SUPPLEMENT INSERTION GUIDE
for
2004 SEATTLE ENERGY CODE SUPPLEMENT PAGES
July 6, 2005

Supplement No. 1
(covering Ordinance 121821)

This supplement contains the 2004 Seattle amendments to the 2004 Washington State Energy Code (WSEC) and consists of reprinted pages to replace existing pages in the 2004 WSEC.

Remove pages listed in the "Remove Pages" column and in their places insert the pages listed in the "Insert Pages" column.

This Supplement Insertion Guide should be retained as a permanent record of pages supplemented and should be inserted in the front of the code.

Remove Pages	**Insert Pages**
-	insert Seattle insertion guide before WSEC cover page
-	insert Seattle cover page before WSEC cover page
-	insert Seattle preface before WSEC cover page
x-xviii	ix-a to xviii
35-36	35-36
51-54	51-54.1
65-72	65-72.2
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29-15 to 29-18	29-15 to 29-18

An electronic version of the Energy Code is located on the Seattle Department of Planning and Development's Energy Code website. This site contains the entire text of the Energy Code in effect in Seattle. This site also contains links to Client Assistance Memos, forms, and Directors Rules, as well as a search function for the Energy Code, residential energy tips and nonresidential energy tips, and links to other websites with energy efficiency information.

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2004 SEATTLE SUPPLEMENT

Ordinance 121821
Effective July 6, 2005

TO THE

2004
Washington State Energy Code

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Seattle Department of Planning and Development

PREFACE

The Seattle Supplement pages have been published to be used in conjunction with the Washington State Energy Code. The Seattle Supplement pages contain all of the Seattle amendments to the Washington State Energy Code. These pages are intended to be substituted for the comparable pages in the Washington State Energy Code. Because the pages are copied back-to-back, some pages may not have changes and are simply a reproduction of a page in the Washington State Energy Code.

The following changes are noted:

- New text in the 2004 Washington State Energy Code as compared to the previous 2003 Washington State Energy Code is indicated by a thick bar that the State adds in the margin, and significant deletions are indicated by an arrow in the margin. However, specific language changes from the 2003 to 2004 Washington State Energy Code are not noted by strikethrough and underlining.
- Seattle amendments to the 2004 Washington State Energy Code are indicated by dashing out deleted language and underlining Seattle language as follows: ((~~deleted State language~~)), Seattle amendment.
- New text in the 2004 Seattle amendments as compared to the previous 2003 Seattle amendments is also indicated by adding a thin bar in the margin next to the underlined 2004 text.

ACKNOWLEDGMENT

The Seattle Department of Planning and Development acknowledges the time, effort and expertise of the Construction Code Advisory Board (CCAB), the Energy Code Review Committee, and many other individuals who participated in the development of this Energy Code. Special thanks and appreciation go to representatives from the development, design, engineering, construction, and building management communities whose assistance was invaluable in the successful completion of this project. Through sharing their expertise, they helped ensure that the Seattle Energy Code is enforceable and results in energy efficient buildings.

DPD INFORMATION

Permit information:	**(206) 684-8850** DPD Applicant Services Center (ASC) 700 Fifth Avenue, Suite 2000 Seattle, Washington Hours: Monday, Wednesday, Friday: 7:30 am - 5:30 pm Tuesday and Thursday: 10:30 am - 5:30 pm
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CHAPTER 7
STANDARDS

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	2001 ASHRAE Fundamentals Handbook.
RS-2	Super Good Cents Technical Reference (Builder's Field Guide).
RS-3:	(Reserved.)
RS-4	ASHRAE Standard 55-92 Thermal Environmental Conditions for Human Occupancy.
RS-5	1998 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 90.1-2001, Energy Standard for Buildings Except Low-Rise Residential Buildings.
RS-10	2000 ASHRAE Systems & Equipment Handbook.
RS-11	((~~1999~~))2003 ASHRAE HVAC Applications Handbook.
RS-12 – 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 100-2001.
RS-32	Seattle EnvStd, available for download at the Seattle Energy Code homepage at: http://www.seattle.gov/dpd/ener

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

Stress Skin Panel

Panel Thickness, Inches	U-factor
3 1/2	0.071
5 1/2	0.048
7 1/4	0.037
9 1/4	0.030
11 1/4	0.025

NOTE:
R-value of expanded polystyrene: R-3.85 per inch

Framing: 6%
Spline: 8%
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

GROUP R OCCUPANCY: OVERALL ASSEMBLY U-FACTORS FOR METAL STUD WALLS

Metal Framing	R-Value of Continuous Foam Board Insulation	Cavity Insulation					
		R-11	R-13	R-15	R-19	R-21	R-25
16” o.c.	R-0 (none)	U-0.14	U-0.13	U-0.12	U-0.10	U-0.097	U-0.091
	R-1	U-0.12	U-0.12	U-0.11	U-0.094	U-0.089	U-0.083
	R-2	U-0.11	U-0.010	U-0.099	U-0.086	U-0.081	U-0.077
	R-3	U-0.10	U-0.095	U-0.090	U-0.079	U-0.075	U-0.071
	R-4	U-0.091	U-0.087	U-0.082	U-0.073	U-0.070	U-0.067
	R-5	U-0.083	U-0.080	U-0.076	U-0.068	U-0.065	U-0.062
	R-6	U-0.077	U-0.074	U-0.071	U-0.064	U-0.061	U-0.059
	R-7	U-0.071	U-0.069	U-0.066	U-0.060	U-0.058	U-0.055
	R-8	U-0.067	U-0.064	U-0.062	U-0.057	U-0.055	U-0.053
	R-9	U-0.062	U-0.060	U-0.058	U-0.054	U-0.052	U-0.050
	R-10	U-0.059	U-0.057	U-0.055	U-0.051	U-0.049	U-0.048
24” o.c.	R-0 (none)	U-0.13	U-0.12	U-0.11	U-0.091	U-0.085	U-0.079
	R-1	U-0.11	U-0.10	U-0.098	U-0.084	U-0.078	U-0.073
	R-2	U-0.10	U-0.091	U-0.089	U-0.077	U-0.073	U-0.068
	R-3	U-0.092	U-0.083	U-0.082	U-0.072	U-0.068	U-0.064
	R-4	U-0.084	U-0.077	U-0.076	U-0.067	U-0.063	U-0.060
	R-5	U-0.078	U-0.071	U-0.070	U-0.063	U-0.060	U-0.057
	R-6	U-0.072	U-0.067	U-0.066	U-0.059	U-0.056	U-0.054
	R-7	U-0.067	U-0.063	U-0.062	U-0.056	U-0.053	U-0.051
	R-8	U-0.063	U-0.059	U-0.058	U-0.053	U-0.051	U-0.048
	R-9	U-0.059	U-0.056	U-0.055	U-0.050	U-0.048	U-0.046
	R-10	U-0.056	U-0.053	U-0.052	U-0.048	U-0.046	U-0.044

OTHER THAN GROUP R OCCUPANCY: OVERALL ASSEMBLY U-FACTORS FOR METAL STUD WALLS

Metal Framing	R-Value of Continuous Foam Board Insulation	Cavity 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

EFFECTIVE R-VALUES FOR METAL FRAMING AND CAVITY ONLY

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

Default Metal Building U-Factors

	R-10	R-11	R-13	R-19	R-24	R-30
Faced fiber glass blanket insulation rolled over and perpendicular to structural frame. Metal covering sheets fastened to the frame, holding insulation in place.	0.133	0.127	0.114	0.091	na	na
Faced fiber glass batt insulation suspended between structural frame. Metal covering sheets fastened directly to frame.	0.131	0.123	0.107	0.079	0.065	0.057
Faced fiber glass blanket insulation rolled over and perpendicular to structural frame. Rigid insulation blocks placed over insulation to align with structural frame.	0.102	0.096	0.084	0.065	na	na
Faced fiber glass batt insulation suspended between structural frame. Rigid insulation blocks placed over insulation to align with structural frame.	0.099	0.093	0.080	0.059	0.048	0.041

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

8" Concrete Masonry

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

12" Concrete Masonry

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

8" Clay Brick

WALL DESCRIPTION	CORE TREATMENT			
	Partial Grout with Ungrouted Cores			Solid Grout
	Empty	Loose-fill insulated		
		Perlite	Vermiculite	
Exposed Block, Both Sides	0.50	0.31	0.32	0.56
R-5 Interior Insulation, Wood Furring	0.15	0.13	0.13	0.16
R-6 Interior Insulation, Wood Furring	0.15	0.12	0.12	0.15
R-10.5 Interior Insulation, Wood Furring	0.12	0.10	0.10	0.12
R-8 Interior Insulation, Metal Clips	0.11	0.10	0.10	0.11
R-6 Exterior Insulation	0.12	0.11	0.11	0.13
R-10 Exterior Insulation	0.08	0.08	0.08	0.09

6" Concrete Poured or Precast

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

Notes for Default Table 10-5B(1)

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

TABLE 10-5B(2)
OTHER THAN GROUP R OCCUPANCY:
DEFAULT U-FACTORS FOR CONCRETE AND MASONRY WALLS

Framing Type and Depth	Rated R-Value of Insulation Alone	Assembly U-Factors for Solid Concrete Walls	Assembly U-Factors for Concrete Block Walls: Solid Grouted	Assembly U-Factors for Concrete Block Walls: Partially Grouted (Cores uninsulated except where specified)
No Framing	R- 0	U- 0.740	U- 0.580	U- 0.480
	Ungrouted Cores Filled with Loose-Fill Insulation	N.A.	N.A.	U- 0.350
Continuous Wood Framing				
0.75 in.	R- 3.0	U- 0.247	U- 0.226	U- 0.210
1.5 in.	R- 6.0	U- 0.160	U- 0.151	U- 0.143
2.0 in.	R- 10.0	U- 0.116	U- 0.111	U- 0.107
3.5 in.	R- 11.0	U- 0.094	U- 0.091	U- 0.088
3.5 in.	R- 13.0	U- 0.085	U- 0.083	U- 0.080
3.5 in.	R- 15.0	U- 0.079	U- 0.077	U- 0.075
5.5 in.	R- 19.0	U- 0.060	U- 0.059	U- 0.058
5.5 in.	R- 21.0	U- 0.057	U- 0.055	U- 0.054
Continuous Metal Framing at 24 in. on center horizontally				
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
3.5-4.0 in.	R- 11.0	U- 0.168	U- 0.158	U- 0.149
3.5-4.0 in.	R- 13.0	U- 0.161	U- 0.152	U- 0.144
3.5-4.0 in.	R- 15.0	U- 0.155	U- 0.147	U- 0.140
5.5-6.0 in.	R- 19.0	U- 0.118	U- 0.113	U- 0.109
5.5-6.0 in.	R- 21.0	U- 0.113	U- 0.109	U- 0.105
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
	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/ft^3.
   (b) Solid grouted concrete block wall: 8-in. medium weight ASTM C90 concrete block with a density of 115 lb/ft^3 and solid grouted cores.
   (c) Partially grouted concrete block wall: 8-in. medium weight ASTM C90 concrete block with a density of 115 lb/ft^3 having reinforcing steel every 32 in. vertically and every 48 in. horizontally, with cores grouted in those areas only. Other cores are filled with insulating material only if there is no other insulation.

3. For walls with insulation contained in a framing layer, the U-factors in Table 10-5B(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 90.1-2001, Appendix A, Section A3.1 and Tables A-5 to A-8, or Section A9.4. If not taken from Table 10-9, heat capacity for mass walls shall be taken from ASHRAE/IESNA Standard 90.1-2001, Appendix A, Table A-6 or A-7.

SECTION 1006 — DEFAULT U-FACTORS FOR GLAZING AND DOORS

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

TABLE 10-6
OTHER THAN GROUP R OCCUPANCY:
DEFAULT U-FACTORS FOR VERTICAL GLAZING, OVERHEAD GLAZING AND OPAQUE DOORS

VERTICAL GLAZING

	U-Factor		
	Any Frame	Aluminum w/Thermal Break	Wood/ Vinyl Frame
Single	1.45	1.45	1.45
Double	0.90	0.85	0.75
½ Inch Air, Fixed	0.75	0.70	0.60
½ Inch Air, Low-e$^{(0.40)}$, Fixed	0.60	0.55	0.50
½ Inch Air, Low-e$^{(0.10)}$, Fixed	0.55	0.50	0.45
½ Inch Argon, Low-e$^{(0.10)}$, Fixed	0.50	0.45	0.40

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

OVERHEAD GLAZING: SLOPED GLAZING (INCLUDING FRAME)

	U-Factor		
	Any Frame	Aluminum w/Thermal Break	Wood/Vinyl Frame
Single	1.74	1.74	1.74
Double	1.08	1.02	0.90
1/2 Inch Air, Fixed	0.90	0.84	0.72
1/2 Inch Air, Low-e$^{(0.40)}$, Fixed	0.72	0.66	0.60
1/2 Inch Air, Low-e$^{(0.10)}$, Fixed	0.66	0.60	0.54
1/2 Inch Argon, Low-e$^{(0.10)}$, Fixed	0.60	0.54	0.48

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

OPAQUE DOORS

	U-Factor
Uninsulated Metal	1.20
Insulated Metal (Including Fire Door and Smoke Vent)	0.60
Wood	0.50

NOTES:

Where a gap width is listed (i.e.: 1/2 inch), that is the minimum allowed.

Where a low-emissivity emittance is listed (i.e.: 0.40, 0.20, 0.10), that is the maximum allowed.

Where a gas other than air is listed (i.e.: Argon), the gas fill shall be a minimum of 90%.

Where an operator type is listed (i.e.: Fixed), the default is only allowed for that operator type.

Where a frame type is listed (i.e.: Wood/Vinyl), the default is only allowed for that frame type. Wood/Vinyl frame includes reinforced vinyl and aluminum-clad wood.

CHAPTER 11
ADMINISTRATION AND ENFORCEMENT

SECTION 1100 — TITLE

Chapters 11 through 20 of this Code shall be known as the "Washington State Nonresidential Energy Code" and may be cited as such; and will be referred to hereafter as "this Code."

SECTION 1110 — PURPOSE AND INTENT

The purpose of this Code is to provide minimum standards for new or altered buildings and structures or portions thereof to achieve efficient use and conservation of energy. It is intended that these provisions provide flexibility to permit the use of innovative approaches and techniques to achieve efficient use and conservation of energy.

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

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

SECTION 1120 — SCOPE

This Code sets forth minimum requirements for the design of new or altered buildings and structures or portions thereof that provide facilities or shelter for public assembly, educational, business, mercantile, institutional, storage, factory, and industrial occupancies by regulating their exterior envelopes and the selection of their HVAC, service water heating, electrical distribution and illuminating systems, and equipment for efficient use and conservation of energy.

> **EXCEPTION:** The provisions of this code do not apply to temporary growing structures used solely for the commercial production of horticultural plants including ornamental plants, flowers, vegetables, and fruits. “Temporary growing structure” means a structure that has the sides and roof covered with polyethylene, polyvinyl, or similar flexible synthetic material and is used to provide plants with either frost protection or increased heat retention. A temporary growing structure is not considered a building for purposes of this Code.

SECTION 1130 — APPLICATION TO EXISTING BUILDINGS

Additions, alterations or repairs, changes of occupancy or use, or historic buildings that do not comply with the requirements for new buildings shall comply with the requirements in Sections 1130 through 1134 as applicable.

