutes after the area has been vacated. Light fixtures controlled by occupancy sensors shall have a wall-mounted, manual switch capable of turning off lights when the space is occupied. Occupancy sensors either shall be manual ON or shall be controlled to automatically turn the lighting on to no more than 50% power.

**EXCEPTIONS:**

1. Occupancy sensors in stairwells are allowed to have two step lighting (high-light and low-light) provided the control fails in the high-light position.
2. Stairwells and parking garages are not permitted to have a wall-mounted manual switch.
3. Restrooms, warehouses, stairwells, and parking garages are allowed to use automatic ON to bring the lighting to 100% power.

**1513.6.2 Automatic Time Switches:** Automatic time switches shall have a minimum 7-day clock and be capable of being set for 7 different day types per week and incorporate an automatic holiday "shut-off" feature, which turns off all loads for at least 24 hours and then resumes normally scheduled operations. Automatic time switches shall also have program back-up capabilities, which prevent the loss of program and time settings for at least 10 hours, if power is interrupted.

Automatic time switches shall incorporate an over-ride switching device which:

a. Is readily accessible;
b. Is located so that a person using the device can see the lights or the areas controlled by the switch, or so that the area being illuminated is annunciated; and
c. Is manually operated;
d. Allows the lighting to remain on for no more than two hours when an over-ride is initiated; and
e. Controls an area not exceeding ((~~5,000~~)) 2,500 square feet or 5 percent of footprint for footprints over 100,000 square feet, whichever is greater.

**1513.8 Commissioning Requirements.**

*Discussion:* (1) Provide more detail for commissioning per addendum az to ASHRAE/IESNA Standard 90.1-2007; (2) establish setpoints for initial installation.

*Proposal:* Amend 2009 WSEC as follows -

**1513.8 Commissioning Requirements:** For lighting controls which include daylight or occupant sensing automatic controls, automatic shut-off controls, occupancy sensors, or

automatic time switches, the lighting controls shall be tested to ensure that control devices, components, equipment and systems are calibrated, adjusted and operate in accordance with approved plans and specifications. Sequences of operation shall be functionally tested to ensure they operate in accordance with approved plans and specifications.

When occupant sensors, time switches, or photosensors are used, the following functionality testing shall be performed:

a. Confirm that the sensitivity and time-out adjustments for occupant sensors yield acceptable performance (i.e. lights turn off only after space is vacated). At initial installation, occupancy sensor controls shall be set to turn lights off at 15 minutes unless other thresholds are specifically mentioned in the approved permit.

b. Confirm that the time switches are programmed to turn the lights off.

c. Confirm that photosensor controls reduce electric light levels based on the amount of usable daylight in the space as specified. At initial installation, automatic daylighting sensor setpoints shall be set at 30 footcandles or not more than 110% of the footcandle level specified on the drawings in the approved permit.

The construction documents for the electrical permit shall state the party who will conduct and certify the functional testing. The party responsible for the functional testing shall provide documentation certifying that the installed lighting controls meet or exceed all documented performance criteria. Certification shall be specific enough to verify conformance.

See Section 1416 for complete requirements. Optional examples of test methods and forms are provided in Reference Standard 34.

**1521 Prescriptive Interior Lighting Requirements.**

*Discussion:* Revise to correspond with changes to Section 1531.

The values in the Lighting Power Allowance compliance option in Section 1531 were changed in the 2009 WSEC, but no companion change was made to the Prescriptive Lighting compliance option in Section 1521. As the Prescriptive Lighting compliance option in Section 1521 allows unlimited numbers of lighting fixtures, the fixtures should be limited to single-lamp. This allows both T-8 and the newer T-5 lamps which are most often installed in single-lamp fixtures.

*Proposal:* Amend 2009 WSEC as follows -

**1521 Prescriptive Interior Lighting Requirements:** Spaces for which the Unit Lighting Power Allowance in Table 15-1 is 0.80 W/ft$^2$ or greater may use unlimited numbers of lighting fixtures and lighting energy, provided that the installed lighting fixtures comply with all ((~~four~~)) three of the following criteria:

a. one-lamp ((~~or two-lamp (but not three-~~)) (but not two- or more lamp);

((~~b. luminaires have a reflector or louver assembly to direct the light (bare lamp strip or industrial fixtures do not comply with this section);~~))

b. ((~~c.~~)) fitted with type T-1, T-2, T-4, T-5, T-8 or compact fluorescent lamps from 5 to 60 watts (but not T-10 or T-12 lamps); and

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c. ((~~d.~~)) hard-wired fluorescent electronic dimming ballasts with photocell or programmable dimming control for all lamps in all zones (nondimming electronic ballasts and electronic ballasts that screw into medium base sockets do not comply with this section).

Track lighting ((~~is~~)) and bare lamp strip or industrial fixtures are not allowed under this path.

**EXCEPTIONS:**

1. Up to a total of 5% of installed lighting fixtures may use any type of ballasted lamp and do not require dimming controls.
2. Clear safety lenses are allowed in food prep and serving areas and patient care areas in otherwise compliant fixtures.
3. LED lights.
4. Metal halide lighting which complies with all three of the following criteria:
   i. luminaires or lamps which have a reflector or louver assembly to direct the light;
   ii. fixtures are fitted with ceramic metal halide lamps not exceeding 150 watts; and
   iii. electronic ballasts.

## 1531 Interior Lighting Power Allowance.

*Discussion:* (1) Retain existing Seattle amendment requiring that parking garage lighting be calculated separately (formerly in Section 1532); (2) add informative note with reference back to trading limitations in Section 1510.

*Proposal:* Amend 2009 WSEC as follows -

**1531 Interior Lighting Power Allowance:** The interior lighting power allowance shall be calculated by multiplying the gross interior floor area, in square feet, by the appropriate unit lighting power allowance, in watts per square foot, for the use as specified in Table 15-1. Accessory uses, including corridors, lobbies and toilet facilities shall be included with the primary use.

The lighting power allowance for each use shall be separately calculated and summed to obtain the interior lighting power allowance.

In cases where a lighting plan for only a portion of a building is submitted, the interior lighting power allowance shall be based on the gross interior floor area covered by the plan. Plans submitted for common areas only, including corridors, lobbies and toilet facilities shall use the lighting power allowance for common areas in Table 15-1.

When insufficient information is known about the specific use of the space, the allowance shall be based on the apparent intended use of the space.

Compliance shall be demonstrated separately for covered parking.

Informative Note: Section 1510 prohibits trading between interior and exterior lighting, and prohibits trading between parking garage lighting and other interior lighting or exterior lighting.

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**1532 Exterior Lighting Power Allowance.**

*Discussion:* (1) Retain existing Seattle light pollution criteria; (2) add limits in Table 15-2B for signs.

*Proposal:* Amend 2009 WSEC as follows -

**1532 Exterior lighting power allowance.** All exterior building grounds luminaires that operate at greater than 100 watts shall contain lamps having a minimum efficacy of 60 lm/W unless the luminaire is controlled by a motion sensor or qualifies for one of the following exceptions.

The total exterior lighting power allowance for all exterior building applications is the sum of the base site allowance plus the individual allowances for areas that are designated on the buildings plans to be illuminated and are permitted in Table 15-2B for the applicable lighting zone. Trade-offs are allowed only among exterior lighting applications listed in the Table 15-2B "Tradable Surfaces" section. The lighting zone for building exterior is determined from Table 15-2A((~~ unless otherwise specified by the local jurisdiction~~)).

**EXCEPTION:** Lighting used for the following exterior applications is exempt when equipped with a control device independent of the control of the nonexempt lighting:

a. Specialized signal, directional, and marker lighting associated with transportation.

b. ((~~Lighting integral to~~)) Internally-illuminated signs.

c. Lighting integral to equipment or instrumentation and installed by its manufacturer.

d. Lighting for theatrical purposes, including performance, stage, film production, and video production.

e. Lighting for athletic playing areas.

f. Temporary lighting.

g. Lighting for industrial production.

h. Theme elements in theme/amusement parks.

i. Lighting used to highlight features of public monuments.

j. Group U Occupancy accessory to Group R-3 or R-4 Occupancy.

For open parking and outdoor areas and roadways, luminaires mounted more than 15 feet above the ground shall be Full Cutoff Luminaires. (Full Cutoff means a luminaire light distribution where zero candela intensity occurs at an angle of 90 degrees above nadir, and all greater angles from nadir.)

**1540 Transformers.**

*Discussion:* Revise criteria for transformers per addendum o of ASHRAE/IESNA Standard 90.1-2007.

*Proposal:* Amend 2009 WSEC as follows -

**Section 1540 Transformers:** ((~~The minimum efficiency of a low voltage dry-type distribution transformer shall be the Class I Efficiency Levels for distribution transformers specified in Table 4-2 of the "Guide for Determining Energy Efficiency for Distribution Transformers" published by the National Electrical Manufacturers Association (NEMA TP-1-2002).~~)) Low voltage dry-type transformers shall comply with the provisions of the Energy Policy Act of 2005 where applicable, as shown in Table 15-3. Transformers that are not

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included in the scope of the Energy Policy Act of 2005 have no performance requirements in this section, and are listed for ease of reference below as exceptions.

**Exceptions:** Transformers that meet the Energy Policy Act of 2005 exclusions based on NEMA TP-1 definition:

1. special purpose applications.
2. not likely to be used in general purpose applications.
3. transformers with multiple voltage taps where the highest tap is at least 20% more than the lowest tap.

Products meeting these criteria and exempted from Section 1540 include the following: drive transformer, rectifier transformer, auto-transformer, uninterruptible power system transformer, impedance transformer, regulating transformer, sealed and nonventilating transformer, machine tool transformer, welding transformer, grounding transformer, or testing transformer.

**Table 15-1 Unit Lighting Power Allowance.**

*Discussion:* (1) Revise lighting power allowances to achieve greater energy efficiency per addendum by to ASHRAE/IESNA Standard 90.1-2007;
(2) add aircraft maintenance and pharmacies;
(3) delete footnotes that are not referenced in the table (and therefore are not applicable).

Retail supplemental lighting based on the AEDG for Small Retail Buildings, ASHRAE/AIA/IESNA/USGBC/USDOE, 2006.

Lamp technology continues to improve. While the first generation of T-8 fluorescent lamps achieved 80+ lumens per Watt, the second achieved 90+ lumens per Watt, and a third generation is now available that achieves 100+ lumens per Watt. Fluorescent lamps have better color rendition and ceramic metal halide lamps have come on to the market.

*Proposal:* Amend 2009 WSEC as follows -

**TABLE 15-1**
**UNIT LIGHTING POWER ALLOWANCE (LPA)**

| **Use[1]** | **LPA[2] (W/ft$^2$)** |
|---|---|
| Automotive facility and aircraft maintenance | ((~~0.85~~)) 0.82 |
| Convention center | ((~~1.10~~)) 1.08 |
| Courthouse | ((~~1.10~~)) 1.05 |
| Cafeterias, fast food establishments[5], restaurants/bars[5] | ((~~1.20~~)) 0.99 |
| Dormitory | ((~~0.85~~)) 0.61 |
| Dwelling unit | 1.00 |
| Exercise center | ((~~0.95~~)) 0.88 |
| Gymnasia((~~[9]~~)), assembly spaces((~~[9]~~)) | 0.95 |
| Health care clinic | ((~~1.00~~)) 0.87 |
| Hospital, pharmacies, nursing homes, and other Group I-1 and I-2 Occupancies | 1.20 |
| Hotel/motel | 1.00 |
| Laboratory spaces (all spaces not classified "laboratory" shall meet office and other appropriate categories) | 1.62 |
| Laundries | 1.20 |

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| | |
|---|---|
| Libraries[5] | ((~~1.20~~)) 1.18 |
| Manufacturing facility | ((~~1.20~~)) 1.11 |
| Museum | 1.00 |
| Office buildings, office/administrative areas in facilities of other use types (including but not limited to schools, hospitals, institutions, museums, banks, churches) [5]((~~,7,11~~)) | ((~~0.91~~)) 0.90 |
| Parking garages | 0.20 |
| Penitentiary and other Group I-3 Occupancies | 0.90 |
| Police and fire stations | 0.90 |
| Post office | ((~~1.00~~) 0.87 |
| Retail[10], retail banking, mall concourses, wholesale stores (pallet rack shelving) | 1.33 |
| School buildings (Group E Occupancy only), school classrooms, day care centers | ((~~1.00~~)) 0.99 |
| Theater, motion picture | ((~~0.97~~)) 0.83 |
| Theater, performing arts | 1.25 |
| Transportation | ((~~0.80~~)) 0.77 |
| Warehouses | 0.50 |
| Workshop | 1.20 |
| | |
| **Plans Submitted for Common Areas Only((~~7~~))** | |
| Main floor building lobbies[3] (except mall concourses) | 1.10 |
| All building common areas, corridors, toilet facilities and washrooms, elevator lobbies, including Group R-1 and R-2 Occupancies | 0.80 |

## Footnotes for Table 15-1

1. In cases in which a general use and a specific use are listed, the specific use shall apply. In cases in which a use is not mentioned specifically, the *Unit Lighting Power Allowance* shall be determined by the building official. This determination shall be based upon the most comparable use specified in the table. See Section 1512 for exempt areas.

2. The watts per square foot may be increased, by 2% per foot of ceiling height above 20 feet, unless specifically directed otherwise by subsequent footnotes.

3. The watts per square foot of room may be increased by 2% per foot of ceiling height above 12 feet.

4. ((~~For all other spaces, such as seating and common areas, use the *Unit Lighting Power Allowance* for assembly.~~)) Reserved.

5. The watts per square foot of room may be increased by 2% per foot of ceiling height above 9 feet.

6. Reserved.

7. ((~~For conference rooms and offices less than 150 ft$^2$ with full-height partitions, a Unit Lighting Power Allowance of 1.1 w/ft$^2$ may be used.~~)) Reserved.

8. Reserved.

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9. ((~~For indoor sport tournament courts with adjacent spectator seating over 5,000, the *Unit Lighting Power Allowance* for the court area is 2.60 W/ft$^2$.~~)) Reserved.

10. Display window illumination installed within 2 feet of the window, provided that the display window is separated from the retail space by walls or at least three-quarter-height partitions (transparent or opaque) and lighting for free-standing display where the lighting moves with the display are exempt.

An additional lighting power allowance is allowed for merchandise display luminaires installed in retail sales area that are specifically designed and directed to highlight merchandise. The following additional wattages apply:

i. ((~~0.6~~)) 0.4 watts per square foot of sales floor area not listed in ii or iii below,

ii. ((~~1.4~~)) 0.9 watts per square foot of furniture, clothing, cosmetics or artwork floor area, or

iii. ((~~2.5~~)) 1.5 watts per square foot of jewelry, crystal, or china floor area.

The specified floor area for i, ii, or iii above, and the adjoining circulation paths shall be identified and specified on building plans. Calculate the additional power allowance by multiplying the above LPDs by the sales floor area for each department excluding major circulation paths. The total additional lighting power allowance is the sum of allowances for sales categories i, ii, or iii plus an additional 1,000 watts for each separate tenant larger than 250 square feet in area.

The additional wattage is allowed only if the merchandise display luminaires comply with all of the following:

a. located on ceiling-mounted track or directly on or recessed into the ceiling itself (not on the wall),

b. adjustable in both the horizontal and vertical axes (vertical axis only is acceptable for fluorescent and other fixtures with two points of track attachment),

This additional lighting power is allowed only if the specified lighting is actually installed and automatically controlled, separately from the general lighting, to be turned off during nonbusiness hours. This additional power shall be used only for the specified luminaires and shall not be used for any other purpose.

11. ((~~Provided that a floor plan, indicating rack location and height, is submitted, the square footage for a warehouse may be defined, for computing the interior *Unit Lighting Power Allowance*, as the floor area not covered by racks plus the vertical face area (access side only) of the racks. The height allowance defined in footnote 2 applies only to the floor area not covered by racks.~~)) Reserved.

## Table 15-2A Exterior Lighting Zones &
## Table 15-2B Lighting Power Densities for Building Exteriors.

*Discussion:* (1) Revise to merge the two highest lighting categories into zone 3; (2) editorial change to display all values to the same number of decimal places.

