

SUBCHAPTER 13-3

REFERENCED STANDARDS AND ORGANIZATIONS

SECTION 13-301 REFERENCED STANDARDS

13-301.0 General. The standards (Std), and portions thereof, which are referred to in various parts of this code shall be part of Chapter 13 of the *Florida Building Code* and are hereby declared to be a part of this code. Section numbers shall read as if prefaced by 13-

FLORIDA BUILDING CODE

AABC

Associated Air Balance Council,
1518 K Street, Suite 503,
Washington, DC 20005

Standard reference number	Title	Referenced in code section number
AABC, 1989	Associated Air Balance Council National Standard	410.1.ABC.4.3

AAMA

American Architectural Manufacturers Association
1827 Walden Office Square, Suite 104
Schaumburg, IL 60173-4268

Standard reference number	Title	Referenced in code section number
AAMA/NWWDA 101/I.S. 2-97	Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors	406.1.ABC.1.1, 606.ABC.1.1

ACCA

Air Conditioning Contractors of America
2800 Shirlington Road, Suite 300
Arlington, VA 22206

Standard reference number	Title	Referenced in code section number
ACCA Manual D-1995	Residential Duct Systems	410.1.ABC.2, 610.ABC.1
ACCA Manual J-2003	Residential Load Calculation, Eighth Edition with posted updates/errata.	607.ABC.1
ACCA Manual N-1988	Commercial Load Calculation, Fourth Edition.	607.1.ABC.1, B-3.1.1

ADC

Air Diffusion Council
11 South LaSalle Street, Suite 1400
Chicago, IL 60603.

Standard reference number	Title	Referenced in code section number
ADC 1996	Flexible Duct Performance & Installation Standards, Third Edition.	410.1.ABC.2.2, 610.1.ABC.2.2

AHAM

Association of Home Appliance Manufacturers
20 North Wacker Dr.
Chicago, IL 60606

Standard reference number	Title	Referenced in code section number
ANSI/AHAM RAC1-03	Room Air Conditioners.	Table 407.1.ABC.3.2D, Table 607.1.ABC.3.2D,

AMCA

Air Movement and Control Association International
30 West University Drive
Arlington Heights, IL 60004-1806

Standard reference number	Title	Referenced in code section number
AMCA 500-1989	Test Methods for Louvers, Dampers, and Shutters	409.1.ABC.3.4

ANSI

American National Standards Institute, Inc.
25 West 43rd Street, Fourth Floor
New York, N.Y.10036.

Standard reference number	Title	Referenced in code section number
ANSI A112.18.1M-1999	Finished and Rough Brass Plumbing Fixture Fittings.	412.1.ABC.2.5.1, 612.1.ABC.2.4
ANSI Z21.10.3-2001	Gas Water Heater, Volume 3, Storage, with Input Ratings above 75,000 Btu/h.	
**	Circulating and Instantaneous Water Heaters	Table 412.1.ABC.3, Table 608.2.A.3.5, 612.1.ABC.3.1.2
ANSI Z21.40.4-96 (with Addenda 1)	American National Standard for Performance Testing and Rating of Gas-Fired, Air-Conditioning and Heat Pump Appliances.	607.2.A.1, C-5.1.1
ANSI Z21.47a-2001	Gas-Fired Central Furnaces.	Table 408.1.ABC.3.2E, Table 608.1.ABC.3.2E
ANSI Z21.56-2001	Gas-Fired Pool Heaters.	412.1.ABC.3.5, 612.1.ABC.2.3.1
ANSI Z21.66-1994	Automatic Vent Damper Devices for Use with Gas-Fired Appliances	408.1.ABC.3.2.1
ANSI Z83.8/CGA 2.6 -02	Gas Unit Heaters and Gas-Fired Duct Furnaces. CGA 2.6	Table 408.1.ABC.3.2E, Table 608.1.ABC.3.2E

ARDM

Association of Refrigerant Desuperheater Manufacturers, Inc,
c/o Trevor-Martin
4151 112 Terrace N
Clearwater, FL 33762

Standard reference number	Title	Referenced in code section number
ARDM-88	Residential Heat Recovery Installation Guide, First Edition.	600.3.ABC.3.2, 612.1.B.3.2, 612.2.A.3.1

ARI

Air-Conditioning and Refrigeration Institute
Suite 200
4100 North Fairfax Drive
Arlington, VA 22203

Standard reference number	Title	Referenced in code section number
ARI Std. 210/240-1994	Unitary Air-Conditioning and Air-Source Heat Pump Equipment	Tables 407.1.ABC.3.2A,B, Tables 607.1.ABC.3.2A,B, 607.1.ABC.3.1, 608.1.ABC.3.1
ARI Std. 310/380-1993	Packaged Terminal Air-Conditioners and Heat Pumps	Tables 407.1.ABC.3.2D, Tables 607.1.ABC.3.2D
ARI Std. 340/360-2000	Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment	Tables 407.1.ABC.3.2A,B Tables 607.1.ABC.3.2A,B
ARI Std. 365-1994	Commercial and Industrial Unitary Air-Conditioning Condensing Units	Tables 407.1.ABC.3.2A, Tables 607.1.ABC.3.2A
** ARI 390-2001	Single Package Vertical Air-Conditioners and Heat Pumps	407.1.ABC.3.2D, 607.1.ABC.3.2D

ARI Std. 460-2000	Remote Mechanical Draft Air-Cooled Refrigerant Condensers	Tables 407.1.ABC.3.2G
ARI Std. 550/590-1998 (with Addenda)	Water Chilling Packages Using the Vapor Compression Cycle	202, 407.1.ABC.3.2, Tables 407.1.ABC.3.2C
ARI Std. 560-2000	Absorption Water Chilling and Water Heating Packages	Tables 407.1.ABC.3.2C
ARI Std. 1160-2004	Performance Rating of Heat Pump Pool Heaters.	Table 13-412.1.ABC.3, 13-612.1.ABC.2.3.4

ASHRAE

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
1791 Tullie Circle, NE
Atlanta, GA 30329-2305

Standard reference number	Title	Referenced in code section number
ANSI/ASHRAE Std.55-1992	Thermal Environmental Conditions for Human Occupancy.	412.1.ABC.1, 412.1.ABC.1
ANSI/ASHRAE Std. 62-2001	Ventilation for Acceptable Indoor Air Quality.	407.1.ABC.2.1.1, 407.1.ABC.2.3, 409.1.ABC.1.1, 409.1.ABC.3.5, 609.1.ABC.1
ANSI/ASHRAE Std. 90.1-2001	Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings.	413.0
ANSI/ASHRAE Std.93-1986 (RA91)	Methods of Testing to Determine the Thermal Performance of Solar Collectors.	612.1.ABC.3.4
ANSI/ASHRAE 124-1991	Methods of Testing for Rating Combination Space-Heating and Water-Heating Appliances	608.2.A.3.5, 612.2.A.1
ANSI/ASHRAE 137-1995 (RA2001)	Methods of Testing for Efficiency of Space-conditioning/Water-Heating Appliances That Include a Desuperheater Water Heater.	412.1.ABC.1, 612.2.A.1
ANSI/ASHRAE 146-1998	Method of Testing for Rating Pool Heaters	Table 412.1.ABC.3
ASHRAE Handbook	HVAC Applications, 1999.	412.1.ABC.1, 412.1.ABC.2.1.1
ASHRAE Handbook	Fundamentals, 2001	202, B-3.1.1, B-3.1.2, B-3.1.3
ASHRAE Handbook	HVAC Systems & Equipment, 2000	410.1.ABC.3, 610.1.ABC.3
ASHRAE, 1998	Cooling and Heating Load Calculation Principles	607.1.ABC.1

ASTM

ASTM International
100 Barr Harbor Dr
West Conshohocken, PA 19428-2959

Standard reference number	Title	Referenced in code section number
ASTM C36/C36M-03	Standard Specification for Gypsum Wallboard	202
ASTM C90-01a	Standard Specification for Loadbearing Concrete Masonry Units	402.1.C.1, B-1.2.3, B-2.2.1.1
ASTM C 177-97	Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.	410.1.ABC.2.3, 610.1.ABC.2.2, B-1.1.1
ASTM C 236-89 (1993 ^{el})	Test Method For Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box.	602.1.A.2, B-1.1.1, B-1.1.2, C-2.2.2
ASTM C272-91	Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions.	B-1.3.4
ASTM C 335-95	Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulations.	Table 411.1.ABC.2
ASTM C 516-02	Vermiculite Loose Fill Thermal Insulation	Table 6C-2
ASTM C 518-02	Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.	
ASTM C 549-02	Perlite Loose Fill Insulation.	
ASTM C 578-01	Rigid, Cellular Polystyrene Thermal Insulation.	Table 6C-2
ASTM C 665-01 ^{el}	Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.	Table 6C-2
ASTM C 727-01	Standard Practice for Installation and Use of Reflective Insulation in Building Constructions.	Table 6C-2
ASTM C 739-2000 ^{el}	Cellulosic Fiber (Wood-Base) Loose-Fill Thermal Insulation.	Table 6C-2
ASTM C 764-2002	Mineral Fiber Loose-Fill Thermal Insulation.	Table 6C-2
ASTM C835-95 (1999)	Standard Test Method for Total Hemispherical Emittance of Surfaces From 20°C to 1400°C	404.1.C.1
ASTM C 976-90 (1996) ^{el}	Test Method for Thermal Performance of Building Assemblies by Means of a Calibrated Hot Box.	B-1.1.1, B-1.1.2
ASTM C 1015-02	Standard Practice for Installation of Cellulosic and Mineral Fiber Loose-Fill Thermal Insulation	Table 6C-2
ASTM C 1158-01	Standard Practice for Use and Installation of Radiant Barrier Systems (RBS) in Building Construction	607.1A.4, Table 6C-2
ASTM C 1224-01	Reflective Insulation for Building Applications.	607.1A.3.2, Table 6C-2
ASTM C 1289-02	Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board	Table 6C-2
ASTM C 1313-00	Sheet Radiant Barriers for Building Construction Applications.	607.1A.3.2, Table 6C-2
ASTM C 1320-99	Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light-Frame Construction	Table 6C-2

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ASTM C 1321-96	Standard Practice for Installation and Use of Interior Radiation Control Coating Systems (IRCC) in Building Construction	607.1.A.4
ASTM C 1371-98	Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emitters.	404.1.C.1, 607.1.A.4
ASTM E 84-01	Test Method for Surface Burning Characteristics of Building Materials	410.1.ABC.3.0.7, 610.1.ABC.3.0.7
ASTM E 283-91(1999)	Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen.	406.1.ABC, 406.1.ABC.1.1, 606.1.ABC.1.1, 606.1.ABC.1.2.4, C-4.2.3
ASTM E 408-71 (2002)	Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques	404.1.C.1
ASTM E 903-96	Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres	404.1.C.1, 607.1.A.5
ASTM E 1175-87 (1996)	Standard Test Method for Determining Solar or Photopic Reflectance, Transmittance, and Absorptance of Materials Using a Large Diameter Integrating Sphere	404.1.C.1
ASTM E 1918-97	Standard Test Method for Measuring Solar Reflectance of Horizontal or Low-Sloped Surfaces in the Field	404.1.C.1

CTI

Cooling Technology Tower Institute
2611 FM 1960 West, Suite H-200
Houston, TX 77068-3730.

Standard reference number	Title	Referenced in code section number
CTI ATC-105(97)	Acceptance Test Code for Water Cooling Towers	Table 407.1.ABC.3.2G
CTI Std. 201-96	Certification Standard for Water Cooling Tower Thermal Performance	Table 407.1.ABC.3.2G

DASMA

Door and Access Systems Manufacturers Association
1300 Sumner Avenue
Cleveland, OH 44115-2851.

Standard reference number	Title	Referenced in code section number
ANSI/DASMA 105-1992 (R1998)	Test Method for Thermal Transmittance and Air Infiltration of Garage Doors	406.1.ABC.1.1

DOE

United States Department of Energy
c/o Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402-9325

Standard reference number	Title	Referenced in code section number
DOE, 10 CFR, Part 430 Subpart B, App. E-1998	Uniform Test Method for Measuring the Energy Consumption of Water Heaters	Tables 408.1.ABC.3.2F, 608.1.ABC.3.2F, 412.1.ABC.3, 612.1.ABC.3.1.1, 612.1.ABC.3.2
Subpart B, App. M	Uniform Test Method for Measuring the Energy Consumption of Central Air Conditioners	607.1.ABC.3.1
10 CFR, Part 430 Subpart B, App N -1998	Uniform Test Method for Measuring the Energy Consumption of Furnaces	Tables 408.1.ABC.3.2E, 608.1.ABC.3.2E
DOE, 10 CFR, Part 430 Subpart B, App O-1998	Uniform Test for Measuring the Energy Consumption of Vented Home Heating Equipment	202
EPACT, 92		
42 USC 6831, et seq	Energy Policy Act of 1992	407.1.ABC.3.2, 414.1.ABC.1, 607.1.ABC.3.2.1
Public Law 102-486	National Appliance Energy Conservation Act of 1987	Tables 407.1.ABC.3.2A, B; 408.1.ABC.2.2, Table 408.1.ABC.3.2E, 607.1.ABC.3.1, Tables 607.1.ABC.3.2A, B, 608.1.ABC.3.1
NAECA, 1987		

Florida Codes

Building Codes and Standards Office
 Florida Department of Community Affairs
 2555 Shumard Oak Blvd.
 Tallahassee, FL 32399-2100

Standard reference number	Title	Referred in code section number
FL-1	Florida Standard for Desuperheater/Water Heaters (See Appendix E of this code).....	612.1.B.3.2, 612.2.A.3.1

FTC

U.S. Federal Trade Commission
 Sixth Street and Pennsylvania Avenue, N.W.
 Washington, DC 20580

Standard reference number	Title	Referred in code section number
FTC, 16 CFR, Part 460, Amended Effective 4/29/96	FTC Labeling and Advertising of Home Insulation.....	202, C-1.2

GAMA

Gas Appliance Manufacturers Association
 PO Box 9245
 Arlington, VA 22209

Standard reference number	Title	Referred in code section number
GAMA	Consumers' Directory of Certified Efficiency Ratings for Water Heating Equipment.....	Table 408.1.ABC.3.2F, Table 608.1.ABC.3.2F, 612.1.ABC.3.5, 612.2.A.1

HI

Hydronics Institute
 P.O. Box 218
 Berkeley Heights, NH 07922

Standard reference number	Title	Referred in code section number
H.I., HBS 86-1989	Testing and Rating Standard for Heating Boilers.....	Tables 408.1.ABC.3.2F, 608.1.ABC.3.2F

HUD

U.S. Dept. Housing and Urban Development
 451 7th Street S.W.
 Washington, DC 20410

Standard reference number	Title	Referred in code section number
HUD, 24 CFR 3282-3283	Manufactured Home Procedural and Enforcement Regulations.....	202
HUD, 42 CFR 70, s. 5401 (24 CFR 3280)	Manufactured Home Construction and Safety Standards.....	202
HUD, 42 USC 77, s. 6295	Energy Conservation Standards.....	202

ISO

International Standards Organization
 1, rue de Varembe, Case postale 56,
 CH-1211 Geneve 20, Switzerland

Standard reference number	Title	Referred in code section number
ISO 9806 (1994, 1995)	Test Methods for Solar Collectors Part 1: Thermal Performance of glazed liquid heating collectors including pressure drop, December 1, 1994. . .	612.1.ABC.3.4

Part 2: Qualification test procedures", August 15, 1995.
 Part 3: Thermal performance of unglazed liquid heating collectors (sensible heat transfer only) including pressure drop", December 15, 1995.

ISO 13256-1 (1998) Water-Source Heat Pumps—Testing and Rating for Performance—Part 1 Water-to-Air and Brine-to-Air Heat Pumps Table 407.1.ABC.3.2B, Table 607.1.ABC.3.2B

NAIMA

North American Insulation Manufacturers Association
 44 Canal Center Plaza, Suite 310,
 Alexandria, VA 22314

Standard reference number	Title	Referenced in code section number
NAIMA 1993	Fibrous Glass Duct Construction Standards, Second Edition.	410.1.ABC.3.2, 610.1.ABC.3.2
NAIMA 1994	Fibrous Glass Duct Liner Standard	410.1.ABC.2.5, 610.1.ABC.2.4, 610.1.ABC.3

NEBB

National Environmental Balancing Bureau
 8575 Grovemont Circle
 Gaithersburg, MD 20877-4121

Standard reference number	Title	Referenced in code section number
NEBB, 1998	Procedural Standards For Testing and Balancing Environmental Systems	410.1.ABC.4.3

NEMA

National Electrical Manufacturers Association
 1300 N 17th Street, Suite 1847
 Rosslyn, VA 22209

Standard reference number	Title	Referenced in code section number
NEMA MG 1-1998	Motors and Generators.	202

NFPA

National Fire Prevention Assoc.
 Batterymarch Park
 Quincy, MA 02269

Standard reference number	Title	Referenced in code section number
NFPA 96-2001	Ventilation Control and Fire Protection of Commercial Cooking Operations.	407.1.ABC.3.5, 409.1.ABC.3.6.1

NFRC

National Fenestration Rating Council, Inc.
 8484 Georgia Avenue, Suite 320
 Silver Spring, MD 20910

Standard reference number	Title	Referenced in code section number
NFRC 100-01	Procedure for Determining Fenestration Product U-factors.	601.1.ABC.1, B-2.1, B-2.3
NFRC 200-01	Procedure for Determining Fenestration Product Solar Heat Gain Coefficients and Visible Transmittance at Normal Incidence.	401.2.AB.5, 601.1.ABC.1, 601.2.A.2
NFRC 300-01	Standard Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems.	B-2.1
NFRC 400-01	Procedure for Determining Fenestration Product U-factors Air Leakage.	406.1.ABC.1.1

SMACNA

Sheet Metal and Air-Conditioning Contractors' National Association, Inc.
 4201 Lafayette Center Dr.
 Chantilly, VA 20151-1209

Standard reference number	Title	Referenced in code section number
SMACNA, 1985	HVAC Air Duct Leakage Test Manual.	410.1.ABC.3.1.3, 610.1.ABC.3, 610.1.ABC.3.1.3

SRCC

Solar Rating and Certification Corporation
 c/o Florida Solar Energy Center
 1679 Clearlake Road
 Cocoa, FL 32922-5703

Standard reference number	Title	Referenced in code section number
FSEC	Directory of Certified Solar Systems	612.1.ABC.3.4, 612.1.B.3.3
SRCC TM-1	Solar Domestic Hot Water System and Component Test Protocol, December 6, 2002.	612.1.ABC.3.4

UL

Underwriters Laboratory, Inc.
 333 Pfingsten Rd.
 Northbrook, IL 60062-2096

Standard reference number	Title	Referenced in code section number
UL 181-96	Standard for Factory-Made Air Ducts and Air Connectors with revisions through December 1998.	410.1.ABC.3.0.7, 410.1.ABC.3.7.1, 610.1.ABC.3, 610.1.ABC.3.0.7, 610.1.ABC.3.7.1
UL 181A-94	Closure Systems for Use With Rigid Air Ducts and Air Connectors, with revisions through December 1998.	410.1.ABC.3.0.7, 610.1.ABC.3, 610.1.ABC.3.0.7
UL 181B-95	Closure Systems for Use With Flexible Air Ducts and Air Connectors with revisions through May 2000.	410.1.ABC.3.0.7, 610.1.ABC.3, 610.1.ABC.3.0.7
UL 723-03	Standard for Test for Surface Burning Characteristics of Building Materials.	410.1.ABC.3.0.7, 610.1.ABC.3.0.7
UL 727-94	Standard for Oil-Fired Central Furnaces, with revisions through January 1999.	Table 408.1.ABC.3.2E, Table 608.1.ABC.3.2E
UL 731-95	Standard for Oil-Fired Unit Heaters, with revisions through January 1999.	Table 408.1.ABC.3.2E, Table 608.1.ABC.3.2E

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SUBCHAPTER 13-4

COMMERCIAL BUILDING COMPLIANCE METHODS

SECTION 13-400 ADMINISTRATION

13-400.0 General. The provisions of this chapter apply to all new commercial occupancy buildings, additions to existing commercial occupancy buildings, and multiple-family residential buildings over three stories in height. Building type classifications shall be those defined in Subchapter 13-2 of this code under “occupancy classification.” This subchapter provides three methods by which commercial buildings may be brought into compliance with this code.

13-400.0.ABC Compliance criteria. Commercial buildings demonstrating compliance with this code by Methods A or B shall meet all of the criteria given in the text as specific to the chosen method of compliance for 1 through 4 below. Commercial buildings utilizing Method C for code compliance shall meet all criteria specified for Method C for 1, 3 and 4 below.

1. Prescriptive requirements.
2. Performance calculation procedure.
3. Certification of compliance.
4. Reporting.

13-400.0.A Method A, the Whole Building Performance Method. This is a computer-based energy code budget method which may be used for determining the compliance of all proposed designs, except designs with no mechanical system. Under this method, cost performance is calculated for the entire building based on the envelope and major energy-consuming systems specified in the design and simultaneously for a baseline building of the same configuration, but with baseline systems. Compliance is met if the design energy cost does not exceed the energy cost budget when calculated in accordance with this section; and the energy efficiency level of components specified in the building design meet or exceed the efficiency levels used to calculate the design energy cost. Compliance calculations are those utilized in the energy gauge FLA/COM 2004 computer program and are as described in the sections called performance calculation procedures. Basic prescriptive requirements described in the sections called prescriptive requirements shall also be met.

Note: The energy cost budget and the design energy cost calculations are applicable only for determining compliance with this standard. They are not predictions of actual energy consumption or costs of the proposed design after construction. Actual experience will differ from these calculations due to variations such as occupancy, building operation and maintenance, weather, energy use not covered by this standard, changes in energy rates between design of the building and occupancy, and precision of the calculation tool.

13-400.0.B Method B, the Building Envelope Trade-off Method. This is a computer-based calculation methodology. The building envelope complies with the standard if the pro-

posed building meets the basic prescriptive requirements (.ABC) and the envelope performance factor of the proposed building is less than or equal to the envelope performance factor of the budget building. The envelope performance factor considers only the building envelope components. Schedules of operation, lighting power, equipment power, occupant density and mechanical systems shall be the same for both the proposed building and the budget building. Envelope performance factor shall be calculated using the EnergyGauge FLA/COM 2004 computer program and the procedures specified for each envelope component under compliance Method B (.2.B).

13-400.0.C Method C, the Buildings Prescriptive Envelope Method. This method requires that prescriptive requirements listed on Form 400C for the appropriate climate zone for a given building type be met or exceeded to comply with this code. For conditioned space, the exterior building envelope shall comply with either the “nonresidential” or “residential” requirements on Form 400C, as applicable. If a building contains any semiheated space or unconditioned space (see Section 400.0.C.1), then the semiexterior building envelope shall comply with the requirements for semiheated space on Form 400C.

13-400.0.C.1 Scope. Method C may be used, provided that:

- (a) The vertical fenestration area does not exceed 50 percent of the gross wall area for each space-conditioning category and
- (b) The skylight fenestration area does not exceed 5 percent of the gross roof area for each space-conditioning category.

Requirements are specified for the exterior building envelope, which separates conditioned space from the exterior.

Exceptions: For buildings that contain spaces that will be only semiheated or unconditioned, and if compliance Method A is used for such spaces, then Method C also specifies requirements for the semiexterior building envelope, which separates:

- (a) Conditioned space from either semiheated space or unconditioned space,
- (b) Semiheated space from either unconditioned space or from the exterior.

NOTE: Method C does not address moisture control or provide design guidelines to prevent moisture migration that leads to condensation, mold and mildew, or deterioration to insulation or equipment performance.

13-400.0.C.2 Space conditioning. Envelope requirements are specified by space-conditioning categories. Separate exterior building envelope requirements are specified for each of two categories of conditioned space:

- a. Nonresidential conditioned space,
- b. Residential > three stories conditioned space.