> **EXCEPTION:** The building official may approve designs of alterations or repairs which do not fully conform with all of the requirements of Sections 1130 through 1134 where in the opinion of the building official full compliance is physically impossible and/or economically impractical and the alteration or repair improves the energy efficiency of the building.

In no case shall energy code requirements be less than those requirements in effect at the time of the initial construction of the building.

1131 Additions to Existing Buildings: Additions to existing buildings or structures may be constructed without making the entire building or structure comply, provided that the new additions shall conform to the provisions of this Code.

> **EXCEPTION:** New additions which do not fully comply with the requirements of this Code and which have a floor area which is less than 750 ft^2 may be approved provided that improvements are made to the existing building to compensate for any deficiencies in the new addition. Compliance shall be demonstrated by either systems analysis per Section 1141.4 or component performance calculations per Sections 1330 through 1334. The nonconforming addition and upgraded existing building shall have an energy budget or target UA and SHGC that are less than or equal to the unimproved existing building, with the addition designed to comply with this Code.

1132 Alterations and Repairs: Alterations and repairs to buildings or portions thereof originally constructed subject to the requirements of this Code shall conform to the provisions of this Code without the use of the exception in Section 1130. Other alterations and repairs may be made to existing buildings and moved buildings without making the entire building comply with all of the requirements of this Code for new buildings, provided the following requirements are met:

1132.1 Building Envelope: Alterations or repairs shall comply with nominal R-values and glazing requirements in Table 13-1 or 13-2.

> **EXCEPTIONS:** 1. Storm windows installed over existing glazing.
>
> 2. Glass replaced in existing sash and frame provided that glazing is of equal or lower U-factor.

3. For solar heat gain coefficient compliance, glazing with a solar heat gain coefficient equal to or lower than that of the other existing glazing.

4. Existing roof/ceiling, wall or floor cavities exposed during construction provided that these cavities are insulated to full depth with insulation having a minimum nominal value of R-3.0 per inch installed per Sections 1311 and 1313.

5. Existing walls and floors without framing cavities, provided that any new cavities added to existing walls and floors comply with Exception 4.

6. Existing roofs where the roof membrane is being replaced and

a. The roof sheathing or roof insulation is not exposed; or

b. If there is existing roof insulation below the deck.

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

1132.2 Building Mechanical Systems: Those parts of systems which are altered or replaced shall comply with Chapter 14 of this Code.

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

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

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

1. Water-cooled refrigeration equipment provided with a water economizer meeting the requirements of Section 1413 need not comply with 1423 or 1433. This exception shall not be used for RS-29 analysis.

2. Alternate designs that are not in full compliance with this Code may be approved when the Building Official determines that existing building or occupancy constraints make full compliance impractical or where full compliance would be economically impractical.

Alterations to existing mechanical cooling systems shall not decrease economizer capacity unless the system complies with Sections 1413 and either 1423 or 1433. In addition, for existing mechanical cooling systems that do not comply with Sections 1413 and either 1423 or 1433, including both the individual unit size limits and the total building capacity limits on units without economizer, other alterations shall comply with Table 11-1, except for approved long-term plans that comply with the 2002 Seattle Energy Code and were submitted prior to 1 July 2004.

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

TABLE 11-1:
ECONOMIZER COMPLIANCE OPTIONS FOR MECHANICAL ALTERATIONS

	Option A	Option B (alternate to A)	Option C (alternate to A)	Option D (alternate to A)
Unit Type	**Any alteration with new or replacement equipment**	**Replacement unit of the same type with the same or smaller output capacity**	**Replacement unit of the same type with a larger output capacity**	**New equipment added to existing system or replacement unit of a different type**
1. Packaged Units	Efficiency: min.[1] Economizer: 1433[2]	Efficiency: min.[1] Economizer: 1433[2,3]	Efficiency: min.[1] Economizer: 1433[2,3]	Efficiency: min.[1] Economizer: 1433[2,4]
2. Split Systems	Efficiency: min.[1] Economizer: 1433[2]	Efficiency: + 10/5%[5] Economizer: shall not decrease existing economizer capability	Only for new units < 54,000 Btuh replacing unit installed prior to 1991 (one of two): Efficiency: + 10/5%[5] Economizer: 50%[6] For units > 54,000 Btuh or any units installed after 1991: Option A	Efficiency: min.[1] Economizer: 1433[2,4]
3. Water Source Heat Pump	Efficiency: min.[1] Economizer: 1433[2]	(two of three): Efficiency: + 10/5%[5] Flow control valve[7] Economizer: 50%[6]	(three of three): Efficiency: + 10/5%[5] Flow control valve[7] Economizer: 50%[6] (except for certain pre-1991 systems[8])	Efficiency: min.[1] Economizer: 1433[2,4] (except for certain pre-1991 systems[8])
4. Hydronic Economizer using Air-Cooled Heat Rejection Equipment (Dry Cooler)	Efficiency: min.[1] Economizer: 1433[2]	Efficiency: + 10/5%[5] Economizer: shall not decrease existing economizer capacity	Option A	Efficiency: min.[1] Economizer: 1433[2,4]
5. Air-Handling Unit (including fan coil units) where the system has an air-cooled chiller	Efficiency: min.[1] Economizer: 1433[2]	Economizer: shall not decrease existing economizer capacity	Option A (except for certain pre-1991 systems[8])	Option A (except for certain pre-1991 systems[8])

	Option A	Option B (alternate to A)	Option C (alternate to A)	Option D (alternate to A)
Unit Type	**Any alteration with new or replacement equipment**	**Replacement unit of the same type with the same or smaller output capacity**	**Replacement unit of the same type with a larger output capacity**	**New equipment added to existing system or replacement unit of a different type**
6. Air-Handling Unit (including fan coil units) and Water-cooled Process Equipment, where the system has a water-cooled chiller[10]	Efficiency: min.[1] Economizer: 1433[2]	Economizer: shall not decrease existing economizer capacity	Option A (except for certain pre-1991 systems[8] and certain 1991-2004 systems[9].)	Efficiency: min.[1] Economizer: 1433[2,4] (except for certain pre-1991 systems[8] and certain 1991-2004 systems[9])
7. Cooling Tower	Efficiency: min.[1] Economizer: 1433[2]	No requirements	Option A	Option A
8. Air-Cooled Chiller	Efficiency: min.[1] Economizer: 1433[2]	Efficiency: + 5%[11] Economizer: shall not decrease existing economizer capacity	Efficiency (two of two): (1) + 10%[12] and (2) multistage Economizer: shall not decrease existing economizer capacity	Efficiency: min.[1] Economizer: 1433[2,4]
9. Water-Cooled Chiller	Efficiency: min.[1] Economizer: 1433[2]	Efficiency (one of two): (1) + 10%[13] or (2) plate frame heat exchanger[15] Economizer: shall not decrease existing economizer capacity	Efficiency (two of two): (1) + 15%[14] and (2) plate-frame heat exchanger[15] Economizer: shall not decrease existing economizer capacity	Efficiency: min.[1] Economizer: 1433[2,4]
10. Boiler	Efficiency: min.[1] Economizer: 1433[2]	Efficiency: + 8%[16] Economizer: shall not decrease existing economizer capacity	Efficiency: + 8%[16] Economizer: shall not decrease existing economizer capacity	Efficiency: min.[1] Economizer: 1433[2,4]

1. Minimum equipment efficiency shall comply with Section 1411.1 and Tables 14-1A through M.
2. System and building shall comply with Section 1433 (including both the individual unit size limits and the total building capacity limits on units without economizer). It is acceptable to comply using one of the exceptions to Section 1433.
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.
   - Effective 1 July 2005, if not already installed, variable frequency drive shall be installed on the main loop pump at this time regardless of the pump size.
   - 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 NPLV efficiency that is a minimum of 10% greater than the NPLV requirements in Table 14-1K, Table 14-1L, or Table 14-1M (1.10 x NPLV values in Table 14-1K, Table 14-1L, or Table 14-1M).

14. The water-cooled chiller shall have an NPLV efficiency that is a minimum of 15% greater than the NPLV requirements in Table 14-1K, Table 14-1L, or Table 14-1M (1.15 x NPLV values in 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 (((~~as defined in Table 15-1) within a tenant space or in an entire floor~~))are new shall comply with Sections 1531 and 1532. (Where this threshold is triggered, the areas of the affected spaces may be aggregated for code compliance calculations.)

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

1134 Historic Buildings: The building official may modify the specific requirements of this Code for historic buildings and require in lieu thereof alternate requirements which will result in a reasonable degree of energy efficiency. This modification may be allowed for those buildings which have been specifically designated as historically significant by the state or local governing body, or listed in The National Register of Historic Places or which have been determined to be eligible for listing.

SECTION 1140 — ENFORCEMENT

The building official shall have the power to render interpretations of this Code and to adopt and enforce rules and supplemental regulations in order to clarify the application of its provisions. Such interpretations, rules and regulations shall be in conformance with the intent and purpose of this Code. Fees may be assessed for enforcement of this Code and shall be as set forth in the fee schedule adopted by the jurisdiction.

1141 Plans and Specifications

1141.1 General: If required by the building official, plans and specifications shall be submitted in support of an application for a building permit. If required by the building official, plans and specifications shall be stamped and authenticated by a registered design professional currently licensed in the state of Washington. All plans and specifications, together with supporting data, shall be submitted to the building official prior to issuance of a building permit.

1141.2 Details: The plans and specifications shall show in sufficient detail all pertinent data and features of the building and the equipment and systems as herein governed including, but not limited to: design criteria; exterior envelope component materials, U-factors of the envelope systems, R-values of insulating materials; U-factors and solar heat gain coefficients or shading coefficients of glazing; area weighted U-factor calculations; efficiency,

economizer, size and type of apparatus and equipment; fan system horsepower; equipment and systems controls; lighting fixture schedule with wattages and controls narrative; and other pertinent data to indicate compliance with the requirements of this Code.

1141.3 Alternate Materials and Method of Construction: The provisions of this Code are not intended to prevent the use of any material, method of construction, design or insulating system not specifically prescribed herein, provided that such construction, design or insulating system has been approved by the building official as meeting the intent of this Code. The building official may approve any such alternate provided the proposed alternate meets or exceeds the provisions of this Code and that the material, method, design or work offered is for the purpose intended, at least the equivalent of that prescribed in this Code, in quality, strength, effectiveness, fire-resistance, durability, safety and energy efficiency. The building official may require that sufficient evidence of proof be submitted to substantiate any claims that may be made regarding performance capabilities.

1141.4 Systems Analysis Approach for the Entire Building: In lieu of using Chapters 12 through 20, compliance may be demonstrated using the systems analysis option in Standard RS-29. When using systems analysis, the proposed building shall provide equal or better conservation of energy than the standard design as defined in Standard RS-29. If required by the building official, all energy comparison calculations submitted under the provisions of Standard RS-29 shall be stamped and authenticated by an engineer or architect licensed to practice by the state of Washington.

1142 Materials and Equipment

1142.1 Identification: All materials and equipment shall be identified in order to show compliance with this Code.

1142.2 Maintenance Information: Maintenance instructions shall be furnished for any equipment which requires preventive maintenance for efficient operation. Required regular maintenance actions shall be clearly stated and incorporated on a readily accessible label. Such label may be limited to identifying, by title or publication number, the operation and maintenance manual for that particular model and type of product.

1143 Inspections

1143.1 General: All construction or work for which a permit is required shall be subject to inspection by the building official and all such construction or work shall remain accessible and exposed for inspection purposes until approved by the building official. No work shall be done on any part of the building or structure beyond the point indicated in each inspection without first obtaining the approval of the building official.

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

1143.2.1 Envelope

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

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

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

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

1143.2.2 Mechanical

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

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

1143.2.3 Lighting and Motors

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

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

1143.3 Re-inspection: The building official may require a structure to be re-inspected. A re-inspection fee may be assessed for each inspection or re-inspection when such portion of work for which inspection is called is not complete or when corrections called for are not made.

1144 Violations <u>and Penalties</u>: ((~~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.~~))

<u>1144.1 Violations:</u> <u>It shall be a violation of this Code for any person, firm or corporation to 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.</u>

<u>It shall be a violation of this Code for any person, firm or corporation to knowingly aid, abet, counsel, encourage, hire, commend, induce or otherwise procure another to violate or fail to comply with this Code.</u>

<u>It shall be a violation of this Code for any person, firm, or corporation to 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.</u>

<u>1144.2 Notice of Violation:</u> <u>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</u>

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 service 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 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 in this section.

1144.3 Civil Penalties: Any person, firm or corporation 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. 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 Director is not itself evidence that a violation exists.

1144.4 Criminal Penalty: Any person who violates or fails to comply with this chapter shall be guilty of a gross misdemeanor subject to the provisions of Chapters 12A.02 and 12A.04, except that absolute liability shall be imposed for such a violation or failure to comply and none of the mental states described in Section 12A04.030 need be proved. The Director may request the City Attorney prosecute such violations criminally as an alternative to the civil penalty provision outlined in the code. Each day any person, firm, or corporation shall continue to violate or fail to comply with the provisions of this chapter sand each occurrence of a prohibited activity 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 which constitutes a violation of this code when civil or criminal penalties are inadequate to effect compliance. In any such action, the City has the burden of proving by a preponderance of the evidence that a violation exists or will exist; the issuance of the notice of violation or of an order following a review by the Director is not itself evidence that a violation exists or will exist.

1144.6 Notices: It shall be unlawful for any person to remove, mutilate, destroy or conceal any notice issued or posted by the building official pursuant to the provisions of this code, or any notice issued or posted by the building official in response to a natural disaster or other emergency.

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.

1144.7 Review by the Director

1144.7.1. Any party affected by a notice of violation issued by the Director pursuant to Section 1144.2 may obtain a review of the notice by requesting such review 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 shall run until 5:00 p.m. of the next business day. Upon receipt of a request, the Director shall notify the person requesting the review of the date, time, and place of the Director's review. The review shall not be less than ten nor more than twenty days after the request is received, unless otherwise agreed by the person requesting the review. Any person affected by the notice of violation may submit any written material to the Director on or before the date of the review.

1144.7.2. The review will consist of an informal review meeting held at the Department. A representative of the Director who is familiar with the case and the applicable regulations will attend. The Director's representative will consider any information presented by the persons attending and in the Department's enforcement file. At or after the review, the Director shall issue an order of the Director that may:

1. Sustain the notice of violation; or
2. Withdraw the notice of violation; or
3. Continue the review to a future date; or
4. Amend the notice of violation.

1144.7.3. The Director shall issue an Order of the Director containing the decision within a reasonable time after the conclusion of the review. The Director shall mail the order by regular first-class mail to the person or persons named in the notice of violation.

SECTION 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.

SECTION 1160 — SEVERABILITY & LIABILITY

1161 Severability: If any provision of this Code or its application to any person or circumstance is held invalid, the remainder of this Code or the application of the provision to other persons or circumstances is not affected.

The legislative body hereby declares that it would have passed this Code, and each section, subsection, clause or phrase thereof, irrespective of the fact that any one or more sections, subsections, sentences, clauses, and phrases be declared unconstitutional.

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. The building official or any employee charged with the enforcement of this Code, acting in good faith and without malice for the City in the discharge of his/her duties, shall not thereby render himself/herself liable personally and he/she is hereby relieved from all personal liability for any damage that may accrue to persons or property as a result of any act required or by reason of any act or omission in the discharge of his/her duties.

CHAPTER 12
(RESERVED)

NOTE: For Nonresidential Definitions, see Chapter 2.

