CHAPTER 5

COMMERCIAL ENERGY EFFICIENCY

SECTION 501
GENERAL

501.1 Scope. The requirements contained in this chapter are applicable to *commercial buildings*, or portions of commercial buildings and to multiple-family residential buildings greater than 3 stories.

501.2 Application. The *commercial building* project for shell buildings, renovations, alterations and lighting and equipment changeouts shall comply with the requirements in Sections 502 (Building envelope requirements), 503 (Building mechanical systems), 504 (Service water heating), and 505 (Electrical power and lighting systems) as applicable. The new *commercial building construction or addition* project shall comply with the requirements of Section 506, provided that the applicable prescriptive and/or mandatory provisions of Sections 502, 503, 504 and 505 are each satisfied.

SECTION 502
BUILDING ENVELOPE REQUIREMENTS

502.1 General (Prescriptive).

502.1.1 Insulation and fenestration criteria.

502.1.1.1 Shell buildings, renovations and alterations. The *building thermal envelope* shall meet the requirements of Table 502.1.1.1(1) or Table 502.1.1.1(2). See Section 101.4.3.

502.1.1.1.1 *U*-factor alternative. An assembly with a *U*-factor, *C*-factor, or *F*-factor equal or less than that specified in Table 502.1.1.1(1) or Table 502.1.1.1(2) shall be permitted as an alternative.

Table 502.1.2 Building envelope requirements opaque element, maximum *U*-factors. Reserved.

502.2 Specific insulation requirements (Prescriptive).

Table 502.2(1) Building envelope requirements—opaque assemblies. Reserved.

Table 502.2(2) Building envelope requirements—opaque assemblies. Reserved.

502.2.1 Roof assembly.

502.2.1.1 Shell buildings, renovations and alterations. The sum of the installed insulating material installed *R*-Values shall meet the minimum thermal resistance requirements as specified in Table 502.1.1.1(1) or Table 502.1.1.1.(2).

502.2.1.2 Ceiling insulation. Insulation installed on a suspended ceiling with removable ceiling tiles shall not be considered part of the minimum thermal resistance of the roof insulation unless the roof/ceiling cavity is sealed from the exterior environment.

502.2.1.3 Above ceiling cavities.

502.2.3.1 Vented Cavities. 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.

502.2.3.2 Cavities Used as Plenums. Cavities beneath a roof deck which will be used as return plenums shall have a roof insulated to at least R-19.

502.2.2 Walls.

502.2.2.1 Shell buildings, renovations and alterations.

502.2.2.1.1 Above-grade walls. The minimum thermal resistance (*R*-value) of the insulating material(s) installed in the wall cavity between the framing members and continuously on the walls shall be as specified in Table 502.1.1.1(1) or Table 502.1.1.1(2), based on framing type and construction materials used in the wall assembly. The *R*-value of integral insulation installed in concrete masonry units (CMU) shall not be used in determining compliance with Table 502.1.1.1(1) or Table 502.1.1.1(2).

502.2.2.1.2. Below-grade walls. The minimum thermal resistance (*R*-value) of the insulating material installed in, or continuously on, the below-grade walls shall be as specified in Table 502.1.1.1(1) or Table 502.1.1.1(2), and shall extend to a depth of 10 feet (3048 mm) below the outside finished ground level, or to the level of the floor, whichever is less.

502.2.3 Floors.

502.2.3.1 Shell buildings, renovations and alterations.

502.2.3.1.1 Floors over outdoor air or unconditioned space. The minimum thermal resistance (*R*-value) of the insulating material installed either between the floor framing or continuously on the floor assembly shall be as specified in Table 502.1.1.1(1) or Table 502.1.1.1(2), based on construction materials used in the floor assembly.

502.2.3.1.2 Slabs on grade. The minimum thermal resistance (*R*-value) of the insulation around the perimeter of heated slab-on-grade floors shall be R-7.5 for 12 inches below the top of the slab or to the top of the footing, whichever is less, or downward to at least the bottom of the slab and then horizontally to the interior or exterior for the total distance.

TABLE 502.1.1.1 (1)
ENVELOPE PRESCRIPTIVE MEASURES FOR SHELL BUILDINGS[a, b]

BUILDING ELEMENT	MANDATORY
Roof:	
Absorptance	≤ 0.22
R-value (*U*-value)	≥ R 40 (≤ U-0.025)
Wall:	
Above grade wall	
Absorptance	≤ 0.3
R-value (*U*-value)	≥ R 30 (U ≤ 0.032)
Below grade wall	No requirement
Raised floor insulation:	
R-value (*U*-value)	R ≥ 30 (*U* ≤ 0.032)
Window:	
***U*-factor**	≤ 0.45
SHGC	
0 - 40% WW Ratio	≤ 0.25
40 - 50% WW Ratio	≤ 0.19
> 50% WW Ratio	Not allowed[c]
Opaque **Door:**	
***U*-value**	
Swinging	≤ 0.70
Non-swinging	≤ 1.45
Skylights:	
SHGC	≤ 0.19
U-factor	≤ 1.36

a. Equipment and lighting shall meet the efficiencies of Section 503, 504 and 505, respectively.
b. Per Section 101.4.9 of the FBC-EC, the building shall demonstrate compliance with Section 506 when completion of the building is permitted.
c. Buildings with greater than 50% WW Ratio shall comply with Section 506.

502.2.4 Doors.

502.2.4.1 Shell buildings, renovations and alterations.

502.2.4.1.1 Opaque doors. Opaque doors (doors having less than 50 percent glass area) shall meet the applicable requirements for doors as specified in Table 502.1.1.1(1) or Table 502.1.1.1(2).

502.2.5 Fenestration (Prescriptive).

502.2.5.1 Shell buildings, renovations and alterations. Fenestration shall comply with Table 502.1.1.1(1) or Table 502.1.1.1(2).

502.2.5.1.1 Maximum area. The vertical fenestration area (not including opaque doors) shall not exceed the percentage of the gross wall area specified in Table 502.1.1.1(1) or Table 502.1.1.1(2). The skylight area shall not exceed 3 percent of the gross roof area.

502.2.5.1.2 Maximum *U*-factor and SHGC. For vertical fenestration, the maximum *U*-factor and solar heat gain coefficient (SHGC) shall be as specified in Table 502.1.1.1(1) or Table 502.1.1.1(2), based on the window projection factor. For skylights, the maximum *U*-factor and solar heat gain coefficient (SHGC) shall be as specified in Table 502.1.1.1(1) or Table 502.1.1.1(2).

The window projection factor shall be determined in accordance with Equation 5-1.

$$PF = A/B \qquad \textbf{(Equation 5-1)}$$

where:

PF = Projection factor (decimal).

A = Distance measured horizontally from the furthest continuous extremity of any overhang, eave, or permanently attached shading device to the vertical surface of the glazing.

B = Distance measured vertically from the bottom of the glazing to the underside of the overhang, eave, or permanently attached shading device.

Where different windows or glass doors have different *PF* values, they shall each be evaluated separately, or an area-weighted *PF* value shall be calculated and used for all windows and glass doors.

Table 502.3 Building envelope requirements: fenstration. Reserved.

502.3 Air leakage (Mandatory).

502.3.1 Window and door assemblies. The air leakage of window and sliding or swinging door assemblies that are part of the building envelope shall be determined in accordance with AAMA/WDMA/CSA 101/I.S.2/A440, or NFRC 400 by an accredited, independent laboratory, and *labeled* and certified by the manufacturer and shall not exceed the values in Section 402.4.4.

Exception: Site-constructed windows and doors that are weatherstripped or sealed in accordance with Section 502.3.3.

502.3.2 Curtain wall, storefront glazing and commercial entrance doors. Curtain wall, *storefront* glazing and commercial-glazed swinging entrance doors and revolving doors shall be tested for air leakage at 1.57 pounds per square foot (psf) (75 Pa) in accordance with ASTM E 283. For curtain walls and *storefront* glazing, the maximum air leakage rate shall be 0.3 cubic foot per minute per square foot (cfm/ft^2) (5.5 m^3/h × m^2) of fenestration area. For commercial glazed swinging entrance doors and revolving doors, the maximum air leakage rate shall be 1.00 cfm/ft^2 (18.3 m^3/h × m^2) of door area when tested in accordance with ASTM E 283.

502.3.3 Sealing of the building envelope. Openings and penetrations in the building envelope shall be sealed with caulking materials or closed with gasketing systems compatible with the construction materials and location. Joints and seams shall be sealed in the same manner or taped or covered with a moisture vapor-permeable wrapping material. Sealing materials spanning joints between construction materials shall allow for expansion and contraction of the construction materials.

502.3.4 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.