Spaces shall be assumed to be conditioned space and shall comply with the requirements for conditioned space at the time of construction, regardless of whether mechanical or electrical equipment is included in the building permit application or installed at that time.

Exceptions: For buildings that contain spaces without air conditioning that will be only semiheated or unconditioned, and if alternative compliance is sought for such spaces, then all semiheated or unconditioned spaces shall be clearly indicated on the floor plan as such, and the following semiexterior building envelope requirements apply:

1. If a space will be only semiheated, the space shall be considered semiheated
2. If a space will remain unconditioned, the space shall be considered unconditioned

13-400.0.C.3 Maximum *U*-factor, *C*-factor, *F*-factor. Compliance shall be shown with the maximum *U*-factor, *C*-factor or *F*-factor for the entire assembly for the component in lieu of complying with the minimum rated *R*-value of insulation for the insulation alone. *U*-factors, *C*-factors, and *F*-factors for typical construction shall be determined from Appendix 13-B or by the procedures established by Appendix 13-B.

13-400.0.C.4 Renovated buildings. Renovated buildings shall, when applicable (see Section 202), meet the efficiencies listed on Form 400C for components being changed or shall comply with the envelope or systems criteria in Method B of FLA/COM for the components being changed. Existing buildings not meeting the definition of a renovation in which new heating, cooling, water heating, electrical or lighting systems are installed shall meet the basic prescriptive minimum efficiencies listed in this code for the system(s) being changed.

13-400.1 Prescriptive requirements. Basic prescriptive requirements shall be met for all buildings. The section number followed by the combined number and letters “.1.ABC” indicates these basic prescriptive requirements (i.e., prescriptive requirements that shall be met by buildings complying by either Method A, B, or C) in Sections 401 through 415. Prescriptive requirements specific to Method A, B, or C (i.e. “.1.B” is specific to Method B) shall be met when complying with the code by that method. Where a prescriptive requirement specific to a method is more stringent than the basic prescriptive Requirement, the more stringent requirement shall be met.

13-400.2 Performance calculation procedures. The calculation procedures contained in the personal computer-based program entitled EnergyGauge FLA/COM and those described in Sections marked either “.2.A,” “.2.B,” or “.2.C,” respectively, shall be used to demonstrate code compliance of the design for commercial buildings complying by Method A, B or C of this chapter. The building components’ efficiency levels specified in the Method A performance compliance calculation (or amended copy submitted to the building department) are the

minimum efficiencies allowed to be installed in the building. Buildings complying by Method B are allowed performance tradeoffs for envelope features only. Buildings complying by Method C have only prescriptive minimum requirements for envelope and equipment.

13-400.2.A.1 Additions. Additions to existing buildings shall follow the same Method A calculation procedure as new construction with the following qualifications:

1. Calculations shall be conducted using only the components of the addition itself, including those preexisting components which separate the addition from other spaces.
2. Efficiencies for heating and cooling systems shall be assumed to be the minimum efficiency allowed by the code for that type and size of equipment unless new equipment is installed to replace existing equipment or to service the addition specifically or higher equipment efficiencies can be documented.

13-400.2.A.2 Shell buildings. Shell buildings shall comply with this code by Method B or Method C. Once all energy-related design parameters are known, a Method A calculation may be resubmitted.

13-400.3 Certification of compliance.

13-400.3.ABC.1 Code compliance preparation. The FLA/COM performance calculation procedures demonstrating code compliance for Methods A and B, and Form 400C demonstrating code compliance for Method C shall be prepared, signed and sealed by an architect or engineer registered in the state of Florida, with the exception of buildings excluded by Section 481.229, *Florida Statutes*, or Section 471.003, *Florida Statutes*. Calculations for buildings falling within the exception of Section 471.003, *Florida Statutes*, may be performed by air conditioning or mechanical contractors licensed in accordance with Chapter 489, *Florida Statutes*, or by state of Florida certified commercial building energy raters.

The person preparing the compliance calculation shall certify that the calculation, or amendments thereto, is true and accurate and demonstrates that the building is in compliance with the requirements of Chapter 13 of this code.

13-400.3.ABC.2 Code compliance certification. The building’s owner, the owner’s architect, or other authorized agent legally designated by the owner shall certify to the building official that the building is in compliance with the requirements of Chapter 13 of this code prior to receiving the permit to begin construction or renovation.

If, during the building’s construction or renovation, alterations are made in the building’s design or in materials or equipment installed in the building which would diminish its energy performance, an amended copy of the compliance certification shall be submitted to the building official on or before the date of final inspection by the building owner or his or her legally authorized agent.

The certified FLA/COM calculation printout or Form 400C shall be a part of the plans and specifications submitted for permitting.

The party responsible under Subsections 471.003 and 481.228 and Chapter 489, *Florida Statutes*, for the design and specification of each building system shall certify that the plans and specifications for that system comply with the requirements of Chapter 13 of this code (see also Section 13-103.2).

13-400.3.ABC.3 Forms. Forms referenced in Table 400.3.ABC.3 shall be used to demonstrate code compliance with this chapter. Climate zones are listed by county and city in Appendix 13-A of this chapter.

13-400.3.A Method A Forms. An accurately completed Form 400A-04R (generated by the FLA/COM-2004 computer program, **Version 2.5**) demonstrating that code compliance has been achieved shall be submitted to the building official for Method A compliance. Calculations shall be performed for the climate zone in which the building will be located and according to the procedures specified for Method A in this subchapter.

13-400.3.B Method B Forms. An accurately completed Form 400B-04R (generated by the FLA/COM-2004 computer program, **Version 2.5**) demonstrating that code compliance has been achieved shall be submitted to the building official for Method B compliance. Calculations shall be performed for the climate zone in which the building will be located and according to the procedures specified for Method B in this subchapter.

13-400.3.C Method C Forms. An accurately completed Form 400C-04 demonstrating that code compliance has been achieved shall be submitted to the building official for Method C compliance. The form submitted shall be specific for the climate zone in which the building will be located.

13-400.4.ABC Reporting. A copy of the front page of the 400 series form submitted to demonstrate code compliance shall be sent by the building official to the Florida Building Commission on a quarterly basis for reporting purposes.

13-401.1.AB Calculations. All calculations and determinations of parameters used in the demonstration of compliance with this code by Methods A or B shall be conducted according to Section 401.2.

13-401.1.A Prescriptive requirements specific to Method A. The fenestrations' solar heat gain coefficient and *U*-factor determined by the FLA/COM Method A performance calculation to demonstrate compliance with this code shall be the minimum performance levels allowed (maximum SHGC and *U*-factor).

13-401.1.B Prescriptive requirements specific to Method B. The fenestrations' solar heat gain coefficient and *U*-factor determined by the FLA/COM Method B performance calculation to demonstrate compliance with this code shall be the minimum performance levels allowed (maximum SHGC and *U*-value).

13-401.1.C Prescriptive requirements specific to Method C. Fenestration areas of buildings complying by Method C shall be no higher than that specified on Form 400C for that occupancy type. Compliance with *U*-factors and SHGC shall be demonstrated for the overall fenestration product, including glass, sash, and frame, as shall be determined from manufacturer's product specification sheets in accordance with applicable test procedures. Gross wall areas and gross roof areas shall be calculated separately for each space-conditioning category for the purposes of determining compliance.

Exception: Alternatively, if there are multiple assemblies within a single class of construction for a single space-conditioning category, compliance shall be based on an area-weighted average *U*-factor or SHGC. It is not acceptable to do an area-weighted average across multiple classes of construction or multiple space-conditioning categories.

Glazing in doors shall be included in the fenestration area.

13-401.1.C.1 Fenestration area. The total vertical fenestration area, including both fixed vertical fenestration and operable vertical fenestration, shall be less than 50 percent of the gross wall area. The total skylight area, including glass skylights, plastic skylights with a curb, and all skylights without a curb, shall be less than 5 percent of the gross roof area.

Exception: Vertical fenestration complying with Exception 3 to Section 401.1.C.3.

13-401.1.C.2 Fenestration *U*-factor. Fenestration, including fixed vertical fenestration, operable vertical fenestration, glass skylights with a curb, plastic skylights with a curb, and all skylights without a curb shall have a *U*-factor not greater than that specified on Form 400C for the appropriate fenestration area. *U*-factor for fenestration shall be determined in accordance with manufacturer's product specification sheets in accordance with applicable test procedures.

Exception: Vertical fenestration complying with Exception 3. To 401.1.C.3 shall have a *U*-factor not

**TABLE 13-400.3.ABC.3
INDEX TO COMMERCIAL CODE COMPLIANCE FORMS**

METHOD	FORM NO.
Method A Whole Building Performance	Form 400A-04R (FLA/COM Computer printout)
Method B Building Envelope Trade-off	Form 400B-04R (FLA/COM Computer printout)
Method C Buildings Prescriptive Envelope	Form 400C-04 (separate forms for N, C & S FL)

**SECTION 401
FENESTRATIONS (Glazing)**

13-401.1 Prescriptive requirements.

13-401.1.ABC Basic prescriptive requirements for Methods A, B, and C.

13-401.1.ABC.1 Window leakage. All exterior windows shall be designed to limit air leakage into and from the building envelope. Windows shall have air infiltration rates not exceeding those in Section 406.1.

greater than that specified for 40 percent of the gross wall area.

13-401.1.C.3 Fenestration solar heat gain coefficient (SHGC). Vertical fenestration shall have an SHGC not greater than that specified for all orientations on Form 400C for the appropriate total vertical fenestration area. Skylights, including glass skylights with a curb, plastic skylights with a curb, and all skylights without a curb, shall have an SHGC not greater than that specified for “all” orientations on Form 400C for the appropriate total skylight area. SHGC for fenestration shall be determined from manufacturer’s product specification sheets in accordance with applicable test procedures. There are no SHGC requirements for semiheated spaces.

Exceptions:

1. Alternatively, in latitudes greater than 10 degrees, the SHGC for north-oriented vertical fenestration shall be calculated separately and shall not be greater than that specified in Form 400C for north-oriented fenestration. When this exception is used, the fenestration area used in selecting the criteria shall be calculated separately for north-oriented and all other-oriented fenestration.
2. For demonstrating compliance for vertical fenestration only, the SHGC in the proposed building shall be reduced by using the multipliers in Table 401.1.C.3 for each fenestration product shaded by permanent projections that will last as long as the building itself.
3. Vertical fenestration that is located on the street side of the street-level story only, provided that (1) the street side of the street-level story does not exceed 20 feet (6096 mm) in height, (2) the fenestration has a continuous overhang with a weighted average projection factor greater than 0.5, and (3) the fenestration area for the street side of the street-level story is less than 75 percent of the gross wall area for the street side of the street-level 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. No credit shall be given here or elsewhere in the building for not fully utilizing the fenestration area allowed.

**TABLE 13-401.1.C.3
SHGC Multipliers for Permanent Projections**

Projection Factor	SHGC Multiplier (All Other Orientations)	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

13-401.2 Performance calculation procedures.

13-401.2.AB Performance calculation procedures for Methods A and B. Calculation procedures for determining fenestration compliance shall be in accordance with the procedures contained within Method A or Method B of the FLA/COM computer program.

13-401.2.AB.1 Thermal transmittance. The thermal resistance of fenestrations shall be calculated in accordance with the criteria in Sections 1.0 and 2.1 of Appendix 13-B of this chapter.

13-401.2.AB.2 Fenestration area. The area of fenestrations shall include sash area and glazing in doors. Areas for vertical glazing in clerestories and roof monitors shall be included in the wall fenestration calculation.

13-401.2.AB.3 Solar heat gain coefficients. The SHGC for fenestrations shall be determined in accordance with the criteria in Section 2.1 of Appendix 13-B of this chapter.

13-401.2.AB.4 Overhangs. Shading may be by recessing the glazing into the building structure, by permanently mounted overhangs and projections or by permanently mounted sun shades with adequate air movement between the shading device and the fenestration.

Complying overhangs shall be completely opaque and have the effect of being solid. Overhangs with slots, slats, grids and other openings are not considered if the sun can penetrate through at any occurring angle. Overhangs shall extend horizontally to points even with the left and right sides of the glazing.

13-401.2.AB.5 Visible light transmittance. Visible light transmittance shall be determined in accordance with NFRC 200. Visible light transmittance shall be verified and certified by the manufacturer.

13-401.2.A Performance calculation procedures specific to Method A. Calculation procedures for Method A shall be those incorporated in the FLA/COM program for Method A compliance.

All components of the building envelope in the proposed design shall be modeled as shown on architectural drawings or as installed for existing building envelopes.

Exceptions: The following building elements are permitted to differ from architectural drawings.

1. Any envelope assembly that covers less than 5 percent of the total area of that assembly type (e.g., exterior walls) need not be separately described. If not separately described, the area of an envelope assembly must be added to the area of the adjacent assembly of that same type.
2. Exterior surfaces whose azimuth orientation and tilt differ by no more than 45 degrees and are otherwise the same may be described as either a single surface or by using multipliers.

13-401.2.B Performance calculation procedures specific to Method B. Calculation procedures for Method B shall be those incorporated in the FLA/COM program for Method B.

13-401.2.B.3 Shell buildings. Only those shading devices that are installed at the time of construction of the building shell shall be considered when determining compliance for shell buildings.

SECTION 13-402 WALLS

13-402.1 Prescriptive requirements.

13-402.1.ABC Basic prescriptive requirements for Methods A, B and C.

13-402.1.AB.1 Calculations. All calculations and determinations of parameters used in the demonstration of compliance with this code by Methods A or B shall be conducted according to Section 402.2.

13-402.1.A Prescriptive requirements specific to Method A. Efficiencies determined by the FLA/COM Method A performance calculation to demonstrate compliance with this code shall be the minimum performance level installed in walls.

13-402.1.B Prescriptive requirements specific to Method B. Efficiencies determined by the FLA/COM Method B performance calculation to demonstrate compliance with this code shall be the minimum performance level installed in walls.

13-402.1.C Prescriptive requirements specific to Method C.

13-402.1.C.1 Above-grade wall insulation. All above-grade walls, including mass walls, metal building walls, steel-framed walls, and wood-framed and other walls, shall have a rated R -value of insulation not less than that specified in Form 400C. Mass wall heat capacity shall be determined from Table B-10 or B-11, as appropriate.

1. For mass walls, the rated R -value of insulation is for continuous insulation uninterrupted by framing other than 20 gauge 1-inch (25 mm) metal clips spaced no closer than 24 inches (25 mm) on center horizontally and 16 inches (406 mm) on center vertically. Where other framing, including metal and wood studs, is used, compliance shall be based

on the maximum assembly U -factor. Where rated R -value of insulation is used for concrete sandwich panels, the insulation shall be continuous throughout the entire panel.

Exception: Alternatively, for mass walls, where the requirement in the table is for a maximum assembly U -0.151 followed by an asterisk only, ASTM C 90 concrete block walls, ungrouted or partially grouted at 32 inches (813 mm) or less on center vertically and 48 inches (1219 mm) or less on center horizontally, shall have ungrouted cores filled with material having a maximum thermal conductivity of 0.44 Btu-inches/h-ft²·°F. Other mass walls with integral insulation shall meet the criteria when their U -factors are equal to or less than those for the appropriate thickness and density in the "Partly Grouted Cells Insulated" column of Table B-11.

2. For metal building walls, the first rated R -Value of insulation is for insulation compressed between metal wall panels and the steel structure. For double-layer installations, the second rated R -value of insulation is for insulation installed from the inside, covering the girts. For continuous insulation (e.g., insulation boards) it is assumed that the insulation boards are installed on the inside of the girts and uninterrupted by the framing members. Insulation exposed to the conditioned space or semiheated space shall have a facing, and all insulation seams shall be continuously sealed to provide a continuous air barrier.
3. For steel-framed walls, the first rated R -value of insulation is for uncompressed insulation installed in the cavity between steel studs. It is acceptable for this insulation to also be continuous insulation uninterrupted by framing. If there are two values, the second rated R -value of insulation is for continuous insulation uninterrupted by framing, etc., to be installed in addition to the first insulation. Opaque mullions in spandrel glass shall be covered with insulation complying with the steel-framed wall requirements.
4. For wood-framed and other walls, the first rated R -value of insulation is for uncompressed insulation installed in the cavity between wood studs. It is acceptable for this insulation to also be continuous insulation uninterrupted by framing. If there are two values, the second rated R -value of insulation is for continuous insulation uninterrupted by framing, etc., to be installed in addition to the first insulation.

When a wall consists of both above-grade and below-grade portions, the entire wall for that story shall be insulated on either the exterior or the interior or be integral. If insulated on the interior, the wall shall be insulated to the above-grade wall requirements. If insulated on the exterior or integral, the below-grade wall portion shall be insulated to the below-grade wall requirements, and the above-grade

wall portion shall be insulated to the above-grade wall requirements.

13-402.1.C.2 Below-grade wall insulation. Below-grade walls shall have a rated R -value of insulation not less than that specified in Form 400C. For below-grade walls, the rated R -value of insulation is for continuous insulation uninterrupted by framing. Where framing, including metal and wood studs, is used, compliance shall be based on the maximum assembly C -factor.

13-402.2 Performance calculation procedures.

13-402.2.AB Performance calculation procedures for methods A and B. Calculation procedures for determining wall compliance shall be in accordance with the procedures contained within Method A or Method B of the FLA/COM computer program.

Data shall be input into FLA/COM by zone, by wall orientation and area (gross length, gross height), by type of wall construction (U -value, thickness, density, specific heat, heat capacity), and by insulation position. Choosing a wall component from the FLA/COM menu assumes ASHRAE-determined thermal transmittance, thickness, density, specific heat and heat capacity for that wall component.

13-402.2.AB.1 Gross wall area. The gross area of exterior or adjacent walls enclosing a heated or cooled space is measured on the exterior and consists of the opaque wall including between floor spandrels, peripheral edges of flooring, window areas (including sash), and door areas but excluding vents, grilles and pipes.

13-402.2.AB.2 Thermal resistance. The thermal resistance of exterior or adjacent walls shall be calculated in accordance with the criteria of Appendix 13-B of this chapter. See Section 13-B-1.3 for insulation installation requirements.

**SECTION 13-403
DOORS**

13-403.1 Prescriptive requirements.

13-403.1.ABC Basic prescriptive requirements for Methods A, B and C.

13-403.1.ABC Door types allowed. All exterior and adjacent doors other than glass doors shall be solid core wood, wood panel, or insulated doors. Hollow core doors shall not be used in either exterior or adjacent walls. Doors may have glass sections.

13-403.1.AB.1 Calculations for Methods A and B. All calculations and determinations of parameters used in the demonstration of compliance with this code by Methods A or B shall be conducted according to Section 403.2.

13-403.1.A Prescriptive requirements specific to Method A. Efficiencies determined by the FLA/COM Method A performance calculation to demonstrate compliance with this code shall be the minimum performance level installed in doors.

13-403.1.B Prescriptive requirements specific to Method B. Efficiencies determined by the FLA/COM Method B performance calculation to demonstrate compliance with this code shall be the minimum performance level installed in doors.

13-403.1.C Prescriptive requirements specific to Method C.

13-403.1.C.1 Opaque doors. All opaque doors, including swinging doors and nonswinging doors, shall have a U -factor not greater than that specified on Form 400C.

13-403.2 Performance calculation procedures.

13-403.2.AB Performance calculation procedures for Methods A and B. Calculation procedures for determining door compliance shall be in accordance with the procedures contained within Method A or B of the FLA/COM computer program. Data shall be input into FLA/COM by zone by door area or by each unit for the following parameters: door orientation and area (or unit width, unit height), number of units, and door type (or by U -value). Choosing a door type from the FLA/COM menu assumes ASHRAE-determined thermal transmittance for that door type.

13-403.2.AB.1 Thermal resistance. The thermal resistance of doors shall be calculated in accordance with the criteria of Appendix B of this chapter. Data input shall be determined from ASHRAE or manufacturer's test data/rating sources.

13-403.2.AB.2 Gross door area. The gross area of exterior or adjacent doors is calculated as part of the wall calculation. Glazing in doors shall be included with the glazing areas in code compliance procedures.

**SECTION 13-404
ROOFS/CEILINGS**

13-404.1 Prescriptive requirements.

13-404.1.ABC Basic prescriptive requirements for Methods A, B, and C.

13-404.1.ABC.1 Roof/ceiling thermal envelopes. The roof or ceiling which functions as the building's thermal envelope shall be insulated to an R -value of at least R -10. Roof insulation shall not be installed on a suspended ceiling with removable ceiling panels. See Section 13-B-1.3 for insulation installation requirements.

13-404.1.ABC.2 Cavities used as plenums. Cavities beneath a roof deck which will be used as supply or return plenums shall have an insulated roof. The insulation shall have a R -value of at least R -19.

13-404.1.ABC.3 Vented cavities above dropped ceilings. Where cavities beneath a roof deck are not sealed from the outside environment, the ceiling shall be treated as the exterior thermal and pressure envelopes of the building.

13-404.1.AB.1 Method A and B calculations. All calculations and determinations of parameters used in the demonstration of compliance with this code by Methods A or B shall be conducted according to Section 404.2.

13-404.1.A Prescriptive requirements specific to Method A. Efficiencies determined by the FLA/COM Method A performance calculation to demonstrate compliance with this code shall be the minimum performance level installed in roofs/ceilings. Multiple-family residential roofs/ceilings shall be insulated. The insulation shall have a R -value of at least R -19, space permitting.

13-404.1.B Prescriptive requirements specific to Method B. Efficiencies determined by the FLA/COM Method B performance calculation to demonstrate compliance with this code shall be the minimum performance level installed in roofs/ceilings. Multiple-family residential roofs/ceilings shall be insulated with an insulation *R*-value of at least R-19, space permitting.

13-404.1.C Prescriptive requirements specific to Method C.

13-404.1.C.1 Roof insulation. All roofs, including roofs with insulation entirely above deck, metal building roofs, and attics and other roofs, shall have a rated *R*-value of insulation not less than that specified on Form 400C (see Appendix 13-D). Sky-light curbs shall be insulated to the level of roofs with insulation entirely above the deck or R-5, whichever is less.

For single-rafter roofs, the requirement is the lesser of the values for attics and other roofs and those listed in Table 404.1.C.1.A below.

Exception: For roofs where the exterior surface has a minimum total solar reflectance of 0.70 when tested in accordance with one of the solar reflectance test methods listed below, and has a minimum thermal emittance of 0.75 when tested in accordance with one of the thermal emittance test methods listed below, other than roofs with ventilated attics or roofs with semiheated spaces, the *U*-factor of the proposed roof shall be permitted to be adjusted using Equation 4-1 for demonstrating compliance:

$$U_{\text{RoofAdj}} = U_{\text{RoofProposed}} \times \text{Factor}_{\text{RoofMultiplier}} \quad \text{Equation (4-1)}$$

where:

U_{RoofAdj} = the adjusted roof *U*-factor for use in demonstrating compliance.

$U_{\text{RoofProposed}}$ = the *U*-factor of the proposed roof, as designed.

$\text{Factor}_{\text{RoofMultiplier}}$ = the roof *U*-factor multiplier from Table 404.1.C.1.B.

Solar Reflectance Test Methods: ASTM E 903, ASTM E 1175, or ASTM E 1918.

Thermal Emittance Test Methods: ASTM C 835, ASTM C 1371, or ASTM E 408.

**TABLE 13-404.1.C.1A
SINGLE RAFTER ROOFS**

Minimum Insulation <i>R</i> -Value or Maximum Assembly <i>U</i> -Factor		
Wood Rafter Depth, <i>d</i> (actual)		
<i>d</i> < 8 inches	8 < <i>d</i> < 10 inches	10 < <i>d</i> < 12 inches
R-19 U-0.055	R-30 U-0.036	R-38 U-0.028

For SI: 1 inch = 25.4 mm.