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.

1302 Space Heat Type: For the purpose of determining building envelope requirements, the following two categories comprise all space heating types:

Electric Resistance: Space heating systems which use electric resistance elements as the primary heating system including baseboard, radiant and forced air units where the total electric resistance heat capacity exceeds 1.0 W/ft^2 of the gross conditioned floor area.

EXCEPTION: Heat pumps and terminal electric resistance heating in variable air volume distribution systems.

Other: All other space heating systems including gas, solid fuel, oil and propane space heating systems and those systems listed in the exception to electric resistance.

1303 Climate Zones: All buildings shall comply with the requirements of the appropriate climate zone as defined herein.

ZONE 1: Climate Zone 1 shall include all counties not included in Climate Zone 2.

ZONE 2: Climate Zone 2 shall include: Adams, Chelan, Douglas, Ferry, Grant, Kittitas, Lincoln, Okanogan, Pend Oreille, Spokane, Stevens and Whitman counties.

SECTION 1310 — GENERAL REQUIREMENTS

The building envelope shall comply with Sections 1311 through 1314.

((~~1310.1 Conditioned Spaces~~:)) The building envelope for all conditioned spaces (as defined in Chapter 2) shall also comply with one of the following paths:

a. Prescriptive Building Envelope Option Sections 1320 through 1323.

b. Component Performance Building Envelope Option Sections 1330 through 1334.

c. Systems Analysis. See Section 1141.4.

EXCEPTION: For semi-heated spaces 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 °F, mounted no lower than the heating unit.

((~~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 • ft^2) or greater but not greater than 8 Btu/(h • ft^2) and in Climate Zone 2, shall be 5 Btu/(h • ft^2) or greater but not greater than 12 Btu/(h • ft^2). Heating shall be controlled by a thermostat mounted not lower than the heating unit and capable of preventing heating above 44°F space temperature. For semi-heated spaces, the only prescriptive, component performance or systems analysis building envelope requirement shall be that:~~

~~Climate Zone 1~~

~~a. U=0.10 maximum for the roof assembly, or~~

~~b. continuous R-9 insulation installed entirely outside of the roof structure, or~~

~~c. R-11 insulation installed inside or within a wood roof structure, or~~

~~d. R-19 insulation installed inside or within a metal roof structure.~~

~~Climate Zone 2~~

~~a. U=0.07 maximum for the roof assembly, or~~

~~b. continuous R-14 insulation installed entirely outside of the roof structure, or~~

~~c. R-19 insulation installed inside or within a wood roof structure, or~~

~~d. R-25 insulation installed inside or within a metal roof structure.~~

FIGURE 13A
BUILDING ENVELOPE COMPLIANCE OPTIONS

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

1311 Insulation

1311.1 Installation Requirements: All insulation materials shall be installed according to the manufacturer's instructions to achieve proper densities, maintain clearances and maintain uniform R-values. To the maximum extent possible, insulation shall extend over the full component area to the intended R-value.

1311.2 Roof/Ceiling Insulation: Open-blown or poured loose-fill insulation may be used in attic spaces where the slope of the ceiling is not more than 3/12 and there is at least 30 inches of clear distance from the top of the bottom chord of the truss or ceiling joist to the underside of the sheathing at the roof ridge. When eave vents are installed, baffling of the vent openings shall be provided so as to deflect the incoming air above the surface of the insulation.

Where lighting fixtures are recessed into a suspended or exposed grid ceiling, the roof/ceiling assembly shall be insulated in a location other than directly on the suspended ceiling.

EXCEPTION: Type IC rated recessed lighting fixtures. Where installed in wood framing, faced batt insulation shall be face stapled.

1311.3 Wall Insulation: Exterior wall cavities isolated during framing shall be fully insulated to the levels of the surrounding walls. When installed in wood framing, faced batt insulation shall be face stapled.

Above grade exterior insulation shall be protected.

1311.4 Floor Insulation: Floor insulation shall be installed in a permanent manner in substantial contact with the surface being insulated. Insulation supports shall be installed so spacing is not more than 24 inches on center. Installed insulation shall not block the airflow through foundation vents.

1311.5 Slab-On-Grade Floor: Slab-on-grade insulation installed inside the foundation wall shall extend downward from the top of the slab a minimum distance of 24 inches or to the top of the footing, whichever is less. Insulation installed outside the foundation shall extend downward a minimum of 24 inches or to the frostline, whichever is greater. Above grade insulation shall be protected.

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

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

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

1312 Glazing and Doors

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

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

> **EXCEPTIONS:** 1. Shading coefficients (SC) or solar heat gain coefficient for the center of glass shall be an acceptable alternate for compliance with solar heat gain coefficient requirements. Shading coefficients or solar heat gain coefficient for the center of glass for glazing shall be taken from Chapter 30 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 30 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 to 0.07 for wood/vinyl/ fiberglass frames), the SHGC for the frame is invariably lower than that for the glass. Consequently, an NFRC-certified SHGC will generally be lower.
>
> Conversely, the VT for the center-of-glass overstates the VT for the overall product (including the frame). The VT for the frame is zero. Consequently, an NFRC-certified VT will always be lower. For this reason, Exception 2 to Section 1312.2 is only applicable to Exception 1 in Section 1323. It is not applicable to other sections.

1313 Moisture Control

1313.1 Vapor Retarders: Vapor retarders shall be installed on the warm side (in winter) of insulation as required by this section.

> **EXCEPTION:** Vapor retarder installed with not more than 1/3 of the nominal R-value between it and the conditioned space.

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

> **EXCEPTION:** Vapor retarders need not be provided where all of the insulation is installed between the roof membrane and the structural roof deck.

1313.3 Walls: Walls separating conditioned space from unconditioned space shall be provided with a vapor retarder.

1313.4 Floors: Floors separating conditioned space from unconditioned space shall be provided with a vapor retarder.

1313.5 Crawlspaces: A ground cover of six mil (0.006 inch thick) black polyethylene or approved equal shall be laid over the ground within crawlspaces. The ground cover shall be overlapped 12 inches minimum at the joints and shall extend to the foundation wall.

> **EXCEPTION:** The ground cover may be omitted in crawl spaces if the crawlspace has a concrete slab floor with a minimum thickness of 3-1/2 inches.

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.

1314.2 Glazing and Doors: 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.

> **EXCEPTION:** Openings that are required to be fire resistant.

1314.3 Building Assemblies Used as Ducts or Plenums: Building assemblies used as ducts or plenums shall be sealed, caulked and gasketed to limit air leakage.

SECTION 1320 — PRESCRIPTIVE BUILDING ENVELOPE OPTION

1321 General: This section establishes building envelope design criteria in terms of prescribed requirements for building construction.

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 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-46 (in lieu of R-30) for electric resistance space heat and R-27 (in lieu of R-21) for other fuels.

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 exception may only be used for the first 20 feet of that story.

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

2. Single glazing for ornamental, security or architectural purposes shall be included in the percentage of the 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.

1323.1 Area: The percentage of total glazing (vertical and overhead) area relative to the gross exterior wall area shall not be greater than the appropriate value from Tables 13-1 or 13-2 for the vertical glazing U-factor, overhead glazing U-factor and solar heat gain coefficient selected.

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

1323.3 Solar Heat Gain Coefficient: The area-weighted average solar heat gain coefficient of all glazing 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 Factor	SHGC Multiplier (All Orientations except North-oriented)	SHGC Multiplier (North-Oriented)
0 - 0.10	1.00	1.00
<0.10 - 0.20	0.91	0.95
<0.20 - 0.30	0.82	0.91
<0.30 - 0.40	0.74	0.87
<0.40 - 0.50	0.67	0.84
<0.50 - 0.60	0.61	0.81
<0.60 - 0.70	0.56	0.78
<0.70 - 0.80	0.51	0.76
<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.)

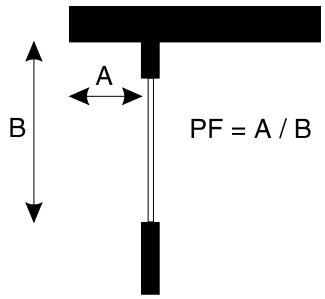

Exhibit 1323.3

SECTION 1330 — COMPONENT PERFORMANCE BUILDING ENVELOPE OPTION

1331 General: Buildings or structures whose design heat loss rate (UA_p) and solar heat gain coefficient rate (SHGC * A_p) are less than or equal to the target heat loss rate (UA_t) and solar heat gain coefficient rate (SHGC * A_t) shall be considered in compliance with this section. The stated U-factor, F-factor or allowable area of any component assembly, listed in Tables 13-1 or 13-2, such as roof/ceiling, opaque wall, opaque door, 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.

1332 Component U-Factors: The U-factors for typical construction assemblies are included in Chapter 10. These values shall be used for all calculations. Where proposed construction assemblies are not represented in Chapter 10, values shall be calculated in accordance with Chapters 23 through 30 in Standard RS-1 listed in Chapter 7, using the framing factors listed in Chapter 10. For envelope assemblies containing metal framing, the U-factor shall be determined by one of the following methods:

1. Results of laboratory measurements according to acceptable methods of test.
2. Standard RS-1, listed in Chapter 7, where the metal framing is bonded on one or both sides to a metal skin or covering.
3. The zone method as provided in Chapter 25 of Standard RS-1, listed in Chapter 7.
4. Effective framing/cavity R-values as provided in Table 10-5A.

When return air ceiling plenums are employed, the roof/ceiling assembly shall:

a. For thermal transmittance purposes, not include the ceiling proper nor the plenum space as part of the assembly; and

b. For gross area purposes, be based upon the interior face of the upper plenum surface.

1333 UA Calculations: The target UA_t and the proposed UA_p shall be calculated using Equations 13-1 and 13-2 and the corresponding areas and U-factors from Table 13-1 or 13-2. For the target UA_t calculation, the overhead glazing 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.

1334 Solar Heat Gain Coefficient Rate Calculations: Solar heat gain coefficient shall comply with Section 1323.3. The target $SHGCA_t$ and the proposed $SHGCA_p$ shall be calculated using Equation 13-3 and 13-4 and the corresponding areas and SHGCs from Table 13-1 or 13-2.

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 Attic[3]	All Other Roofs[3]	Opaque Walls[1,2]	Opaque Doors	Floor Over Uncond Space	Slab-On-Grade[5]
1. Electric resistance heat**	R-38 or U=0.031	R-30 or U=0.034	R-19 or U=0.062	U=0.60	R-30 or U=0.029	R-10 or F=0.54
2. All others including heat pumps and VAV	R-30 or U=0.036	R-21 or U=0.046	(a) Metal framing: ((~~R-19 or U=0.109~~)) R-13 cavity insul. + R-3.8 continuous insul. or U=0.084; (b) Wood framing & framing other than metal: R-19 or U=0.062	U=0.60	R-19 or U=0.056	R-10 or F=0.54

**** 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 Area as % of Wall	0% to 30%			>30% to 45%		
	Maximum U-Factor		Max SHGC[4,8]	Maximum U-Factor		Max SHGC[4,8]
	VG	OG		VG	OG	
1. Electric resistance heat[7]	0.40	((~~0.60~~)) 0.48	0.40	PRESCRIPTIVE PATH NOT ALLOWED		
2. All others including heat pumps and VAV[6]	0.55	((~~0.70~~)) 0.66	((~~0.45~~)) 0.40	0.45	((~~0.60~~)) 0.54	0.40

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 U_{bgwt} ,
   b) walls insulated on the exterior shall use a target U-factor of U=0.070 for U_{bgwt} ,
   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 A_{bgwt} and A_{bgw}.

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/ft^2 • °F, then:
   a) The area weighted average U-factor may be increased to ((~~U-0.15 maximum, or a minimum additional R-5.7 continuous insulation uninterrupted by framing~~)) 0.11 maximum for interior insulation:
      i) minimum R-11 insulation between wood studs; or
      ii) minimum R-19 insulation between metal studs; or
      iii) minimum R-10 insulation held in place solely by 1 inch metal clips at 24 inches on center vertically and 16 inches on center horizontally; or
   b) 0.12 for integral and exterior insulation for insulation position as defined in Chapter 2.
      i) minimum additional R-7 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•ft^2•°F.~~))
   -- Individual walls with heat capacities less than 9.0 Btu/ft^2 •°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 Wall:	Maximum U-Factor		Max.
	VG	OG	SHGC[4]
>45% to 50%	0.40	0.48	0.35

7. **Prescriptive Alternate for Electric Resistance Space Heat** (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), 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.

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TABLE 13-2
BUILDING ENVELOPE REQUIREMENTS FOR CLIMATE ZONE 2

Minimum Insulation R-Values or Maximum Component U-Factors for Zone 2

Building Components

Space Heat Type	Components					
	Roofs Over Attic	All Other Roofs	Opaque Walls[1,2]	Opaque Doors	Floor Over Uncond Space	Slab On Grade[5]
1. Electric resistance heat**	R-38 or U=0.031	R-30 or U=0.034	R-24 or U=0.044	U=0.60	R-30 or U=0.029	R-10 or F=0.54
2. All others including heat pumps and VAV	R-38 or U=0.031	R-25 or U=0.039	(a) Metal framing: R-13 cavity insul. + R-3.8 continuous insul. or U=0.084; (b) Wood framing & framing other than metal: R-19 or U=0.062	U=0.60	R-21 or U=0.047	R-10 or F=0.54

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

Maximum Glazing Areas and U-Factors and Maximum Glazing Solar Heat Gain Coefficients for Zone 2

Glazing

Maximum Glazing Area as % of Wall	0% to 30%			>30% to 45%		
	Maximum U-Factor		Max SHGC[4]	Maximum U-Factor		Max SHGC[4]
	VG	OG		VG	OG	
1. Electric resistance heat	0.40	0.60	0.40	Prescriptive Path Not Allowed		
2. All others including heat pumps and VAV	0.55	0.70	0.45	0.45	0.60	0.40

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-12 insulation,
   c) walls shall be insulated for the first 10 feet below grade. (There shall be no credit for insulating 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=0.061 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 • °F, then the U-factor may be increased to 0.123 maximum, or minimum additional R-7.6 continuous insulation uninterrupted by framing.

   --Individual walls with heat capacities less than 9.0 Btu/ft2 • °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.

CHAPTER 14
BUILDING MECHANICAL SYSTEMS

1401 Scope: This section covers the determination of requirements, system and component performance, control requirements and duct construction.

1402 Mechanical Ventilation: The minimum requirements for ventilation shall comply with the ((~~Washington State Ventilation and Indoor Air Quality Code (WAC 51-13)~~)) Seattle Mechanical Code.