502.3.5 Building cavities.

502.3.5.1 Vented dropped ceiling cavities. 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. See the definition of air barrier in Section 202.

TABLE 502.1.1.1 (2)
ENVELOPE PRESCRIPTIVE MEASURES FOR RENOVATIONS AND ALTERATIONS[1]

BUILDING ELEMENT	MANDATORY
Roof:	
Absorptance	≤ 0.22
R-value (*U*-value)	≥ R 38 (U ≤ 0.033)
Wall:	
Above grade wall	
Absorptance	≤ 0.3
R-value (*U*-value)	≥ R 19(≤ U 0.052)
Below grade wall	No requirement
Raised floor insulation:	
R-value (*U*-value)	≥ R 19 (≤ U 0.052)
Window:	
***U*-factor**	≤ 0.45
SHGC	
0 - 40% WW Ratio	≤ 0.25
> 40% WW Ratio	≤ 0.25
Skylights:	
SHGC	≤ 0.19
U-factor	≤ 1.36
Opaque Door *U*-value:	
Swinging	≤ 0.7
Non-swinging	≤ 1.45

1. Equipment and lighting shall meet the efficiencies of Section 503, 504 and 505, respectively.

502.3.5.2 Unvented dropped ceiling cavities. 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.

502.3.5.3 Separate tenancies. 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.

502.3.5.4 Air distribution system components. Building cavities designed to be air distribution system components shall be sealed according to the criteria for air ducts, plenums, etc. in Section 503.2.7.

502.3.6 Loading dock weather-seals. Cargo doors and loading dock doors shall be equipped with weather-seals to restrict infiltration when vehicles are parked in the doorway.

502.3.7 Vestibules. Reserved.

502.3.8 Recessed lighting. Recessed luminaires installed in the *building thermal envelope* shall be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaires shall be IC-rated and *labeled* as meeting ASTM E 283 when tested at 1.57 psf (75 Pa) pressure differential with no more than 2.0 cfm (0.944 L/s) of air movement from the *conditioned space* to the ceiling cavity. All recessed luminaires shall be sealed with a gasket or caulk between the housing and interior wall or ceiling covering.

SECTION 503
BUILDING MECHANICAL SYSTEMS

503.1 General. Mechanical systems and equipment serving the building heating, cooling or ventilating needs shall comply with Section 503.2 (referred to as the mandatory provisions) and either:

1. Section 503.3 (Simple systems), or
2. Section 503.4 (Complex systems).

503.2 Provisions applicable to all mechanical systems (Mandatory).

503.2.1 Calculation of heating and cooling loads. Design loads shall be determined in accordance with the procedures described in the ASHRAE/ACCA Standard 183 or ACCA Manual N and 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. Heating and cooling loads shall be adjusted to account for load reductions that are achieved when energy recovery systems are utilized in the HVAC system in accordance with the ASHRAE *HVAC Systems and Equipment Handbook*. Alternatively,

design loads shall be determined by an *approved* equivalent computation procedure, using the design parameters specified in Chapter 3.

Exception: 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 to the building department in lieu of the complete sizing calculation(s). Such summary sheet shall include the following (by zone):

1. Project name/owner
2. Project address
3. Area in square feet
4. Sizing method used
5. Outdoor dry bulb use
6. Indoor dry bulb
7. Outdoor wet bulb used
8. Grains water (difference)
9. Total sensible gain
10. Total latent gain
11. Relative humidity
12. Total cooling required with outside air
13. Total heating required with outside air

503.2.2 Equipment and system sizing. Equipment and system sizing. Heating and cooling equipment and systems capacity shall not exceed the loads calculated in accordance with Section 503.2.1. A single piece of equipment providing both heating and cooling must satisfy this provision for one function with the capacity for the other function as small as possible, within available equipment options.

Exceptions:

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

503.2.2.1 Assembly occupancies. Buildings that 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.

503.2.3 HVAC equipment performance requirements. Equipment shall meet the minimum efficiency requirements of Tables 503.2.3(1), 503.2.3(2), 503.2.3(3), 503.2.3(4), 503.2.3(5), 503.2.3(6), 503.2.3(7), and 503.2.3(8) when tested and rated in accordance with the applicable test procedure. The efficiency shall be verified through certification under an *approved* certification program or, if no certification program exists, the equipment efficiency ratings shall be supported by data furnished by the manufacturer. Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all stated requirements. Where components, such as indoor or outdoor coils, from different manufacturers are used, calculations and supporting data shall be furnished by the designer that demonstrates that the combined efficiency of the specified components meets the requirements herein.

Exception: Water-cooled centrifugal water-chilling packages listed in Table 503.2.3(7) not designed for operation at AHRI Standard 550/590 test conditions of 44°F (7°C) leaving chilled water temperature and 85°F (29°C) entering condenser water temperature with 3 gpm/ton (0.054 L/s/kW) condenser water flow shall have maximum full load and NPLV ratings adjusted using the following equations:

Adjusted maximum full load kW/ton rating = [full load kW/ton from Table 503.2.3(7)]/K_{adj}

Adjusted maximum NPLV rating = [IPLV from Table 503.2.3(7)]/K_{adj}

where:

K_{adj} = 6.174722 - 0.303668(X) + 0.00629466(X)2 - 0.000045780(X)3

X = DT_{std} + LIFT

DT_{std} = {24+[full load kW/ton from Table 503.2.3(7)] × 6.83}/Flow

Flow = Condenser water flow (GPM)/Cooling Full Load Capacity (tons)

LIFT = CEWT – CLWT (°F)

CEWT = Full Load Condenser Entering Water Temperature (°F)

CLWT = Full Load Leaving Chilled Water Temperature (°F)

The adjusted full load and NPLV values are only applicable over the following full-load design ranges:

Minimum Leaving Chilled Water Temperature: 38°F (3.3°C)

Maximum Condenser Entering Water Temperature: 102°F (38.9°C)

Condensing Water Flow: 1 to 6 gpm/ton 0.018 to 0.1076 1/s . kW) and x ≥ 39 and ≤ 60

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

503.2.4 HVAC system controls. Each heating and cooling system shall be provided with thermostatic controls as required in Section 503.2.4.1, 503.2.4.2, 503.2.4.3, 503.2.4.4, 503.4.2, 503.4.3 or 503.4.4.

503.2.4.1 Thermostatic controls. The supply of heating and cooling energy to each zone shall be controlled by individual thermostatic controls capable of 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 heat losses or gains or both serving one or more perimeter 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 (within +/- 45 degrees) (0.8 rad) for more than 50 contiguous feet (15.2 m); and
2. The perimeter system heating and cooling supply is controlled by a thermostat(s) located within the zone(s) served by the system.

503.2.4.1.1 Heat pump supplementary heat. Heat pumps having supplementary electric resistance heat shall have controls that, except during defrost, prevent supplementary heat operation when the heat pump can meet the heating load.

503.2.4.2 Setpoint overlap restriction. Where used to control both heating and cooling, *zone* thermostatic controls shall provide a temperature range or dead band of at least 5°F (2.8°C) within which the supply of heating and cooling energy to the zone is capable of being shut off or reduced to a minimum.

Exception: Thermostats requiring manual changeover between heating and cooling modes.

503.2.4.3 Off-hour controls. Each zone shall be provided with thermostatic setback controls that are controlled by either an automatic time clock or programmable control system.

Exceptions:

1. Zones that will be operated continuously.
2. Zones with a full HVAC load demand not exceeding 6,800 Btu/h (2 kW) and having a readily accessible manual shutoff switch.

503.2.4.3.1 Thermostatic setback capabilities. Thermostatic setback controls shall have the capability to set back or temporarily operate the system to maintain zone temperatures down to 55°F (13°C) or up to 85°F (29°C).

503.2.4.3.2 Automatic setback and shutdown capabilities. Automatic time clock or programmable controls shall be capable of starting and stopping the system for seven different daily schedules per week and retaining their programming and time setting during a loss of power for at least 10 hours. Additionally, the controls shall have a manual override that allows temporary operation of the system for up to 2 hours; a manually operated timer capable of being adjusted to operate the system for up to 2 hours; an occupancy sensor; or 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.

503.2.4.3.3 Humidistatic control. Where humidification, or dehumidification, or both is provided, the following shall be met:

1. At least one humidity control device shall be provided for each humidity control system.
2. Controls 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, as approved by the building official.

503.2.4.4 Shutoff damper controls. Both outdoor air supply and exhaust ducts shall be equipped with dampers that will automatically shut when the systems or spaces served are not in use.

503.2.4.5 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.