*Proposal:* Amend 2009 WSEC as follows –

### TABLE 15-2A
### EXTERIOR LIGHTING ZONES

| Lighting Zone | Description |
|---|---|
| 1 | Developed areas of national parks, state and city parks, forest |
| 2 | Areas predominantly consisting of residential zoning, neighborhood business districts, light industrial with limited nighttime use and residential mixed areas |
| 3 | All other areas |
| 4 | High activity commercial districts in major metropolitan areas as designated by the local jurisdiction |

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# TABLE 15-2B
# LIGHTING POWER DENSITIES FOR BUILDING EXTERIORS

| | **Specific area description** | **Zone 1** | **Zone 2** | **Zone 3 and Zone 4** | **((~~Zone 4~~))** |
|---|---|---|---|---|---|
| **Base site allowance[1]** | | 500 W | 600 W | 750 W | ((~~1300 W~~)) |
| **Tradable Surfaces [2]** | | | | | |
| **Uncovered Parking Areas** | Parking areas and drives | 0.04 W/ft$^2$ | 0.06 W/ft$^2$ | 0.10 W/ft$^2$ | ((~~0.13 W/ft$^2$~~)) |
| **Building Grounds** | Walkways less than 10 ft wide | 0.70 W/linear foot | 0.70 W/linear foot | 0.80 W/linear foot | ((~~1.0 W/linear foot~~)) |
| | Walkways 10 ft wide or greater, Plaza areas, Special feature areas | 0.14 W/ft$^2$ | 0.14 W/ft$^2$ | 0.16 W/ft$^2$ | ((~~0.2 W/ft$^2$~~)) |
| | Exterior stairways | 0.75 W/ft$^2$ | 1.00 W/ft$^2$ | 1.00 W/ft$^2$ | ((~~1.0 W/ft$^2$~~)) |
| | Pedestrian tunnel | 0.15 W/ft$^2$ | 0.15 W/ft$^2$ | 0.20 W/ft$^2$ | ((~~0.3 W/ft$^2$~~)) |
| | Landscaping | 0.04 W/ft$^2$ | 0.05 W/ft$^2$ | 0.05 W/ft$^2$ | ((~~0.05 W/ft$^2$~~)) |
| **Building Entrances and Exits** | Main entries | 20 W/linear foot of door width | 20 W/linear foot of door width | 30 W/linear foot of door width | ((~~30 W/linear foot of door width~~)) |
| | Other doors | 20 W/linear foot of door width | 20 W/linear foot of door width | 20 W/linear foot of door width | ((~~20 W/linear foot of door width~~)) |
| | Entry canopies | 0.25 W/ft$^2$ | 0.25 W/ft$^2$ | 0.40 W/ft$^2$ | ((~~0.4 W/ft$^2$~~)) |
| **Sales Canopies** | Free standing and attached | 0.60 W/ft$^2$ | 0.60 W/ft$^2$ | 0.80 W/ft$^2$ | ((~~1.0 W/ft$^2$~~)) |
| **Outdoor Sales** | Open areas[3] | 0.25 W/ft$^2$ | 0.25 W/ft$^2$ | 0.50 W/ft$^2$ | ((~~0.7 W/ft$^2$~~)) |
| | Street frontage for vehicle sales lots in addition to "open area" allowance | No Allowance | 10 W/linear foot | 10 W/linear foot | ((~~30 W/linear foot~~)) |
| **Nontradable Surfaces[4]** | | | | | |
| **Building Facades and Signs** | | No Allowance | 0.10 W/ft$^2$ for each illuminated wall or surface[5] | 0.15 W/ft$^2$ for each illuminated wall or surface[6] | ((~~0.2 W/ft$^2$ for each illuminated wall or surface[7]~~)) |
| **Automated Teller Machines and Night Depositories** | | 270 W per location[8] | 270 W per location[8] | 270 W per location[8] | ((~~270 W per location[8]~~)) |
| **Entrances and Gatehouse Inspection Stations at Guarded Facilities** | | 0.75 W/ft$^2$ of covered and uncovered area | 0.75 W/ft$^2$ of covered and uncovered area | 0.75 W/ft$^2$ of covered and uncovered area | ((~~0.75 W/ft$^2$ of covered and uncovered area~~)) |

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| | | | | |
|---|---|---|---|---|
| **Loading Areas for Law Enforcement, Fire, Ambulance and Other Emergency Service Vehicles** | 0.50 W/ft$^2$ of covered and uncovered area | 0.50 W/ft$^2$ of covered and uncovered area | 0.50 W/ft$^2$ of covered and uncovered area | ((~~0.5 W/ft$^2$ of covered and uncovered area~~)) |
| **Material Handling and Associated Storage** | No Allowance | No Allowance | 0.50 W/ft$^2$ | ((~~0.5 W/ft$^2$~~)) |
| **Drive-up Windows and Doors** | 400 W per drive-through | 400 W per drive-through | 400 W per drive-through | ((~~400 W per drive-through~~)) |
| **Parking Near 24-hour Retail Entrances** | 800 W per main entry | 800 W per main entry | 800 W per main entry | ((~~800 W per main entry~~)) |

FOOTNOTES FOR TABLE 15-2B:

1. Base site allowance may be used in tradable or nontradable surfaces.

2. Lighting power densities for uncovered parking areas, building grounds, building entrances and exits, canopies and overhangs and outdoor sales areas may be traded.

3. Including vehicle sales lots.

4. Lighting power density calculations for the following applications can be used only for the specific application and cannot be traded between surfaces or with other exterior lighting. The following allowances are in addition to any allowance otherwise permitted in the "Tradable Surfaces" section of this table.

5. May alternately use 2.5 watts per linear foot for each wall or surface length.

6. May alternately use 3.75 watts per linear foot for each wall or surface length.

7. May alternately use 5 watts per linear foot for each wall or surface length.

8. An additional 90 watts is allowed per additional ATM location.

## Table 15-3 Minimum Nominal Efficiency Levels for NEMA Class I Low Voltage Dry-Type Distribution Transformers.

*Discussion:* Revise criteria for transformers per addendum o of ASHRAE/IESNA Standard 90.1-2007 (companion change to Section 1540).

*Proposal:* Amend 2009 WSEC as follows -

**TABLE 15-3**
**MINIMUM NOMINAL EFFICIENCY LEVELS FOR**
**NEMA CLASS I LOW VOLTAGE DRY-TYPE DISTRIBUTION TRANSFORMERS[a]**

| **Single Phase Transformers** | | **Three Phase Transformers** | |
|---|---|---|---|
| **KVA[b]** | **Efficiency (%)[c]** | **KVA[b]** | **Efficiency (%)[c]** |
| 15 | 97.7 | 15 | 97.0 |
| 25 | 98.0 | 30 | 97.5 |
| 37.5 | 98.2 | 45 | 97.7 |
| 50 | 98.3 | 75 | 98.0 |

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| **Single Phase Transformers** | | **Three Phase Transformers** | |
|---|---|---|---|
| **KVA[b]** | **Efficiency (%)[c]** | **KVA[b]** | **Efficiency (%)[c]** |
| 75 | 98.5 | 112.5 | 98.2 |
| 100 | 98.6 | 150 | 98.3 |
| 167 | 98.7 | 225 | 98.5 |
| 250 | 98.8 | 300 | 98.6 |
| 333 | 98.9 | 500 | 98.7 |
| | | 750 | 98.8 |
| | | 1000 | 98.9 |

a. A low voltage distribution transformer is a transformer that is air-cooled, does not use oil as a coolant, has an input voltage <= 600 Volts, and is rated for operation at a frequency of 60 Hertz.

b. kiloVolt-Amp rating.

c. Nominal efficiencies shall be established in accordance with the NEMA TP-1 2002 test procedure for low voltage dry-type transformers. Class I Low Voltage Dry-Type is a National Electrical Manufacturers Association (NEMA) design class designation.

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# CHAPTER 16
# ON-SITE RENEWABLE ENERGY SYSTEMS

*Discussion:* Add requirements for on-site renewable energy systems from ASHRAE/USGBC/IESNA Standard 189.1-2009, format for installed capacity from Section 7.4.1.1, but with much less-stringent criteria - only 1/12 as stringent with minimum annual energy production equivalent of 500 Btu/ft$^2$ of gross conditioned floor area (instead of minimum annual energy production equivalent of 6,000 Btu/ft$^2$ of gross conditioned floor area); requirement does not take effect until DPD develops Director's Rule with alternate means of compliance.

Reduced thresholds mean that solar water heating systems would satisfy the criteria for most buildings. For photovoltaic (PV) systems, local conservative rules of thumb are 1000 kWh and 100 ft$^2$ per kW of DC rated PV capacity. In practice, performance in any given year may be 1200 kWh/kW or higher, based on metered data from customer systems in the Seattle City Light service area (approximately 235 systems). Some newer crystalline modules are rated at 12 - 14 W/ft$^2$.

See DPD's Client Assistance Memo 420, Solar Energy Systems, for discussion of permit requirements, land use requirements, design and installation considerations, interconnection and net metering requirements, financial incentives, and sources for further information.

*Proposal:* Amend 2009 WSEC as follows –

## CHAPTER 16
## ON-SITE RENEWABLE ENERGY SYSTEMS

**1601 Scope, Effective Date:** This chapter covers the requirements for on-site renewable energy systems or additional energy savings by other means. This chapter applies to new buildings and additions of more than 5,000 ft$^2$ to existing buildings.

This Chapter 16 shall take effect on the effective date of a rule adopted under Section 1631 that provides alternate means of compliance. Prior to that date, references in this Code to Chapter 16 are not effective.

**1610 General Requirements:** The building shall include on-site renewable energy systems or shall comply with another option as indicated in Figure 16A:

a. Prescriptive. See Section 1621.

b. Alternate Means of Compliance. See Section 1631.

c. Systems Analysis. See Section 1141.4.

## FIGURE 16A
## ON-SITE RENEWABLE ENERGY SYSTEMS COMPLIANCE OPTIONS

| Section Number | Subject | Prescriptive Option | DR with Alternate Means of Compliance | Systems Analysis Option |
|---|---|---|---|---|
| 1610 | General Requirements | X | X | X |
| 1620 | Prescriptive Option | X | | |
| 1621 | Annual Production | X | | |

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| Section Number | Subject | Prescriptive Option | DR with Alternate Means of Compliance | Systems Analysis Option |
|---|---|---|---|---|
| 1630<br>1631 | Alternate Means of Compliance<br>Director's Rule | | X<br>X | |
| RS-29 | Systems Analysis | | | X |

**1620 Prescriptive Option for On-Site Renewable Energy Systems.**

**1621 Annual Production of On-site Renewable Energy Systems.** Building projects shall contain on-site renewable energy systems that provide the annual energy production equivalent of 500 Btu/ft$^2$ of gross conditioned floor area. The annual energy production shall be the combined sum of all on-site renewable energy systems.

**1630 Alternate Means of Compliance.**

**1631 Development by Director's Rule.** The Director of DPD shall develop and adopt by rule one or more alternate means of compliance for this Chapter. Each alternate means of compliance shall be designed to achieve energy savings that are at least as great as the energy production achieved over the expected life of the building through compliance with Section 1621. Alternate means allowed by rule may include, without limitation, payments or contributions related to off-site renewable energy production.

On-site renewable energy systems are preferred. This section is intended to ensure that a feasible alternative is available when the nature of a site or project makes on-site renewable energy systems impracticable, without requiring a determination as to practicality in each case. This section is not intended to authorize any financially more attractive means of compliance for a typical project than compliance with Section 1621, taking into account expected costs and benefits of each option over the expected life of the building, and without regard to any subsidies that may be available for on-site renewable energy systems.

Informative Note: The 2030 Challenge specifies a set of total building energy consumption thresholds that gradually reduce over time to reach net-zero energy consumption in new buildings by 2030. (A rough rule-of-thumb from those working on net-zero energy buildings in the Northwest is that net-zero energy buildings would be achieved by a combination of a 75% reduction in building energy load with the remaining 25% being provided by on-site renewable energy.)

The 2010 threshold is for new buildings to use at least 60% less energy than the average existing building. Taking office buildings as an example, the maximum energy use for new office buildings in Seattle is approximately 32,400 Btu/ft$^2$·yr (as the baseline for the average existing office building is 81,000 Btu/ft$^2$·yr).

The value of 500 Btu/ft$^2$ of gross conditioned floor area is approximately 1.5 % of the total energy consumption of a new office building complying with the 2030 Challenge and consuming 32,400 Btu/ft$^2$·yr. As service water heating loads in office buildings are often in the range of 3-5% of total energy consumption, this means that a solar water heating system could be an option for complying with the prescriptive on-site renewable energy system option (as an alternative to photovoltaics).

For photovoltaic (PV) systems, local conservative rules of thumb are 1000 kWh and 100 ft$^2$ per kW of DC rated PV capacity. In practice, performance in any given year may be 1200 kWh/kW or higher, based on metered data from customer systems in the Seattle City Light service area (approximately 235 systems as of early 2010). Some newer crystalline modules are rated at 12 - 14 W/ft$^2$.

See DPD's Client Assistance Memo 420, Solar Energy Systems, for discussion of permit requirements, land use requirements, design and installation considerations, interconnection and net metering requirements, financial incentives, and sources for further information.

**RS-29**
**NONRESIDENTIAL AND MULTIFAMILY RESIDENTIAL**
**BUILDING DESIGN BY SYSTEMS ANALYSIS**

**RS-29 Nonresidential and Multifamily Residential Building Design by Systems Analysis.**

*Discussion:* (1) Modify title to specifically include multifamily residential buildings; and (2) revise reference to cite Seattle code.
*Proposal:* Amend 2009 WSEC as follows –

**((~~APPENDIX~~))**

**REFERENCE STANDARD 29**
**(RS-29)**

**NONRESIDENTIAL <u>AND MULTIFAMILY RESIDENTIAL</u> BUILDING DESIGN BY SYSTEMS ANALYSIS**
*******

**REFERENCE STANDARD<u>-29</u>**
**NONRESIDENTIAL <u>AND MULTIFAMILY RESIDENTIAL</u>**
**BUILDING DESIGN BY SYSTEMS ANALYSIS**

NOTE: ((~~Washington State~~))<u>Seattle</u> Energy Code Reference Standard 29 (RS-29) is a modified version of Appendix G from ASHRAE/IESNA Standard 90.1-2007.
RS-29 has been completely rewritten from the 2006 Edition.

**RS-29, 1.1 General.**

*Discussion:* Revise to reference Seattle Energy Code.
*Proposal:* Amend 2009 WSEC as follows -

**1.1 General:** This Standard establishes design criteria in terms of total energy consumption of a building, including all of its systems.

The building permit application for projects utilizing this Standard shall include in one submittal all building and mechanical drawings and all information necessary to verify that the building envelope and mechanical design for the project corresponds with the annual energy analysis. If credit is proposed to be taken for lighting energy savings, then an electrical permit application shall also be submitted and approved prior to the issuance of the building permit. If credit is proposed to be taken for energy savings from other components, then the corresponding permit application (e.g., plumbing, boiler, etc.) shall also be submitted and approved prior to the building permit application. Otherwise, components of the project that would not be approved as part of a building permit application shall be modeled the same in both the proposed building and the baseline

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building and shall comply with the requirements of the ((~~Washington State~~)) Seattle Energy Code.

**RS-29, 1.2 Performance Rating.**

*Discussion:* (1) Revise for consistency with other changes (companion change to Chapters 12 and 14); (2) carry over existing criteria from Director's Rule 27-2005.
*Proposal:* Amend 2009 WSEC as follows -

**1.2 Performance Rating.** This performance rating method requires conformance with the following provisions:

All requirements of Sections 1201 through ((~~1202~~)) 1204, 1310 through 1314, 1410 through 1416, 1440 through 1446, 1450 through 1455, 1460 through 1465, 1510 through 1514, and 1540 are met. These sections contain the mandatory provisions of the standard and are prerequisites for this rating method. The proposed design shall not vary from those requirements in Sections 1320 through 1334, 1420 through 1439, 1470, 1475, 1520 through 1532, and 1620 through 1621 except to the extent those variations have been accurately and completely modeled. Where variations are not specifically analyzed, the proposed design shall comply with the requirements of the sections referred to in the preceding sentence.

The improved performance of the proposed building design is calculated in accordance with provisions of this ((~~appendix~~))standard using the following formula:

Percentage improvement = 100 x (Baseline building performance - Proposed building performance) / Baseline building performance

A "proposed building" designed in accordance with this standard will be deemed as complying with this Code, if the calculated annual energy consumption is 5% LESS than that of a corresponding "baseline building."

Notes: 1. Both the proposed building performance and the baseline building performance shall include all end-use load components, such as receptacle and process loads.

2. Neither the proposed building performance nor the baseline building performance are predictions of actual energy consumption or costs for the proposed design after construction. Actual experience will differ from these calculations due to variations such as occupancy, building operation and maintenance, weather, energy use not covered by this procedure, changes in energy rates between design of the building and occupancy, and the precision of the calculation tool.

**RS-29, 1.3 Trade-Off Limits.**

*Discussion:* Revise for consistency with other changes (companion change to Chapter 16).
*Proposal:* Amend 2009 WSEC as follows -

**1.3 Trade-Off Limits.** When the proposed modifications apply to less than the whole building, only parameters related to the systems to be modified shall be allowed to vary. Parameters relating to unmodified existing conditions or to future building components shall be identical for determining both the baseline building performance and the proposed building performance. Future building components shall meet the requirements of Sections 1320 through 1334, 1420 through 1439, 1470, 1475, ((~~and~~)) 1530 through 1532, and 1620 through 1631.

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**RS-29, 1.4 Documentation Requirements.**

*Discussion:* Carry over existing criteria from Director's Rule 27-2005.
*Proposal:* Amend 2009 WSEC as follows -

**1.4 Documentation Requirements:** Simulated performance shall be documented, and documentation shall be submitted to the building official in accordance with the Reporting Format in Section 5 of RS-29. The information submitted shall include the material specified in Section 5 of RS-29 as well as the following:

a. Calculated values for the baseline building performance, the proposed building performance, and the percentage improvement.

b. A list of the energy-related features that are included in the design and on which the performance rating is based. This list shall document all energy features that differ between the models used in the baseline building performance and proposed building performance calculations.

c. Input and output report(s) from the simulation program or compliance software including a breakdown of energy usage by at least the following components: Lights, internal equipment loads, service water heating equipment, space heating equipment, space cooling and heat rejection equipment, fans, and other HVAC equipment (such as pumps). The output reports shall also show the amount of time any loads are not met by the HVAC system for both the proposed design and baseline building design.

d. An explanation of any error messages noted in the simulation program output.

**RS-29, 2.3 Climatic Data.**

*Discussion:* Carry over existing criteria from Director's Rule 27-2005.
*Proposal:* Amend 2009 WSEC as follows -

**2.3 Climatic Data:** The simulation program shall perform the simulation using hourly values of climatic data, such as temperature and humidity from representative climatic data, for the site in which the proposed design is to be located. For cities or urban regions with several climatic data entries, and for locations where weather data are not available, the designer shall select available weather data that best represent the climate at the construction site. The selected weather data shall be approved by the building official.

Exterior design conditions are 24 ºF dry bulb for heating and 82 ºF dry bulb/66 ºF wet bulb for cooling.

For ground temperatures for below-grade wall and basement floor heat loss calculations, it is acceptable to use an annual average ground temperature of 53ºF. If monthly temperatures are desired, the following values are acceptable: J - 49ºF, F - 48ºF, M - 49ºF, A - 51ºF, M - 53ºF, J - 55ºF, J - 57ºF, A - 58ºF, S - 57ºF, O - 55ºF, N - 53ºF, D - 51ºF.

For water main temperatures, it is acceptable to use an annual water main supply temperature of 53ºF. If monthly temperatures are desired, the following values are acceptable:

J - 44ºF, F - 44ºF, M - 46ºF, A - 51ºF, M - 56ºF, J - 61ºF, J - 65ºF, A - 66ºF, S - 59ºF, O - 50ºF, N - 49ºF, D - 45ºF (based on 14-year average from Seattle Water Department).

**RS-29, 2.4 Energy Conversion.**

*Discussion:* Companion change to Chapter 16.
*Proposal:* Amend 2009 WSEC as follows -

**2.4 Energy Conversion:** The comparison between the baseline building and proposed design shall be expressed as kBtu input per square foot of conditioned floor area per year at the building site. Buildings which use electricity as the only fuel source, comparisons may be expressed in kWh. When converting electricity in kWh to kBtu a multiplier of 3.413 kWh/kBtu shall be used.

> **EXCEPTION:** On-site renewable energy sources or site recovered energy shall not be considered to be consumed energy and shall not be included in the proposed building performance. When Chapter 16 of this Code applies, baseline building performance shall exclude from consumed energy the amount that is or would be provided by on-site renewable energy sources to comply with the prescriptive option in Section 1621. ((~~Where~~)) To the extent that on-site renewable or site-recovered sources are used and would not be required to satisfy Section 1621, the baseline building performance shall be based on the energy source used as the backup energy source or on the use of electricity if no backup energy source has been specified.