SECTION 1410 — GENERAL REQUIREMENTS:

The building mechanical system shall comply with Sections 1411 through 1416, Sections 1440 through 1443, Sections 1450 through 1454, and with one of the following paths:

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

b. Complex Systems, Sections 1430 through 1439

c. Systems Analysis. See Section 1141.4

FIGURE 14A
MECHANICAL SYSTEMS COMPLIANCE PATH

Section Number	Subject	Simple Systems Path	Complex Systems Path	Systems Analysis Option
1410	General Requirements	X	X	X
1411	HVAC Equipment Performance Requirements	X	X	X
1412	Controls	X	X	X
1413	Air Economizers	X	X	X
1414	Ducting Systems	X	X	X
1415	Piping Systems	X	X	X
1416	Completion Requirements	X	X	X
1420	Simple Systems (Packaged Unitary Equipment)	X		
1421	System Type	X		
1422	Controls	X		
1423	Economizers	X		
1424	Separate Air Distribution Systems	X		
1430	Complex Systems		X	
1431	System Type		X	
1432	Controls		X	
1433	Economizers		X	
1434	Separate Air Distribution Systems		X	
1435	Simultaneous Heating and Cooling		X	
1436	Heat Recovery		X	
1437	Electric Motor Efficiency		X	
1438	Variable Flow Systems		X	
1439	Exhaust Hoods		X	
RS-29	Systems Analysis			X
1440	Service Water Heating	X	X	X
1441	Water Heater Installation	X	X	X
1442	Shut Off Controls	X	X	X
1443	Pipe Insulation	X	X	X
1450	Heated Pools	X	X	X
1451	General	X	X	X
1452	Pool Water Heaters	X	X	X
1453	Controls	X	X	X
1454	Pool Covers	X	X	X

1411 HVAC Equipment Performance Requirements

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.

EXCEPTION: Water-cooled water-chilling packages that are not designed for operation at ARI Standard 550/590 test conditions (and thus cannot be tested to meet the requirements of Table 14-1C) of 44°F leaving chilled water temperature and 85°F entering condenser water temperature shall have a minimum NPLV rating as shown in Tables 14-1K, L, and M. The table values are only applicable over the following full load design ranges:

Leaving Chiller Water Temp.:	40 to 48°F
Entering Condenser Water Temp.:	75 to 85°F
Condensing Water Temp. Rise:	5 to 15°F

Chillers designed to operate outside of these ranges are not covered by this Code. 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.

Gas-fired and oil-fired forced air furnaces with input ratings ≥ 225,000 Btu/h (65 kW) 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°F or less at peak design conditions.

Cooling towers serving chilled water systems with waterside economizer shall also comply with Section 1433, Exception 2.

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.

1411.3 Combination Space and Service Water Heating: For combination space and service water heaters with a principal function of providing space heat, the Combined Annual Efficiency (CAE) may be calculated by using ASHRAE Standard 124-1991. Storage water heaters used in combination space heat and water heat applications shall have either an Energy Factor (EF) or a Combined Annual Efficiency (CAE) of not less than the following:

	Energy Factor (EF)	Combined Annual Efficiency (CAE)
< 50 gallon storage	0.58	0.71
50 to 70 gallon storage	0.57	0.71
> 70 gallon storage	0.55	0.70

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. 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 Controls

1412.1 Temperature Controls: Each system shall be provided with at least one temperature control device. Each zone shall be controlled by individual thermostatic controls responding to temperature within the zone. At a minimum, each floor of a building shall be considered as a separate zone.

1412.2 Deadband Controls: When used to control both comfort heating and cooling, zone thermostatic controls shall be capable of a deadband of at least 5°F within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum.

EXCEPTIONS: 1. Special occupancy, special usage or code requirements where deadband controls are not appropriate.

2. ((~~Buildings complying with Section 1141.4, if in the proposed building energy analysis, heating and cooling thermostat setpoints are set to the same temperature between 70°F and 75°F inclusive, and assumed to be constant throughout the year.~~)) (Reserved.)

3. Thermostats that require manual changeover between heating and cooling modes.

1412.3 Humidity Controls: If a system is equipped with a means for adding moisture, a humidistat shall be provided.

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 setting during loss of power for a period of at least ten hours, and

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

EXCEPTIONS: 1. Systems serving areas which require continuous operation at the same temperature setpoint.

2. Equipment with full load demands of 2 kW (6,826 Btu/h) or less may be controlled by readily accessible manual off-hour controls.

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 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 (non-motorized) dampers are acceptable in buildings less than 3 stories in height.

4. Gravity (non-motorized) 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.

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/ft^2 of damper area at 1.0 inch w.g.

b. Non-motorized dampers: 20 cfm/ft^2 of damper area at 1.0 inch w.g., except that for non-motorized dampers smaller than 24 inches in either dimension: 40 cfm/ft^2 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.

1412.5 Heat Pump Controls: Unitary air cooled heat pumps shall include microprocessor controls that minimize supplemental heat usage during start-up, set-up, and defrost conditions. These controls shall anticipate need for heat and use compression heating as the first stage of heat. Controls shall indicate when supplemental heating is being used through visual means (e.g., LED indicators).

1412.6 Combustion Heating Equipment Controls: Combustion heating equipment with a capacity over 225,000 Btu/h shall have modulat((~~ing~~))ed 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.

1412.7 Balancing: Each air supply outlet or air or water terminal device shall have a means for balancing, including but not limited to, dampers, temperature and pressure test connections and balancing valves.

1412.8 Enclosed Parking Garage Ventilation. Garage ventilation fan systems with a total design capacity greater than 30,000 cfm shall include the equipment specified in (a) and (b) below. Smaller systems shall include the equipment specified in either (a) or (b).

(a) An automatic control that is capable of staging fans or modulating fan speed as required to maintain carbon monoxide (CO) concentration below a level of 50 ppm as stated in ASHRAE Standard 62. This provision only applies to garages used predominantly by gasoline powered vehicles.

(b) An automatic control that is capable of shutting off fans or reducing fan speed during periods when the garage is not in use. The system shall be equipped with at least one of the following:

(i) An automatic timeclock that can start and stop the system under different schedules for seven different day-types per week, is capable of retaining programming and time setting during loss of power for a period of at least 10 hours, and includes an accessible manual override that allows temporary operation of the system for up to 2 hours.

(ii) An occupant sensor.

See the Seattle Building Code for sizing requirements for parking garage ventilation. See the Seattle Mechanical Code , Section 404.1 for other requirements for parking garage ventilation.

1412.9 Ventilation Controls for High-Occupancy Areas (Demand Ventilation Controls). The following systems shall incorporate means to automatically reduce outside air intake below design rates when spaces are unoccupied or partially occupied (demand ventilation controls):

a. Single-zone systems where all of the following criteria are met:

(1) an air economizer is installed to comply with Sections 1413 and either 1423 or 1433, and

(2) design outside airflow is greater than 1,200 cfm, and

(3) design occupancy of the spaces served by the system is greater than 40 people per 1,000 ft^2 of floor area.

b. All other single-zone where both of the following criteria are met:

(1) design outside airflow is greater than 3,000 cfm, and

(2) design occupancy of the spaces served by the system is greater than 40 people per 1,000 ft^2 of floor area.

c. Multiple-zone where both of the following criteria are met:

(1) design outside airflow is greater than 3,000 cfm, and

(2) design occupancy averaged over all of the spaces served by the system is greater than 100 people per 1,000 ft^2 of floor area.

The demand ventilation control system shall have CO_2 sensors installed in each room where the design occupancy is greater than 40 people per 1,000 ft^2 of floor area for single-zone systems and where the design occupancy is greater than 100 people per 1,000 ft^2 of floor area for multiple-zone systems. The CO_2 sensors shall be located between one foot and six feet above the floor. Ventilation controls shall be in compliance with ASHRAE Standard 62 and the Seattle Mechanical Code.

Demand ventilation controls shall maintain CO_2 concentrations less than or equal to 600 ppm plus the outdoor air CO_2 concentration in all rooms with CO_2 sensors.

EXCEPTION: The outdoor air ventilation rate is not required to be larger than the design outdoor air ventilation rate required by the Seattle Mechanical Code regardless of CO_2 concentration.

The outdoor air CO_2 concentration shall be assumed to be 400 ppm without any direct measurement or the CO_2 concentration shall be dynamically measured using a CO_2 sensor located near the position of the outdoor air intake.

When the system is operating during hours of expected occupancy, the controls shall maintain system outdoor air ventilation rates no less than the rate listed in the Seattle Mechanical Code for spaces with CO_2 sensors.

CO_2 sensors shall be certified by the manufacturer to have an accuracy of no less than 75 ppm, factory calibrated or calibrated at start-up, and certified by the manufacturer to require calibration no more frequently than once every 5 years.

1413 Economizers

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 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.~~))

1413.2 Documentation: Water economizer plans submitted for approval shall include the following information:

1. Maximum outside air conditions for which economizer is sized to provide full cooling.
2. Design cooling load to be provided by economizer at this outside air condition.
3. Heat rejection and terminal equipment performance data including model number, flow rate, capacity, entering and leaving temperature in full economizer cooling mode.

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

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

2. Water-cooled water chillers with waterside economizer.

1413.4 Humidification: If an air economizer is required on a cooling system for which humidification equipment is to be provided to maintain minimum indoor humidity levels, then the humidifier shall be of the adiabatic type (direct evaporative media or fog atomization type).

EXCEPTIONS: 1. Health care facilities where WAC 246-320-525 allows only steam injection humidifiers in ductwork downstream of final filters.

2. Systems with water economizer

3. 100% outside air systems with no provisions for air recirculation to the central supply fan.

4. Nonadiabatic humidifiers cumulatively serving no more than 10% of a building's air economizer capacity as measured in cfm. This refers to the system cfm serving rooms with stand alone or duct mounted humidifiers.

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, a water economizer must be used, or 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 6.3.1.4 of ASHRAE/IESNA Standard 90.1 in the Users Manual.

1414 Ducting Systems

1414.1 Sealing: Duct work which is designed to operate at pressures above ½ inch water column static pressure shall be sealed ((~~in accordance with Standard RS-18. Extent of sealing required is~~)) as follows:

1. ((~~Static pressure: ½ inch to 2 inches; seal transverse joints~~)) (Reserved).

2. Static pressure: ((~~2~~)) ½ 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 pressure 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.

1415 Piping Systems

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

EXCEPTION: Piping installed within unitary HVAC equipment.

Cold water pipes outside the conditioned space shall be insulated in accordance with the Washington State Plumbing Code (WAC 51-46).

~~((**1416 Completion Requirements**~~

~~**1416.1 Drawings:** Construction documents shall require that within 90 days after the date of system acceptance, record drawings of the actual installation be provided to the building owner. Record drawings shall include as a minimum the location and performance data on each piece of equipment, general configuration of duct and pipe distribution system, including sizes, and the terminal air and water design flow rates.~~

~~**1416.2 Manuals:** Construction documents shall require an operating manual and maintenance manual be provided to the building owner. The manual shall be in accordance with industry accepted standards and shall include, at a minimum, the following:~~

~~1. Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance.~~

~~2. Operation and maintenance manuals for each piece of equipment requiring maintenance, except equipment not furnished as part of the project. Required routine maintenance actions shall be clearly identified.~~

~~3. Names and addresses of at least one service agency.~~

~~4. HVAC controls system maintenance and calibration information, including wiring diagrams, schematics, and control sequence descriptions. Desired or field determined set points shall be permanently recorded on control drawings at control devices, or, for digital control systems, in programming comments.~~

~~5. A complete narrative of how each system is intended to operate including suggested set points.~~

~~**1416.3 System Balancing**~~

~~**1416.3.1 General:** Construction documents shall require that all HVAC systems be balanced in accordance with generally accepted engineering standards. Air and water flow rates shall be measured and adjusted to deliver final flow rates within 10% of design rates, except variable flow distribution systems need not be balanced upstream of the controlling device (for example, VAV box or control valve). Construction documents shall require a written balance report be provided to the owner.~~

~~**1416.3.2 Air System Balancing:** Air systems shall be balanced in a manner to first minimize throttling losses then, for fans with system power of greater than 1 hp, fan speed shall be adjusted to meet design flow conditions.~~

~~**1416.3.3 Hydronic System Balancing:** Hydronic systems shall be proportionately balanced in a manner to first minimize throttling losses, then the pump impeller shall be trimmed or pump speed shall be adjusted to meet design flow conditions. Each hydronic system shall have either the ability to measure pressure across the pump, or test ports at each side of each pump.~~

~~**EXCEPTIONS:** 1. Pumps with pump motors of 10 hp or less.~~

~~2. When throttling results in no greater than 5% of the nameplate horsepower draw above that required if the impeller were trimmed.~~

~~**1416.4 Systems Commissioning**~~

~~**1416.4.1 Simple Systems:** For simple systems, as defined in Section 1421, and for warehouses and semi-heated~~

~~spaces, HVAC control systems shall be tested to ensure that control devices, components, equipment and systems are calibrated, adjusted and operate in accordance with approved plans and specifications. Sequences of operation shall be functionally tested to ensure they operate in accordance with approved plans and specifications. A complete report of test procedures and results shall be prepared and filed with the owner. Drawing notes shall require commissioning in accordance with this paragraph.~~

~~**1416.4.2 Other Systems:** All other HVAC control systems, and other automatically controlled systems for which energy consumption, performance, or mode of operation are regulated by this code, shall be tested to ensure that control devices, equipment and systems are calibrated, adjusted and operate in accord with approved plans and specifications. Sequences of operation shall be functionally tested to ensure they operate in accord with approved plans and specifications.~~

~~**1416.4.2.1 Documentation:** Drawing notes shall require commissioning in accordance with this section. Drawing notes may refer to specifications for further commissioning requirements. Plans and specifications shall require tests mandated by this section be performed and the results recorded. Plans and specifications shall require preparation of preliminary and final reports of test procedures and results as described in Section 1416.4.2.2. Plans and specifications shall identify the following for each test:~~

~~1. Equipment and systems to be tested, including the extent of sampling tests,~~

~~2. Functions to be tested (for example, calibration, economizer control, etc.),~~

~~3. Conditions under which the test shall be performed (for example, winter design conditions, full outside air, etc.),~~

~~4. Measurable criteria for acceptable performance.~~

~~**1416.4.2.2 Commissioning Reports**~~

~~**1416.4.2.2.1 Preliminary Commissioning Report:** A preliminary commissioning report of test procedures and results shall be prepared. The preliminary report shall identify:~~

~~1. Deficiencies found during testing required by this section which have not been corrected at the time of report preparation and the anticipated date of correction.~~

~~2. Deferred tests which cannot be performed at the time of report preparation due to climatic conditions.~~

~~3. Climatic conditions required for performance of the deferred tests, and the anticipated date of each deferred test.~~

~~**1416.4.2.2.2 Final Commissioning Report:** A complete report of test procedures and results shall be prepared and filed with the owner.~~

~~**1416.4.2.3 Acceptance:** Buildings or portions thereof, required by this code to comply with this section, shall not be issued a final certificate of occupancy until such time that the building official determines that the preliminary commissioning report required by this section has been completed.~~))

1416 Mechanical Systems Commissioning and Completion Requirements

1416.1 General. Commissioning is a systematic process of verification and documentation that ensures that the selected building systems have been designed, installed, and function properly, efficiently, and can be maintained in accordance with the contract documents in order to satisfy the building owner's design intent and operational requirements. Drawing notes shall require commissioning and completion requirements in accordance with this section. Drawing notes may refer to specifications for further requirements.

1416.1.1 Simple Mechanical Systems. For simple mechanical systems, as defined in Section 1421, and for warehouses and semi-heated spaces, commissioning shall include, as a minimum:

a. A Commissioning Plan,

b. System Testing and Balancing,

c. Controls Functional Performance Testing,

d. A Preliminary Commissioning Report,

e. Post Construction Documentation in the form of O&M and Record Drawing Review, and

f. A Final Commissioning Report.

1416.1.2 All Other Mechanical Systems. For all other mechanical systems, commissioning shall include, as a minimum:

a. A Commissioning Plan,

b. System Testing and Balancing,

c. Equipment Functional Performance Testing,

d. Controls Functional Performance Testing,

e. A Preliminary Commissioning Report,

f. Post Construction Documentation (all), and

g. A Final Commissioning Report.