**TABLE 13-404.1.C.1.B
ROOF U-FACTOR MULTIPLIERS FOR EXCEPTION TO 404.1.C.1**

Climate Zone	Roof <i>U</i> -Factor Multiplier
4,5,6, 7,8,9	0.77
1,2,3	0.83

13-401.1.C.1.1. For roofs with insulation entirely above deck, the rated *R*-value of insulation is for continuous insulation. Interruptions presented by framing and pads for mechanical equipment with the combined total area no greater than one percent of the opaque assembly area shall be permitted.

13-401.1.C.1.2. For metal building roofs, the first rated *R*-value of insulation is for insulation draped over purlins and then compressed when the metal spanning members are attached, or for insulation hung between the purlins, provided there is a minimum 1 inch (25 mm) thermal break between the purlins and the metal spanning members. For double-layer installations, the second rated *R*-value of insulation is for insulation installed parallel to the purlins. For continuous insulation (e.g., insulation boards), it is assumed that the insulation boards are installed below the purlins and are uninterrupted by framing members. Insulation exposed to the conditioned space or semiheated space shall have a facing, and all insulation seams shall be continuously sealed to provide a continuous air barrier.

13-401.1.C.1.3. For attics and other roofs, the rated *R*-value of insulation is for insulation installed both inside and outside the roof, or entirely inside the roof cavity, and it allows occasional interruption by framing members but requires that the framing members be covered with insulation when the depth of the insulation exceeds the depth of the framing cavity. Insulation in attics and other roofs shall be permitted to be tapered at the eaves where the building structure does not allow full depth. For single-rafter roofs, the requirement is the lesser of the values for attics and other roofs and those listed in Table 404.1.C.1.A.

13-404.2 Performance calculation procedures.

13-404.2.AB Performance calculation procedures for Methods A and B. Calculation procedures for determining roof/ceiling compliance shall be in accordance with the procedures contained within Method A or B of the FLA/COM computer program.

Data shall be input into FLA/COM by zone for the following parameters: roof area (or by width and length), roof construction type (or by components and *U*-value), and roof color. Choosing a roof type from the FLA/COM menu assumes ASHRAE-determined thermal transmittance and shading coefficients for that roof type.

Where cavities beneath a roof deck are ventilated, the ceiling shall be considered the envelope component utilized in the FLA/COM calculation.

13-404.2.AB.1 General. Data input shall be determined in accordance with applicable requirements and procedures given in Appendix 13-B of this chapter.

13-404.2.AB.2 Thermal resistance. The thermal resistance of roof or roof/ceiling assemblies shall be calculated in accordance with the criteria of Appendix 13-B of this chapter.

13-404.2.AB.3 Gross roof/ceiling area. Areas of exterior or adjacent roof/ceiling assemblies consist of the total surface of the roof assembly exposed to outside air or unconditioned spaces. The roof or ceiling assembly shall be considered to include all roof or ceiling components through which heat may flow between indoor and outdoor environments including sky-light surfaces but excluding service openings.

Areas for vertical glazing in clerestories and roof monitors shall be included in the wall fenestration calculation.

SECTION 13-405 FLOORS

13-405.1 Prescriptive requirements.

13-405.1.ABC Basic prescriptive requirements for Methods A, B and C.

13-405.1.AB.1 Calculations for Methods A and B. All calculations and determinations of parameters used in the demonstration of compliance with this code by Methods A or B shall be conducted according to Section 405.2.

13-405.1.A Prescriptive requirements specific to Method A. Efficiencies determined by the FLA/COM Method A performance calculation to demonstrate compliance with this code shall be the minimum performance level installed in floors.

13-405.1.B Prescriptive requirements specific to Method B. Efficiencies determined by the FLA/COM Method B performance calculation to demonstrate compliance with this code shall be the minimum performance level installed in floors.

13-405.1.C Prescriptive requirements specific to Method C.

13-405.1.C.1 Floor insulation. All floors, including mass floors, steel joist floors, and wood-framed and other floors, shall have a rated *R*-value of insulation not less than that specified on Form 400C (see Appendix 13-D of this code).

13-405.1.C.1.1 Mass floors. For mass floors, the rated *R*-value of insulation is for continuous insulation uninterrupted by framing. Where framing, including metal and wood joists, is used, compliance shall be based on the maximum assembly *U*-factor rather than the minimum rated *R*-value of insulation. For waffle-slab floors, the floor shall be insulated either on the interior above the slab or on all exposed surfaces of the waffle. For floors with beams that extend below the floor slab, the floor shall be insulated either on the interior above the slab or on the exposed floor and all exposed surfaces of the beams that extend 24 inches (610 mm) and less below the exposed floor.

13-405.1.C.1.2. Steel joist floors. For steel joist floors, the first rated *R*-value of insulation is for uncompressed insulation installed in the cavity between steel joists or for spray-on insulation. It is acceptable for this insulation to also be continuous insulation uninterrupted by framing. All continuous insulation shall be installed either on the interior above the floor structure or below a framing cavity completely filled with insulation.

13-405.1.C.1.3 Wood-framed and other floors. For wood-framed and other floors, the first rated *R*-value of insulation is for uncompressed insulation installed in the cavity between wood joists. It is acceptable for this insulation to also be continuous insulation uninterrupted by framing. All continuous insulation shall be installed either on the interior above the floor structure or below a framing cavity completely filled with insulation.

13-405.1.C.4 Slab-on-grade floor insulation. All slab-on-grade floors, including heated slab-on-grade floors and unheated slab-on-grade floors, shall have a rated *R*-value

of insulation not less than that specified on Form 400C (see Appendix 13-D) and shall be installed around the perimeter of the slab-on-grade floor to the distance specified. Perimeter insulation installed inside the foundation wall shall extend downward from the top of the slab a minimum of the distance specified or to the top of the footing, whichever is less. Perimeter insulation installed outside the foundation wall shall extend from the top of the slab, or downward to at least the bottom of the slab and then horizontally to a minimum of the distance specified. In all climates, the horizontal insulation extending outside of the foundation shall be covered by pavement or by soil a minimum of 10 inches (254 mm) thick.

Exception: For a monolithic slab-on-grade floor, the insulation shall extend from the top of the slab-on-grade to the bottom of the footing.

13-405.2 Performance calculation procedures.

13-405.2.AB Performance calculation procedures for methods A and B. Calculation procedures for determining floor compliance shall be in accordance with the procedures contained within Method A or Method B of the FLA/COM computer program.

Data shall be input into FLA/COM by zone by perimeter or area (width, length), floor type, and insulation level. Choosing a floor type from the FLA/COM menu assumes ASHRAE-determined thermal transmittance for that floor type.

13-405.2.AB.1 Thermal resistance. The thermal resistance of floors shall be calculated in accordance with the criteria of Appendix 13-B of this chapter.

413-05.2.AB.2 Gross floor area. The gross area of floor assemblies over outside or unconditioned spaces consists of the total surface of the floor assembly exposed to outside air or unconditioned space. The floor assembly shall include all floor components through which heat may flow between indoor and outdoor or unconditioned space environments.

SECTION 13-406 AIR INFILTRATION

13-406.1 Prescriptive requirements.

13-406.1.ABC Basic prescriptive requirements for Methods A, B and C. The requirements of this section shall apply only to those locations that separate interior building conditioned space from the outdoors or from unconditioned space or crawl spaces. Compliance with the criteria for air leakage through building components shall be determined by tests conducted in accordance with ASTM E 283.

13-406.1.ABC.1 Minimum infiltration levels allowed.

13-406.1.ABC.1.1 Exterior doors and windows. Air leakage for fenestration and doors shall be determined in accordance with NFRC 400 or other code-approved certification program requiring testing in accordance with ASTM E 283. Air leakage shall be determined by a laboratory accredited by a nationally recognized accreditation organization, such as the National Fenestration Rating Council, and shall be labeled and certified by the manufacturer. Air leakage shall not exceed 1.0 cubic foot per minute (cfm) per square foot [$.005 \text{ m}^3/(\text{s} \cdot \text{m}^2)$] for glazed swinging entrance doors and for revolving doors and 0.4 cubic

foot per minute (cfm) per square foot $[.005 \text{ m}^3/(\text{s} \cdot \text{m}^2)]$ for all other products.

Exceptions:

- (a) Field-fabricated fenestration and doors.
- (b) For garage doors, air leakage determined by test at standard test conditions in accordance with ANSI/DASMA 105 shall be an acceptable alternate for compliance with air leakage requirements.

13-406.1.ABC.1.2 Exterior joints in the envelope. The following areas of the building envelope shall be sealed, caulked, gasketed, or weather-stripped to minimize air leakage:

- a. Joints around fenestration and door frames.
- b. Junctions between walls and foundations, between walls at building corners, between walls and structural floors or roofs, and between walls and roof or wall panels.
- c. Openings at penetrations of utility services through roofs, walls, and floors.
- d. Site-built fenestration and doors.
- e. Building assemblies used as ducts or plenums.
- f. Joints, seams, and penetrations of vapor retarders.
- g. All other openings in the building envelope. Outside air intakes, exhaust outlets, relief outlets, stair shaft, elevator shaft smoke relief openings, and other similar elements shall also comply with Sections 407.1.ABC.2.4.3 and 409.1.ABC.3.3.

13-406.1.ABC.1.3 Apertures in the building envelope. Any intentional apertures or openings in walls, ceilings or floor between conditioned and unconditioned space (such as hydrostatic openings in stairwells for coastal buildings) shall have dampers which limit air flow between the spaces.

13-406.1.ABC.1.4. Building cavities.

13-406.1.ABC.1.4.1 Where vented dropped ceiling cavities occur over conditioned spaces, the ceiling shall be considered to be both the upper thermal envelope and pressure envelope of the building and shall contain a continuous air barrier between the conditioned space and the vented unconditioned space that is also sealed to the air barrier of the walls.

NOTE: See the definition of “Air barrier” in Section 13-202.

Where unvented dropped ceiling cavities occur over conditioned spaces that do not have an air barrier between the conditioned and unconditioned space (such as T-bar ceilings), they shall be completely sealed from the exterior environment (at the roof plane) and adjacent spaces by a continuous air barrier that is also sealed to the air barrier of the walls. In that case, the roof assembly shall constitute both the upper thermal envelope and pressure envelope of the building.

Unconditioned spaces above separate tenancies shall contain dividing partitions between the tenancies to form a continuous air barrier that is sealed at the ceiling and roof to prevent air flow between them.

13-406.1.ABC.1.4.2 Building cavities designed to be air distribution system components shall be sealed according to the criteria for air ducts, plenums, etc., in Section 410.1.ABC.3.6.

13-406.1.A Prescriptive requirements specific to Method A. Blank for numbering consistency.

13-406.1.B Prescriptive requirements specific to Method B. Blank for numbering consistency.

13-406.1.C Prescriptive requirements specific to Method C. Blank for numbering consistency.

13-406.2.AB Performance calculation procedures for Methods A and B. Blank for numbering consistency.

**SECTION 13-407
SPACE COOLING SYSTEMS**

13-407.0 Applicability. This section covers the determination of minimum cooling system design requirements and efficiencies. The requirements of this section apply to equipment and mechanical component performance of all air conditioning systems installed in new and renovated buildings including, but not limited to: unitary (central) cooling equipment (air-cooled, water-cooled and evaporatively cooled); the cooling mode of unitary (central) and packaged terminal heat pumps (air source and water source); packaged terminal air conditioners; roof air conditioners; room air conditioners; and heat-operated cooling equipment such as absorption equipment, engine-driven equipment and turbine-driven equipment.

13-407.1 Prescriptive requirements.

13-407.1.ABC Basic prescriptive requirements for Methods A, B and C.

13-407.1.ABC.1 Sizing. A cooling load calculation shall be performed for newly installed units as per criteria of Section 3.1 of Appendix 13-B of this chapter. This calculation shall be attached to the code compliance form submitted to the building department when the building is permitted or, in the event the mechanical permit is obtained at a later time, the sizing calculation shall be submitted with the application for the mechanical permit.

Exceptions:

1. Where mechanical systems are designed by an engineer registered in the state of Florida, the engineer has the option of submitting a signed and sealed summary sheet in lieu of the complete sizing calculation(s). Such summary sheet shall include the following (by zone):

Project name/owner	Outdoor dry bulb used	Total heating required with outside air
Project address	Outdoor wet bulb used	Total sensible gain
Sizing method used	Relative humidity	Total latent gain
Area in square feet.	Indoor dry bulb	Grains water (difference)

Total cooling required with outside air

2. Systems installed in existing buildings not meeting the definition of renovation in Section 13-202.

13-407.1.ABC.1.1 HVAC systems and equipment shall be sized to provide no more than the space and system loads calculated in accordance with Section 407.1.ABC.1. A single piece of equipment providing both cooling and heating shall satisfy this provision when the cooling function meets the provisions of Section 407.1.ABC.1, and the heating function is sized as small as possible to meet the load within available equipment options.

Exceptions:

1. When the equipment selected is the smallest size needed to meet the load within available options of the desired equipment line.
2. Stand-by equipment provided with controls and devices that allow such equipment to operate automatically only when the primary equipment is not operating.
3. Multiple units of the same equipment type with combined capacities exceeding the design load and are provided with controls that sequence or otherwise optimally control the operation of each unit based on load.

13-407.1.ABC.1.2 Buildings which contain assembly occupancies shall have equipment sized or controlled to prevent continuous space cooling or heating of such spaces with peak capacity equipment by the following options:

1. Equipment is staged to include cooling or heating to the space and stages are controlled by an electronically controlled energy management system.
2. A separate cooling or heating system is utilized to provide cooling or heating to the assembly occupancy.
3. A variable speed compressor is utilized to provide incremental cooling or heating to the assembly occupancy.

13-407.1.ABC.2 Controls.

13-407.1.ABC.2.1 Simultaneous heating and cooling.

13-407.1.ABC.2.1.1 Zone controls. Zone thermostatic controls shall be capable of operating in sequence the supply of heating and cooling energy to the zone. Such controls shall prevent: (1) reheating; (2) recooling; (3) mixing or simultaneously supplying air that has been previously mechanically heated and air that has been previously cooled, either by mechanical cooling or by economizer systems; and (4) other simultaneous operation of heating and cooling systems to the same zone.

Exceptions:

- a. Zones for which the volume of air that is reheated, re-cooled, or mixed is no greater than the larger of the following:
 1. The volume of outside air required to meet the ventilation requirements of Section 6.1.3 of ASHRAE 62 for the zone.
 2. 0.4 per square foot [$.002 \text{ m}^3/(\text{s} \cdot \text{m}^2)$] of the zone conditioned floor area.
 3. Thirty percent of the zone design peak supply rate.

4. Three-hundred cfm ($.14 \text{ m}^3/\text{s}$). This exception is for zones whose peak flow rate totals no more than 10 percent of the total fan system flow rate.
 5. Any higher rate that can be demonstrated, to the satisfaction of the authority having jurisdiction, to reduce overall system annual energy usage by offsetting reheat/recool energy losses through a reduction in outdoor air intake in accordance with Method A of this subchapter.
- b. Zones where special pressurization relationships, cross-contamination requirements, or code-required minimum circulation rates are such that variable air volume systems are impractical.
 - c. Zones where at least 75 percent 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.
 - d. Systems that are designed and dedicated to condition only the outdoor ventilation air stream to meet the requirements of ASHRAE 62. Such systems shall be controlled so that they do not allow overcooling of the building. Any building utilizing this exception that has a system that requires reheat, other than reclaimed waste heat, shall comply by Method A of this code.

13-407.1.ABC.2.2 Hot gas bypass limitation. Cooling systems shall not use hot gas bypass or other evaporator pressure control systems unless the system is designed with multiple steps of unloading or continuous capacity modulation. The capacity of the hot gas bypass shall be limited to the following:

Rated Capacity	Max. Hot Gas Bypass Capacity (percent Total Capacity)
$\leq 240,000 \text{ Btu/h}$	50 percent
$> 240,000 \text{ Btu/h}$	25 percent

Exception: Unitary packaged systems with cooling capacities not greater than 90,000 Btu/h (432 W).

13-407.1.ABC.2.2 Temperature controls.

13-407.1.ABC.2.2.1 General. The supply of heating and cooling energy to each zone shall be individually controlled by thermostatic controls responding to temperature within the zone. For the purposes of this section, a dwelling unit shall be permitted to be considered a single zone.

Exception: Independent perimeter systems that are designed to offset only building envelope loads shall be permitted to serve one or more zones also served by an interior system provided:

1. The perimeter system includes at least one thermostatic control zone for each building exposure having exterior walls facing only one orientation for 50 contiguous feet (15 240 mm) or more, and
2. The perimeter system heating and cooling supply is controlled by a thermostatic control(s) located within the zones(s) served by the system. Exterior walls are considered to have different orientations if the directions they face differ by more than 45 degrees.

13-407.1.ABC.2.2.2 Dead band. Where used to control both heating and cooling, zone thermostatic controls shall be capable of providing a temperature range or dead band of at least

5°F (-15°C) within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum.

Exceptions:

1. Thermostats that require manual changeover between heating and cooling modes.
2. Special occupancy or special applications where wide temperature ranges are not acceptable (such as retirement homes, process applications, data processing, museums, some areas of hospitals) and are approved by the authority having jurisdiction.
3. In the case of VAV systems, the deadband may be reduced to 2½°F (-16°C) if the occupant control of the thermostat is programmed to limit the adjustment of the VAV system zone temperature to plus or minus 1½°F (-17°C) from the thermostat set point.

13-407.1.ABC.2.2.3 Set point overlap restriction. Where heating and cooling to a zone are controlled by separate zone thermostatic controls located within the zone, means (such as limit switches, mechanical stops, or, for DDC systems, software programming) shall be provided to prevent the heating set point from exceeding the cooling set point minus any applicable proportional band.

13-407.1.ABC.2.2.4 Hydronic systems, reset controls. See Section 411.1.ABC.1.3.

13-407.1.ABC.2.3 Humidity control.

13-407.1.ABC.2.3.1 Dehumidification. Where humidistatic controls are provided, such controls shall prevent reheating, mixing of hot and cold airstreams, or other means of simultaneous heating and cooling of the same airstream.

Exceptions:

1. The system is capable of reducing supply air volume to 50 percent or less of the design airflow rate or the minimum rate specified in 6.1.3 of ASHRAE 62, whichever is larger, before simultaneous heating and cooling takes place.
2. The individual fan cooling unit has a design cooling capacity of 80,000 Btu/h (23 448 W) or less and is capable of unloading to 50-percent capacity before simultaneous heating and cooling takes place.
3. The individual mechanical cooling unit has a design cooling capacity of 40,000 Btu/h (11 724 W) or less. An individual mechanical cooling unit is a single system composed of a fan or fans and a cooling coil capable of providing mechanical cooling.
4. Systems serving spaces where specific humidity levels are required to satisfy process needs, such as computer rooms, museums, surgical suites, and buildings with refrigerating systems, such as supermarkets, refrigerated warehouses, and ice arenas. This exception also applies to other applications for which fan volume controls in accordance with Exception 1 are proven to be impractical to the enforcement agency.
5. At least 75 percent 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.

6. Systems where the heat added to the airstream is the return air enthalpy result of the use of a desiccant system and 75 percent of the heat added by the desiccant system is removed by a heat exchanger, either before or after the desiccant system with energy recovery.

13-407.1.ABC.2.3.2 Humidifier preheat. Humidifiers with preheating jackets mounted in the airstream shall be provided with an automatic valve to shut off preheat when humidification is not required.

13-407.1.ABC.2.3.3 Humidification and dehumidification. Where a zone is served by a system or systems with both humidification and dehumidification capability, means (such as limit switches, mechanical stops, or, for DDC systems, software programming) shall be provided capable of preventing simultaneous operation of humidification and dehumidification equipment.

Exceptions:

1. Zones served by desiccant systems, used with direct evaporative cooling in series.
2. Systems serving zones where specific humidity levels are required, such as computer rooms, museums, and hospitals, and approved by the building official.

13-407.1.ABC.2.4 Off-hour controls. HVAC systems having a design heating or cooling capacity greater than 65,000 Btu/h (312 m³ xW) and fan system power greater than ¾ hp shall have all of the following off-hour controls: automatic shutdown (see Section 407.1.ABC.2.4.1), setback controls (see Section 408.1.ABC.2.1), optimum start controls (see Section 407.1.ABC.2.4.2), shutoff damper controls (see Section 409.1.ABC.3.3), and zone isolation (see Section 407.1.ABC.2.4.3).

Exceptions:

1. HVAC systems serving hotel/motel guest rooms.
2. HVAC systems intended to operate continuously.

13-407.1.ABC.2.4.1 Automatic shutdown. HVAC systems shall be equipped with at least one of the following:

1. Controls that can start and stop the system under different time schedules for seven different day-types per week, are capable of retaining programming and time setting during loss of power for a period of at least 10 hours, and include an accessible manual override, or equivalent function, that allows temporary operation of the system for up to 2 hours.
2. An occupant sensor that is capable of shutting the system off when no occupant is sensed for a period of up to 30 minutes.
3. A manually operated timer capable of being adjusted to operate the system for up to two hours.
4. An interlock to a security system that shuts the system off when the security system is activated.

Exception: Residential occupancies may use controls that can start and stop the system under two different time schedules per week.

13-407.1.ABC.2.4.2 Optimum start controls. Individual heating and cooling air distribution systems with a total design

supply air capacity exceeding 10,000 cfm (5 m³/s), served by one or more supply fans, shall have optimum start controls. 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.

13-407.1.ABC.2.4.3 Zone isolation. HVAC systems serving zones that are intended to operate or be occupied nonsimultaneously shall be divided into isolation areas. Zones may be grouped into a single isolation area provided it does not exceed 25,000 square feet (2323 m³) of conditioned floor area nor include more than one floor. Each isolation area shall be equipped with isolation devices capable of automatically shutting off the supply of conditioned air and outside air to and exhaust air from the area. Each isolation area shall be controlled independently by a device meeting the requirements of Section 13-407.1.ABC.2.4.1. For central systems and plants, controls and devices shall be provided to allow stable system and equipment operation for any length of time while serving only the smallest isolation area served by the system or plant.

Exceptions: Isolation devices and controls are not required for the following:

1. Exhaust air and outside air connections to isolation zones when the fan system to which they connect is 5,000 cfm (2.4 m³/s) and smaller.
2. Exhaust airflow from a single isolation zone of less than 10 percent of the design airflow of the exhaust system to which it connects.
3. Zones intended to operate continuously or intended to be inoperative only when all other zones are inoperative.

13-407.1.ABC.2.5 Controls testing. HVAC control systems shall be tested to ensure that control elements are calibrated, adjusted, and in proper working condition.

13-407.1.ABC.3 Equipment performance standards.

13-407.1.ABC.3.1.1 Equipment efficiency verification. Equipment covered under the Federal Energy Policy Act of 1992 (EPACT) shall comply with U.S. Department of Energy certification requirements. For other equipment, if a certification program exists for a product covered in Tables 13-407.1.ABC.3.2A through 13-407.1.ABC.3.2D, and it includes provisions for verification and challenge of equipment efficiency ratings, then the product shall be either listed in the certification program or, alternatively, the ratings shall be verified by an independent laboratory test report. If no certification program exists for a product covered in Tables 13-407.1.ABC.3.2A through 13-407.1.ABC.3.2D, the equipment efficiency ratings shall be supported by data furnished by the manufacturer. Products covered in Table 13-407.1.ABC.3.2G shall have efficiency ratings supported by data furnished by the manufacturer. Where components, such as indoor or outdoor coils, from different manufacturers are used, a Florida-registered engineer shall specify component efficiencies whose combined efficiency meets the minimum equipment efficiency requirements in 13-407.1.ABC.3.2.

13-407.1.ABC.3.2 Minimum efficiencies for cooling equipment.