**RS-29, 2.5 Exceptional Calculation Methods.**

*Discussion:* Revise criteria for exceptional calculation method per addendum r of ASHRAE/IESNA Standard 90.1-2007.
*Proposal:* Amend 2009 WSEC as follows -

**2.5 Exceptional Calculation Methods.** Where no simulation program is available that adequately models a design, material, or device, the building official may approve an exceptional calculation method to demonstrate above-standard performance using this method.

Applications for approval of an exceptional method shall include documentation of the calculations performed and theoretical and/or empirical information supporting the accuracy of the method.

If there are multiple designs, materials or devices that the simulation program does not model, each shall be calculated separately and energy savings from the exceptional method determined for each. Unless otherwise approved by the building official, at no time shall the total energy savings from the exceptional method constitute more than one-half of the difference between the baseline building performance and the proposed building performance. All applications for approval of an exceptional method shall include:

a. step-by-step documentation of the exceptional calculation method performed detailed enough to enable the reader to reproduce the results;

b. copies of all spreadsheets used to perform the calculations;

c. a sensitivity analysis of energy consumption when each of the input parameters is varied from half to double the value assumed;

d. calculations performed on a time step basis consistent with the simulation program used;

e. the percentage improvement calculated with and without the exceptional calculation method.

**RS-29, 3.1 Building Performance Calculations.**

*Discussion:* (1) Carry over existing criteria from Director's Rule 27-2005; (2) clarify that the baseline building must comply with the prescriptive requirements.
*Proposal:* Amend 2009 WSEC as follows -

**3.1 Building Performance Calculations.** The simulation model for calculating the proposed and baseline building performance shall be developed in accordance with the requirements in Table 3.1. The specifications of the proposed design used in the analysis shall be as similar as is reasonably practical to those in the plans submitted for a permit. In all cases, the baseline building shall comply with Sections 1320 through 1334, 1420 through 1439, 1470, 1475, 1520 through 1532, and 1620 through 1631. Where this Code does not contain requirements, the specifications and operations of the standard design and of the proposed design shall be identical. Where assumptions are not specified in this Code, the values shall be based on accepted engineering practice and are subject to the review and approval of the building official.

For the baseline building and the proposed building, shading by permanent structures and terrain shall be taken into account for computing energy consumption whether or not these features are located on the building site. A permanent fixture is one that is likely to remain for the life of the proposed design.

**RS-29, 3.1.2.2 Equipment Capacities.**

*Discussion:* Revise so that the proposed design does not provide less comfort than the standard design through more hours of unmet loads.
*Proposal:* Amend 2009 WSEC as follows -

**3.1.2.2 Equipment Capacities.** The equipment capacities for the baseline building design shall be based on sizing runs for each orientation (per Table 3.1, No. 5a) and shall be oversized by 15% for cooling and 25% for heating, i.e., the ratio between the capacities used in the annual simulations and the capacities determined by the sizing runs shall be 1.15 for cooling and 1.25 for heating. Unmet load hours for the proposed design or baseline building designs shall not exceed 300 (of the 8760 hours simulated), and unmet load hours for the proposed design shall not exceed the number of unmet load hours for the baseline building design ((~~by more than 50~~)). ((~~If unmet load hours in the proposed design exceed the unmet load hours in the baseline building by more than 50, simulated capacities in the baseline building shall be decreased incrementally and the building resimulated until the unmet load hours are within 50 of the unmet load hours of the proposed design.~~)) If unmet load hours for the proposed design or baseline building design exceed 300, simulated capacities shall be increased incrementally, and the building with unmet loads resimulated until unmet load hours are reduced to 300 or less. Alternatively, unmet load hours exceeding these limits may be accepted at the discretion of the building official provided that sufficient justification is given indicating that the accuracy of the simulation is not significantly compromised by these unmet loads.

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**RS-29, 3.1.2.9 System Fan Power.**

*Discussion:* Revise criteria for fans systems per addendum ca of ASHRAE/IESNA Standard 90.1-2007.

*Proposal:* Amend 2009 WSEC as follows -

**3.1.2.9 System Fan Power.** System fan electrical power for supply, return, exhaust, and relief (excluding power to fan-powered VAV boxes) shall be calculated using the following formulas:

For Systems 1 and 2,

$$P_{fan} = CFMS \times 0.3.$$

For Systems 3 through 8,

$$P_{fan} = bhp \times 746/\text{Fan Motor Efficiency}.$$

Where:

| | | |
|---|---|---|
| $P_{fan}$ | = | Electric power to fan motor (watts) and |
| bhp | = | Brake horsepower of baseline fan motor from Table 3.1.2.9. Single zone variable-air-volume systems shall comply with the constant volume fan power limitation. |
| Fan Motor Efficiency | = | The efficiency from Table 14-4 for the next motor size greater than the bhp using the enclosed motor at 1800 rpm. |
| CFMS | = | The baseline system maximum design supply fan airflow rate in cfm. |

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**RS-29, Table 3-1 Modeling Requirements for Calculating Proposed and Baseline Building Performance.**

*Discussion:* Revise for greater consistency with Chapters 11-16 as follows:
(1) In 3, Space Use Classification: eliminate extra text that is not applicable;
(2) In 5, Building Envelope: provide guidance on modeling air leakage, require that uninsulated components be separately modeled;
(3) In 6, Lighting: clarify that interior and exterior lighting cannot be traded.

*Proposal:* Amend 2009 WSEC as follows -

**TABLE 3.1**
**Modeling Requirements for Calculating Proposed and Baseline Building Performance**

| No. Proposed Building Performance | Baseline Building Performance |
|---|---|
| **1. Design Model** | |
| a. The simulation model of the proposed design shall be consistent with the design documents, including proper accounting of fenestration and opaque envelope types and areas; interior lighting power and controls; HVAC system types, sizes, and controls; and service water heating systems and controls. All end-use load components within and associated with the building shall be modeled, including, but not limited to, exhaust fans, parking garage ventilation fans, snow-melt and freeze-protection equipment, facade lighting, swimming pool heaters and pumps, elevators and escalators, refrigeration, and cooking. Where the simulation program does not specifically model the functionality of the installed system, spreadsheets or other documentation of the assumptions shall be used to generate the power demand and operating schedule of the systems.<br>b. All conditioned spaces in the proposed design shall be simulated as being both heated and cooled even if no heating or cooling system is to be installed, and temperature and humidity control setpoints and schedules shall be the same for proposed and baseline building designs. Unless otherwise expressly permitted by the building official based on the needs of a particular use, space temperature controls shall be set at 70°F for space heating and 75°F for space cooling, with a deadband in accordance with Section 1412.2. The system shall be OFF during off-hours according to the appropriate schedule in Table 3.3, except that the heating system shall cycle ON if any space should drop below the setback temperature of 55°F and the cooling system shall cycle ON if any space should rise above the setup temperature of 99°F.<br>c. When the performance rating method is applied to buildings in which energy-related features have not yet been designed (e.g., a lighting system), those yet-to-be-designed features shall be described in the proposed design exactly as they are defined in the baseline building design. Where the space classification for a space is not known, the space shall be categorized as an office space. | The baseline building design shall be modeled with the same number of floors and identical conditioned floor area as the proposed design. |
| **2. Additions and Alterations** | |

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| **No. Proposed Building Performance** | **Baseline Building Performance** |
|---|---|
| | |
| It is acceptable to predict performance using building models that exclude parts of the existing building provided that all of the following conditions are met:<br>a. Work to be performed in excluded parts of the building shall meet the requirements of Chapters 11 through ((~~15~~)) 16.<br>b. Excluded parts of the building are served by HVAC systems that are entirely separate from those serving parts of the building that are included in the building model.<br>c. Design space temperature and HVAC system operating setpoints and schedules on either side of the boundary between included and excluded parts of the building are essentially the same.<br>d. If a declining block or similar utility rate is being used in the analysis and the excluded and included parts of the building are on the same utility meter, the rate shall reflect the utility block or rate for the building plus the addition. | Same as Proposed Design |
| **3. Space Use Classification** | |
| Usage for each space shall be specified using the ((~~building type or space type~~)) lighting classifications in accordance with Sections 1530 through 1531. ((~~The user shall specify the space use classifications using either the building type or space type categories but shall not combine the two types of categories. More than one building type category may be used in a building if it is a mixed-use facility. If space type categories are used, the user may simplify the placement of the various space types within the building model, provided that building-total areas for each space type are accurate.~~)) | Same as Proposed Design |
| **4. Schedules** | |
| Schedules capable of modeling hourly variations in occupancy, lighting power, miscellaneous equipment power, thermostat setpoints, and HVAC system operation shall be used. The schedules shall be typical of the proposed building type as determined by the designer and approved by the building official.<br>Default schedules are included in Tables 3.3A through 3.3J.<br>HVAC Fan Schedules. Schedules for HVAC fans that provide outdoor air for ventilation shall run continuously whenever spaces are occupied and shall be cycled on and off to meet heating and cooling loads during unoccupied hours.<br>**Exceptions:**<br>a. Where no heating and/or cooling system is to be installed and a heating or cooling system is being simulated only to meet the requirements described in this table, heating and/or cooling system fans shall not be simulated as running continuously during occupied hours but shall be cycled on and off to meet heating and cooling loads during all hours.<br>b. HVAC fans shall remain on during occupied and unoccupied hours in spaces that have health and safety mandated minimum ventilation requirements during unoccupied hours. | Same as Proposed Design<br>**Exception:** Schedules may be allowed to differ between proposed design and baseline building design when necessary to model nonstandard efficiency measures, provided that the revised schedules have the approval of the building official. Measures that may warrant use of different schedules include, but are not limited to, lighting controls, ((~~natural ventilation,~~)) demand control ventilation, and measures that reduce service water heating loads. |
| **5. Building Envelope** | |

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| **No. Proposed Building Performance** | **Baseline Building Performance** |
|---|---|
| | |
| All components of the building envelope in the proposed design shall be modeled as shown on architectural drawings or as built for existing building envelopes.<br><br>For infiltration, the air leakage rate as determined below shall be modeled at 100% when the building fan system is off, and at 25% when the building fan system is on, unless otherwise approved by the building official for unusually pressurized buildings. Per PNNL Report 18898, Infiltration Modeling Guidelines for Commercial Building Energy Analysis, the building air leakage rates as determined in accordance with Section 1314.6.2 at 0.30 in. w.g. (75 Pa) shall be converted for modeling in annual energy analysis programs by being multiplied by 0.112 unless other multipliers are approved by the building official (e.g. a tested air leakage of 0.40 cfm/ft$^2$ of building envelope area at 0.30 in. w.g. (75 Pa) would be modeled at 0.045 cfm/ft$^2$ of building envelope area). The Proposed Building air leakage rate shall be the same as the Standard Design. The Proposed Building shall comply with Section 1314.6.3.<br><br>**Exceptions:** The following building elements are permitted to differ from architectural drawings.<br><br>a. All uninsulated assemblies (e.g., projecting balconies, perimeter edges of intermediate floor slabs, concrete floor beams over parking garages, roof parapet) shall be separately modeled ((~~using either of the following techniques:~~<br><br>~~1. Separate model of each of these assemblies within the energy simulation model.~~<br><br>~~2. Separate calculation of the U-factor for each of these assemblies. The U-factors of these assemblies are then averaged with larger adjacent surfaces using an area-weighted average method. This average U-factor is modeled within the energy simulation model~~)).<br><br>Any other envelope assembly that covers less than 5% of the total area of that assembly type (e.g., exterior walls) need not be separately described provided that it is similar to an assembly being modeled. If not separately described, the area of an envelope assembly shall be added to the area of an assembly of that same type with the same orientation and thermal properties.<br><br>b. Exterior surfaces whose azimuth orientation and tilt differ by less than 45 degrees and are otherwise the same may be described as either a single surface or by using multipliers.<br><br>c. For exterior roofs, the roof surface may be modeled with a reflectance of 0.45 if the reflectance of the proposed design roof is greater than 0.70 and its emittance is greater than 0.75 or has a minimum SRI of 82. Reflectance values shall be based on testing in accordance with ASTM C1549, ASTM E903, or ASTM E1918, and emittance values shall be based on testing in accordance with ASTM C1371 or ASTM E408, and SRI shall be based on ASTM E1980 calculated at medium wind speed. All other roof surfaces shall be modeled with a reflectance of 0.30.<br><br>d. Manual fenestration shading devices such as blinds or shades shall not be modeled. Automatically controlled fenestration shades or blinds may be modeled. Permanent shading devices such as fins, overhangs, and light shelves may be modeled. | Equivalent dimensions shall be assumed for each exterior envelope component type as in the proposed design; i.e., the total gross area of exterior walls shall be the same in the proposed and baseline building designs. The same shall be true for the areas of roofs, floors, and doors, and the exposed perimeters of concrete slabs on grade shall also be the same in the proposed and baseline building designs. The following additional requirements shall apply to the modeling of the baseline building design:<br><br>a. **Orientation.** The baseline building performance shall be generated by simulating the building with its actual orientation and again after rotating the entire building 90, 180, and 270 degrees, then averaging the results. The building shall be modeled so that it does not shade itself.<br><br>b. **Opaque Assemblies.** Opaque assemblies used for new buildings or additions shall conform with the following common, lightweight assembly types and shall match the appropriate assembly maximum U-factors in Tables 13-1 and 13-2:<br><br>· Roofs--Insulation entirely above deck<br><br>· Above-grade walls--Steel-framed<br><br>· Floors--Steel-joist<br><br>· Opaque door types shall match the proposed design and conform to the U-factor requirements from the same tables.<br><br>· Slab-on-grade floors shall match the F-factor for unheated slabs from the same tables.<br><br>Opaque assemblies used for alterations shall conform with Section 1132.1. |

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| No. Proposed Building Performance | Baseline Building Performance |
|---|---|
| | c. **Vertical Fenestration.** Vertical fenestration areas for new buildings and additions shall equal that in the proposed design or 40% of gross above-grade wall area, whichever is smaller, and shall be distributed on each face of the building in the same proportions in the proposed design. Fenestration U-factors and SHGC shall match the appropriate requirements in Tables 13-1 and 13-2. All vertical glazing shall be assumed to be flush with the exterior wall, and no shading projections shall be modeled. Manual window shading devices such as blinds or shades shall not be modeled. The fenestration areas for envelope alterations shall reflect the limitations on area, U-factor, and SHGC as described in Section 1132.1.<br><br>d. **Skylights and Glazed Smoke Vents.** Skylight area shall be equal to that in the proposed building design or 5% of the gross roof area that is part of the building envelope, whichever is smaller. If the skylight area of the proposed building design is greater than 5% of the gross roof area, baseline skylight area shall be decreased by an identical percentage in all roof components in which skylights are located to reach the 5% skylight-to-roof ratio. Skylight orientation and tilt shall be the same as in the proposed building design. Skylight U-factor and SHGC properties shall match the appropriate requirements in Tables 13-1 and 13-2.<br><br>e. **Roof albedo.** All roof surfaces shall be modeled with a reflectivity of 0.30.<br><br>f. **Existing Buildings.** For existing building envelopes, the baseline building design shall reflect existing conditions prior to any revisions that are part of the scope of work being evaluated.<br><br>g. **Air leakage.** The Baseline Building air leakage rate shall match the value determined according to Section 1314.6.2. The air leakage rates at standard test conditions shall be converted for energy modeling purposes as described under "Proposed Building Performance" in this table.<br><br>The air leakage percentage modeled for hours when the fan system is off and the air leakage percentage modeled for hours when the fan system is on shall be the same as the Proposed Building. |
| **6. Lighting** | |

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| **No. Proposed Building Performance** | **Baseline Building Performance** |
|---|---|
| | |
| Lighting power in the proposed design shall be determined as follows:<br>a. Where a complete lighting system exists, the actual lighting power for each thermal block shall be used in the model.<br>b. Where a lighting system has been designed, lighting power shall be determined in accordance with Chapter 15.<br>c. Where lighting neither exists nor is specified, lighting power shall be determined in accordance with the building area method for the appropriate building type.<br>d. Lighting system power shall include all lighting system components shown or provided for on the plans (including lamps and ballasts and task and furniture-mounted fixtures).<br>**Exception:** For multifamily dwelling units, hotel/motel guest rooms, and other spaces in which lighting systems are connected via receptacles and are not shown or provided for on building plans, assume identical lighting power for the proposed and baseline building designs in the simulations.<br>e. Lighting power for parking garages and building facades shall be modeled.<br>f. Credit may be taken for the use of automatic controls for daylight utilization not otherwise required by Section 1513 but only if their operation is either modeled directly in the building simulation or modeled in the building simulation through schedule adjustments determined by a separate daylighting analysis approved by the building official.<br>g. For automatic lighting controls in addition to those required for minimum code compliance under Section 1513, credit may be taken for automatically controlled systems by reducing the connected lighting power by the applicable percentages listed in Table 3.2. Alternatively, credit may be taken for these devices by modifying the lighting schedules used for the proposed design, provided that credible technical documentation for the modifications are provided to the building official. | Lighting power in the baseline building design shall be determined using the same categorization procedure and categories as the proposed design with lighting power set equal to the maximum allowed for the corresponding method and category in Chapter 15. Automatic lighting controls (e.g., programmable controls or automatic controls for daylight utilization) shall be modeled in the baseline building design as required by Section 1513. |
| Informative Note: Per Section 1510, interior and exterior lighting cannot be traded. In addition, parking garage lighting cannot be traded with other interior lighting or with exterior lighting. | |
| | |
| **7. Thermal Blocks--HVAC Zones Designed** | |
| Where HVAC zones are defined on HVAC design drawings, each HVAC zone shall be modeled as a separate thermal block.<br>Exception: Different HVAC zones may be combined to create a single thermal block or identical thermal blocks to which multipliers are applied, provided that all of the following conditions are met:<br>a. The space use classification is the same throughout the thermal block.<br>b. All HVAC zones in the thermal block that are adjacent to glazed exterior walls face the same orientation or their orientations vary by less than 45 degrees.<br>c. All of the zones are served by the same HVAC system or by the same kind of HVAC system. | Same as Proposed Design |
| **8. Thermal Blocks--HVAC Zones Not Designed** | |
| Where the HVAC zones and systems have not yet been designed, thermal blocks shall be defined based on similar internal load densities, occupancy, lighting, thermal and space temperature schedules, and in combination with the following guidelines: | Same as Proposed Design. |