1416.2 Commissioning Requirements

1416.2.1 General. Drawing notes shall require commissioning in accordance with this section. Drawing notes may refer to specifications for further commissioning requirements.

1416.2.2 Commissioning Plan. The Plan shall require tests mandated by this section be performed and the results recorded. The Plan shall require preparation of preliminary and final reports of test procedures and results as described herein. At a minimum, the Plan shall identify the following for each test:

a. A detailed explanation of the original design intent.

b. Equipment and systems to be tested, including the extent of tests,

c. Functions to be tested (for example calibration, economizer control, etc.),

d. Conditions under which the test shall be performed (for example winter and summer design conditions, full outside air, etc.), and

e. Measurable criteria for acceptable performance.

1416.2.3 Systems Balancing

1416.2.3.1 General. Construction documents shall require that all HVAC systems be balanced in accordance with generally accepted engineering standards. Air and water flow rates shall be measured and adjusted to deliver final flow rates within 10% of design rates, except variable flow distribution systems need not be balanced upstream of the controlling device (for example, VAV box or control valve). Construction documents shall require a written balance report be provided to the owner. Drawing notes may refer to specifications for further systems balancing requirements.

1416.2.3.2 Air Systems Balancing. Air systems shall be balanced in a manner to first minimize throttling losses then, for fans with system power of greater than 1 hp, fan speed shall be adjusted to meet design flow conditions.

1416.2.3.3 Hydronic Systems Balancing: Hydronic systems shall be proportionately balanced in a manner to first minimize throttling losses, then the pump impeller shall be trimmed or pump speed shall be adjusted to meet design flow conditions. Each hydronic system shall have either the ability to measure pressure across the pump, or test ports at each side of each pump.

> **EXCEPTIONS:** 1. Pumps with pump motors of 10 hp or less.
>
> 2. When throttling results in no greater than 5% of the nameplate horsepower draw above that required if the impeller was trimmed.

1416.2.4 Functional Performance Testing

1416.2.4.1 General. Drawing notes shall require commissioning in accordance with this section. Drawing notes may refer to specifications for further commissioning requirements.

1416.2.4.2 Equipment/Systems Testing. Functional Performance Testing shall demonstrate the correct installation and operation of each component, system, and system-to-system intertie relationship in accordance with approved plans and specifications. This demonstration is to prove the operation, function, and maintenance serviceability for each of the Commissioned systems. Testing shall include all modes of operation, including:

a. All modes as described in the Sequence of Operation,

b. Redundant or automatic back-up mode,

c. Performance of alarms, and

d. Mode of operation upon a loss of power and restored power.

1416.2.4.3 Controls Testing: HVAC control systems shall be tested to ensure that control devices, components, equipment and systems are calibrated, adjusted and operate in accordance with approved plans and specifications. Sequences of operation shall be functionally tested to ensure they operate in accordance with approved plans and specifications.

1416.2.5 Post Construction Commissioning

1416.2.5.1 General: Construction documents shall require post construction commissioning be provided to the building owner prior to date of final acceptance. Drawing notes may refer to specifications for further commissioning requirements. Post construction commissioning shall include, as a minimum, review and approval of Operation and Maintenance Materials, Record Drawings, and Systems Operational Training.

1416.2.5.2 Operation and Maintenance (O & M) Materials: The O&M Materials shall be in accordance with industry accepted standards and shall include, at a minimum, the following:

a. Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance.

b. Operation and maintenance manuals for each piece of equipment requiring maintenance, except equipment not furnished as part of the project. Required routine maintenance actions shall be clearly identified.

c. Names and addresses of at least one service agency.

d. HVAC controls system maintenance and calibration information, including wiring diagrams, schematics, and control sequence descriptions. Desired or field determined set points shall be permanently recorded on control drawings at control devices, or, for digital control systems, in programming comments.

e. A complete written narrative of how each system and piece of equipment is intended to operate including:

i. A detailed explanation of the original design intent.

ii. The basis of design (how the design was selected to meet the design intent).

iii. A detailed explanation of how new equipment is to interface with existing equipment or systems (where applicable).

iv. Suggested control set points.

NOTE: Sequence of Operation is not acceptable as a narrative for this requirement.

1416.2.5.3 Record Drawings: Record drawings shall include, as a minimum, the location and performance data on each piece of equipment, general configuration of duct and pipe distribution system, including sizes, and the terminal air and water design flow rates of the actual installation.

1416.2.5.4 Systems Operational Training: The training of the appropriate maintenance staff for each equipment type and or system shall include, as a minimum, the following:

a. System/Equipment overview (what it is, what it does and which other systems and or equipment does it interface with).

b. Review of the available O&M materials.

c. Review of the Record Drawings on the subject system/equipment.

d. Hands-on demonstration of all normal maintenance procedures, normal operating modes, and all emergency shutdown and start-up procedures.

1416.2.6 Commissioning Reports

1416.2.6.1 General. Drawing notes shall require commissioning in accordance with this section. Drawing notes may refer to specifications for further commissioning requirements.

1416.2.6.2 Preliminary Commissioning Report: A preliminary report of commissioning test procedures and results shall be completed and provided to the Owner. The Preliminary Commissioning Report shall identify:

a. Deficiencies found during testing required by this section which have not been corrected at the time of report preparation and the anticipated date of correction.

b. Deferred tests which cannot be performed at the time of report preparation due to climatic conditions.

c. Climatic conditions required for performance of the deferred tests, and the anticipated date of each deferred test.

1416.2.6.3 Final Commissioning Report: A complete report of test procedures and results shall be prepared and filed with the Owner. The Final Commissioning Report shall identify:

a. Results of all Functional Performance Tests.

b. Disposition of all deficiencies found during testing, including details of corrective measures used or proposed.

c. All Functional Performance Test procedures used during the commissioning process including measurable criteria for test acceptance, provided herein for repeatability.

EXCEPTION: Deferred tests which cannot be performed at the time of report preparation due to climatic conditions.

1416.3 Acceptance Requirements

1416.3.1 General. Drawing notes shall require commissioning in accordance with this section. Drawing notes may refer to specifications for further commissioning requirements.

1416.3.2 Acceptance: Buildings or portions thereof, required by this Code to comply with this section, shall not be issued a final certificate of occupancy until such time that the building official determines that the preliminary commissioning report required by Section 1416.2.6.2 has been completed.

SECTION 1420 — SIMPLE SYSTEMS (Packaged Unitary Equipment)

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.

1421.1 System Sizing Limits: Installed space heating equipment output shall not exceed 16 Btu/h per square foot of gross conditioned floor area and installed space cooling equipment output shall not exceed 25 Btu/h per square foot of gross conditioned floor area.

EXCEPTIONS: 1. For equipment which provides both heating and cooling in one package unit, compliance need only be demonstrated for either the space heating or space cooling system size.

2. Equipment sized in accordance with Section 1431.2.

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 requirements of Section 1413 shall be installed on single package unitary fan-cooling units having a total cooling capacity greater than 54,000 Btu/h.

The total capacity of all units without economizers (i.e., those units with a total cooling capacity less than 20,000 Btuh ((~~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

SECTION 1430 — COMPLEX SYSTEMS

1431 System Type: All systems not qualifying for Sections 1420 through 1424 (Simple Systems), including field fabricated and constructed of system components, shall comply with Sections 1430 through 1439. Simple systems may also comply with Sections 1430 through 1439.

1431.1 Field-Assembled Equipment and Components: Field-assembled equipment and components from more than one manufacturer shall show compliance with this section and Section 1411 through calculations of total on-site energy input and output. The combined component efficiencies as measured per Section 1411.2, shall be in compliance with the requirements of Section 1411.1.

Total on-site energy input to the equipment shall be determined by combining the energy inputs to all components, elements and accessories such as compressors, internal circulating pumps, purge devices, viscosity control heaters and controls.

1431.2 System Sizing Limits: Heating and cooling design loads for the purpose of sizing systems shall be determined in accordance with one of the procedures described in Chapter 29 of Standard RS-1 listed in Chapter 7 or an equivalent computation procedure. For interior temperatures, 70°F shall be used for heating and 75°F for cooling, except where different values are specified in the Washington Administrative Code (WAC). For exterior temperatures, 24°F shall be used for heating and 82°F drybulb and 66°F wetbulb 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, equipment shall have multiple unloadings or no one unit shall have a capacity of more than 2/3 of the load.

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.

1432 Controls

1432.1 Setback and Shut-Off: Systems that serve zones with different uses, as defined in Table 15-1,

1. shall be served by separate systems, or

2. shall include isolation devices and controls to shut-off or set back the supply of heating and cooling to each zone independently.

> **EXCEPTION:** Isolation or separate systems are not required for zones expected to operate continuously or expected to be inoperative only when all other zones are inoperative.

1432.2 Systems Temperature Reset Controls

1432.2.1 Air Systems for Multiple Zones: Systems supplying heated or cooled air to multiple zones shall include controls which automatically reset supply air temperatures by representative building loads or by outside air temperature. Temperature shall be reset by at least 25% of the design supply-air-to-room-air temperature difference.

> **EXCEPTION:** Where specified humidity levels are required to satisfy process needs, such as computer rooms or museums.

1432.2.2 Hydronic Systems: Systems with a design capacity of ((~~600,000~~)) 300,000 Btu/h or greater supplying heated or mechanically refrigerated water ((~~to comfort conditioning systems~~)) shall include controls which automatically reset supply water temperatures by representative building loads (including return water temperature) or by outside air temperature. Temperature shall be reset by at least 25% of the design supply-to-return water temperature differences.

> **EXCEPTIONS:**
>
> 1. Hydronic systems that use variable flow devices complying with Section 1438 to reduce pumping energy.
> 2. Steam boilers.
> 3. Systems that provide heating with 100°F or lower supply temperature (e.g. water source heat pump loops).

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

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

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

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

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

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

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

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

1433 Economizers: 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 systems: 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 of less than 54,000 Btu/h (hereafter referred to as qualifying small systems) provided that these are ((~~H~~))high-efficiency cooling units with EER values more than 10% 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 qualifying small systems without economizers shall not exceed 480,000 Btu/h per building, or 20% 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~~)).

2. ((~~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.

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

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

5. Systems 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.

6. 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.

7. 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.

8. 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 Efficiency**	**Part-load Control**	**Economizer**
Option a	Table 14-1A and Table 14-1B[a]	+ 15%[b]	Required over 85,000 Btu/h[c]	None required
Option b	Table 14-1A and Table 14-1B[a]	+ 5%[d]	Required over 85,000 Btu/h[c]	Waterside economizer[e]
Option c	Table 14-1K, Table 14-1L, and Table 14-1M[f]	+ 5%/10%[g]	Required for all chillers[h]	Waterside economizer[e]
Option d	ASHRAE Standard 127[i]	+ 0%[j]	Required over 85,000 Btu/h[c]	Waterside economizer[e]

Notes to Exception 8.

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.

f. For a system with chillers subject to the ARI standards listed in 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 NPLV value that is a minimum of 10% greater than the NPLV value listed in Table 14-1K, Table 14-1L, and Table 14-1M (1.10 x values in 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: For hydronic systems over 300,000 Btuh, see Section 1432.2.2.

1434 Separate Air Distribution Systems: Zones with special process temperature requirements and/or humidity requirements shall be served by separate air distribution systems from those serving zones requiring only comfort conditions; or shall include supplementary control provisions so that the primary systems may be specifically controlled for comfort purposes only.

EXCEPTION: Zones requiring only comfort heating or comfort cooling that are served by a system primarily used for process temperature and humidity control provided that:

1. The total supply air to those comfort zones is no more that 25% of the total system supply air, or
2. The total conditioned floor area of the zones is less than 1,000 square feet.

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 ventilation requirements of the ((~~Washington State Ventilation and Indoor Air Quality Code~~)) Seattle Mechanical Code for the zone.

b. 0.4 cfm/ft^2 of the zone conditioned floor area, provided that the temperature of the primary system air is, by design or through reset controls, 0-12°F below the design space heating temperature when outside air temperatures are below 60°F for reheat systems and the cold deck of mixing systems and 0-12°F above design space temperature when outside air temperatures are above 60°F for recooling systems and the 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 warehoused and ice arenas.

1436 Heat Recovery

1436.1 Fan Systems: Fan systems which have both

a. capacity of 5,000 cfm or greater ((~~and~~)) or serve a space with a design heating or cooling load exceeding 150 Btu/h-ft^2 and

b. which have a minimum outside air supply of 70% 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°F. Provisions shall be made to bypass or control the heat recovery system to permit air economizer operation as required by Section 1433. Heat recovery energy 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 heat 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°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 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 85°F, 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 and 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 fans and pumps 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.

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

((~~variable flow devices installed. Acceptable variable flow devices include variable inlet vanes, variable blade pitch and variable fan geometry. T~~)) Variable inlet vanes, throttling valves (dampers), scroll dampers or bypass circuits shall not be allowed.

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 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 on the pony motor to operate without the primary motor while meeting the condenser water setpoint.

1439 Exhaust Hoods

1439.1 Kitchen Hoods. Individual kitchen exhaust hoods larger than 5000 cfm shall be provided with make-up air sized so that at least 50% of exhaust air volume be (a) unheated or heated to no more than 60°F and (b) uncooled or cooled without the use of mechanical cooling.

EXCEPTIONS: 1. Where hoods are used to exhaust ventilation air which would otherwise exfiltrate or be exhausted by other fan systems.

2. Certified grease extractor hoods that require a face velocity no greater than 60 fpm.

1439.2 Fume Hoods: Each fume hood in buildings with fume hood systems having a total exhaust rate greater than 15,000 cfm shall include at least one of the following features:

a. Variable air volume hood exhaust and room supply systems capable of reducing exhaust and make-up air volume to 50% or less of design values.

b. Direct make-up (auxiliary) air supply equal to at least 75% of the exhaust rate, heated no warmer than 2°F below room set point, cooled to no cooler than 3°F above room set point, no humidification added, and no simultaneous heating and cooling used for dehumidification control.

c. Heat recovery systems to precondition make-up air in accordance with Section 1436, without using any exception.

d. Constant volume fume hood designed and installed to operate at less than 50 fpm face velocity.

SECTION 1440 — SERVICE WATER HEATING:

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

Effective January 1, 2004, 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 a 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.

1441 Water Heater Installation: Electric water heaters in unconditioned spaces or on concrete floors shall be placed on an incompressible, insulated surface with a minimum thermal resistance of R-10.

1442 Shut-Off Controls: Systems designed to maintain usage temperatures in hot water pipes, such as circulating hot water systems or heat traced pipes shall be equipped with automatic time switches or other controls to turn off the system during periods of non-use.

1443 Pipe Insulation: Piping shall be thermally insulated in accordance with Section 1415.1.

SECTION 1450 — HEATED POOLS

1451 General: The requirements in this section apply to "general and limited use pools" as defined in the Washington Water Recreation Facilities Regulations (WAC 246-260).

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.

1453 Controls: All pool heaters shall be equipped with a readily accessible ON/OFF switch to allow shutting off the operation of the heater without adjusting the thermostat setting. Controls shall be provided to allow the water temperature to be regulated from the maximum design temperature down to 65°F.

