Council Bill Number: 116033
Ordinance Number: 122530

AN ORDINANCE relating to energy efficiency and energy conservation, amending Section 22.700.010 of the Seattle Municipal Code; adopting by reference the 2006 Washington State Energy Code, amending certain chapters of the 2006 Washington State Energy Code, and repealing Sections 2-76 of Ordinance 121821.

Status: Passed
Note: Returned unsigned by Mayor 8/23/07
Vote: 8-0 (Excused: McIver)
Date filed with the City Clerk: 2007/10/11
Date of Mayor's signature: 2007/10/02 (about the signature date)

Date introduced/referred to committee: 2007/09/24
Committee: Urban Development and Planning
Sponsor: STEINBRUECK
Committee Recommendation: Pass

Index Terms: BUILDING-CODES, ENERGY-CODES

Fiscal Note: Fiscal Note to Council Bill No. 116033

Electronic Copy: PDF scan of Ordinance No. 122530

Reference: Amending: Ord 121821; Related: CF 308938

Text:

AN ORDINANCE relating to energy efficiency and energy conservation, amending Section 22.700.010 of the Seattle Municipal Code; adopting by reference the 2006 Washington State Energy Code, amending certain chapters of the 2006 Washington State Energy Code, and repealing Sections 2-76 of Ordinance 121821.

BE IT ORDAINED BY THE CITY OF SEATTLE AS FOLLOWS:

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

22.700.010 Adoption of the ~~2004~~ 2006 Washington State Energy Code and local amendments.

The ~~2004~~ 2006 Washington State Energy Code (WAC 51- 11), which is filed with the City Clerk in C.F. ~~307271~~ 308938, and the amendments thereto adopted by Council Bill ~~121821~~ 116033 that incorporate the Seattle Amendments, are hereby adopted and by this reference made a part of this subtitle and ~~shall~~ constitute the ~~official Energy Code of the City~~ Washington State Energy Code with Seattle amendments. ~~The 2001 Washington State Energy Code, and amendments thereto, are hereby repealed.~~

Section The following section of Chapter 2 of the 2006 Washington State Energy Code is amended as follows:

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Section 201 General Definitions

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BUILDING ENTRANCE: any doorway, set of doors, turnstile, vestibule, or other form of portal that is ordinarily used to gain access to the building by its users and occupants.

***

NOMINAL R-VALUE: The thermal resistance of the 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*ft2* degrees F/Btu at a mean temperature of 75 degrees 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.

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).

***

PERSON. Any individual, receiver, administrator, executor, assignee, trustee in bankruptcy, trust, estate, firm, partnership, joint venture, club, company, joint stock company, business trust, municipal corporation, 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.

***

Section The following sections of Chapter 7 of the 2006 Washington State Energy Code are amended as follows:

Section 701 Standards: The following standards shall apply to Chapters 1 through 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 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 SMACNA, Installation Standards for Residential Heating and Air Conditioning Systems, 6th Edition, 1988.

RS-7 SMACNA, HVAC Duct Construction Standards Metal and Flexible, 2nd Edition, 1995.

RS-8 SMACNA, Fibrous Glass Duct Construction Standards, 6th Edition, 1992.

RS-9 ASHRAE/IESNA Standard 90.1-2004, Energy Standard for Buildings Except Low-Rise Residential Buildings.

RS-10 2004 ASHRAE Systems & Equipment Handbook.

RS-11 2003 ASHRAE HVAC Applications Handbook.

RS-12 through RS-28: (Reserved.)

RS-29 Nonresidential Building Design by Systems Analysis.

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, available for download at the Seattle Energy Code homepage at:~~http://www.seattle.gov/dpd/energy

ACCREDITED AUTHORITATIVE AGENCIES

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

ARI refers to the Air-Conditioning and Refrigeration Institute, 4301 N. Fairfax Dr., Suite 425, Arlington, VA 22203

Phone (703) 524-8800 Fax (703) 528-3816, Internet www.ari.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~~588-0854~~, Internet www.nfrc.org

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

Section The following sections of Chapter 10 of the 2006 Washington State Energy Code are amended as follows:

1001 General.

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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.

***

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

TABLE 10-B DEFAULT R-VALUES FOR BUILDING MATERIALS

Material Nominal Actual R-Value Size Size (Heat (in.) (in.) Capacity)

Air cavity (unventilated), between metal - - 0.79 studs at 16 inches on center1

Air cavity (unventilated), all other - - 0.91 depths and framing materials1

Airfilm, exterior surfaces2 - - 0.17

Airfilm, interior horizontal surfaces, - - 0.61 heat flow up2

Airfilm, interior horizontal surfaces, - - 0.92 heat flow down2

Airfilm, interior vertical surfaces2 - - 0.68

Brick at R-0.12/in. 4 - 0.48

Carpet and rubber pad - - 1.23

Concrete at R-0.0625/in. - 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, 6 - 0.80 lightweight (95 lbs/ft3) (HC-11.4)

Concrete masonry units, solid grouted, 6 - 0.51 normal weight (135 lbs/ft3) (HC-13.2)

Concrete masonry units, partly grouted, 6 - 1.33 lightweight (95 lbs/ft3) (HC-6.7)

Concrete masonry units, partly grouted, 6 - 0.82 normal weight (135 lbs/ft3) (HC-9.0)

Concrete masonry units, solid grouted, 8 - 1.05 lightweight (95 lbs/ft3) (HC-15.5)

Concrete masonry units, solid grouted, 8 - 0.69 normal weight (135 lbs/ft3) (HC-17.9)

Concrete masonry units, partly grouted, 8 - 1.44 lightweight (95 lbs/ft3) (HC-9.6)

Concrete masonry units, partly grouted, 8 - 0.98 normal weight (135 lbs/ft3) (HC-12.0)

Concrete masonry units, solid grouted, 10 - 1.30 lightweight (95 lbs/ft3) (HC-19.7)

Concrete masonry units, solid grouted, 10 - 0.87 normal weight (135 lbs/ft3) (HC-22.6)

Concrete masonry units, partly grouted, 10 - 1.61 lightweight (95 lbs/ft3) (HC-11.9)

Concrete masonry units, partly grouted, 10 - 1.11 normal weight (135 lbs/ft3) (HC-14.8)

Concrete masonry units, solid grouted, 12 - 1.53 lightweight (95 lbs/ft3) (HC-23.9)

Concrete masonry units, solid grouted, 12 - 1.06 normal weight (135 lbs/ft3) (HC-27.2)

Concrete masonry units, partly grouted, 12 - 1.75 lightweight (95 lbs/ft3) (HC-14.2)

Concrete masonry units, partly grouted, 12 - 1.23 normal weight (135 lbs/ft3) (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

Steel, mild 1 0.0031807

Stucco - 0.75 0.08

Wood, 2 x 4 at R-1.25/in. 4 3.5 4.38

Wood, 2 x 6 at R-1.25/in. 6 5.5 6.88

Wood, 2 x 8 at R-1.25/in. 8 7.25 9.06

Wood, 2 x 10 at R-1.25/in. 10 9.25 11.56

Wood, 2 x 12 at R-1.25/in. 12 11.25 14.06

Wood, 2 x 14 at R-1.25/in. 14 13.25 16.56

1 There is no credit for cavities that are open to outside air.

2 Air films do not apply to air cavities within an assembly.

***

SECTION 1005 - ABOVE-GRADE WALLS

1005.1 General: Table 10-5, 10-5A and 10-5B list heat loss coefficients for the opaque portion of above-grade wood stud frame walls, metal stud frame walls and concrete masonry walls (Btu/h?ft2? degrees F) respectively. They are derived from procedures listed in Standard RS-1, listed in Chapter 7. For intermediate floor slabs which penetrate the insulated wall, use the concrete wall U-factors in Table 10-5B(5).

Insulation is assumed to uniformly fill the entire cavity and to be installed as per manufacturer's directions. All walls are assumed to be finished on the inside with 1/2 inch gypsum wallboard, and on the outside with either beveled wood siding over 1/2 inch plywood sheathing or with 5/8 inch T1-11 siding. Insulated sheathing (either interior or exterior) is assumed to cover the entire opaque wall surface.

Metal building walls have a different construction and are addressed in Table 10-5A(3).

***

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

Single-Stud Wall, Tables 10-5(1)-(8): Assumes either 2x4 or 2x6 studs framed on 16 or 24 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.

~~Metal Stud Wall: 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.~~

Strap Wall, Table 10-5(9): Assumes 2x6 studs framed on 16 or 24 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)-(11): Assumes an exterior structural wall and a separate interior, non-structural wall. Insulation is placed in both wall cavities and in the space between the two 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 layer in walls 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). 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 installed on the inside of the girts and uninterrupted by the 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.

Concrete Masonry, 8", Table 10-5B(1a). Group R occupancy.

Concrete Masonry, 12", Table 10-5B(1b). Group R occupancy.

Clay Brick, 8", Table 10-5B(1c). Group R occupancy.

Concrete, 6" Poured or Precast, Table 10-5B(1d). Group R occupancy.

Peripheral Edges of Intermediate Concrete Floors, Table 10-5B(1e). Group R occupancy and other than Group R occupancy.

Concrete and Masonry Walls, Table 10-5B(2). Other than Group R occupancy.