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| No. Proposed Building Performance | Baseline Building Performance |
|---|---|
| a. Separate thermal blocks shall be assumed for interior and perimeter spaces. Interior spaces shall be those located greater than 15 ft from an exterior wall. Perimeter spaces shall be those located within 15 ft of an exterior wall.<br><br>b. Separate thermal blocks shall be assumed for spaces adjacent to glazed exterior walls; a separate zone shall be provided for each orientation, except that orientations that differ by less than 45 degrees may be considered to be the same orientation. Each zone shall include all floor area that is 15 ft or less from a glazed perimeter wall, except that floor area within 15 ft of glazed perimeter walls having more than one orientation shall be divided proportionately between zones.<br><br>c. Separate thermal blocks shall be assumed for spaces having floors that are in contact with the ground or exposed to ambient conditions from zones that do not share these features.<br><br>d. Separate thermal blocks shall be assumed for spaces having exterior ceiling or roof assemblies from zones that do not share these features. | |
| **9. Thermal Blocks--Multifamily Residential Buildings** | |
| Residential spaces shall be modeled using at least one thermal block per dwelling unit, except that those units facing the same orientations may be combined into one thermal block. Corner units and units with roof or floor loads shall only be combined with units sharing these features. | Same as Proposed Design. |
| **10. HVAC Systems** | |
| The HVAC system type and all related performance parameters in the proposed design, such as equipment capacities and efficiencies, shall be determined as follows:<br><br>a. Where a complete HVAC system exists, the model shall reflect the actual system type using actual component capacities and efficiencies.<br><br>b. Where an HVAC system has been designed, the HVAC model shall be consistent with design documents. Mechanical equipment efficiencies shall be adjusted from actual design conditions to the standard rating conditions specified in Section 1411 if required by the simulation model.<br><br>c. Where no heating system exists or no heating system has been specified, the heating system classification shall be assumed to be electric, and the system characteristics shall be identical to the system modeled in the baseline building design.<br><br>d. Where no cooling system exists or no cooling system has been specified, the cooling system shall be identical to the system modeled in the baseline building design. | The HVAC system(s) in the baseline building design shall be of the type and description specified in Section 3.1.1, shall meet the general HVAC system requirements specified in Section 3.1.2, and shall meet any system-specific requirements in Section 3.1.3 that are applicable to the baseline HVAC system type(s). |
| **11. Service Hot-Water Systems** | |
| The service hot-water system type and all related performance parameters, such as equipment capacities and efficiencies, in the proposed design shall be determined as follows:<br><br>a. Where a complete service hot-water system exists, the proposed design shall reflect the actual system type using actual component capacities and efficiencies. | The service hot-water system in the baseline building design shall use the same energy source as the corresponding system in the proposed design and shall conform with the following conditions:<br><br>a. Where the complete service hot-water system exists, the baseline building design shall reflect the actual system type using the actual component capacities and efficiencies. |

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| No. Proposed Building Performance | Baseline Building Performance |
|---|---|
| b. Where a service hot-water system has been specified, the service hot-water model shall be consistent with design documents. | b. Where a new service hot-water system has been specified, the system shall be sized using the same methods and values as the proposed design and the equipment shall match the minimum efficiency requirements in Chapter 14. Where the energy source is electricity, the heating method shall be electrical resistance. |
| c. Where no service hot-water system exists or has been specified but the building will have service hot-water loads, a service hot-water system shall be modeled that matches the system in the baseline building design and serves the same hot-water loads. | c. Where no service hot-water system exists or has been specified but the building will have service hot-water loads, a service water system(s) using electrical-resistance heat and matching minimum efficiency requirements of Chapter 14 shall be assumed and modeled identically in the proposed and baseline building designs. |
| d. For buildings that will have no service hot-water loads, no service hot-water system shall be modeled. | d. For buildings that will have no service hot-water loads, no service hot-water heating shall be modeled. |
| | e. Where a combined system has been specified to meet both space heating and service water heating loads, the baseline building system shall use separate systems meeting the minimum efficiency requirements applicable to each system individually. |
| | f. For large, 24-hour-per-day facilities that meet the prescriptive criteria for use of condenser heat recovery systems described in Section 1436.3, a system meeting the requirements of that section shall be included in the baseline building design regardless of the exceptions to Section 1436.3.<br><br>Exception: If a condenser heat recovery system meeting the requirements described in Section 1436.3 cannot be modeled, the requirement for including such a system in the actual building shall be met as a prescriptive requirement in accordance with Section 1436.3, and no heat-recovery system shall be included in the proposed or baseline building designs. |
| | g. Service hot-water energy consumption shall be calculated explicitly based upon the volume of service hot water required and the entering makeup water and the leaving service hot-water temperatures. Entering water temperatures shall be estimated based upon the location. Leaving temperatures shall be based upon the end-use requirements. |
| | h. Where recirculation pumps are used to ensure prompt availability of service hot water at the end use, the energy consumption of such pumps shall be calculated explicitly. |

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| No. Proposed Building Performance | Baseline Building Performance |
|---|---|
| | i. Service water loads and usage shall be the same for both the baseline building design and the proposed design and shall be documented by the calculation procedures recommended by the manufacturer's specifications or generally accepted engineering methods.<br><br>Exceptions:<br><br>1. Appliances that are not built-in (e.g., washing machines) and plumbing fixtures (e.g., faucets and low-flow showerheads) shall be modeled the same for both the baseline building design and the proposed design. Other service hot-water usage can be demonstrated to be reduced by documented water conservation measures that reduce the physical volume of service water required. Such reduction shall be demonstrated by calculations.<br><br>2. Service hot-water energy consumption can be demonstrated to be reduced by reducing the required temperature of service mixed water, by increasing the temperature, or by increasing the temperature of the entering makeup water. Examples include alternative sanitizing technologies for dishwashing and heat recovery to entering makeup water. Such reduction shall be demonstrated by calculations.<br><br>3. Service hot-water usage can be demonstrated to be reduced by reducing the hot fraction of mixed water to achieve required operational temperature. Examples include shower or laundry heat recovery to incoming cold-water supply, reducing the hot-water fraction required to meet required mixed-water temperature. Such reduction shall be demonstrated by calculations. |
| **12. Receptacle and Other Loads** | |

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| No. Proposed Building Performance | Baseline Building Performance |
|---|---|
| | |
| Receptacle and process loads where not otherwise covered by this Code, such as those for office and other equipment, shall be estimated based on the building type or space type category and shall be assumed to be identical in the proposed and baseline building designs. These loads shall be included in simulations of the building and shall be included when calculating the baseline building performance and proposed building performance.<br><br>Default process loads are included in Table 3.4.1. | Other systems, such as motors covered by Sections 1437, 1438 and 1511, and miscellaneous loads shall be modeled as identical to those in the proposed design including schedules of operation and control of the equipment. Where there are specific efficiency requirements in Sections 1437, 1438 and 1511, these systems or components shall be modeled as having the lowest efficiency allowed by those requirements. Where no efficiency requirements exist, power and energy rating or capacity of the equipment shall be identical between the baseline building and the proposed design with the following exception: Variations of the power requirements, schedules, or control sequences of the equipment modeled in the baseline building from those in the proposed design may be allowed by the building official based upon documentation that the equipment installed in the proposed design represents a significant verifiable departure from documented conventional practice. The burden of this documentation is to demonstrate that accepted conventional practice would result in baseline building equipment different from that installed in the proposed design. Occupancy and occupancy schedules may not be changed. Process loads must represent a minimum of 25% of the total baseline building energy consumption. For buildings where the process energy is less than 25% of the baseline building energy usage, the permit submittal must include supporting documentation substantiating that process energy inputs are appropriate. |
| **13. Modeling Limitations to the Simulation Program** | |
| If the simulation program cannot model a component or system included in the proposed design explicitly, substitute a thermodynamically similar component model that can approximate the expected performance of the component that cannot be modeled explicitly. | Same as Proposed Design. |

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**RS-29, Table 3.3 Schedules.**

*Discussion:* Revise for consistency with other requirements such as for occupancy sensors within conditioned spaces and within parking garages (companion change to Chapter 15).
*Proposal:* Amend 2009 WSEC as follows –

**TABLE 3.3A**
**Assembly Occupancy[1]**

| Hour of Day (Time) | Schedule for Occupancy Percent of Maximum Load | | | Schedule for Lighting[2]/Receptacle Percent of Maximum Load | | | Schedule for HVAC System | | | Schedule for Service Hot Water Percent of Maximum Load | | | Schedule for Elevator Percent of Maximum Load | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun |
| 1 (12-1 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 (1-2 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 (2-3 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 (3-4 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 (4-5 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 (5-6 am) | 0 | 0 | 0 | 5 | 5 | 5 | On | Off | Off | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 (6-7 am) | 0 | 0 | 0 | 35/40 | 5 | 5 | On | On | On | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 (7-8 am) | 0 | 0 | 0 | 35/40 | 30 | 30 | On | On | On | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 (8-9 am) | 20 | 20 | 10 | 35/40 | 30 | 30 | On | On | On | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 (9-10 am) | 20 | 20 | 10 | 65/75 | 40/50 | 30 | On | On | On | 5 | 5 | 5 | 0 | 0 | 0 |
| 11 (10-11 am) | 20 | 20 | 10 | 65/75 | 40/50 | 30 | On | On | On | 5 | 5 | 5 | 0 | 0 | 0 |
| 12 (11-12 pm) | 80 | 60 | 10 | 65/75 | 40/50 | 30 | On | On | On | 35 | 20 | 10 | 0 | 0 | 0 |
| 13 (12-1 pm) | 80 | 60 | 10 | 65/75 | 40/50 | 55/65 | On | On | On | 5 | 0 | 0 | 0 | 0 | 0 |
| 14 (1-2 pm) | 80 | 60 | 70 | 65/75 | 40/50 | 55/65 | On | On | On | 5 | 0 | 0 | 0 | 0 | 0 |
| 15 (2-3 pm) | 80 | 60 | 70 | 65/75 | 40/50 | 55/65 | On | On | On | 5 | 0 | 0 | 0 | 0 | 0 |
| 16 (3-4 pm) | 80 | 60 | 70 | 65/75 | 40/50 | 55/65 | On | On | On | 5 | 0 | 0 | 0 | 0 | 0 |
| 17 (4-5 pm) | 80 | 60 | 70 | 65/75 | 40/50 | 55/65 | On | On | On | 5 | 0 | 0 | 0 | 0 | 0 |
| 18 (5-6 pm) | 80 | 60 | 70 | 65/75 | 40/50 | 55/65 | On | On | On | 0 | 0 | 0 | 0 | 0 | 0 |
| 19 (6-7 pm) | 20 | 60 | 70 | 65/75 | 40/50 | 55/65 | On | On | On | 0 | 0 | 0 | 0 | 0 | 0 |
| 20 (7-8 pm) | 20 | 60 | 70 | 65/75 | 40/50 | 55/65 | On | On | On | 0 | 65 | 65 | 0 | 0 | 0 |
| 21 (8-9 pm) | 20 | 60 | 70 | 65/75 | 40/50 | 55/65 | On | On | On | 0 | 30 | 30 | 0 | 0 | 0 |
| 22 (9-10 pm) | 20 | 80 | 70 | 65/75 | 40/50 | 55/65 | On | On | On | 0 | 0 | 0 | 0 | 0 | 0 |
| 23 (10-11 pm) | 10 | 10 | 20 | 25 | 40/50 | 5 | On | On | On | 0 | 0 | 0 | 0 | 0 | 0 |
| 24 (11-12 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 0 | 0 | 0 | 0 | 0 | 0 |
| Total/Day | 710 | 750 | 700 | 1010/ 1155 | 660/ 800 | 745/ 845 | 1800 | 1700 | 1700 | 70 | 125 | 115 | 0 | 0 | 0 |
| Total/Week | 50.50 hours | | | 64.55/74.20 hours | | | 124 hours | | | 5.9 hours | | | 0 hours | | |
| Total/Year | 2633 hours | | | 3357/3869 hours | | | 6465 hours | | | 308 hours | | | 0 hours | | |

Wk = Weekday

1. Schedules for occupancy, lighting, receptacle, HVAC system, and service hot water are from ASHRAE Standard 90.1-1989 and addendums, except that 5% emergency lighting has been added for all off hours. Elevator schedules, except for restaurants, are from the U.S. Department of Energy Standard Evaluation Techniques except changed to 0% when occupancy is 0%. **These values may be used only if actual schedules are not known.**
2. Lighting profiles are modified to reflect the requirement for occupancy sensors in Section 1513.6.

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## TABLE 3.3B
## Health Occupancy[1]

| Hour of Day (Time) | Schedule for Occupancy Percent of Maximum Load | | | Schedule for Lighting[2]/Receptacle Percent of Maximum Load | | | Schedule for HVAC System | | | Schedule for Service Hot Water Percent of Maximum Load | | | Schedule for Elevator Percent of Maximum Load | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun |
| 1 (12-1 am) | 0 | 0 | 0 | 10 | 10 | 5 | On | On | On | 1 | 1 | 1 | 0 | 0 | 0 |
| 2 (1-2 am) | 0 | 0 | 0 | 10 | 10 | 5 | On | On | On | 1 | 1 | 1 | 0 | 0 | 0 |
| 3 (2-3 am) | 0 | 0 | 0 | 10 | 10 | 5 | On | On | On | 1 | 1 | 1 | 0 | 0 | 0 |
| 4 (3-4 am) | 0 | 0 | 0 | 10 | 10 | 5 | On | On | On | 1 | 1 | 1 | 0 | 0 | 0 |
| 5 (4-5 am) | 0 | 0 | 0 | 10 | 10 | 5 | On | On | On | 1 | 1 | 1 | 0 | 0 | 0 |
| 6 (5-6 am) | 0 | 0 | 0 | 10 | 10 | 5 | On | On | On | 1 | 1 | 1 | 0 | 0 | 0 |
| 7 (6-7 am) | 0 | 0 | 0 | 10 | 10 | 5 | On | On | On | 1 | 1 | 1 | 0 | 0 | 0 |
| 8 (7-8 am) | 10 | 10 | 0 | 45/50 | 20 | 5 | On | On | On | 17 | 1 | 1 | 2 | 2 | 0 |
| 9 (8-9 am) | 50 | 30 | 5 | 80/90 | 35/40 | 10 | On | On | On | 58 | 20 | 1 | 75 | 46 | 2 |
| 10 (9-10 am) | 80 | 40 | 5 | 80/90 | 35/40 | 10 | On | On | On | 66 | 28 | 1 | 100 | 70 | 2 |
| 11 (10-11 am) | 80 | 40 | 5 | 80/90 | 35/40 | 10 | On | On | On | 78 | 30 | 1 | 100 | 70 | 2 |
| 12 (11-12 pm) | 80 | 40 | 5 | 80/90 | 35/40 | 10 | On | On | On | 82 | 30 | 1 | 100 | 70 | 2 |
| 13 (12-1 pm) | 80 | 40 | 5 | 80/90 | 35/40 | 10 | On | On | On | 71 | 24 | 1 | 75 | 51 | 2 |
| 14 (1-2 pm) | 80 | 40 | 5 | 80/90 | 35/40 | 10 | On | On | On | 82 | 24 | 1 | 100 | 51 | 2 |
| 15 (2-3 pm) | 80 | 40 | 5 | 80/90 | 35/40 | 10 | On | On | On | 78 | 23 | 1 | 100 | 51 | 2 |
| 16 (3-4 pm) | 80 | 40 | 5 | 80/90 | 35/40 | 10 | On | On | On | 74 | 23 | 1 | 100 | 51 | 2 |
| 17 (4-5 pm) | 80 | 40 | 0 | 30 | 35/40 | 5 | On | On | On | 63 | 23 | 1 | 100 | 51 | 0 |
| 18 (5-6 pm) | 50 | 10 | 0 | 30 | 35/40 | 5 | On | On | On | 41 | 10 | 1 | 100 | 25 | 0 |
| 19 (6-7 pm) | 30 | 10 | 0 | 30 | 10 | 5 | On | On | On | 18 | 1 | 1 | 52 | 2 | 0 |
| 20 (7-8 pm) | 30 | 0 | 0 | 30 | 10 | 5 | On | On | On | 18 | 1 | 1 | 52 | 0 | 0 |
| 21 (8-9 pm) | 20 | 0 | 0 | 30 | 10 | 5 | On | On | On | 18 | 1 | 1 | 52 | 0 | 0 |
| 22 (9-10 pm) | 20 | 0 | 0 | 30 | 10 | 5 | On | On | On | 10 | 1 | 1 | 28 | 0 | 0 |
| 23 (10-11 pm) | 0 | 0 | 0 | 30 | 10 | 5 | On | On | On | 1 | 1 | 1 | 0 | 0 | 0 |
| 24 (11-12 am) | 0 | 0 | 0 | 10 | 10 | 5 | On | On | On | 1 | 1 | 1 | 0 | 0 | 0 |
| Total/Day | 850 | 380 | 40 | 975/1060 | 500/550 | 160 | 2400 | 2400 | 2400 | 783 | 249 | 24 | 1136 | 540 | 16 |
| Total/Week | 46.70 hours | | | 55.35/60.10 hours | | | 168 hours | | | 41.88 hours | | | 62.36 hours | | |
| Total/Year | 2435 hours | | | 2878/3134 hours | | | 8760 hours | | | 2148 hours | | | 3251 hours | | |

Wk = Weekday

1. Schedules for occupancy, lighting, receptacle, HVAC system, and service hot water are from ASHRAE Standard 90.1-1989 and addendums, except that 5% emergency lighting has been added for all off hours. Elevator schedules, except for restaurants, are from the U.S. Department of Energy Standard Evaluation Techniques except changed to 0% when occupancy is 0%. **These values may be used only if actual schedules are not known.**
2. Lighting profiles are modified to reflect the requirement for occupancy sensors in Section 1513.6.

