SUBCHAPTER 13-4
COMMERCIAL BUILDING
COMPLIANCE METHODS

SECTION 13-400
ADMINISTRATION

13-400.0 Scope, Methods of compliance. The provisions of this chapter apply to all new commercial occupancy buildings, additions to existing commercial occupancy buildings, and multifamily 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.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 EnergyGauge Summit --Fla/Com-2007 computer program and are as described in Appendix 13-B. Basic prescriptive requirements described in the sections called Mandatory 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 Tradeoff Method. This is a computer-based calculation methodology. The *building envelope* complies with the standard if the proposed building meets the Mandatory 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 Summit-- Fla/Com 2007 computer program and the procedures specified for each envelope component under compliance Method B.

13-400.0.C Method C, the Buildings Prescriptive Envelope Method. This method requires that prescriptive requirements listed on Form 400C for the building's location for a given building type be met or exceeded to comply with this code.

Buildings complying by Method C by using the EnergyGauge Summit Fla/Com computer program shall be compared to a Baseline set for one of the following building categories:

Office buildings up to 20,000 square feet;
Retail buildings up to 20,000 square feet;
K-12 school Buildings;
all other buildings (separate Baselines for ASHRAE Climate Zones 1 and 2).

Baseline sets for these categories are as shown in Tables B5.1 through B-5.5 in Appendix 13-B of this Chapter.

All buildings complying by Method C using Form 400C$_{\text{All Climate Zones}}$ shall meet the same set of minimum criteria as contained on the form.

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 *semi-exterior 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 40 ~~50~~ percent of the *gross wall area* for each *space-conditioning category* and

(b) the *skylight fenestration area* does not exceed 5% 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 semi-heated or unconditioned, and if compliance Method A is used for such spaces, then Method C also specifies requirements for the semi-exterior 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 > 3 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 *semi-heated* or *unconditioned*, and if alternative compliance is sought for such spaces, then all *semi-heated* or *unconditioned* spaces shall be clearly indicated on the floor plan as such, and the following *semi-exterior 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 Envelope requirements. Building envelope components shall meet the efficiencies shown on Form 400C for the building's location.

13-400.0.C.3.1 Insulation. Where insulation is utilized to meet a given building component on Form 400C, it shall comply with the requirements found in Appendix 13-B for that component.

13-400.0.C.3.2 Maximum U-factor, C-factor, F-factor. In lieu of complying with the minimum rated R-value of insulation for the insulation alone, compliance shall be shown with the maximum U-factor, C-factor, or F-factor for the entire assembly for the component. 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 13-202), meet the efficiencies listed on Form 400C for components being changed or shall comply with the envelope or systems criteria in Method B of EnergyGauge Summit 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 Mandatory minimum efficiencies listed in this code for the system(s) being changed.

13-400.1 Types of Requirements. Mandatory requirements shall be met for all buildings. The section number followed by the combined number and letters ".ABC" indicates these Mandatory Requirements (i.e., requirements that shall be met by buildings complying by either Method A, B, or C) in Sections 13-401 through 13-415. Requirements specific to Method A, B, or C (i.e. ".B" is specific to Method B) shall be met when complying with the code by that Method. Where a requirement specific to a Method is more stringent than the Mandatory 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 Summit Fla/Com—2007 and those described in Appendix 13-B shall be used to demonstrate code compliance of the design for commercial buildings complying by Method A, Method B or Method C of this chapter. The building components' efficiency levels specified in the Method A performance compliance calculation 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 pre-existing 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 re-submitted.

13-400.3 Certification of Compliance.

13-400.3.ABC.1 Code Compliance Preparation. The EnergyGauge Summit Fla/Com Performance Calculation Procedures demonstrating code compliance for Methods A and B, and Form 400C demonstrating code compliance for Method~~s~~ 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 it's 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/her legally authorized agent.

The certified EnergyGauge Summit 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 13-400.3.ABC.3 shall be used to demonstrate code compliance with this chapter. Climate zones used in Subchapter 13-4 shall be as defined in Section 13-202 under ASHRAE Climate Zone.

13-400.3.A Method A Forms. An accurately completed Form 400A-08~~7~~ (generated by the EnergyGauge Summit FLA/COM-2007 computer program) demonstrating that code compliance has been achieved shall be submitted to the building official for Method A compliance. Calculations shall be performed for the building's location.

13-400.3.B Method B Forms. An accurately completed Form 400B-08~~7~~ (generated by the EnergyGauge Summit FLA/COM-2007 computer program) demonstrating that code compliance has been achieved shall be submitted to the building official for Method B compliance. Calculations shall be performed for the the building's location

13-400.3.C Method C Forms. An accurately completed Form 400C-08~~7~~ , either Form 400C-08 generated by the EnergyGauge Summit Fla/Com or a hand completed Form 400C$_{\text{AllClimateZones}}$ ~~demonstrating that code compliance has been achieved~~ shall be submitted to the building official to demonstrate compliance by ~~for~~ Method C ~~compliance~~. ~~The form submitted shall be specific for the climate zone in which the building will be located. See Section 13-202 for ASHRAE Climate Zone definitions.~~

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.

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

METHOD	FORM NO.
Method A Whole Building Performance	Form 400A-08~~7~~ (EnergyGauge Summit Fla/Com computer printout)
Method B Building Envelope Tradeoff	Form 400B-08~~7~~ (EnergyGauge Summit Fla/Com computer printout)
Method C Buildings Prescriptive Envelope	Form 400C-08~~7~~ (either hand form or printout form or EnergyGauge Summit Fla/Com computer printout) ~~separate forms for ASHRAE Climate Zones 1 and 2~~)

SECTION 13-401
FENESTRATIONS (Glazing)

13-401.ABC Mandatory requirements for Methods A, B and C. The requirements of Section 13-104.4.5 and criteria contained in Appendix 13-B relevant to fenestrations shall be met.

13-401.A Requirements Specific to Method A. The fenestrations' solar heat gain coefficient and U-factor determined by the EnergyGauge Summit 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.B Requirements Specific to Method B. The fenestrations' solar heat gain coefficient and U-factor determined by the EnergyGauge Summit 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.C 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 *solar heat gain coefficient (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: 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.C.1 Fenestration Area. The total *vertical fenestration area* shall be less than 40 ~~50~~ percent of the *gross wall area*.

Exception: *Vertical fenestration* complying with Exception 3 to Section 13-401.C.3.2.

The total *skylight area* shall be less than 5 percent of the *gross roof area*.

13-401.C.2 Fenestration U-Factor. *Fenestrations* 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 to13-401.C.3 shall have a *U-factor n*ot greater than that specified for 40 percent of the *gross wall area*.~~

13-401.C.3 Fenestration Solar Heat Gain Coefficient (SHGC).

13-401.C.3.1 Vertical fenestration. *Vertical fenestration* shall have an *SHGC* not greater than that specified for "all" orientations on Form 400C for the appropriate total *vertical fenestration area*.

~~**13-401.C.3.2** *Skylights* hall have an *SHGC* not greater than that specified for "all" orientations on Form 400C for the appropriate total *skylight area*.~~

Exceptions:

~~1. 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*.~~

1 ~~2~~. For demonstrating compliance for *vertical fenestration* shaded by opaque permanent projections that will last as long as the building itself ~~only~~, the *SHGC* in the proposed building shall be reduced by using the multipliers in Table 13-401.C.3 ~~for each *fenestration* product shaded by permanent projections that will last as long as the building itself~~. Permanent projections consisting of open louvers shall be considered to provide shading, provided that no sun penetrates the louvers during the peak sun angle on June 21.

2. For demonstrating compliance for vertical fenestration shaded by partially opaque permanent projections (e.g. framing with glass or perforated metal) that will last as long as the building itself, the projection factor shall be reduced by multiplying it by a factor O_s derived as follows:

$O_s = A_i * O_i) + (A_f * O_f)$

Where:

O_s = percent opacity of the shading device

A_i = percent of the area of the shading device that is a partially opaque infill

O_i = percent opacity of the infill. For glass $O_i = (100\% - T_s)$. Where T_s is the solar transmittance as determined in accordance with NFRC 300. For perforated or decorative metal panels, O_i = percentage of solid material.

A_f = percent of the area of the shading device that represents the framing members.

O_f = percent opacity of the framing members. If solid then 100%.

And then the SHGC in the proposed building shall be reduced by using the multipliers in Table 13-401.C.3.

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 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.

13-401.C.3.2 Skylights. *Skylights* hall have an *SHGC* not greater than that specified for "all" orientations on Form 400C for the appropriate total *skylight area*.

TABLE 13-401.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

SECTION 13-402
WALLS

13-402.ABC Mandatory requirements for Methods A, B and C. Criteria contained in Appendix 13-B relevant to walls shall be met.

13-402.A Requirements Specific to Method A. Efficiencies determined by the EnergyGauge Summit Fla/Com Method A performance calculation to demonstrate compliance with this code shall be the minimum performance level installed in walls.

13-402.B Requirements Specific to Method B. Efficiencies determined by the EnergyGauge Summit Fla/Com Method B performance calculation to demonstrate compliance with this code shall be the minimum performance level installed in walls.

13-402.C Requirements Specific to Method C. 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.C.1 Above-Grade Wall Insulation. All *above grade walls* shall have a *rated R-value of insulation* not less than that specified in Form 400C (see Appendix 13-D). Mass wall heat capacity shall be determined from Table B-10 or B-11 in Appendix 13-B, as appropriate.

13-402.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 (see Appendix 13-D). 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* (see Appendix 13-B).

SECTION 13-403
DOORS

13-403.ABC Mandatory Requirements for Methods A, B and C.

13-403.ABC.1 Door Types Allowed. All *exterior* and *adjacent* doors other than glass doors shall meet the U-factor specified on Form 400C (see Appendix 13-D). Hollow core doors shall not be used in either *exterior* or *adjacent* walls. Doors may have glass sections.

13-403.ABC.2 General criteria contained in Appendix 13-B relevant to doors shall be met.

13-403.A Requirements Specific to Method A. Efficiencies determined by the EnergyGauge Summit Fla/Com Method A performance calculation to demonstrate compliance with this code shall be the minimum performance level installed in doors.

13-403.B Requirements Specific to Method B. Efficiencies determined by the EnergyGauge Summit Fla/Com Method B performance calculation to demonstrate compliance with this code shall be the minimum performance level installed in doors.

13-403.C Requirements Specific to Method C.

13-403.C.1 Opaque Doors. All *opaque doors*, including *swinging doors* and *non-swinging doors*, shall have a *U-factor* not greater than that specified on Form 400C.

SECTION 13-404
ROOFS/CEILINGS

13-404.ABC Mandatory Requirements for Methods A, B and C

13-404.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. Where cavities beneath a roof deck are ventilated, the ceiling shall be considered the envelope component utilized in the EnergyGauge Summit Fla/Com calculation.

13-404.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.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.ABC.4 General criteria contained in Appendix 13-B relevant to roofs/ceilings shall be met.

13-404.A Requirements Specific to Method A. Efficiencies determined by the EnergyGauge Summit 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~~ to an R-value of at least R-19, space permitting.

13-404.B Requirements Specific to Method B. Efficiencies determined by the EnergyGauge Summit 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.C Requirements Specific to Method C.

13-404.C.1 Roof Insulation. All *roofs* shall have a *rated R-value of insulation* not less than that specified on Form 400C. *Skylight* curbs shall be insulated to the level of *roofs with insulation entirely above the deck* or R-5, whichever is less.

Exception: High albedo roofs meeting the criteria of Section 13-404.C.1.1.