13-407.1.ABC.3.2.1 Mandatory provisions. Equipment shown in Tables 13-407.1.ABC.3.2A through 13-407.1.ABC.3.2D shall have a minimum performance at the specified rating conditions when tested in accordance with the specified test procedure. Omission of minimum performance requirements for equipment not listed in Tables 13-407.1.ABC.3.2A through 13-407.1.ABC.3.2D does not preclude use of such equipment. Equipment not listed in Tables 13-407.1.ABC.3.2A through 13-407.1.ABC.3.2D has no minimum performance requirements. Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all stated requirements, unless otherwise exempted by footnotes in the table. However, equipment covered under the Federal Energy Policy Act of 1992 (EPACT) shall have no minimum efficiency requirements for operation at minimum capacity or other than standard rating conditions. Equipment used to provide water heating functions as part of a combination system shall satisfy all stated requirements for the appropriate space heating or cooling category.

Tables 13-407.1.ABC.3.2A through 13-407.1.ABC.3.2D contain the minimum efficiency requirements for equipment covered by this section of the standard. The tables are organized to cover the following types of equipment:

Table 13-407.1.ABC.3.2A, Air Conditioners and Condensing Units.

Table 13-407.1.ABC.3.2B, Heat Pumps.

Table 13-407.1.ABC.3.2C, Water Chilling Packages.

Table 13-407.1.ABC.3.2D, Packaged Terminal and Room Air Conditioners and Heat Pumps.

Exception: Water-cooled centrifugal water-chilling packages that are not designed for operation at ARI 550/590 test conditions (and thus cannot be tested to meet the requirements of Table 13-407.1.ABC.3.2C) of 44°F (7°C) leaving chilled water temperature and 85°F (29°C) entering condenser water temperature shall have a minimum full-load COP as shown in Tables 13-407.1.ABC.3.2H, I and J and a minimum (NPLV) rating as shown in Tables 13-407.1.ABC.3.2K, L and M. The table values are only applicable over the following full-load design ranges:

Leaving chiller water temperature: 40°F to 48°F (4°C to 9°C).

Condenser water temperature: 75°F to 85°F (24°C to 29°C).

Condensing water temperature rise: 5°F to 15°F (-15°C to 9°C).

Chillers designed to operate outside of these ranges or applications utilizing fluids or solutions with secondary coolants (e.g. glycol solutions or brines) with a freeze point of 27°F (-2.8°C) or less for freeze protection are not covered by this standard.

NPLV is defined as a single-number part-load efficiency figure of merit for chillers referenced to conditions other than integrated part-load value (IPLV) conditions.

**TABLE 13-407.1.ABC.3.2A
ELECTRICALLY OPERATED UNITARY AIR CONDITIONERS AND CONDENSING UNITS—MINIMUM EFFICIENCY REQUIREMENTS**

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency ²	Test Procedure ¹
Air Conditioners, Air Cooled	< 65,000 Btu/h ³	All	Split System	13.0 SEER	ARI 210/240
			Single Package	13.0 SEER	
	≥ 65,000 Btu/h and <135,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	10.3 EER	
		All other	Split System and Single Package	10.1 EER	
	≥135,000 Btu/h and <240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	9.7 EER	ARI 340/360
		All other	Split System and Single Package	9.5 EER	
	≥240,000 Btu/h and <760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	9.5 EER, 9.7 IPLV	
		All other	Split System and Single Package	9.3 EER, 9.5 IPLV	
	>760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	9.2 EER, 9.4 IPLV	
		All other	Split System and Single Package	9.0 EER, 9.2 IPLV	
Through-the-Wall, Air Cooled	<30,000 Btu/h ³	All	Split System Single Package	10.9 SEER 10.6 SEER	ARI 210/240
Small-Duct High-Velocity, Air Cooled	<65,000 Btu/h ³	All	Split System or Single Package	11.0 SEER ⁴	ARI 210/240
Space constrained products, air conditioners	<65,000 Btu/h ³	All	Split System or Single Package	12.0 SEER	ARI 210/240
Air Conditioners, Water and Evaporatively Cooled	<65,000 Btu/h	All	Split System and Single Package	12.1 EER	ARI 210/240
			Electric Resistance (or None)	Split System and Single Package	
	≥65,000 Btu/h and <135,000 Btu/h	All other	Split System and Single Package	11.3 EER	
	≥135,000 Btu/h and <240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.0 EER	ARI 340/360
		All other	Split System and Single Package	10.8 EER	
	≥240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.0 EER, 10.3 IPLV	
		All other	Split System and Single Package	10.8 EER, 10.1 IPLV	
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	

For SI: 1 Btu/h = .0048 m³/kw, °C = [(°F) - 32]/1.8.

- Subchapter 13-3 contains a complete specification of the reference test procedure, including the referenced year version of the test procedure.
- IPLVs are only applicable to equipment with capacity modulation.
- Single-phase, air-cooled air-conditioners <65,000 Btu/h are regulated by NAECA. SEER values are those set by NAECA.
- As granted by U.S. Department of Energy letter of exception specific to individual companies. SDHV products without a letter of exception shall have the same efficiency as air-cooled air-conditioners.

**TABLE 13-407.1.ABC.3.2B
ELECTRICALLY OPERATED UNITARY AND APPLIED HEAT PUMPS – MINIMUM EFFICIENCY REQUIREMENTS**

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency ²	Test Procedure ¹
Air Cooled (Cooling Mode)	<65,000 Btu/h ³	All	Split System	13.0 SEER	ARI 210/240
			Single Package	13.0 SEER	
	≥65,000 Btu/h and <135,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	10.1 EER	
		All other	Split System and Single Package	9.9 EER	
	≥135,000 Btu/h and <240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	9.3 EER	ARI 340/360
		All other	Split System and Single Package	9.1 EER	
	≥240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	9.0 EER 9.2 IPLV	
		All other	Split System and Single Package	8.8 EER 9.0 IPLV	
Through-the-Wall, Air Cooled	<30,000 Btu/h ³	All	Split System	10.9 SEER	ARI 210/240
			Single Package	10.6 SEER	
Small-Duct High-Velocity, Air Cooled, Cooling Mode	<65,000 Btu/h ³	All	Split System	11.0 SEER ⁴	ARI 210/240
Air Cooled (Heating Mode)	<65,000 Btu/h ³ (Cooling Capacity)		Split System	7.7 HSPF	ARI 210/240
			Single Package	7.7 HSPF	
Through-the-Wall (Air Cooled, Heating Mode)	<30,000 Btu/h ³ (Cooling Capacity)		Split System	7.1 HSPF	ARI 210/240
			Single Package	7.0 HSPF	
Small-Duct High-Velocity (Air Cooled, Heating Mode)	<65,000 Btu/h ³ (Cooling Capacity)		Split System or Single Package	6.8 HSPF ⁴	ARI 210/240
Space Constrained Products, Heat Pumps	<65,000 Btu/h ³		Split System or Single Package	7.4 HSPF	ARI 210/240
Water Source (Cooling Mode)	<17,000 Btu/h	All	86°F Entering Water	11.2 EER	ISO-13256-1
	≥17,000 Btu/h and <135,000 Btu/h	All	86°F Entering Water	12.0 EER	
Groundwater Source (Cooling Mode)	<135,000 Btu/h	All	59°F Entering Water	16.2 EER	
Ground Source (Cooling Mode)	<135,000 Btu/h	All	77°F Entering Water	13.4 EER	
Air Cooled (Heating Mode)	<65,000 Btu/h ³ (Cooling Capacity)		Split System	6.8 HSPF	ARI 210/240
			Single Package	6.6 HSPF	
	≥65,000 Btu/h and <135,000 Btu/h (Cooling Capacity)		47°F db/43°F wb Outdoor Air	3.2 COP	
			17°F db/15°F wb Outdoor Air	2.2 COP	
≥135,000 Btu/h (Cooling Capacity)		47°F db/43°F wb Outdoor Air	3.1 COP	ARI 340/360	
		17°F db/15°F wb Outdoor Air	2.0 COP		
Water-Source (Heating Mode)	<135,000 Btu/h (Cooling Capacity)		68°F Entering Water	4.2 COP	ISO-13256-1
Groundwater Source (Heating Mode)	<135,000 Btu/h (Cooling Capacity)		50°F Entering Water	3.6 COP	
Ground Source (Heating Mode)	<135,000 Btu/h (Cooling Capacity)		32°F Entering Water	3.1 COP	

For SI: 1 Btu/h = .0048 m³/kw, °C = [(°F) - 32]/1.8.

1. Subchapter 13-3 contains a complete specification of the reference test procedure, including the referenced year version of the test procedure.

2. IPLVs and Part Load rating conditions are only applicable to equipment with capacity modulation.

3. Single-phase, air-cooled heat pumps <65,000 Btu/h are regulated by NAECA. SEER and HSPF values are those set by NAECA.

4. As granted by U.S. Department of Energy letter of exception specific to individual companies. SDHV products without a letter of exception shall have the same efficiency as air-cooled air-conditioners.

**TABLE 13-407.1.ABC.3.2C
WATER CHILLING PACKAGES MINIMUM EFFICIENCY REQUIREMENTS**

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Minimum Efficiency ¹	Test Procedure ²
Air Cooled, with Condenser, Electrically Operated	All Capacities	95°F db Outdoor Air	2.80 COP (1.26 kw/ton) 3.05 IPLV (1.15 kw/ton)	ARI 550/590
Air Cooled, without Condenser, Electrically Operated	All Capacities	95°F db Outdoor Air	3.10 COP (1.13 kw/ton) 3.45 IPLV (1.02 kw/ton)	
Water Cooled, Electrically Operated, Positive Displacement (Reciprocating)	All Capacities	85°F Cond 44°F Evap	4.20 COP (.84 kw/ton) 5.05 IPLV (.70 kw/ton)	ARI 550/590
Water Cooled, Electrically Operated, Positive Displacement (Rotary Screw and Scroll)	<150 tons	85°F Cond 44°F Evap	4.45 COP (.79 kw/ton) 5.20 IPLV (.68 kw/ton)	ARI 550/590
	≥150 tons and <300 tons	85°F Cond 44°F Evap	4.90 COP (.72 kw/ton) 5.60 IPLV (.63 kw/ton)	
	≥300 tons	85°F Cond 44°F Evap	5.50 COP (.64 kw/ton) 6.15 IPLV (.57 kw/ton)	
Water Cooled, Electrically Operated, Centrifugal	<150 tons	85°F Cond 44°F Evap	5.00 COP (.70 kw/ton) 5.25 IPLV (.67 kw/ton)	ARI 550/590
	≥150 tons and <300 tons	85°F Cond 44°F Evap	5.55 COP (.63 kw/ton) 5.90 IPLV (.60 kw/ton)	
	≥300 tons	85°F Cond 44°F Evap	6.10 COP (.58 kw/ton) 6.40 IPLV (.55 kw/ton)	
Air Cooled Absorption Single Effect	All Capacities		0.60 COP	ARI 560
Water Cooled Absorption Single Effect	All Capacities		0.70 COP	
Absorption Double Effect, Indirect-Fired	All Capacities		1.0 COP 1.05 IPLV	
Absorption Double Effect, Direct-Fired	All Capacities		1.0 COP 1.00 IPLV	

For SI: 1 Btu/h = .0048 m³/kw, °C = [(°F) - 32]/1.8.

- The chiller equipment requirements do not apply for chillers used in low-temperature applications where the design leaving fluid temperature is <40°F.
- Subchapter 13-3 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

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TABLE 13-407.1.ABC.3.2D
ELECTRICALLY OPERATED PACKAGED TERMINAL AIR CONDITIONERS, PACKAGED TERMINAL HEAT PUMPS,
SINGLE-PACKAGE VERTICAL AIR CONDITIONERS, SINGLE-PACKAGE VERTICAL HEAT PUMPS,
ROOM AIR CONDITIONERS, AND ROOM AIR CONDITIONER HEAT PUMPS – MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Size Category	Subcategory or Rating Condition	Minimum Efficiency ¹	Test Procedure ²
** 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	
** SPVHP (Heating Mode)	All Capacities	47°F db/43°F wb Outdoor Air	2.7 COP	
PTAC (Cooling Mode), New Construction	7,000 ≥ Btu/h < 8,000	95°F db Outdoor Air [₁ Based on capacity at lower range using EER= 12.5 – (0.213 × Cap/1000)] ⁴	11.0 EER	ARI 310/380
	8,000 ≤ Btu/h < 9,000		10.8 EER	
	9,000 ≤ Btu/h < 10,000		10.6 EER	
	10,000 ≤ Btu/h < 11,000		10.4 EER	
	11,000 ≤ Btu/h < 12,000		10.2 EER	
	12,000 ≤ Btu/h < 13,000		9.9 EER	
	13,000 ≤ Btu/h < 14,000		9.7 EER	
	14,000 ≤ Btu/h < 15,000		9.5 EER	
PTAC (Cooling Mode), Replacements ²	>15,000 Btu/h		9.3 EER	
	7,000 ≥ Btu/h < 8,000	95°F db Outdoor Air [₁ Based on capacity at lower range using EER= 10.9 – (0.213 × Cap/1000)] ⁴	9.4 EER	
	8,000 ≤ Btu/h < 9,000		9.2 EER	
	9,000 ≤ Btu/h < 10,000		9.0 EER	
	10,000 ≤ Btu/h < 11,000		8.8 EER	
	11,000 ≤ Btu/h < 12,000		8.6 EER	
	12,000 ≤ Btu/h < 13,000		8.3 EER	
	13,000 ≤ Btu/h < 14,000		8.1 EER	
14,000 ≤ Btu/h < 15,000	7.9 EER			
PTHP (Cooling Mode), New Construction	>15,000 Btu/h		7.7 EER	
	7,000 ≥ Btu/h < 8,000	95°F db Outdoor Air [₁ Based on capacity at lower range using EER= 12.3 – (0.213 × Cap/1000)] ⁴	10.8 EER	
	8,000 ≤ Btu/h < 9,000		10.6 EER	
	9,000 ≤ Btu/h < 10,000		10.4 EER	
	10,000 ≤ Btu/h < 11,000		10.2 EER	
	11,000 ≤ Btu/h < 12,000		10.0 EER	
	12,000 ≤ Btu/h < 13,000		9.7 EER	
	13,000 ≤ Btu/h < 14,000		9.5 EER	
14,000 ≤ Btu/h < 15,000	9.3 EER			
PTHP (Cooling Mode), Replacements ²	>15,000 Btu/h		9.1 EER	
	7,000 ≥ Btu/h < 8,000	95°F db Outdoor Air [₁ Based on capacity at lower range using EER= 10.8 – (0.213 × Cap/1000)] ⁴	9.3 EER	
	8,000 ≤ Btu/h < 9,000		9.1 EER	
	9,000 ≤ Btu/h < 10,000		8.9 EER	
	10,000 ≤ Btu/h < 11,000		8.7 EER	
	11,000 ≤ Btu/h < 12,000		8.5 EER	
	12,000 ≤ Btu/h < 13,000		8.2 EER	
	13,000 ≤ Btu/h < 14,000		8.0 EER	
14,000 ≤ Btu/h < 15,000	7.8 EER			
PTHP (Heating Mode), New Construction	>15,000 Btu/h		7.6 EER	
	7,000 ≥ Btu/h < 8,000	47°F db Outdoor Air [₁ Based on capacity at lower range using COP= 3.2 – (0.026 × Cap/1000)] ⁴	3.02 COP	
	8,000 ≤ Btu/h < 9,000		2.99 COP	
	9,000 ≤ Btu/h < 10,000		2.97 COP	
	10,000 ≤ Btu/h < 11,000		2.94 COP	
	11,000 ≤ Btu/h < 12,000		2.91 COP	
	12,000 ≤ Btu/h < 13,000		2.89 COP	
	13,000 ≤ Btu/h < 14,000		2.86 COP	
14,000 ≤ Btu/h < 15,000	2.84 COP			

continued

TABLE 13-407.1.ABC.3.2D – continued

Equipment Type	Size Category	Subcategory or Rating Condition	Minimum Efficiency ¹	Test Procedure ²
PTHP (Heating Mode), Replacements	7,000 ≥ Btu/h < 8,000	47°F db Outdoor Air [Based on capacity at lower range using COP = 2.9 – (0.026 × Cap/1000)] ⁴	2.72 COP	ARI 310/380
	8,000 ≤ Btu/h < 9,000		2.69 COP	
	9,000 ≤ Btu/h < 10,000		2.67 COP	
	10,000 ≤ Btu/h < 11,000		2.64 COP	
	11,000 ≤ Btu/h < 12,000		2.61 COP	
	12,000 ≤ Btu/h < 13,000		2.59 COP	
	13,000 ≤ Btu/h < 14,000		2.56 COP	
	14,000 ≤ Btu/h < 15,000		2.54 COP	
	> 15,000 Btu/h		2.51 COP	
Room Air Conditioners with Louvered Sides	< 8,000 Btu/h		9.7 EER	ANSI/AHAM RAC-1
	≥ 8,000 < 14,000 Btu/h		9.8 EER	
	≥ 14,000 < 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		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	

For SI: 1 Btu/h = .0048 m³/kw, °C = [(°F) - 32]/1.8.

- See each subcategory for minimum efficiency equation.
- Subchapter 13-3 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
- 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 inches high and less than 42 inches wide.
- Cap means the rated cooling capacity of the product in Btu/h. If the unit's capacity is less than 7,000 Btu/h, use 7,000 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.

TABLE 13-407.1.ABC.3.2G
PERFORMANCE REQUIREMENTS FOR HEAT REJECTION EQUIPMENT

Equipment Type	Total System Heat Rejection Capacity at Rated Conditions	Sub-Category or Rating Condition	Performance Required ^{1,2}	Test Procedure ³
Propeller or Axial Fan Cooling Towers	All	95°F Entering Water	>38.2 gpm/hp	CTI ATC-105 and CTI STD-201
		85°F Leaving Water		
		75°F wb Outdoor Air		
Centrifugal Fan Cooling Towers	All	95°F Entering Water	>20.0 gpm/hp	CTI ATC-105 and CTI STD-201
		85°F Leaving Water		
		75°F wb Outdoor Air		
Air Cooled Condensers	All	125°F Condensing Temperature R-22 Test Fluid 190°F Entering Gas Temperature 15°F Subcooling 95°F Entering db	>176,000 Btu/h	ARI 460

For SI: 1 Btu/h = .0048 m³/kw, °C = [(°F) - 32]/1.8.

- 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.
- 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.
- Subchapter 13-3 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

TABLE 13-407.1.ABC.3.2H
COPs FOR CENTRIFUGAL CHILLERS < 150 TONS¹
COP_{STD} = 5.0

Leaving Chilled Water Temperature (°F)	Entering Condenser Water Temperature (°F)	LIFT ² (°F)	Condenser Flow Rate					
			2 gpm/ton	2.5 gpm/ton	3 gpm/ton	4 gpm/ton	5 gpm/ton	6 gpm/ton
			Required COP					
46	75	29	5.58	5.83	6.03	6.32	6.54	6.7
45	75	30	5.5	5.74	5.92	6.19	6.38	6.53
44	75	31	5.42	5.65	5.82	6.07	6.24	6.37
43	75	32	5.35	5.57	5.72	5.95	6.11	6.23
42	75	33	5.27	5.49	5.64	5.85	6	6.11
41	75	34	5.19	5.41	5.56	5.75	5.89	5.99
46	80	34	5.19	5.41	5.56	5.75	5.89	5.99
40	75	35	5.11	5.33	5.48	5.67	5.79	5.88
45	80	35	5.11	5.33	5.48	5.67	5.79	5.88
44	80	36	5.03	5.26	5.4	5.58	5.7	5.79
43	80	37	4.94	5.18	5.32	5.5	5.62	5.7
42	80	38	4.84	5.1	5.25	5.43	5.53	5.61
41	80	39	4.73	5.01	5.17	5.35	5.46	5.53
46	85	39	4.73	5.01	5.17	5.35	5.46	5.53
40	80	40	4.62	4.92	5.09	5.27	5.38	5.45
45	85	40	4.62	4.92	5.09	5.27	5.38	5.45
44	85	41	4.49	4.82	5	5.2	5.3	5.38
43	85	42	4.35	4.71	4.91	5.12	5.23	5.3
42	85	43	4.19	4.59	4.81	5.03	5.15	5.22
41	85	44	4.02	4.46	4.7	4.94	5.06	5.14
40	85	45	3.84	4.32	4.58	4.84	4.98	5.06
Cond DT ³			14.04	11.23	9.36	7.02	5.62	4.68

For SI: 1 Btu/h = .0048 m³/kw, °C = [(°F) - 32]/1.8.

1. The table values are only applicable over the following full load design ranges: Leaving Chilled Water Temp 40-48°F, Entering Condenser Water Temp. 75-85°F, Condensing Water Temp. Rise 5-15°F. Chillers designed to operate outside these ranges are not covered by this standard.

2. LIFT = Entering Condenser Water Temperature – Leaving Chilled Water Temperature.

3. Cond DT = Leaving Condenser Water Temperature (°F) – Entering Condenser Water Temperature (°F)

$$K_{adj} = 6.1507 - 0.30244(X) + 0.0062692(X)^2 - 0.000045595(X)^3$$

Where X = Cond DT + LIFT

$$COP_{adj} = K_{adj} \times COP_{std}$$

TABLE 13-407.1.ABC.3.2I
COPS FOR CENTRIFUGAL CHILLERS ≥ 150 TONS, ≤ 300 TONS¹
COP_{std} = 5.55

Leaving Chilled Water Temperature (°F)	Entering Condenser Water Temperature (°F)	LIFT ² (°F)	Condenser Flow Rate					
			2 gpm/ton	2.5 gpm/ton	3 gpm/ton	4 gpm/ton	5 gpm/ton	6 gpm/ton
			Required COP					
46	75	29	6.17	6.44	6.66	6.99	7.23	7.4
45	75	30	6.08	6.34	6.54	6.84	7.06	7.22
44	75	31	6	6.24	6.43	6.71	6.9	7.05
43	75	32	5.91	6.15	6.33	6.58	6.76	6.89
42	75	33	5.83	6.07	6.23	6.47	6.63	6.75
41	75	34	5.74	5.8	6.14	6.36	6.51	6.62
46	80	34	5.74	5.8	6.14	6.36	6.51	6.62
40	75	35	5.65	5.9	6.05	6.26	6.4	6.51
45	80	35	5.65	5.9	6.05	6.26	6.4	6.51
44	80	36	5.56	5.81	5.97	6.17	6.3	6.4
43	80	37	5.46	5.73	5.89	6.08	6.21	6.3
42	80	38	5.35	5.64	5.8	6	6.12	6.2
41	80	39	5.23	5.54	5.71	5.91	6.03	6.11
46	85	39	5.23	5.54	5.71	5.91	6.03	6.11
40	80	40	5.1	5.44	5.62	5.83	5.95	6.03
45	85	40	5.1	5.44	5.62	5.83	5.95	6.03
44	85	41	4.96	5.33	5.55	5.74	5.86	5.94
43	85	42	4.81	5.21	5.42	5.66	5.78	5.86
42	85	43	4.63	5.08	5.31	5.56	5.69	5.77
41	85	44	4.45	4.93	5.19	5.46	5.6	5.69
40	85	45	4.24	4.77	5.06	5.35	5.5	5.59
Cond DT ³			14.04	11.23	9.36	7.02	5.62	4.68

For SI: 1 Btu/h = .0048 m³/kw, °C = [(°F) - 32]/1.8.

1. The table values are only applicable over the following full load design ranges: Leaving Chilled Water Temp 40-48°F, Entering Condenser Water Temp. 75-85°F, Condensing Water Temp. Rise 5-15°F. Chillers designed to operate outside these ranges are not covered by this standard.