503.2.4.6 Air distribution system 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.

503.2.5 Ventilation. Ventilation, either natural or mechanical, shall be provided in accordance with Chapter 4 of the *Florida Building Code, Mechanical*. Where mechanical ventilation is provided, the system shall provide the capability to reduce the outdoor air supply to the minimum required by Chapter 4 of the *Florida Building Code, Mechanical.*

503.2.5.1 Demand controlled ventilation. Demand control ventilation (DCV) is required for spaces larger than 500 ft^2 (50 m^2) and with an average occupant load of 40 people per 1000 ft^2 (93 m^2) of floor area (as established in Table 403.3 of the *Florida Building Code, Mechanical*) and served by systems with one or more of the following:

1. An air-side economizer;
2. Automatic modulating control of the outdoor air damper; or
3. A design outdoor airflow greater than 3,000 cfm (1400 L/s).

Exceptions:

1. Systems with energy recovery complying with Section 503.2.6.
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 airflow rate minus any makeup or outgoing transfer air requirement is less than 1,200 cfm (600 L/s).

503.2.5.2 Outdoor air intakes and exhaust openings.

503.2.5.2.1 Stair and elevator 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.

Exception: Gravity (nonmotorized) dampers are permitted to be used in buildings less than three stories in height above grade.

503.2.5.2.2 Exhaust hoods.

503.2.5.2.2.1 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 inch 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 item 1 above is maintained throughout all cooking hours, and all variations of cooking operations.

503.2.5.2.2.2 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 503.2.6 (Exhaust Air Energy Recovery) without using any exception.

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

Exception: Ventilation systems serving unconditioned spaces.

503.2.5.4 Shutoff damper controls. Both outdoor air supply and exhaust ducts shall be equipped with 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.

503.2.5.4.1 Damper leakage. Motorized dampers shall be not less than a Class I leakage-rated damper with a maximum leakage rate of 4 cfm per square foot (6.8 L/s · C m^2) at 1.0 inch water gauge (w.g.) (1250 Pa) when tested in accordance with AMCA 500D.

503.2.6 Exhaust air energy recovery for cooling systems. Individual cooling fan systems that have both a design sup-

TABLE 503.2.3(1)
UNITARY AIR CONDITIONERS AND CONDENSING UNITS, ELECTRICALLY OPERATED, MINIMUM EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY[b]	TEST PROCEDURE[a]
Air conditioners, Air cooled	< 65,000 Btu/h[d]	Split system	13.0 SEER	AHRI 210/240
		Single package	13.0 SEER	
	≥ 65,000 Btu/h and < 135,000 Btu/h	Split system and Single package	11.2 EER[c] 11.4 IEER[c]	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Split system and Single package	11.0 EER[c] 11.2 IEER[c]	AHRI 340/360
	≥ 240,000 Btu/h and < 760,000 Btu/h	Split system and Single package	10.0 EER[c] 10.1 IEER[c]	
	≥ 760,000 Btu/h	Split system and Single package	9.7 EER[c] 9.8 IEER[c]	
Through-the-wall, Air cooled	< 30,000 Btu/h[d]	Split system	12.0 SEER	AHRI 210/240
		Single package	12.0 SEER	
Space constrained products, air conditioners	< 65,000 Btu/h[c]	Split system or Single package	12.0 SEER[e]	
Air conditioners, Water and Evaporatively cooled	< 65,000 Btu/h	Split system and Single package	12.1 EER 12.3 IEER[c]	AHRI 210/240
	≥ 65,000 Btu/h and < 135,000 Btu/h	Split system and Single package	11.5 EER[c] 11.7 IEER[c]	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Split system and Single package	11.0 EER[c] 11.2 IEER[c]	AHRI 340/360
	≥ 240,000 Btu/h	Split system and Single package	11.0 EER[c] 11.1 IEER[c]	

For SI: 1 British thermal unit per hour = 0.2931 W.

a. Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

b. IPLVs are only applicable to equipment with capacity modulation.

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

d. Single-phase air-cooled air conditioners < 65,000 Btu/h are regulated by the National Appliance Energy Conservation Act of 1987 (NAECA); SEER values are those set by NAECA.

e. 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 503.2.3(2)
UNITARY AND APPLIED HEAT PUMPS, ELECTRICALLY OPERATED, MINIMUM EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY[b]	TEST PROCEDURE[a]
Air cooled, (Cooling mode)	< 65,000 Btu/h[d]	Split system	13.0 SEER	AHRI 210/240
		Single package	13.0 SEER	
	≥ 65,000 Btu/h and < 135,000 Btu/h	Split system and Single package	11.0 EER[c] 11.2 IEER[c]	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Split system and Single package	10.6 EER[c] 10.7 IEER[c]	AHRI 340/360
	≥ 240,000 Btu/h	Split system and Single package	9.5 EER[c] 9.6 IEER[c]	
Through-the-Wall (Air cooled, cooling mode)	< 30,000 Btu/h[d]	Split system	12.0 SEER	AHRI 210/240
		Single package	12.0 SEER	
Space constrained products, heat pumps, cooling mode	< 65,000 Btu/h[c]	Split system or Single package	12.0 SEER[e]	
Space constrained products, heat pumps, heating mode	< 65,000 Btu/h	Split system or Single package	7.4 HSPF	
Air Water Source (Cooling mode)	< 17,000 Btu/h	86ºF entering water	11.2 EER	AHRI/ASHRAE 13256-1
	≥ 17,000 Btu/h and < 135,000 Btu/h	86ºF entering water	12.0 EER	AHRIASHRAE 13256-1
Groundwater Source (Cooling mode)	< 135,000 Btu/h	59ºF entering water	16.2 EER	AHRI/ASHRAE 13256-1
Ground source (Cooling mode)	< 135,000 Btu/h	77ºF entering water	13.4 EER	AHRI/ASHRAE 13256-1
Air cooled (Heating mode)	< 65,000 Btu/h[d] (Cooling capacity)	Split system	7.7 HSPF	AHRI 210/240
		Single package	7.7 HSPF	
	≥ 65,000 Btu/h and < 135,000 Btu/h (Cooling capacity)	47ºF db/43ºF wb Outdoor air	3.3 COP	
	≥ 135,000 Btu/h (Cooling capacity)	47ºF db/43ºF wb Outdoor air	3.2 COP	AHRI 340/360

(continued)

TABLE 503.2.3(2)—continued
UNITARY AIR CONDITIONERS AND CONDENSING UNITS, ELECTRICALLY OPERATED, MINIMUM EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY[b]	TEST PROCEDURE[a]
Through-the-wall (Air cooled, heating mode)	< 30,000 Btu/h	Split System	7.4 HSPF	AHRI 210/240
		Single package	7.4 HSPF	
Water source (Heating mode)	< 135,000 Btu/h (Cooling capacity)	68°F entering water	4.2 COP	AHRI/ASHRAE 13256-1
Groundwater source (Heating mode)	< 135,000 Btu/h (Cooling capacity)	50°F entering water	3.6 COP	AHRI/ASHRAE 13256-1
Ground source (Heating mode)	< 135,000 Btu/h (Cooling capacity)	32°F entering water	3.1 COP	AHRI/ASHRAE 13256-1

For SI: °C = [(°F) - 32]/1.8, 1 British thermal unit per hour = 0.2931 W.
db = dry-bulb temperature, °F; wb = wet-bulb temperature, °F.

a. Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
b. IPLVs and Part load rating conditions are only applicable to equipment with capacity modulation.
c. Deduct 0.2 from the required EERs and IEERs or units with a heating section other than electric resistance heat.
d. Single-phase air-cooled heat pumps < 65,000 Btu/h are regulated by the National Appliance Energy Conservation Act of 1987 (NAECA), SEER and HSPF values are those set by NAECA.
e. 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 503.2.3(3)
PACKAGED TERMINAL AIR CONDITIONERS AND PACKAGED TERMINAL HEAT PUMPS, SINGLE PACKAGED VERTICAL AIR CONDITIONERS AND HEAT PUMPS, ROOM AIR CONDITIONERS, AND ROOM AIR CONDITIONER HEAT PUMPS MINIMUM EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY[b]	TEST PROCEDURE[a]
PTAC (Cooling mode) Standard size	All capacities	95°F db outdoor air	12.5 - (0.213 · Cap/1000) EER	AHRI 310/380
PTAC (Cooling mode) Nonstandard size	All capacities	≥ 95°F db outdoor air	10.9 - (0.213 · Cap/1000) EER	
PTHP (Cooling mode) Standard size	All capacities	95°F db outdoor air	12.3 - (0.213 · Cap/1000) EER	
PTHP (Cooling mode) Nonstandard size	All capacities	95°F db outdoor air	10.8 - (0.213 · Cap/1000) EER	
PTHP (Heating mode) Standard size	All capacities	—	3.2 - (0.026 · Cap/1000) COP	
PTHP (Heating mode) Nonstandard size	All capacities	—	2.9 - (0.026 · Cap/1000) COP	
SPVAC (Cooling mode)	< 65,000 Btu/h ≥ 65,000 < 135,000 Btu/h ≥ 135000 < 240,000 Btu/h	95°F db/75°F wb outdoor air	9.0 EER 8.9 EER 8.6 EER	AHRI 390
SPVHP (Cooling mode)	< 65,000 Btu/h ≥ 65,000 < 135,000 Btu/h ≥ 135,000 < 240,000 Btu/h	95°F db/75°F wb outdoor air	9.0 EER 8.9 EER 8.6 EER	
SPVHP (Heating mode)	< 65,000 Btu/h ≥ 65,000 < 135,000 Btu/h ≥ 135,000 < 240,000 Btu/h	47°F db/43°F wb outdoor air	3.0 COP 3.0 COP 2.9 COP	
Room air conditioners with louvered sides	< 6,000 Btu/h ≥ 6,000 < 8,000 Btu/h ≥ 8,000 < 14,000 Btu/h ≥ 14,000 < 20,000 Btu/h ≥ 20,000 Btu/h		9.7 EER 9.7 EER 9.8 EER 9.7 EER 8.5 EER	ANSI/AHAM RAC-1
Room air conditioners without louvered sides	< 8,000 Btu/h ≥ 8,000 < 20,000 Btu/h		9.0 EER 8.5 EER	
Room air conditioner heat pumps with louvered sides	< 20,000 ≥ 20,000 Btu/h		9.0 EER 8.5 EER	
Room air conditioner heat pumps without louvered sides	< 1,400 ≥ 1,400 Btu/h		8.5 EER 8.0 EER	
Room air conditioner, casement only	All capacities		8.7 EER	
Room air conditioner, casement-Slider	All capacities		9.5 EER	

For SI: °C - [(°F) - 32]/1.8, 1 British thermal unit per hour - 0.2931 W.
db = dry-bulb temperature, °F.
wb = wet-bulb temperature, °F.

a. Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

b. 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.

c. Nonstandard size units must be factory labeled as follows: "MANUFACTURED FOR NONSTANDARD SIZE APPLICATIONS ONLY: NOT TO BE INSTALLED IN NEW CONSTRUCTION PROJECTS." Nonstandard size efficiencies apply only to units being installed in existing sleeves having an external wall opening of less than 16 inches (406 mm) high or less than 42 inches (1067 mm) wide and having a cross-sectional area less than 670 in^2.

TABLE 503.2.3(4)
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 (INPUT)	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY [d, e]	TEST PROCEDURE[a]
Warm air furnaces, gas fired	< 225,000 Btu/h	—	78% AFUE or 80% E_t[c]	DOE 10 CFR Part 430 or Section 2.39, Thermal Efficiency, of ANSI Z21.47
	≥ 225,000 Btu/h	Maximum capacity[c]	80% E_t[f]	Section 2.39, Thermal Efficiency, of ANSI Z21.47
Warm air furnaces, oil fired	< 225,000 Btu/h	—	78% AFUE or 80% E_t[c]	DOE 10 CFR Part 430 or Section 42, Combustion, of UL 727
	≥ 225,000 Btu/h	Maximum capacity[b]	81% E_t[g]	Section 42, Combustion, of UL 727
Warm air duct furnaces, gas fired	All capacities	Maximum capacity[b]	80% E_c	Section 2.10, Efficiency, of ANSI Z83.8
Warm air unit heaters, gas fired	All capacities	Maximum capacity[b]	80% E_c	Section 2.10, Efficiency, of ANSI Z83.8
Warm air unit heaters, oil fired	All capacities	Maximum capacity[b]	80% E_c	Section 40, Combustion, of UL 731

For SI: 1 British thermal unit per hour = 0.2931 W.

a. Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

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

c. Combination units not covered by the National Appliance Energy Conservation Act of 1987 (NAECA) (3-phase power or cooling capacity greater than or equal to 65,000 Btu/h [19 kW]) shall comply with either rating.

d. E_t = Thermal efficiency. See test procedure for detailed discussion.

e. E_c = Combustion efficiency (100% less flue losses). See test procedure for detailed discussion.

f. E_c = Combustion efficiency. Units must also include an IID, have jackets not exceeding 0.75 percent of the input rating, and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for those furnaces where combustion air is drawn from the conditioned space.

g. E_t = Thermal efficiency. Units must also include an IID, have jacket losses not exceeding 0.75 percent of the input rating, and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for those furnaces where combustion air is drawn from the conditioned space.

TABLE 503.2.3(5)
BOILERS, GAS- AND OIL-FIRED, MINIMUM EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE[f]	SIZE CATEGORY	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY[b]	TEST PROCEDURE[e]
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 Btu/h	Minimum capacity[b]	80% E_t (See Note c, d)	DOE 10 CFR Part 431
	> 2,500,000 Btu/h[f]	Hot water	82% E_c (See Note c, d)	
		Steam Natural draft Other	77% E_t 79% E_t (See Note c, d)	
Boilers, Oil-fired	< 300,000 Btu/h	—	80% AFUE	DOE 10 CFR Part 430
	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h	Minimum capacity[b]	82% E_t and 84% E_c (See Note c, d)	DOE 10 CFR Part 431
	> 2,500,000 Btu/h[a]	Hot water	84% E_c (See Note c, d)	
		Steam	81% E_c (See Note c, d)	
Boilers, Oil-fired (Residual)	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h	Minimum capacity[b]	82% E_t and 84% E_c (See Note c, d)	DOE 10 CFR Part 431
	> 2,500,000 Btu/h[a]	Hot water	84% E_c (See Note c, d)	
		Steam	81% E_t (See Note c, d)	

For SI: 1 British thermal unit per hour = 0.2931 W.

a. Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

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

c. E_c = Combustion efficiency (100 percent less flue losses). See reference document for detailed information.

d. E_t = Thermal efficiency. See reference document for detailed information.

e. Alternative test procedures used at the manufacturer's option are ASME PTC-4.1 for units greater than 5,000,000 Btu/h input, or ANSI Z21.13 for units greater than or equal to 300,000 Btu/h and less than or equal to 2,500,000 Btu/h input.

f. 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.

TABLE 503.2.3(6)
CONDENSING UNITS, ELECTRICALLY OPERATED, MINIMUM EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY	MINIMUM EFFICIENCY[b]	TEST PROCEDURE[a]
Condensing units, air cooled	≥ 135,000 Btu/h	10.1 EER 11.2 IPLV	AHRI 365
Condensing units, water or evaporatively cooled	≥ 135,000 Btu/h	13.1 EER 13.1 IPLV	

For SI: 1 British thermal unit per hour = 0.2931 W.

a. Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

b. IPLVs are only applicable to equipment with capacity modulation.

TABLE 503.2.3(7)
WATER CHILLING PACKAGES, EFFICIENCY REQUIREMENTS[a]

Equipment Type	Size Category	Units	Path A		Path B		Test Procedure
			Full Load	IPLV	Full Load	IPLV	
Air-cooled chillers	< 150 tons	EER	≥ 9.562	≥ 12.500	NA[d]	NA[d]	AHRI 550/590
	≥ 150 tons	EER	≥ 9.562	≥ 12.500	NA[d]	NA[d]	
Air cooled wihtout condenser, electrically operated	All capacities	EER	Air-cooled chillers without condensers must be rated with matching condensers and comply with the air-cooled chiller efficiency requirements				
Water cooled, electrically operated, reciprocating	All capacities	kW/ton	Reciprocating units must comply with water cooled positive displacement efficiency requirements.				
Water cooled, electrically operated, positive displacement	< 75 tons	kW/ton	≤ 0.780	≤ 0.630	≤ 0.800	≤ 0.600	
	≥ 75 tons and < 150 tons	kW/ton	≤ 0.775	≤ 0.615	≤ 0.790	≤ 0.586	
	≥ 150 tons and < 300 tons	kW/ton	≤ 0.680	≤ 0.580	≤ 0.718	≤ 0.540	
	≥ 300 tons	kW/ton	≤ 0.620	≤ 0.540	≤ 0.639	≤ 0.490	
Water cooled, electrically operated, centrifugal	< 300 tons	kW/ton	≤ 0.634	≤ 0.596	≤ 0.639	≤ 0.450	
	≥ 300 tons and < 600 tons	kW/ton	≤ 0.576	≤ 0.549	≤ 0.600	≤ 0.400	
	≥ 600 tons	kW/ton	≤ 0.570	≤ 0.539	≤ 0.590	≤ 0.400	
Air cooled, absorption single effect	All capacities	COP	≥ 0.600	NR[d]	NA[d]	NA[d]	AHRI 560
Water-cooled, absorption single effect	All capacities	COP	≥ 0.700	NR[d]	NA[d]	NA[d]	
Absorption double effect, indirect-fired	All capacities	COP	≥ 1.000	≥ 1.050	NA[d]	NA[d]	
Absorption double effect, direct-fired	All capacities	COP	≥ 1.000	≥ 1.000	NA[d]	NA[d]	

For SI: 1 British thermal unit per hour = 0.2931 W.