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

TABLE 14-1A

UNITARY AIR CONDITIONERS AND CONDENSING UNITS, ELECTRICALLY OPERATED, MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Size Category	Sub-Category or Rating Condition	Minimum Efficiency[b]	Test Procedure[a]
Air Conditioners, Air Cooled	< 65,000 Btu/h[d]	Split System Before Jan 23, 2006 After Jan 23, 2006	 10.0 SEER 12.0 SEER	ARI 210/240
		Single Package Before Jan 23, 2006 After Jan 23, 2006	 9.7 SEER 12.0 SEER	
	≥65,000 Btu/h and < 135,000 Btu/h	Split System and Single Package	10.3 EER[c] 10.6 IPLV[c]	
	≥135,000 Btu/h and < 240,000 Btu/h	Split System and Single Package	9.7 EER[c] 9.9 IPLV[c]	ARI 340/360
	≥ 240,000 Btu/h and <760,000 Btu/h	Split System and Single Package	9.5 EER[c] 9.7 IPLV[c]	
	≥760,000 Btu/h	Split System and Single Package	9.2 EER[c] 9.4 IPLV[c]	
Through-the-Wall, Air Cooled	<30,000 Btu/h[d]	Split System Before Jan 23, 2006 After Jan 23, 2006	 10.0 SEER 10.9 SEER	ARI 210/240
		Single Package Before Jan 23, 2006 After Jan 23, 2006	 9.7 SEER 10.6 SEER	
Small-Duct High-Velocity, Air Cooled	<65,000 Btu/h[d]	Split System	10.0 SEER	ARI 210/240
Air Conditioners, Water and Evaporatively Cooled	< 65,000 Btu/h	Split System and Single Package	12.1 EER 11.2 IPLV	ARI 210/240
	≥ 65,000 Btu/h and < 135,000 Btu/h	Split System and Single Package	11.5 EER[c] 10.6 IPLV[c]	
	≥135,000 Btu/h and ≤240,000 Btu/h	Split System and Single Package	11.0 EER[c] 10.3 IPLV[c]	ARI 340/360
	> 240,000 Btu/h	Split System and Single Package	11.0 EER[c] 10.3 IPLV[c]	
Condensing Units, Air Cooled	≥135,000 Btu/h		10.1 EER 11.2 IPLV	ARI 365
Condensing Units, Water or Evaporatively Cooled	≥135,000 Btu/h		13.1 EER 13.1 IPLV	

[a] Reserved.
[b] IPLVs are only applicable to equipment with capacity modulation.
[c] Deduct 0.2 from the required EERs and IPLVs for units with a heating section other than electric resistance heat.
[d] Single-phase air-cooled air-conditioners < 65,000 Btu/h are regulated by NAECA. SEER values are those set by NAECA.

TABLE 14-1C
WATER CHILLING PACKAGES, MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Size Category	((~~Sub-Category or Rating Condition~~)) Maximum kW/ton[d]	Minimum Efficiency	Test Procedure
Air Cooled, With Condenser, Electrically Operated	All Capacities	1.26 1.15	2.80 COP 3.05 IPLV	ARI 550/590
Air Cooled, Without Condenser, Electrically Operated	All Capacities	1.13 1.02	3.10 COP 3.45 IPLV	
Water Cooled, Electrically Operated	< 40 tons	0.84 0.70	4.20 COP 5.05 IPLV	ARI 550/590
	> 40 tons and < 150 Tons	0.79 0.67	4.45 COP 5.25 IPLV	
	≥150 Tons and < 300 Tons	0.63 0.60	5.55 COP[c] 5.90 IPLV	
	≥300 Tons	0.58 0.55	6.10 COP[c] 6.40 IPLV	
((~~Water Cooled, Electrically Operated, Positive Displacement (Reciprocating)~~))	((~~All Capacities~~))		((~~4.20 COP~~)) ((~~5.05 IPLV~~))	((~~ARI 550/590~~))
((~~Water Cooled, Electrically Operated, Positive Displacement (Rotary Screw and Scroll)~~))	((~~<150 Tons~~))		((~~4.45 COP 5.05 IPLV~~))	((~~ARI 550/590~~))
	((~~≥150 Tons and <300 Tons~~))		((~~4.90 COP 5.60 IPLV~~))	
	((~~≥300 Tons~~))		((~~5.50 COP 6.15 IPLV~~))	
((~~Water Cooled, Electrically Operated, Positive Displacement (Centrifugal)~~))	((~~<150 Tons~~))		((~~5.00 COP 5.25 IPLV~~))	((~~ARI 550/590~~))
	((~~≥150 Tons and <300 Tons~~))		((~~5.55 COP 5.90 IPLV~~))	
	((~~≥300 Tons~~))		((~~6.10 COP 6.40 IPLV~~))	
Air Cooled Absorption Single Effect	All Capacities		0.60 COP	ARI 560
Water Cooled Absorption Single Effect	All Capacities		0.70 COP	ARI 560
Absorption Double Effect, Indirect-Fired	All Capacities		1.00 COP 1.05 IPLV	ARI 560
Absorption Double Effect, Direct-Fired	All Capacities		1.00 COP 1.00 IPLV	ARI 560

[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°F.
[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 14-1D

PACKAGED TERMINAL AIR CONDITIONERS, PACKAGED TERMINAL HEAT PUMPS, ROOM AIR CONDITIONERS, AND ROOM AIR CONDITIONER HEAT PUMPS, ELECTRICALLY OPERATED, MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Size Category (Input)	Sub-Category or Rating Condition	Minimum Efficiency[b]	Test Procedure[a]
PTAC (Cooling Mode) New Construction	All Capacities	95°F db Outdoor Air	12.5 - (0.213 x Cap/1000)[b] EER	ARI 310/380
		82°F db Outdoor Air	14.7 - (0.213 x Cap/1000)[b] EER	
PTAC (Cooling Mode) Replacements[c]	All Capacities	95°F db Outdoor Air	10.9 - (0.213 x Cap/1000)[b] EER	
		82°F db Outdoor Air	13.1 - (0.213 x Cap/1000)[b] EER	
PTHP (Cooling Mode) New Construction	All Capacities	95°F db Outdoor Air	12.3 - (0.213 x Cap/1000)[b] EER	
		82°F db Outdoor Air	14.5 - (0.213 x Cap/1000)[b] EER	
PTHP (Cooling Mode) Replacements[c]	All Capacities	95°F db Outdoor Air	10.8 - (0.213 x Cap/1000)[b] EER	
		82°F db Outdoor Air	13.0 - (0.213 x Cap/1000)[b] EER	
PTHP (Heating Mode) New Construction	All Capacities		3.2 - (0.026 x Cap/1000)[b] COP	
PTHP (Heating Mode) Replacements[c]	All Capacities		2.9 - (0.026 x Cap/1000)[b] COP	
SPVAC (Cooling Mode)	All Capacities	95°F db/75°F wb Outdoor Air	8.6 EER	ARI-390
SPVHP (Cooling Mode)	All Capacities	95°F db/75°F wb Outdoor Air	8.6 EER	
SPVAC (Heating Mode)	All Capacities	47°F db/43° wb Outdoor Air	2.7 COP	
Room Air Conditioners, with Louvered Sides	< 6,000 Btu/h		9.7 EER	ANSI/AHAM RAC-1
	≥6,000 Btu/h and < 8,000 Btu/h		9.7 EER	
	≥ 8,000 Btu/h and < 14,000 Btu/h		9.8 EER	
	≥14,000 Btu/h and < 20,000 Btu/h		9.7 EER	
	≥20,000 Btu/h		8.5 EER	
Room Air Conditioners, without Louvered Sides	< 8,000 Btu/h		9.0 EER	
	≥8,000 Btu/h and < 20,000 Btu/h		8.5 EER	
	≥20,000 Btu/h		8.5 EER	
Room Air Conditioner Heat Pumps with Louvered Sides	< 20,000 Btu/h		9.0 EER	
	≥ 20,000 Btu/h		8.5 EER	
Room Air Conditioner Heat Pumps without Louvered Sides	< 14,000 Btu/h		8.5 EER	
	≥ 14,000 Btu/h		8.0 EER	
Room Air Conditioner, Casement Only	All Capacities		8.7 EER	
Room Air Conditioner, Casement –Slider	All Capacities		9.5 EER	

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

Table 14-1G
Performance Requirements for Heat Rejection Equipment

Equipment Type	Total System Heat Rejection Capacity at Rated Conditions	Sub-Category or Rating Condition	Minimum Efficiency[b]	Test Procedure[c]
Propeller or Axial Fan Cooling Towers	All	95°F (35°C) Entering Water 85°F (29°C) Leaving Water 75°F (24°C) wb Outdoor Air	≥38.2 gpm/hp	CTI ATC-105 and CTI STD-201
Centrifugal Fan Cooling Towers	All	95°F (35°C) Entering Water 85°F (29°C) Leaving Water 75°F (24°C) wb Outdoor Air	≥ 20.0 gpm/hp	CTI ATC-105 and CTI STD-201
Air Cooled Condensers	All	125°F (52°C) Condensing Temperature R22 Test Fluid 190°F (88°C) Entering Gas Temperature 15°F (8°C) Subcooling 95°F (35°C) Entering Drybulb	≥176,000 Btu/h·hp	ARI 460

[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.
[c] Reserved.

Table 14-1H Reserved

Table 14-1I Reserved

Table 14-1J Reserved

Table 14-1K
IPLV/NPLV for Water Cooled Chillers < 150 Tons

Water Cooled Chillers < 150 Tons $IPLV_{std}$ = 5.25								
			Condenser Flow Rate					
			2 gpm/ton[d]	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)	LIFT[a] (°F)	Required IPLV/NPLV					
46	75	29	5.84	6.10	6.30	6.61	6.84	7.00
45	75	30	5.75	6.00	6.19	6.47	6.68	6.83
44	75	31	5.67	5.91	6.08	6.34	6.53	6.67
43	75	32	5.59	5.82	5.99	6.23	6.39	6.52
42	75	33	5.51	5.74	5.90	6.12	6.27	6.39
41	75	34	5.43	5.66	5.81	6.02	6.16	6.26
46	80	34	5.43	5.66	5.81	6.02	6.16	6.26
40	75	35	5.35	5.58	5.73	5.93	6.06	6.15
45	80	35	5.35	5.58	5.73	5.93	6.06	6.15
44	80	36	5.26	5.50	5.65	5.84	5.96	6.06
43	80	37	5.16	5.42	5.57	5.76	5.87	5.96
42	80	38	5.06	5.33	5.49	5.67	5.79	5.87
41	80	39	4.95	5.24	5.41	5.60	5.71	5.78
46	85	39	4.95	5.24	5.41	5.60	5.71	5.78
40	80	40	4.83	5.14	5.32	5.52	5.63	5.70
45	85	40	4.83	5.14	5.32	5.52	5.63	5.70
44	85	41	4.69	5.04	**5.25**[c]	5.43	5.55	5.62
43	85	42	4.55	4.93	5.13	5.35	5.47	5.54
42	85	43	4.38	4.80	5.03	5.26	5.38	5.46
41	85	44	4.21	4.67	4.91	5.17	5.30	5.38
40	85	45	4.01	4.52	4.79	5.06	5.20	5.29
Condenser DT[b]			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.
$K_{adj.} = 6.1507 - 0.30244(X) + 0.0062692(X)^2 - 0.000045595(X)^3$
where X = Condenser DT + LIFT
$COP_{adj.} = K_{adj.} * COP_{std}$
[d] Retrofit applications only.

Table 14-1L
IPLV/NPLV for Water Cooled Chillers
> 150 Tons, < 300 Tons

Water Cooled Chillers > 150 Tons, < 300 Tons $IPLV_{std}$ = 5.90								
			Condenser Flow Rate					
			2 gpm/ton[d]	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)	LIFT[a] (°F)	Required IPLV/NPLV					
46	75	29	6.58	6.87	7.11	7.46	7.71	7.90
45	75	30	6.49	6.76	6.98	7.30	7.53	7.70
44	75	31	6.40	6.66	6.86	7.15	7.36	7.52
43	75	32	6.31	6.56	6.75	7.02	7.21	7.35
42	75	33	6.22	6.47	6.65	6.90	7.07	7.20
41	75	34	6.13	6.38	6.55	6.79	6.95	7.06
46	80	34	6.13	6.38	6.55	6.79	6.95	7.06
40	75	35	6.03	6.29	6.46	6.68	6.83	6.94
45	80	35	6.03	6.29	6.46	6.68	6.83	6.94
44	80	36	5.93	6.20	6.37	6.58	6.72	6.82
43	80	37	5.82	6.11	6.28	6.49	6.62	6.72
42	80	38	5.71	6.01	6.19	6.40	6.53	6.62
41	80	39	5.58	5.91	6.10	6.31	6.44	6.52
46	85	39	5.58	5.91	6.10	6.31	6.44	6.52
40	80	40	5.44	5.80	6.00	6.22	6.35	6.43
45	85	40	5.44	5.80	6.00	6.22	6.35	6.43
44	85	41	5.29	5.68	**5.90**[c]	6.13	6.26	6.34
43	85	42	5.13	5.55	5.79	6.03	6.16	6.25
42	85	43	4.94	5.41	5.67	5.93	6.07	6.16
41	85	44	4.74	5.26	5.54	5.82	5.97	6.07
40	85	45	4.52	5.09	5.40	5.71	5.87	5.97
Condenser DT[b]			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.
$K_{adj.} = 6.1507 - 0.30244(X) + 0.0062692(X)^2 - 0.000045595(X)^3$
where X = Condenser DT + LIFT
$COP_{adj.} = K_{adj.} * COP_{std}$
[d] Retrofit applications only.

Table 14-1M
IPLV/NPLV for Water Cooled Chillers > 300 Tons

Water Cooled Chillers > 300 Tons $IPLV_{std}$ = 6.40								
			Condenser Flow Rate					
			2 gpm/ton[d]	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)	LIFT[a] (°F)	Required IPLV/NPLV					
46	75	29	7.15	7.47	7.72	8.10	8.37	8.58
45	75	30	7.05	7.35	7.58	7.93	8.18	8.36
44	75	31	6.95	7.23	7.45	7.77	8.00	8.16
43	75	32	6.85	7.13	7.33	7.63	7.83	7.98
42	75	33	6.75	7.03	7.22	7.49	7.68	7.82
41	75	34	6.65	6.93	7.12	7.37	7.55	7.67
46	80	34	6.65	6.93	7.12	7.37	7.55	7.67
40	75	35	6.55	6.83	7.01	7.26	7.42	7.54
45	80	35	6.55	6.83	7.01	7.26	7.42	7.54
44	80	36	6.44	6.73	6.92	7.15	7.30	7.41
43	80	37	6.32	6.63	6.82	7.05	7.19	7.30
42	80	38	6.20	6.53	6.72	6.95	7.09	7.19
41	80	39	6.06	6.42	6.62	6.85	6.99	7.08
46	85	39	6.06	6.42	6.62	6.85	6.99	7.08
40	80	40	5.91	6.30	6.52	6.76	6.89	6.98
45	85	40	5.91	6.30	6.52	6.76	6.89	6.98
44	85	41	5.75	6.17	**6.40**[c]	6.66	6.79	6.89
43	85	42	5.57	6.03	6.28	6.55	6.70	6.79
42	85	43	5.37	5.88	6.16	6.44	6.59	6.69
41	85	44	5.15	5.71	6.01	6.33	6.49	6.59
40	85	45	4.91	5.53	5.86	6.20	6.37	6.48
Condenser DT[b]			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.
$K_{adj.} = 6.1507 - 0.30244(X) + 0.0062692(X)^2 - 0.000045595(X)^3$
where X = Condenser DT + LIFT
$COP_{adj.} = K_{adj.} * COP_{std}$
[d] Retrofit applications only.