TABLE 10-5

DEFAULT U-FACTORS FOR ABOVE-GRADE WALLS

TABLE 10-5(1) 2 x 4 Single Wood Stud: R11 Batt

Siding Material/Framing Type

Lapped Wood T1-11

R-value NOTE: of Foam STD ADV STD ADV Board

Nominal Batt Rvalue: 0 0.088 0.084 0.094 0.090

R11 at 3.5 inch thickness 1 0.080 0.077 0.085 0.082

2 0.074 0.071 0.078 0.075

Installed Batt Rvalue: 3 0.069 0.066 0.072 0.070

R11 in 3.5 inch cavity 4 0.064 0.062 0.067 0.065

5 0.060 0.058 0.063 0.061

6 0.056 0.055 0.059 0.057

7 0.053 0.052 0.055 0.054

8 0.051 0.049 0.052 0.051

9 0.048 0.047 0.050 0.049

10 0.046 0.045 0.047 0.046

11 0.044 0.043 0.045 0.044

12 0.042 0.041 0.043 0.042

TABLE 10-5(2) 2 x 4 Single Wood Stud: R13 Batt

Siding Material/Framing Type

Lapped Wood T1-11

R-value NOTE: of Foam STD ADV STD ADV Board

Nominal Batt Rvalue: 0 0.082 0.078 0.088 0.083

R13 at 3.63 inch thickness 1 0.075 0.072 0.080 0.076

2 0.069 0.066 0.073 0.070

Installed Batt Rvalue: 3 0.065 0.062 0.068 0.065

R12.7 in 3.5 inch cavity 4 0.060 0.058 0.063 0.061

5 0.057 0.055 0.059 0.057

6 0.053 0.052 0.056 0.054

7 0.051 0.049 0.052 0.051

8 0.048 0.047 0.050 0.048

9 0.046 0.045 0.047 0.046

10 0.044 0.043 0.045 0.044

11 0.042 0.041 0.043 0.042

12 0.040 0.039 0.041 0.040

TABLE 10-5(3) 2 x 4 Single Wood Stud: R15 Batt

Siding Material/Framing Type

Lapped Wood T1-11

R-value of Foam NOTE: Board STD ADV STD ADV

Nominal Batt Rvalue: 0 0.076 0.071 0.081 0.075

R15 at 3.5 inch thickness 1 0.069 0.065 0.073 0.069

2 0.064 0.061 0.068 0.069

Installed Batt Rvalue: 3 0.060 0.057 0.063 0.059

R15 in 3.5 inch cavity 4 0.056 0.053 0.059 0.056

5 0.053 0.051 0.055 0.052

6 0.050 0.048 0.052 0.050

7 0.047 0.046 0.049 0.047

8 0.045 0.044 0.047 0.045

9 0.043 0.042 0.044 0.043

10 0.041 0.040 0.042 0.041

11 0.039 0.038 0.041 0.039

12 0.038 0.037 0.039 0.038

TABLE 10-5(4) 2 x 6 Single Wood Stud: R19 Batt

Siding Material/Framing Type

Lapped Wood T1-11

R-value of NOTE: Foam Board STD INT ADV STD INT ADV

Nominal Batt Rvalue: 0 0.062 0.058 0.055 0.065 0.061 0.058

R19 at 6 inch thickness 1 0.058 0.055 0.052 0.060 0.057 0.055

2 0.054 0.052 0.050 0.056 0.054 0.051

Installed Batt Rvalue: 3 0.051 0.049 0.047 0.053 0.051 0.049

R18 in 5.5 inch cavity 4 0.048 0.046 0.045 0.050 0.048 0.046

5 0.046 0.044 0.043 0.048 0.046 0.044

6 0.044 0.042 0.041 0.045 0.044 0.042

7 0.042 0.040 0.039 0.043 0.042 0.040

8 0.040 0.039 0.038 0.041 0.040 0.039

9 0.038 0.037 0.035 0.039 0.038 0.037

10 0.037 0.036 0.035 0.038 0.037 0.036

11 0.036 0.035 0.034 0.036 0.035 0.035

12 0.034 0.033 0.033 0.035 0.034 0.033

TABLE 10-5(5) 2 x 6 Single Wood Stud: R21 Batt

Siding Material/Framing Type

Lapped Wood T1-11

R-value NOTE: of Foam STD INT ADV STD INT ADV Board

Nominal Batt Rvalue: 0 0.057 0.054 0.051 0.060 0.056 0.053

R21 at 5.5 inch 1 0.054 0.051 0.048 0.056 0.053 0.050 thickness

2 0.050 0.048 0.045 0.052 0.050 0.047

Installed Batt Rvalue: 3 0.048 0.045 0.043 0.049 0.047 0.045

R21 in 5.5 inch cavity 4 0.045 0.043 0.041 0.047 0.045 0.043

5 0.043 0.041 0.040 0.044 0.042 0.041

6 0.041 0.039 0.038 0.042 0.041 0.039

7 0.039 0.038 0.036 0.040 0.039 0.037

8 0.038 0.036 0.035 0.039 0.037 0.036

9 0.036 0.035 0.034 0.037 0.036 0.035

10 0.035 0.034 0.033 0.036 0.035 0.033

11 0.033 0.033 0.032 0.034 0.033 0.032

12 0.032 0.031 0.031 0.033 0.032 0.031

TABLE 10-5(6) 2 x 6 Single Wood Stud: R22 Batt

Siding Material/Framing Type

Lapped Wood T1-11

R-value NOTE: of Foam STD INT ADV STD INT ADV Board

Nominal Batt Rvalue: 0 0.059 0.055 0.052 0.062 0.058 0.054

R22 at 6.75 inch 1 0.055 0.052 0.049 0.057 0.054 0.051 thickness

2 0.052 0.049 0.047 0.054 0.051 0.048

Installed Batt Rvalue: 3 0.049 0.046 0.044 0.050 0.048 0.046

R20 in 5.5 inch cavity 4 0.046 0.044 0.042 0.048 0.046 0.044

5 0.044 0.042 0.041 0.045 0.043 0.042

6 0.042 0.040 0.039 0.043 0.042 0.040

7 0.040 0.039 0.037 0.041 0.040 0.038

8 0.038 0.037 0.036 0.039 0.038 0.037

9 0.037 0.036 0.035 0.038 0.037 0.035

10 0.035 0.034 0.033 0.036 0.035 0.034

11 0.034 0.033 0.032 0.035 0.034 0.033

12 0.033 0.032 0.031 0.034 0.033 0.032

TABLE 10-5(7) 2 x 6 Single Wood Stud: Two R11 Batts

Siding Material/Framing Type

Lapped Wood T1-11

R-value of NOTE: Foam Board STD INT ADV STD INT ADV

Nominal Batt Rvalue: 0 0.060 0.057 0.054 0.063 0.059 0.056

R22 at 7 inch thickness 1 0.056 0.053 0.051 0.059 0.056 0.053

2 0.053 0.050 0.048 0.055 0.052 0.050

Installed Batt Rvalue: 3 0.050 0.048 0.046 0.052 0.049 0.047

R18.9 in 5.5 inch cavity 4 0.047 0.045 0.044 0.049 0.047 0.045

5 0.045 0.043 0.042 0.046 0.045 0.043

6 0.043 0.041 0.040 0.044 0.043 0.041

7 0.041 0.040 0.038 0.042 0.041 0.039

8 0.039 0.038 0.037 0.040 0.039 0.038

9 0.038 0.037 0.036 0.039 0.038 0.036

10 0.036 0.035 0.034 0.037 0.036 0.035

11 0.035 0.034 0.033 0.036 0.035 0.034

12 0.034 0.033 0.032 0.034 0.034 0.033

TABLE 10-5(8) 2 x 8 Single Stud: R25 Batt

Siding Material/Framing Type

Lapped Wood T1-11

R-value of NOTE: Foam Board STD INT ADV STD INT ADV

Nominal Batt Rvalue: 0 0.051 0.047 0.045 0.053 0.049 0.046

R25 at 8 inch thickness 1 0.048 0.045 0.043 0.049 0.046 0.044

2 0.045 0.043 0.041 0.047 0.044 0.042

Installed Batt Rvalue: 3 0.043 0.041 0.039 0.044 0.042 0.040

R23.6 in 7.25 inch cavity 4 0.041 0.039 0.037 0.042 0.040 0.038

5 0.039 0.037 0.036 0.040 0.038 0.037

6 0.037 0.036 0.035 0.038 0.037 0.036

7 0.036 0.035 0.033 0.037 0.035 0.034

8 0.035 0.033 0.032 0.035 0.034 0.033

9 0.033 0.032 0.031 0.034 0.033 0.032

10 0.032 0.031 0.030 0.033 0.032 0.031

11 0.031 0.030 0.029 0.032 0.031 0.030

12 0.030 0.029 0.028 0.031 0.030 0.029

TABLE 10-5(9)2 x 6: Strap Wall

Siding Material/Frame Type

Lapped Wood T111

STD ADV STD ADV

R19 + R11 Batts 0.036 0.035 0.038 0.036

R19 + R8 Batts 0.041 0.039 0.042 0.040

TABLE 10-5(10)2 x 6 + 2 x 4: Double Wood Stud

Siding Material/Frame Type

Batt Configuration Lapped Wood T111

Exterior Middle Interior STD ADV STD ADV

R19 R11 0.040 0.037 0.041 0.038

R19 R19 0.034 0.031 0.035 0.032

R19 R8 R11 0.029 0.028 0.031 0.029

R19 R11 R11 0.027 0.026 0.028 0.027

R19 R11 R19 0.024 0.023 0.025 0.023

R19 R19 R19 0.021 0.020 0.021 0.020

TABLE 10-5(11)2 x 4 + 2 x 4: Double Wood Stud

Siding Material/Frame Type

Batt Configuration Lapped Wood T111

Exterior Middle Interior STD ADV STD ADV

R11 R11 0.050 0.046 0.052 0.048

R19 R11 0.039 0.037 0.043 0.039

R11 R8 R11 0.037 0.035 0.036 0.036

R11 R11 R11 0.032 0.031 0.033 0.032

R13 R13 R13 0.029 0.028 0.029 0.028

R11 R19 R11 0.026 0.026 0.027 0.026

TABLE 10-5(12) Log Walls

Average Log Diameter, U-factor Inches

NOTE:

Rvalue of wood: 6 0.148

R1.25 per inch thickness 8 0.111

10 0.089

Average wall thickness 12 0.074

90% average log diameter 14 0.063

16 0.056

TABLE 10-5(13) Stress Skin Panel

Panel Thickness, U-factor Inches

NOTE:

Rvalue of expanded 3 1/2 0.071

polystyrene: R-3.85 per inch 5 1/2 0.048

7 1/4 0.037

Framing: 6% 9 1/4 0.030

Spline: 8% 11 1/4 0.025

No thermal bridging between interior and exterior splines

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 25 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

R-Value of Cavity Insulation Metal Continuous Framing Foam Board Insulation

R-0 R-11 R-13 R-15 R-19 R-21

16" o.c. R-0 (none) U-0.352 U-0.132 U-0.124 U-0.118 U-0.109 U-0.106

R-1 U-0.260 U-0.117 U-0.111 U-0.106 U-0.099 U-0.096

R-2 U-0.207 U-0.105 U-0.100 U-0.096 U-0.090 U-0.087

R-3 U-0.171 U-0.095 U-0.091 U-0.087 U-0.082 U-0.080

R-4 U-0.146 U-0.087 U-0.083 U-0.080 U-0.076 U-0.074

R-5 U-0.128 U-0.080 U-0.077 U-0.074 U-0.071 U-0.069

R-6 U-0.113 U-0.074 U-0.071 U-0.069 U-0.066 U-0.065

R-7 U-0.102 U-0.069 U-0.066 U-0.065 U-0.062 U-0.061

R-8 U-0.092 U-0.064 U-0.062 U-0.061 U-0.058 U-0.057

R-9 U-0.084 U-0.060 U-0.059 U-0.057 U-0.055 U-0.054

R-10 U-0.078 U-0.057 U-0.055 U-0.054 U-0.052 U-0.051

24" o.c. R-0 (none) U-0.338 U-0.116 U-0.108 U-0.102 U-0.094 U-0.090

R-1 U-0.253 U-0.104 U-0.098 U-0.092 U-0.086 U-0.083

R-2 U-0.202 U-0.094 U-0.089 U-0.084 U-0.079 U-0.077

R-3 U-0.168 U-0.086 U-0.082 U-0.078 U-0.073 U-0.071

R-4 U-0.144 U-0.079 U-0.075 U-0.072 U-0.068 U-0.066

R-5 U-0.126 U-0.073 U-0.070 U-0.067 U-0.064 U-0.062

R-6 U-0.112 U-0.068 U-0.066 U-0.063 U-0.060 U-0.059

R-7 U-0.100 U-0.064 U-0.062 U-0.059 U-0.057 U-0.055

R-8 U-0.091 U-0.060 U-0.058 U-0.056 U-0.054 U-0.052

R-9 U-0.084 U-0.057 U-0.055 U-0.053 U-0.051 U-0.050

R-10 U-0.077 U-0.054 U-0.052 U-0.050 U-0.048 U-0.048

TABLE 10-5A(2) EFFECTIVE R-VALUES FOR METAL FRAMING AND CAVITY ONLY

Cavity Insulation

Nominal Actual Nominal Effective R-Value Depth, Depth, R-Value

Inches Inches

16" O.C. 24" O.C.

Air Cavity Any Any R-0.91 0.79 0.91 (air)

4 3-1/2 R-11 5.5 6.6

Wall

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

Insulation R-11 5.5 6.1 Roof is uncompressed

R-19 7.0 9.1

R-30 9.3 11.4

TABLE 10-5A(3)

Default Metal Building Wall U-Factors

Insulation Nominal Total Overall Overall U-Factor for Assembly of Base Wall Plus System R-Value of Nominal U-Factor Continuous Insulation (uninterrupted by framing) Insulation R-Value of for Entire Nominal R-Value of Continuous Insulation Insulation Base Wall Assembly

R-5.6 R-11.2 R-16.8 R-22.4 R-28.0 R-33.6

Single Layer of Mineral Fiber 0.161 0.086 0.059 0.045 0.036 0.030 None 0 1.180

R-6 6 0.184 0.091 0.060 0.045 0.036 0.030 0.026

R-10 10 0.134 0.077 0.054 0.051 0.033 0.028 0.024

R-11 11 0.123 0.073 0.052 0.040 0.033 0.028 0.024

R-13 13 0.113 0.069 0.050 0.039 0.032 0.027 0.024

Double Layer of Mineral Fiber (Second layer inside of girts) (Multiple layers are listed in order from inside to outside) R-6 + R-13 19 0.070 N/A N/A N/A N/A N/A N/A N/A R-10 + R-13 23 0.061 N/A N/A N/A N/A N/A N/A N/A R-13 + R-13 26 0.057 N/A N/A N/A N/A N/A R-19 + R-13 32 0.048 N/A N/A N/A N/A N/A

~~((R-10 R-11 R-13 R-19 R-24 R-30~~

~~Faced fiber glass blanket insulation rolled over and 0.133 0.127 0.114 0.091 na Na perpendicular to structural frame. Metal covering sheets fastened to the frame, holding insulation in place.~~

~~Faced fiber glass batt insulation suspended between structural frame. 0.131 0.123 0.107 0.079 0.065 0.057 Metal covering sheets fastened directly to frame.~~

~~Faced fiber glass blanket insulation rolled over and 0.102 0.096 0.084 0.065 na Na perpendicular to structural frame. Rigid insulation blocks placed over insulation to align with structural frame.~~

~~Faced fiber glass batt insulation suspended between structural frame. 0.099 0.093 0.080 0.059 0.048 0.041)) Rigid insulation blocks placed over insulation to align with structural frame.~~

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 25 of Standard RS-1.

TABLE 10-5B(1)

GROUP R OCCUPANCY: DEFAULT U-FACTORS FOR CONCRETE AND MASONRY WALLS

TABLE 10-5B(1a): Group R Occupancy

8" Concrete Masonry

0

TABLE 10-5B(1b): Group R Occupancy

12" Concrete Masonry

WALL DESCRIPTION CORE TREATMENT

Partial Grout with Ungrouted Cores

Empty Loose-fill insulated Solid Grout Perlite Vermiculite

Exposed Block, Both Sides 0.40 0.23 0.24 0.43

R-5 Interior Insulation, Wood 0.14 0.11 0.12 0.15 Furring

R-6 Interior Insulation, Wood 0.14 0.11 0.11 0.14 Furring

R-10.5 Interior Insulation, Wood 0.11 0.09 0.09 0.11 Furring

R-8 Interior Insulation, Metal 0.11 0.09 0.09 0.11 Clips

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(1c): Group R Occupancy

8" Clay Brick

WALL DESCRIPTION CORE TREATMENT

Partial Grout with Ungrouted Cores Empty Loose-fill insulated Solid Grout Perlite Vermiculite

Exposed Block, Both Sides 0.50 0.31 0.32 0.56

R-5 Interior Insulation, Wood 0.15 0.13 0.13 0.16 Furring

R-6 Interior Insulation, Wood 0.15 0.12 0.12 0.15 Furring

R-10.5 Interior Insulation, Wood 0.12 0.10 0.10 0.12 Furring

R-8 Interior Insulation, Metal 0.11 0.10 0.10 0.11 Clips

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): Group R Occupancy

6" Concrete Poured or Precast

WALL DESCRIPTION CORE TREATMENT

Partial Grout with Ungrouted Cores Empty Loose-fill insulated Solid Grout Perlite Vermiculite

Exposed Concrete, Both Sides NA NA NA 0.61

R-5 Interior Insulation, Wood NA NA NA 0.16 Furring

R-6 Interior Insulation, Wood NA NA NA 0.15 Furring

R-10.5 Interior Insulation, Wood NA NA NA 0.12 Furring

R-8 Interior Insulation, Metal NA NA NA 0.12 Clips

R-6 Exterior Insulation NA NA NA 0.13

R-10 Exterior Insulation NA NA NA 0.09

TABLE 10-5B(1e): Group R Occupancy and Other than Group R Occupancy

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 0.161 0.157 0.154 0.152 Insulation

R-6 Exterior 0.138 0.136 0.134 0.132 Insulation

R-7 Exterior 0.122 0.120 0.118 0.116 Insulation

R-8 Exterior 0.108 0.107 0.106 0.104 Insulation

R-9 Exterior 0.098 0.097 0.095 0.094 Insulation

R-10 Exterior 0.089 0.088 0.087 0.086 Insulation

R-11 Exterior 0.082 0.081 0.080 0.079 Insulation

R-12 Exterior 0.076 0.075 0.074 0.074

Insulation

R-13 Exterior 0.070 0.070 0.069 0.068 Insulation

R-14 Exterior 0.066 0.065 0.065 0.064 Insulation

R-15 Exterior 0.062 0.061 0.061 0.060 Insulation

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)

OTHER THAN GROUP R OCCUPANCY:

DEFAULT U-FACTORS FOR CONCRETE AND MASONRY WALLS

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

No Framing R- 0 U- 0.740 U- 0.580 U- 0.480

Ungrouted Cores Filled with Loose-Fill N.A. N.A. U- 0.350 Insulation

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

0.75 in. R- 3.0 U- 0.364 U- 0.321 U- 0.288

1.5 in. R- 6.0 U- 0.274 U- 0.249 U- 0.229

2.0 in. R- 10.0 U- 0.225 U- 0.207 U- 0.193

3.5-4. in. R- 11.0 U- 0.168 U- 0.158 U- 0.149 0

3.5-4. in. R- 13.0 U- 0.161 U- 0.152 U- 0.144 0

3.5-4. in. R- 15.0 U- 0.155 U- 0.147 U- 0.140 0

5.5-6. in. R- 19.0 U- 0.118 U- 0.113 U- 0.109 0

5.5-6. in. R- 21.0 U- 0.113 U- 0.109 U- 0.105 0

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

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

Continuous Insulation Uninterrupted by Framing

No Framing 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 ..TX 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

R- 20.0 U- 0.047 U- 0.046 U- 0.045

Notes for Default Table 10-5B(2)

1. It is acceptable to use the U-factors in Table 10-5B(2) 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(2), 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/ft3.

(b) Solid grouted concrete block wall: 8-in. medium weight ASTM C90 concrete block with a density of 115 lb/ft3 and

solid grouted cores.

(c) Partially grouted concrete block wall: 8-in. medium weight ASTM C90 concrete block with a density of 115 lb/ft3 having reinforcing steel every 32 in. vertically and every 48 in. horizontally, with cores grouted in 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(2) 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(2), mass wall U-factors shall be determined in accordance with ASHRAE/IESNA Standard 90.1-2004, 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 ASHRAE/IESNA Standard 90.1-2004, Appendix A, Table A3.1B or A3.1C.

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SECTION 1007 -- CEILINGS

1007.1 General: Table 10-7 lists heat loss coefficients for the opaque portion of exterior ceilings below vented attics, vaulted ceilings and roof decks in units of Btu/h?ft2? degrees F of ceiling.

They are derived from procedures listed in Standard RS-1, listed in Chapter 7. Ceiling U-factors are modified for the buffering effect of the attic, assuming an indoor temperature of 65 degrees F and an outdoor temperature of 45 degrees F.

Metal Framed Ceilings: The nominal R-values in Table 10-5A(2):~~Effective R-Values for Metal Framing and Cavity Only may be used for

purposes of calculating metal framed ceiling section U-factors in lieu of the ASHRAE zone calculation method as provided in Chapter 25 of Standard RS-1.

Metal building roofs have a different construction and are addressed in Table 10-7(F).

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

Ceilings Below a Vented Attic: Attic insulation is assumed to be blown-in, loose-fill fiberglass with a K-value of 2.6 h?ft2? degrees F/Btu per inch. Full bag count for specified R-value is assumed in all cases. Ceiling dimensions for flat ceiling calculations are 45 by 30 feet, with a gabled roof having a 4/12 pitch. The attic is assumed to vent naturally at the rate of 3 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 Roof Pitch Standard Framing

R-30 R-38

4/12 0.036 0.031

5/12 0.035 0.030

6/12 0.034 0.029

7/12 0.034 0.029

8/12 0.034 0.028

9/12 0.034 0.028

10/12 0.033 0.028

11/12 0.033 0.027

12/12 0.033 0.027

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.

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 Uo for metal framed truss assemblies from approved laboratories shall be used, when such data is acceptable to the building official.

Alternatively, the Uo 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 draped over the steel structure (purlins) and then compressed when the metal roof panels are attached to the steel structure (purlins). Additional

assemblies include continuous insulation, uncompressed and uninterrupted by framing.

The first nominal R-value is for insulation draped over purlins and then compressed when the metal roof panels are attached, or for insulation hung between the purlins. A minimum 1 in. R-5 thermal spacer block between the purlins and the metal roof panels is required when specified in Table 10-7F.