2. LIFT = Entering Condenser Water Temperature – Leaving Chilled Water Temperature.

3. Cond DT = Leaving Condenser Water Temperature (°F) – Entering Condenser Water Temperature (°F)

$$K_{adj} = 6.1507 - 0.30244(X) + 0.0062692(X)^2 - 0.000045595(X)^3$$

Where X = Cond DT + LIFT

$$COP_{adj} = K_{adj} \times COP_{std}$$

TABLE 13-407.1.ABC.3.2J
COPS FOR CENTRIFUGAL CHILLERS > 300 TONS¹
COP_{std} = 6.1

Leaving Chilled Water Temperature (°F)	Entering Condenser Water Temperature (°F)	LIFT ² (°F)	Condenser Flow Rate					
			2 gpm/ton	2.5 gpm/ton	3 gpm/ton	4 gpm/ton	5 gpm/ton	6 gpm/ton
			Required COP					
46	75	29	6.8	7.11	7.35	7.71	7.97	8.16
45	75	30	6.71	6.99	7.21	7.55	7.78	7.96
44	75	31	6.61	6.89	7.09	7.4	7.61	7.77
43	75	32	6.52	6.79	6.98	7.26	7.45	7.6
42	75	33	6.43	6.69	6.87	7.13	7.31	7.44
41	75	34	6.33	6.6	6.77	7.02	7.18	7.3
46	80	34	6.33	6.6	6.77	7.02	7.18	7.3
40	75	35	6.23	6.5	6.68	6.91	7.06	7.17
45	80	35	6.23	6.5	6.68	6.91	7.06	7.17
44	80	36	6.13	6.41	6.58	6.81	6.95	7.05
43	80	37	6.02	6.31	6.49	6.71	6.85	6.94
42	80	38	5.9	6.21	6.4	6.61	6.75	6.84
41	80	39	5.77	6.11	6.3	6.52	6.65	6.74
46	85	39	5.77	6.11	6.3	6.52	6.65	6.74
40	80	40	5.63	6	6.2	6.43	6.56	6.65
45	85	40	5.63	6	6.2	6.43	6.56	6.65
44	85	41	5.47	5.87	6.1	6.33	6.47	6.55
43	85	42	5.3	5.74	5.98	6.24	6.37	6.46
42	85	43	5.11	5.6	5.86	6.13	6.28	6.37
41	85	44	4.9	5.44	5.72	6.02	6.17	6.27
40	85	45	4.68	5.26	5.58	5.9	6.07	6.17
Cond DT ³			14.04	11.23	9.36	7.02	5.62	4.68

For SI: 1 Btu/h = .0048 m³/kw, °C = [(°F) - 32]/1.8.

1. The table values are only applicable over the following full load design ranges: Leaving Chilled Water Temp 40-48°F, Entering Condenser Water Temp. 75-85°F, Condensing Water Temp. Rise 5-15°F. Chillers designed to operate outside these ranges are not covered by this standard.

2. LIFT = Entering Condenser Water Temperature – Leaving Chilled Water Temperature.

3. Cond DT = Leaving Condenser Water Temperature (°F) – Entering Condenser Water Temperature (°F)

$$K_{adj} = 6.1507 - 0.30244(X) + 0.0062692(X)^2 - 0.000045595(X)^3$$

Where X = Cond DT + LIFT

$$COP_{adj} = K_{adj} \times COP_{std}$$

**TABLE 13-407.1.ABC.3.2K
IPLV/NPLV FOR CENTRIFUGAL CHILLERS < 150TONS
IPLV_{std} = 5.25**

Leaving Chilled Water Temperature (°F)	Entering Condenser Water Temperature (°F)	LIFT ¹ (°F)	Condenser Flow Rate					
			2 gpm/ton	2.5 gpm/ton	3 gpm/ton	4 gpm/ton	5 gpm/ton	6 gpm/ton
			Required IPLV/NPLV					
46	75	29	5.84	6.1	6.3	6.61	6.84	7
45	75	30	5.75	6	6.19	6.47	6.68	6.83
44 ²	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	5.9	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	5.5	5.65	5.84	5.96	6.05
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	5.6	5.71	5.78
46	85	39	4.95	5.24	5.41	5.6	5.71	5.78
40	80	40	4.83	5.14	5.32	5.52	5.63	5.7
45	85	40	4.83	5.14	5.32	5.52	5.63	5.7
44	85	41	4.69	5.04	5.25 ^b	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	4.8	5.03	5.26	5.38	5.46
41	85	44	4.21	4.67	4.91	5.17	5.3	5.38
40	85	45	4.01	4.52	4.79	5.06	5.2	5.29
Cond DT ³			14.04	11.23	9.36	7.02	5.62	4.68

For SI: 1 Btu/h = .0048 m³/kw, °C = [(°F) - 32]/1.8.

- LIFT = Entering Condenser Water Temperature – Leaving Chilled Water Temperature.
- All values shown are NPLV except at conditions of 3 gpm/ton and 41°F lift, which is IPLV.
- Cond DT= Leaving Condenser Water Temperature (°F) – Entering Condenser Water Temperature (°F)
 $K_{adj} = 6.1507 - 0.30244(X) + 0.0062692(X)^2 - 0.000045595(X)^3$
 Where X = Cond DT + LIFT
 NPLV= K_{adj} x IPLV_{std}

TABLE 13-407.1.ABC.3.2L
IPLV/NPLV FOR CENTRIFUGAL CHILLERS ≥ 150 ≤ 300 TONS
IPLV_{std} = 5.9

Leaving Chilled Water Temperature (°F)	Entering Condenser Water Temperature (°F)	LIFT ¹ (°F)	Condenser Flow Rate					
			2 gpm/ton	2.5 gpm/ton	3 gpm/ton	4 gpm/ton	5 gpm/ton	6 gpm/ton
			Required IPLV/NPLV					
46	75	29	6.58	6.87	7.11	7.46	7.71	7.9
45	75	30	6.49	6.76	6.98	7.3	7.53	7.7
44	75	31	6.4	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	6.9	7.07	7.2
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	6.2	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	6.4	6.53	6.62
41	80	39	5.58	5.91	6.1	6.31	6.44	6.52
46	85	39	5.58	5.91	6.1	6.31	6.44	6.52
40	80	40	5.44	5.8	6	6.22	6.35	6.43
45	85	40	5.44	5.8	6	6.22	6.35	6.43
44	85	41	5.29	5.68	5.90 ²	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	5.4	5.71	5.87	5.97
Cond DT ³			14.04	11.23	9.36	7.02	5.62	4.68

For SI: 1 Btu/h = .0048 m³/kw, °C = [(°F) - 32]/1.8.

- LIFT = Entering Condenser Water Temperature – Leaving Chilled Water Temperature.
- All values shown are NPLV except at conditions of 3 gpm/ton and 41°F lift, which is IPLV.
- Cond DT = Leaving Condenser Water Temperature (°F) – Entering Condenser Water Temperature (°F)
 $K_{adj} = 6.1507 - 0.30244(X) + 0.0062692(X)^2 - 0.000045595(X)^3$
 Where X = Cond DT + LIFT
 NPLV = $K_{adj} \times IPLV_{std}$

TABLE 13-407.1.ABC.3.2M
IPLV/NPLV FOR CENTRIFUGAL CHILLERS > 300 TONS
IPLV_{std} = 6.4

Leaving Chilled Water Temperature (°F)	Entering Condenser Water Temperature (°F)	LIFT ¹ (°F)	Condenser Flow Rate					
			2 gpm/ton	2.5 gpm/ton	3 gpm/ton	4 gpm/ton	5 gpm/ton	6 gpm/ton
			Required IPLV/NPLV					
46	75	29	7.15	7.47	7.72	8.1	8.37	8.58
45	75	30	7.05	7.35	7.58	7.93	8.18	8.36
44 ²	75	31	6.95	7.23	7.45	7.77	8	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	7.3	7.41
43	80	37	6.32	6.63	6.82	7.05	7.19	7.3
42	80	38	6.2	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	6.3	6.52	6.76	6.89	6.98
45	85	40	5.91	6.3	6.52	6.76	6.89	6.98
44	85	41	5.75	6.17	6.40 ²	6.66	6.79	6.89
43	85	42	5.57	6.03	6.28	6.55	6.7	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
Cond DT ³			14.04	11.23	9.36	7.02	5.62	4.68

For SI: 1 Btu/h = .0048 m³/kw, °C = [(°F) - 32]/1.8.

1. LIFT = Entering Condenser Water Temperature – Leaving Chilled Water Temperature.

2. 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 = Cond DT + LIFT

$$NPLV = K_{adj} \times IPLV_{std}$$

3. Cond DT = Leaving Condenser Water Temperature (°F) – Entering Condenser Water Temperature (°F)

13-407.1.ABC.3.3 Condensing coils installed in cool air stream of another air-conditioning unit. The condensing coil of one air-conditioning unit shall not be installed in the cool air stream of another air-conditioning unit.

Exceptions:

1. Where condenser heat reclaim is used in a properly designed system including enthalpy control devices to achieve requisite humidity control for process, special storage or equipment spaces and occupant comfort within the criteria of ASHRAE 55. Such systems shall result in less energy use than other appropriate options.
2. For computer or clean rooms whose location precludes the use of systems which would not reject heat into conditioned spaces.

13-407.1.ABC.3.4 Heat rejection equipment.

13-407.1.ABC.3.4.1 General. Subsection 407.1.ABC.3.4 applies to heat rejection equipment used in comfort cooling systems such as aircooled condensers, open cooling towers, closed-circuit cooling towers and evaporative condensers.

Exception: Heat rejection devices whose energy usage is included in the equipment efficiency ratings listed in Tables 407.1.ABC.3.2A through 407.1.ABC.3.2D.

13-407.1.ABC.3.4.2 Fan speed control. Each fan powered by a motor of 7.5 hp or larger shall have the capability to operate that fan at two-thirds of full speed or less and shall have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature/pressure of the heat rejection device.

Exceptions:

1. Condenser fans serving multiple refrigerant circuits.
2. Condenser fans serving flooded condensers.
3. Up to one-third of the fans on a condenser or tower with multiple fans, where the lead fans comply with the speed control requirement.

13-407.1.ABC.3.5 Exhaust air energy recovery for cooling systems. Individual fan systems that have both a design supply air capacity of 5,000 cfm (2.4 m³/s) or greater and have a minimum outside air supply of 70 percent or greater of the design supply air quantity shall have an energy recovery system with at least 50 percent recovery effectiveness. Fifty-percent energy recovery effectiveness shall mean a change in the enthalpy of the outdoor air supply equal to 50 percent of the difference between the outdoor air and return air at design conditions.

Exceptions:

1. Laboratory systems meeting Section 409.1.ABC.3.6.2.
2. Systems serving spaces that are not cooled and that are heated to less than 60°F (16°C).
3. Systems exhausting toxic, flammable, paint or corrosive fumes or dust.
4. Commercial kitchen hoods (grease) classified as Type 1 by NFPA 96.
5. Where the largest exhaust source is less than 75 percent of the design outdoor airflow.

6. Systems requiring dehumidification that employ series-style energy recovery coils wrapped around the cooling coil.

13-407.1.A Prescriptive requirements specific to Method A. Cooling system efficiencies determined by the FLA/COM Method A performance calculation to demonstrate compliance with this code shall be the minimum performance level installed in buildings.

13-407.1.BC Prescriptive requirements specific to Methods B and C. Cooling system minimum efficiency requirements for buildings complying by Methods B and C shall meet or exceed the code minimum for the equipment installed per Tables 407.1.ABC.3.2A through D.

Electric resistance reheat shall not be used when complying with this code by Methods B and C.

13-407.2 Performance calculation procedures.

13-407.2.A Performance calculation procedures specific to Method A. Calculation procedures for space cooling system efficiencies shall be in accordance with the procedures contained within Method A of the FLA/COM computer program.

Data shall be input into FLA/COM for each zone by equipment type, size and efficiency.

13-407.2.A.1 Thermal energy storage (TES) systems. This provision shall be available to all new buildings and to major renovations (30 percent of building assessed value) of existing buildings. The code compliance procedure (FLA/COM) shall consider the demand and off-peak energy saving capabilities of TES-equipped buildings.

13-407.2.B Performance calculation procedures specific to Method B. Blank for numbering consistency.

**SECTION 13-408
SPACE HEATING EQUIPMENT**

13-408.0 Applicability. This section covers the determination of minimum heating system design requirements and efficiencies. The requirements of this section apply to equipment and mechanical component performance of all heating systems installed in new and renovated buildings including, but not limited to: unitary central heat pumps, either air or water source in the heating mode; water source (hydronic) heat pumps as used in multiple unit hydronic HVAC systems; packaged terminal heat pumps and room air conditioner heat pumps in the heating mode; and all gas- and oil-fired warm air furnaces, boilers and direct heating equipment.

13-408.1 Prescriptive requirements.

13-408.1.ABC Basic prescriptive requirements for Methods A, B and C.

13-408.1.ABC.1 Sizing. Heating equipment and systems shall be sized to provide no more than the space and system loads calculated in accordance with Section 407.1.ABC.1, with exceptions.

13-408.1.ABC.2 Controls. Heating equipment and systems shall meet all applicable prescriptive requirements for controls in Section 407.1.ABC.2.

13-408.1.ABC.2.1 Setback controls. Heating systems located in Climate Zones 1, 2 or 3 shall be equipped with controls that have the capability to automatically restart and temporarily operate the system as required to maintain zone temperatures above a heating set point adjustable down to 55°F (13°C) or lower.

13-408.1.ABC.2.2 Heat pump auxiliary heat control. Heat pumps equipped with internal electric resistance heaters shall have controls that prevent supplemental heater operation when the heating load can be met by the heat pump alone during both steady-state operation and setback recovery. Supplemental heater operation is permitted during outdoor coil defrost cycles. **Two means of meeting this requirement are (1) a digital or electronic thermostat designed for heat pump use that energizes auxiliary heat only when the heat pump has insufficient capacity to maintain setpoint or to warm up the space at a sufficient rate, or (2) a multistage space thermostat and an outdoor air-thermostat wired to energize auxiliary heat only on the last stage of the space thermostat and when outside air temperature is less than 40°F (4°C).**

Exception: Heat pumps whose minimum efficiency is regulated by NAECA and whose HSPF rating both meets the requirements shown in Table 13-407.1.ABC.3.2B and includes all usage of internal electric resistance heating.

13-408.1.ABC.2.3 Freeze protection. Freeze protection systems, such as heat tracing of outdoor piping and heat exchangers, including self-regulating heat tracing, shall include automatic controls capable of shutting off the systems when outside air temperatures are above 40°F (4°C) or when the conditions of the protected fluid will prevent freezing.

13-408.1.ABC.3 Equipment performance standards.

13-408.1.ABC.3.1.1 Equipment efficiency verification. If a certification program exists for a product covered in Tables 13-408.1.ABC.3.2E through 13-408.1.ABC.3.2G, and it includes provisions for verification and challenge of equipment efficiency ratings, then the product shall be either listed in the certification program or, alternatively, the ratings shall be verified by an independent laboratory test report. If no certification program exists for a product covered in Tables 13-408.1.ABC.3.2E through 13-408.1.ABC.3.2G, the equipment efficiency ratings shall be supported by data furnished by the manufacturer. Where equipment is not rated, a Florida-registered engineer shall specify component efficiencies whose combined efficiency meets the minimum equipment efficiency requirements in Section 13-408.1.ABC.3.2.

13-408.1.ABC.3.2 Minimum efficiencies for heating equipment.

13-408.1.ABC.3.2.1 Equipment ratings. Tables 13-407.1.ABC.3.2B, 13-407.1.ABC.3.2D, and 13-408.1.ABC.3.2E through 13-408.1.ABC.3.2G contain the minimum efficiency requirements for equipment covered by this section of the standard. The tables are organized to cover the following types of equipment:

Table 13-407.1.ABC.3.2B, Heat Pumps.

Table 13-407.1.ABC.3.2D, Packaged Terminal Air Conditioners and Heat Pumps.

Table 13-408.1.ABC.3.2E, Furnaces, Duct Furnaces and Unit Heaters.

Table 13-408.1.ABC.3.2F, Boilers.

Table 13-408.1.ABC.3.2G, Heat rejection equipment.

Gas-fired and oil-fired forced air furnaces with input ratings >225,000 Btu/h shall also have an intermittent ignition or interrupted device (IID) and have either power venting or a flue

**TABLE 13-408.1.ABC.3.2E
WARM AIR FURNACES AND COMBINATION WARM AIR FURNACES/AIR-CONDITIONING UNITS,
WARM AIR DUCT FURNACES AND UNIT HEATERS. MINIMUM EFFICIENCY REQUIREMENTS**

Equipment Type	Size Category	Subcategory or Rating Condition	Minimum Efficiency ¹	Test Procedure ²
Warm Air Furnace, Gas-Fired	<225,000 Btu/h		78 percent AFUE or ;80 percent E _t ⁴	DOE 10 CFR, Part 430 or ANSI Z 21.47
	≥225,000 Btu/h	Maximum Capacity ⁴	80 percent E _c ³	ANSI Z21.47
Warm Air Furnace, Oil-Fired	<225,000 Btu/h		78 percent AFUE or ;80 percent E _t ⁴	DOE 10 CFR, Part 430 or UL 727
	≥225,000 Btu/h	Maximum Capacity ⁵	81 percent E _t ⁶	UL 727
Warm Air Duct Furnaces, Gas-Fired	All Capacities	Maximum Capacity ⁵	80 percent E _c ⁷	ANSI Z83.8
Warm Air Unit Heaters, Gas-Fired	All Capacities	Maximum Capacity ⁵	80 percent E _c ⁷	ANSI Z83.8
Warm Air Unit Heaters, Oil-Fired	All Capacities	Maximum Capacity ⁵	80 percent E _c ⁷	UL 731

For SI: 1Btu/h = .0048 m3/kw, °C = [(°F) - 32]/1.8.

- E_t = thermal efficiency. See test procedure for detailed discussion.
- Subchapter 13-3 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
- E_c = combustion efficiency. Units must also include an IID, have jacket losses not exceeding 0.75 percent of the input rating, and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for those furnaces where combustion air is drawn from the conditioned space.
- Combination units not covered by NAECA (3 phase power or cooling capacity greater than or equal to 65,000 Btu/h) may comply with either rating.
- Minimum and maximum ratings as provided for and allowed by the unit's controls.
- E_t = thermal efficiency. Units must also include an IID, have jacket losses not exceeding 0.75 percent of the input rating, and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for those furnaces where combustion air is drawn from the conditioned space.
- E_c = combustion efficiency (100% less flue losses). See test procedure for detailed discussion.

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, including electric furnaces, that are not located within the conditioned space shall have jacket losses not exceeding 0.75 percent of the input.

13-408.1.ABC.3.2.2 Radiant heating systems.

13-408.1.ABC.3.2.2.1 Heating unenclosed spaces. Radiant heating shall be used when heating is required for unenclosed spaces.

Exception: Loading docks equipped with air curtains.

13-408.1.ABC.3.2.2.2 Heating enclosed spaces. Radiant heating systems that are used as primary or supplemental enclosed space heating shall be in conformance with the governing provisions of the standard, including, but not limited, to the following:

- a. Radiant hydronic ceiling or floor panels (used for heating or cooling).
- b. Combination or hybrid systems incorporating radiant heating (or cooling) panels.
- c. Radiant heating (or cooling) panels used in conjunction with other systems such as variable air volume or thermal storage systems.

13-408.1.ABC.3.2.5 Heating systems having additional functions. Space heating equipment used to provide additional functions (e.g. service water heating) as part of a combination (integrated) system shall comply with minimum performance re-

quirements for the appropriate space heating equipment category. Service water heating equipment used to provide additional functions (e.g. space heating) as part of a combination (integrated) system shall, as a minimum, meet the minimum performance requirements for water heating equipment in Section 412.1.ABC.

13-408.1.AB.1 Calculations. All calculations and determinations of parameters used in the demonstration of compliance with this code by Methods A or B shall be conducted according to Section 408.2.

13-408.1.A Prescriptive requirements specific to Method A. Heating system efficiencies determined by the FLA/COM Method A performance calculation to demonstrate compliance with this code shall be the minimum performance level installed in buildings.

13-408.1.BC Prescriptive requirements specific to Methods B and C.

Heating system minimum efficiency requirements for buildings complying by Methods B and C shall meet or exceed the appropriate code minimum for the equipment installed. See Tables 407.1.ABC.3.2B, 407.1.ABC.3.2D, and 408.1.ABC.3.2E through 408.1.ABC.3.2G.

13-408.2 Performance calculation procedures.

13-408.2.AB Calculation procedures for Methods A and B. Calculation procedures for determining space heating system compliance shall be in accordance with the procedures contained within Method A or Method B of the FLA/COM computer program. Data shall be input into FLA/COM for each zone by equipment type, size and efficiency.

**TABLE 13-408.1.ABC.3.2F
GAS- AND OIL-FIRED BOILERS MINIMUM EFFICIENCY REQUIREMENTS**

Equipment Type ⁴	Size Category (Input)	Subcategory or Rating Condition	Minimum Efficiency ¹	Test Procedure ²
Boilers, Gas-Fired	<300,000 Btu/h	Hot water	80 percent AFUE	DOE 10 CFR Part 430
		Steam	75 percent AFUE	
	≥300,000 Btu/h and <2,500,000	Maximum Capacity ³	75 percent E _t ¹	H.I. Htg Boiler Std.
		>2,500,000 Btu/h ⁴	Hot Water	
Boilers, Oil-Fired	<300,000 Btu/h	Hot Water	80 percent E _c	DOE 10 CFR Part 430
		Steam	80 percent E _c	
	≥300,000 Btu/h and ≤250,000,000 Btu/h	Maximum Capacity ³	78 percent E _t ¹	H.I. Htg Boiler Std.
		>2,500,000 Btu/h ⁴	Hot Water	
>2,500,000 Btu/h ⁴	Hot Water	83 percent E _c	H.I. Htg Boiler Std.	
	Steam	83 percent E _c		
Oil-Fired (Residual)	≥300,000 Btu/h and ≤250,000,000 Btu/h	Maximum Capacity ³	78 percent E _t ¹	H.I. Htg Boiler Std.
		>2,500,000 Btu/h ⁴	Hot Water	
	>2,500,000 Btu/h ⁴	Steam	83 percent E _c	

For SI: 1Btu/h = .0048 m3/kw, °C = [(°F) - 32]/1.8.

1. E_t = thermal efficiency. See reference documents for detailed information.

2. Subchapter 13-3 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

3. Minimum and maximum ratings as provided for and allowed by the unit's controls.

4. These requirements apply to boilers with rated input of 8,000,000 Btu/h or less that are not packaged boilers, and to all package boilers. Minimum efficiency requirements for boilers cover all capacities of packaged boilers.

SECTION 13-409 VENTILATION

13-409.1 Prescriptive requirements.

13-409.1.ABC Basic prescriptive requirements for Methods A, B and C.

13-409.1.ABC.1 Air quality. Sources of pollutants within the conditioned space shall be minimized or eliminated, if possible, in order to minimize the outside air intake required for dilution. Concentrated sources shall be controlled at the source by containment, local exhaust systems, or both.

13-409.1.ABC.1.1 Ventilation systems shall be designed to be capable of reducing the supply of outdoor air to the minimum ventilation rates required by section 6.1.3 of ASHRAE 62. Systems may be designed to supply outside air quantities exceeding minimum levels, but they shall be capable of operating at no more than minimum levels through the use of return ducts, manually or automatically operated control dampers, fan volume controls, or other devices.

Exception: Minimum outdoor air quantities may be greater if required to make up air exhausted for source control of contaminants or if required by process systems.

13-409.1.ABC.2 Building pressures. Mechanical systems shall be designed to assure that buildings are pressurized with respect to outdoors.

13-409.1.ABC.3 Ventilation system controls.

13-409.1.ABC.3.1 Stair and shaft vents. Stair and elevator shaft vents shall be equipped with motorized dampers that are capable of being automatically closed during normal building operation and are interlocked to open as required by fire and smoke detection systems.

13-409.1.ABC.3.2 Gravity hoods, vents, and ventilators. All outdoor air supply and exhaust hoods, vents, and ventilators shall be equipped with motorized dampers that will automatically shut when the spaces served are not in use.