13-404.C.1.1 High albedo roofs. For roofs other than roofs over ventilated attics or semiheated spaces or roofs over conditioned spaces that are not cooled spaces where the exterior surface has:

1. a ~~minimum total~~ solar reflectance of 0.70 when tested in accordance with ASTM C1549, ASTM E903, or ASTM E1918 ~~one of the solar reflectance test methods listed below,~~ and, in addition, ~~has~~ a minimum thermal emittance of 0.75 when tested in accordance with ASTM C1371 or ASTM E408 or ~~one of the thermal emittance test methods listed below, other than roofs with ventilated attics or roofs with semiheated spaces~~,
2. a minimum Solar Reflective Index of 82 when determined in accordance with the Solar Reflectance Index method in ASTM E 1980,

the insulation value for ~~U-factor of~~ the ~~proposed~~ roof shall comply with the values in Table 13-404.C.1.1. ~~be permitted to be adjusted using Equation 4-1 for demonstrating compliance:~~ The values for solar reflectance and thermal emittance shall be determined by a laboratory accredited by a nationally recognized accreditation organization, such as the Cool Roof Rating Council CCRC-1 Product Rating program, and shall be labeled and certified by the manufacturer.

~~$U_{RoofAdj} = U_{RoofProposed} \times Factor_{RoofMultiplier}$ (4-1)~~

~~Where:~~

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

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

~~$Factor_{RoofMultiplier}$ = the roof U-factor multiplier from Table 404.1.C.1.B.~~

~~Solar Reflectance Test Methods: ASTM C1549, ASTM E903, or ASTM E1918.~~

~~Thermal Emittance Test Methods: ASTM C1371, or ASTM E408.~~

~~TABLE 13-404.C.1~~
~~Roof U-Factor Multipliers for Exception to 13-404.C.1~~

~~*Climate Zone*~~	~~Roof U-Factor Multiplier~~
~~ASHRAE Climate Zone 1~~	~~0.77~~
~~ASHRAE Climate Zone 2~~	~~0.83~~

TABLE 13-404.C.1.1
High Albedo Roof Insulation

ASHRAE Climate Zone	Opaque Elements (Roofs)	Nonresidential		Residential	
		Assembly Maximum	Insulation[1] Min. R-Value	Assembly Maximum	Insulation[1] Min. R-value
1	Insulation entirely above deck	U-0.082	R-12.0 ci	U-0.081	R-12.0 ci
	Metal building	U-0.084	R-13.0	U-0.084	R-13.0
	Attic and other[2]	U-0.044	R-24.0	U-0.035	R-30.0
2	Insulation entirely above deck	U-0.076	R-13.0 ci	U-0.076	R-13.0 ci
	Metal building	U-0.078	R-13.0	U-0.078	R-13.0
	Attic and other[2]	U-0.041	R-25.0	U-0.032	R-30.0

[1] ci = continuous insulation.
[2] Excludes roofs over ventilated attics, or roofs oversemiheated spaces, or roofs over conditioned spaces that are not cooled spaces.

SECTION 13-405
FLOORS

13-405.ABC Mandatory requirements for Methods A, B and C. General criteria contained in Appendix 13-B relevant to floors shall be met.

13-405.A Requirements Specific to Method A. Efficiencies determined by the EnergyGauge Summit Fla/Com Method A performance calculation to demonstrate compliance with this code shall be the minimum performance level installed in floors.

13-405.B Requirements Specific to Method B. Efficiencies determined by the EnergyGauge Summit Fla/Com Method B performance calculation to demonstrate compliance with this code shall be the minimum performance level installed in floors.

13-405.C Requirements Specific to Method C

13-405.C.1 Floor Insulation. All *floor* shall have a *rated R-value of insulation* not less than that specified on Form 400C.

13-405.C.2 Slab-on-Grade Floor Insulation. All *slab-on-grade floors* shall have a *rated R-value of insulation* not less than that specified on Form 400C and shall be installed around the perimeter of the *slab-on-grade floor* to the distance specified on the form.

SECTION 13-406

AIR INFILTRATION

13-406.ABC Mandatory 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 E283.

13-406.ABC.1 Minimum Infiltration Levels Allowed.

13-406.ABC.1.1 Exterior Doors and Windows. Air leakage for *fenestration* and *doors* shall be determined in accordance with NFRC 400. Air leakage shall be determined by a laboratory accredited by a nationally recognized accreditation organization, such as the National Fenestration Rating Council, and shall be *labeled* and certified by the manufacturer. Air leakage shall not exceed 1.0 cfm/ft^2 for glazed swinging entrance doors and for revolving doors and 0.4 cfm/ft^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.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*.

13-406.ABC.2 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.ABC.3 Building Cavities.

13-406.ABC.3.1 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.

IMPORTANT NOTE: See the definition of air barrier in Section 13-202.

13-406.ABC.3.2 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.

13-406.ABC.3.3 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.ABC.3.4 Building cavities designed to be air distribution system components shall be sealed according to the criteria for air ducts, plenums, etc. in Section 13-410.ABC.3.6.

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.ABC Mandatory Requirements for Methods A, B and C

13-407.ABC.1 Sizing. A cooling load calculation shall be performed for newly installed units as per criteria of Section B3.1 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 sq.ft.	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.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 13-407.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 13-407.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.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.ABC.2 Controls

13-407.ABC.2.1 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, recooled, or mixed is no greater than the larger of the following:

(1) The volume of outside air required to meet the ventilation requirements of 6.1.3 of ASHRAE Standard 62 for the zone.

(2) 0.4 cfm/ft^2 of the zone conditioned floor area.

(3) 30% of the zone design peak supply rate.

(4) 300 cfm. This exception is for zones whose peak flow rate totals no more than 10% 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 <u>for the system</u> ~~in accordance with Method A of this sub-chapter~~.

(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 Standard 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.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 (% Total Capacity)
< 240,000 Btu/h	50 percent
> 240,000 Btu/h	25 percent

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

13-407.ABC.2.3 Temperature Controls.

13-407.ABC.2.3.1 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 ft 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.ABC.2.3.2 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^{o}F (-15^{o}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 ^{o}F
4. (-16^{o}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 ^{o}F (-17^{o}C) from the thermostat set point.

13-407.ABC.2.3.3 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.ABC.2.4 Humidity Control.

13-407.ABC.2.4.1 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 6.2 of ASHRAE Standard 62.1 ~~Section 6.1.3 of ASHRAE Standard 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.ABC.2.4.2 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.ABC.2.4.3 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 approve by the building official.

13-407. ABC.2.5 Off-Hour Controls. HVAC systems having a design heating or cooling capacity greater than 65,000 Btu/h (19 051W) and fan

system power greater than 3/4 hp shall have all of the following off-hour controls: Automatic Shutdown (13-407.ABC.2.4.1), Setback Controls (13-408.ABC.2.1), Optimum Start Controls (13-407.ABC.2.4.2), Shutoff Damper Controls (13-409.ABC.3.3), and Zone Isolation (13-407.ABC.2.4.3).

Exceptions:

~~**1.** HVAC systems serving hotel/motel guest rooms.~~

1 ~~2.~~ HVAC systems intended to operate continuously.

2 ~~3~~. HVAC systems having a design heating capacity and cooling capacity less than 15,000 Btu/h (4 396 W) that are equipped with readily accessible manual on/off controls.

13-407.ABC.2.5.1 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 two 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.ABC.2.5.2 Optimum Start Controls. Individual heating and cooling air distribution systems with a total design supply air capacity exceeding 10,000 cfm (5 m^3/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.ABC.2.5.3 Zone Isolation. HVAC systems serving zones that are intended to operate or be occupied non-simultaneously shall be divided into isolation areas. Zones may be grouped into a single isolation area provided it does not exceed 25,000 square feet (2 323 m^3) 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.ABC.2.4.1 (Automatic Shutdown). 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 5000 cfm and smaller.
2. Exhaust airflow from a single isolation zone of less than 10% 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.ABC.2.6 Controls Testing. HVAC control systems shall be tested to assure that control elements are calibrated, adjusted, and in proper working condition.

13-407.ABC.3 Equipment Performance Standards

13-407.ABC.3.1 Equipment Efficiency Verification Equipment efficiency information supplied by manufacturers shall be verified as follows:

1. Equipment covered under the Federal Energy policy Act of 1992 (EPACT) shall comply with U.S. Department of Energy certification requirements.
2. If a certification program exists for a covered product, and it includes provisions for verification and challenge of equipment efficiency ratings, then the product shall be listed in the certification program, or,
3. If a certification program exists for a covered product, and it includes provisions for verification and challenge of equipment efficiency ratings, but the product is not listed in the existing certification program, the ratings shall be verified by an independent laboratory test report, or
4. If no certification program exists for a covered product, the equipment efficiency ratings shall be supported by data furnished by the manufacturer, or
5. Where components such as indoor or outdoor coils from different manufacturers are used, the system designer shall specify component efficiencies whose combined efficiency meets the minimum equipment efficiency requirements in Section 13-407.ABC.3.
6. Products covered in Table 13-407.ABC.3.2G shall have efficiency ratings supported by data furnished by the manufacturer.

13-407.ABC.3.2 Minimum Efficiencies for Cooling Equipment.

13-407.ABC.3.2.1 Minimum equipment efficiencies—listed equipment—standard rating and operating conditions. Equipment shown in Tables 13-407.ABC.3.2A through 13-407.ABC.3.2D shall have a minimum performance at the specified rating conditions when tested in accordance with the specified test procedure.Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all stated requirements, unless otherwise exempted by footnotes in the table. 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.ABC.3.2.1A through 13-407.ABC.3.2.1D and 13-407.ABC.3.2.1G 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.ABC.3.2.1A Air Conditioners and Condensing Units

Table 13-407.ABC.3.2.1B Heat Pumps
Table 13-407.ABC.3.2.1C Water Chilling Packages (see Section 13-407.ABC.3.2.2 for water-cooled centrifugal water-chilling packages that are designed to operate at nonstandard conditions).
Table 13-407.ABC.3.2D Packaged Terminal and Room Air Conditioners and Heat Pumps
Table 13-407.ABC.3.2.1G Heat Rejection Equipment.

13-407.ABC.3.2.2 Minimum Equipment Efficiencies – Listed Equipment—Nonstandard Conditions. Water-cooled centrifugal water-chilling packages that are not designed for operation at ARI Standard 550/590 test conditions (and thus cannot be tested to meet the requirements of Table 13-407.ABC.3.2.1C) 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 and a minimum NPLV rating as shown in Tables 13-407.ABC.3.2.2H, I, and J referenced below.

Centrifugal chillers <150 tons shall meet the minimum full-load COP and IPLV/NPLV in Table 13-407.ABC.3.2.2H.
~~1.~~ Centrifugal chillers ≥ 150 tons and < 300 tons shall meet the minimum full-load COP and IPLV/NPLV in Table 13-407.ABC.3.2.2I.
~~2.~~ Centrifugal chillers ≥30 tons shall meet the minimum full-load COP and IPLV/NPLV in Table 13-407.ABC.3.2.2J.

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)
Entering 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.

~~Non-standard part-load value (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.~~

13-407.ABC.3.2.3 Equipment not listed. Equipment not listed in the tables referenced in Sections 13-407.ABC.3.2.1 and 13-407.ABC.3.2.2 may be used.