For double-layer installations, the second nominal R-value is for insulation installed parallel to the purlins.

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.

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 10-7

DEFAULT U-FACTORS FOR CEILINGS

Standard Frame Advanced Frame

Ceilings Below Vented Attics

Flat Baffled

R19 0.049 0.047

R30 0.036 0.032

R38 0.031 0.026

R49 0.027 0.020

R60 0.025 0.017

Scissors Truss

R30 (4/12 roof pitch) 0.043 0.031

R38 (4/12 roof pitch) 0.040 0.025

R49 (4/12 roof pitch) 0.038 0.020

R30 (5/12 roof pitch) 0.039 0.032

R38 (5/12 roof pitch) 0.035 0.026

R49 (5/12 roof pitch) 0.032 0.020

Vaulted Ceilings 16" O.C. 24" O.C.

Vented

R19 2x10 joist 0.049 0.048

R30 2x12 joist 0.034 0.033

R38 2x14 joist 0.027 0.027

Unvented

R30 2x10 joist 0.034 0.033

R38 2x12 joist 0.029 0.027

R21 + R21 2x12 joist 0.026 0.025

Roof Deck 4x Beams, 48" O.C.

R12.5 2" Rigid insulation 0.064

R21.9 3.5" Rigid insulation 0.040

R37.5 6" Rigid insulation 0.025

R50 8" Rigid insulation 0.019

TABLE 10-7A

Steel Truss1 Framed Ceiling Uo

Cavity Truss Span (ft)

R-value 12 14 16 18 20 22 24 26 28 30 32 34 36

19 0.1075 0.0991 0.0928 0.0878 0.0839 0.0807 0.0780 0.0757 0.0737 0.0720 0.0706 0.0693 0.0681

30 0.0907 0.0823 0.0760 0.0710 0.0671 0.0638 0.0612 0.0589 0.0569 0.0552 0.0538 0.0525 0.0513

38 0.0844 0.0759 0.0696 0.0647 0.0607 0.0575 0.0548 0.0525 0.0506 0.0489 0.0474 0.0461 0.0449

49 0.0789 0.0704 0.0641 0.0592 0.0552 0.0520 0.0493 0.0470 0.0451 0.0434 0.0419 0.0406 0.0395

TABLE 10-7B

Steel Truss1 Framed Ceiling Uo with R-3 Sheathing

Cavity Truss Span (ft)

R-value 12 14 16 18 20 22 24 26 28 30 32 34 36

19 0.0809 0.0763 0.0728 0.0701 0.0679 0.0661 0.0647 0.0634 0.0623 0.0614 0.0606 0.0599 0.0592

30 0.0641 0.0595 0.0560 0.0533 0.0511 0.0493 0.0478 0.0466 0.0455 0.0446 0.0438 0.0431 0.0424

38 0.0577 0.0531 0.0496 0.0469 0.0447 0.0430 0.0415 0.0402 0.0392 0.0382 0.0374 0.0367 0.0361

49 0.0523 0.0476 0.0441 0.0414 0.0393 0.0375 0.0360 0.0348 0.0337 0.0328 0.0319 0.0312 0.0306

TABLE 10-7C

Steel Truss1 Framed Ceiling Uo with R-5 Sheathing

Cavity Truss Span (ft)

R-value 12 14 16 18 20 22 24 26 28 30 32 34 36

19 0.0732 0.0697 0.0670 0.0649 0.0633 0.0619 0.0608 0.0598 0.0590 0.0583 0.0577 0.0571 0.0567

30 0.0564 0.0529 0.0502 0.0481 0.0465 0.0451 0.0440 0.0430 0.0422 0.0415 0.0409 0.0403 0.0399

38 0.0501 0.0465 0.0438 0.0418 0.0401 0.0388 0.0376 0.0367 0.0359 0.0351 0.0345 0.0340 0.0335

49 0.0446 0.0410 0.0384 0.0363 0.0346 0.0333 0.0322 0.0312 0.0304 0.0297 0.0291 0.0285 0.0280

TABLE 10-7D

Steel Truss1 Framed Ceiling Uo with R-10 Sheathing

Cavity Truss Span (ft)

R-value 12 14 16 18 20 22 24 26 28 30 32 34 36

19 0.0626 0.0606 0.0590 0.0578 0.0569 0.0561 0.0555 0.0549 0.0545 0.0541 0.0537 0.0534 0.0531

30 0.0458 0.0437 0.0422 0.0410 0.0401 0.0393 0.0387 0.0381 0.0377 0.0373 0.0369 0.0366 0.0363

38 0.0394 0.0374 0.0359 0.0347 0.0337 0.0330 0.0323 0.0318 0.0313 0.0309 0.0305 0.0302 0.0299

49 0.0339 0.0319 0.0304 0.0292 0.0283 0.0275 0.0268 0.0263 0.0258 0.0254 0.0251 0.0247 0.0245

TABLE 10-7E

Steel Truss1 Framed Ceiling Uo with R-15 Sheathing

Cavity Truss Span (ft)

R-value 12 14 16 18 20 22 24 26 28 30 32 34 36

19 0.0561 0.0550 0.0541 0.0535 0.0530 0.0526 0.0522 0.0519 0.0517 0.0515 0.0513 0.0511 0.0509

30 0.0393 0.0382 0.0373 0.0367 0.0362 0.0358 0.0354 0.0351 0.0349 0.0347 0.0345 0.0343 0.0341

38 0.0329 0.0318 0.0310 0.0303 0.0298 0.0294 0.0291 0.0288 0.0285 0.0283 0.0281 0.0279 0.0278

49 0.0274 0.0263 0.0255 0.0249 0.0244 0.0239 0.0236 0.0233 0.0230 0.0228 0.0226 0.0225 0.0223

1. Assembly values based on 24 inch on center truss spacing; 11 Truss member connections penetrating insulation (4 at the eaves, 7 in the interior space); 1/2 inch drywall ceiling; all truss members are 2x4 "C" channels with a solid web.

2. Ceiling sheathing installed between bottom chord and drywall.

TABLE 10-7F

Default Metal Building Roof U-Factors

Insulation Nominal Total Nominal Overall Overall U-Factor for Assembly of Base Roof Plus Continuous System R-Value of R-Value of U-Factor for Insulation (uninterrupted by framing) Insulation Insulation Entire Base Nominal R-Value of Continuous Insulation Roof Assembly

R-5.6 R-11.2 R-16.8 R-22.4 R-28.0 R-33.6

Standing Seam Roofs with Thermal Spacer Blocks

Single Layer None 0 1.280 0.162 0.087 0.059 0.045 0.036 0.030

R-6 6 0.167 0.086 0.058 0.044 0.035 0.029 0.025

R-10 10 0.097 0.063 0.046 0.037 0.031 0.026 0.023

R-11 11 0.092 0.061 0.045 0.036 0.030 0.026 0.022

R-13 13 0.083 0.057 0.043 0.035 0.029 0.025 0.022

R-16 16 0.072 0.051 0.040 0.033 0.028 0.024 0.021

R-19 19 0.065 0.048 0.038 0.031 0.026 0.023 0.020

Double Layer R-10 + R-10 20 0.063 0.047 0.037 0.031 0.026 0.023 0.020 R-10 + R-11 21 0.061 0.045 0.036 0.030 0.026 0.023 0.020 R-11 + R-11 22 0.060 0.045 0.036 0.030 0.026 0.022 0.020 R-10 + R-13 23 0.058 0.044 0.035 0.029 0.025 0.022 0.020 R-11 + R-13 24 0.057 0.043 0.035 0.029 0.025 0.022 0.020 R-13 + R-13 26 0.055 0.042 0.034 0.029 0.025 0.022 0.019 R-10 + R-19 29 0.052 0.040 0.033 0.028 0.024 0.021 0.019 R-11 + R-19 30 0.051 0.040 0.032 0.027 0.024 0.021 0.019

R-13 + R-19 32 0.049 0.038 0.032 0.027 0.023 0.021 0.019 R-16 + R-19 35 0.047 0.037 0.031 0.026 0.023 0.020 0.018 R-19 + R-19 38 0.046 0.037 0.030 0.026 0.023 0.020 0.018

Thru-Fastened Roofs Without Thermal Spacer Blocks R-10 10 0.153 N/A N/A N/A N/A N/A N/A R-11 11 0.139 N/A N/A N/A N/A N/A N/A R-13 13 0.130 N/A N/A N/A N/A N/A N/A R-16 16 0.109 N/A N/A N/A N/A N/A N/A R-19 19 0.098 N/A N/A N/A N/A N/A N/A

Filled Cavity with Thermal Spacer Blocks

R-19 + R-10 29 0.041 0.033 0.028 0.024 0.021 0.020 0.017

TABLE 10-7G Assembly U-Factors for Roofs with Insulation Entirely Above Deck

(uninterrupted by framing)

Rated R-Value of Rated R-Value of Overall Insulation Alone: Insulation Alone: U-Factor for Minimum Throughout, Average (R-5 minimum), Entire Unsloped Sloped (1/4 inch per Assembly foot maximum)

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

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-35 R-61 U-0.028

R-40 R-73 U-0.025

R-45 R-86 U-0.022

R-50 R-99 U-0.020

R-55 R-112 U-0.018

R-60 R-126 U-0.016

***

Section The following sections of Chapter 11 of the 2006 Washington State Energy Code are amended as follows:

***

TABLE 11-1:

ECONOMIZER COMPLIANCE OPTIONS FOR MECHANICAL ALTERATIONS

Option A Option B Option C Option D (alternate to A) (alternate to A) (alternate to A)

Unit Type Any alteration Replacement unit Replacement unit New equipment with new or of the same type of the same type added to replacement with the same or with a larger existing system equipment smaller output output capacity or replacement capacity unit of a different type

1. Packaged Efficiency: Efficiency: min.1 Efficiency: min.1 Efficiency:~~Units min.1 Economizer: Economizer: min.1 Economizer: 14332,3 14332,3 Economizer: 14332 14332,4

2. Split Efficiency: Efficiency: + Only for new Efficiency:~~Systems min.1 10/5%5 units min.1 Economizer: Economizer: shall < 54,000 Btuh Economizer: 14332 not decrease replacing unit 14332,4 existing installed prior economizer to 1991 (one of capability two): Efficiency: + 10/5%5 Economizer: 50%6

For units > 54,000 Btuh or any units installed after 1991: Option A

2a. ASHRAE Efficiency: Efficiency: none Efficiency: none Efficiency:~~Std 127 none1 1 1 none 1 equipment

Economizer: Economizer: 14332 Economizer: 14332 Economizer: 14332 14332

3. Water Efficiency: (two of three): (three of three): Efficiency:~~Source Heat min.1 Efficiency: + Efficiency: + min.1 Pump Economizer: 10/5%5 10/5%5 Economizer: 14332 Flow control Flow control 14332,4 valve7 valve7 (except for Economizer: 50%6 Economizer: 50%6 certain (except for pre-1991

certain pre-1991 systems8) systems8)

4. Hydronic Efficiency: Efficiency: + Option A Efficiency:~~Economizer min.1 10/5%5 min.1 using Economizer: Economizer: shall Economizer:~~Air-Cooled 14332 not decrease 14332,4 Heat existing Rejection economizer Equipment capacity (Dry Cooler)

4a. Hydronic Efficiency: Efficiency: none Efficiency: none Efficiency:~~Economizer none1 1 1 none 1 using ASHRAE Economizer: Economizer: 14332 Economizer: 14332 Economizer:~~Std 127 14332 14332 equipment

5. Efficiency: Economizer: 14332 Option A Option A Air-Handling min.1 if outside, (except for (except for Unit Economizer: otherwise shall certain pre-1991 certain (including 14332 not decrease systems8) pre-1991 fan coil existing systems8) units) economizer where the capacity system has an air-cooled chiller

6. Air- Efficiency: Economizer: 14332 Option A Efficiency:~~Handling min.1 if outside, (except for min.1 Unit Economizer: otherwise shall certain pre-1991 Economizer:~~(including 14332 not decrease systems8 and 14332,4 fan coil existing certain 1991-2004 (except for units) and economizer systems9.) certain Water-cooled capacity pre-1991 Process systems8 and Equipment, certain where the 1991-2004 system has a systems9) water-cooled chiller10

7. Cooling Efficiency: No requirements Option A Option A Tower min.1 Economizer: 14332

8. Efficiency: Efficiency: + Efficiency Efficiency:~~Air-Cooled min.1 5%11 (two of two): min.1 Chiller Economizer: Economizer: shall (1) + 10%12 and Economizer: 14332 not decrease (2) multistage 14332,4 existing Economizer: shall economizer not decrease capacity existing economizer capacity

9. Efficiency: Efficiency Efficiency Efficiency:~~Water-Cooled min.1 (one of two): (two of two): min.1 Chiller Economizer: (1) + 10%13or (1) + 15%14 and Economizer: 14332 (2) plate frame (2) plate-frame 14332,4 heat exchanger15 heat exchanger15 Economizer: shall Economizer: shall not decrease not decrease existing existing economizer economizer capacity capacity

10. Boiler Efficiency: Efficiency: + Efficiency: + Efficiency: min.1 8%16 8%16 min.1 Economizer: Economizer: shall Economizer: shall Economizer: 14332 not decrease not decrease 14332,4 existing existing economizer economizer capacity capacity

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

"ASHRAE Std. 127 equipment" means equipment that both

(a) is not subject to one of the rating standards in Tables 14-1A through M and

(b) is within the scope of ASHRAE Std. 127-2001.

Note that there is no minimum efficiency in Section 1411.1 for equipment not within the scope of the rating standards in Tables 14- 1A through M. However, there may be a minimum efficiency associated with compliance with other criteria (e.g. Section 1433, Exception 9, Option d).

2. System and building shall comply with Section 1433 (including both the individual unit size limits and the total building capacity limits on units without economizer). It is acceptable to comply using one of the exceptions to Section 1433.

3. All equipment replaced in 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, 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 Table 14-1C (1.05 x IPLV values 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 Table 14-1C (1.10 x IPLV values in Table 14- 1C), and

b. be multistage with a minimum of two compressors.

13. The water-cooled chiller shall have an IPLV or NPLV efficiency that is a minimum of 10% greater than the IPLV or

NPLV requirements in Table 14-1C, Table 14-1K, Table 14-1L, or Table 14-1M (1.10 x IPLV or NPLV values in Table 14-1C, Table 14-1K, Table 14-1L, or Table 14-1M).

14. The water-cooled chiller shall have IPLV or NPLV efficiency that is a minimum of 15% greater than the IPLV or NPLV requirements in Table 14-1C, Table 14-1K, Table 14-1L, or Table 14-1M (1.15 x IPLV or NPLV values in Table 14-1C, Table 14-1K, Table 14-1L, or Table 14-1M).

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 ARI 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.

***

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 percent or more of the fixtures in a space enclosed by walls or ceiling-height partitions are new 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 percent of the fixtures in s apace enclosed by walls or ceiling-height partitions are new, the installed lighting wattage shall be maintained or reduced. Where 60 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.

Where new wiring is being installed to serve added fixtures and/or fixtures are being relocated to a new circuit (except as noted in the following paragraph), controls shall comply with Sections 1513.1 through 1513.5 and, as applicable, 1513.7. For compliance with Section 1513.3.2 for existing luminaires where the existing ballasts are not being changed, the number of required incremental steps of automatic daylighting control shall be equal to one plus the number of ballasts in the luminaire. In addition, office areas less than 300 ft2 enclosed by walls or ceiling-height

partitions, and all meeting and conference rooms, and all school classrooms, shall be equipped with occupancy sensors that comply with Section 1513.6 and 1513.7. 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 and 1513.7.

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 1513.7.

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

1133 Change of Occupancy or Use: Changes of occupancy or use 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. For spaces constructed prior to this Code, the installed heating output capacity shall not exceed 16 Btu/h per square foot unless the building envelope complies with Chapter 13. 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 Group R Occupancy which is converted to other than a Group R Occupancy shall be required to comply with all of the provisions of Sections 1130 through 1132 of this Code.