Table 14-2 RESERVED
Table 14-3 RESERVED

TABLE 14-4
ENERGY EFFICIENT ELECTRIC MOTORS
MINIMUM NOMINAL FULL-LOAD EFFICIENCY

	Open Motors			Closed Motors		
Synchronous Speed (RPM)	3,600	1,800	1,200	3,600	1,800	1,200
HP	Efficiency	Efficiency	Efficiency	Efficiency	Efficiency	Efficiency
1.0	-	82.5	80.0	75.5	82.5	80.0
1.5	82.5	84.0	84.0	82.5	84.0	85.5
2.0	84.0	84.0	85.5	84.0	84.0	86.5
3.0	84.0	86.5	86.5	85.5	87.5	87.5
5.0	85.5	87.5	87.5	87.5	87.5	87.5
7.5	87.5	88.5	88.5	88.5	89.5	89.5
10.0	88.5	89.5	90.2	89.5	89.5	89.5
15.0	89.5	91.0	90.2	90.2	91.0	90.2
20.0	90.2	91.0	91.0	90.2	91.0	90.2
25.0	91.0	91.7	91.7	91.0	92.4	91.7
30.0	91.0	92.4	92.4	91.0	92.4	91.7
40.0	91.7	93.0	93.0	91.7	93.0	93.0
50.0	92.4	93.0	93.0	92.4	93.0	93.0
60.0	93.0	93.6	93.6	93.0	93.6	93.6
75.0	93.0	94.1	93.6	93.0	94.1	93.6
100.0	93.0	94.1	94.1	93.6	94.5	94.1
125.0	93.6	94.5	94.1	94.5	94.5	94.1
150.0	93.6	95.0	94.5	94.5	95.0	95.0
200.0	94.5	95.0	94.5	95.0	95.0	95.0

TABLE 14-5
DUCT INSULATION

Duct Type	Duct Location	Insulation R-Value	Other Requirements
Supply, Return	Not within conditioned space: On exterior of building, on roof, in attic, in enclosed ceiling space, in walls, in garage, in crawl spaces	R-7	Approved weather proof barrier
Outside air intake	Within conditioned space	R-7	See Section 1414.2
Supply, Return, Outside air intake	Not within conditioned space: in concrete, in ground	R-5.3	
Supply with supply air temperature <55°F or >105°F	Within conditioned space	R-3.3	

NOTE: Requirements apply to the duct type listed, whether heated or mechanically cooled. Mechanically cooled ducts requiring insulation shall have a vapor retarder, with a perm rating not greater than 0.5 and all joints sealed.

INSULATION TYPES: Minimum densities and out of package thickness. Nominal R-values are for the insulation as installed and do not include air film resistance.

INSTALLED:

R-3.3 1.0 inch 1.5 to 3.0 lb/cu.ft. duct liner, mineral or glass fiber blanket or equivalent to provide an installed total thermal resistance of at least R-3.3.

R-5.3 2.0 inch 0.75 lb/cu.ft. mineral or glass fiber blanket, 1.5 inch 1.5 to 3.0 lb/cu.ft. duct liner, mineral or glass fiber blanket, 1.5 inch 3.0 to 7.0 lb/cu.ft. mineral or glass fiber board or equivalent to provide an installed total thermal resistance of at least R-5.3.

R-7 3.0 inch 0.75 lb/cu.ft. mineral or glass fiber blanket, 2.0 inch 1.5 to 3.0 lb/cu.ft. duct liner, mineral or glass fiber blanket, 2.0 inch 3.0 to 7.0 lb/cu.ft. mineral or glass fiber board or equivalent to provide an installed total thermal resistance of at least R-7.

CHAPTER 15
LIGHTING, ((~~AND~~)) MOTORS, AND TRANSFORMERS

1501 Scope: Interior and exterior lighting, ((~~and~~)) electric motors, and transformers shall comply with the requirements of this chapter.

SECTION 1510 -- GENERAL REQUIREMENTS:

Lighting and motors shall comply with Sections 1511 through 1513. Lighting systems shall comply with one of the following paths:

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

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

c. Systems Analysis. See Section 1141.4.

The compliance path selected for interior and exterior lighting need not be the same. However, interior and exterior lighting cannot be traded.

Transformers shall comply with Section 1540.

FIGURE 15A
LIGHTING, ((~~and~~)) MOTOR, and TRANSFORMER COMPLIANCE OPTIONS

Section Number	Subject	Prescriptive Lighting Option	Lighting Power Allowance Option	Systems Analysis Option
1510	General Requirements	X	X	X
1511	Electric Motors	X	X	X
1512	Exempt Lighting	X	X	X
1513	Lighting Controls	X	X	X
1520	Prescriptive Lighting Option	X		
1521	Prescriptive Interior Lighting Requirements	X		
1522	Prescriptive Exterior Lighting Requirements	Sec. 1532		
1530	Lighting Power Allowance Option		X	
1531	Interior Lighting Power Allowance		X	
1532	Exterior Lighting Power Allowance		X	
1540	Transformers	X	X	X
RS-29	Systems Analysis			X

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

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

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

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 integral to signs ((~~, and permanently ballasted lighting fixtures for walkways and pathways~~)).

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

5. Lighting that is used solely for indoor plant growth during the hours of 10:00 p.m. to 6:00 a.m. <u>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.</u>

6. 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. <u>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.</u>

7. Lighting <u>in galleries, museums and in main building entry lobbies</u> for ((~~art~~)) exhibits, ((~~non-retail displays, portable plug in display fixtures and show case lighting~~)) <u>inspection, and restoration</u>. <u>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.</u>

8. Exterior lighting for public monuments.

<u>9. 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.</u>

<u>10. 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.</u>

<u>11. Audio-visual and video-conferencing lighting with multi-level or dimming controls in rooms with permanently installed audio-visual equipment or video-conferencing equipment.</u>

1513 Lighting Controls: Lighting, including exempt lighting in Section 1512, shall comply with this section. Where occupancy sensors are cited, they shall have the features listed in Section 1513.6.1. Where automatic time switches are cited, they shall have the features listed in Section 1513.6.2.

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<u>, when provided in addition to manual controls, need not be accessible to the users and may be centralized in a remote location</u>.

3. Controls requiring trained operators.

4. Controls for safety hazards and security.

1513.2 Area Controls: The maximum lighting power that may be controlled from a single switch or automatic control shall not exceed that which is provided by a 20 ampere circuit loaded to not more than 80%. A master control may be installed provided the individual switches retain their capability to function independently. Circuit breakers may not be used as the sole means of switching.

EXCEPTIONS: 1. Industrial or manufacturing process areas, as may be required for production.

2. Areas less than 5% of the building footprint for footprints over 100,000 ft^2.

1513.3 Daylight Zone Control: Lighting in ((~~A~~)) 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 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 light 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.

1513.4 Display, Exhibition and Specialty Lighting Controls: All display, exhibition or specialty lighting shall be controlled independently of general area lighting.

1513.5 Automatic Shut-off Controls, Exterior: Exterior lighting ((~~not intended for 24-hour continuous use shall be automatically switched by timer, photocell or~~)), including signs, shall be capable of being automatically switched off during daylight hours and non-use nighttime hours by either a combination of timer and photocell, or a timer with astronomic control. Automatic time switches shall also have program back-up capabilities, which prevent the loss of program and time settings for at least 10 hours, if power is interrupted.

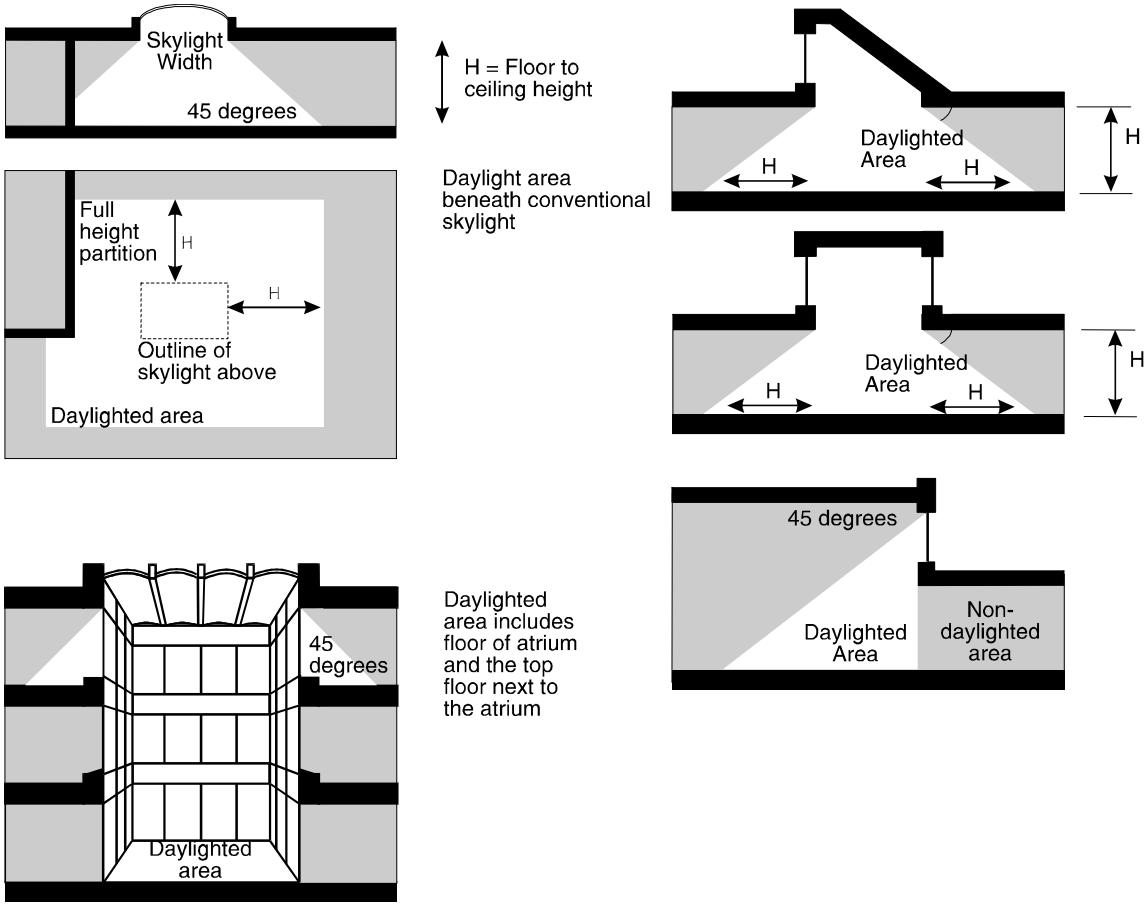

Exhibit 1513.3a

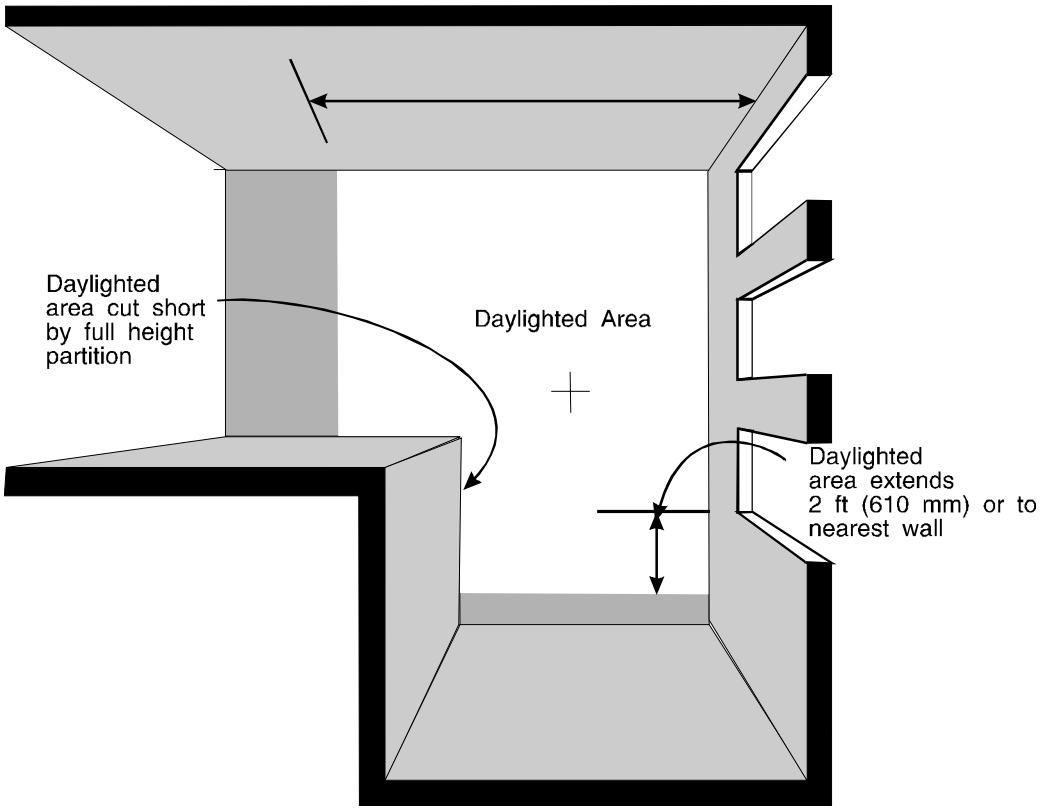

Exhibit 1513.3b

1513.6 Automatic Shut-Off Controls, Interior: Buildings greater than 5,000 ft^2 and all school classrooms shall be equipped with separate automatic controls to shut off the lighting during unoccupied hours. Within these buildings, all office areas less than 300 ft^2 enclosed by walls or ceiling-height partitions, and all meeting and conference rooms, and all school classrooms, shall be equipped with occupancy sensors that comply with Section 1513.6.1. For other spaces, automatic controls may be an occupancy sensor, time switch or other device capable of automatically shutting off lighting.

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

2. Emergency lighting systems.

3. Switching for industrial or manufacturing process facilities as may be required for production.

4. Hospitals and laboratory spaces.

5. Areas in which medical or dental tasks are performed are exempt from the occupancy sensor requirement.

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

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

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

a. is readily accessible;

b. is located so that a person using the device can see the lights or the areas controlled by the switch, or so that the area being illuminated is annunciated;

c. is manually operated;

d. allows the lighting to remain on for no more than 2 hours when an over-ride is initiated; and

e. controls an area not exceeding 5,000 ft^2 or 5% of the building footprint for footprints over 100,000 ft^2, whichever is greater.

1513.7 Commissioning Requirements: For lighting controls which include daylight or occupant sensing automatic controls, automatic shut-off controls, occupancy sensors, or automatic time switches, the lighting controls shall be tested to ensure that control devices, components, equipment and systems are calibrated, adjusted and operate in accordance with approved plans and specifications. Sequences of operation shall be functionally tested to ensure they operate in accordance with approved plans and specifications. A complete report of test procedures and results shall be prepared and filed with the owner. Drawing notes shall require commissioning in accordance with this paragraph.

SECTION 1520 — PRESCRIPTIVE LIGHTING OPTION

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

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

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

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

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

Track lighting is not allowed under this path.

EXCEPTIONS: 1. Up to a total of 5% of installed lighting fixtures may use any type of ballasted lamp and do not require dimming controls.

2. Clear safety lenses are allowed in food prep and serving areas and patient care areas in otherwise compliant fixtures.