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

b. Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

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

d. NA means that this requirement is not applicable and cannot be used for compliance.

e. NR means that there are no minimum requirements for this category.

TABLE 503.2.3(8)
PERFORMANCE REQUIREMENTS FOR HEAT REJECTION EQUIPMENT

Equipment Type	Total System Heat Rejection Capacity at Rated Conditions	Subcategory or Rating Condition	Performance Required[1,2]	Test Procedure[3, 4]
Propeller or Axial Fan Open-Circuit Cooling Towers	All	95°F entering water 85°F leaving water 75°F entering wb	≥ 38.2 gpm/hp	CTI ATC-105 and CTI STD-201
Centrifugal Fan Open-Circuit Cooling Towers	All	95°F entering water 85°F leaving water 75°F entering wb	≥ 20.0 gpm/hp	CTI ATC-105 and CTI STD-201
Propeller or Axial Fan Closed-Circuit Cooling Towers	All	102°F entering water 90°F leaving water 75°F entering wb	≥ 14.0 gpm/hp	CTI ATC-105S and CTI STD-201
Centrifugal Closed-Circuit Cooling Towers	All	102°F entering water 90°F leaving water 75°F entering wb	≥ 7.0 gpm/hp	CTI ATC-105S 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	AHRI 460

1. For purposes of this table, open-circuit cooling tower performance is defined as the water flow rating of the tower at the thermal rating condition listed in Table 503.2.3(8) divided by the fan motor nameplate power.
2. For the purposes of this table, closed-circuit cooling tower performance is defined as the process water flow rating of the tower at the thermal rating condition listed in Table 505.2.3(8) divided by the sum of the fan motor nameplate power and the integral spray pump motor nameplate power.
3. For purposes of this table, air-cooled condenser performance is defined as the heat rejected from the refrigerant divided by the fan motor nameplate power.
4. Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
5. The efficiencies and test procedures for both open- and closed-circuit cooling towers listed in Table 503.2.3(8) are not applicable to hybrid cooling towers that contain a combination of separate wet and dry heat exchange sections.

ply air capacity of 5,000 cfm (2.36 m^3/s) or greater and a minimum outside air supply of 70 percent or greater of the design supply air quantity shall have an energy recovery system that provides a change in the enthalpy of the outdoor air supply of 50 percent or more of the difference between the outdoor air and return air at design conditions.

Exception: An energy recovery ventilation system shall not be required in any of the following conditions:

1. Where energy recovery systems are prohibited by the *Florida Building Code, Mechanical*.
   - 1.1 Systems exhausting toxic, flammable, paint or corrosive fumes or dust.
   - 1.2 Commercial kitchen hoods (grease) used for collecting and removing grease vapors and smoke.
2. Laboratory fume hood systems that include at least one of the following features:
   - 2.1. 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.
   - 2.2. Direct makeup (auxiliary) air supply equal to at least 75 percent of the exhaust rate, heated no warmer than 2°F (1.1°C) below room setpoint, cooled to no cooler than 3°F (1.7°C) above room setpoint, no humidification added, and no simultaneous heating and cooling used for dehumidification control.
   - 2.3. Where the largest exhaust source is less than 75 percent of the design outdoor airflow.
3. Systems serving spaces that are not cooled
4. Systems requiring dehumidification that employ series-style energy recovery coils wrapped around the cooling coil.

503.2.7 Duct and plenum insulation, construction and sealing (Mandatory).

503.2.7.1 Insulation.

503.2.7.1.1 Insulation required. All supply and return air ducts and plenums shall be insulated to the levels shown in Table 503.2.7.1.

Exceptions:

1. When located within equipment.
2. When the design temperature difference between the interior and exterior of the duct or plenum does not exceed 15°F (8°C).
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-5.

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 for building cavities which will be used as return air plenums.

503.2.7.1.2 Insulation protection. 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 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.

503.2.7.1.3 Condensation control. Additional insulation with vapor barrier shall be provided where the minimum duct insulation requirements of Section 503.2.7.1.1 are determined to be insufficient to prevent condensation.

TABLE 503.2.7.1
MINIMUM DUCT INSULATION *R*-VALUES, 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	R-4.2
Unvented attic with roof insulation	R-4.2	None
Unconditioned spaces[a]	R-4.2	R-4.2
Indirectly conditioned spaces[b]	None	None
Conditioned spaces	None	None
Buried	R-4.2	None

a. Includes crawl spaces, both ventilated and non-ventilated.
b. Includes return air plenums with or without exposed roofs above.

503.2.7.2 Duct construction. All ducts, air handlers, filter boxes, building cavities, mechanical closets and enclosed support platforms that form the primary air containment passageways for air distribution systems shall be considered ducts or plenum chambers and shall be constructed and erected in accordance with Table 503.2.7.2 and with Chapter 6 of the *Florida Building Code, Mechanical*. 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 in accordance with the applicable standards of this section.

503.2.7.3 Sealing, general (Mandatory). All ducts, air handlers, filter boxes, building cavities, mechanical closets and enclosed support platforms that form the primary air containment passageways for air distribution systems shall be sealed in accordance with the applicable criteria of this section and Table 503.2.7.2.

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

503.2.7.3.2 Sealing. Air distribution system components shall be sealed with approved closure systems.

503.2.7.3.3 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 503.2.7; (2) inspection; and (3) cleaning and maintenance. A minimum of 4 inches (102 mm) is considered sufficient space around air-handling units.

Exception: Retrofit or replacement units not part of a renovation.

503.2.7.3.4 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.

503.2.7.3.5 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.

503.2.7.3.6 Approved mechanical attachments. Approved mechanical attachments for air distribution system components include screws, rivets, welds, interlocking joints crimped and rolled, staples, twist in (screw attachment), and compression systems created by bend tabs or screw tabs and flanges or by

clinching straps. Mechanical attachments shall be selected from Table 503.2.7.2 to be appropriate to the duct system type.

503.2.7.3.7 Approved closure systems. The following closure systems and materials are approved for air distribution construction and sealing for the applications and pressure classes shown in Table 503.2.7.2.

1. Metal closures.
    a. Welds applied continuously along metal seams or joints through which air could leak.
    b. Snaplock seams, and grooved, standing, double-corner, single-corner and Pittsburgh-lock seams, as defined by SMACNA, as well as all other rolled mechanical seams. All seams shall be rolled or crimped.
2. Gasketing, which achieves a 25/50 flame spread/smoke-density-development rating under ASTM E 84 or UL 723, provided that it is used only between mated surfaces which are mechanically fastened with sufficient force to compress the gasket and to fill all voids and cracks through which air leakage would otherwise occur.
3. Mastic closures. Mastics shall be placed over the entire joint between mated surfaces. Mastics shall not be diluted. Approved mastics include the following:
    a. Mastic or mastic-plus-embedded fabric systems applied to fibrous glass ductboard that are listed and labeled in accordance with UL 181A, Part III.
    b. Mastic or mastic-plus-embedded fabric systems applied to nonmetal flexible duct that are listed and labeled in accordance with UL 181B, Part II.
    c. Mastic ribbons, which achieve a 25/50 flame spread/smoke density development rating under ASTM E 84 or UL 723, provided that they may be used only in flange-joints and lap-joints, such that the mastic resides between two parallel surfaces of the air barrier and that those surfaces are mechanically fastened.
4. Tapes. Tapes shall be applied such that they extend not less than 1 inch 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.
        i.) Pressure-sensitive tapes applied to fibrous glass ductboard that are listed and labeled in accordance with UL 181A, Part I.
        ii.) Pressure-sensitive tapes applied to nonmetal flexible duct that are listed and labeled in accordance with UL 181B, Part I.
    b. Heat-activated tapes applied to fibrous glass ductboard that are listed and labeled in accordance with UL 181A, Part II.
5. Aerosol sealant. Such sealants shall be installed by manufacturer-certified installers following manufacturer instructions and shall achieve 25/50 flame spread/smoke-density-development ratings under ASTM E 84 or UL 723.

503.2.7.4 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 503.2.7.1 and constructed and sealed in accordance with the requirements of Section 503.2.7.2.2 appropriate for the duct materials used.