TABLE 13-407.ABC.3.2.1A
Electrically Operated Unitary Air Conditioners and Condensing Units

Equipment Type	Size Category	Heating Section Type	Sub-Category 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 After 1/1/10: 11.2 EER	
		All other	Split System and Single Package	10.1 EER After 1/1/10: 11.0 EER	
	≥135,000 Btu/h and <240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	9.7 EER After 1/1/10: 11.0 EER	
		All other	Split System and Single Package	9.5 EER After 1/1/10: 10.8 EER	
	≥240,000 Btu/h and <760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	9.5 EER, 9.7IPLV After 1/1/10: 10.0 EER	
		All other	Split System and Single Package	9.3 EER,9.5 IPLV After 1/1/10: 9.8 EER	
	≥760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	9.2EER, 9.4 IPLV After 1/1/10: 9.7 EER	ARI 340/360
		All other	Split System and Single Package	9.0 EER, 9.2IPLV After 1/1/10: 9.5 EER	
Computer room air conditioner	<65,000 Btu/h	Air cooled		11.0 EER	
		Water-Glycol, Evaporatively cooled		11.1 EER	
	65,000–135,000 Btu/h	Air cooled		10.4 EER	
		Water-Glycol, Evaporatively cooled		10.5 EER	
	135,001-240,000Btu/h	Air cooled		10.2 EER	ANSI/ ASHRAE 127
		Water-Glycol, Evaporatively cooled		10.0 EER	
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	<65,000 Btu/h[3]	All	Split system or Single Package	11.0 SEER	ARI 210/240
Space constrained products, air conditioners	<65,000 Btu/h[3]	All	Split system or Single Package	12.0 SEER[4]	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
	≥65,000 Btu/h and <135,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.5 EER	ARI 340/360
		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	
		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	

[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 air-conditioners <65,000 Btu/h are regulated by NAECA. SEER 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.ABC.3.2.1B
Electrically Operated Unitary and Applied Heat Pumps –
Minimum Efficiency Requirements

Equipment Type	Size Category	Heating Section Type	Sub-Category 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 After 1/1/10: 11.0 EER	
		All other	Split System and Single Package	9.9 EER After 1/1/10: 10.8 EER	
	≥135,000 Btu/h and <240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	9.3 EER After 1/1/10: 10.6 EER	ARI 340/360
		All other	Split System and Single Package	9.1 EER After 1/1/10: 10.4 EER	
	≥240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	9.0 EER 9.2 IPLV After 1/1/10: 9.5 EER	
		All other	Split System and Single Package	8.8 EER 9.0 IPLV After 1/1/10: 9.3 EER	
Through-the Wall, Air-cooled	≤30,000 Btu/h[3]	All	Split System	10.9 SEER After 1/1/10: 12.0 SEER	ARI 210/240
			Single Package	10.6 SEER After 1/1/10: 12.0 SEER	
Small-Duct High-Velocity, Air cooled	<65,000 Btu/h[3]	All	Split system	11.0 SEER	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 < 65,000 ~~135,000~~ Btu/h	All	86°F Entering Water	12.0 EER	
	≥65,000 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	7.7 HSPF	ARI 210/240
			Single Package	7.7 HSPF	
	≥65,000 Btu/h and <135,000 Btu/h (Cooling Capacity)		47°F db/43°F wb Outdoor Air	3.2 COP After 1/1/10: 3.3 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 After 1/1/10: 3.2 COP	ARI 340/360
			17°F db/15°F wb Outdoor Air	2.0 COP	
Through-the Wall, Air-cooled, heating mode)	≤30,000 ~~<65,000~~ Btu/h[3] (Cooling Capacity)		Split System	7.1 HSPF After 1/1/10: 7.4 HSPF	
			Single Package	7.0 HSPF After 1/1/10: 7.4 HSPF	ARI 210/240
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, heap pumps	<65,000 Btu/h[3]		Split System or Single Package	7.4 HSPF	ARI 210/240
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	

[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.ABC.3.2.1C
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	

[1] The chiller equipment requirements do not apply for chillers used in low-temperature applications where the design leaving fluid temperature is <40°F.

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

TABLE 13-407.ABC.3.2.1D
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]
PTAC (Cooling Mode), New Construction	7,000 ≥Btu/h <8,000	95°F db Outdoor Air [Based on capacity at lower range using EER= 12.5 – (0.213 x Cap/1000)][3]	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	
	>15,000 Btu/h		9.3 EER	
PTAC (Cooling Mode), Replacements[2]	7,000 ≥Btu/h <8,000	95°F db Outdoor Air [Based on capacity at lower range using EER= 10.9 – (0.213 x Cap/1000)][3]	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	
	>15,000 Btu/h		7.7 EER	
PTHP (Cooling Mode), New Construction	7,000 ≥Btu/h <8,000	95°F db Outdoor Air [Based on capacity at lower range using EER= 12.3 – (0.213 x Cap/1000)][3]	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	
	>15,000 Btu/h		9.1 EER	
PTHP (Cooling Mode), Replacements[2]	7,000 ≥Btu/h <8,000	95°F db Outdoor Air [Based on capacity at lower range using	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	EER= 10.8 – (0.213 x Cap/1000)][3]	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	
	>15,000 Btu/h		7.6 EER	
PTHP (Heating Mode), New Construction	7,000 ≥Btu/h <8,000	47°F db Outdoor Air [Based on capacity at lower range using COP= 3.2 – (0.026 x Cap/1000)][3]	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	
	>15,000 Btu/h		2.81 COP	
PTHP (Heating Mode), Replacements[2]	7,000 ≥Btu/h <8,000	47°F db Outdoor Air [Based on capacity at lower range using COP= 2.9 – (0.026 x Cap/1000)][3]	2.72 COP	
	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	<6,000 Btu/h		9.7 SEER	ANSI/AHAM RAC-1
	≥6,000 <8,000 Btu/h		9.7 EER	
	≥8,000<14,000Btu/h		9.8 EER	
	≥14,000<20,000Btu/h		9.7 EER	
	≥20,000 Btu/h		8.5 EER	
Room Air Conditioners, without Louvered Sides	<8,000 Btu/h		9.0 EER	
	≥8,000 Btu/h and <20,000 Btu/h		8.5 EER	
	≥20,000 Btu/h		8.5 EER	
Room Air Conditioner Heat Pumps with Louvered Sides	<20,000 Btu/h ≥20,000 Btu/h		9.0 EER 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	

SPVAC (Cooling Mode)	~~All Capacities~~ <65,000 Btu/h	95°F db/75°F wb Outdoor Air	~~8.6 EER~~ 9.0 EER	ARI 390
	>=65,000 Btu/h and <135,000 Btu/h	95°F db/75°F wb Outdoor Air	8.9 EER	
	>=135,000 Btu/h and <240,000Btu/h	95°F db/75°F wb Outdoor Air	8.6 EER	
SPVHP (Cooling Mode)	~~All Capacities~~ <65,000 Btu/h	95°F db/75°F wb Outdoor Air	~~8.6 EER~~ 9.0 EER	
	>=65,000 Btu/h and <135,000 Btu/h	95°F db/75°F wb Outdoor Air	8.9 EER	
	>=135,000 Btu/h and <240,000Btu/h	95°F db/75°F wb Outdoor Air	8.6 EER	
SPVHP (Heating Mode)	~~All Capacities~~ <65,000 Btu/h	47°F db/43°F wb Outdoor Air	~~2.7 COP~~ 3.0 COP	
	>=65,000 Btu/h and <135,000 Btu/h	47°F db/43°F wb Outdoor Air	3.0 COP	
	>=135,000 Btu/h and <240,000Btu/h	47°F db/43°F wb Outdoor Air	2.9 COP	
SPVAC (Cooling Mode)	< 19kW	35.0°C db/ 23.9°C wb Outdoor air	2.64 COP	
	>=19 kW and <40 kW	35.0°C db/ 23.9°C wb Outdoor air	2.61 COP	
	<=40 kW and < 70 Btu/h	35.0°C db/ 23.9°C wb Outdoor air	2.52 COP	
SPVHP (Cooling Mode)	< 19kW	35.0°C db/ 23.9°C wb Outdoor air	2.64 COP	
	>=19 kW and <40 kW	35.0°C db/ 23.9°C wb Outdoor air	2.61 COP	
	<=40 kW and < 70 Btu/h	35.0°C db/ 23.9°C wb Outdoor air	2.52 COP	
SPVHP (Heating Mode)	< 19kW	8.3°C db /6.1°C wb Outdoor Air	3.0 COP	
	>=19 kW and <40 kW	8.3°C db /6.1°C wb Outdoor Air	3.0 COP	
	<=40 kW and < 70 Btu/h	8.3°C db /6.1°C wb Outdoor Air	2.9 COP	

[1] Subchapter 13-3 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
[2] Replacement units must be factory labeled as follows: "MANUFACTURED FOR REPLACEMENT APPLICATIONS ONLY; NOT TO BE INSTALLED IN NEW CONSTRUCTION PROJECTS." Replacement efficiencies apply only to units with existing sleeves less than 16 in. high and less than 42 in. wide.
[3] 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.ABC.3.2.1G
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 85°F Leaving Water 75°F wb Outdoor Air	≧38.2 gpm/hp	CTI ATC-105 and CTI Std-201
Centrifugal Fan Cooling Towers	All	95°F Entering Water 85°F Leaving Water 75°F wb Outdoor Air	≧20.0 gpm/hp	CTI ATC-105 and CTI Std-201
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 hp	ARI 460

[1] 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.
[2] 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.
[3] Subchapter 13-3 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

TABLE 13-407.ABC.3.2.2H
Minimum Efficiencies for Centrifugal Chillers <150tons
COP_{std} = 5.00; $IPLV_{std}$ = 5.25

			Condenser Flow Rate											
Leaving Chilled Water Temperature (^oF)	Entering Condenser Water Temperature (^oF)	LIFT[1] (^oF)	2gpm/ton		2.5gpm/ton		3gpm/ton		4gpm/ton		5gpm/ton		6gpm/ton	
			COP	NPLV[3]	COP	NPLV[3]	COP	NPLV[3]	COP	NPLV[3]	COP	NPLV[3]	COP	NPLV[3]
40	75	35	5.11	5.35	5.33	5.58	5.48	5.73	5.67	5.93	5.79	6.06	5.88	6.15
40	80	40	4.62	4.83	4.92	5.14	5.09	5.32	5.27	5.52	5.38	5.63	5.45	5.70
40	85	45	3.84	4.01	4.32	4.52	4.58	4.79	4.84	5.06	4.98	5.20	5.06	5.29
41	75	34	5.19	4.43	5.41	5.66	5.56	5.81	5.75	6.02	5.89	6.16	5.99	6.26
41	80	39	4.73	4.95	5.01	5.24	5.17	5.41	5.35	5.60	5.46	5.71	5.53	5.78
41	85	44	4.02	4.21	4.46	4.67	4.70	4.91	4.94	5.17	5.06	5.30	5.14	5.38
42	75	33	5.27	5.51	5.49	5.74	5.64	5.90	5.85	6.12	6.00	6.27	6.11	6.39
42	80	38	4.84	5.06	5.10	5.33	5.25	5.49	5.43	5.67	5.53	5.79	5.61	5.87
42	85	43	4.19	4.38	4.59	4.80	4.81	5.03	5.03	5.26	5.15	5.38	5.22	5.46
43	75	32	5.35	5.59	5.57	5.82	5.72	5.99	5.95	6.23	6.11	6.39	6.23	6.52
43	80	37	4.94	5.16	5.18	5.42	5.32	5.57	5.50	5.76	5.62	5.87	5.70	5.96
43	85	42	4.35	4.55	4.71	4.93	4.91	5.13	5.12	5.35	5.23	5.47	5.30	5.54
44	75	31	5.42	5.67	5.65	5.91	5.82	6.08	6.07	6.34	6.24	6.53	6.37	6.67
44	80	36	5.03	5.26	5.26	5.50	5.40	5.65	5.58	5.84	5.70	5.96	5.79	6.05
44	85	41	4.49	4.69	4.82	5.04	5.00	5.25	5.20	5.43	5.30	5.55	5.38	5.62
45	75	30	5.50	5.75	5.74	6.00	5.92	6.19	6.19	6.47	6.38	6.68	6.53	6.83
45	80	35	5.11	5.35	5.33	5.58	5.48	5.73	5.67	5.93	5.79	6.06	5.88	6.15
45	85	40	4.62	4.83	4.92	5.14	5.09	5.32	5.27	5.52	5.38	5.63	5.45	5.70
46	75	29	5.58	5.84	5.83	6.10	6.03	6.30	6.32	6.61	6.54	6.84	6.70	7.00
46	80	34	5.19	5.43	5.41	5.66	5.56	5.81	5.,75	6.02	5.89	6.16	5.99	6.26
46	85	39	4.73	4.95	5.01	5.24	5.17	5.41	5.35	5.60	5.46	5.71	5.53	5.78
47	75	28	5.66	5.92	5.93	6.20	6.15	6.43	6.47	6.77	6.71	7.02	6.88	7.20
47	80	33	5.27	5.51	5.49	5.74	5.64	5.90	5.85	6.12	6.00	6.27	6.11	6.39
47	85	38	4.84	5.06	5.10	5.33	5.25	5.49	5.43	5.67	5.53	5.79	5.61	5.87
48	75	27	5.75	6.02	6.04	6.32	6.28	6.56	6.64	6.94	6.89	7.21	7.09	7.41
48	80	32	5.35	5.59	5.57	5.82	5.72	5.99	5.95	6.23	6.211 6.39		6.23	6.52
48	85	37	4.94	5.16	5.18	5.42	5.32	5.57	5.50	5.76	5.62	5.87	5.70	5.96
Condenser DT[2]			14.04		11.23		9.36		7.02		5.62		4.68	