3. Exit lights are not included in the count of fixtures provided that they do not exceed 5 watts per fixture and are light emitting diode (LED) type or T-1 fluorescent type only. (See the Fire Code for face illumination footcandle requirements and other requirements.)

4. LED lights other than exit lights address by exception 3.

5. Metal halide lighting which complies with all three of the following criteria:

i. luminaires or lamps which have a reflector or louver assembly to direct the light;

ii. fixtures are fitted with ceramic metal halide lamps not exceeding 150 watts; and

iii. electronic ballasts.

1522 Prescriptive Exterior Lighting Requirements: See Section 1532.

SECTION 1530 — LIGHTING POWER ALLOWANCE OPTION

The installed lighting wattage shall not exceed the lighting power allowance. Lighting wattage includes lamp and ballast wattage. Wattage for fluorescent lamps and ballasts shall be tested per ANSI Standard C82.2-1984.

The wattage used for any unballasted fixture shall be the maximum UL listed wattage for that fixture regardless of the lamp installed. The wattage used for track lighting shall be:

a. for line voltage track, 50 watts per lineal foot of track or actual luminaire wattage, whichever is greater.

b. for low voltage track (i.e. with remote transformer) (less than 30 volts), ((~~25 watts per lineal foot of track or~~))the VA rating of the transformer((~~, whichever is greater~~)).

No credit towards compliance with the lighting power allowances shall be given for the use of any controls, automatic or otherwise.

Exit lights that are 5 watts or less per fixture shall not be included in the lighting power allowance calculations. Other exit lights shall be included in the lighting power allowance calculations.

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

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

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

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

1532 Exterior Lighting Power Allowance: The exterior lighting power allowance shall be ((~~the sum of the calculated allowances~~)) 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/ft^2, and the allowance for open parking and outdoor areas shall be ((~~0.20~~)) 0.15 W/ft^2. 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 ((~~0.25~~)) 0.15 W/ft^2 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. ((~~For covered parking, 0.30 W/ft^2 may be used for the lighting provided that the ceilings and walls are painted or stained with a reflectance value of 0.70 or higher.~~)) Reserved.

3. 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.

4. For the gas station pump area under canopy only, 1.00 W/ft^2 may be used. For automobile sales area only, and for other exterior retail sales, including but not limited to gardening supplies, 0.50 W/ft^2 may be used.

SECTION 1540 — TRANSFORMERS:

Internal building transformers that are single-phase and three-phase dry-type and liquid-filled distribution transformers with a primary voltage of 34.5 kV and below and a secondary voltage of 600 Volts and below shall have a minimum efficiency that complies with NEMA TP-1-1996.

Editor's note: See EPA Energy Star Website for Energy Star Transformers at:

http://www.energystar.gov/index.cfm?c=ci_transformers.pr_ci_transformers

INFORMATIVE GUIDE TO SECTION 1532: NOTE THAT THIS GUIDE DOES NOT SUPERCEDE THE REQUIREMENTS IN THE TEXT.		
CATEGORY	**LIGHTING POWER ALLOWANCE**	**TRADEOFF LIMITATIONS**
PARKING AND OUTDOOR AREAS		
Covered Parking	0.20 Watts/square foot	Calculated separately. Trade offs not allowed with other categories.
Open parking and outdoor areas	0.15 Watts/square foot of area that is illuminated	Calculated separately, but see allowance below for use of façade lighting credit
FAÇADE LIGHTING		
Perimeter option	7.5 Watts/lineal foot of building perimeter	Calculated separately, but any wattage allowance not used for façade lighting may be used for open parking and outdoor areas that are illuminated
Surface area option	0.15 Watts/square foot of wall surface area that is illuminated	Calculated separately, but any wattage allowance up to 7.5 Watts/lineal foot of building perimeter that is not used for façade lighting may be used for open parking and outdoor areas that are illuminated

TABLE 15-1
UNIT LIGHTING POWER ALLOWANCE (LPA)

Use[1]	LPA[2] (W/ft^2)
Painting, welding, carpentry, machine shops	2.30
Barber shops, beauty shops	2.00
Hotel banquet/conference/exhibition hall[3,4]	2.00
Laboratories (see also office and other appropriate categories)	1.80
Aircraft repair hangars	1.50
Cafeterias, fast food establishments[5]	1.50
Factories, workshops, handling areas	1.50
Gas stations, auto repair shops[6]	1.50
Institutions	1.50
Libraries[5]	1.50
Nursing homes and hotel/motel guest rooms	1.50
Retail[10], retail banking	1.50
Wholesale stores (pallet rack shelving)	1.50
Mall concourses	1.40
School buildings (Group E occupancy only, school classrooms, day care centers	((~~1.35~~)) 1.20
Laundries	1.20
Medical offices, clinics[12]	1.20
Atria (atriums)	1.00
Assembly spaces[9], auditoriums, gymnasia[9], theaters	1.00
Group R-1 and R-2 common areas	1.00
Office buildings, office/administrative areas in facilities of other use types (including but not limited to schools, hospitals, institutions, museums, banks, churches)[5,7,11]	1.00
Police and fire stations[8]	1.00
Process plants	1.00
Restaurants/bars[5]	1.00
Locker and/or shower facilities	0.80
Warehouses[11], storage areas	0.50
Aircraft storage hangars	0.40
Parking garages	See Section 1532
Plans Submitted for Common Areas Only[7]	
Main floor building lobbies[3] (except mall concourses)	1.20
Common areas, corridors, toilet facilities and washrooms, elevator lobbies	0.80

Footnotes For Table 15-1

1. In cases in which a general use and a specific use are listed, the specific use shall apply. In cases in which a use is not mentioned specifically, the Unit Lighting Power Allowance shall be determined by the building official. This determination shall be based upon the most comparable use specified in the table. See Section 1512 for exempt areas.

2. The watts per square foot may be increased, by 2% per foot of ceiling height above 20 feet, unless specifically directed otherwise by subsequent footnotes.

3. The watts per square foot of room may be increased by 2% per foot of ceiling height above 12 feet.

4. For all other spaces, such as seating and common areas, use the Unit Lighting Power Allowance for assembly.

5. The watts per square foot of room may be increased by 2% per foot of ceiling height above 9 feet.

6. See Section 1532 for exterior lighting.

7. For conference rooms and offices less than 150 ft^2 with full-height partitions, a Unit Lighting Power Allowance of 1.20 w/ft^2 may be used.

8. For the fire engine room, the Unit Lighting Power Allowance is 1.00 W/ft^2.

9. For indoor sport tournament courts with adjacent spectator seating, the Unit Lighting Power Allowance for the court area is 2.60 W/ft^2 provided that there is a manual dimmer or at least two additional steps of lighting control in addition to off.

10. Display window illumination installed within 2 feet of the window, provided that the lighting is fitted with LED, tungsten halogen, fluorescent or high intensity discharge lamps and 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/ft^2 of merchandise display luminaires are exempt 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 are acceptable with vertical axis only),

c. fitted with LED, tungsten halogen, fluorescent or 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.

12. Medical and clinical offices include those facilities which, although not providing overnight patient care, do provide medical, dental, or psychological examination and treatment. These spaces include, but are not limited to, laboratories and treatment centers.

3.2.3 Receptacle: Receptacle loads and profiles are default assumptions. The same assumptions shall be made in calculating proposed energy consumption as were used in calculating the standard energy consumption. Receptacle loads include all general service loads that are typical in a building. These loads should include additional process electrical usage but exclude HVAC primary or auxiliary electrical usage. Table 3-1 establishes the density in W/ft^2 to be used. The receptacle energy profiles shall be the same as the lighting energy profiles in Table 3-2. This profile establishes the percentage of the receptacle load that is switched ON by hour of the day and by building type.

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) or shading coefficient 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. 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 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
> 2. health/institutional
> 3. hotel/motel
> 4. light manufacturing
> 5. office (business)
> 6. restaurant
> 7. retail (mercantile)
> 8. school (educational)
> 9. warehouse (storage)

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 standard design.

> **EXCEPTION:** For underfloor systems, a 25 percent reduction is allowed for the proposed design.

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

3.5 Service Water Heating: The service water heating loads for prototype buildings are defined in terms of Btu/person-hour in Table 3-1. The values in the table refer to energy content of the heated water. The service water heating loads from Table 3-1 are default for all buildings. The same service-water-heating load assumptions shall be made in calculating proposed energy consumption as were used in calculating the standard energy consumption. The service water heating system for the standard building shall be modeled as closely as possible as if it were designed in accordance with RS-11 and meeting all the requirements of Sections 1440 through 1443.

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 3-2J
Warehouse Occupancy[1]

Hour of Day (Time)	Schedule for Occupancy Percent of Maximum Load			Schedule for Lighting Receptacle Percent of Maximum Load			Schedule for HVAC System			Schedule for Service Hot Water Percent of Maximum Load			Schedule for Elevator Percent of Maximum Load		
	Wk	Sat	Sun	Wk	Sat	Sun	Wk	Sat	Sun	Wk	Sat	Sun	Wk	Sat	Sun
1 (12-1 am)	0	0	0	5	5	5	Off	Off	Off	2	2	2	0	0	0
2 (1-2 am)	0	0	0	5	5	5	Off	Off	Off	2	2	2	0	0	0
3 (2-3 am)	0	0	0	5	5	5	Off	Off	Off	2	2	2	0	0	0
4 (3-4 am)	0	0	0	5	5	5	Off	Off	Off	2	2	2	0	0	0
5 (4-5 am)	0	0	0	5	5	5	Off	Off	Off	5	2	2	0	0	0
6 (5-6 am)	0	0	0	5	5	5	Off	Off	Off	7	2	2	0	0	0
7 (6-7 am)	0	0	0	5	5	5	Off	Off	Off	7	2	2	0	0	0
8 (7-8 am)	15	0	0	40	5	5	On	Off	Off	10	2	2	0	0	0
9 (8-9 am)	70	20	0	70	8	5	On	On	Off	30	6	2	0	0	0
10 (9-10 am)	90	20	0	90	24	5	On	On	Off	36	12	2	0	0	0
11 (10-11 am)	90	20	0	90	24	5	On	On	Off	36	12	2	30	0	0
12 (11-12 pm)	90	20	0	90	24	5	On	On	Off	46	17	2	0	0	0
13 (12-1 pm)	50	10	0	80	5	5	On	On	Off	57	4	4	0	0	0
14 (1-2 pm)	85	10	0	90	5	5	On	On	Off	43	4	4	0	0	0
15 (2-3 pm)	85	10	0	90	5	5	On	On	Off	38	2	2	0	0	0
16 (3-4 pm)	85	10	0	90	5	5	On	On	Off	40	2	2	40	0	0
17 (4-5 pm)	20	0	0	90	5	5	On	Off	Off	30	2	2	0	0	0
18 (5-6 pm)	0	0	0	30	5	5	Off	Off	Off	18	2	2	0	0	0
19 (6-7 pm)	0	0	0	5	5	5	Off	Off	Off	3	2	2	0	0	0
20 (7-8 pm)	0	0	0	5	5	5	Off	Off	Off	3	2	2	0	0	0
21 (8-9 pm)	0	0	0	5	5	5	Off	Off	Off	3	2	2	0	0	0
22 (9-10 pm)	0	0	0	5	5	5	Off	Off	Off	3	2	2	0	0	0
23 (10-11 pm)	0	0	0	5	5	5	Off	Off	Off	3	2	2	0	0	0
24 (11-12 am)	0	0	0	5	5	5	Off	Off	Off	3	2	2	0	0	0
Total/Day	680	120	0	915	180	120	1000	800	0	429	91	52	70	0	0
Total/Week	35.20 hours			48.75 hours			58.00 hours			22.88 hours			3.50 hours		
Total/Year	1835 hours			2542 hours			3024 hours			1193 hours			182 hours		

Wk = Weekday

1. Schedules for occupancy, lighting, receptacle, HVAC system, and service hot water are from ASHRAE Standard 90.1-1989 and addendums, except that 5% emergency lighting has been added for all off hours. Elevator schedules, except for restaurants, are from the U.S. Department of Energy Standard Evaluation Techniques except changed to 0% when occupancy is 0%. **These values may be used only if actual schedules are not known.**

TABLE 3-3
HVAC Systems of Prototype Buildings[3]

Use	System #	Remarks
1. Assembly		
a. Churches (any size)	1	
b. ≤ 50,000 ft^2 or ≤ 3 floors	1 or 3	Note 2
c. > 50,000 ft^2 or > 3 floors	3	
2. Health		
a. Nursing Home (any size)	2	
b. ≤ 15,000 ft^2	1	
c. > 15,000 ft^2 and ≤ 50,000 ft^2	4	Note 3
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 ((~~either~~)) ≤ ((~~3~~)) 7 floors ((~~or ≤ 75,000 ft^2~~))	4	
c. > ((~~75,000 ft^2 or > 3~~)) 7 floors	5	
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 ≤ 3 floors	1	
b. > 75,000 ft^2 or > 3 floors	3	
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 Buildings[1]

HVAC Component	System #1	System #2
System Description	Packaged rooftop single zone, one unit per zone	Packaged terminal air conditioner with space heater or heat pump, heating or cooling unit per zone
Fan system Design Supply Circulation Rate	Note 10	Note 11
Supply Fan Control	Constant volume	Fan cycles with call for heating or cooling
Return Fan Control	NA	NA
Cooling System	Direct expansion air cooled	Direct expansion air cooled
Heating System	Furnace, heat pump or electric resistance	Heat pump with electric resistance auxiliary or air conditioner with space heater
Remarks	Drybulb economizer per Section 1433, heat recovery if required by Section 1436	No economizer, if not required by Section 1433

TABLE 3-3 (Continued)
HVAC System Descriptions for Prototype Buildings[1]

HVAC Component	System #3	System #4
System Description	Air handler per zone with central plant	Packaged rooftop VAV with perimeter reheat and fan-powered terminal units
Fan system Design Supply Circulation Rate	Note 10	Note 10
Supply Fan Control	Constant volume	Variable Air Volume systems with controls per Section 1438 ((~~forward curved centrifugal fan and variable inlet fans~~))
Return Fan Control	Constant volume	Variable Air Volume systems with controls per Section 1438 ((~~forward curved centrifugal fan and variable inlet fans~~))
Cooling System	Chilled water (Note 12)	Direct expansion air cooled
Heating System	Hot water (Note 13)	Hot water (Note 13) or electric resistance
Remarks	Drybulb economizer per Section 1433, heat recovery if required by Section 1436	Drybulb economizer per Section 1433. Minimum VAV setting per Section 1435 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 Buildings[1]

HVAC Component	System #5	System #6
System Description	Built-up central VAV with perimeter reheat and fan-powered terminal units	Four-pipe fan coil per zone with central plant
Fan system Design Supply Circulation Rate	Note 10	Note 10
Supply Fan Control	VAV with air-foil centrifugal fan and AC frequency variable speed drive	Fan cycles with call for heating or cooling
Return Fan Control	VAV with air-foil centrifugal fan and AC frequency variable speed drive	NA
Cooling System	Chilled water (Note 12)	Chilled water (Note 12)
Heating System	Hot water (Note 13) or electric resistance	Hot water (Note 13) or electric resistance
Remarks	Drybulb economizer per Section 1433. Minimum VAV setting per Section 1435 Exception 1, Supply air reset by zone of greatest cooling demand, heat recovery if required by Section 1436	No economizer, if not required by Section 1433

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.