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## TABLE 3.3C
## Hotel/Motel Occupancy[1]

| Hour of Day (Time) | Schedule for Occupancy Percent of Maximum Load | | | Schedule for Lighting Receptacle Percent of Maximum Load | | | Schedule for HVAC System | | | Schedule for Service Hot Water Percent of Maximum Load | | | Schedule for Elevator Percent of Maximum Load | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun |
| 1 (12-1 am) | 90 | 90 | 70 | 20 | 20 | 30 | On | On | On | 20 | 20 | 25 | 40 | 44 | 55 |
| 2 (1-2 am) | 90 | 90 | 70 | 15 | 20 | 30 | On | On | On | 15 | 15 | 20 | 33 | 35 | 55 |
| 3 (2-3 am) | 90 | 90 | 70 | 10 | 10 | 20 | On | On | On | 15 | 15 | 20 | 33 | 35 | 43 |
| 4 (3-4 am) | 90 | 90 | 70 | 10 | 10 | 20 | On | On | On | 15 | 15 | 20 | 33 | 35 | 43 |
| 5 (4-5 am) | 90 | 90 | 70 | 10 | 10 | 20 | On | On | On | 20 | 20 | 20 | 33 | 35 | 43 |
| 6 (5-6 am) | 90 | 90 | 70 | 20 | 10 | 20 | On | On | On | 25 | 25 | 30 | 33 | 35 | 43 |
| 7 (6-7 am) | 70 | 70 | 70 | 40 | 30 | 30 | On | On | On | 50 | 40 | 50 | 42 | 40 | 52 |
| 8 (7-8 am) | 40 | 50 | 70 | 50 | 30 | 40 | On | On | On | 60 | 50 | 50 | 42 | 32 | 52 |
| 9 (8-9 am) | 40 | 50 | 50 | 40 | 40 | 40 | On | On | On | 55 | 50 | 50 | 52 | 45 | 65 |
| 10 (9-10 am) | 20 | 30 | 50 | 40 | 40 | 30 | On | On | On | 45 | 50 | 55 | 52 | 45 | 65 |
| 11 (10-11 am) | 20 | 30 | 50 | 25 | 30 | 30 | On | On | On | 40 | 45 | 50 | 40 | 42 | 53 |
| 12 (11-12 pm) | 20 | 30 | 30 | 25 | 25 | 30 | On | On | On | 45 | 50 | 50 | 51 | 60 | 60 |
| 13 (12-1 pm) | 20 | 30 | 30 | 25 | 25 | 30 | On | On | On | 40 | 50 | 40 | 51 | 65 | 53 |
| 14 (1-2 pm) | 20 | 30 | 20 | 25 | 25 | 20 | On | On | On | 35 | 45 | 40 | 51 | 65 | 51 |
| 15 (2-3 pm) | 20 | 30 | 20 | 25 | 25 | 20 | On | On | On | 30 | 40 | 30 | 51 | 65 | 50 |
| 16 (3-4 pm) | 30 | 30 | 20 | 25 | 25 | 20 | On | On | On | 30 | 40 | 30 | 51 | 65 | 44 |
| 17 (4-5 pm) | 50 | 30 | 30 | 25 | 25 | 20 | On | On | On | 30 | 35 | 30 | 63 | 65 | 64 |
| 18 (5-6 pm) | 50 | 50 | 40 | 25 | 25 | 20 | On | On | On | 40 | 40 | 40 | 80 | 75 | 62 |
| 19 (6-7 pm) | 50 | 60 | 40 | 60 | 60 | 50 | On | On | On | 55 | 55 | 50 | 86 | 80 | 65 |
| 20 (7-8 pm) | 70 | 60 | 60 | 80 | 70 | 70 | On | On | On | 60 | 55 | 50 | 70 | 80 | 63 |
| 21 (8-9 pm) | 70 | 60 | 60 | 90 | 70 | 80 | On | On | On | 50 | 50 | 40 | 70 | 75 | 63 |
| 22 (9-10 pm) | 80 | 70 | 80 | 80 | 70 | 60 | On | On | On | 55 | 55 | 50 | 70 | 75 | 63 |
| 23 (10-11 pm) | 90 | 70 | 80 | 60 | 60 | 50 | On | On | On | 45 | 40 | 40 | 45 | 55 | 40 |
| 24 (11-12 am) | 90 | 70 | 80 | 30 | 30 | 30 | On | On | On | 25 | 30 | 20 | 45 | 55 | 40 |
| Total/Day | 1390 | 1390 | 1300 | 855 | 785 | 810 | 2400 | 2400 | 2400 | 915 | 930 | 900 | 1217 | 1303 | 1287 |
| Total/Week | 96.40 hours | | | 58.70 hours | | | 168.0 hours | | | 64.05 hours | | | 86.75 hours | | |
| Total/Year | 5026 hours | | | 3061 hours | | | 8760 hours | | | 3340 hours | | | 4523 hours | | |

Wk = Weekday

1. Schedules for occupancy, lighting, receptacle, HVAC system, and service hot water are from ASHRAE Standard 90.1-1989 and addendums, except that 5% emergency lighting has been added for all off hours. Elevator schedules, except for restaurants, are from the U.S. Department of Energy Standard Evaluation Techniques except changed to 0% when occupancy is 0%. **These values may be used only if actual schedules are not known.**

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

## TABLE 3.3D
## Light Manufacturing Occupancy[1]

| Hour of Day (Time) | Schedule for Occupancy Percent of Maximum Load | | | Schedule for Lighting[2]/Receptacle Percent of Maximum Load | | | Schedule for HVAC System | | | Schedule for Service Hot Water Percent of Maximum Load | | | Schedule for Elevator Percent of Maximum Load | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun |
| 1 (12-1 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 5 | 4 | 0 | 0 | 0 |
| 2 (1-2 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 5 | 4 | 0 | 0 | 0 |
| 3 (2-3 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 5 | 4 | 0 | 0 | 0 |
| 4 (3-4 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 5 | 4 | 0 | 0 | 0 |
| 5 (4-5 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 5 | 4 | 0 | 0 | 0 |
| 6 (5-6 am) | 0 | 0 | 0 | 10 | 5 | 5 | Off | Off | Off | 8 | 8 | 7 | 0 | 0 | 0 |
| 7 (6-7 am) | 10 | 10 | 5 | 10 | 10 | 5 | On | On | Off | 7 | 7 | 4 | 0 | 0 | 0 |
| 8 (7-8 am) | 20 | 10 | 5 | 30 | 10 | 5 | On | On | Off | 19 | 11 | 4 | 35 | 16 | 0 |
| 9 (8-9 am) | 95 | 30 | 5 | 85/90 | 30 | 5 | On | On | Off | 35 | 15 | 4 | 69 | 14 | 0 |
| 10 (9-10 am) | 95 | 30 | 5 | 85/90 | 30 | 5 | On | On | Off | 38 | 21 | 4 | 43 | 21 | 0 |
| 11 (10-11 am) | 95 | 30 | 5 | 85/90 | 30 | 5 | On | On | Off | 39 | 19 | 4 | 37 | 18 | 0 |
| 12 (11-12 pm) | 95 | 30 | 5 | 85/90 | 30 | 5 | On | On | Off | 47 | 23 | 6 | 43 | 25 | 0 |
| 13 (12-1 pm) | 50 | 10 | 5 | 75/80 | 15 | 5 | On | On | Off | 57 | 20 | 6 | 58 | 21 | 0 |
| 14 (1-2 pm) | 95 | 10 | 5 | 85/90 | 15 | 5 | On | On | Off | 54 | 19 | 9 | 48 | 13 | 0 |
| 15 (2-3 pm) | 95 | 10 | 5 | 85/90 | 15 | 5 | On | On | Off | 34 | 15 | 6 | 37 | 8 | 0 |
| 16 (3-4 pm) | 95 | 10 | 5 | 85/90 | 15 | 5 | On | On | Off | 33 | 12 | 4 | 37 | 4 | 0 |
| 17 (4-5 pm) | 95 | 10 | 5 | 85/90 | 15 | 5 | On | On | Off | 44 | 14 | 4 | 46 | 5 | 0 |
| 18 (5-6 pm) | 30 | 5 | 5 | 50 | 5 | 5 | On | On | Off | 26 | 7 | 4 | 62 | 6 | 0 |
| 19 (6-7 pm) | 10 | 5 | 0 | 30 | 5 | 5 | On | Off | Off | 21 | 7 | 4 | 20 | 0 | 0 |
| 20 (7-8 pm) | 10 | 0 | 0 | 30 | 5 | 5 | On | Off | Off | 15 | 7 | 4 | 12 | 0 | 0 |
| 21 (8-9 pm) | 10 | 0 | 0 | 20 | 5 | 5 | On | Off | Off | 17 | 7 | 4 | 4 | 0 | 0 |
| 22 (9-10 pm) | 10 | 0 | 0 | 20 | 5 | 5 | On | Off | Off | 8 | 9 | 7 | 4 | 0 | 0 |
| 23 (10-11 pm) | 5 | 0 | 0 | 10 | 5 | 5 | Off | Off | Off | 5 | 5 | 4 | 0 | 0 | 0 |
| 24 (11-12 am) | 5 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 5 | 4 | 0 | 0 | 0 |
| Total/Day | 920 | 200 | 60 | 995/1040 | 280 | 120 | 1600 | 1200 | 0 | 537 | 256 | 113 | 555 | 151 | 0 |
| Total/Week | 48.60 hours | | | 53.75/56.00 hours | | | 92.00 hours | | | 30.54 hours | | | 29.26 hours | | |
| Total/Year | 2534 hours | | | 2795/2920 hours | | | 4797 hours | | | 1592 hours | | | 1526 hours | | |

Wk = Weekday

1. Schedules for occupancy, lighting, receptacle, HVAC system, and service hot water are from ASHRAE Standard 90.1-1989 and addendums, except that 5% emergency lighting has been added for all off hours. Elevator schedules, except for restaurants, are from the U.S. Department of Energy Standard Evaluation Techniques except changed to 0% when occupancy is 0%. **These values may be used only if actual schedules are not known.**
2. Lighting profiles are modified to reflect the requirement for occupancy sensors in Section 1513.6.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

# TABLE 3.3E
## Office Occupancy[1]

| Hour of Day (Time) | Schedule for Occupancy Percent of Maximum Load | | | Schedule for Lighting[2]/Receptacle Percent of Maximum Load | | | Schedule for HVAC System | | | Schedule for Service Hot Water Percent of Maximum Load | | | Schedule for Elevator Percent of Maximum Load | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun |
| 1 (12-1 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 5 | 4 | 0 | 0 | 0 |
| 2 (1-2 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 5 | 4 | 0 | 0 | 0 |
| 3 (2-3 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 5 | 4 | 0 | 0 | 0 |
| 4 (3-4 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 5 | 4 | 0 | 0 | 0 |
| 5 (4-5 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 5 | 4 | 0 | 0 | 0 |
| 6 (5-6 am) | 0 | 0 | 0 | 10 | 5 | 5 | Off | Off | Off | 8 | 8 | 7 | 0 | 0 | 0 |
| 7 (6-7 am) | 10 | 10 | 5 | 10 | 10 | 5 | On | On | Off | 7 | 7 | 4 | 0 | 0 | 0 |
| 8 (7-8 am) | 20 | 10 | 5 | 30 | 10 | 5 | On | On | Off | 19 | 11 | 4 | 35 | 16 | 0 |
| 9 (8-9 am) | 95 | 30 | 5 | 65/90 | 30 | 5 | On | On | Off | 35 | 15 | 4 | 69 | 14 | 0 |
| 10 (9-10 am) | 95 | 30 | 5 | 65/90 | 30 | 5 | On | On | Off | 38 | 21 | 4 | 43 | 21 | 0 |
| 11 (10-11 am) | 95 | 30 | 5 | 65/90 | 30 | 5 | On | On | Off | 39 | 19 | 4 | 37 | 18 | 0 |
| 12 (11-12 pm) | 95 | 30 | 5 | 65/90 | 30 | 5 | On | On | Off | 47 | 23 | 6 | 43 | 25 | 0 |
| 13 (12-1 pm) | 50 | 10 | 5 | 55/80 | 15 | 5 | On | On | Off | 57 | 20 | 6 | 58 | 21 | 0 |
| 14 (1-2 pm) | 95 | 10 | 5 | 65/90 | 15 | 5 | On | On | Off | 54 | 19 | 9 | 48 | 13 | 0 |
| 15 (2-3 pm) | 95 | 10 | 5 | 65/90 | 15 | 5 | On | On | Off | 34 | 15 | 6 | 37 | 8 | 0 |
| 16 (3-4 pm) | 95 | 10 | 5 | 65/90 | 15 | 5 | On | On | Off | 33 | 12 | 4 | 37 | 4 | 0 |
| 17 (4-5 pm) | 95 | 10 | 5 | 65/90 | 15 | 5 | On | On | Off | 44 | 14 | 4 | 46 | 5 | 0 |
| 18 (5-6 pm) | 30 | 5 | 5 | 35/50 | 5 | 5 | On | On | Off | 26 | 7 | 4 | 62 | 6 | 0 |
| 19 (6-7 pm) | 10 | 5 | 0 | 30 | 5 | 5 | On | Off | Off | 21 | 7 | 4 | 20 | 0 | 0 |
| 20 (7-8 pm) | 10 | 0 | 0 | 30 | 5 | 5 | On | Off | Off | 15 | 7 | 4 | 12 | 0 | 0 |
| 21 (8-9 pm) | 10 | 0 | 0 | 20 | 5 | 5 | On | Off | Off | 17 | 7 | 4 | 4 | 0 | 0 |
| 22 (9-10 pm) | 10 | 0 | 0 | 20 | 5 | 5 | On | Off | Off | 8 | 9 | 7 | 4 | 0 | 0 |
| 23 (10-11 pm) | 5 | 0 | 0 | 10 | 5 | 5 | Off | Off | Off | 5 | 5 | 4 | 0 | 0 | 0 |
| 24 (11-12 am) | 5 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 5 | 4 | 0 | 0 | 0 |
| Total/Day | 920 | 200 | 60 | 800/1040 | 280 | 120 | 1600 | 1200 | 0 | 537 | 256 | 113 | 555 | 151 | 0 |
| Total/Week | | 48.60 hours | | | 44.00/56.00 hours | | | 92.00 hours | | | 30.54 hours | | | 29.26 hours | |
| Total/Year | | 2534 hours | | | 2288/2920 hours | | | 4797 hours | | | 1592 hours | | | 1526 hours | |

Wk = Weekday

1. Schedules for occupancy, lighting, receptacle, HVAC system, and service hot water are from ASHRAE Standard 90.1-1989 and addendums, except that 5% emergency lighting has been added for all off hours. Elevator schedules, except for restaurants, are from the U.S. Department of Energy Standard Evaluation Techniques except changed to 0% when occupancy is 0%. **These values may be used only if actual schedules are not known.**
2. Lighting profiles are modified to reflect the requirement for occupancy sensors in Section 1513.6.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

## TABLE 3.3F
## Parking Garage Occupancy[1]

| Hour of Day (Time) | Schedule for Occupancy Percent of Maximum Load | | | Schedule for Lighting[2]/Receptacle Percent of Maximum Load | | | Schedule for HVAC System | | | Schedule for Service Hot Water Percent of Maximum Load | | | Schedule for Elevator Percent of Maximum Load | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun |
| 1 (12-1 am) | NA | | | 50/100 | 50/100 | 50/100 | Based on likely use | | | NA | | | Included with other occupancies | | |
| 2 (1-2 am) | | | | 50/100 | 50/100 | 50/100 | | | | | | | | | |
| 3 (2-3 am) | | | | 50/100 | 50/100 | 50/100 | | | | | | | | | |
| 4 (3-4 am) | | | | 50/100 | 50/100 | 50/100 | | | | | | | | | |
| 5 (4-5 am) | | | | 50/100 | 50/100 | 50/100 | | | | | | | | | |
| 6 (5-6 am) | | | | 50/100 | 50/100 | 50/100 | | | | | | | | | |
| 7 (6-7 am) | | | | 100 | 100 | 50/100 | | | | | | | | | |
| 8 (7-8 am) | | | | 100 | 100 | 50/100 | | | | | | | | | |
| 9 (8-9 am) | | | | 100 | 100 | 50/100 | | | | | | | | | |
| 10 (9-10 am) | | | | 100 | 100 | 50/100 | | | | | | | | | |
| 11 (10-11 am) | | | | 100 | 100 | 50/100 | | | | | | | | | |
| 12 (11-12 pm) | | | | 100 | 100 | 50/100 | | | | | | | | | |
| 13 (12-1 pm) | | | | 100 | 100 | 50/100 | | | | | | | | | |
| 14 (1-2 pm) | | | | 100 | 100 | 50/100 | | | | | | | | | |
| 15 (2-3 pm) | | | | 100 | 100 | 50/100 | | | | | | | | | |
| 16 (3-4 pm) | | | | 100 | 100 | 50/100 | | | | | | | | | |
| 17 (4-5 pm) | | | | 100 | 100 | 50/100 | | | | | | | | | |
| 18 (5-6 pm) | | | | 100 | 50/100 | 50/100 | | | | | | | | | |
| 19 (6-7 pm) | | | | 100 | 50/100 | 50/100 | | | | | | | | | |
| 20 (7-8 pm) | | | | 100 | 50/100 | 50/100 | | | | | | | | | |
| 21 (8-9 pm) | | | | 100 | 50/100 | 50/100 | | | | | | | | | |
| 22 (9-10 pm) | | | | 100 | 50/100 | 50/100 | | | | | | | | | |
| 23 (10-11 pm) | | | | 50/100 | 50/100 | 50/100 | | | | | | | | | |
| 24 (11-12 am) | | | | 50/100 | 50/100 | 50/100 | | | | | | | | | |
| Total/Day | | | | 2000/2400 | 1750/2400 | 1200/2400 | | | | | | | | | |
| Total/Week | | | | | 129.50/168 hours | | | | | | | | | | |
| Total/Year | | | | | 6734/8760 hours | | | | | | | | | | |

Wk = Weekday

1. Schedules for occupancy, lighting, receptacle, HVAC system, and service hot water are from ASHRAE Standard 90.1-1989 and addendums, except that 5% emergency lighting has been added for all off hours. Elevator schedules, except for restaurants, are from the U.S. Department of Energy Standard Evaluation Techniques except changed to 0% when occupancy is 0%. **These values may be used only if actual schedules are not known.**
2. Lighting profiles are modified to reflect the requirement for occupancy sensors in Section 1513.6. For parking garage lighting, the schedule has been revised to accompany the office schedule: the lighting in the parking garage is set to be on at 100% for all hours when the building occupancy is 10% or greater, but reduced to 50% (per Section 1513.6) for all hours when the building occupancy is less than 10%. For a parking garage serving a use other than office, it is acceptable to modify the parking garage schedule to parallel that use.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