Exceptions:

- Gravity (nonmotorized) dampers are acceptable in buildings less than three stories in height above grade and for buildings of any height located in climates with less than 2,700 HDD 65.
- Ventilation systems serving unconditioned spaces.

13-409.1.ABC.3.3 Shutoff damper controls. Both outdoor air supply and exhaust systems shall be equipped with motorized dampers that will automatically shut when the systems or spaces served are not in use. Ventilation outside air dampers shall be capable of automatically shutting off during pre-occupancy building warmup, cooldown, and setback, except when ventilation reduces energy costs (e.g., night purge) or when ventilation must be supplied to meet code requirements.

Exceptions:

- Gravity (nonmotorized) dampers are acceptable in building exhaust air systems.
- Gravity (nonmotorized) dampers are acceptable in systems with a design outside air intake or exhaust capacity of 300 cfm (.14 m³/s) or less.

13-409.1.ABC.3.4 Dampers. Where outdoor air supply and exhaust air dampers are required by Section 409.1.ABC.3, they shall have a maximum leakage rate at 1 inches w.g. of 4 cfm [.02 m³/(s • m²)] per square foot of damper area for motorized dampers when tested in accordance with AMCA 500 as indicated in Table 409.1.ABC.3.3.

**TABLE 13-409.1.ABC.3.3
MAXIMUM DAMPER LEAKAGE**

Climate	Maximum Damper Leakage at 1.0 inches w.g. cfm per ft ² of damper area	
	Motorized	Non-motorized
HDD65>7200 or CDD50>7200	4	Not allowed ^a
HDD65<2701 and CDD50<3601	20	20 ^b
All others	10	20 ^b

For SI: 1Btu/h = .0048 m³/kw, °C = [(°F) - 32]/1.8.

a. 20^b when allowed by Exception 1 to Section 409.1.ABC.3.2.

b. Dampers smaller than 24 inches in either dimension may have leakage of 40 cfm/ft².

13-409.1.ABC.3.5 Ventilation controls for high-occupancy areas. Systems with design outside air capacities greater than 3,000 cfm (1.4 m³/s) serving areas having an average design occupancy density exceeding 100 people per 1,000 feet (93 m³) shall include means to automatically reduce outside air intake below design rates when spaces are partially occupied. Ventilation controls shall be in compliance with ASHRAE 62 and local standards.

Exception: Systems with heat recovery complying with Section 407.1.ABC.3.5.

13-409.1.ABC.3.6 Exhaust hoods.

13-409.1.ABC.3.6.1 Nonresidential kitchen spaces. Nonresidential kitchen space and areas in dining rooms or open malls where a kitchen exhaust hood is required by NFPA 96 shall comply with the following requirements:

- Be designed with an exhaust air and make up air balance such that the space is never under a positive pressure, and never under a negative pressure exceeding 0.02 inch w.g. relative to all indoor spaces surrounding the kitchen space, during all cooking hours.
- All exhaust and makeup air system components (fans, dampers, etc.) shall be interlocked in such a way that the balance prescribed in Item 1 above is maintained throughout all cooking hours, and all variations of cooking operations.

13-409.1.ABCD.3.6.2 Fume hoods. Buildings with fume hood systems having a total exhaust rate greater than 15,000 cfm (7 m³/s) shall include at least one of the following features:

- Variable air volume hood exhaust and room supply systems capable of reducing exhaust and makeup air volume to 50 percent or less of design values.
- Direct makeup (auxiliary) air supply equal to at least 75 percent of the exhaust rate, heated no warmer than 2°F (-17°C) below room set point, cooled to no cooler than 3°F (-16°C) above room set point, no humidification added, and no simultaneous heating and cooling used for dehumidification control.

- Heat recovery systems to precondition makeup air from fume hood exhaust in accordance with Section 407.1.ABC.3.5 without using any exception.

13-409.2 Performance calculation procedures. Blank for numbering consistency.

**SECTION 13-410
AIR DISTRIBUTION SYSTEMS**

13-410.1 Prescriptive requirements.

13-410.1.ABC Basic prescriptive requirements for Methods A, B and C.

13-410.1.ABC.1 Sizing and design criteria.

13-410.1.ABC.1.1 Air system design and control. HVAC systems having a total fan system power exceeding 5 hp shall meet the provisions of Table 410.1.ABC.1.1.1 and Section 410.1.ABC.1.1.2 unless otherwise noted.

13-410.1.ABC.1.1.1 Fan power limitation. Fan power shall be limited by the following:

- The ratio of the fan system power to the supply fan airflow rate (main fan) of each HVAC system at design conditions shall not exceed the allowable fan system power shown in Table 410.1.ABC.1.1.1.
- Where air systems require air treatment or filtering systems with pressure drops over 1 inches w.c. when filters are clean, or heat recovery coils or devices, or direct evaporative humidifiers/coolers, or other devices to serve process loads in the airstream, the allowable fan system power may be adjusted using the pressure credit in the allowable fan system equation below.
- If the temperature difference between design room temperature and supply air temperature at cooling design conditions that is used to calculate design zone supply airflow is larger than 20°F (-7°C), the allowable fan system power may be adjusted using the temperature ratio in the Allowable fan system power equation below.

**TABLE 13-410.1.ABC.1.1.1
FAN POWER LIMITATION**

Supply Air Volume	Allowable Nameplate Motor Power	
	Constant Volume	Variable Volume
<20,000 cfm	1.2 hp/1000 cfm	1.7 hp/1000 cfm
≥20,000 cfm	1.1 hp/1000 cfm	1.5 hp/1000 cfm

For SI: 1Btu/h = .0048 m³/kw, °C = [(°F) - 32]/1.8.

Allowable fan system power = [fan power limitation × (Temperature ratio) + Pressure credit + Relief fan credit]

Where:

Fan power limitation = Table 410.1.ABC.1.1.1 Value X
CFM_n/1000

Temperature ratio = (T_{t-stat} - T_s) / 20

Pressure credit (hp) = Sum of [CFM_n · (SP_n - 1.0) / 3718] + Sum of [CFM_{HR} · SP_{HR} / 3718]

Relief fan credit HP (kW) = F_R HP (kW) × [1 - (CFM_{RF} / CFM_n)]

CFM_n = supply air volume of the unit with the filtering system (cfm)

CFM_{HR} = supply air volume of heat recovery coils or direct evaporative humidified/ cooler (cfm)

CFM_{RF} = relief fan air volume at normal cooling design operation

SP_n = air pressure drop of the filtering system when filters are clean (inches w.g.)

SP_{HR} = air pressure drop of heat recovery coils or direct evaporative humidifier/cooler (inches w.g.).

T_{t-stat} = room thermostat set point

T_s = design supply air temperature for the zone in which the thermostat is located

F_R = name plate rating of the relief fan in hp

13-410.1.ABC.1.1.2 Variable air volume (VAV) fan control. (Including systems using series fan power boxes).

13-410.1.ABC.1.1.2.1 Part-load fan power limitation. Individual VAV fans with motors 15 hp (11 kW) and larger shall meet one of the following:

- The fan shall be driven by a mechanical or electrical variable-speed drive.
- The fan shall be a vane-axial fan with variable-pitch blades.
- The fan shall have other controls and devices that will result in fan motor demand of no more than 30 percent of design wattage at 50 percent of design air volume when static pressure set point equals one-third of the total design static pressure, based on manufacturer's certified fan data

13-410.1.ABC.1.1.2.2 Static pressure sensor location. 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 one-third the total design fan static pressure, except for systems with zone reset control complying with Section 410.1.ABC.1.1.2.3. If this results in the sensor being located downstream of major duct splits, multiple sensors shall be installed in each major branch to ensure that static pressure can be maintained in each.

13-410.1.ABC.1.1.2.3 Set point reset. For systems with direct digital control of individual zone boxes reporting to the central control panel, 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.

13-410.1.ABC.1.2 Duct sizing and design. Duct systems shall be sized and designed through the use of ASHRAE, ACCA or other nationally recognized design procedure.

13-410.1.ABC.2 Air distribution system insulation. All air distribution system components which move or contain conditioned air including, but not limited to, air filter enclosures, air ducts and plenums that are located in or on buildings shall be thermally insulated in accordance with the criteria of Sections 410.1.ABC.2.1 through 410.1.ABC.2.5.

13-410.1.ABC.2.1 General. Insulation shall be protected from damage, including that due to sunlight, moisture, equipment maintenance, and wind, but not limited to the following:

1. Insulation exposed to weather shall be suitable for outdoor service, e.g., protected by aluminum, sheet metal, painted canvas, or plastic cover. Cellular foam insulation shall be protected as above or painted with a coating that is water retardant and provides shielding from solar radiation that can cause degradation of the material.
2. Insulation covering chilled water piping, refrigerant suction piping, or cooling ducts located outside the conditioned space shall include a vapor retardant located outside the insulation (unless the insulation is inherently vapor retardant), all penetrations and joints of which shall be sealed.

13-410.1.ABC.2.2. Insulation required. All supply and return ducts and plenums installed as part of an HVAC air distribution system shall be thermally insulated in accordance with Table 410.1.ABC.2.2.

Exceptions:

1. Factory-installed plenums, casings, or ductwork furnished as a part of HVAC equipment tested and rated in accordance with Sections 407.ABC.3.2 and 408.1.ABC.3.2.1.
2. Ducts or plenums located in heated spaces, semiheated spaces, or cooled spaces.
3. For runouts less than 10 feet (3048 mm) in length to air terminals or air outlets, the rated *R*-value of insulation need not exceed *R*-4.2.
4. Backs of air outlets and outlet plenums exposed to unconditioned or indirectly conditioned spaces with face areas exceeding 5 square feet (.46 m²) need not exceed *R*-2; those 5 square feet (.46 m²) or smaller need not be insulated.
5. Return air ducts meeting all the requirements of Section 410.1.ABC.3.6 for building cavities which will be used as return air plenums.

**TABLE 13-410.1.ABC.2.2
MINIMUM INSULATION LEVELS AIR DISTRIBUTION
SYSTEM COMPONENTS¹**

Location	Duct Insulation R-Value	Duct Insulation R-Value
Exterior of building	R-8	
Attic with ceiling insulation	R-6	
Dropped ceiling cavity with roof insulation ¹		
Climate zones 1, 2, 3	Roof ≥R-16 R-4.2	Roof < R-16: R-6
Climate zones 4, 5, 6	Roof ≥R-14 R-4.2	Roof < R-14: R-6
Climate zones 7, 8, 9	Roof ≥R-12 R-4.2	Roof < R-12: R-6
Unconditioned interior spaces ²	R-4.2	
Indirectly conditioned spaces ³	None	
Conditioned interior spaces	None	
Buried	R-4.2	

1. Roof R-value specified is of the insulation only.
2. Includes crawl spaces, both ventilated and nonventilated.
3. Includes return air plenums with or without exposed roofs above.

13-410.1.ABC.2.3 R-value determination. All duct insulation and factory-made ducts shall be labeled with *R*-values based on flat sections of insulation only at installed thickness and excluding any air film resistance. The thermal resistance (*R*) shall be determined using the relationship $R=t/k$ where *t* (inches) is the installed thickness and *k* (Btu-in/hr-ft²°F) is the measured apparent thermal conductivity at 75°F (24°C) mean temperature and at installed thickness tested in accordance with ASTM C 518 or ASTM C 177.

The installed thickness of duct insulation used to calculate *R*-values shall be determined as follows:

1. Duct board, duct liner and factory-made rigid ducts not normally subjected to compression shall use the nominal insulation thickness.
2. Duct wrap shall have an assumed installed thickness of 75 percent of nominal thickness (25-percent compression).
3. Factory-made flexible air ducts shall have the installed thickness and calculated *R*-values determined in accordance with Paragraph 3.4, of the Air Diffusion Council Standard, *Flexible Duct Performance & Installation Standards*.

13-410.1.ABC.2.4 Condensation control. Additional insulation with vapor barrier shall be provided where the minimum duct insulation requirements of 410.1.ABC.2.2 are determined to be insufficient to prevent condensation.

13-410.1.ABC.2.5 Fibrous glass duct liner. Fibrous glass duct liner shall be fabricated and installed in accordance with the provisions of the NAIMA *Fibrous Glass Duct Liner Standard*.

13-410.1.ABC.3 Air distribution system construction and installation. Ducts shall be constructed, braced, reinforced and installed to provide structural strength and durability. All

transverse joints, longitudinal seams and fitting connections shall be securely fastened and sealed in accordance with the applicable standards of this section.

13-410.1.ABC.3.0 General. All enclosures which form the primary air containment passageways for air distribution systems shall be considered ducts or plenum chambers and shall be constructed and sealed in accordance with the applicable criteria of this section.

13-410.1.ABC.3.0.1 Mechanical fastening. All joints between sections of air ducts and plenums, between intermediate and terminal fittings and other components of the air distribution system, and between subsections of these components shall be mechanically fastened to secure the sections independently of the closure system(s).

13-410.1.ABC.3.0.2 Sealing. Air distribution system components shall be sealed with approved closure systems.

13-410.1.ABC.3.0.3 Space provided. Sufficient space shall be provided adjacent to all mechanical components located in or forming a part of the air distribution system to assure adequate access for (1) construction and sealing in accordance with the requirements of Section 410.1.ABC.3 of this code, (2) inspection and (3) cleaning and maintenance. A minimum of 4 inches (102 mm) is considered sufficient space around air handling units.

Exception: Retrofit or replacement units not part of a renovation are exempt from the minimum clearance requirement.

13-410.1.ABC.3.0.4 Product application. Closure products shall be applied to the air barriers of air distribution system components being joined in order to form a continuous barrier or they may be applied in accordance with the manufacturer's instructions or appropriate industry installation standard where more restrictive.

13-410.1.ABC.3.0.5 Surface preparation. The surfaces upon which closure products are to be applied shall be clean and dry in accordance with the manufacturer's installation instructions.

13-410.1.ABC.3.0.6 Approved mechanical attachments. Approved mechanical attachments for air distribution system components include screws, rivets, welds, interlocking joints crimped and rolled, staples, twist in (screw attachment), and compression systems created by bend tabs or screws tabs and flanges or by clinching straps. Mechanical attachments shall be selected to be appropriate to the duct system type.

13-410.1.ABC.3.0.7 Approved closure systems. The following closure systems and materials are approved for air distribution construction and sealing for the applications and pressure classes prescribed in Sections 410.1.ABC.3.1 through 410.1.ABC.3.8:

1. Metal closures.
 - a. Welds applied continuously along metal seams or joints through which air could leak.
 - b. Longitudinal grooved metal seams and snaplock seams that are rolled and crimped by the manufacturer.
2. Gasketing, which achieves a 25/50 flame spread/smoke density development rating under ASTM E 84 or UL

723, provided that it is used only between mated surfaces which are mechanically fastened with sufficient force to compress the gasket and to fill all voids and cracks through which air leakage would otherwise occur.

3. Mastics closures. Mastics shall be placed over the entire joint between mated surfaces. Mastics shall not be diluted. Approved mastics include the following:

- a. Mastic or mastic-plus-embedded fabric systems applied to fibrous glass ductboard that are listed and labeled in accordance with UL 181A, Part III.
- b. Mastic or mastic-plus-embedded fabric systems applied to nonmetal flexible duct that are listed and labeled in accordance with UL 181B, Part II.
- c. Mastic ribbons, which achieve a 25/50 flame spread/smoke-density-development rating under ASTM E 84 or UL 723, provided that they may be used only in flange-joints and lap-joints, such that the mastic resides between two parallel surfaces of the air barrier and that those surfaces are mechanically fastened.

4. Tapes. Tapes shall be applied such that they extend not less than 1 inch (25 mm) onto each of the mated surfaces and shall totally cover the joint. When used on rectangular ducts, tapes shall be used only on joints between parallel rigid surfaces and on right angle joints. Approved tapes include the following:

- a. Pressure-sensitive tapes.
 - 1) Pressure-sensitive tapes applied to fibrous glass ductboard that are listed and labeled in accordance with UL 181A, Part I.
 - 2) Pressure-sensitive tapes applied to nonmetal flexible duct that are listed and labeled in accordance with UL 181B, Part I
- b. Heat-activated tapes applied to fibrous glass ductboard that are listed and labeled in accordance with UL 181A, Part II.

5. Aerosol sealant. Such sealants shall be installed by manufacturer-certified installers following manufacturer instructions and shall achieve 25/50 flame spread/smoke-density-development ratings under ASTM E 84 or UL 723.

13-410.1.ABC.3.1 Metal duct, rigid and flexible. All transverse joints, longitudinal seams and duct wall penetration of ducts and joints with other air distribution system components shall be mechanically attached and sealed using approved closure systems for that pressure class as specified in Section 410.1.ABC.3.1.1 or Section 410.1.ABC.3.1.2.

13-410.1.ABC.3.1.1 Pressures less than 1 inch water gauge, approved closure systems. The following closure systems are approved for rigid metal duct designed to be operated at pressures less than 1 inch w.g. when they conform to the approved closure and mechanical attachment requirements of Section 410.1.ABC.3.0:

1. Continuous welds.

2. Snaplock seams and grooved, standing, double-corner, single-corner and Pittsburgh-lock seams, and all other rolled mechanical seams.
3. Mastic, mastic-plus-embedded fabric or mastic ribbons.
4. Gaskets.
5. Pressure-sensitive tape.
6. Aerosol sealant.

13-410.1.ABC.3.1.2 Pressures 1-inch water gauge or greater, approved closure systems. The following closure systems are approved for rigid metal duct designed to be operated at pressures 1-inch w.g. or greater when they conform to the approved closure and mechanical attachment requirements of Section 410.1.ABC.3.0:

1. Continuous welds.
2. Mastic, mastic-plus-embedded fabric systems, or mastic ribbons.
3. Gaskets.

13-410.1.ABC.3.1.3 High pressure duct systems. High pressure duct systems designed to operate at pressures greater than 3-inch water gauge (4-inch water gauge pressure class), shall be tested in accordance with the SMACNA *HVAC Air Duct Leakage Test Manual*. The tested duct leakage class, at a test pressure equal to the design duct pressure class rating, shall be equal to or less than Leakage Class 6. Leakage testing may be limited to representative sections of the duct system but in no case shall such tested sections include less than 25 percent of the total installed duct area for the designated pressure class.

13-410.1.ABC.3.2 Fibrous glass duct, rigid. All rigid fibrous glass ducts and plenums shall be constructed and erected in accordance with the provisions of the NAIMA *Fibrous Glass Duct Construction Standards*.

All joints, seams and duct wall penetrations including, but not limited to, the joints between sections of duct and the joints between duct and other distribution system components shall be mechanically attached and sealed using approved closure systems as specified in Section 410.1.ABC.3.2.1.

13-410.1.ABC.3.2.1 Approved closure systems. The following closure systems are approved for rigid fibrous glass duct when they meet the approved closure and mechanical attachment requirements of Section 410.1.ABC.3.0:

1. Heat-activated tapes.
2. Pressure-sensitive tapes.
3. Mastics or mastic-plus-embedded fabric systems.

13-410.1.ABC.3.2.2 Mechanical fastening. Attachments of ductwork to air handling equipment shall be by mechanical fasteners. Where access is limited, two fasteners on one side shall be acceptable when installed in accordance with Section 410.1.ABC.3.0.6.

13-410.1.ABC.3.3. Flexible duct systems, nonmetal. Flexible nonmetal ducts shall be joined to all other air distribution system components by either terminal or intermediate fittings. All duct collar fittings shall have a minimum $5/8$ -inch (16 mm) integral flange for sealing to other component and a minimum 3-inch (76 mm) shaft for insertion into the inner duct core.

Flexible ducts having porous inner cores shall not be used.

Exception: Ducts having a nonporous liner between the porous inner core and the outer jacket. Fastening and sealing requirements shall be applied to such intermediate liners.

All joints of flexible ducts to fittings and fittings to other air distribution system components shall be mechanically attached and sealed as specified in Sections 410.1.ABC.3.3.1 through 410.1.ABC.3.3.6.

13-410.1.ABC.3.3.1 Duct core to duct fitting, mechanical attachment. The reinforced core shall be mechanically attached to the duct fitting by a drawband installed directly over the wire-reinforced core and the duct fitting. The duct fitting shall extend a minimum of 2 inches (51 mm) into each section of duct core. When the flexible duct is larger than 12 inches (305 mm) in diameter or the design pressure exceeds 1 inch water gauge, the drawband shall be secured by a raised bead or indented groove on the fitting.

13-410.1.ABC.3.3.2 Duct core to duct fitting, approved closure systems. The reinforced core shall be sealed to the duct fitting using one of the following sealing materials which conforms to the approved closure and mechanical attachment requirements of Section 410.1.ABC.3.0:

1. Gasketing.
2. Mastic, mastic-plus-embedded fabric systems, or mastic ribbons.
3. Pressure-sensitive tape.
4. Aerosol sealants, provided that their use is consistent with UL 181.

13-410.1.ABC.3.3.3 Duct outer jacket to duct collar fitting. The outer jacket of a flexible duct section shall be secured at the juncture of the air distribution system component and intermediate or terminal fitting in such a way as to prevent excess condensation. The outer jacket of a flexible duct section shall not be interposed between the flange of the duct collar fitting and the flexible duct, rigid fibrous glass duct board, or sheet metal to which it is mated.

13-410.1.ABC.3.3.4 Duct collar fittings to rigid duct, mechanical attachment. The duct collar fitting shall be mechanically attached to the rigid duct board or sheet metal by appropriate mechanical fasteners, either screws, spin-in flanges, or dovetail flanges.

13-410.1.ABC.3.3.5 Duct collar fitting to rigid duct, approved closure systems. The duct collar fitting's integral flange shall be sealed to the rigid duct board or sheet metal using one of the following closure systems/materials which conforms to the approved closure and mechanical attachment standards of Sections 410.1.ABC.3.0:

1. Gasketing.
2. Mastic or mastic-plus-embedded fabric.
3. Mastic ribbons when used to attach a duct collar to sheet metal.
4. Pressure-sensitive tape.
5. Aerosol sealants, provided that their use is consistent with UL 181.

13-410.1.ABC.3.3.6 Flexible duct installation and support.

Flexible ducts shall be configured and supported so as to prevent the use of excess duct material, prevent duct dislocation or damage, and prevent constriction of the duct below the rated duct diameter in accordance with the following requirements:

1. Ducts shall be installed fully extended. The total extended length of duct material shall not exceed 5 percent of the minimum required length for that run.
2. Bends shall maintain a center line radius of not less than one duct diameter.
3. Terminal devices shall be supported independently of the flexible duct.
4. Horizontal duct shall be supported at intervals not greater than 5 feet (1524 mm). Duct sag between supports shall not exceed $\frac{1}{2}$ inch (12.7 mm) per foot of length. Supports shall be provided within $1\frac{1}{2}$ feet (457 mm) of intermediate fittings and between intermediate fittings and bends. Ceiling joists and rigid duct or equipment may be considered to be supports.
5. Vertical duct shall be stabilized with support straps at intervals not greater than 6 feet (1829 mm).
6. Hangers, saddles and other supports shall meet the duct manufacturer's recommendations and shall be of sufficient width to prevent restriction of the internal duct diameter. In no case shall the material supporting flexible duct that is in direct contact with it be less than $1\frac{1}{2}$ inches (38 mm).

13-410.1.ABC.3.4 Terminal and intermediate fittings. All seams and joints in terminal and intermediate fittings, between fitting subsections and between fittings and other air distribution system components or building components shall be mechanically attached and sealed using approved closure systems for that joining application as specified in Section 410.1.ABC.3.4.1 or Section 410.1.ABC.3.4.2.

13-410.1.ABC.3.4.1 Fittings and joints between dissimilar duct types, approved closure systems. Approved closure systems shall be as designated by air distribution system component material type in Section 410.1.ABC.3.

Exception: When the components of a joint are fibrous glass duct board and metal duct, including collar fittings and metal equipment housings, the closure systems approved for fibrous glass duct shall be used.

13-410.1.ABC.3.4.2 Terminal fittings and air ducts to building envelope components, approved closure systems.