***

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, 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 which does not comply with the applicable standards of this Code or which has not been approved by the building official.

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.

1144.2 Notice of Violation: If after investigation the building official determines that standards or requirements of this code have been violated, the building official may serve a notice of violation upon the owner or other person responsible for the action or condition. The notice of violation shall state the standards or requirements violated, shall state what corrective action, if any, is necessary to comply with the standards or requirements, and shall set a reasonable time for compliance. The notice shall be served upon the owner or other responsible person by regular first class mail addressed to the last known address of such person. In addition, a copy of the notice may be posted at a conspicuous place on the property. The notice may also be posted even if served by personal service or first class mail. The notice of violation shall be considered an order of the building official. Nothing in this subsection shall be deemed to limit or preclude any action or proceeding pursuant to Sections 102, 103 or 104 of the Seattle Building Code, 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.

1144.2.1 Review by the building official for notice of violation

1144.2.1.1 Any person affected by a notice of violation issued pursuant to Section 1144.2 may obtain a review of the notice by making a request in writing within ten days after service of the notice. When the last day of the period computed is a Saturday, Sunday, federal or City holiday, the period runs until 5:00 p.m. of the next business day. The review shall occur not less than ten nor more than twenty days after the request is received by the building official unless otherwise agreed by the person requesting the review. Any person aggrieved by or interested in the notice of violation may submit additional information to the building official.

1144.2.1.2 The review shall be made by a representative of the building official who will review any additional information that is submitted and the basis for issuance of the notice of violation. The reviewer may request clarification of the information received and a site visit. After the review, the building official shall:

1. Sustain the notice; or

2. Withdraw the notice; or

3. Continue the review to a date certain; or

4. Amend the notice.

1144.2.1.3 The building official shall issue an order containing the decision within 15 days of the date that the review is completed and shall cause the order to be mailed by regular first class mail to the persons requesting the review and the persons named on the notice of violation, addressed to their last known address.

1144.2.1.4 Because civil actions to enforce Title 22 SMC are brought in Seattle Municipal Court pursuant to Section 1144.3.2, orders of the building official issued under this chapter are not subject to judicial review pursuant to chapter 36.70C RCW.

1144.3 Civil Penalties:

1144.3.1 Any person violating or failing to comply with the

provisions of this code shall be subject to a cumulative civil penalty in an amount not to exceed $500 per day for each violation from the date the violation occurs or begins until compliance is achieved. In cases where the building official has issued a notice of violation, the violation will be deemed to begin, for purposes of determining the number of days of violation, on the date compliance is required by notice of violation.

1144.3.2 Civil actions to enforce this chapter shall be brought exclusively in Seattle Municipal Court, except as otherwise required by law or court rule. In any civil action for a penalty, the City has the burden of proving by a preponderance of the evidence that a violation exists or existed; the issuance of the notice of violation or of an order following a review by the building official is not itself evidence that a violation exists.

1144.4 Alternative Criminal Penalty: Anyone who violates or fails to comply with any order issued by the building official pursuant to this code or who removes, mutilates, destroys or conceals a notice issued or posted by the building official shall, upon conviction thereof, be punished by a fine of not more than $5000 or by imprisonment for not more than 365 days, or by both such fine and imprisonment. Each day's violation or failure to comply shall constitute a separate offense.

1144.5 Additional Relief: The building official may seek legal or equitable relief to enjoin any acts or practices and abate any condition when necessary to achieve compliance.

1144.6 Recording of Orders and Notices: The building official may record a copy of any order or notice with the Department of Records and Elections of King County. The building official may record with

the Department of Records and Elections of King County a notification that a permit has expired without a final inspection after reasonable efforts have been made to provide a final inspection.

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.

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.

1160 Severability and Liability

***

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 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 related in any manner to the enforcement of this Code or by its officers or agents. 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 the Department of Planning and Development 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.

Section The following sections of Chapter 13 of the 2006 Washington State Energy Code are amended as follows:

CHAPTER 13

BUILDING ENVELOPE

1301 Scope: Conditioned buildings or portions thereof shall be constructed to provide the required thermal performance of the various components according to the requirements of this chapter. Unless otherwise approved by the building official, all spaces shall be assumed to be at least semi-heated.

EXCEPTIONS:

1. Greenhouses isolated from any conditioned space and not intended for occupancy.

2. As approved by the building official, spaces not assumed to be at least semi-heated.

3. Unconditioned Group U occupancy accessory to Group R occupancy.

4. Unstaffed equipment shelters or cabinets used solely for personal wireless service facilities.

5. Parking lot attendant booths no larger than 100 square feet, provided that the roof insulation is R-21 minimum and the wall insulation is R-13 minimum, unless otherwise allowed by Section 1310.

***

1310.2 Semi-Heated Spaces: All spaces shall be considered conditioned spaces, and shall comply with the requirements in Section 1310.1 unless they meet the following criteria for semi-heated spaces. The installed heating equipment output, in Climate Zone 1, shall be 3 Btu/(h * ft2) or greater but not greater than 8 Btu/(h * ft2) and in Climate Zone 2, shall be 5 Btu/(h * ft2) or greater but not greater than 12 Btu/(h * ft2).

For semi-heated spaces, the building envelope shall comply with the same requirements as that for conditioned spaces in Section 1310.1. However, semi-heated spaces shall be calculated separately from other conditioned spaces for compliance purposes.

EXCEPTION: For semi-heated spaced heated by other fuels only, wall insulation is not required for those walls that separate semi- heated spaces (see definition in Section 201.1) from the exterior provided that the space is heated solely by a heating system controlled by a thermostat with a maximum setpoint capacity of 45 degrees F, mounted no lower than the heating unit.

***

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 that 36 inches.

~~If required by the building official where soil conditions warrant such insulation, the~~ The entire area of 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.

***

1312.2 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 31 of Standard RS-1 or from the manufacturer's ~~test~~ data using a spectral data file determined in accordance with NFRC 300.

2. For the purposes of 1323, Exception 1, visible transmittance for the center of the glazing assembly shall be taken from Chapter 31 of Standard RS-1 or from the manufacturer's data using a spectral data file determined in accordance with NFRC 300.

Note that 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 0.02-0.07 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.

***

1314 Air Leakage

1314.1 ~~Building Envelope: The requirements of this section shall apply to building elements separating conditioned from unconditioned spaces. Exterior joints around windows and door frames, openings between walls and foundation, between walls and roof and wall panels; openings at penetrations of utility services through walls, floors and roofs; and all other openings in the building envelope shall be~~

~~sealed, caulked, gasketed or weatherstripped to limit air leakage.~~

Building Envelope Sealing. The following areas of the building envelope shall be sealed, caulked, gasketed, or weather-stripped to minimize air leakage:

a. joints around fenestration and door frames,

b. junctions between walls and foundations, between walls at building corners, between walls and structural floors or roofs, and between walls and roof or wall panels,

c. openings at penetrations of utility services through roofs, walls,

and floors,

d. site-built fenestration and doors,

e. building assemblies used as ducts or plenums,

f. joints, seams, and penetrations of vapor retarders,

g. all other openings in the building envelope.

1314.2 Glazing and Doors: Air leakage for fenestration and doors shall be determined in accordance with NFRC 400 or AAMA/WDMA/CSA101/I.S.2/A440. 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 1.0 cfm/ft2 for glazed swinging entrance doors and for revolving doors and 0.3 cfm/ft2 for all other products. ~~Doors and operable glazing separating conditioned from unconditioned space shall be weatherstripped. Fixed windows shall be tight fitting with glass retained by stops with sealant or caulking all around.~~

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 1314.1.

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 weather-stripped or sealed in accordance with 1314.1.

***

1314.5 Loading Dock Weatherseals. Cargo doors and loading dock doors shall be equipped with weatherseals to restrict infiltration when vehicles are parked in the doorway.

1314.6 Vestibules. Building entrances that separate conditioned space from the exterior shall be protected with an enclosed vestibule, 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 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.

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 ft2 in area.

4. Doors that open directly from a space that is less than 3000 ft2 in area and is separate from the building entrance.

***

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

For 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 Table 13-1. 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 prescriptive compliance only:

~~a. For glazing areas that are 30% and less of the gross wall area, the~~ The insulation of the perimeter edge of an above grade floor slab which penetrates the exterior wall may be reduced to R-5 provided the glazing U-factor is reduced to U-0.05 below that required in Tables 13-1 and 13-2.

~~b. For glazing areas that exceed 30% of the gross wall area, the perimeter edge of an above grade floor slab which penetrates the exterior wall may be left uninsulated provided the glazing U-factor is reduced by U-0.10 below that required in Tables 13-1 and 13-2.~~

3. For roofs with continuous rigid 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-50 (in lieu of R-30).

1323 Glazing: 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 glazing assembly has an overall U- factor that complies with the values in Table 13-1.

EXCEPTIONS:

1. Vertical 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 provided the 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-0.40 in any type of frame or

(ii) has an area-weighted U-factor of 0.60 or less.

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

b. has a visible transmittance of (i) 0.60 or greater for the center of the glazing assembly in any type of frame or (ii) has

an area-weighted visible transmittance for the overall assembly including the frame of 0.52 or greater for fixed glazing and 0.44 or greater for operable glazing. Visible transmittance shall be determined in accordance with Section 1312.2, and,

~~b.~~ c. does not exceed 75% of the gross exterior wall area of the display side of the street level story. However, if the display side of the street level story exceeds 20 feet in height, then this exemption 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. Single glazing for ornamental, security, or architectural purposes shall be included in the percentage of total glazing 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 single glazing is 1% of the gross exterior wall area.

***

1323.3 Solar Heat Gain Coefficient: The area-weighted average solar heat gain coefficient of all glazing shall not be greater than that specified in Tables 13-1 or 13-2 for the appropriate area and U- factor.

EXCEPTIONS:

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

2. Vertical 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 Table 13-1.

3. For demonstrating compliance for vertical glazing only, the SHGC in the proposed building shall be allowed to be reduced by using the multipliers in the table below for each glazing product shaded by permanent projections that will last as long as the building itself.

Projection SHGC Multiplier SHGC Factor (All Orientations Multiplier except (North-Oriented 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

≤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 Exhibit 1323.3.)

Exhibit 1323.3

***

1331 General: Buildings or structures whose design heat loss rate (UAp) and solar heat gain coefficient rate (SHGC * Ap) are less than or equal to the target heat loss rate (UAt) and solar heat gain coefficient rate (SHGC * At) 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, 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.

EXCEPTIONS:

1. Compliance is also allowed to be shown using RS-32.

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.

***

1333 UA Calculations: The target UAt and the proposed UAp 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 UAt calculation, the overhead glazing shall be located in roof/ceiling area and the remainder of the glazing 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.

***

TABLE 13-1

BUILDING ENVELOPE REQUIREMENTS FOR CLIMATE ZONE 1

Minimum Insulation R-Values or Maximum Component U-Factors for Zone 1

Building Components

Space Heat Type Components

Roofs Over Attic3 All Other Roofs3 Opaque Walls1,2 Opaque Doors Floor Over Slab-On-Grade5 Uncond Space

1. Electric U=0.031 or R-38 U=0.034 or R-30 U=0.062 or R-19 U=0.60 for metal U=0.029 or R-30 F=0.54 or R-10 resistance heat** door; and wood-frame U=0.50 for wood, portions of all fiberglass, other others door

2. All others U=0.031or U=0.034 or U=0.062 or U=0.60 for metal U=0.029 or F=0.54 or R-10 including (a) Metal framing: (a) Insulation (a) Metal framing: door; (a) Concrete heat pumps and VAV R-38 cavity insul. entirely above R-13 cavity insul. U=0.50 for wood, floor: + R-15 continuous deck: + R-7.5 continuous fiberglass, other R-30 continuous insulation R-30 continuous insulation, and door insulation ~~((R-30 or U=0.036))~~ insulation R-15 continuous (b) Metal joist: (b) Metal insulation for buildings: peripheral edges of R-19 cavity R-19 cavity intermediate insul. + R-15 insul. + R-15 concrete floors continuous continuous ~~(((a) Metal framing:~~ insulation insulation ~~((R-19 or ((R-21 or R-19 or U=0.109 U=0.056)) U=0.046)) (b) Wood framing & framing other than metal: R-19 or =0.062))~~

** Compliance with nominal prescriptive R-values requires wood framing

Maximum Glazing Areas and U-Factors and

Maximum Glazing Solar Heat Gain Coefficients for Zone 1

GLAZING

Maximum Glazing 0% to 30% >30% to 45% Area as % of Wall

Maximum UFactor Max SHGC4,8,9 Maximum UFactor Max SHGC4,8,9

VG OG VG OG

1. Electric 0.40 0.48 0.35 without PF, or Prescriptive Path Not Allowed resistance heat7 ~~((0.60))~~ 0.40 with PF > 0.3 for south and west

2. All others 0.40 0.48 0.35 without PF, or 0.40 0. 48 0.35 without including heat ~~((0.55))~~ ~~((0.70))~~ 0.40 with PF > 0.3 ~~((0.45))~~ ~~((0.60))~~ PF, or pumps and VAV6,7 for south and west 0.40 with PF ~~((0.45))~~ > 0.3 for south and west

Footnotes

1. Below Grade Walls:

When complying by the prescriptive approach, Section 1322:

a) walls insulated on the interior shall use opaque wall values,

b) walls insulated on the exterior shall use a minimum of R-10 insulation,

c) walls shall be insulated for the first 10 feet below grade.

(There shall be no credit for those portions of below grade walls and footings that are more than 10 feet below grade, and those portions below 10 feet shall not be included in the gross exterior wall area.)

When complying by the component performance approach, Section 1331:

a) walls insulated on the interior shall use the opaque wall values when determining Ubgwt ,

b) walls insulated on the exterior shall use a target U-factor of U=0.070 for Ubgwt ,

c) the calculations shall include the first 10 feet of walls below grade. (Those portions of below grade walls and footings that are more than 10 feet below grade shall not be included in the gross exterior wall area and shall not be included when determining Abgwt and Abgw.

2. Concrete and Masonry Walls: If the area weighted heat capacity of the total opaque above grade wall is a minimum of 9.0 Btu/ft2 * degrees F, then:

a) The area weighted average U-factor for interior insulation may be increased to ~~U-0.15~~ U-0.071 maximum, or

i) minimum R-19 insulation between wood studs; or

ii) minimum R-13 cavity insulation between metal studs + R-6 continuous insulation; or

iii) minimum R-15.2 insulation held in place solely by 1 inch metal clips at 24 inches on center vertically and 16 inches on center horizontally~~a minimum additional R-5.7 continuous insulation~~

~~uninterrupted by framing; or~~.

b) The area weighted average U-factor for integral and exterior insulation for insulation position as defined in Chapter 2 may be increased to U-0.073 maximum or a minimum additional R-12 continuous insulation uninterrupted by framing.

~~The wall may be ASTM C90 concrete block walls, ungrouted or partially grouted at 32 in. or less on center vertically and 48 in.~~

~~or less on center horizontally, with ungrouted cores filled with material having a maximum thermal conductivity of 0.44 Btu-in/h*ft2* degrees F.~~

-- Individual walls with heat capacities less than 9.0 Btu/ft2 * degrees F and below grade walls shall meet opaque wall requirements listed above.

-- Glazing shall comply with the glazing requirements listed above.

3. Roof Types: A roof over attic is where the roof structure has at least 30 inches clear distance from the top of the bottom chord of a truss or ceiling joist to the underside of the sheathing at the roof ridge, and the ceiling is attached to the ceiling joist or the bottom of the truss or ceiling joist. Anything else is considered all other roofs.

4. SHGC (Solar Heat Gain Coefficient per Section 1312.2): May substitute Maximum Shading Coefficient (SC) for SHGC (See Chapter 2 for definition of Shading Coefficient).

5. Radiant Floors: Where insulation is required under the entire slab, radiant floors shall use a minimum of R-10 insulation or F=0.55 maximum. Where insulation is not required under the entire slab, radiant floors shall use R-10 perimeter insulation according to Section 1311.6 or F=0.78 maximum.