## TABLE 3.3G
## Restaurant Occupancy[1]

| Hour of Day (Time) | Schedule for Occupancy Percent of Maximum Load | | | Schedule for Lighting[2]/Receptacle Percent of Maximum Load | | | Schedule for HVAC System | | | Schedule for Service Hot Water Percent of Maximum Load | | | Schedule for Elevator Percent of Maximum Load | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun |
| 1 (12-1 am) | 15 | 30 | 20 | 15 | 20 | 20 | On | On | On | 20 | 20 | 25 | 0 | 0 | 0 |
| 2 (1-2 am) | 15 | 25 | 20 | 15 | 15 | 15 | On | On | On | 15 | 15 | 20 | 0 | 0 | 0 |
| 3 (2-3 am) | 5 | 5 | 5 | 15 | 15 | 15 | On | On | On | 15 | 15 | 20 | 0 | 0 | 0 |
| 4 (3-4 am) | 0 | 0 | 0 | 15 | 15 | 15 | Off | Off | Off | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 (4-5 am) | 0 | 0 | 0 | 15 | 15 | 15 | Off | Off | Off | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 (5-6 am) | 0 | 0 | 0 | 20 | 15 | 15 | Off | Off | Off | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 (6-7 am) | 0 | 0 | 0 | 35/40 | 30 | 30 | Off | Off | Off | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 (7-8 am) | 5 | 0 | 0 | 35/40 | 30 | 30 | On | Off | Off | 60 | 0 | 0 | 0 | 0 | 0 |
| 9 (8-9 am) | 5 | 0 | 0 | 55/60 | 55/60 | 45/50 | On | Off | Off | 55 | 0 | 0 | 0 | 0 | 0 |
| 10 (9-10 am) | 5 | 5 | 0 | 55/60 | 55/60 | 45/50 | On | On | Off | 45 | 50 | 0 | 0 | 0 | 0 |
| 11 (10-11 am) | 20 | 20 | 10 | 85/90 | 75/80 | 65/70 | On | On | On | 40 | 45 | 50 | 0 | 0 | 0 |
| 12 (11-12 pm) | 50 | 45 | 20 | 85/90 | 75/80 | 65/70 | On | On | On | 45 | 50 | 50 | 0 | 0 | 0 |
| 13 (12-1 pm) | 80 | 50 | 25 | 85/90 | 75/80 | 65/70 | On | On | On | 40 | 50 | 40 | 0 | 0 | 0 |
| 14 (1-2 pm) | 70 | 50 | 25 | 85/90 | 75/80 | 65/70 | On | On | On | 35 | 45 | 40 | 0 | 0 | 0 |
| 15 (2-3 pm) | 40 | 35 | 15 | 85/90 | 75/80 | 65/70 | On | On | On | 30 | 40 | 30 | 0 | 0 | 0 |
| 16 (3-4 pm) | 20 | 30 | 20 | 85/90 | 75/80 | 65/70 | On | On | On | 30 | 40 | 30 | 0 | 0 | 0 |
| 17 (4-5 pm) | 25 | 30 | 25 | 85/90 | 75/80 | 55/60 | On | On | On | 30 | 35 | 30 | 0 | 0 | 0 |
| 18 (5-6 pm) | 50 | 30 | 35 | 85/90 | 85/90 | 55/60 | On | On | On | 40 | 40 | 40 | 0 | 0 | 0 |
| 19 (6-7 pm) | 80 | 70 | 55 | 85/90 | 85/90 | 55/60 | On | On | On | 55 | 55 | 50 | 0 | 0 | 0 |
| 20 (7-8 pm) | 80 | 90 | 65 | 85/90 | 85/90 | 55/60 | On | On | On | 60 | 55 | 50 | 0 | 0 | 0 |
| 21 (8-9 pm) | 80 | 70 | 70 | 85/90 | 85/90 | 55/60 | On | On | On | 50 | 50 | 40 | 0 | 0 | 0 |
| 22 (9-10 pm) | 50 | 65 | 35 | 85/90 | 85/90 | 55/60 | On | On | On | 55 | 55 | 50 | 0 | 0 | 0 |
| 23 (10-11 pm) | 35 | 55 | 20 | 45/50 | 45/50 | 45/50 | On | On | On | 45 | 40 | 40 | 0 | 0 | 0 |
| 24 (11-12 am) | 20 | 35 | 20 | 30 | 30 | 30 | On | On | On | 25 | 30 | 20 | 0 | 0 | 0 |
| Total/Day | 750 | 740 | 485 | 1370/ 1455 | 1290/ 1365 | 1040/ 1115 | 2000 | 1800 | 1700 | 790 | 730 | 625 | 0 | 0 | 0 |
| Total/Week | | 49.75 hours | | | 91.80/97.55 hours | | | 135 hours | | | 53.05 hours | | | 0 hours | |
| Total/Year | | 2594 hours | | | 4774/5086 hours | | | 7039 hours | | | 2766 hours | | | 0 hours | |

Wk = Weekday

1. Schedules for occupancy, lighting, receptacle, HVAC system, and service hot water are from ASHRAE Standard 90.1-1989 and addendums, except that 5% emergency lighting has been added for all off hours. Elevator schedules, except for restaurants, are from the U.S. Department of Energy Standard Evaluation Techniques except changed to 0% when occupancy is 0%. **These values may be used only if actual schedules are not known.**
2. Lighting profiles are modified to reflect the requirement for occupancy sensors in Section 1513.6.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

## TABLE 3.3H
## Retail Occupancy[1]

| Hour of Day (Time) | Schedule for Occupancy Percent of Maximum Load | | | Schedule for Lighting[2]/Receptacle Percent of Maximum Load | | | Schedule for HVAC System | | | Schedule for Service Hot Water Percent of Maximum Load | | | Schedule for Elevator Percent of Maximum Load | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun |
| 1 (12-1 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 4 | 11 | 7 | 0 | 0 | 0 |
| 2 (1-2 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 10 | 7 | 0 | 0 | 0 |
| 3 (2-3 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 8 | 7 | 0 | 0 | 0 |
| 4 (3-4 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 4 | 6 | 6 | 0 | 0 | 0 |
| 5 (4-5 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 4 | 6 | 6 | 0 | 0 | 0 |
| 6 (5-6 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 4 | 6 | 6 | 0 | 0 | 0 |
| 7 (6-7 am) | 0 | 0 | 0 | 5 | 5 | 5 | On | On | Off | 4 | 7 | 7 | 0 | 0 | 0 |
| 8 (7-8 am) | 10 | 10 | 0 | 20 | 10 | 5 | On | On | Off | 15 | 20 | 10 | 12 | 9 | 0 |
| 9 (8-9 am) | 20 | 20 | 0 | 50 | 30 | 10 | On | On | On | 23 | 24 | 12 | 22 | 21 | 0 |
| 10 (9-10 am) | 50 | 50 | 10 | 85/90 | 55/60 | 10 | On | On | On | 32 | 27 | 14 | 64 | 56 | 11 |
| 11 (10-11 am) | 50 | 60 | 20 | 85/90 | 85/90 | 40 | On | On | On | 41 | 42 | 29 | 74 | 66 | 13 |
| 12 (11-12 pm) | 70 | 80 | 20 | 85/90 | 85/90 | 40 | On | On | On | 57 | 54 | 31 | 68 | 68 | 35 |
| 13 (12-1 pm) | 70 | 80 | 40 | 85/90 | 85/90 | 55/60 | On | On | On | 62 | 59 | 36 | 68 | 68 | 37 |
| 14 (1-2 pm) | 70 | 80 | 40 | 85/90 | 85/90 | 55/60 | On | On | On | 61 | 60 | 36 | 71 | 69 | 37 |
| 15 (2-3 pm) | 70 | 80 | 40 | 85/90 | 85/90 | 55/60 | On | On | On | 50 | 49 | 34 | 72 | 70 | 39 |
| 16 (3-4 pm) | 80 | 80 | 40 | 85/90 | 85/90 | 55/60 | On | On | On | 45 | 48 | 35 | 72 | 69 | 41 |
| 17 (4-5 pm) | 70 | 80 | 40 | 85/90 | 85/90 | 55/60 | On | On | On | 46 | 47 | 37 | 73 | 66 | 38 |
| 18 (5-6 pm) | 50 | 60 | 20 | 85/90 | 85/90 | 40 | On | On | Off | 47 | 46 | 34 | 68 | 58 | 34 |
| 19 (6-7 pm) | 50 | 20 | 10 | 55/60 | 50 | 20 | On | On | Off | 42 | 44 | 25 | 68 | 47 | 3 |
| 20 (7-8 pm) | 30 | 20 | 0 | 55/60 | 30 | 5 | On | On | Off | 34 | 36 | 27 | 58 | 43 | 0 |
| 21 (8-9 pm) | 30 | 20 | 0 | 50 | 30 | 5 | On | On | Off | 33 | 29 | 21 | 54 | 43 | 0 |
| 22 (9-10 pm) | 0 | 10 | 0 | 20 | 10 | 5 | Off | On | Off | 23 | 22 | 16 | 0 | 8 | 0 |
| 23 (10-11 pm) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 13 | 16 | 10 | 0 | 0 | 0 |
| 24 (11-12 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 8 | 13 | 6 | 0 | 0 | 0 |
| Total/Day | 720 | 750 | 280 | 1060/ 1115 | 940/ 985 | 500/ 525 | 1500 | 1600 | 900 | 662 | 690 | 459 | 844 | 761 | 288 |
| Total/Week | | 46.30 hours | | 67.40/70.85 hours | | | 100 hours | | | 44.59 hours | | | 52.69 hours | | |
| Total/Year | | 2414 hours | | 3505/3694 hours | | | 5214 hours | | | 2325 hours | | | 2747 hours | | |

Wk = Weekday

1. Schedules for occupancy, lighting, receptacle, HVAC system, and service hot water are from ASHRAE Standard 90.1-1989 and addendums, except that 5% emergency lighting has been added for all off hours. Elevator schedules, except for restaurants, are from the U.S. Department of Energy Standard Evaluation Techniques except changed to 0% when occupancy is 0%. **These values may be used only if actual schedules are not known.**
2. Lighting profiles are modified to reflect the requirement for occupancy sensors in Section 1513.6.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

## TABLE 3.3I
## School Occupancy[1]

| Hour of Day (Time) | Schedule for Occupancy Percent of Maximum Load | | | Schedule for Lighting[2]/Receptacle Percent of Maximum Load | | | Schedule for HVAC System | | | Schedule for Service Hot Water Percent of Maximum Load | | | Schedule for Elevator Percent of Maximum Load | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun |
| 1 (12-1 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 3 | 3 | 0 | 0 | 0 |
| 2 (1-2 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 3 | 3 | 0 | 0 | 0 |
| 3 (2-3 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 3 | 3 | 0 | 0 | 0 |
| 4 (3-4 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 3 | 3 | 0 | 0 | 0 |
| 5 (4-5 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 3 | 3 | 0 | 0 | 0 |
| 6 (5-6 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 3 | 3 | 0 | 0 | 0 |
| 7 (6-7 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 3 | 3 | 0 | 0 | 0 |
| 8 (7-8 am) | 5 | 0 | 0 | 30 | 5 | 5 | On | Off | Off | 10 | 3 | 3 | 0 | 0 | 0 |
| 9 (8-9 am) | 75 | 10 | 0 | 60/85 | 15 | 5 | On | On | Off | 34 | 3 | 5 | 30 | 0 | 0 |
| 10 (9-10 am) | 90 | 10 | 0 | 65/95 | 15 | 5 | On | On | Off | 60 | 5 | 5 | 30 | 0 | 0 |
| 11 (10-11 am) | 90 | 10 | 0 | 65/95 | 15 | 5 | On | On | Off | 63 | 5 | 5 | 30 | 0 | 0 |
| 12 (11-12 pm) | 80 | 10 | 0 | 65/95 | 15 | 5 | On | On | Off | 72 | 5 | 5 | 30 | 0 | 0 |
| 13 (12-1 pm) | 80 | 10 | 0 | 55/80 | 15 | 5 | On | On | Off | 79 | 5 | 5 | 30 | 0 | 0 |
| 14 (1-2 pm) | 80 | 0 | 0 | 55/80 | 5 | 5 | On | Off | Off | 83 | 3 | 5 | 30 | 0 | 0 |
| 15 (2-3 pm) | 80 | 0 | 0 | 55/80 | 5 | 5 | On | Off | Off | 61 | 3 | 3 | 30 | 0 | 0 |
| 16 (3-4 pm) | 45 | 0 | 0 | 50/70 | 5 | 5 | On | Off | Off | 65 | 3 | 3 | 15 | 0 | 0 |
| 17 (4-5 pm) | 15 | 0 | 0 | 35/50 | 5 | 5 | On | Off | Off | 10 | 3 | 3 | 0 | 0 | 0 |
| 18 (5-6 pm) | 5 | 0 | 0 | 35/50 | 5 | 5 | On | Off | Off | 10 | 3 | 3 | 0 | 0 | 0 |
| 19 (6-7 pm) | 15 | 0 | 0 | 35 | 5 | 5 | On | Off | Off | 19 | 3 | 3 | 0 | 0 | 0 |
| 20 (7-8 pm) | 20 | 0 | 0 | 35 | 5 | 5 | On | Off | Off | 25 | 3 | 3 | 0 | 0 | 0 |
| 21 (8-9 pm) | 20 | 0 | 0 | 35 | 5 | 5 | On | Off | Off | 22 | 3 | 3 | 0 | 0 | 0 |
| 22 (9-10 pm) | 10 | 0 | 0 | 30 | 5 | 5 | On | Off | Off | 22 | 3 | 3 | 0 | 0 | 0 |
| 23 (10-11 pm) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 12 | 3 | 3 | 0 | 0 | 0 |
| 24 (11-12 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 9 | 3 | 3 | 0 | 0 | 0 |
| Total/Day | 710 | 50 | 0 | 750/990 | 170 | 120 | 1500 | 500 | 0 | 691 | 80 | 84 | 285 | 0 | 0 |
| Total/Week | 36.00 hours | | | 40.40/52.40 hours | | | 80.00 hours | | | 36.19 hours | | | 14.25 hours | | |
| Total/Year | 1877 hours | | | 2101/2732 hours | | | 4171 hours | | | 1887 hours | | | 743 hours | | |

Wk = Weekday

1. Schedules for occupancy, lighting, receptacle, HVAC system, and service hot water are from ASHRAE Standard 90.1-1989 and addendums, except that 5% emergency lighting has been added for all off hours. Elevator schedules, except for restaurants, are from the U.S. Department of Energy Standard Evaluation Techniques except changed to 0% when occupancy is 0%. **These values may be used only if actual schedules are not known.**
2. Lighting profiles are modified to reflect the requirement for occupancy sensors in Section 1513.6.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

## TABLE 3.3J
## Warehouse Occupancy[1]

| Hour of Day (Time) | Schedule for Occupancy Percent of Maximum Load | | | Schedule for Lighting[2]/Receptacle Percent of Maximum Load | | | Schedule for HVAC System | | | Schedule for Service Hot Water Percent of Maximum Load | | | Schedule for Elevator Percent of Maximum Load | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun |
| 1 (12-1 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 2 | 2 | 2 | 0 | 0 | 0 |
| 2 (1-2 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 2 | 2 | 2 | 0 | 0 | 0 |
| 3 (2-3 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 2 | 2 | 2 | 0 | 0 | 0 |
| 4 (3-4 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 2 | 2 | 2 | 0 | 0 | 0 |
| 5 (4-5 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 2 | 2 | 0 | 0 | 0 |
| 6 (5-6 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 7 | 2 | 2 | 0 | 0 | 0 |
| 7 (6-7 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 7 | 2 | 2 | 0 | 0 | 0 |
| 8 (7-8 am) | 15 | 0 | 0 | 25/40 | 5 | 5 | On | Off | Off | 10 | 2 | 2 | 0 | 0 | 0 |
| 9 (8-9 am) | 70 | 20 | 0 | 45/70 | 8 | 5 | On | On | Off | 30 | 6 | 2 | 0 | 0 | 0 |
| 10 (9-10 am) | 90 | 20 | 0 | 55/90 | 24 | 5 | On | On | Off | 36 | 12 | 2 | 0 | 0 | 0 |
| 11 (10-11 am) | 90 | 20 | 0 | 55/90 | 24 | 5 | On | On | Off | 36 | 12 | 2 | 30 | 0 | 0 |
| 12 (11-12 pm) | 90 | 20 | 0 | 55/90 | 24 | 5 | On | On | Off | 46 | 17 | 2 | 0 | 0 | 0 |
| 13 (12-1 pm) | 50 | 10 | 0 | 50/80 | 5 | 5 | On | On | Off | 57 | 4 | 4 | 0 | 0 | 0 |
| 14 (1-2 pm) | 85 | 10 | 0 | 55/90 | 5 | 5 | On | On | Off | 43 | 4 | 4 | 0 | 0 | 0 |
| 15 (2-3 pm) | 85 | 10 | 0 | 55/90 | 5 | 5 | On | On | Off | 38 | 2 | 2 | 0 | 0 | 0 |
| 16 (3-4 pm) | 85 | 10 | 0 | 55/90 | 5 | 5 | On | On | Off | 40 | 2 | 2 | 40 | 0 | 0 |
| 17 (4-5 pm) | 20 | 0 | 0 | 55/90 | 5 | 5 | On | Off | Off | 30 | 2 | 2 | 0 | 0 | 0 |
| 18 (5-6 pm) | 0 | 0 | 0 | 30 | 5 | 5 | Off | Off | Off | 18 | 2 | 2 | 0 | 0 | 0 |
| 19 (6-7 pm) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 3 | 2 | 2 | 0 | 0 | 0 |
| 20 (7-8 pm) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 3 | 2 | 2 | 0 | 0 | 0 |
| 21 (8-9 pm) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 3 | 2 | 2 | 0 | 0 | 0 |
| 22 (9-10 pm) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 3 | 2 | 2 | 0 | 0 | 0 |
| 23 (10-11 pm) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 3 | 2 | 2 | 0 | 0 | 0 |
| 24 (11-12 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 3 | 2 | 2 | 0 | 0 | 0 |
| Total/Day | 680 | 120 | 0 | 600/915 | 180 | 120 | 1000 | 800 | 0 | 429 | 91 | 52 | 70 | 0 | 0 |
| Total/Week | 35.20 hours | | | 33.00/48.75 hours | | | 58.00 hours | | | 22.88 hours | | | 3.50 hours | | |
| Total/Year | 1835 hours | | | 1716/2542 hours | | | 3024 hours | | | 1193 hours | | | 182 hours | | |

Wk = Weekday

1. Schedules for occupancy, lighting, receptacle, HVAC system, and service hot water are from ASHRAE Standard 90.1-1989 and addendums, except that 5% emergency lighting has been added for all off hours. Elevator schedules, except for restaurants, are from the U.S. Department of Energy Standard Evaluation Techniques except changed to 0% when occupancy is 0%. **These values may be used only if actual schedules are not known.**
2. Lighting profiles are modified to reflect the requirement for occupancy sensors in Section 1513.6.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

**RS-29, 5 Reporting Format.**

*Discussion:* Carry over existing criteria from Director's Rule 27-2005. (Note this entire section is an amendment to RS-29 but has not been underlined for readability.)