For SI: 1 Btu/h=.2931W, $^{o}C=[(^{o}F) – 32]/1.8$

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

[2] Condenser DT = Leaving Condenser Water Temperature (F) – Entering Condenser Water Temperature (F)

[3] All NPLV values shown are NPLV except at conditions of 3 gpm/ton Condenser Flow Rate with $44^{o}F$ Leaving Chilled Water Temperature and $85^{o}F$ Entering Condenser Water Temperature which is IPLV.

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

Where X = Condenser DT + LIFT

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

TABLE 13-407.ABC.3.2.2I
Minimum Efficiencies for Centrifugal Chillers >150Tons, <300 tons
COP_{std} = 5.55; $IPLV_{std}$ = 5.90

			Condenser Flow Rate											
Leaving Chilled Water Temperature (^oF)	Entering Condenser Water Temperature (^oF)	LIFT[1] (^oF)	2gpm/ton		2.5gpm/ton		3gpm/ton		4gpm/ton		5gpm/ton		6gpm/ton	
			COP	NPLV[3]	COP	NPLV[3]	COP	NPLV[3]	COP	NPLV[3]	COP	NPLV[3]	COP	NPLV[3]
40	75	35	5.65	6.03	5.90	6.29	6.05	6.46	6.26	6.68	6.40	6.83	6.51	6.94
40	80	40	5.10	5.44	5.44	5.80	5.62	6.00	5.83	6.22	5.95	6.35	6.03	6.43
40	85	45	4.24	4.52	4.77	5.09	5.06	5.40	5.35	5.71	5.50	5.87	5.59	5.97
41	75	34	5.74	6.13	5.80	6.38	6.14	6.55	6.36	6.79	6.51	6.95	6.62	7.06
41	80	39	5.23	5.58	5.54	5.91	5.71	6.10	5.91	6.31	6.03	6.44	6.11	6.52
41	85	44	4.45	4.74	4.93	5.26	5.19	5.54	5.46	5.82	5.60	5.97	5.69	6.07
42	75	33	5.83	6.22	6.07	6.47	6.23	6.65	6.47	6.90	6.63	7.07	6.75	7.20
42	80	38	5.35	5.71	5.64	6.01	5.80	6.19	6.00	6.40	6.12	6.53	6.20	6.62
42	85	43	4.63	4.94	5.08	5.41	5.31	5.67	5.56	5.93	5.69	6.07	5.77	6.16
43	75	32	5.91	6.31	6.15	6.56	6.33b 6.75		6.58	7.02	6.76	7.21	6.89	7.35
43	80	37	5.46	5.82	5.73	6.11	5.89	6.28	6.08	6.49	6.21	6.62	6.30	6.72
43	85	42	4.81	5.13	5.21	5.55	5.42	5.79	5.66	6.03	5.78	6.16	5.86	6.25
44	75	31	6.00	6.40	6.24	6.66	6.43	6.86	6.71	7.15	6.90	7.36	7.05	7.52
44	80	36	5.56	5.93	5.81	6.20	5.97	6.37	6.17	6.58	6.30	6.72	6.40	6.82
44	85	41	4.96	5.29	5.33	5.68	5.55	5.90	5.74	6.13	5.86	6.26	5.94	6.34
45	75	30	6.08	6.49	6.34	6.76	6.54	6.98	6.84	7.30	7.06	7.53	7.22	7.70
45	80	35	5.65	6.03	5.90	6.29	6.05	6.46	6.26	6.68	6.40	6/83	6.51	6.94
45	85	40	5.10	5.44	5.44	5.80	5.62	6.00	5.83	6.22	5.95	6.35	6.03	6.43
46	75	29	6.17	6.58	6.44	6.87	6.66	7.11	6.99	7.46	7.23	7.71	7.409	7.90
46	80	34	5.74	6.13	5.80	6.38	6.14	6.55	6.36	6.79	6.51	6.95	6.62	7.06
46	85	39	5.23	5.58	5.54	5.91	5.71	6.10	5.91	6.31	6.03	6.44	6.11	6.52
47	75	28	6.26	6.68	6.56	6.99	6.79	7.24	7.16	7.63	7.42	7.91	7.61	8.11
47	80	33	5.83	6.21	6.07	6.47	6.23	6.64	6.47	6.90	6.63	7.07	6.75	7.20
47	85	38	5.35	5.70	5.64	6.01	5.80	6.19	6.00	6.40	6.12	6.52	6.20	6.61
48	75	27	6.36	6.78	6.68	7.12	6.94	7.40	7.34	7.82	7.62	8.13	7.83	8.35
48	80	32	5.91	6.30	6.15	6.56	6.33	6.75	6.58	7.02	6.76	7.21	6.89	7.35
48	85	37	5.46	5.82	5.73	6.10	5.89	6.28	6.08	6.49	6.21	6.62	6.30	6.71
Condenser DT^2			14.04		11.23		9.36		7.02		5.62		4.68	

For SI: 1 Btu/h=.2931W, $^{o}C=[(^{o}F) – 32]/1.8$

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

[2] Condenser DT = Leaving Condenser Water Temperature (F) – Entering Condenser Water Temperature (F)

[3] All NPLV values shown are NPLV except at conditions of 3 gpm/ton Condenser Flow Rate with $44^{o}F$ Leaving Chilled Water Temperature and $85^{o}F$ Entering Condenser Water Temperature which is IPLV.

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

Where X = Condenser DT + LIFT

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

TABLE 13-407.ABC.3.2.2J
Minimum Efficiencies for Centrifugal Chillers >300Tons
COP_{std} = 6.10; $IPLV_{std}$ = 6.40

			Condenser Flow Rate											
Leaving Chilled Water Temperature (^oF)	Entering Condenser Water Temperature (^oF)	LIFT[1] (^oF)	2gpm/ton		2.5gpm/ton		3gpm/ton		4gpm/ton		5gpm/ton		6gpm/ton	
			COP	NPLV[3]	COP	NPLV[3]	COP	NPLV[3]	COP	NPLV[3]	COP	NPLV[3]	COP	NPLV[3]
40	75	35	6.23	6.55	6.50	6.83	6.68	7.01	6.91	7.26	7.06	7.42	7.17	7.54
40	80	40	5.63	5.91	6.00	6.30	6.20	6.52	6.43	6.76	6.56	6.89	6.65	6.98
40	85	45	4.68	4.91	5.26	5.53	5.58	5.86	5.90	6.20	6.07	6.37	6.17	6.48
41	75	34	6.33	6.65	6.60	6.93	6.77	7.12	7.02	7.37	7.18	7.55	7.30	7.67
41	80	39	5.77	6.06	6.11	6.42	6.30	6.62	6.52	6.85	6.65	6.99	6.74	7.08
41	85	44	4.90	5.15	5.44	5.71	5.72	6.01	6.02	6.33	6.17	6.49	6.27	6.59
42	75	33	6.43	6.75	6.69	7.03	6.87	7.22	7.13	7.49	7.31	7.68	7.44	7.82
42	80	38	5.90	6.20	6.21	6.53	6.40	6.72	6.61	6.95	6.75	7.09	6.84	7.19
42	85	43	5.11	5.37	5.60	5.88	5.86	6.16	6.13	6.44	6.28	6.59	6.37	6.69
43	75	32	6.52	6.85	6.79	7.13	6.98	7.33	7.26	7.63	7.45	7.83	7.60	7.98
43	80	37	6.02	6.32	6.31	6.63	6.49	6.82	6.71	7.05	6.85	7.19	6.94	7.30
43	85	42	5.30	5.57	5.74	6.03	5.98	6.28	6.24	6.55	6.37	6.70	6.46	6.79
44	75	31	6.61	6.95	6.89	7.23	7.09	7.45	7.40	7.77	7.61	8.00	7.77	8.16
44	80	36	6.13	6.44	6.41	6.73	6.58	6.92	6.81	7.15	6.95	7.30	7.05	7.41
44	85	41	5.57	5.75	5.87	6.17	6.10	6.40	6.33	6.66	6.47	6.79	6.55	6.89
45	75	30	6.71	7.05	6.99	7.35	7.21	7.58	7.55	7.93	7.78	8.18	7.96	8.36
45	80	35	6.23	6.55	6.50	6.83	6.68	7.01	6.91	7.23	7.06	7.42	7.17	7.54
45	85	40	5.63	5.91	6.00	6.30	6.20	6.52	6.43	6.76	6.56	6.89	6.65	6.98
46	75	29	6.80	7.15	7.11	7.47	7.35	7.72	7.71	8.10	7.97	8.37	8.16	8.58
46	80	34	6.33	6.65	6.60	6.93	6.77	7.12	7.02	7.37	7.18	7.55	7.30	7.67
46	85	39	5.77	6.06	6.11	6.42	6.30	6.62	6.52	6.85	6.65	6.99	6.74	7.08
47	75	28	6.91	7.26	7.23	7.60	7.49	7.87	7.89	8.29	8.18	8.59	8.39	8.82
47	80	33	6.43	6.75	6.69	7.03	6.87	7.22	7.13	7.49	7.31	7.68	7.44	7.82
47	85	38	5.90	6.20	6.21	6.53	6.40	6.72	6.61	6.95	6.75	7.09	6.84	7.19
48	75	27	7.01	7.37	7.36	7.74	7.65	8.04	8.09	8.50	8.41	8.83	8.64	9.08
48	80	32	6.52	6.85	6.79	7.13	6.98	7.33	7.26	7.63	7.45	7.83	7.60	7.98
48	85	37	6.02	6.32	6.31	6.63	6.49	6.82	6.71	7.05	6.85	7.19	6.94	7.30

Condenser DT[2]	14.04	11.23	9.36	7.02	5.62	4.68

For SI: 1 Btu/h=.2931W, $^{o}C=[(^{o}F) - 32]/1.8$

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

[2] Condenser DT = Leaving Condenser Water Temperature (F) – Entering Condenser Water Temperature (F)

[3] All NPLV values shown are NPLV except at conditions of 3 gpm/ton Condenser Flow Rate with 44°F Leaving Chilled Water Temperature and 85°F Entering Condenser Water Temperature which is IPLV.