Exception: Return air plenums beneath a roof deck that is insulated to at least R-19.

503.2.7.5 Air distribution system sizing and design. All air distribution systems shall be sized and designed in accordance with recognized engineering standards such as ACCA Manual D or other standards based on the following:

1. Calculation of the supply air for each room shall be based on the greater of the heating load or sensible cooling load for that room.
2. Duct size shall be determined by the supply air requirements of each room, the available static pressure and the total equivalent length of the various duct runs.
3. Friction loss data shall correspond to the type of material used in duct construction.

503.2.7.6 Air-handling units. Air-handling units shall not be allowed in attics of commercial buildings.

503.2.8 Piping insulation. All piping serving as part of a heating or cooling system shall be thermally insulated in accordance with Table 503.2.8.

Exceptions:

1. Factory-installed piping within HVAC equipment tested and rated in accordance with a test procedure referenced by this code.
2. Factory-installed piping within room fan-coils and unit ventilators tested and rated according to AHRI 440 (except that the sampling and variation provi-

sions of Section 6.5 shall not apply) and 840, respectively.

3. Piping that conveys fluids that have a design operating temperature range between 55°F (13°C) and 105°F (41°C).
4. Piping that conveys fluids that have not been heated or cooled through the use of fossil fuels or electric power (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.
5. Runout piping not exceeding 4 feet (1219 mm) in length and 1 inch (25 mm) in diameter between the control valve and HVAC coil when located in conditioned spaces.
6. Pipe unions in heating systems (steam, steam condensate, and hot water).

503.2.9 HVAC system completion. Prior to the issuance of a certificate of occupancy, the design professional shall provide evidence of system completion in accordance with Sections 503.2.9.1 through 503.2.9.3.

503.2.9.1 Air distribution system testing, adjusting and balancing. 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). 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 in accordance with generally accepted engineering standards.

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.

Air system balancing shall be accomplished in a manner to first minimize throttling losses. Then for fans with fan system power greater than 1 hp, fan speeds 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.

Discharge dampers are prohibited on constant volume fans and variable volume fans with motors 10 horsepower (hp) (7.5 kW) and larger.

503.2.9.2 Hydronic system balancing. Individual hydronic heating and cooling coils shall be equipped with means for balancing and pressure test connections.

503.2.9.3 Manuals. The construction documents shall require that an operating and maintenance manual be provided to the building owner by the mechanical contractor. The manual shall include, at least, the following:

1. Equipment capacity (input and output) and required maintenance actions.
2. Equipment operation and maintenance manuals.
3. HVAC system control maintenance and calibration information, including wiring diagrams, schematics, and control sequence descriptions. Desired or field-determined setpoints shall be permanently recorded on control drawings, at control devices or, for digital control systems, in programming comments.
4. A complete written narrative of how each system is intended to operate.

503.2.10 Air system design and control. Each HVAC system having a total fan system motor nameplate horsepower (hp) exceeding 5 horsepower (hp) (3.7 kW) shall meet the provisions of Sections 503.2.10.1 through 503.2.10.2. Criteria in sections 503.2.10.3 through 503.2.10.6 shall also be met.

503.2.10.1 Allowable fan floor horsepower. 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 503.2.10.1(1). This includes supply fans, return/relief fans, and fan-powered terminal units associated with systems providing heating or cooling 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 shall be permitted to use variable volume fan power limitation.
2. Individual exhaust fans with motor nameplate horsepower of 1 hp (0.7 kW) 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 503.2.10.1(2) and the Fume Exhaust Exception Deduction must be taken from Table 503.2.10.1(2).

503.2.10.2 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 (bhp). The fan brake horsepower (bhp) 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 bhp, selection of the next larger nameplate motor size is allowed.
2. For fans 6 bhp and larger, where the first available motor larger than the bhp has a nameplate rating within 30 percent of the bhp, selection of the next larger nameplate motor size is allowed.

503.2.10.3 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.

503.2.10.4 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 503.2.4.3.2 (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 percent of the design airflow of the exhaust system to which it connects.
3. Zones intended to operate continuously or intended to be inoperative only when all other zones are inoperative.

503.2.10.5 Ventilation systems. Ventilation systems shall be designed to be capable of reducing the supply of outdoor air to the minimum ventilation rates required by section 6.1.3 of ASHRAE 62.1. 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.

503.2.10.5.1 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.

503.2.10.6 Building pressures. Mechanical systems shall be designed to assure that buildings are pressurized with respect to outdoors.

503.2.11 Heating outside a building. Systems installed to provide heat outside a building shall be radiant systems. Such heating systems shall be controlled by an occupancy sensing device or a timer switch, so that the system is automatically deenergized when no occupants are present.

503.2.12 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 504.2.

503.3 Simple HVAC systems and equipment (Prescriptive). This section applies to buildings served by unitary or packaged HVAC equipment listed in Tables 503.2.3(1) through 503.2.3(5), each serving one zone and controlled by a single thermostat in the zone served.

This section does not apply to fan systems serving multiple zones, nonunitary or nonpackaged HVAC equipment and systems or hydronic or steam heating and hydronic cooling equipment and distribution systems that provide cooling or cooling and heating which are covered by Section 503.4.

503.3.1 Economizers. Reserved.

Table 503.3.1(1) Economizer Requirements. Reserved.

Table 503.3.1(2) Equipment Efficiency Performance Exception for Economizers. Reserved.

503.3.2 Hydronic system controls. Hydronic systems of at least 300,000 Btu/h (87,930 W) design output capacity supplying heated and chilled water to comfort conditioning systems shall include controls that meet the requirements of Section 503.4.3.

503.4 Complex HVAC systems and equipment. (Prescriptive). This section applies to buildings served by HVAC equipment and systems not covered in Section 503.3.

503.4.1 Economizers. Reserved.

TABLE 503.2.7.2
DUCT SYSTEM CONSTRUCTION AND SEALING

DUCT TYPE/CONNECTION	SEALING REQUIREMENTS	MECHANICAL ATTACHMENT	TEST STANDARD
Material duct, rigid and flexible			
Pressure less than 1-inch water gauge	Closure systems as described in Section 503.2.7.3: 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	Mechanical attachments approved: 1. Continuous welds. 2. Snaplock seams, and grooved, standing, double-corner, single-corner and Pittsburgh-lock seams and all other rolled mechanical seams. Crimp joints for round metal ducts shall have a contact lap of at least $1^1/_2$ inches (38 mm). Round metal ducts shall be mechanically fastened by means of at least three sheet-metal screws or rivets equally spaced around the joint.[1]	SMACNA HVAC Air Duct Leakage Test Manual
Pressures 1-inch water gauge or greater	Closure systems as described in Section 503.2.7.3: 1. Continuous welds. 2. Mastic or mastic-plus-embedded fabric systems. 3. Gaskets.	Mechanical attachments approved: Continuous welds. Round metal ducts shall be mechanically fastened by means of at least three sheet-metal screws or rivets equally spaced around the joint.[1]	SMACNA HVAC Air Duct Leakage Test Manual
High pressure duct systems designed to operate at pressures greater than 3-inch water gauge (4-inch water gauge pressure class)	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.		SMACNA HVAC Air Duct Leakage Test Manual
Plastic duct	See Section 603.8.3 of the *Florida Building Code, Mechanical.*	Joints between plastic ducts and plastic fittings shall be made in accordance with the manufacturer's installation instructions.	ASTM D 2412
Fibrous glass duct, rigid.	All joints, seams and duct wall penetrations between sections of duct and between duct and other distribution system components shall be sealed with closure systems as described in Section 503.2.7.3: 1. Heat-activated tapes. 2. Pressure-sensitive tapes. 3. Mastics or mastic-plus-embedded fabric systems.	Mechanically fastened per standard to secure the sections independent of the closure system(s). Attachments of ductwork to air-handling equipment shall be by mechanical fasteners. Where access is limited, two fasteners on one side shall be acceptable.	NAIMA Fibrous Glass Duct Construction Standards. UL 181 UL 181A
Flexible duct systems, nonmetal.	All duct collar fittings shall have a minimum $^5/_8$ inch (16 mm) integral flange for sealing to other components and a minimum 3-inch (76 mm) shaft for insertion into the inner duct core. Flexible ducts having porous inner cores shall not be used. **Exception:** Ducts having a nonporous liner between the porous inner core and the outer jacket. Fastening and sealing requirements shall be applied to such intermediate liners.	Flexible nonmetal ducts shall be joined to all other air distribution system components by either terminal or intermediate fittings. Mechanical fasteners for use with flexible nonmetallic air ducts shall comply with UL 181B and shall be marked 181B-C. See Section 603.10.3 of the *Florida Building Code, Mechanical* for duct support requirements.	UL 181 UL 181B ADC FDPIS