*Proposal:* Amend 2009 WSEC as follows -

**Section 5 – Reporting Format.**

The reporting format has been developed to guide both staff and applicants through the energy analysis process. The report (three copies are to be submitted) begins with a text summary including project description, methodology description, and a discussion of the estimated energy consumption differences. These are accompanied by an appendix which has summary forms, calculations to support the inputs, and copies of the computer inputs and outputs (all with numbered pages).

The text and summary forms are among the most important parts of the submittal. This information is read prior to any review of the computer inputs and outputs to give an overall orientation to the project. The first evaluation of the project is based on a review of the text and summary forms. These indicate what the key energy-efficiency strategies are and form the basis for a more-detailed review of the drawings and of the computer analysis. Information for statistical summaries or other evaluations is drawn from the text and summary forms. While these may be the last items completed by the applicant prior to submittal, the importance of having them complete and accurate cannot be overemphasized.

**REPORTING FORMAT OUTLINE**

I. Executive Summary

II. Project Description

III. Methodology Description

IV. Discussion of Estimated Energy Consumption Differences

Appendices (Supporting Material)

A. Energy Analysis Summary Form
   1. Energy Consumption by End-use portion
   2. Design Parameter Comparison portion
B. General Information
   1. Site Plan
   2. HVAC Zoning Diagram
C. Building Envelope
   1. Fenestration: NFRC Certification Authorization Report (CAR) or Simulation Report for U-factor and SHGC or Manufacturer's Specifications for Shading Coefficient
   2. Opaque Elements: Cross-sections and U-factor Calculations

   3. Shading Diagrams
D. Lighting System
   1. Lighting for Interior
   2. Lighting for Parking and Outdoor Areas
   3. Lighting for Façade
E. Space Heating and Space Cooling
   1. Equipment Efficiency – Manufacturer's Specifications
F. Ventilation
G. Interior Exhaust Fans
H. Parking Ventilation Fans
I. Service Water Heating
J. Other End-uses
   1. Office Equipment
   2. Elevators and Escalators
   3. Refrigeration
   4. Cooking
   5. Other
K. Computer Printout of Inputs and Outputs

## I. Executive Summary

The executive summary is the condensed version of the text. This is usually several paragraphs long, never more than one page, and includes:

1. A brief description of the project with name, address, number of stories, and total square footage, as well as a listing of the various uses and the square footage of each use.
2. An explanation about why the systems analysis compliance option was chosen (i.e. what elements of the Proposed Design do not comply with the prescriptive option).
3. A listing of the key energy efficiency features that are being used to compensate for the elements that do not comply.
4. The total energy consumption on a Btu-per-conditioned-square-foot-per-year basis for both the Standard Design and the Proposed Design, and the percentage ratio of the Proposed Design to the Standard Design (i.e. what the energy efficiency improvement has been).

## II. Project Description

The project description is a detailed summary of the project. First is the name and the street address as well as adjacent cross-streets or streets on all four sides of the building if it is a full-block development. Indicate the number of stories and total square footage. A listing of the various uses and square footage of each use should be done on a floor-by-floor or a system-by-system basis. Thus, for mixed-use floors, specify how much is office and how

much is retail, or how much is office and how much is lab. Include parking garage number of floors and area in the listing.

The description should also include information on the energy efficiency of the Proposed Design systems.

1. For the building envelope: indicate the glazing area, and how the fenestration U-factor and SHGC compare with the Standard Design requirements; and point out any opaque component U-factors or R-values which are better than the Standard Design requirements.
2. For each HVAC system: provide an explanation of the system including area served, key features, economizer percentage, control strategies, etc. Indicate any differences between the Standard Design and the Proposed Design, such as equipment efficiency.
3. For the lighting: indicate whether any tradeoffs are included in this analysis, and, if so, what they are.
4. For other end-uses: indicate any differences between the Standard Design and the Proposed Design.

It is intended that the material in this section be descriptive, supporting calculations are to be included in the appendices.

## III.Methodology Description

The methodology description is an explanation of any aspects of the modeling which are unusual or not perfectly clear. (The algorithms in approved analysis programs are generally acceptable and do not need to be explained.) For example:

1. Explain what shading by adjacent buildings has been included in the analysis and how it has been modeled (e.g. either using the program capabilities or as a north-facing wall, etc.).
2. If there are below-grade walls and floors, explain how the heat loss has been modeled for these (e.g. either as an exterior wall with a limited ground temperature variation or as a constant negative load to a zone, etc.)
3. If a program cannot model a system exactly, explain why the modeling assumptions used are the best representation of that system.

It is intended that the material in this section provide a heads-up for anything unusual. Again, it is intended that the material in this section be descriptive, supporting calculations are to be included in the appendices.

## IV. Discussion of Estimated Energy Consumption Differences

The discussion of estimated energy consumption differences is a summary and explanation of the energy savings.

1. First, list the total energy consumption on a Btu-per-conditioned-square-foot-per-year basis for both the Standard Design and the Proposed Design, and the percentage ratio of the Proposed Design to the Standard Design (i.e. what the energy efficiency improvement would be).

2. Then, review the energy savings by end-use, starting with the end-use which has the largest difference as a percent of the Standard Design total. Attempt to correlate the differences by end-use with the strategies used. While some changes will have a simple, direct correlation with consumption, other end-use differences may have a more complex explanation due to interactive effects. For example:
   - Changes in exterior lighting will have a simple, direct correlation with consumption.
   - Differences in space heating and space cooling are likely due to a combination of building envelope and HVAC system strategies. (Lacking any better information, the following procedure can provide a rough-cut disaggregation. First, determine the ratio of the design heating load of the Proposed Design to the design heating load of the Standard Design. Multiply the space heating energy consumption of the Standard Design by this ratio and assume that the resulting figure is what the space heating energy consumption would have been for the Proposed Design if only the building envelope had changed. This difference is what could be attributed to the building envelope. Second, determine the ratio of the average equipment efficiency of the Proposed Design to the average equipment efficiency of the Standard Design. Multiply the space heating energy consumption from the first step by this ratio and assume that the resulting figure is what the space heating energy consumption would have been for the Proposed Design if only the building envelope and equipment efficiency had changed. This second difference is what could be attributed to changes in equipment efficiency. Finally, assume that whatever energy consumption differences remain are due to other HVAC system strategies. Follow this same process for space cooling, starting with a comparison of loads, then equipment efficiency, then system type. Differences in economizer cycle, however, add another layer of complexity.)

This section should, at a minimum, provide confirmation that the results of the analysis are reasonable.

**<u>Appendices (Supporting Materials)</u>**

A. Energy Analysis Summary Form (required)
   1. Complete the Energy Consumption by End-use portion of the form for each project. Where a project has multiple buildings which are individually analyzed, complete the form for each building as well as for the overall project. (An automated electronic spreadsheet version of this page is on the DPD Seattle Energy Code website at: www.seattle.gov/dpd/energy.)
   2. Complete the Design Parameter Comparison portion of the form for each project. Where a project has multiple HVAC systems, complete the HVAC information for each system. (An electronic version of these pages is on the DPD Seattle Energy Code website at: www.seattle.gov/dpd/energy.)

B. General Information
   1. Site Plan (required) – provide site plan (8½ x 11 preferred) showing location and height, in feet or stories, of all adjacent buildings and also any other buildings and topography which would provide significant shading of the proposed building.

2. HVAC zoning diagram used in the modeling process (required) – provide zoning diagram indicating zone lines and with zones labeled to match the modeling. (Providing takeoff sheets with area inputs will simplify review.)

C. Building Envelope
1. Glazing and opaque doors, including windows, skylights, sliding/swinging/rollup doors, glass block (required):
   a. for U-factor,
      i. provide NFRC Certification Authorization Report (CAR) from NFRC-licensed Inspection Agency for the overall fenestration product including the frame OR
      ii. copy of simulation by NFRC-accredited simulation laboratory for the overall fenestration product including the frame OR
      iii. manufacturer's specifications where default U-factors from Chapter 10 have been used;
   b. for Solar Heat Gain Coefficient (SHGC),
      i. provide NFRC Certification Authorization Report (CAR) from NFRC-licensed Inspection Agency for the overall fenestration product including the frame OR
      ii. copy of simulation by NFRC-accredited simulation laboratory for the overall fenestration product including the frame OR
      iii. manufacturer's specifications where shading coefficient of the glass alone has been used.

   (Note products claiming NFRC values shall be labeled. For site-assembled products, the NFRC Label Certificate shall be on job site prior to installation of first fenestration product. See CAM 403 for more information.)
2. Opaque roof, wall, floor (required):
   a. provide cross-sections and U-factor calculations for each different assembly where default U-factors from Chapter 10 have not been used;
   b. if multiple elements (e.g.. three wall types) are combined into one value for modeling purposes, provide calculations used to determine weighted-average value.
3. Shading diagrams (required):
   a. provide information on how shading by adjacent buildings and topography has been modeled,
   b. provide wall and roof sections showing overhangs and setbacks for glazing to justify the shading modeled.
4. Building air leakage:
   a. provide specific statement of the proposed building air leakage test rate when tested in accordance with the procedure in Section 1314.6.2,
   b. provide calculation showing how the building air leakage test rate at the standard rating conditions in Section 1314.6.2 has been converted to an air leakage test rate appropriate for the energy modeling using the conversion factors as specified in RS-29, Table 3.1, #5 Building Envelope, Proposed Design,
   c. for modeling, as specified in RS-29, Table 3.1, #5 Building Envelope, Proposed Design, indicate:
      i. what percentage of air leakage is modeled for the hours when the building fan system is off and
      ii. what percentage of air leakage is modeled for the hours when the building fan system is on.

D. Lighting
   1. Interior lighting (as applicable):
      a. explain any special assumptions about interior lighting,
      b. discuss lighting inputs to account for any exempt lighting (e.g. retail, kitchen).
   2. Parking/outdoor areas lighting (as applicable):
      a. provide calculation of areas for parking garages, then multiply by allowed Watts/square foot; provide calculation of areas for surface parking, and other lighted outdoor areas, then multiply by allowed Watts/square foot to obtain Standard Design;
      b. provide supporting information for Proposed only if different from Standard Design;
      c. if program does not list parking/outdoor area lighting energy consumption separately, then provide calculation of annual energy consumption for this end-use.
   3. Façade lighting (required):
      a. provide calculation of building façade, then multiply by allowed Watts/square foot to obtain Standard Design;
      b. provide supporting information for Proposed only if different from Standard Design;
      c. if program does not list facade lighting energy consumption separately, then provide calculation of annual energy consumption for this end-use.

E. Space Heating and Space Cooling Equipment and Plant
   1. provide manufacturer's specifications for equipment efficiency,
   2. provide calculations per AHRI standards for COP, EER, IPLV,
   3. provide list of equipment and size and calculations to justify if Proposed Design includes multiple pieces of equipment and a weighted average equipment efficiency is used in the energy analysis,
   4. provide calculations to justify the equipment size for the Standard Design
      a. provide calculations of ratio of Proposed Design equipment size to Proposed Design design heating load and design cooling load,
      b. provide calculations of ratio of Standard Design equipment size to Standard Design design heating load and design cooling load.

F. Ventilation - interior (required):
   1. provide W/CFM calculations for the ventilation system for the Proposed Design and for the Standard Design to justify inputs for the Standard Design,
   2. if program does not list energy consumption for interior ventilation separately in the output, then provide calculation of annual energy consumption for this end-use.

G. Interior Exhaust Fans (as applicable):
   1. where multiple toilet exhaust and relief fans are to be installed, provide listing of capacity for each and total for the interior exhaust fans,
   2. if program does not list energy consumption for interior exhaust fans separately in the output, then provide calculation of annual energy consumption for this end-use.

H. Parking Garage Fans (as applicable):
   1. where multiple parking garage fans are to be installed, provide listing of capacity for each and total for the parking garage fans,
   2. if program does not list energy consumption for parking garage fans separately in the output, then provide calculation of annual energy consumption for this end-use.

I. Service Water Heating (required):
   1. provide calculations used to size equipment (see RS-29 Table 3.1.4 for default assumptions for service hot water quantities in Btuh per person),

2. if program does not list energy consumption for service water heating separately in the output, then provide calculation of annual energy consumption for this end-use.

J. Other End-uses
1. Office/miscellaneous equipment (as applicable):
   a. if program requires an input of total equipment capacity rather than capacity on a square foot basis, then provide calculations used to size equipment (see RS-29 Table 3.1.4 for default assumptions for service hot water quantities in Watts/square foot),
   b. if program does not list energy consumption for office/miscellaneous equipment separately in the output, then provide calculation of annual energy consumption for this end-use.
2. Elevators and escalators (as applicable):
   a. where multiple elevators and escalators are to be installed, provide listing of capacity for each and total for the system,
   b. if program does not list energy consumption for elevators and escalators separately in the output, then provide calculation of annual energy consumption for this end-use.
3. Refrigeration - food, etc. (as applicable):
   a. where multiple units are to be installed for refrigeration other than for comfort cooling, provide listing of capacity for each and total for the system,
   b. if program does not list energy consumption for refrigeration other than for comfort cooling separately in the output, then provide calculation of annual energy consumption for this end-use.
4. Cooking (as applicable):
   a. where multiple units are to be installed for cooking, provide listing of capacity for each and total for the system,
   b. if program does not list energy consumption for cooking separately in the output, then provide calculation of annual energy consumption for this end-use.
5. Other (as applicable):
   a. provide supporting data for other end-uses (e.g. commercial washers and dryers, etc.),
   b. if program does not list energy consumption for other end-uses separately in the output, then provide calculation of annual energy consumption for these end-uses.

K. Computer Printout of Inputs and Outputs

Provide inputs and outputs <u>with pages numbered</u> so cross-references can be made to the Energy Analysis Summary Form.

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

# ENERGY ANALYSIS SUMMARY FORM

## PROJECT INFORMATION

DPD Project Address: _____ DPD Project Number: _____

Project Name: _____ Date of this submittal: _____

| | Conditioned Space | | | | | | Unconditioned Space | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Building Uses: | Office | Retail | Group R | _____ | _____ | Subtotal | Parking | _____ | Subtotal | Total |
| Area (sq.ft.): | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ |

## ENERGY CONSUMPTION BY END-USE

| | | STANDARD DESIGN | | | PROPOSED DESIGN | | | DIFFERENCES | | |
|---|---|---|---|---|---|---|---|---|---|---|
| END-USE | FUEL SOURCE | Total Energy Use Estimate | BTU/ Cond. Sq.Ft.-Year | % of Standard Design Total | Total Energy Use Estimate | BTU/ Cond. Sq.Ft.-Year | % of Proposed Design Total | Total Energy Use Estimate | BTU/ Cond. Sq.Ft.-Year | % of Standard Design Total |
| Lighting - interior | | _____ | _____ | _____% | _____ | _____ | _____% | _____ | _____ | _____% |
| Lighting - parking | | _____ | _____ | _____% | _____ | _____ | _____% | _____ | _____ | _____% |
| Lighting - façade | | _____ | _____ | _____% | _____ | _____ | _____% | _____ | _____ | _____% |
| Space Heating (1) | | _____ | _____ | _____% | _____ | _____ | _____% | _____ | _____ | _____% |
| Space Heating (2) | | _____ | _____ | _____% | _____ | _____ | _____% | _____ | _____ | _____% |
| Space Cooling | | _____ | _____ | _____% | _____ | _____ | _____% | _____ | _____ | _____% |
| Fans - interior ventilation | | _____ | _____ | _____% | _____ | _____ | _____% | _____ | _____ | _____% |
| Fans - interior exhaust | | _____ | _____ | _____% | _____ | _____ | _____% | _____ | _____ | _____% |
| Fans - parking garage | | _____ | _____ | _____% | _____ | _____ | _____% | _____ | _____ | _____% |
| Service water heating | | _____ | _____ | _____% | _____ | _____ | _____% | _____ | _____ | _____% |
| Office equipment | | _____ | _____ | _____% | _____ | _____ | _____% | _____ | _____ | _____% |
| Elevators & escalators | | _____ | _____ | _____% | _____ | _____ | _____% | _____ | _____ | _____% |
| Refrigeration (food, etc.) | | _____ | _____ | _____% | _____ | _____ | _____% | _____ | _____ | _____% |
| Cooking (commercial) | | _____ | _____ | _____% | _____ | _____ | _____% | _____ | _____ | _____% |
| _____ | | _____ | _____ | _____% | _____ | _____ | _____% | _____ | _____ | _____% |
| _____ | | _____ | _____ | _____% | _____ | _____ | _____% | _____ | _____ | _____% |
| Total | | _____ | _____ | 100.0% | _____ | _____ | 100.0% | _____ | _____ | |

Percent of Standard Design: 100.0% = _____ % + _____ %

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

**INSTRUCTIONS:**

**Electronic Version:**

A spreadsheet version is available on the Seattle Energy Code website @ www.seattle.gov/dpd/energy

**Project Information:**

Enter DPD address, project number, and date of this Energy End-use Summary Form.
Enter the space uses in the building and the gross square footage of each.
(Add/revise headings as necessary.) Spreadsheet automatically calculates subtotals and total.

**Energy Consumption by End-use:**

Enter fuel source for each end-use (e.g. electric, gas, oil, steam, etc.).
Enter total energy consumption in **BTU** for each end-use for both the Standard Design and Proposed Design.
(Spreadsheet calculates the BTU/conditioned-square-foot-year, percentages, and differences.)