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

Where X = Condenser DT + LIFT

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

13-407.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 Standard ASHRAE Standard 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.ABC.3.4 Exhaust air energy recovery for cooling systems. Individual fan systems that have both a design supply air capacity of 5000 cfm (2.4 m^3/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 13-409.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) used for collecting and removing grease vapors and smoke.
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.A Requirements Specific to Method A. Cooling system efficiencies determined by the EnergyGauge Summit Fla/Com Method A performance calculation to demonstrate compliance with this Code shall be the minimum performance level installed in buildings.

13-407.BC 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 13-407.ABC.3.2.1A through D and G.

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

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.ABC Mandatory Requirements for Methods A, B and C.

13-408.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 13-407.ABC.1, with exceptions.

13-408.ABC.2 Controls. Heating equipment and systems shall meet all applicable prescriptive requirements for controls in Section 13-407.ABC.2.

13-408.ABC.2.1 Setback Controls. Heating systems 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.

Exception: Buildings located in Miami-Dade, Broward or Monroe Counties.

13-408.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 multi-stage 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.ABC.3.2.1B and includes all usage of internal electric resistance heating.

13-408.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.ABC.3 Equipment Performance Standards

13-408.ABC.3.1 Equipment Efficiency Verification. If a certification program exists for a product covered in Tables 13-408.ABC.3.2.1E through 13-408.ABC.3.2.1F, 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.ABC.3.2.1E through 13-408.ABC.3.2.1F, 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.ABC.3.2.1

13-408.ABC.3.2 Minimum Efficiencies for Heating Equipment.

13-408.ABC.3.2.1 Equipment Ratings. Tables 407.ABC.3.2.1B, 407. ABC.3.2.1D, and 408.ABC.3.2.1E through 408.ABC.3.2.1F 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.ABC.3.2.1B Heat Pumps
Table 13-407.ABC.3.2.1D Packaged Terminal Air Conditioners and Heat Pumps
Table 13-408.ABC.3.2.1E Furnaces, Duct Furnaces, and Unit Heaters
Table 13-408.ABC.3.2.1F Boilers

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.

TABLE 13-408.ABC.3.2.1E
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	Maximum	78% AFUE or 80% E_t[4]	DOE 10 CFR, Part 430 or ANSI Z 21.47

	≥225,000 Btu/h	Capacity[4]	80% E_c[3]	ANSI Z21.47
Warm Air Furnace, Oil-Fired	<225,000 Btu/h	Maximum Capacity[4]	78% AFUE or ;80% E_t[5]	DOE 10 CFR, Part 430 or UL 727
	≥225,000 Btu/h		81% E_t[6]	UL 727
Warm Air Duct Furnaces, Gas-Fired	All Capacities	Maximum Capacity[5]	80% E_c[7]	ANSI Z83.89
Warm Air Unit Heaters, Gas-Fired	All Capacities	Maximum Capacity[5]	80% E_c[7,8]	ANSI Z83.8
Warm Air Unit Heaters, Oil-Fired	All Capacities	Maximum Capacity[5]	80% E_c[7,8]	UL 731

[1] E_t = thermal efficiency. See test procedure for detailed discussion.
[2] Subchapter 13-3 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
[3] E_c = combustion efficiency. Units must also include an IID, have jacket losses not exceeding 0.75% 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.
[4] Minimum and maximum ratings as provided for and allowed by the unit's controls.
[5][4] 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.
[6] E_t = thermal efficiency. Units must also include an IID, have jacket losses not exceeding 0.75% 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.
[7] E_c = combustion efficiency (100% less flue losses). See test procedure for detailed discussion.
[8] As of August 8, 2008, according to the Energy Policy Act of 2005, units must also include an interrupted or intermittent ignition device (IID) and have either power venting or an automatic flue damper. A vent damper is an acceptable alternative to a flue damper for those unit heaters where combustion air is drawn from the conditioned space.

TABLE 13-408.ABC.3.2.1F
Gas- and Oil-Fired Boilers
Minimum Efficiency Requirements

Equipment Type[1]	Subcategory or Rating Condition	Size Category (Input)	Minimum Efficiency[2,3]	Efficiency as of 3/2/2010	Test Procedure
Boilers, hot water	Gas-fired	<300,000 Btu/h	80% AFUE	80% AFUE	10 CFR Part 430
		≥300,000 Btu/h and ≤2,500,000 Btu/h[4]	75% E_t	80% E_t	10 CFR Part 431
		>2,500,000 Btu/h[1]	80% E_c	82% E_c	
	Oil-fired[5]	<300,000 Btu/h	80% AFUE	80% AFUE	10 CFR Part 430
		≥300,000 Btu/h and ≤2,500,000 Btu/h[4]	78% E_t	82% E_t	10 CFR Part 431
		>2,500,000 Btu/h[1]	83% E_c	84% E_c	
Boilers, steam	Gas-fired	<300,000 Btu/h	75% AFUE	75% AFUE	10 CFR Part 430
	Gas-fired—all, except natural draft	≥300,000 Btu/h and ≤2,500,000 Btu/h[4]	75% E_t	79% E_t	10 CFR Part 431
		>2,500,000 Btu/h[1]	80% E_c	79% E_t	
	Gas-fired—natural draft	≥300,000 Btu/h and ≤2,500,000 Btu/h[4]	75% E_t	77% E_t	
		>2,500,000 Btu/h[1]	80% E_c	77% E_t	
	Oil-fired[5]	<300,000 Btu/h	80% AFUE	80% AFUE	10 CFR Part 430
		≥300,000 Btu/h and ≤2,500,000 Btu/h[4]	78% E_t	81% E_t	10 CFR Part 431
		>2,500,000 Btu/h[1]	83% E_c	81% E_t	

[1] These requirements apply to boilers with rated input of 8,000,000 Btu/h or less that are not packaged boilers and to all packaged boilers. Minimum efficiency requirements for boilers cover all capacities of packaged boilers.
[2] E_c =combustion efficiency (100% less flue losses). See reference document for detailed information.
[3] E_t = thermal efficiency. See reference document for detailed information.
[4] Maximum capacity – minimum and maximum ratings as provided for and allowed by the unit's controls.
[5] Includes oil-fired (residual).

~~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% AFUE~~	~~DOE 10 CFR Part 430~~
		~~Steam~~	~~75% AFUE~~	
	~~>300,000 Btu/h and ≤2,500,000~~	~~Maximum Capacity[3]~~	~~75% E_t[1]~~	~~H.I. Htg Boiler Std.~~
	~~>2,500,000 Btu/h[4]~~	~~Hot Water~~	~~80% E_c~~	
	~~>2,500,000 Btu/h[4]~~	~~Steam~~	~~80% E_c~~	
~~Boilers, Oil-Fired~~	~~<300,000 Btu/h~~		~~80% AFUE~~	~~DOE 10 CFR Part 430~~
	~~>300,000 Btu/h and ≤2,500,000 Btu/h~~	~~Maximum Capacity[3]~~	~~78% E_t[1]~~	~~H.I. Htg Boiler Std.~~
	~~>2,500,000 Btu/h[4]~~	~~Hot Water~~	~~83% E_c~~	
	~~>2,500,000 Btu/h[4]~~	~~Steam~~	~~83% E_c~~	
~~Oil-Fired (Residual)~~	~~>300,000 Btu/h and ≤2,500,000 Btu/h~~	~~Maximum Capacity[3]~~	~~78% E_t[1]~~	~~H.I. Htg Boiler Std.~~
	~~>2,500,000 Btu/h[4]~~	~~Hot Water~~	~~83% E_c~~	
	~~>2,500,000 Btu/h[4]~~	~~Steam~~	~~83% E_c~~	

~~[1] Et = thermal efficiency. See reference documents for detailed information.~~
~~[2] Subchapter 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.~~

13-408.ABC.3.2.2 Radiant heating systems

13-408.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.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 this subchapter, 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.ABC.3.2.3 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 requirements 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 13-412.ABC.

13-408.A Requirements Specific to Method A. Heating system efficiencies determined by the EnergyGauge Summit Fla/Com Method A performance calculation to demonstrate compliance with this code shall be the minimum performance level installed in buildings.

SECTION 409
VENTILATION

13-409.ABC Mandatory Requirements for Methods A, B and C.

13-409.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.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 Standard 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.ABC.2 Building Pressures. Mechanical systems shall be designed to assure that buildings are pressurized with respect to outdoors.

13-409.ABC.2.1 Balanced return air.

Restricted return air occurs in buildings when returns are located in central zones and closed interior doors impede air flow to the return grill or when ceiling spaces are used as return plenums and fire walls restrict air movement from one portion of the return plenum to another. Provisions shall be made in both residential and commercial buildings to avoid unbalanced air flows and pressure differentials caused by restricted return air. Pressure differentials across closed doors where returns are centrally located shall be limited to 0.01 inch WC (2.5 pascals) or less. Pressure differentials across fire walls in ceiling space plenums shall be limited to 0.01 inch WC (2.5 pascals) by providing air duct pathways or air transfer pathways from the high pressure zone to the low zone.

Exceptions:

1. Transfer ducts may achieve this by increasing the return transfer one and one-half times the cross-sectional area (square inches) of the supply duct entering the room or space it is serving and the door having at least an unrestricted 1-inch (25 mm) undercut to achieve proper return air balance.
2. Transfer grilles shall use 50 square inches (.03 m2) (of grille area) to 100 cfm (.05 m3/s) (of supply air) for sizing through-the-wall transfer grilles and using an unrestricted 1-inch (25 mm) undercutting of doors to achieve proper return air balance.
3. Habitable rooms only shall be required to meet these requirements for proper balanced return air excluding bathrooms, closets, storage rooms and laundry rooms, except that all supply air into the master suite shall be included.

13-409.ABC.3 Ventilation System Controls

13-409.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.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:

1. Gravity (non-motorized) 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 2700 HDD65.
2. Ventilation systems serving unconditioned spaces.

13-409.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 preoccupancy 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:

1. Gravity (nonmotorized) dampers are acceptable in building exhaust air systems.
2. Gravity (nonmotorized) dampers are acceptable in systems with a design outside air intake or exhaust capacity of 300 cfm or less.

13-409.ABC.3.3.1 Damper leakage. Where outdoor air supply and exhaust air dampers are required by Section 13-409.ABC.3, they shall have a maximum leakage rate at 1 in. w.g. of 4 cfm per square foot of damper area for motorized dampers when tested in accordance with AMCA Standard 500 as indicated in Table 13-409.ABC.3.3.1.

Table 13-409.ABC.3.3.1
Maximum Damper Leakage

Maximum Damper Leakage at 1.0 in. w.g. cfm per ft^2 of damper area	
Motorized	**Non-motorized**
4	Not allowed[a]

13-409.ABC.3.4 Ventilation Controls for High-Occupancy Areas. Demand Control Ventilation (DCV) is required for spaces larger than 500 ft^2 (50 m^2) with a design occupancy for ventilation of greater than 40 people per 1000 ft^2 (100 m^2) of floor area that are served by system(s) with one or more of the following: ~~Systems with design outside air capacities greater than 3000 cfm (1.4 m^3/S) serving areas having an average design occupancy density exceeding 100 people per 1000 square feet (93 m^2) 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 Standard 62 and local standards.~~

1. an air-side economizer
2. automatic modulating control of the outdoor air damper, or
3. a design outdoor airflow greater than 3000 CFM (1,400 L/s).