(continued)

TABLE 503.2.7.2 —continued
DUCT SYSTEM CONSTRUCTION AND SEALING

DUCT TYPE/CONNECTION	SEALING REQUIREMENTS	MECHANICAL ATTACHMENT	TEST STANDARD
Duct core to duct fitting	The reinforced lining 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 503.2.7.3: 1. Gasketing. 2. Mastic, mastic-plus-embedded fabric, or mastic ribbons. 3. Pressure-sensitive tape. 4. Aerosol sealants, provided that their use is consistent with UL 181.	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 (303 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.	
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 fitting and the flexible duct, rigid fibrous glass duct board, or sheet metal to which it is mated.		
Duct collar fitting to rigid duct	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 Section 503.2.7.3: 1. Gasketing. 2. Mastic or mastic-plus-embedded fabric systems. 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.	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.	
Terminal and intermediate fittings.			
Fittings and joints between dissimilar duct types	Approved closure systems shall be as designated by air distribution system component material type in Section 503.2.7.3. **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.		
Terminal fittings and air ducts to building envelope components	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 503.2.7.3: 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.		
Air-handling units.	Air-handling units located outside the conditioned space shall be sealed using approved closure systems described in Section 503.2.7.3 for metallic ducts.	All air-handling units shall be mechanically attached to other air distribution system components.	

(continued)

TABLE 503.2.7.2—continued
DUCT SYSTEM CONSTRUCTION AND SEALING

DUCT TYPE/CONNECTION	SEALING REQUIREMENTS	MECHANICAL ATTACHMENT	TEST STANDARD
Return plenums.	Building cavities which will be used as return air plenums shall be lined with a continuous air barrier made of durable nonporous materials. All penetrations to the air barrier shall be sealed with a suitable long-life mastic material. **Exception:** Surfaces between the plenum and conditioned spaces from which the return/mixed air is drawn. Roof decks above building cavities used as a return air plenum shall be insulated to at least R-19.		
Mechanical closets	All joints between the air barriers of walls, ceiling, floor and door framing and all penetrations of the air barrier shall be sealed to the air barrier with approved closure systems. Through-wall, through-floor and through-ceiling air passageways into the closet shall be framed and sealed to form an air-tight passageway. **Exception:** Air passageways into the closet from conditioned space that are specifically designed for return air flow. The following air barriers are approved for use in mechanical closets: 1. One-half-inch-thick (12.7 mm) or greater gypsum wallboard, sealed with joint compound over taped joints between gypsum wall board panels. 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 by one of the following: a. Sealants complying with the product and application standards of this table for fibrous glass ductboard or b. A suitable long-life caulk or mastic for all applications..		
Enclosed support platforms in unconditioned spaces	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 503.2.7.2 and insulated according to the requirements of Section 503.2.7.1. 1. 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 2. 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. 3. Through-wall, through-floor and through ceiling penetrations into the duct system shall contain a branch duct fabricated of rigid fibrous glass duct board or rigid metal and shall extend to and be sealed by 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 requirements for the duct type used.	

1. Where a duct connection is made that is partially inaccessible, three screws or rivets shall be equally spaced on the exposed portion of the joint so as to prevent a hinge effect.

503.4.2 Variable air volume (VAV) fan control.

503.4.2.1 Part-load fan power limitation. Individual VAV fans with motors of 10 horsepower (7.5 kW) or greater shall be either:

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

503.4.2.2 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 503.4.2.3. 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.

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

503.4.3 Hydronic systems controls. The heating of fluids that have been previously mechanically cooled and the cooling of fluids that have been previously mechanically heated shall be limited in accordance with Sections 503.4.3.1 through 503.4.3.3. Hydronic heating systems comprised of multiple-packaged boilers and designed to deliver conditioned water or steam into a common distribution system shall include automatic controls capable of sequencing operation of the boilers. Hydronic heating systems comprised of a single boiler and greater than 500,000 Btu/h input design capacity shall include either a multistaged or modulating burner.

503.4.3.1 Three-pipe system. Hydronic systems that use a common return system for both hot water and chilled water are prohibited.

503.4.3.2 Two-pipe changeover system. Systems that use a common distribution system to supply both heated and chilled water shall be designed to allow a dead band between changeover from one mode to the other of at least 15°F (8.3°C) outside air temperatures; be designed

TABLE 503.2.8
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$^1/_2$	1$^1/_2$ - 4	4 < 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 feet of the coil and the pipe size is 1 inch 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.

TABLE 503.2.10.1(1)
FAN POWER LIMITATION[a, b]

	LIMIT	CONSTANT VOLUME	VARIABLE VOLUME
Option 1: Fan system motor nameplate hp	Allowable nameplate motor hp	$hp \le CFM_S \times 0.0011$	$hp \le CFM_S \times 0.0015$
Option 2: Fan system bhp	Allowable fan system bhp	$bhp \le CFM_S \times 0.00094 + A$	$bhp \le CFM_S \times 0.0013 + A$

a. 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 503.2.10.1(2) in. w.c.

CFM_D = The design airflow through each applicable device from Table 503.2.10.1(2) in cubic feet per minute.

b. For Section 506, the Standard Reference Design building HVAC system will use the smaller value of the appropriate fan power from Table 503.2.10.1(1) or the equivalent proposed (design) building HVAC system fan power for supply and return fans.

TABLE 503.2.10.1(2)
FAN POWER LIMITATION

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 thru 12	0.5 in w.c.
Particulate filtration credit: MERV 13 thru 15	0.9 in w.c.
Particulate filtration credit: MERV 16 and greater 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 humidifier/cooler in series with another cooling coil	Pressure drop of device at fan system design conditions
Sound attenuation section	0.15 in w.c.
Deductions	
Fume hood exhaust exception (required if Section 503.2.10.1, Exception 3, is taken)	-1.0 in w.c.

to and provided with controls that will allow operation in one mode for at least 4 hours before changing over to the other mode; and be provided with controls that allow heating and cooling supply temperatures at the changeover point to be no more than 30°F (16.7°C) apart.

503.4.3.3 Hydronic (water loop) heat pump systems. Hydronic heat pump systems shall comply with Sections 503.4.3.3.1 through 503.4.3.3.3.

503.4.3.3.1 Temperature dead band. Hydronic heat pumps connected to a common heat pump water loop with central devices for heat rejection and heat addition shall have controls that are capable of providing a heat pump water supply temperature dead band of at least 20°F (11.1°C) between initiation of heat rejection and heat addition by the central devices.

Exception: Where a system loop temperature optimization controller is installed and can determine the most efficient operating temperature based on realtime conditions of demand and capacity, dead bands of less than 20°F (11°C) shall be permitted.

503.4.3.3.2 Heat rejection. Heat rejection equipment shall comply with Table 503.2.3(8).

Exception: Where it can be demonstrated that a heat pump system will be required to reject heat throughout the year.

503.4.3.3.3 Two position valve. Each hydronic heat pump on the hydronic system having a total pump system power exceeding 10 horsepower (hp) (7.5 kW) shall have a two-position valve.

503.4.3.4 Part load controls. Hydronic systems greater than or equal to 300,000 Btu/h (87 930 W) in design output capacity supplying heated or chilled water to comfort conditioning systems shall include controls that have the capability to:

1. Automatically reset the supply-water temperatures using zone-return water temperature, building-return water temperature, or outside air temperature as an indicator of building heating or cooling demand. The temperature shall be capable of being reset by at least 25 percent of the design supply-to-return water temperature difference; or
2. Reduce system pump flow by at least 50 percent of design flow rate utilizing adjustable speed drive(s) on pump(s), or multiple-staged pumps where at least one-half of the total pump horsepower is capable of being automatically turned off or control valves designed to modulate or step down, and close, as a function of load, or other *approved* means.

503.4.3.5 Pump isolation. Chilled water plants including more than one chiller shall have the capability to reduce flow automatically through the chiller plant when a chiller is shut down. Chillers piped in series for the purpose of increased temperature differential shall be considered as one chiller.

Boiler plants including more than one boiler shall have the capability to reduce flow automatically through the boiler plant when a boiler is shut down.

503.4.4 Heat rejection equipment fan speed control. Each fan powered by a motor of 7.5 hp (5.6 kW) or larger shall have the capability to operate that fan at two-thirds of full speed or less, and shall have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature/pressure of the heat rejection device.

Exception: Factory-installed heat rejection devices within HVAC equipment tested and rated in accordance with Tables 503.2.3(6) and 503.2.3(7).