*Seattle amendments do not apply to residential spaces, except that procedural requirements and informative notes in boxed text or brackets, and amendments to administrative and enforcement provisions, apply to all projects.*

# DESIGN PARAMETER COMPARISON

| Element | Standard Design Value | (Page) | Proposed Design Value | (Page) |
|---|---|---|---|---|
| | | | | |
| **Building Envelope** | | | | |
| **Space heat type** (electric resistance vs. other): | | | | |
| **Glazing**: total vertical + overhead area (sq. feet): | | | | |
| Glazing area as a percentage of gross wall (%): | | | | |
| **Overhead**: total area (square feet): | | | | |
| Overhead U-factor (weighted-average): | | | | |
| Overhead SHGC (weighted-average): | | | | |
| **Vertical**: total area (square feet): | | | | |
| Vertical U-factor (weighted-average): | | | | |
| Vertical SHGC (weighted-average): | | | | |
| **Roof**: total area (square feet): | | | | |
| Opaque roof: net area (square feet): | | | | |
| Opaque roof U-factor (weighted-average): | | | | |
| **Wall**: total above-grade area (square feet): | | | | |
| Opaque above-grade wall: net area (square feet): | | | | |
| Above-grade wall U-factor (weighted-average): | | | | |
| Below-grade wall: net area (square feet): | | | | |
| Below-grade wall U-factor (weighted-average): | | | | |
| **Opaque door**: area (sq. feet): | | | | |
| Opaque door U-factor (weighted-average): | | | | |
| **Floor over unconditioned space**: area (sq. feet): | | | | |
| Floor U-factor (weighted-average): | | | | |
| **Slab-on-grade floor**: perimeter (lineal feet): | | | | |
| Slab-on-grade F-factor (weighted-average): | | | | |
| **Below-grade slab floor**: net area (square feet): | | | | |
| Below-grade floor U-factor (weighted-average): | | | | |
| **Infiltration rate**: | | | | |
| **Design heating load**: | | | | |
| **Design cooling load**: | | | | |
| | | | | |
| **Lighting** | | | | |
| **Interior** | | | | |
| Watts/sq.ft.: Office | | | | |
| Watts/sq.ft.: Retail | | | | |
| Watts/sq.ft.: | | | | |
| Watts/sq.ft.: | | | | |
| **Parking/outdoor**: total area (square feet) | | | | |
| Watts/square foot | | | | |
| **Façade**: total area (square feet) | | | | |
| Watts/square foot | | | | |
| | | | | |

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# DESIGN PARAMETER COMPARISON (cont.)

| Element | Standard Design Value | (Page) | Proposed Design Value | (Page) |
|---|---|---|---|---|
| | | | | |
| **Space Heating and Space Cooling System** | | | | |
| **Space Heating**: system type: | | | | |
| Peak equipment efficiency: | | | | |
| Output capacity: | | | | |
| Percent of design heating load: | | | | |
| Other features: | | | | |
| **Space Cooling**: system type: | | | | |
| Peak equipment efficiency: | | | | |
| Output capacity: | | | | |
| Percent of design cooling load: | | | | |
| Other features: | | | | |
| | | | | |
| **Ventilation** | | | | |
| Interior ventilation fans | | | | |
| Economizer type (air or water): | | | | |
| Economizer percentage: | | | | |
| Supply fan: total CFM: | | | | |
| Fan KW: | | | | |
| Return fan: total CFM: | | | | |
| Fan KW: | | | | |
| Exhaust fan: total CFM: | | | | |
| Fan KW: | | | | |
| System Watts/CFM: | | | | |
| Other features: | | | | |
| Other features: | | | | |
| | | | | |
| **Service Water Heating** | | | | |
| Capacity: | | | | |
| | | | | |
| **Other End-uses** | | | | |
| Fans – toilet and other exhaust: capacity (KW) | | | | |
| Fans – parking garage: capacity (KW) | | | | |
| Elevator and escalator: capacity | | | | |
| Refrigeration: capacity | | | | |
| Cooking: capacity | | | | |
| _____: capacity | | | | |
| _____: capacity | | | | |
| _____: capacity | | | | |
| | | | | |

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**RS-35**
**ADVANCED CRITERIA FOR OTHER PROGRAMS**

*Discussion:* Provide advanced criteria to achieve compliance with the 2030 Challenge (as well as the 20% energy savings goal in Resolution 30280).
*Proposal:* Amend 2009 WSEC as follows -

**RS-35**
**ADVANCED CRITERIA FOR OTHER PROGRAMS**

Reference Standard (RS)-35 contains advanced criteria for energy efficiency and energy conservation beyond the requirements of the Seattle Energy Code. The goal of these criteria is to achieve compliance with the 2030 Challenge. This RS-35 is adopted for incorporation in programs, agreements, or initiatives toward that goal.

**PRESCRIPTIVE COMPLIANCE OPTION**

Comply with the 2009 Seattle Energy Code with the following modifications and additions:

**Section 901, Additional Residential Energy Efficiency Requirements:** Achieve a minimum of five credits (instead of one credit) from Table 9-1 or, if using the exception, achieve 30 percent less (instead of 16 percent less) than the target building energy use in Chapter 4.

**Section 1314.6.2.1, Testing of Overall Building Air Leakage:** Tested air leakage of 0.25 cfm/ft$^2$ maximum for all buildings (instead of 0.40 cfm/ft$^2$).

**Sections 1320-1323, Prescriptive Building Envelope Option:** Compliance to be based on Table A13-1 Advanced Criteria (instead of Table 13-1). See below.

**Sections 1330-1334, Component Performance Building Envelope Option:** Compliance to be based on Table A13-1 Advanced Criteria (instead of Table 13-1).

**Table 13-1:** Opaque envelope and fenestration to comply with Table A13-1 Advanced Criteria (instead of Table 13-1):

**Table A13-1**
**Advanced Criteria**

| | Nonresidential | | Residential, Other than Single-Family | |
|---|---|---|---|---|
| **Opaque Elements** | **Assembly Max. U-factor** | **Insulation Min. R-Value** | **Assembly Max. U-factor** | **Insulation Min. R-Value** |

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| | | | | |
|---|---|---|---|---|
| **Roofs** | | | | |
| Insulation entirely above deck | U-0.025 | R-40 c.i. | U-0.025 | R-40 c.i. |
| Metal building | U-0.024 | R-30 + R-11 + R-11 Ls | U-0.024 | R-30 + R-11 + R-11 Ls |
| Single-rafter | U-0.025 | R-42 | U-0.025 | R-42 |
| Attic and other | U-0.025 | R-49 adv or R-60 | U-0.025 | R-49 adv or R-60 |
| **Walls, Above Grade** | | | | |
| Mass | U-0.051 for exterior and integral insulation<br><br>U-0.050 for interior insulation; | Exterior and integral insulation:<br>a. R-18 c.i.<br><br>Interior insulation:<br>b. R-13 cavity insulation + R-8 c.i. wood studs; or<br>c. R-13 cavity insulation + R-12 c.i. metal studs; or<br>d. R-25.2 insulation held solely by 1-in metal clips | U-0.046 for exterior and integral insulation<br><br>U-0.045 for interior insulation; | Exterior and integral insulation:<br>a. R-20 c.i.<br><br>Interior insulation:<br>b. R-13 cavity insulation + R-10 c.i. wood studs; or<br>c. R-13 cavity insulation + R-14 c.i. metal studs; or<br>d. R-28 insulation held solely by 1-in metal clips |
| Metal building | U-0.046 | R-13 + R-15.8 c.i. | U-0.040 | R-13 + R-19 c.i. |
| Steel framed | U-0.049 | R-13 + R-12.5 c.i. | U-0.043 | R-13 + R-15 c.i. |
| Wood framed and other | U-0.045 | R-13 + R-10 c.i. | U-0.040 | R-13 + R-12.5 c.i. |
| **Walls, Below Grade** | | | | |
| Below grade wall | U-0.070 | Exterior insulation:<br>a. R-10 c.i.<br>Interior insulation:<br>b. R-19 cavity insulation wood studs; or<br>c. R-13 cavity insulation + R-6 c.i. metal studs; or<br>d. R-16.8 insulation held solely by 1-in metal clips. | U-0.070 | Exterior insulation:<br>a. R-10 c.i.<br>Interior insulation:<br>b. R-19 cavity insulation wood studs; or<br>c. R-13 cavity insulation + R-6 c.i. metal studs; or<br>d. R-16.8 insulation held solely by 1-in metal clips. |
| **Floors** | | | | |
| Mass | U-0.027 | R-35 c.i. | U-0.027 | R-35 c.i. |
| Steel joist | U-0.027 | R-38 + R-6 c.i. | U-0.027 | R-38 + R-6 c.i. |
| Wood framed and other | U-0.025 | R-38 | U-0.025 | R-38 |
| **Slab-on-Grade Floors** | | | | |
| Unheated | F-0.520 | R-15 for 24 in. (with thermal break) | F-0.520 | R-15 for 24 in. (with thermal break) |
| Heated | F-0.360 | R-15 c.i. (with thermal break) | F-0.360 | R-15 c.i. (with thermal break) |

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| | | | | |
|---|---|---|---|---|
| **Opaque Doors** | | | | |
| Swinging | U-0.470 | | U-0.400 | |
| Nonswinging | U-0.390 | | U-0.400 | |
| | | | | |
| **Fenestration** | **Assembly Max. U-Factor**<br><br>**NFRC-certified or per 1006** | **Assembly Max. SHGC**<br><br>**NFRC-certified or per 1312.1** | **Assembly Max. U-Factor**<br><br>**NFRC-certified or per 1006** | **Assembly Max. SHGC**<br><br>**NFRC-certified or per 1312.1** |
| **Total fenestration (vertical and overhead) area relative to the gross exterior wall area** | **0-30% of wall** | | | |
| **Vertical Fenestration** | | | | |
| Nonmetal framing: All | U-0.27 | For all frame types: | U-0.27 | |
| Metal framing: Fixed/operable | U-0.34 | SHGC-0.35 all OR | U-0.34 | |
| Entrance doors (revolving doors & vestibules) | U-0.60 (U-0.65) | SHGC-0.45 all PLUS permanent PF>0.50 on west, south and east | U-0.60 (U-0.65) | |
| **Skylights** | | | | |
| Without curb (i.e., sloped glazing) | U-0.40 | SHGC-0.30 all | U-0.40 | SHGC-0.35 all |
| With curb (i.e., individual unit skylights) | U-0.50 | | U-0.50 | |
| **Total fenestration (vertical and overhead) area relative to the gross exterior wall area** | **<30-40% of wall** | | | |
| **Vertical Fenestration** | | | | |
| Nonmetal framing: All | U-0.25 | For all frame types: | U-0.25 | |
| Metal framing: Fixed/operable | U-0.31 | SHGC-0.33 all OR | U-0.31 | |
| Entrance doors (revolving doors & vestibules) | U-0.60 (U-0.65) | SHGC-0.45 all PLUS permanent PF>0.50 on west, south and east | U-0.60 (U-0.65) | |
| Skylights | | | | |
| Without curb (i.e., sloped glazing) | U-0.36 | SHGC-0.30 all | U-0.36 | SHGC-0.35 all |
| With curb (i.e., individual unit skylights) | U-0.45 | | U-0.45 | |

c.i. = continuous insulation, Ls = liner system (see definitions).

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**Section 1411.1, HVAC Equipment Performance Requirements, General:** Building projects to have high-efficiency mechanical equipment, meaning that 90% of the equipment from each table (same category) has an efficiency that is 1.10 times the corresponding minimum efficiency in Tables 14-1A through 14-1G. The absolute gain in minimum efficiency shall be in addition to that required elsewhere in the code such as for Section 1433 and Section 1132.2.

**Section 1521, Prescriptive Interior Lighting Requirements:** This section is not allowed to be used.

**Section 1531, Interior Lighting Power Allowance:** The interior lighting power allowance shall be no greater than 0.90 times the lighting power allowance in Table 15-1.

**Section 1532, Exterior Lighting Power Allowance:** The exterior lighting power allowance shall be no greater than 0.90 times the lighting power allowance in Table 15-2.

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**RS-36**
**ILLUSTRATIVE GOALS FOR THE 2030 CHALLENGE IN SEATTLE**

*Discussion:* Provide illustrative goals for the 2030 Challenge in Seattle.
*Proposal:* Amend 2009 WSEC as follows -

**RS-36**
**ILLUSTRATIVE GOALS FOR THE 2030 CHALLENGE IN SEATTLE**

## Note that these tables are only a reference point, not prescriptive standards nor a means of compliance.

How to use these tables:

The building types listed in bold define a broad building activity category. Some of the broader building type categories are broken down into more specific building activities. The building types in regular type are regional numbers calculated by Target Finder for zip code 98104 using default project parameters. For building types available in Target Finder, use Target Finder and input project specific parameters in order to establish an accurate target.

When identifying your building within this table, first identify where your building's function falls within the broader blue categories. Then determine if you are able to identify your building's function more specifically by the white categories underneath. Matching your building's main use activities most closely with the building use descriptions below will give you the most accurate energy performance target. Please note all site EUI values displayed below are annual figures.

Targets can be calculated for mixed use buildings by multiplying site EUI for each type by the square footage for that type, summing the totals of energy use by type and dividing by total square footage.

Secondary Space/Building Types – Ambulatory Surgical Center, Computer Data Center, Garage, Open Parking Lot and Swimming Pool – available in Target Finder, are not presented here. More complex projects containing these secondary uses are advised to use Target Finder to establish a target.

**Table B-1. Seattle 2030 Challenge Targets for Nonresidential buildings based on U.S. National Averages and Regional Averages calculated with Energy Star Target Finder based on CBECS (2003)**

| Building Use Description | Available in Target Finder | Average Site EUI kBtu/ $ft^2$·yr | Average Percent Electric | 60% Target for 2010 | 70% Target for 2015 | Energy Star Rating @ 60% Target |
|---|---|---|---|---|---|---|
| **Education** | | 76 | 63% | 30 | 23 | |
| K-12 School[1] | X | 76 | 45% | 31 | 24 | 99 |
| College/University (Campus) | | 120 | 63% | 48 | 36 | |
| **Food Sales** | | 225 | 86% | 90 | 68 | |
| Grocery Store/Food Market[2] | X | 218 | 52% | 87 | 65 | 100 |
| Convenience Store (w/or w/o gas station) | | 241 | 90% | 96 | 72 | |
| **Food Service** | | | | | | |
| Restaurant/Cafeteria | | 302 | 54% | 121 | 91 | |
| Fast Food | | 534 | 64% | 214 | 160 | |
| **Health Care: Inpatient (Specialty Hospitals, Excluding Children')** | | 227 | 47% | 91 | 68 | |
| Hospital (Acute Care, Children's)[3] | X | 356 | 36% | 142 | 107 | 100 |
| **Health Care: Long Term Care (Nursing Home, Assisted Living)** | | 124 | 54% | 50 | 37 | |
| **Health Care: Outpatient** | | 73 | 76% | 29 | 22 | |
| Clinic/Other Outpatient Health | | 84 | 76% | 34 | 25 | |
| Medical Office[4] | X | 85 | 62% | 34 | 26 | 91 |
| **Lodging** | | 87 | 61% | 35 | 26 | |
| Dormitory/Fraternity/Sorority[5] | X | 83 | 48% | 33 | 25 | 95 |
| Hotel, Motel or Inn[6] | X | 97 | 48% | 39 | 29 | 99 |
| **Mall (Strip Mall or Enclosed)** | | 107 | 71% | 43 | 32 | |
| **Office[7]** | | 105 | 70% | 42 | 32 | 97 |
| Bank/Financial Institution[8] | X | 90 | 70% | 36 | 27 | 97 |
| **Public Assembly** | | 66 | 57% | 26 | 20 | |
| Entertainment/Culture | | 95 | 63% | 38 | 29 | |
| Library | | 104 | 59% | 42 | 31 | |
| Recreation | | 65 | 55% | 26 | 20 | |
| Social/Meeting | | 52 | 57% | 21 | 16 | |
| **Public Order and Safety** | | 90 | 57% | 36 | 27 | |
| Fire Station/Police Station | | 78 | 56% | 31 | 23 | |
| Courthouse[9] | X | 86 | 70% | 34 | 28 | 97 |
| **Service (Vehicle Repair/Service, Postal Service)** | | 77 | 63% | 31 | 23 | |
| **Storage/Shipping/Nonrefrigerated Warehouse** | | 25 | 56% | 10 | 8 | |
| Self-storage | | 4 | 44% | 2 | 1 | |
| Non-Refrigerated Warehouse[10] | X | 45 | 61% | 18 | 14 | 92 |
| Refrigerated Warehouse[11] | X | 63 | 62% | 25 | 19 | 92 |
| Distribution/Shipping Center | | 44 | 61% | 18 | 13 | |
| **Refrigerated Warehouse[12]** | | 63 | 62% | 25 | 19 | 92 |
| **Religious Worship** | | 46 | 52% | 18 | 14 | |
| House of Worship[13] | X | 34 | 49% | 13 | 10 | 96 |
| **Retail (Non-mall Stores, Vehicle Dealerships)** | | 82 | 67% | 33 | 25 | |
| Retail Stores[14] | X | 56 | 78% | 22 | 17 | 95 |
| **Other[15]** | | 104 | 56% | 42 | 31 | |

[1] 100,000 $ft^2$, open weekends, 200 PCs, 2 walk-in refrigeration/freezer units, cooking facilities, high school

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[2] 100,000 $ft^2$, 140 operating hours, 50 workers on main shift, 5 walk-in refrigerator/freezer units, cooking facilities
[3] 100,000 $ft^2$, 400 licensed beds, 4 floors, tertiary care
[4] 100,000 $ft^2$, 100 workers, 72 operating hours
[5] 100,000 $ft^2$, 220 rooms
[6] 100,000 $ft^2$, 220 rooms, 12 workers on Main Shift, 2 Commercial Refrigeration/Freezer Units, cooking facilities
[7] 100,000 $ft^2$, 72 weekly operating hours, 400 workers on main shift, 375 PCs
[8] 100,000 $ft^2$, 66 weekly operating hours, 200 workers on main shift, 200 PCs
[9] 100,000 $ft^2$, 60 weekly operating hours, 200 workers on main shift, 150 PCs
[10] 100,000 $ft^2$, 12 workers on main shift, 100 weekly operating hours, 2 walk-in refrigeration/freezer units
[11] 100,000 $ft^2$, 12 workers on main shift, 100 weekly operating hours
[12] 100,000 $ft^2$, 12 workers on main shift, 100 weekly operating hours
[13] 100,000 $ft^2$, seating capacity 300, 5 weekday operation, 12 PCs, cooking, 2 commercial refrigeration/freezer units
[14] 100,000 $ft^2$, 84 weekly operating hours, 3 open or closed refrigeration/freezer cases, 1 walk-in refrigeration/freezer unit, 15 workers on main shift, 4 PCs, 12 cash registers, exterior entrance to the public
[15] For all building types not defined by the list above, the applicant may choose to use the performance benchmark categorized by "other". Note that this category is not well defined therefore source energy use varies greatly with source EUI ranging over 1500 kBtu/$ft^2$·yr. As categorized by EIA, "other" may include airplane hangars, laboratory, crematorium, data center, etc.

## Table B-2. Seattle 2030 Challenge Targets by Residential Space/Building Type based on U.S. West Regional Averages (RECS 2001)

| Building Use Description | Average Site EUI kBtu/$ft^2$·yr | Average Percent Electric | 60% Target for 2010 | 70% Target for 2015 | Energy Star Rating @ 60% Target |
|---|---|---|---|---|---|
| Single-Family Detached | 38 | | 15 | 12 | |
| Single-Family Attached | 39 | | 16 | 12 | |
| Multi-Family, 2 to 4 units | 48 | | 19 | 14 | |
| Multi-Family, 5 or more units | 40 | | 16 | 12 | |
| Mobile Homes | 66 | | 26 | 20 | |

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