6. Prescriptive Alternate (not applicable to Target UA or annual energy analysis): For the prescriptive building envelope option only, for other than electric resistance heat only, glazing may comply with the following:

Maximum Glazing Area as % of Maximum U-Factor Max. Wall:

VG OG SHGC4

>45% to 50% 0.35 0.42 0.30

7. Prescriptive Alternate (not applicable to Target UA or annual energy analysis): For glazed wall systems, assemblies with all of the following features are deemed to satisfy the vertical glazing U-factor requirement of U-0.40 and the overhead glazing U- factor or U-0.48:

a. Double glazing with a minimum 1/2 inch gap width, having a low- emissivity coating with e=0.10 maximum, with 90% minimum argon gas fill, and a non-aluminum spacer (as defined in footnote 1 to Table 10-6B), and

b. Frame that is thermal break aluminum (as defined in footnote 7 to Table 10-6A), fiberglass, wood, aluminum clad wood, vinyl, aluminum clad vinyl, or reinforced vinyl.

8. 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.

9. Projection Factor (PF). See definition of projection factor in 1323.3 Exception 3 and Exhibit 1323.3. South-oriented glazing is vertical glazing oriented within 45 degrees of due south. West- oriented glazing is vertical glazing oriented within 45 degrees of due west. If area-weighted average projection factor for south- oriented and west-oriented vertical glazing is greater than 0.3, then the area-weighted average SHGC for all vertical glazing shall not exceed 0.40.

Section The following sections of Chapter 14 of the 2006 Washington State Energy Code are amended as follows:

***

1402 Mechanical Ventilation: The minimum requirements for ventilation shall comply with the ~~Washington State Ventilation and Indoor Air Quality Code (WAC51-13)~~ Seattle Mechanical Code.

***

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. 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.

If equipment is subject to an ARI Standard, it shall be listed in the ARI certification program.

EXCEPTION: Water-cooled centrifugal water-chilling packages that are not designed for operation at ARI Standard 550/590 test conditions of 44?F leaving chilled water temperature and 85?F entering condenser water temperature with 3 gpm/ton condenser water flow shall have a minimum NPLV rating as shown in Tables 14-1K, L, and M. The table values are only specified for the following full load design ranges:

Leaving Chiller Water Temp.: 40 to 48 degrees F

Entering Condenser Water Temp.: 75 to 85 degrees F

Condensing Water Temp. Rise: 5 to 15 degrees F

Glycol percent 0%

Chillers designed to operate outside of these ranges shall have a code compliant selection at the nearest table operating point based on an all-water system. Non-standard Part Load Value (NPLV) is defined as single number part-load efficiency figure of merit for chillers references to conditions other than IPLV conditions. Design condenser water flow rate shall not be less than 2.5 gpm/ton.

Equipment not listed in Tables 14-1A to 14-1G is allowed to be used.

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.

Electric furnaces over 15kW shall have a minimum of two stages of control for heating.

Cooling towers serving chilled water systems with airside economizer complying with Section 1433 without using the exceptions shall be selected to be able to maintain a return condenser water temperature to the tower of 86 degrees F or less at peak design conditions.

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: medical and dental equipment; equipment using less than 1 gpm; replacement of existing icemakers; or use of single pass cooling during power outages and other emergencies.

1411.2 Rating Conditions: Cooling equipment shall be rated at ARI test conditions and procedures when available. Where no applicable procedures exist, data shall be furnished by the equipment manufacturer.

If equipment is rated in accordance with an ARI Standard,

it shall be rated at Standard (not "design") ARI Rating Conditions.

***

1411.4 Packaged and Split System Electric Heating and Cooling Equipment: Packaged and split system electric equipment providing both heating and cooling with a total cooling capacity greater than 20,000 Btu/h shall be a heat pump.

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

1411.5 Heating Systems in Unenclosed Spaces. Where heating is provided to unenclosed spaces, only radiant heating systems shall be used unless otherwise approved by the building official. The heating system shall be controlled by an occupancy sensor. An unenclosed space is one that is not substantially surrounded by solid surfaces such as walls, floors, roofs, and openable devices such as doors and operable windows. Warehouses and repair garages are considered enclosed spaces.

***

1412.4 Setback and Shut-Off: 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 non- use 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 settings 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.

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.

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. 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) dampers are acceptable in systems with a design outdoor air intake or exhaust capacity of 300 cfm or less.~~buildings less than three stories in height.~~

4. ~~Gravity (nonmotorized) dampers are acceptable in exhaust and relief outlets in the first story and levels below the first story of buildings three or more stories in height.~~ Reserved.

5. Type 1 Grease hoods exhaust.

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

a. Motorized Dampers: 10 cfm/ft2 of damper area at 1.0 inch w.g.

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

Dampers used as a component of packaged HVAC equipment shall comply with the damper leakage requirements, unless it is the lowest leakage available as a factory option. Drawings shall indicate compliance with this section.

1412.4.2 Optimum Start Controls: Heating and cooling systems with design supply air capacities exceeding 10,000 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.

***

1412.6 Combustion Heating Equipment Controls: Combustion heating equipment with a capacity over 225,000 Btu/h shall have ~~modulating~~ modulated or staged combustion control. Boilers shall have proportionately-modulated or staged combustion control to control both the fuel and the air.

EXCEPTIONS:

1. Boilers under 1,000,000 Btu/h input capacity.

2. Radiant Heaters.

3. Systems with multiple boilers which are sequentially- staged.

Boilers shall comply with the reset requirements in Section 1432.2.

***

1412.9 Enclosed Parking Garage Ventilation. See the Seattle Mechanical Code, Section 404 for requirements for controls for parking garage ventilation.

***

1413.1 Operation: Air economizers shall be capable of automatically modulating outside and return air dampers to provide 100% of the

design supply air as outside air to reduce or eliminate the need for mechanical cooling. 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 exception 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 45?F dry-bulb/40?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.

~~EXCEPTION: Water economizers using air-cooled heat rejection equipment may use a 35?F dry-bulb outside air temperature for this~~

~~calculation. This exception is limited to a maximum of 20 tons per~~

~~building.~~

Note that this requirement will result in a larger cooling tower.

***

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).

EXCEPTIONS:

1. Where the heating is allowed by Section 1435.

2. Water source heat pump systems that comply with Section 1433, Exception 2.

Note that 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 the heating impact 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 of Section 6.5.1.4 of ASHRAE/IESNA Standard 90.1 in the Users Manual.

***

1414.1 Sealing: Duct work which is designed to operate at pressures above 1/2 inch water column static pressure shall be sealed ~~in accordance with Standard RS-18. Extent of sealing required is~~ as follows:

1. ~~Static pressure: 1/2 inch to 2 inches; seal transverse joints.~~(Reserved.)

2. Static pressure: ~~2~~1/2 inches to 3 inches; seal all transverse joints and longitudinal seams. Spiral lock seams in round and flat oval ductwork do not require sealing, however, other seams shall be sealed.

3. Static pressure: above 3 inches; seal all transverse joints, longitudinal seams and duct wall penetrations.

~~Duct tape and other pressure sensitive tape shall not be used as the primary sealant where ducts are designed to operate at static pressures of 1 inch W.C. or greater.~~

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. Ductwork 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.

Note that 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.

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

***

1421 System Type: To qualify as a simple system, systems shall be one of the following:

a. Air cooled, constant volume packaged equipment, which provide heating, cooling or both, and require only external connection to duct work and energy services with cooling capacity of 135,000 Btu/h or less.

b. Air cooled, constant volume split systems, which provide heating, cooling or both, with cooling capacity of 84,000 Btu/h or less.

c. Heating only systems which have a capacity of less than 5,000 cfm or which have a minimum outside air supply of less than 70% of the total air circulation.

All ~~other~~ systems shall comply with Sections 1430 through 1439.

~~1422 Controls: In addition to the control requirements in Section 1412, where separate heating and cooling equipment serve the same temperature zone, thermostats shall be interlocked to prevent simultaneous heating and cooling. Systems which provide heating and cooling simultaneously to a zone are prohibited.~~

~~1423 Economizers: Economizers meeting the requirements of Section 1413 shall be installed on:~~

~~a. cooling units installed outdoors or in a mechanical room adjacent to outdoors having a total cooling capacity greater than 20,000 Btu/h including those serving computer server rooms, electronic equipment, radio equipment, and telephone switchgear; and~~

~~b. other cooling units with a total cooling capacity greater than 54,000 Btu/h, including those serving computer server rooms, electronic equipment, radio equipment, and telephone switchgear.~~

~~EXCEPTION: For Group R Occupancy, economizers meeting the requirement of Section 1413 shall be installed on single package unitary fan-cooling units having a total cooling capacity greater than 54,000Btu/h.~~

~~The total capacity of all units without economizers (i.e., those units with a total cooling capacity less than a and b above) shall not exceed 240,000 Btu/h per building, or 10% of its aggregate cooling (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.~~

***

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 degrees F shall be used for heating and 75 degrees F for cooling, except where different values are specified in the Washington Administrative Code (WAC). For exterior temperatures, 24 degrees F shall be used for heating and 82 degrees F dry bulb and 66 degrees 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% 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.

EXCEPTIONS: 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% 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 14 Btu/h per square foot of gross conditioned floor area and installed space cooling equipment output that does not exceed 23 Btu/h per square foot of gross conditioned floor area. No additional safety factor is allowed.

***

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.

EXCEPTIONS: 1. 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 1411.2 of less than 33,000 Btu/h (hereafter referred to as qualifying small systems) provided that these are ~~High~~high-efficiency cooling ~~units~~ equipment with SEER and EER values more than ~~10%~~ 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. The total capacity of all ~~systems~~ qualifying small equipment 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. Redundant units are not counted in the capacity limitations. This exception shall not be used for RS-29 analysis~~ nor include unitary cooling equipment installed outdoors nor in a mechanical room adjacent to outdoors~~.

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 the ARI program does

satisfy those criteria, products subject to the ARI standards must be listed in the ARI 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 ARI standard. Energy Code compliance is determined at standard conditions (not at project specific conditions). Compliance should be verifiable through the ARI directory at www.aridirectory.org. It is not acceptable for a manufacturer to submit their own calculations for ARI standards.

- Consequently, to use Exception 1 to Section 1433, a product must both: be within the scope of the specified ARI standard and be included in the ARI certification program. 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).

2. Chilled water terminal units connected to systems with chilled water generation equipment with ~~COP and~~ IPLV or NPLV values more than 10% higher than minimum efficiencies listed in Table 14-1C, 14-1K, 14-1L or 14-1M, in the appropriate size category, using the same test procedures. 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 RS-29 analysis.

3. ~~Water-cooled refrigeration equipment provided with a water economizer meeting the requirements of Section 1413. Water economizer capacity per building shall not exceed 500 tons. This exception shall not be used for RS-29 analysis.~~ Reserved.

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

~~(such as dehumidification and supermarket refrigeration 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:

i. 90% minimum for units up to 199,000 Btu/h; and

ii. 85% minimum for units above 199,000 Btu/h input; 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.

9. Equipment used to cool any dedicated server room, electronic equipment room or telecom switch room provided that they completely comply with option a or option b or option c or option d in the table below. This exception shall not be used for RS-29 analysis.

Equipment Type Higher Equipment Part-load Economizer Efficiency Control

Option 9a Table 14-1A and + 15%b Required over None required Table 14-1Ba 85,000 Btu/hc

Option 9b Table 14-1A and + 5%d Required over Waterside Table 14-1Ba 85,000 Btu/hc economizere

Option 9c Table 14-1C, Table + 5%/10%g Required for all Waterside 14-1K, chillersh economizere Table 14-1L, and Table 14-1Mf

Option 9d ASHRAE Standard 127i + 0%j Required over Waterside 85,000 Btu/hc economizere

Notes to Exception 9.

a. For a system where all of cooling equipment is subject to the ARI standards listed in Table 14-1A and Table 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 Table14-1A or Table 14-1B, or if the system contains any cooling equipment that is not included in Table14-1A or Table 14-1B, then system is not allowed to use this option).

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

c. For units with a total cooling capacity over 85,000 Btuh, the system shall utilize part-load capacity control schemes that are able to modulate to a part-load capacity of 50% 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 EER value and an IPLV value that is a minimum of 5% greater than the value listed in Table 14-1A and Table 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 45?F dry-bulb/40?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 non-dedicated condenser water system exists that can provide appropriate water temperatures during hours when waterside economizer cooling is available.

f. For a system with chillers subject to the ARI standards listed in Table 14-1C, Table 14-1K, Table 14-1L, and Table

14-1M

(e.g. a chilled water system with fan coil units).

g. For air-cooled chillers, the cooling equipment shall have an IPLV value that is a minimum of 5% greater than the IPLV value listed in Table 14-1C (1.05 x values in Table 14-1C). For water- cooled chillers, the cooling equipment shall have an IPLV or NPLV value that is a minimum of 10% greater than the IPLV or NPLV value listed in Table 14-1C, Table 14-1K, Table 14-1L, and Table 14-1M (1.10 x values in Table 14-1C, Table 14-1K, Table 14-1L, and Table 14-1M).

h. The chiller shall utilize part-load capacity control schemes that are able to modulate to a part-load capacity of 50% 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).

i. For a system where all of cooling equipment is subject to ASHRAE Standard 127-2001.

j. The cooling equipment subject to the ASHRAE Standard 127-2001 shall have an EER value and an IPLV value that is equal or greater than the value listed in Table 14-1A and Table 14-1B when determined in accordance with the rating conditions ASHRAE Standard 127-2001 (i.e. not the rating conditions in ARI Standard 210/240 or 340/360).

Note: Exception 9, 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 the ARI program does satisfy those criteria, products subject to the ARI standards must be listed in the ARI 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 ARI standard. Energy Code compliance is determined at standard conditions (not at project specific conditions). Compliance should be verifiable through the ARI directory at www.aridirectory.org. It is not acceptable for a manufacturer to submit their own calculations for ARI standards.

- Consequently, to use Exception 9 options 9a and 9b to Section 1433, a product must both: be within the scope of the specified ARI

standard and be included in the ARI certification program. Certain equipment used in computer server rooms is not within the scope of the standards listed in Tables 14-1A and 14-1B and is not eligible for certification. Therefore, such equipment does not qualify to use Exception 9 options 9a and 9b to Section 1433.

- Certain equipment used in computer server rooms is not within the scope of the standards listed in Tables 14-1A and 14-1B, but is within the scope of ASHRAE Standard 127, Method of Testing for Rating Computer and Data Processing Room Unitary Air Conditioners. This equipment is eligible to use Exception 9 option 9d to Section 1433.

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

***

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 or by mechanical refrigeration.

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

e. Reheating for humidity control.

EXCEPTIONS: 1. Zones for which the volume of air that is reheated, recooled, or mixed is no greater than the larger of the

following:

a. The volume of air required to meet the minimum required to meet the ventilation requirements of the ~~Washington State Ventilation and Indoor Air Quality Code~~ Seattle Mechanical Code for the zone.

b. 0.4 cfm/ft2 of the zone conditioned floor area (before reheating), provided that the temperature of the primary system air is, by design or through reset controls, 0-12F below the design space heating temperature when outside air temperatures are below 60F for reheat systems and cold deck of mixing systems and 0-12F above design space temperature when outside air temperatures are above 60F for recooling systems and hot deck of mixing systems. For multiple zone systems, each zone need not comply with this exception provided the average of all zones served by the system that have both heating and cooling ability comply.

c. 300 cfm. This exception is for zones whose peak flow rate totals no more than 10% of the total fan system flow rate.

d. Any higher rate that can be demonstrated, to the satisfaction of the building official, to reduce overall system annual energy usage by offsetting reheat/recool energy losses through a reduction in outdoor air intake in accordance with the multiple space requirements defined in ASHRAE Standard 62.

2. Zones where special pressurization relationships, cross- contamination requirements, or code required minimum circulation rates are such that variable air volume systems are impractical.

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.