Exceptions:

1. Systems with heat recovery complying with Section 13-407.ABC.3.5**.**
2. Multiple-zone systems without direct-digital control of individual zones communicating with a central control panel.
3. System with a design outdoor airflow less than 1,200 CFM (600 L/s).
4. Spaces where the supply air flow rate minus any make up or outgoing transfer air requirement is less than 1,200 CFM (600 L/s).

13-409.ABC.3.5 Exhaust Hoods

13-409.ABC.3.5.1 Non-residential Kitchen Spaces. Non-residential 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:

1. 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” w.g. relative to all indoor spaces surrounding the kitchen space, during all cooking hours.
2. All exhaust and makeup air system components (fans, dampers,

etc.) shall be interlocked in such a way that the balance prescribed in #1 above is maintained throughout all cooking hours, and all variations of cooking operations.

13-409.ABC.3.5.2 Fume Hoods. Buildings with fume hood systems having a total exhaust rate greater than 15,000 cfm shall include at least one of the following features:

1. 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.
2. 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.
3. Heat recovery systems to precondition makeup air from fume hood exhaust in accordance with Section 13-407.ABC.3.5 (Exhaust Air Energy Recovery) without using any exception.

13-410 AIR DISTRIBUTION SYSTEMS

13-410.ABC Mandatory Requirements for Methods A, B and C

13-410.ABC.1 Sizing and Design Criteria

13-410.ABC.1.1 Air System Design and Control. Each HVAC system~~s~~ having a total fan system motor nameplate hp ~~power~~ exceeding 5 hp shall meet the provisions of Section ~~Table~~ 13-410.ABC.1.1.1 and Section 13-410.ABC.1.1.2 unless otherwise noted.

13-410.ABC.1.1.1 Fan System Power Limitation.

13-410.ABC.1.1.1.1 Each HVAC system at fan system design conditions shall not exceed the allowable fan system motor nameplate hp (Option 1) or fan system bhp (Option 2) as shown in Table 13-410.ABC.1.1.1A. This includes supply fans, return/relief fans, exhaust fans, and fan-powered terminal units associated with systems providing heating or cool capability.

Exceptions:

1. Hospital and laboratory systems that utilize flow control devices on exhaust and/or return to maintain space pressure relationships necessary for occupant health and safety or environmental control may use variable volume fan power limitation.
2. Individual exhaust fans with motor nameplate horsepower of 1 hp or less.
3. Fans exhausting air from fume hoods. (Note: If this exception is taken, no related exhaust side credits shall be taken from Table 13-410.ABC.1.1B and the fume Hood Exhaust Exception Deduction must be taken from Table 13-410.ABC.1.1.1B.)

13-410.ABC.1.1.1.2 Motor Nameplate Horsepower. For each fan, the selected fan motor shall be no larger than the first available motor size greater than the brake horsepower. The fan brake horsepower shall be indicated on the design documents to allow for compliance

verification by the code official.

Exceptions:

1. For fans less than 6 bhp, where the first available motor larger than the brake horsepower has a nameplate rating within 50 percent of the brake horsepower, the next larger nameplate motor size may be selected.
2. For fans 6 bhp and larger, where the first available motor larger than the brake horsepower has a nameplate rating within 30 percent of the brake horsepower, the next larger nameplate motor size may be selected.

TABLE 13-410.ABC.1.1.1A
FAN POWER LIMITATION[1]

	Limit	**Constant Volume**	**Variable Volume**
Option 1: Fan System Motor Nameplate HP	Allowable Nameplate Motor hp	$hp \leq CFM_s * 0.0011$	$hp \leq CFM_s * 0.0015$
Option 2: Fan System bhp	Allowable Fan System bhp	$bhp \leq CFM_s * 0.00094 + A$	$bhp \leq CFM_s * 0.0013 + A$

[1] Where:

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

hp = the maximum combined motor nameplate horsepower

bhp = the maximum combined fan brake horsepower

A = sum of ($PD \times CFM_D/4131$)

Where:

PD = each applicable pressure drop adjustment from Table 13-410.ABC.1.1.1B in w.c.

CFM_D = the design airflow through each applicable device from Table 13-410.ABC.1.1.1 in cubic feet per minute.

TABLE 13-410.ABC.1.1.1B
Fan Power Limitation Pressure Drop Adjustment

Device	**Adjustment**
Credits	
Fully ducted return and/or exhaust air systems	0.5 in. w.c.
Return and/or exhaust airflow control devices	0.5 in. w.c.
Exhaust filters, scrubbers, or other exhaust treatment	The pressure drop of device calculated at fan system design condition
Particulate Filtration Credit: MERV 9 through 12	0.5 in. w.c.
Particulate Filtration Credit: MERV 13 through 15	0.9 in. w.c.
Particulate Filtration Credit: MERV ≥16 and electronically enhanced filters	Pressure drop calculated at 2x clean filter pressure drop at fan system design condition
Carbon and other gas-phase air cleaners	Clean filter pressure drop at fan system design condition
Heat recovery device	Pressure drop of device at fan system design condition
Evaporative humidified/cooler in series with another cooling coil	Pressure drop of device at fan system design condition
Sound Attenuation Section	0.15 in. w.c.
Deductions	
Fume Hood Exhaust Exception (required if Section 13-410.ABC.1.1.1, Exception 3 is taken)	-1.0 in. w.c.

~~**13-410.ABC.1.1.1 Fan Power Limitation**. Fan power shall be limited by~~

the following:

1.. 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 13-410.ABC.1.1.1.

2. Where air systems require air treatment or filtering systems with pressure drops over 1 in. 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 air stream, the allowable fan system power may be adjusted using the pressure credit in the allowable fan system equation below.

3. 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.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

Allowable Fan System Power = [Fan Power Limitation X (Temperature Ratio) + Pressure Credit + Relief Fan Credit]

Where:

Fan Power Limitation = Table 13-410.ABC.1.1.1 Value X CFM_n/1000

Temperature Ratio = $(T_{t\text{-}stat} - T_S) / 20$

Pressure Credit (hp) = Sum of [CFM_n x (SP_n – 1.0) / 3718] + Sum of [CFM_{HR} x SP_{HR}/3718]

Relief Fan Credit HP (kW) = F_R HP (kW) x [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 (in. w.g.)

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

$T_{t\text{-}stat}$ = 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.ABC.1.1.2 Variable Air Volume (VAV) Fan Control (Including Systems Using Series Fan Power Boxes).

13-410.ABC.1.1.2.1 Part-Load Fan Power Limitation. Individual VAV fans with motors 10 ~~15~~ hp (11 kW) and larger shall meet one of the following:

1. The fan shall be driven by a mechanical or electrical variable-speed drive.

2. The fan shall be a vane-axial fan with variable-pitch blades.

3. 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.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 13-410.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.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.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.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 13-410.ABC.2.1 through 13-410.ABC.2.5.4.

13-410.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.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 13-410.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 13-407.ABC.3.2 and 13-408.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 m^2) need not exceed R-2; those 5 square feet (.46 m^2) or smaller need not be insulated.

5. Return air ducts meeting all the requirements of Section 13-410.ABC.3.6 for building cavities which will be used as return air plenums.

13-410.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·ft^2·^oF) is the measured apparent thermal conductivity at 75^{o}F (24^{o}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.

TABLE 13-410.ABC.2.2
MINIMUM DUCT INSULATION R-VALUES,
Combined Heating and Cooling Supply and Return Ducts

Location	Supply Duct	Return Duct
Exterior of building	R-6	R-4.2
Ventilated Attic	R-6	R-4.2
Unvented attic above insulated ceiling	R-6[3]	R4.2
Unvented attic with roof insulation	R-4.2	None
Unconditioned spaces[2]	None	None
Indirectly conditioned spaces[3]	None	None
Conditioned spaces	None	None
Buried	R-4.2	None

[1] Includes crawl spaces, both ventilated and non-ventilated.
[2] Includes return air plenums with or without exposed roofs above.
[3] R-8 duct insulation is required for Miami-Dade, Broward and Monroe Counties.

13-410.ABC.2.4 Condensation Control. Additional insulation with vapor barrier shall be provided where the minimum duct insulation requirements of 410.ABC.2.2 are determined to be insufficient to prevent condensation.
13-410.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.

410.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.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.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.ABC.3.0.2 Sealing. Air distribution system components shall be sealed with approved closure systems.

13-410.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 13-410.ABC.3 of this code, 2) inspection and 3) cleaning and maintenance. A minimum of 4" (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.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.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.ABC.3.0.6 Approved Mechanical Attachments. Approved mechanical attachments for air distribution system components include screws, rivets, welds, inter-locking 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.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 13-410.ABC.3.1 through 13-410.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 E84 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 non-metal 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 E84 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 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 non-metal 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 E84 or UL 723.

13-410.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 13-410.ABC.3.1.1 or Section 13-410.ABC.3.1.2.

13-410.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" w.g. when they conform to the approved closure and mechanical attachment requirements of Section 13-410.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.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" w.g. or greater when they conform to the approved closure and mechanical attachment requirements of Section 13-410.ABC.3.0:

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

13-410.ABC.3.1.3 High Pressure Duct Systems. High pressure duct systems designed to operate at pressures greater than 3 inches water gauge (4 inches 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.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 13-410.ABC.3.2.1.

13-410.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 13-410.ABC.3.0:

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

13-410.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 13-410.ABC.3.0.6.

13-410.ABC.3.3. Flexible Duct Systems, Non-Metal. Flexible non-metal 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 non-porous 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 13-410.ABC.3.3.1 through 13-410.ABC.3.3.6.

13-410.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.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 13-410. 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.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.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.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 13-410.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.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 ½ inch (12.7 mm) per foot of length. Supports shall be provided within 1.5 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 1½ inches (38 mm).

13-410.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 13-410. ABC.3.4.1 or Section 13-410.ABC.3.4.2.

13-410.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 13-410.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.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 13-410.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.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 13-410.ABC.3.1.

13-410.ABC.3.5.1 Approved Closure Systems. Systems conforming to the product and application standards of Section 13-410.ABC.3.0 may be used when sealing air handling units.

13-410.ABC.3.5.2 Air Handling Units. Air handling units shall not be installed in attics (see definition of “Attic” in Section 13-202).

13-410.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 13-410.ABC.2 and constructed and sealed in accordance with the requirements of Section 13-410.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 13-410.ABC.3.7 and shall be insulated in accordance with Section 13-410.ABC.2.

Building cavities which will be used as return air plenums shall be lined with a continuous air barrier made of durable non-porous 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.ABC.3.7 Mechanical Closets. The interior surfaces of mechanical closets shall be sheathed with a continuous air barrier as specified in Section 13-410.ABC.3.7.1 and shall be sealed with approved closure systems as specified in Section 13-410.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.ABC.3.7.1 Approved Air Barriers. The following air barriers are approved for use in mechanical closets:

1. One-half inch 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.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 13-410.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.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 13-410.ABC.3 and insulated according to the requirements of Section 13-410.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 13-410.ABC.3.2 or Section 13-410.ABC.3.1 for the duct type used.

13-410.ABC.4 Air Distribution System Testing, Adjusting, and Balancing.

13-410.ABC.4.1Duct 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 agency 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.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 5000 square feet (465 m^2).

13-410.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 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 13-409.ABC.2 and NFPA 96).

13-410.A Requirements Specific to Method A. Air distribution system efficiencies determined by the EnergyGauge Summit Fla/Com Method A performance calculation to demonstrate compliance with this code shall be the minimum performance level installed in buildings.