Terminal fittings and air ducts which penetrate the building envelope shall be mechanically attached to the structure and sealed to the envelope component penetrated and shall use one of the following closure systems/materials which conform to the approved closure and mechanical application requirements of Section 410.1.ABC.3.0:

1. Mastics or mastic-plus-embedded fabrics.
2. Gaskets used in terminal fitting/grille assemblies which compress the gasket material between the fitting and the wall, ceiling or floor sheathing.

13-410.1.ABC.3.5 Air-handling units. All air-handling units shall be mechanically attached to other air distribution system

components. Air-handling units located outside the conditioned space shall be sealed using approved closure systems conforming to the approved closure and mechanical application requirements of Section 410.1.ABC.3.1.

13-410.1.ABC.3.5.1 Approved closure systems. Systems conforming to the product and application standards of Section 410.1.ABC.3.0 may be used when sealing air handling units.

13-410.1.ABC.3.5.2 Air-handling units. Air-handling units shall not be installed in attics (see definition of "Attic" in Section 202).

13-410.1.ABC.3.6 Cavities of the building structure. Cavities in framed spaces, such as dropped soffits and walls, shall not be used to deliver air from or return air to the conditioning system unless they contain an air duct insert which is insulated in accordance with Section 410.1.ABC.2 and constructed and sealed in accordance with the requirements of Section 410.1.ABC.3 appropriate for the duct materials used.

Exception: Return air plenums.

Cavities designed for air transport such as mechanical closets, chases, air shafts, etc. shall be lined with an air barrier and sealed in accordance with Section 410.1.ABC.3.7 and shall be insulated in accordance with Section 410.1.ABC.2.

Building cavities which will be used as return air plenums shall be lined with a continuous air barrier made of durable nonporous materials. All penetrations to the air barrier shall be sealed with a suitable long-life mastic material.

Exception: Surfaces between the plenum and conditioned spaces from which the return/mixed air is drawn.

Building cavities beneath a roof deck that will be used as return air plenums shall have an insulated roof with insulation having an *R*-value of at least R-19.

13-410.1.ABC.3.7 Mechanical closets. The interior surfaces of mechanical closets shall be sheathed with a continuous air barrier as specified in Section 410.1.ABC.3.7.1 and shall be sealed with approved closure systems as specified in Section 410.1.ABC.3.7.2. All joints shall be sealed between air barrier segments and between the air barriers of walls and those of the ceiling, floor and door framing. All penetrations of the air barrier including but not limited to those by air ducts, service lines, refrigerant lines, electrical wiring, and condensate drain lines shall be sealed to the air barrier with approved closure systems.

Exception: Air passageways into the closet from conditioned space that are specifically designed for return air flow.

Through-wall, through-floor and through-ceiling air passageways into the closet shall be framed and sealed to form an airtight passageway using approved air duct materials and approved closure systems.

Duct penetrations through any part of the ceiling, walls or floor of a mechanical closet shall have sufficient space between surrounding ceiling, walls or floor and any duct or plenum penetration to allow for sealing of the penetration and inspection of the seal.

Clothes washers, clothes dryers, combustion water heaters and atmospheric combustion furnaces shall not be located in mechanical closets used as return air plenums.

13-410.1.ABC.3.7.1 Approved air barriers. The following air barriers are approved for use in mechanical closets:

1. One-half inch (12.7 mm) thick or greater gypsum wallboard;
2. Other panelized materials having inward facing surfaces with an air porosity no greater than that of a duct product meeting Section 22 of UL 181 which are sealed on all interior surfaces to create a continuous air barrier.

13-410.1.ABC.3.7.2 Approved closure systems. The following closure systems are approved for use in mechanical closets:

1. Gypsum wallboard joint compound over taped joints between gypsum wallboard panels.
2. Sealants complying with the product and application standards of Section 410.1.ABC.3.2.1 for fibrous glass ductboard;
3. A suitable long-life caulk or mastic compliant with the locally adopted mechanical code for all applications.

13-410.1.ABC.3.8 Enclosed support platforms. Enclosed support platforms located between the return air inlet(s) from conditioned space and the inlet of the air handling unit or furnace, shall contain a duct section constructed entirely of rigid metal, rigid fibrous glass duct board, or flexible duct which is constructed and sealed according to the respective requirements of Section 410.1.ABC.3 and insulated according to the requirements of Section 410.1.ABC.2.

The duct section shall be designed and constructed so that no portion of the building structure, including adjoining walls, floors and ceilings, shall be in contact with the return air stream or function as a component of this duct section.

The duct section shall not be penetrated by a refrigerant line chase, refrigerant line, wiring, pipe or any object other than a component of the air distribution system.

Through-wall, through-floor and through-ceiling air passageways into the duct section shall contain a branch duct which is fabricated of rigid fibrous glass duct board or rigid metal and which extends to and is sealed to both the duct section and the grille side wall surface. The branch duct shall be fabricated and attached to the duct insert in accordance with Section 410.1.ABC.3.2 or Section 410.1.ABC.3.1 for the duct type used.

13-410.1.ABC.4 Air distribution system testing, adjusting, and balancing.

13-410.1.ABC.4.1 Duct leakage tests. Air distribution systems shall be tested, adjusted, and balanced by an engineer licensed in this state or a company or individual holding a current certification from a recognized testing and balancing organization.

Exceptions:

1. Buildings with cooling or heating system capacities of 15 tons or less per system may be tested and balanced by a mechanical contractor licensed to design and install such system(s).
2. Buildings with cooling or heating system capacities of 65,000 Btu/h or less per system are exempt from the requirements of this section.

13-410.1.ABC.4.2 General. Construction documents shall require that all HVAC systems be balanced in accordance with generally accepted engineering standards. Construction documents shall require that a written balance report be provided to the owner or the designated representative of the building owner for HVAC systems serving zones with a total conditioned area exceeding 5,000 square feet (465 m²).

13-410.1.ABC.4.3 Air system balancing shall be accomplished in a manner to first minimize throttling losses, then fan speed shall be adjusted to meet design flow conditions. Balancing procedures shall be in accordance with the National Environmental Balancing Bureau (NEBB) Procedural Standards, the Associated Air Balance Council (AABC) National Standards, or equivalent procedures.

Exception: Damper throttling may be used for air system balancing with fan motors of 1 hp or less, or if throttling results in no greater than $\frac{1}{3}$ hp fan horsepower draw above that required if the fan speed were adjusted.

NOTES:

1. Building envelope pressurization should be either neutral or positive to prevent infiltration of excess latent load.
2. Commercial kitchen hood exhaust cfm should be sized to prevent depressurization (see Section 409.1.ABC.2 and NFPA 96).

13-410.1.A Prescriptive requirements specific to Method A. Air distribution system efficiencies determined by the FLA/COM Method A performance calculation to demonstrate compliance with this code shall be the minimum performance level installed in buildings.

13-410.1.BC Prescriptive requirements specific to Methods B and C. Air distribution systems for buildings covered by Methods B and C shall meet the code minimums in Section 410.1.ABC.

13-410.2 Performance calculation procedures.

413-10.2.AB Calculation procedures for Methods A and B. Calculation procedures for determining air distribution compliance shall be in accordance with the procedures contained within Method A or B of the FLA/COM computer program.

Data shall be input into FLA/COM by zone by air-handling system type.

**SECTION 13-411
PUMPS AND PIPING**

13-411.1 Prescriptive requirements

13-411.1.ABC Basic prescriptive requirements for Methods A, B and C.

13-411.1.ABC.1 Hydronic system design and control. HVAC hydronic systems having a total pump system power exceeding 10 hp shall meet provisions of Sections 411.1.ABC.1.1 through 411.1.ABC.1.4.

13-411.1.ABC.1.1 Hydronic variable flow systems. HVAC pumping systems that include control valves designed to modulate or step open and close as a function of load shall be designed for variable fluid flow and shall be capable of reducing

pump flow rates to 50 percent or less of the design flow rate. Individual pumps serving variable flow systems having a pump head exceeding 100 feet (30 480 mm) and motor exceeding 50 hp shall have controls and/or devices (such as variable speed control) that will result in pump motor demand of no more than 30 percent of design wattage at 50 percent of design water flow. The controls or devices shall be controlled as a function of desired flow or to maintain a minimum required differential pressure. Differential pressure shall be measured at or near the most remote heat exchanger or the heat exchanger requiring the greatest differential pressure.

Exceptions:

1. Systems where the minimum flow is less than the minimum flow required by the equipment manufacturer for the proper operation of equipment served by the system, such as chillers, and where total pump system power is 75 hp or less.
2. Systems that include no more than three control valves.

13-411.1.ABC.1.2 Pump isolation. When a chilled water plant includes more than one chiller, provisions shall be made so that the flow in the chiller plant can be automatically reduced, correspondingly, when a chiller is shut down. Chillers referred to in this section, piped in series for the purpose of increased temperature differential, shall be considered as one chiller. When a boiler plant includes more than one boiler, provisions shall be made so that the flow in the boiler plant can be automatically reduced, correspondingly, when a boiler is shut down.

13-411.1.ABC.1.3 Chilled and hot water temperature reset controls. Chilled and hot water systems with a design capacity exceeding 300,000 Btu/h supplying chilled or heated water (or both) to comfort conditioning systems shall include controls that automatically reset supply water temperatures by representative building loads (including return water temperature) or by outside air temperature.

Exceptions:

1. Where the supply temperature reset controls cannot be implemented without causing improper operation of heating, cooling, humidifying, or dehumidifying systems.
2. Hydronic systems, such as those required by Section 411.1.ABC.1.1 that use variable flow to reduce pumping energy.

13-411.1.ABC.1.4 Hydronic (water loop) heat pump systems. Each hydronic heat pump shall have a two-position automatic valve interlocked to shut off water flow when the compressor is off.

13-411.1.ABC.2 Piping insulation. Piping shall be thermally insulated in accordance with Table 411.1.ABC.2

Exceptions:

1. Factory-installed piping within HVAC equipment tested and rated in accordance with Sections 407.1.ABC.3.2 and 408.1.ABC.3.2.1.
2. Piping that conveys fluids having a design operating temperature range between 60°F and 105°F (16°C and 41°C), inclusive.

3. Piping that conveys fluids that have not been heated or cooled through the use of nonrenewable energy (such as roof and condensate drains, domestic cold water supply, natural gas piping, or refrigerant liquid piping) or where heat gain or heat loss will not increase energy usage.

4. Hot water piping between the shutoff valve and the coil, not exceeding 4 feet (1219 mm) in length, when located in conditioned spaces.

5. Pipe unions in heating systems (steam, steam condensate, and hot water).

13-411.1.ABC.3 Construction and installation. Blank for numbering consistency.

13-411.1.ABC.4 Hydronic system testing, adjusting, and balancing. Hydronic systems shall be tested, adjusted and balanced by a company holding a current certification from a nationally recognized testing and balancing organization.

13-411.2 Performance calculation procedures. Blank for numbering consistency.

SECTION 13-412 WATER HEATING SYSTEMS

13-412.1 Prescriptive requirements.

13-412.1.ABC Basic prescriptive requirements for Methods A, B and C.

13-412.1.ABC.1 Water heater sizing and design. Service water heating system design loads for the purpose of sizing systems and equipment shall be determined in accordance with manufacturers' published sizing guidelines or generally accepted engineering standards and handbooks acceptable to the adopting authority (e.g., ASHRAE *Handbook—HVAC Applications*).

13-412.1.ABC.2 Service water heating system controls.

13-412.1.ABC.2.1 Temperature controls. Temperature controls shall be provided that allow for storage temperature adjustment from 120°F (49°C) or lower to a maximum temperature compatible with the intended use.

Exception: When the manufacturer's installation instructions specify a higher minimum thermostat setting to minimize condensation and resulting corrosion.

13-412.1.ABC.2.2 Temperature maintenance controls. Systems designed to maintain usage temperatures in hot water pipes, such as recirculating hot water systems or heat trace, shall be equipped with automatic time switches or other controls that can be set to switch off the usage temperature maintenance system during extended periods when hot water is not required.

13-412.1.ABC.2.3 Circulating pump controls. When used to maintain storage tank water temperature, recirculating pumps shall be equipped with controls limiting operation to a period from the start of the heating cycle to a maximum of 5 minutes after the end of the heating cycle.

13-412.1.ABC.2.4. Heat traps. Vertical pipe risers serving storage water heaters and storage tanks not having integral heat traps and serving a nonrecirculating system shall have heat

**TABLE 13-411.1.ABC.2
MINIMUM PIPE INSULATION (inches)¹**

Fluid Design Operating Temperature °F	Insulation Conductivity		Nominal Pipe or Tube Size (inches)					
	Conductivity Btu in/(h ft ² °°F)	Mean Temperature Rating	<1	1-1 ½	1 ½ to 4	4 to <8	≥8	
<i>Heating Systems (Steam, Steam Condensate, and Hot Water)^{2,3}</i>								
>350	0.32 - 0.34	250	2.5	3.0	3.0	4.0	4.0	
251 - 350	0.29 - 0.32	200	1.5	2.5	3.0	3.0	3.0	
201 - 250	0.27 - 0.30	150	1.5	1.5	2.0	2.0	2.0	
141 - 200	0.25 - 0.29	125	1.0	1.0	1.0	1.5	1.5	
105 - 140	0.22-0.28	100	0.5	0.5	1.0	1.0	1.0	
<i>Domestic and Service Hot Water Systems³</i>								
>105	0.22-0.28	100	0.5	0.5	1.0	1.0	1.0	
<i>Cooling Systems (Chilled Water, Brine, and Refrigerant)⁴</i>								
40 - 60	0.22-0.28	100	0.5	0.5	1.0	1.0	1.0	
<40	0.22-0.28	100	0.5	1.0	1.0	1.0	1.5	

- For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows:
 $T = r(1+t/r)^{K/k} - 1$
 Where T = minimum insulation thickness (inches), r = actual outside radius of pipe (inches), t = insulation thickness listed in this table for applicable fluid temperature and pipe size, K = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu. inches [h · ft² · °°F]); and k = upper value of the conductivity range listed in this table for applicable fluid temperature.
- These thicknesses are based on energy efficiency considerations only. Additional insulation is sometimes required relative to safety issues/surface temperatures.
- Piping insulation is not required between the control valve and coil on run-outs when the control valve is located within 4 feet of the coil and the pipe size is inches or less.
- These thicknesses are based on energy efficiency considerations only. Issues such as water vapor permeability or surface condensation sometimes require vapor retarders or additional insulation.

traps on both the inlet and outlet piping as close as practical to the storage tank. A heat trap is a means to counteract the natural convection of heated water in a vertical pipe run. The means is either a device specifically designed for the purpose or an arrangement of tubing that forms a loop of 360 degrees or piping that from the point of connection to the water heater (inlet or outlet) includes a length of piping directed downward before connection to the vertical piping of the supply water or hot water distribution system, as applicable.

13-412.1.ABC.2.5. Water flow rate controls.

13-412.1.ABC.2.5.1 Showers. Showers used for other than safety reasons shall be equipped with flow control devices to limit the water discharge to a maximum of 2.5 gpm (.16 L/S) per shower head at a distribution pressure of 80 psig (552 kPa) when tested in accordance with the procedures of ANSI A112.18.1M. Flow restricting inserts used as a component part of a shower-head shall be mechanically retained at the point of manufacture.

13-412.1.ABC.2.5.2 Lavatories or restrooms of public facilities. Lavatories or restrooms of public facilities shall:

- Be equipped with outlet devices which limit the flow of hot water to a maximum of 0.5 gpm (.03 L/s) or be equipped with self-closing valves that limit delivery to a per cycle maximum of 0.25 gallons (.95 L) of hot water for recirculating systems and to a maximum of 0.50 gallons (1.9 L) for nonrecirculating systems.

Exception: Separate lavatories for physically handicapped persons shall not be equipped with self-closing valves.

- Be equipped with devices which limit the outlet temperature to a maximum of 110°F (43°C).
- Meet the provisions of 42 CFR 6295 (k), *Standards for Water Closets and Urinals.*

13-412.1.ABC.2.6 Swimming pool and spa temperature controls.

13-412.1.ABC.2.6.1 Time switches. Time switches shall be installed on swimming pool heaters and pumps.

Exceptions:

- Where public health standards require 24-hour pump operation.
- Where pumps are required to operate solar and waste heat recovery pool heating systems.

13-412.1.ABC.2.6.2 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 (32°C) shall have a pool cover with a minimum insulation value of R-12.

Exception: Pools deriving over 60 percent of the energy for heating from site-recovered energy or solar energy source.

13-412.1.ABC.2.6.3 Pool heaters. Pool heaters shall be equipped with a readily accessible on-off switch to allow shutting off the heater without adjusting the thermostat setting. Pool heaters fired by natural gas shall not have continuously burning pilot lights.

13-412.1.ABC.3 Equipment performance standards.

13-412.1.ABC.3.1 Equipment efficiency. All water heating equipment, hot water supply boilers used solely for heating potable water, pool heaters, and hot water storage tanks shall meet the criteria listed in Table 412.1.ABC.3. Where multiple criteria are listed, all criteria shall be met. Omission of minimum performance requirements for certain classes of equipment does not preclude use of such equipment where appropriate.

Equipment not listed in Table 412.1.ABC.3 has no minimum performance requirements.

Exception: All water heaters and hot water supply boilers having more than 140 gallons (530 L) of storage capacity are not required to meet the standby loss (SL) requirements of Table 412.1.ABC.3 when:

**TABLE 13-412.1.ABC.3
PERFORMANCE REQUIREMENTS FOR WATER HEATING EQUIPMENT**

Equipment Type	Size Category (input)	Subcategory or Rating Condition	Performance Required ¹	Test Procedure ²
Electric Water Heaters	≤12kW	Resistance ≥20 gal	0.97-0.00132V EF	DOE 10 CFR Part 430 ³
	≥12 kW	Resistance	20+35 √V SL, Btu/h	ANSI Z21.10.3
Gas Storage Water Heaters	≤24 Amps & ≤250Volts	Heat Pump	0.93-0.00132V EF	DOE 10 CFR Part 430 ³
	≤75,000 Btu/h	≥20 gal	0.67-0.0019V EF	DOE 10 CFR Part 430 ³
Gas Instantaneous Water Heaters	>75,000 Btu/h and	<4,000 (Btu/h)/gal	80 percent E _t (Q/800+110√V) SL, Btu/h	ANSI Z21.10.3
	>50,000 Btu/h and <200,000 Btu/h ⁴	≥4,000 (Btu/h)/gal and < 2 gal	0.62-0.0019V EF	DOE 10 CFR Part 430
Heat Pump Pool Heaters	All	≥4,000 (Btu/h)/gal and <10 gal	80 percent E _t	ANSI Z21.10.3
		>200,000 Btu/h	80 percent E _t (Q/800+110√V) SL, Btu/h	
Oil Storage Water Heaters	≤105,000 Btu/h	≥20 gal	4.0 COP At low air temperature	ARI 1160 ⁵
Oil Instantaneous Water Heaters	>105,000 Btu/h	<4,000 (Btu/h)/gal	0.59-0.0019V EF	DOE 10 CFR Part 430 ³
	≤210,000 Btu/h	≥4,000 (Btu/h)/gal and <2 gal	78 percent E _t (Q/800+100√V) SL, Btu/h	ANSI Z21.10.3
Hot Water Supply Boilers, Gas and Oil	>210,000 Btu/h	≥4,000 (Btu/h)/gal and <10 gal	0.59-0.0019V EF	DOE 10 CFR Part 430
	>210,000 Btu/h	≥4,000 (Btu/h)/gal and >10 gal	80 percent E _t	ANSI Z21.10.3
Hot Water Supply Boilers, Gas	≤300,000 Btu/h and <12,500,000 Btu/h	≥4,000 (Btu/h)/gal and <10 gal	78 percent E _t (Q/800+110√V) SL, Btu/h	ANSI Z21.10.3
Hot Water Supply Boilers, Gas		≥4000 (Btu/h)/gal and >10 Gal	80 percent E _t (Q/800+110√V) SL, Btu/h	ANSI Z21.10.3
Hot Water Supply Boilers, Oil		≥4000 (Btu/h)/gal and >10 Gal	78 percent E _t (Q/800+110√V) SL, Btu/h	
Pool Heaters, Oil and Gas	All		80 percent E _t	ASHRAE 146
Unfired Storage Tanks	All		R-12.5	(none)

For SI: 1Btu/h = .2931W, °C = [(°F) - 32]/1.8

1. Energy factor (ER) and thermal efficiency (Et) are minimum requirements, while standby loss (SL) is maximum Btu/h based on a 70°F temperature difference between stored water and ambient requirements. In the EF equation, V is the rated volume in gallons. In the SL equation, V is the rated volume in gallons and Q is the nameplate input rate in Btu/h.
2. Subchapter 13-3 contains a complete specification, including year version, of the referenced test procedure.
3. Electric, gas and oil water heaters' EF ratings in the residential size range are the same as those found in Table 612.1.ABC.3.2 of this code.
4. Instantaneous water heaters with input rates below 200,000 Btu/h must comply with these requirements if the water heater is designed to heat water to temperatures 180°F or higher.
5. Test reports from independent laboratories are required to verify procedure compliance.

1. The tank surface is thermally insulated to R-12.5,
2. A standing pilot light is not installed,
3. Gas- or oil-fired storage water heaters have a flue damper or fan-assisted combustion.

13-412.1.ABC.3.4 Combination service water heating and space heating equipment.

13-412.1.ABC.3.4.1 Space heating and water heating. The use of a gas-fired or oil-fired space heating boiler system otherwise complying with Section 408.1.ABC.3 to provide the total space heating and water heating for a building is allowed when one of the following conditions is met.

1. The single space heating boiler, or the component of a modular or multiple boiler system that is heating the service water, has a standby loss in Btu/h not exceeding $(13.3 \times pmd + 400) / n$ where *pmd* is the probable maximum demand in gal/h, determined in accordance with the procedures described in generally accepted engineering standards and handbooks, and *n* is the fraction of the year when the outdoor daily mean temperature is greater than 64.9°F (18°C). The standby loss is to be determined for a test period of 24 hours duration while maintaining a boiler water temperature of at least 90°F (90°C) above ambient, with an ambient temperature between 60°F and 90°F (16°C and 32°C). For a boiler with a modulating burner, this test shall be conducted at the lowest input.
2. It is demonstrated to the satisfaction of the building official that the use of a single heat source will consume less energy than separate units.
3. The energy input of the combined boiler and water heater system is less than 150,000 Btu/h (720 m²/kW).

13-412.1.ABC.3.4.2 Service water heating equipment. Service water heating equipment used to provide the additional function of space heating as part of a combination (integrated) system shall satisfy all stated requirements for the service water heating equipment.

13-412.1.ABC.3.4.3 Combination water and space heating systems. Combination water and space heating systems with input ratings of less than 105,000 Btu/h shall utilize a water heater listed by the Gas Appliance Manufacturer's Association (GAMA). Changeouts of burners to increase capacity shall not be made unless the unit has been listed at that capacity by GAMA.

13-412.1.ABC.4 Service hot water piping insulation. The following piping shall be insulated to levels shown in Table 411.1.ABC.2:

1. Recirculating system piping, including the supply and return piping of a circulating tank type water heater.
2. The first 8 feet (2438 mm) of outlet piping for a constant temperature nonrecirculating storage system.
3. The inlet pipe between the storage tank and a heat trap in a nonrecirculating storage system.
4. Pipes that are externally heated (such as heat trace or impedance heating).

13-412.1.A Prescriptive requirements specific to Method A. Water heater efficiencies determined by the FLA/COM

Method A performance calculation to demonstrate compliance with this code shall be the minimum performance level installed in buildings.

13-412.1.BC Prescriptive requirements specific to Methods B and C. Blank for numbering consistency.

13-412.2 Performance calculation procedures.

13-412.2.A Performance calculation procedures specific to Method A. Calculation procedures for determining water heating compliance shall be in accordance with the procedures contained within Method A of the FLA/COM computer program.