1436 Heat Recovery

1436.1 Fan Systems: Fan systems which

a. have both (1) a capacity of 5,000 cfm or greater or serve a space with a design heating or cooling load exceeding 150 Btu/h-ft2 and ~~which have~~ (2) a minimum outside air supply of 70% or greater of the total air circulation, or

b. have both (1) a capacity of 10,000 cfm or greater and (2) a minimum outside air supply of 50% or greater of the total

air circulation, or

c. have both (1) a capacity of 20,000 cfm or greater and (2) a minimum outside air supply of 30% or greater of the total air circulation,

shall have a heat recovery system with at least 50% 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 degrees F (44.5 degrees F in Seattle). Provisions shall be made to bypass or control the heat recovery system to permit air economizer operation as required by Section 1433. Heat recovery may be provided from any site-recovered or site- solar source.

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.

Exhibit 14-1

INSTRUCTIONS TO OPERATOR

To be in compliance with the Seattle 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.

1436.2 Condensate Systems: On-site steam heating systems 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.

Other buildings with steam heating systems which do not have condensate water recovery shall have condensate heat recovery.

1436.3 Heat Recovery for Service Water Heating: Condenser 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 6,000,000 Btu/h of heat rejection.

c. The capacity of service water heating equipment exceeds 1,000,000 Btu/h.

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

a. 60% of the peak heat rejection load at design conditions, or

b. preheat of the peak service hot water draw to 85F , or

c. 50% of the service water heating load.

EXCEPTIONS:

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

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

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 multi-speed 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 shall

a. be electronically-commutated motors, or

b. have a minimum motor efficiency of 65% when rated in accordance with NEMA Standard MG-1 at full load rating conditions.

1438 ~~Variable Flow Systems and~~ System Criteria for All Fans and Pumps: For fans and pumps 7.5 hp and greater ~~than 10 hp, where the application involves variable flow, and water source heat pump loops subject to the requirements of Section 1432.2.2~~, 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.

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

EXCEPTIONS: Variable speed devices are not required for motors 7.5 hp and greater that serve:

1. Fans or pumps in packaged equipment where variable speed devices 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.).

Static pressure sensors used to control variable air volume fans shall be placed in a position such that the controller set point is no greater than 1/3 the total design fan static pressure.

For systems with direct digital control of individual zone boxes reporting to the central control panel, there shall be static pressure reset controls and the static pressure set point shall be reset based on the zone requiring the most pressure; i.e., the set point is reset lower until one zone damper is nearly wide open.

1438.1 Cooling Towers: All cooling towers with a total fan motor horsepower 7.5 hp and greater ~~than 10 hp~~ shall be equipped with a variable speed drive or with a pony motor of a rated hp no greater than 1/3 of the hp of the primary motor. For pony motors, the cooling tower control shall provide two-stage operation of fans and shall bring the pony motor to operate without the primary motor while meeting the condenser water setpoint.

***

1440 Service Water Heating: Service water heating equipment shall comply with the applicable efficiencies in Tables 14-1A through 14-1M.

Effective January 1, 2006, commercial clothes washers installed in Seattle shall have a minimum modified energy factor (MEF) of 1.26. The MEF definition and test procedure set forth at 10 C.F.R. Part 430 (Energy Conservation Program For Consumer Products), as amended, is incorporated into this section by reference. Commercial clothes washers are defined as all clothes washers

a. installed for use on fee basis, e.g. coin- or card-

operated;

b. not covered by federal residential clothes washer efficiency standards; and

c. having a capacity of 20 lbs. or less.

***

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 determined in accordance with 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~~14-1M.

***

1454 Pool Covers and Insulation: Heated pools shall be equipped with a vapor retardant pool cover on or at the water surface. Pools heated to more than 90 degrees F shall have a pool cover with a minimum insulation value of R-12, and the sides and bottom of the pool shall also have a minimum insulation value of R-12 .

***

TABLE 14-1C

WATER CHILLING PACKAGES,

MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type Size ((Sub-Category Minimum Test Category or Rating Efficiency[b] Procedure[a] Condition)) Maximum kW/ton[d]

Air Cooled, With All 1.26 2.80 COP ARI Condenser, Capacities 0.95 ~~((3.05))~~3.70 550/590 Electrically IPLV Operated

Air Cooled, All 1.13 3.10 COP Without Condenser, Capacities 0.85 ~~((3.45))~~4.10 Electrically IPLV Operated

Water Cooled, < 40 tons 0.84 4.20 COP ARI Electrically 0.63 5.55 IPLV 550/590 Operated

> 40 tons 0.79 4.45 COP and 0.61 5.80 IPLV < 150 Tons

3150 Tons 0.63 5.55 COPc and 0.54 6.50 IPLV < 300 Tons

3300 Tons 0.58 6.10 COPc 0.50 7.05 IPLV

~~((Water Cooled, ((All ((4.20 ((ARI Electrically Capacities)) COP)) 550/590)) Operated, ((5.05 Positive IPLV)) Displacement (Reciprocating)))~~

~~((Water Cooled, ((<150 ((4.45 COP ((ARI Electrically Tons)) 5.05 550/590)) Operated, IPLV)) Positive Displacement (Rotary Screw and Scroll)))~~

~~((>150 Tons ((4.90 COP and 5.60 <300 Tons)) IPLV))~~

~~((5.50 COP ((>300 6.15 Tons)) IPLV))~~

~~((Water Cooled, ((<150 ((5.00 COP ((ARI Electrically Tons)) 5.25 550/590)) Operated, IPLV)) Positive Displacement (Centrifugal)))~~

~~((>150 Tons ((5.55 COP and 5.90 <300 Tons)) IPLV))~~

~~((6.10 COP ((>300 6.40~~

~~Tons)) IPLV))~~

Air Cooled All 0.60 COP ARI 560 Absorption Capacities Single Effect

Water Cooled All 0.70 COP ARI 560 Absorption Capacities Single Effect

Absorption Double All 1.00 COP ARI 560 Effect, Capacities 1.05 IPLV Indirect-Fired

Absorption Double All 1.00 COP ARI 560 Effect, Capacities 1.00 IPLV Direct-Fired

a Reserved. b ~~((The chiller equipment requirements do not apply for chillers used in low temperature applications where the design leaving fluid temperature is less than or equal to 40 degrees F.))~~Reserved. c COP requirements do not apply to other than centrifugal equipment. d This column is inserted for the convenience of users. The values are converted

from the COP and IPVL values in the following column using the equation: kW/ton=1/(COP x 3413/12000).

TABLE 14-1G

PERFORMANCE REQUIREMENTS FOR HEAT REJECTION EQUIPMENT

Equipment Total System Sub-Category Minimum Test Type Heat Rejection or Efficiency[b] Procedure[c] Capacity Rating Condition at Rated Conditions

Propeller or All 95 degrees F (35 degrees C) >=38.2 gpm/hp CTI ATC-105 Axial Fan Entering Water and Cooling Towers 85 degrees F (29 degrees C) CTI STD-201 Leaving Water 75 degrees F (24 degrees C) wb Outdoor Air

Centrifugal All 95 degrees F (35 degrees C) >=20.0 CTI ATC-105 Fan Entering Water gpm/hp and Cooling Towers 85 degrees F (29 degrees C) CTI STD-201 Leaving Water 75 degrees F (24 degrees C) wb Outdoor Air

Air Cooled All 125 degrees F (52 degrees C) >=176,000 ARI 460 Condensers Condensing Btu/h hp Temperature R22 Test Fluid 190 degrees F (88 degrees C) Entering Gas Temperature 15 degrees F (8 degrees C) Subcooling 95 degrees F (35 degrees C) Entering Drybulb

a For purposes of this table, cooling tower performance is defined as the maximum flow rating of the tower divided by the fan nameplate rated motor power. b 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. Note that the gpm/hp criteria in Table 14-1G does not apply to water- or evaporatively-cooled closed-circuit cooling towers. c Reserved.

TABLE 14-1H Reserved

TABLE 14-1I Reserved

TABLE 14-1J Reserved

TABLE 14-1K

IPLV/NPLV FOR CENTRIFUGAL CHILLERS < 150 TONS

Water Cooled Chillers < 150 Tons IPLVstd = 5.80

Condenser Flow Rate

2 gpm/ton d 2.5 gpm/ton 3 gpm/ton 4 gpm/ton 5 gpm/ton 6 gpm/ton

Leaving Entering LIFTa Chilled Condenser (F) Water Water Required IPLV/NPLV Temperature Temperature (F) (F)

46 75 29 6.42 6.71 6.93 7.27 7.52 7.70

45 75 30 6.33 6.60 6.81 7.12 7.35 7.51

44 75 31 6.24 6.50 6.69 6.97 7.18 7.34

43 75 32 6.15 6.40 6.59 6.85 7.03 7.17

42 75 33 6.06 6.31 6.49 6.73 6.90 7.03

41 75 34 5.97 6.23 6.39 6.62 6.78 6.89

46 80 34 5.97 6.23 6.39 6.62 6.78 6.89

40 75 35 5.89 6.14 6.30 6.52 6.67 6.77

45 80 35 5.89 6.14 6.30 6.52 6.67 6.77

44 80 36 5.79 6.05 6.22 6.42 6.56 6.67

43 80 37 5.68 5.96 6.13 6.34 6.46 6.56

42 80 38 5.57 5.86 6.04 6.24 6.37 6.46

41 80 39 5.45 5.76 5.95 6.16 6.28 6.36

46 85 39 5.45 5.76 5.95 6.16 6.28 6.36

40 80 40 5.31 5.65 5.85 6.07 6.19 6.27

45 85 40 5.31 5.65 5.85 6.07 6.19 6.27

44 85 41 5.16 5.54 5.80c 5.97 6.11 6.18

43 85 42 5.01 5.42 5.64 5.89 6.02 6.09

42 85 43 4.82 5.28 5.53 5.79 5.92 6.01

41 85 44 4.63 5.14 5.40 5.69 5.83 5.92

40 85 45 4.41 4.97 5.27 5.57 5.72 5.82

Condenser DTb 14.04 11.23 9.36 7.02 5.62 4.68

a LIFT = Entering Condenser Water Temperature - Leaving Chilled Water Temperature b Condenser DT = Leaving Condenser Water Temperature (F) - Entering Condenser Water Temperature (F) c All values shown are NPLV except at conditions of 3 gpm/ton and 41 F LIFT which is IPLV. d Retrofit applications only.

TABLE 14-1L

IPLV/NPLV FOR CENTRIFUGAL CHILLERS

> 150 TONS, < 300 TONS

Water Cooled Chillers > 150 Tons, < 300 Tons

IPLVstd = 6.50

Condenser Flow Rate

2 gpm/tond 2.5 gpm/ton 3 gpm/ton 4 gpm/ton 5 gpm/ton 6 gpm/ton

Leaving Entering LIFTa Chilled Condenser (F) Water Water Required IPLV/NPLV Temperature Temperature (F) (F)

46 75 29 7.24 7.56 7.82 8.21 8.48 8.69

45 75 30 7.14 7.44 7.68 8.03 8.28 8.47

44 75 31 7.04 7.33 7.55 7.87 8.10 8.27

43 75 32 6.94 7.22 7.43 7.72 7.93 8.09

42 75 33 6.84 7.12 7.32 7.59 7.78 7.92

41 75 34 6.74 7.02 7.21 7.47 7.65 7.77

46 80 34 6.74 7.02 7.21 7.47 7.65 7.77

40 75 35 6.63 6.92 7.11 7.35 7.51 7.63

45 80 35 6.63 6.92 7.11 7.35 7.51 7.63

44 80 36 6.52 6.82 7.01 7.24 7.39 7.50

43 80 37 6.40 6.72 6.91 7.14 7.28 7.39

42 80 38 6.28 6.61 6.81 7.04 7.18 7.28

41 80 39 6.14 6.50 6.71 6.94 7.08 7.17

46 85 39 6.14 6.50 6.71 6.94 7.08 7.17

40 80 40 5.98 6.38 6.60 6.84 6.99 7.07

45 85 40 5.98 6.38 6.60 6.84 6.99 7.07

44 85 41 5.82 6.25 6.50c 6.74 6.89 6.97

43 85 42 5.64 6.11 6.37 6.63 6.78 6.88

42 85 43 5.43 5.95 6.24 6.52 6.68 6.78

41 85 44 5.21 5.79 6.09 6.40 6.57 6.68

40 85 45 4.97 5.60 5.94 6.28 6.46 6.57

Condenser DTb 14.04 11.23 9.36 7.02 5.62 4.68

a LIFT = Entering Condenser Water Temperature - Leaving Chilled Water Temperature b Condenser DT = Leaving Condenser Water Temperature (F) - Entering Condenser Water Temperature (F) c All values shown are NPLV except at conditions of 3 gpm/ton and 41 F LIFT which is IPLV. d Retrofit applications only.

TABLE 14-1M

IPLV/NPLV FOR CENTRIFUGAL CHILLERS > 300 TONS

Water Cooled Chillers > 300 Tons IPLVstd = 7.05

Condenser Flow Rate						
2 gpm/tond	2.5 gpm/ton	3 gpm/ton	4 gpm/ton	5 gpm/ton	6 gpm/ton	
Leaving Chilled Water Temperature (F)	Entering Condenser Water Temperature (F)	LIFTa	Required IPLV/NPLV			
46	75	29	7.87	8.22	8.49	8.91	9.21	9.44
45	75	30	7.76	8.09	8.34	8.72	9.00	9.20
44	75	31	7.65	7.95	8.20	8.55	8.80	8.98
43	75	32	7.54	7.84	8.06	8.39	8.61	8.78
42	75	33	7.43	7.73	7.94	8.24	8.45	8.60
41	75	34	7.32	7.62	7.83	8.11	8.31	8.44
46	80	34	7.32	7.62	7.83	8.11	8.31	8.44
40	75	35	7.21	7.51	7.71	7.99	8.16	8.29
45	80	35	7.21	7.51	7.71	7.99	8.16	8.29
44	80	36	7.08	7.40	7.61	7.87	8.03	8.15
43	80	37	6.95	7.29	7.50	7.76	7.91	8.03
42	80	38	6.82	7.18	7.39	7.65	7.80	7.91
41	80	39	6.67	7.06	7.28	7.54	7.69	7.79
46	85	39	6.67	7.06	7.28	7.54	7.69	7.79
40	80	40	6.50	6.93	7.17	7.44	7.58	7.68
45	85	40	6.50	6.93	7.17	7.44	7.58	7.68
44	85	41	6.33	6.79	7.05c	7.33	7.47	7.58
43	85	42	6.13	6.63	6.91	7.21	7.37	7.47
42	85	43	5.91	6.47	6.78	7.08	7.25	7.36
41	85	44	5.67	6.28	6.61	6.96	7.14	7.25
40	85	45	5.40	6.08	6.45	6.82	7.01	7.13
Condenser DTb			14.04	11.23	9.36	7.02	5.62	4.68

a LIFT = Entering Condenser Water Temperature - Leaving Chilled Water Temperature b Condenser DT = Leaving Condenser Water Temperature (F) - Entering Condenser Water Temperature (F) c All values shown are NPLV except at conditions of 3 gpm/ton and 41 F LIFT which is IPLV. d Retrofit applications only.

***

Section The following sections of Chapter 15 of the 2006 Washington State Energy Code are amended as follows:

***

1512 Exempt Lighting: The use of these exemptions is at the applicant's option.

1512.1 Exempt Spaces: The following rooms, spaces and areas, are exempt from the ~~lighting power~~ requirements in Sections 1520 through 1522 and 1530 through 1532 but shall comply with all other requirements of this chapter.

1. ~~Areas in which medical or dental tasks are performed.~~ Reserved.

2. High risk security areas or any area identified by building officials as requiring additional lighting.

3. Spaces designed for primary use by the visually impaired~~,~~ or hard of hearing (lip-reading) ~~or by senior citizens~~.

4. ~~Food preparation areas.~~Reserved.