SECTION 13-411
PUMPS AND PIPING

13-411.ABC Mandatory Requirements for Methods A, B and C.

13-411.ABC.1 Hydronic System Design and Control. HVAC hydronic systems having a total pump system power exceeding 10 hp shall meet provisions of Sections 13-411.ABC.1.1 through 13-411.ABC.1.4.

13-411.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 ft (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.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.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 13-411.ABC.1.1 that use variable flow to reduce pumping energy.

13-411.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.ABC.2 Piping Insulation. Piping shall be thermally insulated in accordance with Table 13-411.ABC.2

Exceptions:

1. Factory-installed piping within HVAC equipment tested and rated in accordance with Sections 13-407.ABC.3.2 and 13-408.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.ABC.3 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.

TABLE 13-411.ABC.2
MINIMUM PIPE INSULATION (in.)[1]

Fluid Design Operating Temperature Range (°F)	Insulation Conductivity		Nominal Pipe or Tube Size (in.)				
	Conductivity Btu in/(h ft^2.°F)	Mean Temperature Rating	<1	1-1 ½ -	1 ½ to 4	4to <8	>8
Heating Systems (Steam Condensate, and Hot Water)[2,3]							
>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	1.01	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
Domestic and Service Hot Water Systems[3]							
>105	0.22-0.28-	100	0.5	0.5	1.0	1.0	1.0
Cooling Systems (Chilled Water, Brine, and Refrigerant)[4]							
40 - 60	0.22-0.28	100	0.5	1.0	1.0	1.0	1.0
<40	0.22-0.28-	100	0.5	1.5	1.5	1.0	1.5

[1]For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows: $T=r(1+t/r)^{K/k} - 1$

Where T= minimum insulation thickness (in.), r=actual outside radius of pipe (in.), t=insulation thickness listed in this table for applicable fluid temperature and pipe size, K=conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu.in.[h.ft^2.°F]; and k=upper value of the conductivity range listed in this table for applicable fluid temperature.

[2]These thicknesses are based on energy efficiency considerations only. Additional insulation is sometimes required relative to safety issues/surface temperatures.

[3]Piping insulation is not required between the control valve and coil on run-outs when the control valve is located within 4 ft. of the coil and the pipe size is in. or less.

[4]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.

SECTION 13-412
WATER HEATING SYSTEMS

13-412.ABC Mandatory Requirements for Methods A, B and C

13-412.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.ABC.2 Service Water Heating System Controls.

13-412.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.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.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 five minutes after the end of the heating cycle.

13-412.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 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.ABC.2.5 Water Flow Rate Controls.

13-412.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 showerhead shall be mechanically retained at the point of manufacture.

13-412.ABC.2.5.2 Lavatories or Restrooms of Public Facilities. Lavatories or restrooms of public facilities shall:

1. 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 non-recirculating systems.

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

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

13-412.ABC.2.6 Swimming Pool and Spa Temperature Controls

13-412.ABC.2.6.1 Time Switches. Time switches shall be installed on swimming pool heaters and pumps.

Exceptions:

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

13-412.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.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.ABC.3 Equipment Performance Standards

13-412.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 13-412.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 13-412.ABC.3 has no minimum performance requirements.

Exception: All water heaters and hot water supply boilers having more than 140 gal of storage capacity are not required to meet the standby loss (SL) requirements of Table 13-412.ABC.3 when:

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

13-412.ABC.3.2 Combination Service Water Heating and Space Heating Equipment.

13-412.ABC.3.2 4.1 Space Heating and Water Heating. The use of a gas-fired or oil-fired space heating boiler system otherwise complying with Section 13-408.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 x 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 (32 °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 m^2/kW).

13-412.ABC.3.2.2 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.ABC.3.2.3 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.ABC.3 Service Hot Water Piping Insulation. The following piping shall be insulated to levels shown in Table 13-411.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.A Requirements Specific to Method A. Water heater efficiencies determined by the EnergyGauge Summit Fla/Com Method A performance calculation to demonstrate compliance with this code shall be the minimum performance level installed in buildings.

TABLE 13-412.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	0.93-0.00132V EF	DOE 10 CRF Part 430[3]
	>12 kW	Resistance >20 gal	20+35 √V SL, Btu/h	ANSI Z21.10.3
	<24 Amps & <250Volts	Heat Pump	0.93-0.00132V EF	DOE 10 CFR Part 430[3]
Gas Storage Water Heaters	<75,000 Btu/h	> 20 gal	0.62-0.0019V EF	DOE 10 CFR Part 430[3]
	>75,000 Btu/h and	<4,000 (Btu/h)/gal	80% E_t (Q/800+110√V) SL, Btu/h	ANSI Z21.10.3
Gas Instantaneous Water Heaters	>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
	≥200,000 Btu/h	>4,000 (Btu/h)/gal and <10 gal	80% E_t	ANSI Z21.10.3
	≥200,000 Btu/h	>4,000 (Btu/h)/gal and ≥10 gal	80% E_t (Q/800+110√V) SL, Btu/h	
Oil Storage Water Heaters	<105,000 Btu/h	>20 gal	0.59-0.0019V EF	DOE 10 CFR Part 430[3]
	>105,000 Btu/h	<4,000 (Btu/h)/gal	78% E_t (Q/800+100√V) SL, Btu/h	ANSI Z21.10.3
Oil Instantaneous Water Heaters	<210,000 Btu/h	>4,000 (Btu/h)/gal and <2 gal	0.59-0.0019V EF	DOE 10 CFR Part 430
	>210,000 Btu/h	>4,000 (Btu/h)/gal and <10 gal	80% E_t	ANSI Z21.10.3
	>210,000 Btu/h	>4,000 (Btu/h)/gal and ≥10 gal	78% E_t (Q/800+110√V) SL, Btu/h	
Hot Water Supply Boilers, Gas and Oil	≥300,000 Btu/h and <12,500,000 Btu/h	>4,000 (Btu/h)/gal and <10 gal	80% E_t	ANSI Z21.10.3
Hot Water Supply Boilers, Gas		>4000 (Btu/h)/gal and ≥10 Gal	80% E_t (Q/800+110√V) SL, Btu/h	
Hot Water Supply Boilers, Oil		>4000 (Btu/h)/gal and ≥10 Gal	78% E_t (Q/800+110√V) SL, Btu/h	
Pool Heaters, Oil and Gas	All		78% E_t	ASHRAE 146
Unfired Storage Tanks	All		R-12.5	(none)
Heat Pump Pool Heaters	All	---	4.0 COP At low air temperature	ARI 1160[5]

For SI: 1 Btu/h=.2931W, $^{o}C=[(^{o}F) - 32]/1.8$

[1] Energy factor (ER) and thermal efficiency (E_t) 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 13-612.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.

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 Standard 90.1*.

13-413.ABC Mandatory Requirements for Methods A, B and C.

13-413.ABC.1 Voltage Drop

13-413.ABC.1.1 Feeders and customer owned service conductors. Feeder and customer owned service conductors shall be sized for a maximum voltage drop of 2 percent at design load.

13-413.ABC.1.2 Branch Circuits. Branch circuit conductors shall be sized for a maximum voltage drop of 3 percent at design load.

13-413.ABC.2 Completion Requirements

13-413.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.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.

SECTION 13-414
MOTORS

13-414.0 Applicability. All permanently wired electric motors shall meet the requirements of Section 13-414.ABC.1.

13-414.ABC Mandatory Requirements for Methods A, B and C.

13-414.ABC.1 Electric Motors. Electric motors shall comply with the requirements of the Energy Policy Act of 1992 where applicable, as shown in Table 13-414.ABC.1. Motors that are not included in the scope of the Energy Policy Act have no performance requirements in this section.

TABLE 13-414.ABC.1
MINIMUM NOMINAL EFFICIENCY FOR
GENERAL PURPOSE Design A and Design B Motors[1]

	Minimal Nominal Full-Load Efficiency (%)					
	Open Motors			Enclosed Motors		
Number of Poles	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	84.0	82.5	84.0	85.5
2.0	84.0	84.0	85.5	84.0	84.0	86.5
3.0	84.0	86.5	86.5	85.5	87.5	87.5
5.0	85.5	87.5	87.5	87.5	87.5	87.5
7.5	87.5	88.5	88.5	88.5	89.5	89.5
10.0	88.5	89.5	90.2	89.5	89.5	89.5
15.0	89.5	91.0	90.2	90.2	91.0	90.2
20.0	90.2	91.0	91.0	90.2	91.0	90.2
25.0	91.0	91.7	91.7	91.0	92.4	91.7
30.0	91.0	92.4	92.4	91.0	92.4	91.7
40.0	91.7	93.0	93.0	91.7	93.0	93.0
50.0	92.4	93.0	93.0	92.4	93.0	93.0
60.0	93.0	93.6	93.6	93.0	93.6	93.6
75.0	93.0	94.1	93.6	93.0	94.1	93.6
100.0	93.0	94.1	94.1	93.6	94.5	94.1
125.0	93.6	94.5	94.1	94.5	94.5	94.1
150.0	93.6	95.0	94.5	94.5	95.0	95.0
200.0	94.5	95.0	94.5	95.0	95.0	95.0

[1] Nominal efficiencies shall be established in accordance with NEMA Standard MG1. Design A and Design B are National Electric Manufacturers Association (NEMA) design class designations for fixed frequency small and medium AC squirrel-cage induction motors.

SECTION 13-415
LIGHTING

13-415.0 Applicability. Lighting systems and equipment shall comply with the requirements of 13-415.ABC and applicable requirements of Appendix 13-B. 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 dwelling ~~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.ABC Mandatory Requirements for Methods A, B and C

13-415.ABC.1 Controls

13-415.ABC.1.1 Automatic Lighting Controls. Interior lighting in buildings larger than 5,000 square feet (465 m^2) shall be controlled with an automatic control device to shut off building 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 m^2) 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 or building occupant(s).

13-415.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 multi-scene 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.

Exception: Spaces with multi-scene control.

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 m^2) area for a space 10,000 square feet (929 m^2) or less and a maximum of 10,000 square feet (929 m^2) area for a space greater than 10,000 square feet (929 m^2)., ~~and~~ All spaces shall be capable of overriding any time-of-day scheduled shut-off control for no more than four 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.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 device at the main room entry that controls all permanently installed luminaires and switched receptacles.

4. Task Lighting. Supplemental task lighting, including permanently installed undershelf or undercabinet 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. Non-visual 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.ABC.1.4 Exterior lighting control. Lighting for all exterior applications not exempted in Section 13-415.0 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 either

1. a combination of a photosensor and a time switch or

2. an astronomical time switch.

Lighting designated for dusk-to-dawn operation shall be controlled by an astronomical time switch or photosensor. All ~~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.ABC.2 Exterior lighting.

13-415.ABC.2.1 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 13-415.0 and 13-415.ABC.2.2.

13-415.ABC.2.2 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 13-415.ABC.2.2 for these applications plus an additional unrestricted allowance of 5% of that sum. Trade-offs are allowed only among exterior lighting applications listed in the Table 13-415.ABC.2.2, "Tradable Surfaces" section. Exterior lighting for all applications (except those included in the exceptions to Section 13-415.0 and this section) shall comply with the requirements of Section 13-415.ABC.2.1.

Exceptions: Lighting used for the following exterior applications is exempt when equipped with 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.ABC.3 Tandem Wiring. Luminaires designed for use with one or three linear fluorescent lamps >30 W 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.ABC.4 Exit Signs. Internally illuminated exit signs shall not exceed 5 watts per face.