Data shall be input into FLA/COM by zone by water heater type, volume and efficiency.

SECTION 13-413 ELECTRIC POWER

13-413.0 Applicability. This section applies to all building power distribution systems. The provisions for electrical distribution for all sections of this Code are subject to the applicable Florida Public Service Commission rules regarding electric utilities set forth in Chapter 25-6, *Florida Administrative Code*, and the design conditions in ASHRAE 90.1.

13-413.1 Prescriptive requirements.

13-413.1.ABC—Basic Prescriptive requirements for Methods A, B and C.

13-413.1.ABC.1 Voltage drop.

13-413.1.ABC.1.1 Feeders. Feeder conductors shall be sized for a maximum voltage drop of 2 percent at design load.

13-413.1.ABC.1.2 Branch circuits. Branch circuit conductors shall be sized for a maximum voltage drop of 3 percent at design load.

13-413.1.ABC.2 Completion requirements.

13-413.1.ABC.2.1 Drawings. Construction documents shall require that within 30 days after the date of system acceptance, record drawings of the actual installation shall be provided to the building owner, including:

1. A single-line diagram of the building electrical distribution system and
2. Floor plans indicating location and area served for all distribution.

13-413.1.ABC.2.2 Manuals. Construction documents shall require that an operating manual and maintenance manual be provided to the building owner. The manuals shall include, at a minimum, the following:

1. Submittal data stating equipment rating and selected options for each piece of equipment requiring maintenance.
2. Operation manuals and maintenance manuals for each piece of equipment requiring maintenance. Required routine maintenance actions shall be clearly identified.
3. Names and addresses of at least one qualified service agency.

NOTE: Enforcement agencies should only check to be sure that the construction documents require this information to

be transmitted to the owner and should not expect copies of any of the materials.

13-413.2 Performance calculation procedures. Blank for numbering consistency.

**SECTION 13-414
MOTORS**

13-414.0 Applicability. All permanently wired electric motors shall meet the requirements of Section 414.1.ABC.1.

13-414.1 Prescriptive requirements.

13-414.1.ABC Basic prescriptive requirements for Methods A, B and C.

13-414.1.ABC.1 Electric motors. Electric motors shall comply with the requirements of the Energy Policy Act of 1992 where applicable, as shown in Table 414.1.ABC.1. Motors that are not included in the scope of the Energy Policy Act have no performance requirements in this section.

414.2 Performance calculation procedures. Blank for numbering consistency.

**SECTION 13-415
LIGHTING**

13-415.0 Applicability. Lighting systems and equipment shall comply with the requirements of 415.1.ABC and applicable re-

quirements of Section 415.2. This section shall apply to the following:

1. Interior spaces of buildings;
2. Exterior building features, including facades, illuminated roofs, architectural features, entrances, exits, loading docks, and illuminated canopies; and
3. Exterior building grounds lighting provided through the building's electrical service.

Exceptions:

1. Emergency lighting that is automatically off during normal building operation,
2. Lighting within living units,
3. Lighting that is specifically designated as required by a health or life safety statute, ordinance, or regulation,
4. Decorative gas lighting systems.

13-415.1 Prescriptive requirements.

13-415.1.ABC Basic prescriptive requirements for Methods A, B-and C.

13-415.1.ABC.1 Controls.

13-415.1.ABC.1.1 Automatic lighting shutoff. Interior lighting in buildings larger than 5,000 square feet (465 m²) shall be controlled with an automatic control device to shut off building

**TABLE 13-414.1.ABC.1
MINIMUM NOMINAL EFFICIENCY FOR GENERAL PURPOSE Design A and Design B**

Number of Poles	Minimal Nominal Full-Load Efficiency (percent)					
	Open Motors			Enclosed Motors		
	2	4	6	2	4	6
Synchronous speed (RPM)	3600	1800	1200	3600	1800	1200
Motor Horsepower						
1.0	—	82.5	80.0	75.5	82.5	80.0
1.5	82.5	84.0	85.5	82.5	84.0	84.0
2.0	84.0	84.0	86.5	84.0	84.0	85.5
3.0	84.0	87.5	87.5	85.5	86.5	86.5
5.0	85.5	87.5	87.5	87.5	87.5	87.5
7.5	87.5	89.5	89.5	88.5	88.5	88.5
10.0	88.5	89.5	89.5	89.5	89.5	90.2
15.0	89.5	91.0	90.2	90.2	91.0	90.2
20.0	90.2	91.0	90.2	90.2	91.0	91.0
25.0	91.0	92.4	91.7	91.0	91.7	91.7
30.0	91.0	92.4	91.7	91.0	92.4	92.4
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	94.5	94.1	93.6	94.1	94.1
125.0	93.6	94.5	94.1	94.5	94.5	94.1
150.0	93.6	95.0	95.0	94.5	95.0	94.5
200.0	94.5	95.0	95.0	95.0	95.0	94.5

lighting in all spaces. This automatic control device shall function on either:

1. A scheduled basis using a time-of-day operated control device that turns lighting off at specific programmed times—an independent program schedule shall be provided for areas of no more than 25,000 square feet (2323 m²) but not more than one floor.
2. An occupant sensor that shall turn lighting off within 30 minutes of an occupant leaving a space.
3. A signal from another control or alarm system that indicates the area is unoccupied.

Exceptions: The following shall not require an automatic control device.

- a. Lighting intended for 24-hour operation.
- b. Lighting in spaces where patient care is rendered.
- c. Spaces where an automatic shutoff would endanger the safety or security of the room's or building's occupant(s).

13-415.1.ABC.1.2 Space control. Each space enclosed by ceiling-height partitions shall have at least one control device to independently control the general lighting within the space. Each manual device shall be readily accessible and located so the occupants can see the controlled lighting.

- a. A control device shall be installed that automatically turns lighting off within 30 minutes of all occupants leaving a space, except spaces with multiscene control, in the following:
 1. Classrooms (not including shop classrooms, laboratory classrooms, and preschool through 12th grade classrooms).
 2. Conference/meeting rooms.
 3. Employee lunch and break rooms.

These spaces are not required to be connected to other automatic lighting shutoff controls.

- b. For all other spaces, each control device shall be activated either manually by an occupant or automatically by sensing an occupant. Each control device shall control a maximum of 2,500 square feet (232 m²) area for a space 10,000 square feet (929 m²) or less; and a maximum of 10,000 square feet (929 m²) area for a space greater than 10,000 square feet (929 m²); and be capable of overriding any time-of-day scheduled shut-off control for no more than 4 hours.

Exception: Remote location shall be permitted for reasons of safety or security when the remote control device has an indicator pilot light as part of or next to the control device, and the light is clearly labeled to identify the controlled lighting.

13-415.1.ABC.1.3 Additional controls. Controls are required in the following cases:

1. Display or accent lighting. Display or accent lighting shall have a separate control.
2. Case lighting. Lighting in cases used for display purposes shall have a separate control device.
3. Hotel and motel guest room lighting. Hotel and motel guest rooms and guest suites shall have a master control de-

vice at the main room entry that controls all permanently installed luminaires and switched receptacles.

4. Task lighting. Supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting, shall have a control device integral to the luminaires or be controlled by a wall-mounted control device provided the control device is readily accessible and located so that the occupant can see the controlled lighting.

5. Nonvisual lighting. Lighting for nonvisual applications, such as plant growth and food warming, shall have a separate control device.

6. Demonstration lighting. Lighting equipment that is for sale or for demonstrations in lighting education shall have a separate control device.

13-415.1.ABC.1.4 Exterior lighting control. Lighting for all exterior applications not exempted in Section 415.0 shall have automatic controls capable of turning off exterior lighting when sufficient daylight is available, or when the lighting is not required during nighttime hours. Lighting not designated for dusk-to-dawn operation shall be controlled by an astronomical time switch. Lighting designated for dusk-to-dawn operation shall be controlled by an astronomical time switch or photosensor. Astronomical time switches shall be capable of retaining programming and the time setting during loss of power for a period of at least 10 hours.

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

13-415.1.ABC.2 Exterior building grounds lighting. All exterior building grounds luminaires that operate at greater than 100 watts shall contain lamps having a minimum efficacy of 60 lm/W unless the luminaire is controlled by a motion sensor or qualifies for one of the exceptions under Sections 415.0 and 415.2.ABC.1.3.

13-415.1.ABC.3 Tandem wiring. Luminaires designed for use with one or three linear fluorescent lamps >30W each shall use two-lamp tandem-wired ballasts in place of single lamp ballasts when two or more luminaires are in the same space and on the same control device.

Exceptions:

1. Recessed luminaires more than 10 feet (3048 mm) apart measured center to center.
2. Surface-mounted or pendant luminaires that are not continuous.
3. Luminaires using single-lamp high-frequency electronic ballasts.
4. Luminaires using three-lamp high-frequency electronic or three-lamp electromagnetic ballasts.
5. Luminaires on emergency circuits.
6. Luminaires with no available pair.

13-415.1.ABC.4 Exit signs. Internally illuminated exit signs shall not exceed 5 watts per face.

13-415.1.AB.1 Calculations. All calculations and determinations of parameters used in the demonstration of compliance

with this code by Methods A or B shall be conducted according to Section 415.2.

13-415.1.A Prescriptive requirements specific to Method A. Lighting levels and types determined by the FLA/COM Method A performance calculation to demonstrate compliance with this code shall be the maximum performance levels installed for lighting.

13-415.1.B Prescriptive requirements specific to Method B. Lighting levels and types determined by the FLA/COM Method B performance calculation to demonstrate compliance with this code shall be the maximum performance levels installed for lighting (see Section 415.2.B).

13-415.1.C Prescriptive requirements specific to Method C. See Section 415.2.C.

13-415.2 Performance calculation procedures.

13-415.2.ABC.1 Performance calculation procedures, General. The interior lighting power allowance for a building or a separately metered or permitted portion of a building shall be determined by either the building area method described in Section 415.2.C.1 or the space-by-space method described in Section 415.2.B.1. Trade-offs of interior lighting power allowance among portions of the building for which a different method of calculation has been used are not permitted. The installed interior lighting power identified in accordance with Section 415.2.ABC.1.1 shall not exceed the interior lighting power allowance developed in accordance with Section 415.2.C.1 or 415.2.B.1

Exceptions: The following lighting equipment and applications shall not be considered when determining the interior lighting power allowance developed in accordance with Sections 415.2.C.1 or 415.2.B.1, nor shall the wattage for such lighting be included in the installed interior lighting power identified in accordance with Section 415.2.ABC.1.1. However, any such lighting shall not be exempt unless it is an addition to general lighting and is controlled by an independent control device.

1. Display or accent lighting that is an essential element for the function performed in galleries, museums, and monuments.
2. Lighting that is integral to equipment or instrumentation and is installed by its manufacturer.
3. Lighting specifically designed for use only during medical or dental procedures and lighting integral to medical equipment.
4. Lighting integral to both open and glass enclosed refrigerator and freezer cases.
5. Lighting integral to food warming and food preparation equipment.
6. Lighting for plant growth or maintenance.
7. Lighting in spaces specifically designed for use by the visually impaired.
8. Lighting in retail display windows, provided the display area is enclosed by ceiling-height partitions.
9. Lighting in interior spaces that have been specifically designated as a registered interior historic landmark.

10. Lighting that is an integral part of advertising or directional signage.

11. Exit signs.

12. Lighting that is for sale or lighting educational demonstration systems.

13. Lighting for theatrical purposes, including performance, stage, and film and video production.

14. Lighting for television broadcasting in sporting activity areas.

15. Casino gaming areas.

13-415.2.ABC.1.1 Installed interior lighting power. The installed interior lighting power shall include all power used by the luminaires, including lamps, ballasts, current regulators, and control devices except as specifically exempted in Section 415.2.ABC.1.

Exception: If two or more independently operating lighting systems in a space are capable of being controlled to prevent simultaneous user operation, the installed interior lighting power shall be based solely on the lighting system with the highest wattage

13-415.2.ABC.1.2 Luminaire wattage. Luminaire wattage incorporated into the installed interior lighting power shall be determined in accordance with the following criteria:

1. The wattage of incandescent or tungsten-halogen luminaires with medium screw base sockets and not containing permanently installed ballasts shall be the maximum labeled wattage of the luminaire.
2. The wattage of luminaires with permanently installed or remote ballasts or transformers shall be the operating input wattage of the maximum lamp/auxiliary combination based on values from the auxiliary manufacturer's literature or recognized testing laboratories.
3. The wattage of line-voltage lighting track and plug-in busway that allow the addition and/or relocation of luminaires without altering the wiring of the system shall be the specified wattage of the luminaires included in the system with a minimum of 30 watts per linear foot.
4. The wattage of low-voltage lighting track, cable conductor, rail conductor, and other flexible lighting systems that allow the addition and/or relocation of luminaires without altering the wiring of the system shall be the specified wattage of the transformer supplying the system.
5. The wattage of all other miscellaneous lighting equipment shall be the specified wattage of the lighting equipment.

13-415.2.ABC.1.3 Exterior building lighting power. The total exterior lighting power allowance for all exterior building applications is the sum of the individual lighting power densities permitted in Table 415.2.ABC.1.3 for these applications, plus an additional unrestricted allowance of 5 percent of that sum. Trade-offs are allowed only among exterior lighting applications listed in the Table 13-415.2.ABC.1.3, "Tradable Surfaces" section. Exterior lighting for all applications (except those included in the exceptions to Sections 415.0 and 415.2.ABC.1.3) shall comply with the requirements of Section 415.1.ABC.2.

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

- (a) specialized signal, directional, and marker lighting associated with transportation;
- (b) advertising signage or directional signage;
- (c) Lighting that is integral to equipment or instrumentation and is installed by its manufacturer;
- (d) Lighting for theatrical purposes, including performance, stage, film and video production;
- (e) Lighting for athletic playing areas;
- (f) Temporary lighting;
- (g) Lighting for industrial production, material handling, transportation sites and associated storage areas;
- (h) Theme elements in theme/amusement parks; and
- (i) Lighting used to highlight features of public monuments and registered historic landmark structures or buildings.

13-415.2.A Performance calculation procedures specific to Method A. Calculation procedures for Method A shall be those incorporated in the FLA/COM program for Method A compliance.

13-415.2.B Performance calculation procedures specific to Method B. Calculation procedures for Method B shall be those incorporated in the FLA/COM program for Method B compliance.

13-415.2.B.1 Space-by-space method of calculating interior lighting power allowance. FLA/COM uses the following steps to determine the interior lighting power allowance by the space-by-space method.

1. Determine the appropriate building type from Table 415.2.B. For building types not listed, selection of a reasonably equivalent type shall be permitted.
2. For each space enclosed by partitions 80 percent or greater than ceiling height, determine the gross interior floor area by measuring to the center of the partition wall. Include the floor area of balconies or other projections. Retail spaces do not have to comply with the 80-percent partition height requirements.
3. Determine the interior lighting power allowance by using the columns designated space-by-space method in Table 415.2.B. Multiply the floor area(s) of the space(s) times the allowed lighting power density for the space type that most closely represents the proposed use of the space(s). The product is the lighting power allowance for the space(s). For space types not listed, selection of a reasonable equivalent category shall be permitted.
4. The interior lighting power allowance is the sum of lighting power allowances of all spaces. Trade-offs among spaces are permitted provided that the total installed interior lighting power does not exceed the interior lighting power allowance.

**TABLE 13-415.2.ABC.1.3
LIGHTING POWER DENSITIES FOR BUILDING EXTERIORS**

APPLICATIONS	LIGHTING POWER DENSITIES
Tradable Surfaces (Lighting Power Densities for uncovered parking areas, building grounds, building entrances and exits, canopies and overhangs, and outdoor sales areas may be traded.)	
Uncovered Parking Areas	
Parking lots and drives	0.15 W/ft ²
Building Grounds	
Walkways less than 10 feet wide	1.0 watts per linear foot
Walkways 10 feet wide or greater, plaza areas, and special feature areas	0.2 W/ft ²
Stairways	1.0 W/ft ²
Building Entrances and Exits	
Main entries	30 watts per linear foot of door width
Other doors	20 watts per linear foot of door width
Canopies and Overhangs	
Canopies (free-standing and attached) and overhangs	1.25 W/ft ²
Outdoor Sales	
Open areas (including vehicle sales lots)	0.5 W/ft ²
Street frontage for vehicle sales lots in addition to "open area" allowance	20 watts per linear foot
Nontradable Surfaces (Lighting Power Density calculations for the following applications can be used only for the specific application and cannot be traded between surfaces or with other exterior lighting. The following allowances are in addition to any allowance otherwise permitted in the "Tradable Surfaces" section of this table.)	
Building facades	0.2 W/ft ² for each illuminated wall or surface or 5.0 watts per linear foot for each illuminated wall or surface length
Automated teller machines and night depositories	270 watts per location plus 90 watts per additional ATM per location
Entrances and gatehouse inspection stations at guarded facilities	1.25 W/ft ² of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")
Loading areas for law enforcement, fire, ambulance and other emergency service vehicles	0.5 W/ft ² of uncovered area (covered areas are included in the Canopies and Overhangs" section of "Tradable Surfaces")
Drive-up windows at fast food restaurants	400 watts per drive-through
Parking near 24-hour retail entrances	800 watts per main entry

**TABLE 13-415.2.B
LIGHTING POWER DENSITIES USING THE SPACE-BY-SPACE METHOD**

Space-by-Space Method Lighting Power Density (LPD)			
Common Space Types ¹	LPD (W/ft ²)	Building Specific Space Types (Continued)	LPD (W/ft ²)
Office—enclosed	1.1	Fire stations	
Office—open plan	1.1	Fire station engine room	0.8
Conference/Meeting/Multipurpose	1.3	Sleeping quarters	0.3
Classroom/Lecture/Training	1.4	Post Office—sorting area	1.2
for Penitentiary	1.3	Convention center—exhibit space	1.3
Lobby	1.3	Library	
for Hotel	1.1	Card file & cataloging	1.1
for Performing arts theater	3.3	Stacks	1.7
for Motion picture theater	1.1	Reading area	1.2
Audience/seating area	0.9	Hospital	
for Gymnasium	0.4	Emergency	2.7
for Exercise center	0.3	Recovery	0.8
for Convention center	0.7	Nurse station	1.0
for Penitentiary	0.7	Exam/Treatment	1.5
for Religious buildings	1.7	Pharmacy	1.2
for Sports arena	0.4	Patient room	0.7
for Performing arts theater	2.6	Operating room	2.2
for Motion picture theater	1.2	Nursery	0.6
for Transportation	0.5	Medical supply	1.4
Atrium—first three floors	0.6	Physical therapy	0.9
Atrium—each additional floor	0.2	Radiology	0.4
Lounge/Recreation	1.2	Laundry/Washing	0.6
for Hospital	0.8	Automotive—Service/Repair	0.7
Dining area	0.9	Manufacturing	
for Penitentiary	1.3	Low bay (<25 ft floor to ceiling height)	1.2
for Hotel	1.3	High bay (>25 ft floor to ceiling height)	1.7
for Motel	1.2	Detailed manufacturing	2.1
for Bar lounge/Leisure dining	1.4	Equipment room	1.2
for Family dining	2.1	Control room	0.5
Food preparation	1.2	Hotel/Motel guest rooms	1.1
Laboratory	1.4	Dormitory—Living quarters	1.1
Restrooms	0.9	Museum	
Dressing/Locker/Fitting room	0.6	General exhibition	1.0
Corridor/Transition	0.5	Restoration	1.7
for Hospital	1.0	Bank/Office—banking activity area	1.5
for Manufacturing facility	0.5	Religious buildings	
Stairs—active	0.6	Worship—pulpit, choir	2.4
Active storage	0.8	Fellowship hall	0.9
for Hospital	0.9	Retail (for accent lighting see Sec. 415.2.B.2)	
Inactive storage	0.3	Sales area	1.7
for Museum	0.8	Mall concourse	1.7
Electrical/mechanical	1.5	Sports arena	
Workshop	1.9	Ring sports area	2.7
		Court sports area	2.3
		Indoor playing field area	1.4
Building Specific Space Types			
Gymnasium/Exercise center		Warehouse	
Playing area	1.4	Fine material storage	1.4
Exercise area	0.9	Medium/bulky material storage	0.9
Courthouse/Police station/Penitentiary		Parking garage—garage area	0.2
Courtroom	1.9	Transportation	
Confinement cells	0.9	Airport—concourse	0.6
Judges chambers	1.3	Air/Train/Bus—Baggage area	1.0
		Terminal—Ticket counter	1.5

For SI: 1 foot = 304.8 mm.

1. In cases where both a common space type and a building specific space type are listed, the building specific space type shall apply.

13-415.2.B.2 Additional interior lighting power. When using the space-by-space method, an increase in the interior lighting power allowance is allowed for specific lighting functions. Additional power shall be allowed only if the specified lighting is installed, shall be used only for the specified luminaires, and shall not be used for any other purpose or in any other space. An increase in the interior lighting power allowance is permitted in the following cases:

1. For spaces in which lighting is specified to be installed in addition to the general lighting for the purpose of decorative appearance, such as chandelier-type luminaires or sconces or for highlighting art or exhibits, provided that the additional lighting power shall not exceed 1.0 watts per square foot of such spaces.

2. For spaces in which lighting is specified to be installed to meet the requirements of visual display terminals as the primary viewing task, provided that the additional lighting power shall not exceed 0.35 watts per square foot of such spaces and that the specified luminaire meets requirements for use in such spaces. Maximum average luminance measured from the vertical in candelas per square foot of not more than 80 cd/ft² at 65 degrees, 33 cd/ft² at 75 degrees, and 17 cd/ft² at 85 to 90 degrees.

3. For lighting equipment installed in retail spaces that is specifically designed and directed to highlight merchandise, provided that the additional lighting power shall not exceed

(1) 1.6 watts per square foot times the area of specific display or

(2) 3.9 watts per square foot times the area of specific display for valuable merchandise, such as jewelry, fine apparel and accessories, china and silver, art, and similar items, where detailed display and examination of merchandise are important.

13-415.2.C Performance calculation procedures specific to Method C.

13-415.2.C.1 Building area method of calculating interior lighting power allowance. Use the following steps to determine the interior lighting power allowance by the building area method:

1. Determine the appropriate building area type from Table 415.2.C.1 and the allowed lighting power density (watts per unit area) from the building area method column. For building area types not listed, selection of a reasonably equivalent type shall be permitted.

2. Determine the gross lighted floor area (square feet) of the building area type.

3. Multiply the gross lighted floor areas of the building area type(s) times the lighting power density.

4. The interior lighting power allowance for the building is the sum of the lighting power allowances of all building area types. Trade-offs among building area types are permitted provided that the total installed interior lighting power does not exceed the interior lighting power allowance.

**TABLE 13-415.2.C.1
LIGHTING POWER DENSITIES USING
THE BUILDING AREA METHOD**

Building Area Type ¹	Lighting Power Density (W/ft ²)
Automotive Facility	0.9
Convention Center	1.2
Court House	1.2
Dining: Bar Lounge/Leisure	1.3
Dining: Cafeteria/Fast Food	1.4
Dining: Family	1.6
Dormitory	1.0
Exercise Center	1.0
Gymnasium	1.1
Health Care—Clinic	1.0
Hospital	1.2
Hotel	1.0
Library	1.3
Manufacturing Facility	1.3
Motel	1.0
Motion Picture Theater	1.2
Multiple-Family	0.7
Museum	1.1
Office	1.0
Parking Garage	0.3
Penitentiary	1.0
Performing Arts Theater	1.6
Police/Fire Station	1.0
Post Office	1.1
Religious Building	1.3
Retail	1.5
School/University	1.2
Sports Arena	1.1
Town Hall	1.1
Transportation	1.0
Warehouse	0.8
Workshop	1.4

1. In cases where both general building area type and a specific building area type are listed, the specific building area type shall apply.

FLOIDA BUILDING CODE

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