5. Outdoor manufacturing, greenhouses and processing areas.

6. Electrical/mechanical equipment rooms.

7. Outdoor athletic facilities.

8. ~~Inspection and restoration areas in galleries and museums.~~

Reserved.

9. The sanctuary portion of a house of worship, defined as the space or room where the worship service takes place. Classrooms, meeting rooms, offices and multipurpose rooms that are part of the same facility are not exempt.

1512.2 Exempt Lighting Equipment: The following lighting equipment and tasks are exempt from the lighting requirements of Section 1520 through 1522 and need not be included when calculating the installed lighting power under Section 1530 through 1532 but shall comply with all other requirements of this chapter. All other lighting in areas that are not exempted by Section 1512.2, where exempt tasks and equipment are used, shall comply with all of the requirements of this chapter.

1. Special lighting needs for research.

2. Emergency lighting that is automatically OFF during normal building operation.

3. Lighting that is part of machines, equipment or furniture.

4. Lighting that is used solely for indoor plant growth during the hours of 10:00 p.m. to 6:00 a.m. However, such lighting shall not be exempt unless it is in addition to general area lighting, is located in a separate fixture, and is controlled by an independent control device.

5. Lighting for theatrical productions, television broadcasting (including sports facilities), ~~audio-visual presentations~~ and special effects lighting for stage areas and dance floors in entertainment facilities. However, such lighting shall not be exempt unless it is in addition to general area lighting, is located

in a separate fixture, and is controlled by an independent control device.

6. Lighting in galleries, museums and in main building entry lobbies for ~~art~~ exhibits, ~~non-retail displays, portable plug in display fixtures and show case lighting~~ inspection, and restoration. However, such lighting shall not be exempt unless it is in addition to general area lighting, is located in a separate fixture, and is controlled by an independent control device.

7. Lighting specifically designed for use only during medical or dental procedures and lighting integral to medical equipment. However, such lighting shall not be exempt unless it is in addition to general area lighting, designed specifically for medical lighting, and is controlled by an independent control device.

8. Lighting integral to or specifically for food warming and food preparation equipment. However, such lighting shall not be exempt unless it is in addition to general area lighting, is located in a separate fixture, and is controlled by an independent control device.

9. Audio-visual and video-conferencing lighting with multi-level or

dimming controls in rooms with permanently installed audio-visual equipment or video-conferencing equipment.

10. Permanently-installed undershelf or undercabinet lighting that has an automatic shutoff control device integral to or is directly attached to the luminaires or is automatically controlled by a wall- mounted control device that turns off the lighting whenever that particular space is unoccupied. Other permanently-installed undershelf or undercabinet lighting that is not automatically controlled is not exempt and shall be included when determining compliance with the lighting requirements of Section 1520 through 1522 and Section 1530 through 1532.

***

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, need not be accessible to the users and may be centralized in a remote location.

3. Controls requiring trained operators.

4. Controls for safety hazards and security.

***

1513.3 Daylight Zone Control: Lighting in ~~All~~all daylighted zones, as defined in Chapter 2 (see Exhibits 1513.3a and 1513.3b), both under overhead glazing and adjacent to vertical glazing, shall be provided with controls that comply with Sections 1513.3.1 and 1513.3.2~~individual controls, or daylight-or occupant-sensing automatic controls, which control the lights independent of general area lighting~~.

1513.3.1 Separate Control: Daylight zones shall have controls which control the lights independent of general area lighting.

Contiguous daylight zones adjacent to vertical glazing are allowed to be controlled by a single controlling device provided that they do not include zones facing more than two adjacent cardinal orientations (i.e. north, east, south,

west). Daylight zones under overhead glazing more than 15 feet from the perimeter shall be controlled separately from daylight zones adjacent to vertical glazing. For daylight zones under overhead glazing that exceed 5,000 square feet, there must be at least two independent photocontrol systems with each system having a dedicated photosensor.

EXCEPTION: Daylight spaces enclosed by walls or ceiling height partitions and containing 2 or fewer lighting fixtures are not required to have a separate switch for general area lighting.

1513.3.2 Automatic Control: Daylight zones shall have controls which automatically reduce lighting power in response to available daylight by either:

a. a combination of dimming ballasts and daylight-sensing automatic controls, which are capable of dimming the lights continuously, or

b. a combination of stepped switching and daylight-sensing automatic controls, which are capable of incrementally reducing the light level in steps automatically and turning the lights off automatically.

i. Single-lamp luminaire systems shall have three levels of automatic control: all lamps on, approximately half of the luminaires turned off in a relatively uniform pattern, and then all of the luminaires off. As an alternate, where the daylight zone contains two rows of luminaires and they are parallel to a window, three levels of automatic control may also be achieved by having both rows on, the row closest to the window off and the other row on, and both rows off. For rooms, such as small offices, which contain only a single one-lamp luminaire, it is acceptable for the daylighting control system to automatically switch off the entire luminaire.

ii. Two-lamp luminaires shall have three levels of automatic control: both lamps on, one lamp on and one lamp off, and both lamps off. As an alternate, where the daylight zone contains two rows of luminaires and they are parallel to a window, three levels of automatic control may also be achieved by having both rows on, the row closest to the window off and the other row on, and both rows off. For rooms, such as small offices, which contain only a single two-lamp luminaire, it is acceptable for the daylighting control system to automatically switch off the entire luminaire rather than switching off one lamp, then both lamps.

iii. Three-lamp luminaires shall have four levels of automatic control: all three lamps on, two lamps on and one lamp off, one lamp on and two lamps off, and all three lamps off.

iv. For other multi-lamp luminaries with four or more lamps, the number of required incremental steps shall be equal to one plus the number of lamps in the luminaire.

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

EXCEPTIONS: 1. The following are exempt from the requirements for automatic daylighting controls in Section 1513.3.2:

a. retail spaces adjacent to vertical glazing (retail spaces under overhead glazing are not exempt),

b. lighting exempted by Section 1512, and

c. display, exhibition, and specialty lighting complying with Section 1513.4.

2. The following spaces are exempt from the requirements for automatic daylighting controls in Section 1513.3.2 provided that they have occupancy sensor controls that comply with Section 1513.6.1:

a. small spaces in the daylight 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.

3. HID lamps with automatic controls that are capable of reducing the power consumption by at least 50% in lieu of continuous dimming controls in 1513.3.2.

4. HID lamps 150 watts or less are exempt from the dimming requirements in 1513.3.2.

Exhibit 1513.3a

Exhibit 1513.3b

***

1532 Exterior Lighting Power Allowance: The exterior lighting power allowance shall be calculated separately for (1) covered parking, and (2) outdoor parking, outdoor areas and building exteriors. The lighting in these two areas shall not be traded.

The lighting allowance for covered parking shall be 0.20 W/ft2, and the allowance for open parking and outdoor areas shall be 0.15 W/ft2. For open parking and outdoor areas and roadways, luminaires mounted above 15 feet shall meet IESNA requirements for 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.)

The lighting allowance for building exteriors and externally- illuminated signs (including billboards) shall be calculated either by multiplying the building facade area that is illuminated or sign area by 0.15 W/ft2 or multiplying the building perimeter in feet by 7.5 watts per lineal foot. Any building exterior lighting that exceeds 7.5 watts per square foot of total building perimeter is not allowed to be traded with other lighting areas.

EXCEPTIONS: 1. Group U occupancy accessory to Group R-3 or R-4 occupancy.

2. The top level of a parking garage is allowed to be included with the covered parking garage category

provided that the luminaires on the top level meet the IESNA requirements for Full Cutoff Luminaires.

3. For the gas station pump area under canopy only, 1.00 W/ft2 may be used. For automobile sales area only, and for other exterior retail sales, including but not limited to gardening supplies, 0.50 W/ft2 may be used.

INFORMATIVE GUIDE TO SECTION 1532: NOTE THAT THIS GUIDE DOES NOT SUPERCEDE THE REQUIREMENTS IN THE TEXT.

CATEGORY LIGHTING POWER TRADEOFF ALLOWANCE LIMITATIONS

PARKING AND OUTDOOR AREAS

Covered Parking 0.20 Watts/square foot Calculated separately. Trade offs not allowed with other categories.

Open parking and 0.15 Watts/square foot Calculated separately, outdoor areas of area that is but see allowance below for use illuminated of facade lighting credit

FACADE LIGHTING

Perimeter option 7.5 Watts/lineal foot Calculated separately, of building perimeter but any wattage allowance not used for facade lighting may be used for open parking and outdoor areas that are illuminated

Surface area 0.15 Watts/square foot Calculated separately, option of wall surface area but any wattage allowance up to that is illuminated 7.5 Watts/lineal foot of building perimeter that is not used for facade lighting may be used for open parking and outdoor areas that are illuminated

~~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 individual lighting power densities permitted in Table 15-2 for these applications. Trade-offs are allowed only among exterior lighting applications listed in the Table 15-2 "Tradable Surfaces" section.~~

~~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 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.~~

~~TABLE 15-2~~

~~LIGHTING POWER DENSITIES FOR BUILDING EXTERIORS~~

Tradable Surfaces Uncovered Parking Areas (Lighting power densities for uncovered parking areas, building grounds, building entrances and exits, canopies and overhangs and outdoor sales areas may be traded.)

Parking Lots and drives 0.15 W/ft2 Building Grounds Walkways less than 10 feet wide 1.0 W/linear foot Walkways 10 feet wide or greater 0.2W/ft2 Plaza areas Special Feature Areas Stairways 1.0 W/ft2 Building Entrances and Exits Main entries 30 W/linear foot of door width Other doors 20 W/linear foot of door width Canopies and Overhangs Canopies (free standing and 1.25 W/ft2 attached and overhangs) Outdoor Sales Open areas (including vehicle 0.5 W/ft2 sales lots) Street frontage for vehicle 20 W/linear foot sales lots in addition to "open area" allowance

Non-Tradable Surfaces Building Facades 0.2 W/ft2 for each (Lighting power density illuminated wall or calculations for the surface or 5.0W/linear following applications foot for each illuminated can be used only for wall or surface length the specific application and can-not 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.)

Automated teller machines and 270 W per location plus 90 night depositories W per additional ATM per location

Entrances and gatehouse 1.25 W/ft2 of uncovered inspection stations at guarded area (covered areas are facilities included in the "Canopies and Overhangs" section of "Tradable Surfaces")

Loading areas for law 0.5 W/ft2 of uncovered enforcement, fire, ambulance and area (covered areas are other emergency service vehicles included in the "Canopies and Overhangs" section of "Tradable Surfaces")

Material handling and associated 0.5 W/ft2 storage

Drive-up windows at fast food 400W per drive-through restaurants

Parking near 24-hour retail 800 W per main entry)) entrances

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TABLE 15-1 UNIT LIGHTING POWER ALLOWANCE (LPA)

Use1 LPA2 (W/ft2)

Automotive facility 0.9

Convention center 1.2

Courthouse 1.2

Cafeterias, fast food establishments5, 1.3 restaurants/bars5

Dormitory 1.0

Exercise center 1.0

Gymnasia9, assembly spaces9 1.0

Health care clinic 1.0

Hospital, nursing homes, and other Group 1.2 I-1 and I-2 Occupancies

Hotel/motel 1.0

Hotel banquet/conference/exhibition 2.0 hall3,4

Laboratory spaces (all spaces not 1.8 classified "laboratory" shall meet office and other appropriate categories)

Laundries 1.2

Libraries5 1.3

Manufacturing facility 1.3

Museum 1.1

Office buildings, office/administrative 0.95 areas in facilities of other use types ((1.0)) (including but not limited to schools, hospitals, institutions, museums, banks, churches)5,7,11

Parking garages 0.2

Penitentiary and other Group I-3 1.0 Occupancies

Police and fire stations8 1.0

Post office 1.1

Retail10, retail banking, mall concourses, 1.5 wholesale stores (pallet rack shelving)

School buildings (Group E Occupancy only), 1.2 school classrooms, day care centers

Theater, motion picture 1.2

Theater, performing arts 1.6

Transportation 1.0

Warehouses11, storage areas 0.5

Workshop 1.4

Plans Submitted for Common Areas Only7

Main floor building lobbies3 (except mall 1.2 concourses)

All building common areas, corridors, 0.8 toilet facilities and washrooms, elevator lobbies, including Group R-1 and R-2 Occupancies

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.

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 ft2 with full- height partitions, a Unit Lighting Power Allowance of 1.1 W/ft2 may be used.

8. Reserved.

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/ft2.

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 1.5 W/ft2 of merchandise display luminaires are exempt for individual tenant spaces less than 3,000 gross square feet and 1.2 W/ft2 for larger tenant spaces provided that they comply with all three 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),

c. fitted with LED, tungsten halogen, fluorescent, ceramic metal halide or other high intensity discharge lamps.

This additional lighting power is allowed only if the lighting is actually installed.

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.

***

Section The following sections of Reference Standard 29 of the 2006 Washington State Energy Code are amended as follows:

***

3.3 Envelope

3.3.1 Insulation and Glazing: Glazing area and U-factor of the standard building envelope shall be determined by using the Target UA requirements of Equation 13-1 and U-factor values in Table 13-1 or 13-2. The glazing solar heat gain coefficient (SHGC) of the standard building shall be the lesser of 0.65 and the SHGC required by Table 13-1 or 13-2 for the vertical or overhead glazing area for the appropriate wall type. The opaque area U-factors of the standard building shall be determined by using the Target UA requirements from Equation 13-1~~including the appropriate mass for walls~~, except that the walls in the standard design shall be metal stud walls. The insulation characteristics and glazing area are prescribed assumptions for the standard building for calculating the standard energy consumption. In the calculation of the proposed energy consumption of the proposed design, the envelope characteristics of the proposed design shall be used. The standard design shall use the lesser of the glazing area of the proposed design or the maximum glazing areas listed in Tables 13-1 or 13-2 for the appropriate use. The distribution of vertical glazing in the gross wall area of the standard design shall be equal to the distribution of vertical glazing in the proposed design or shall constitute an equal percentage of gross wall area on all sides of the standard building. The distribution of overhead glazing in the gross roof/ceiling area of the standard design shall be equal to the distribution of overhead glazing in the proposed design. The distribution of doors in the gross opaque wall area of the standard design shall be identical to the distribution of doors in the proposed design.

3.3.2 Infiltration: For standard and proposed buildings, infiltration assumptions shall be equal.

3.3.3 Envelope and Ground Absorptivities: For the standard building, absorptivity assumptions shall be default assumptions for computing the standard energy consumption and default assumptions for computing the proposed energy consumption. The solar absorptivity of opaque elements of the building envelope shall be assumed to be 70 %. The solar absorptivity of ground surfaces shall be assumed to be 80 % (20 % reflectivity).

3.3.4 Window Treatment: No draperies or blinds shall be modeled for the standard or proposed building.

3.3.5 Shading: For standard building and the proposed design, 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. Credit may be taken for external shading devices that are part of the proposed design.

3.4 HVAC Systems and Equipment: For the standard building, the HVAC system used shall be the system type used in the proposed design. If

the proposed HVAC system type does not comply with Sections 1432 through 1439 the standard design system shall comply in all respects with those sections.

EXCEPTION: ~~When approved by the building official, a~~A prototype HVAC system may be used~~, if the proposed design system cannot be modified to comply with Sections 1422 and 1432 through 1439,~~ as a standard design. Use of prototype HVAC systems shall only be permitted for the building types listed below. For mixed-use buildings, the floor space of each building type is allocated within the floor space of the standard building. The specifications and requirements for the HVAC systems of prototype buildings shall be those in Table 3-3.

1. assembly 6. restaurant

2. health/institutional 7. retail (mercantile)

3. hotel/motel 8. school (educational)

4. light manufacturing 9. warehouse (storage)

5. office (business)

3.4.1 HVAC Zones: HVAC zones for calculating the standard energy consumption and proposed energy consumption shall consist of at least four perimeter and one interior zone per floor, with at least one perimeter zone facing each orientation. The perimeter zones shall be 15 feet in width or one-third the narrow dimension of the building when this dimension is between 30 and 45 feet inclusive, or half the narrow dimension of the building when this dimension is less than 30 feet.