TABLE 13-415.ABC.2.2
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 (freestanding 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
Non-Tradable 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

13-415.ABC.5 Interior lighting power, scope. 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 13-415.C.1 or the space-by-space method described in Section 13-415.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 13-415.ABC.5.1 shall not exceed the *interior lighting power allowance*

developed in accordance with Section13-415.C.1 or 415.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 13-415.C.1 or 13-415.B.1**,** nor shall the wattage for such lighting be included in the *installed interior lighting power* identified in accordance with Section 13-415.ABC.5.1. 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 occupants with special lighting needs including visual impairment and other medical and age-related issues ~~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.
16. Furniture mounted supplemental task lighting that is controlled by automatic shutoff and complies with Section 13-415.ABC.1.3(4).

13-415.ABC.5.1 Installed interior lighting power. The installed interior lighting power shall include all power used by the luminaires, including lamps, ballasts, transformers ~~current regulators~~, and control devices except as specifically exempted in Section 13-415.ABC.5.

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.ABC.5.2 Luminaire wattage. Luminaire wattage incorporated into the installed interior lighting power shall be determined in accordance with the criteria in Appendix 13-B, Section B4.1.1.

13-415.A Requirements Specific to Method A. Lighting levels and types determined by the EnergyGauge Summit Fla/Com Method A performance calculation to demonstrate compliance with this code shall be the maximum performance levels installed for lighting.

13-415.B Requirements Specific to Method B. Lighting levels and types determined by the EnergyGauge Summit Fla/Com Method B performance calculation to demonstrate compliance with this code shall be the maximum performance levels installed for lighting.

13-415.B.1 Space-by-Space Method of Calculating Interior Lighting Power Allowance. EnergyGauge Summit 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 13-415.B.1. 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.B.1. 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.

13-415.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 and automatically controlled, separately from the general lighting, to be turned off during non-business hours. This additional power~~,~~ 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 luminaries 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/ft^2 at 65 degrees, 33 cd/ft^2 at 75 degrees, and~~

~~17 cd/ft^2 at 85 to 90 degrees.~~

2~~3~~. For lighting equipment installed in retail spaces that is specifically designed and directed to highlight merchandise, calculate the additional lighting power as follows: ~~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.~~

Additional Interior Lighting Power Allowance =

1000 watts + (Retail Area 1 x 1.0 W/ft^2)

+ (Retail Area 2 x 1.7 W/ft^2)

+ (Retail Area 3 x 2.6 W/ft^2)

+ (Retail Area 4 x 4.2 W/ft^2).

Where

Retail Area 1 = the floor area for all products not listed in Retail Area 2, 3 or 4,

Retail Area 2 = the floor area used for the sale of vehicles, sporting goods and small electronics

Retail Area 3 = the floor area used for the sale of furniture, clothing, cosmetics and artwork.

Retail Area 4 = the floor area used for the sale of jewelry, crystal and china.

Exception: Other merchandise categories may be included in Retail Areas 2 through 4 above, provided that justification documenting the need for additional lighting power based on visual inspection, contrast, or other critical display is approved by the authority having jurisdiction.

TABLE 13-415.B.1:
Lighting Power Densities (LPD) Using the Space-By-Space Method

Common Space Types[1a]	LPD (W/ft^2)	Building Specific Space Types (Cont.)	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 & cataloguing	1.1
for Performing arts theater	3.3	Stacks	1.7
for motion picture theatre	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 theatre	2.6	Operating room	2.2
for Motion picture theatre	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.B.2)~~	
Inactive storage	0.3	Sales area[2]	1.7
for Museum	0.8	Mall concourse	1.7
Electrical/mechanical	1.5	Sports arena	
Workshop	1.9	Ring sports area	2.7
Sales area[2]	1.7	Court sports area	2.3
Building Specific Space types		Indoor playing field area	1.4
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

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

[2] For accent lighting, see Section 13-415.B.2(2).

13-415.C Requirements Specific to Method C

13-415.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 13-415.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.C.1
Lighting Power Densities Using
The Building Area Method

Building Area Type[a]	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
Multi-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

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

ASHRAE Climate Zone 2

	Nonresidential		Residential		Semiheated	
Opaque Elements	**Assembly Maximum**	**Insulation[1] Min. R-value**	**Assembly Maximum**	**Insulation[1] Min. R-value**	**Assembly Maximum**	**Insulation[1] Min. R-value**
Roofs						
Insulation entirely above deck	U-0.048 ~~U-0.063~~	R-20.0 ci ~~R-15.0 ci~~	U-0.048 ~~U-0.063~~	R-20 ci ~~R-15 ci~~	U-0.218	R-3.8 ci
Metal building	U-0.065	R-19.0	U-0.065	R-19	U-0.167	R-6.0
Attic and other	U-0.027 ~~U-0.034~~	R-38.0 ~~R-30.0~~	U-0.027	R-38	U-0.081	R-13.0
Walls, above grade						
Mass	U-0.123[2] ~~U-0.580[1]~~	R-7.6 ci[2] ~~NR~~	U-0.123[2] ~~U-0.151[1]~~	R-7.6 ci[2] ~~R-5.7 ci[1]~~	U-0.580	NR
Metal building	U-0.113	R-13.0	U-0.113	R-13.0	U-0.184	R-6.0
Steel framed	U-0.124	R-13.0	U-0.064 ~~U-0.124~~	R-13+R-7.5 ci ~~R-13.0~~	U-0.124 ~~U-0.352~~	R-13.0 ~~NR~~
Wood framed & other	U-0.089	R-13.0	U-0.089	R-13.0	U-0.089 ~~U-0.292~~	R-13.0 ~~NR~~
Walls, below grade						
Below grade wall	C-1.140	NR	C-1.140	NR	C-1.140	NR
Floors						
Mass	U-0.107 ~~U-0.137~~	R-6.3 ci ~~R-4.2 ci~~	U-0.087 ~~U-0.107~~	R-8.3 ci ~~R-6.3 ci~~	U-0.322	NR
Steel joist	U-0.052	R-19.0	U-0.052	R-19	U-0.069	R-13.0
Wood framed and other	U-0.051	R-19.0	U-0.033 ~~U-0.051~~	R-30.0 ~~R-19~~	U-0.066 ~~U-0.282~~	R-13.0 ~~NR~~
Slab-on-grade floors						
Unheated	F-0.730	NR	F-0.730	NR	F-0.730	NR
Heated	F-1.020	R-7.5 for 12 in.	F-1.020	R-7.5 for 12 in	F-1.020	R-7.5 for 12 in
Opaque doors						
Swinging	U-0.700		U-0.700		U-0.700	
Non-swinging	U-1.450		U-0.500 ~~U-1.450~~		U-1.450	
Fenestration	**Assembly Max. U ~~(Fixed/ Operable)~~**	**Assembly. Max. SHGC ~~(AllOrientations/(Fixed/ North Oriented)~~**	**Assembly Max. U ~~Operable)~~**	**Assembly Max. SHGC ~~(All Orientations/ North-Oriented)~~**	**Assembly Max. U ~~(Fixed/ Operable)~~**	**Assembly Max. SHGC ~~(All orientations/ North-Oriented)~~**
Vertical glazing, 0-40% of wall						
Nonmetal framing: all[3]	U-0.75	SHGC 0.25 all	U-0.75	SHGC 0.25 all	U-1.20	NR all
Metal frame:						
Curtainwall/storefront[4]	U-0.70	SHGC 0.25 all	U-0.70	SHGC 0.25 all	U-1.20	NR all
Entrance door[4]	U-1.10	SHGC 0.25 all	U-1.10	SHGC 0.25 all	U-1.20	NR all
All other[4]	U-0.75	SHGC 0.25 all	U-0.75	SHGC 0.25 all	U-1.20	NR all

[Delete the following rows in their entirety: 0 – 10.0%, 10.1-20.0%, 20.1 – 30%, 30.1 – 40%, 40.1 – 50%]

Skylights, Maximum 3% of Roof area	U-1.36	0.19

~~Skylight with curb, Glass, % roof~~						
~~0 – 2.0%~~	~~U_{all} 1.98~~	~~$SHGC_{all}$ 0.39~~	~~U_{all} 1.98~~	~~$SHGC_{all}$ 0.36~~	~~U_{all} 1.98~~	~~$SHGC_{all}$ NR~~
~~2.1 – 5.0%~~	~~U_{all} 1.98~~	~~$SHGC_{all}$ 0.25~~	~~U_{all} 1.98~~	~~$SHGC_{all}$ 0.19~~	~~U_{all} 1.98~~	~~$SHGC_{all}$ NR~~

~~Skylight with curb, Plastic, % roof~~

~~0 – 2.0%~~	~~U_{all} 1.90~~	~~$SHGC_{all}$ 0.65~~	~~U_{all} 1.90~~	~~$SHGC_{all}$ 0.27~~	~~U_{all} 1.90~~	~~$SHGC_{all}$ NR~~	
~~2.1 – 5.0%~~	~~U_{all} 1.90~~	~~$SHGC_{all}$ 0.39~~	~~U_{all} 1.90~~	~~$SHGC_{all}$ 0.27~~	~~U_{all} 1.90~~	~~$SHGC_{all}$ NR~~	

~~Skylight without curb, All, % roof~~

~~0 – 2.0%~~	~~U_{all} 1.36~~	~~$SHGC_{all}$ 0.39~~	~~U_{all} 1.36~~	~~$SHGC_{all}$ 0.36~~	~~U_{all} 1.36~~	~~$SHGC_{all}$ NR~~	
~~2.1 – 5.0%~~	~~U_{all} 1.36~~	~~$SHGC_{all}$ 0.25~~	~~U_{all} 1.36~~	~~$SHGC_{all}$ 0.19~~	~~U_{all} 1.36~~	~~$SHGC_{all}$ NR~~	

Lighting

Office	0.9 W//ft^2
Retail	1.3 W//ft^2
K-12	1.1 W//ft^2
Other	Per Table 13-415.C.1

HVAC Equipment

Air conditioner (0-65KBtuh)	13.0 SEER	13.0 SEER	Not allowed
Air conditioner (>65-135KBtuh)	11.3 EER, 11.5 IPLV		
Air conditioner (>135-240 KBtuh)	11.0 EER, 11.5IPLV		
Air conditioner (>240 KBtuh)	10.6 EER, 11.2IPLV		
Gas furnace (0-225 KBtuh - SP)	80% AFUE or E_t	78% AFUE	
Gas furnace (0-225 KBtuh - split)	80% AFUE or E_t	78% AFUE	
Gas furnace (>225 KBtuh)	80% E_c		
Heat pump (0 – 65 KBtuh)	13.0 SEER, 7.7 HSPF	13.0 SEER, 7.7 HSPF	Not allowed
Heat pump (>65 – 135 KBtuh)	10.6 EER, 11.0 IPLV, 3.2 COP		
Heat pump (>135 KBtuh)	10.1 EER/ 11.5 IPLV/ 3.1 COP		

Service Hot Water			Per Table 13-412.ABC.3
Gas storage	90% E_t	EF >0.67–0.0019V	
Gas instantaneous	0.81 EF or 81% E_t		
Electric storage ≤12 kW	EF >0.99–0.0012V	EF >0.97–0.00132V	
Pipe insulation (d<1.5”, d≥1.5”)	1”, 1.5”	1.0	

[1] The following definitions apply: ci= continuous insulation; NR = no (insulation) requirements.
[2] Exception to 13-402.C.1 applies for mass walls.
[3] Nonmetal framing includes framing materials other than metal with or without metal reinforcing or cladding.
[4] Metal framing includes metal framing with or without thermal break. The all other subcategory includes operable windows, fixed windows and non-entrance doors.