EXCEPTIONS: 1. Building types such as assembly or warehouse may be modeled as a single zone if there is only one space.

2. Thermally similar zones, such as those facing one orientation on different floors, may be grouped together for the purposes of either the standard or proposed building simulation.

3.4.2 Process Equipment Sizing: Process sensible and latent loads shall be equal in calculating both the standard energy consumption and the proposed energy consumption. The designer shall document the installation of process equipment and the size of process loads.

3.4.3 HVAC Equipment Sizing: The equipment shall be sized to include the capacity to meet the process loads. For calculating the proposed energy consumption, actual air flow rates and installed equipment size shall be used in the simulation. Equipment sizing in the simulation of the proposed design shall correspond to the equipment intended to be selected for the design and the designer shall not use equipment sized automatically by the simulation tool.

Equipment sizing for the standard design shall be based on the same as the proposed design or lesser sizing ratio of installed system capacity to the design load for heating and for cooling.

Chilled water systems for the standard building shall be modeled using a reciprocating chiller for systems with total cooling capacities less than 175 tons, and centrifugal chillers for systems with cooling capacities of 175 tons or greater. For systems with cooling capacities of 600 tons or more, the standard energy consumption shall be calculated using two centrifugal chillers, lead/lag controlled. Chilled water shall be assumed to be controlled at a constant 44?F temperature rise, from 44?F to 56?F, operating at 65 % combined impeller and motor efficiency. Condenser water pumps shall be sized using a 10?F temperature rise, operating at 60% combined impeller and motor efficiency. The cooling tower shall be an open circuit, centrifugal blower type sized for the larger of 85?F

leaving water temperature or 10?F approach to design wetbulb temperature. The tower shall be controlled to provide a 65?F leaving water temperature whenever weather conditions permit, floating up to design leaving water temperature at design conditions.

3.4.4 Fans: ~~The power of the combined fan system per air volume at design conditions (w/cfm) of the proposed design shall be equal to that of the~~The standard design shall comply with the following.

3.4.4.1 Fan System Power Limitation: Each HVAC system at fan system design conditions shall not exceed the allowable fan system motor nameplate hp [Option 1] or fan system bhp [Option 2] as shown in the Fan Power Limitation table. This includes supply fans, return/relief fans, exhaust fans, and fan-powered terminal units associated with systems providing heating or cooling capability.

Fan Power Limitation

Limit	Constant Volume	Variable Volume
Option 1: Fan System Motor Nameplate hp	Allowable Nameplate Motor hp	hp= CFMS*0.0015
Option 2: Fan System bhp	Allowable Fan bhp= CFMS * 0.00094 + A	bhp= CFMS *0.0013 + A

where:

fan brake horsepower = the horsepower delivered to the fan's shaft. Brake horsepower does not include the mechanical drive losses (belts, gears, etc.).

fan system design conditions = operating conditions that can be expected to occur during normal system operation that result in the highest supply airflow rate to conditioned spaces served by the system.

fan system bhp = the sum of the fan brake horsepower of all fans that are required to operate at fan system design conditions to supply air from the heating or cooling source to the conditioned space(s) and return it to the source or exhaust it to the outdoors.

fan system motor nameplate hp = the sum of the motor nameplate horsepower of all fans that are required to operate at design conditions to supply air from the heating or cooling source to the conditioned space(s) and return it to the source or exhaust it to the outdoors.

nameplate horsepower = the nominal motor horsepower rating stamped on the motor nameplate.

CFMS = the maximum design supply airflow rate to conditioned spaces served by the system in cubic feet per minute

hp = the maximum combined motor nameplate horsepower

bhp = the maximum combined fan brake horsepower

A = Sum of [PD x CFMD / 4131]

where:

PD = Each applicable pressure drop adjustment from Table 14-8 in in. w.c.

CFMD = the design air flow through each applicable device from Table 14-8 in cubic feet per minute

Exceptions:

(a). Hospital and laboratory systems that utilize flow control devices on exhaust and/or return to maintain space pressure relationships necessary for occupant health and safety or environmental control may use variable volume fan power Limitation.

(b). Individual exhaust fans with motor nameplate horsepower of 1 hp or less.

(c) Fans exhausting air from fume hoods. (Note: If this exception is taken, no related exhaust side credits shall be taken from the table below and the Fume Exhaust Exception Deduction shall be taken from the table below).

Fan Power Limitation Pressure Drop Adjustment

Device Adjustment

Credits

Fully ducted return and/or exhaust air 0.5 in w.c. systems

Return and/or exhaust air flow control 0.5 in w.c. devices

Exhaust filters, scrubbers, or other Pressure drop of device at fan system exhaust treatment. design condition

Particulate filtration credit: MERV 9 0.5 in w.c. thru 12

Particulate filtration credit: MERV 13 0.9 in w.c. thru 15

Particulate filtration credit: MERV 16 Pressure drop calculated at 2x clean and greater and electronically filter pressure drop at fan system enhanced filters design condition

Carbon and other gas-phase air Clean filter pressure drop at fan cleaners system design condition

Heat recovery device Pressure drop of device at fan system design condition

Evaporative humidifier/cooler in Pressure drop of device at fan system series with another cooling coil design condition

Sound attenuation section 0.15 in w.c.

Deductions

Fume hood exhaust exception -1.0 in w.c. (required if 1438.2.1 exception (c) is taken)

3.4.4.2 Motor Nameplate Horsepower: For each fan, the selected fan motor shall be no larger than the first available motor size greater than the brake horsepower. The fan brake horsepower must be indicated on the design documents to allow for compliance verification by the

code official.

Exceptions:

(a) For fans less than 6 bhp, where the first available motor larger than the brake horsepower has a nameplate rating within 50% of the brake horsepower, the next larger nameplate motor size may be selected.

(b) For fans 6 bhp and larger, where the first available motor larger than the brake horsepower has a nameplate rating within 30% of the brake horsepower, the next larger nameplate motor size may be selected.

3.4.4.3 Variable Speed: Variable air volume fan systems in the standard building shall be variable speed.

***

3.6 Controls

3.6.1: All occupied conditioned spaces in standard and proposed design buildings in all climates shall be simulated as being both heated and cooled.

EXCEPTIONS: 1. If a building or portion of a building is to be provided with only heating or cooling, both the standard building and the proposed design shall be simulated using the same assumptions.

2. If warehouses are not intended to be mechanically cooled, both the standard and proposed energy consumption shall be modeled assuming no mechanical cooling.

3.6.2: Space temperature controls for the standard building 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 3-2, except that the heating system shall cycle ON if any space should drop below the night setback setting 55?F. There shall be no similar setpoint during the cooling season. Lesser deadband ranges may be used in calculating the proposed energy consumption.

EXCEPTIONS: 1. Setback shall not be modeled in determining either the standard or proposed energy 2. If deadband controls are not to be installed, the proposed energy consumption shall be calculated with both heating and cooling thermostat setpoints set to the same value between 70?F and 75?F inclusive, assumed to be constant for the year.

3.6.3: When providing for outdoor air ventilation when calculating the standard energy consumption, controls shall be assumed to close the outside air intake to reduce the flow of outside air to 0.0 cfm during "setback" and "unoccupied" periods. Ventilation using inside air may still be required to maintain scheduled setback temperature. Outside air ventilation, during occupied periods, shall be as required by the Washington State Ventilation and Indoor Air Quality Code, Chapter 51-13 WAC.

3.6.4: If humidification is to be used in the proposed design, the same level of humidification and system type shall be used in the standard building.

3.6.5: There shall be no credit in the proposed design for control of parking garage ventilation.

***

TABLE 3-3

HVAC Systems of Prototype Buildings3

Use System # Remarks

1. Assembly

a. Churches (any 1 size)

b. <=50,000 ft^2 or 1 or 3 Note 2 3 floors

c. >50,000 ft^2 or 3 3 floors

2. Health

a. Nursing Home 2 (any size)

b. <=15,000 ft^2 1

c. >15,000 ft^2 and 4 Note 3 <=50,000 ft^2

d. >50,000 ft^2 5 Note 3,4

3. Hotel/Motel

a. ~~((3))~~ 6 Stories 2 Note 6

b. ~~((3))~~ 6 Stories 6 Note 7

4. Light Manufacturing 1 or 3

5. Office

a. <=20,000 ft^2 1

b. >20,000 ft^2 and 4 ~~((either))~~ <=~~((3))~~ 7 floors ~~((or >75,000 ft^2))~~

c. >~~((75,000 ft^2 or~~ 5 ~~3))~~ 7 floors

6. Restaurant 1 or 3 Note 2

7. Retail

a. <=50,000 ft^2 1 or 3 Note 2

b. >50,000 ft^2 4 or 5 Note 2

8. Schools

a. <=75,000 ft^2 or 1 3 floors

b. >75,000 ft^2 or 3 3 floors

9. Warehouse Note 5

Footnote to Table 3-3: The systems and energy types presented in this table are not intended as requirements or recommendations for the proposed design. Floor areas in the table are the total conditioned floor areas for the listed use in the building. The number of floors indicated in the table is the total number of occupied floors for the listed use.

TABLE 3-3 (Continued)

HVAC System Descriptions for Prototype Buildings1

HVAC Component System #1 System #2

System Packaged rooftop Packaged terminal air Description single zone, one conditioner with unit per zone space heater or heat pump, heating or cooling unit per zone

Fan system Design Supply Note 10 Note 11 Circulation Rate

Supply Fan Constant volume Fan cycles with call Control for heating or cooling

Return Fan NA NA Control

Cooling System Direct expansion air Direct expansion air cooled cooled

Heating System Furnace, heat pump Heat pump with ~~((or electric~~ electric resistance ~~resistance))~~ auxiliary or air conditioner with space heater

Remarks Drybulb economizer No economizer, if not per Section 1433, required by Section heat recovery if 1433 required by Section 1436

TABLE 3-3 (Continued)

HVAC System Descriptions for Prototype Buildings1

HVAC Component System #3 System #4

System Air handler per zone Packaged rooftop VAV Description with central plant with perimeter reheat and fan-powered terminal units

Fan system Design Supply Note 10 Note 10 Circulation Rate

Supply Fan Constant volume ~~((VAV))~~Variable Air Control Volume systems with controls per Section 1438 ~~((forward curved centrifugal fan and variable inlet fans))~~

Return Fan Constant volume ~~((VAV))~~Variable Air Control Volume systems with controls per Section 1438 ~~((forward curved centrifugal fan and variable inlet fans))~~

Cooling System Water-cooled Chilled Direct expansion air water (Note 12) cooled

Heating System Hot water (Note 13) Hot water (Note 13) or electric resistance

Remarks Drybulb economizer Drybulb economizer per Section 1433, per Section 1433. heat recovery if Minimum VAV setting required by Section per Section 1435 1436 Exception 1, Supply air reset by zone of greatest cooling demand, heat recovery if required by Section 1436

TABLE 3-3 (Continued)

HVAC System Descriptions for Prototype Buildings1

HVAC Component System #5 System #6

System Built-up central VAV Four-pipe fan coil Description with perimeter per zone with central reheat and plant fan-powered terminal units

Fan system Design Supply Note 10 Note 10 Circulation Rate

Supply Fan VAV with air-foil Fan cycles with call Control centrifugal fan and for heating or AC frequency cooling variable speed drive

Return Fan VAV with air-foil NA Control centrifugal fan and AC frequency variable speed drive

Cooling System Water-cooled Chilled Water-cooled Chilled water (Note 12) water (Note 12)

Heating System Hot water (Note 13) Hot water (Note 13) or electric or electric resistance resistance

Remarks Drybulb economizer No economizer, if not per Section 1433. required by Section Minimum VAV setting 1433 per Section 1435 Exception 1, Supply air reset by zone of greatest cooling demand, heat recovery if required by Section 1436

Numbered Footnotes for Table 3-3

HVAC System Descriptions for Prototype Buildings

1. The systems and energy types presented in this Table are not intended as requirements or recommendations for the proposed design.

2. For occupancies such as restaurants, assembly and retail that are

part of a mixed use building which, according to Table 3-3, includes a central chilled water plant (systems 3, 5, or 6), chilled water system type 3 or 5 shall be used as indicated in the table.

3. Constant volume may be used in zones where pressurization relationships must be maintained by code. Where constant volume is used, the system shall have heat recovery if required by Section 1436. VAV shall be used in all other areas, in accordance with Sections 1432 through 1439.

4. Provide run-around heat recovery systems for all fan systems with a minimum outside air intake greater than 70%. Recovery effectiveness shall be 0.50.

5. If a warehouse is not intended to be mechanically cooled, both the standard and proposed designs shall be calculated assuming no mechanical cooling.

6. The system listed is for guest rooms only. Areas such as public areas and back-of-house areas shall be served by

system 4. Other areas such as offices and retail shall be served by systems listed in Table 3-3 for these occupancy types.

7. The system listed is for guest rooms only. Areas such as public areas and back-of- house areas shall be served by system 5. Other areas such as offices and retail shall be served by systems listed in Table 3-3 for these occupancy types.

8. Reserved.

9. Reserved.

10. Design supply air circulation rate shall be based on a supply-air to room-air temperature difference of 20?F. A higher supply-air temperature may be used if required to maintain a minimum circulation rate of 4.5 air changes per hour or 15 cfm per person to each zone served by the system, at design conditions. If return fans are specified, they shall be sized for the supply fan capacity less the required minimum ventilation with outside air, or 75% of the supply fan capacity, whichever is larger. Except where noted, supply and return fans shall be operated continuously during occupied hours.

11. Fan energy when included in the efficiency rating of the unit as defined in Section 1411, need not be modeled explicitly for this system. The fan shall cycle with calls for heating or cooling.

12. Chilled water systems shall be modeled using a reciprocating chiller for systems with total cooling capacities less than 175 tons, and centrifugal chillers for systems with cooling capacities of 175 tons or greater. For systems with cooling capacities of 600 tons or more, the standard design energy consumption shall be calculated using two centrifugal chillers, lead/lag controlled. Chilled water shall be assumed to be controlled at a constant 44?F. Chiller water pumps shall be sized using a 12?F temperature rise, from 44?F to 56?F, operating at 65% combined impeller and motor efficiency. Condenser water pumps shall be sized using a 10?F temperature rise, operating at 60% combined impeller and motor efficiency. The cooling tower shall be an open circuit, centrifugal blower type sized for the larger of 85?F leaving water temperature or 10?F approach to design wetbulb temperature. The tower shall be controlled to provide a 65?F leaving water temperature whenever weather conditions permit, floating up to design leaving water temperatures at design conditions. Chilled water supply temperature shall be reset in accordance with Section 1432.2.2.

13. Hot water system shall include a natural draft fossil fuel or electric boiler. The hot water pump shall be sized based on a 30?F temperature drop, from 180?F to 150?F, operating at a combined impeller and motor efficiency of 60%. Hot water supply temperature shall be reset in accordance with Section 1432.2.2.

***

Section Sections 2-76 of Ordinance 121821 are repealed.

Section The provisions of this ordinance are declared to be separate and severable. The invalidity of any clause, sentence, paragraph, subdivision, section or portion of this ordinance, or the invalidity of the application thereof to any person, owner, or circumstance shall not affect the validity of the remainder of this ordinance, or the validity of its application to other persons, owners, or circumstances.

Section For a period of 60 days following the effective date of this ordinance, the Director may also accept and thereafter approve applications that are designed to comply with either the requirements of this Ordinance or the requirements of Ordinance 121821.

Section This ordinance shall take effect and be in force thirty (30) days from and after its approval by the Mayor, but if not approved and returned by the Mayor within ten (10) days after presentation, it shall take effect as provided by Municipal Code Section 1.04.020.

Passed by the City Council the ____ day of _____, 2007, and signed by me in open session in authentication of its passage this _____ day of _____, 2007.

_____

President _____of the City Council

Approved by me this ____ day of _____, 2007.

_____

Gregory J. Nickels, Mayor

Filed by me this ____ day of _____, 2007.

_____

City Clerk

(Seal)

John Hogan/jh

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7/6/2007

version #2