503.4.5 Requirements for complex mechanical systems serving multiple zones. Sections 503.4.5.1 through 503.4.5.5 shall apply to complex mechanical systems serving multiple zones. Supply air systems serving multiple zones shall be VAV systems which, during periods of occupancy, are designed and capable of being controlled to reduce primary air supply to each *zone* to one of the following before reheating, recooling or mixing takes place:

1. Thirty percent of the maximum supply air to each *zone*.
2. Three hundred cfm (142 L/s) or less where the maximum flow rate is less than 10 percent of the total fan system supply airflow rate.
3. The minimum ventilation requirements of Chapter 4 of the *Florida Building Code, Mechanical*.

Exception: The following define when individual zones or when entire air distribution systems are exempted from the requirement for VAV control:

1. Zones where special pressurization relationships or cross-contamination requirements are such that VAV systems are impractical.
2. Zones or supply air systems where at least 75 percent of the energy for reheating or for providing warm air in mixing systems is provided from a site-recovered or site-solar energy source.
3. Zones where special humidity levels are required to satisfy process needs.
4. Zones with a peak supply air quantity of 300 cfm (142 L/s) or less and where the flow rate is less than 10 percent of the total fan system supply airflow rate.
5. Zones where the volume of air to be reheated, recooled or mixed is no greater than the volume of outside air required to meet the minimum ventilation requirements of Chapter 4 of the *Florida Building Code, Mechanical*.
6. Zones or supply air systems with thermostatic and humidistatic controls capable of operating in sequence the supply of heating and cooling energy to the *zone*(s) and which are capable of preventing reheating, recooling, mixing or simultaneous supply of air that has been previously cooled, either

mechanically or through the use of economizer systems, and air that has been previously mechanically heated.

7. 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 Section 506 of this code.

503.4.5.1 Single duct variable air volume (VAV) systems, terminal devices. Single duct VAV systems shall use terminal devices capable of reducing the supply of primary supply air before reheating or recooling takes place.

503.4.5.2 Dual duct and mixing VAV systems, terminal devices. Systems that have one warm air duct and one cool air duct shall use terminal devices which are capable of reducing the flow from one duct to a minimum before mixing of air from the other duct takes place.

503.4.5.3 Single fan dual duct and mixing VAV systems, economizers. Individual dual duct or mixing heating and cooling systems with a single fan and with total capacities greater than 90,000 Btu/h [(26 375 W) 7.5 tons] shall not be equipped with air economizers.

503.4.5.4 Supply-air temperature reset controls. Multiple *zone* HVAC systems shall include controls that automatically reset the supply-air temperature in response to representative building loads, or to outdoor air temperature. The controls shall be capable of resetting the supply air temperature at least 25 percent of the difference between the design supply-air temperature and the design room air temperature.

Exceptions:

1. Systems that prevent reheating, recooling or mixing of heated and cooled supply air.
2. Seventy five percent of the energy for reheating is from site-recovered or site solar energy sources.
3. Zones with peak supply air quantities of 300 cfm (142 L/s) or less.

503.4.5.5 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 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.

503.4.6 Heat recovery for service water heating. Condenser heat recovery shall be installed for heating or reheating of service hot water provided the facility operates 24 hours a day, the total installed heat capacity of water-cooled systems exceeds 6,000,000 Btu/hr of heat rejection, and the design service water heating load exceeds 1,000,000 Btu/h.

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

1. Sixty percent of the peak heat rejection load at design conditions; or
2. The preheating required to raise the peak service hot water draw to 85°F (29°C).

Exceptions:

1. Facilities that employ condenser heat recovery for space heating or reheat purposes with a heat recovery design exceeding 30 percent of the peak water-cooled condenser load at design conditions.
2. Facilities that provide 60 percent of their service water heating from site solar or site recovered energy or from other sources.

503.4.7 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 as indicated in Table 503.4.7.

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

TABLE 503.4.7
MAXIMUM HOT GAS BYPASS CAPACITY

RATED CAPACITY	MAXIMUM HOT GAS BYPASS CAPACITY (% of total capacity)
≤ 240,000 Btu/h	50%
> 240,000 Btu/h	25%

For SI: 1 Btu/h = 0.29 watts.

503.4.8 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.

SECTION 504
SERVICE WATER HEATING
(Mandatory)

504.1 General. This section covers the minimum efficiency of, and controls for, service water-heating equipment and insulation of service hot water piping.

504.2 Service water-heating equipment performance efficiency. Water-heating equipment and hot water storage tanks shall meet the requirements of Table 504.2. The efficiency shall be verified through data furnished by the manufacturer or through certification under an *approved* certification program.

504.2.1 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.

504.3 Temperature controls. Service water-heating equipment shall be provided with controls to allow a setpoint of 110°F (43°C) for equipment serving dwelling units and 90°F (32°C) for equipment serving other occupancies. The outlet temperature of lavatories in public facility rest rooms shall be limited to 110°F (43°C).

504.4 Heat traps. Water-heating equipment not supplied with integral heat traps and serving noncirculating systems shall be provided with heat traps on the supply and discharge piping associated with the equipment.

504.5 Pipe insulation. For automatic-circulating hot water systems, piping shall be insulated with 1 inch (25 mm) of insulation having a conductivity not exceeding 0.27 Btu per inch/h × ft² × °F (1.53 W per 25 mm/m² × K). The first 8 feet (2438 mm) of piping in noncirculating systems served by equipment without integral heat traps shall be insulated with 0.5 inch (12.7 mm) of material having a conductivity not exceeding 0.27 Btu per inch/h × ft² × °F (1.53 W per 25 mm/m² × K).

504.6 Hot water system controls. Automatic-circulating hot water system pumps or heat trace shall be arranged to be conveniently turned off automatically or manually when the hot water system is not in operation.

504.7 Pools. Pools shall be provided with energy conserving measures in accordance with Sections 504.7.1 through 504.7.3.

504.7.1 Pool heaters. All pool heaters shall meet the minimum efficiency listed for that type of pool heater in Table 504.2 and shall be equipped with a readily *accessible* on-off switch that is mounted outside the heater to allow shutting off the heater without adjusting the thermostat setting. Pool heaters fired by natural gas or LPG shall not have continuously burning pilot lights.

504.7.2 Time switches. Time switches that can automatically turn off and on heaters and pumps according to a preset schedule 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.

504.7.3 Pool covers. Heated swimming pools and inground permanently installed spas shall be equipped with a vapor retardant cover on or at the water surface or a liquid cover or other means proven to reduce heat loss.

Exception: Outdoor pools deriving over 70 percent of the energy for heating from site-recovered energy or solar energy source computed over an operating season.

504.8 Water flow rate controls.

504.8.1 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.

504.8.2 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*.

SECTION 505
ELECTRICAL POWER AND LIGHTING SYSTEMS
(Mandatory)

505.1 General (Mandatory). This section covers lighting system controls, the connection of ballasts, the maximum lighting power for interior applications and minimum acceptable lighting equipment for exterior applications including facades, illuminated roofs, architectural features, entrances, exits, loading docks, and illuminated canopies; and exterior building grounds lighting provided through the building's electrical service.

Exceptions:

1. Lighting within dwelling units where 50 percent or more of the permanently installed interior light fixtures are fitted with high-efficacy lamps.
2. Emergency lighting that is automatically off during normal building operation.
3. Lighting that is specifically designated as required by a health or life safety statute, ordinance, or regulation.
4. Decorative gas lighting systems.

505.2 Lighting controls (Mandatory). Lighting systems shall be provided with controls as required in Sections 505.2.1, 505.2.2, 505.2.3 and 505.2.4.

505.2.1 Interior lighting controls. Each area enclosed by walls or floor-to-ceiling 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.

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.

505.2.1.1 Classrooms and meeting rooms. A control device shall be installed in classrooms (except shop classrooms, laboratory classrooms, and preschool through 12th grade classrooms), conference/meeting rooms and employee lunch and break rooms that automatically turns lighting off within 30 minutes of all occupants leaving a space. These spaces are not required to be connected to other automatic lighting shutoff controls.

Exception: Spaces with multi-scene control,

505.2.1.2 All other spaces. Each control device shall be activated either manually by an occupant or automatically by sensing an occupant and be capable of overriding any time-of-day scheduled shut-off control for no more than four hours in accordance with Section 505.2.2.1. Spatial control shall be limited as shown in Table 505.2.1.2:

Table 505.2.1.2
Spatial Control Limitations

Space Size	Maximum Controlled Space
≤ 10,00 square feet (929 m^2)	2,500 square feet (232 m^2)
> 10,00 square feet (929 m^2)	10,000 square feet (929 m^2)

505.2.1.3 Additional controls. Additional 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. Sleeping unit controls. *Sleeping units* in hotels, motels, boarding houses or similar buildings shall have at least one master switch at the main entry door that controls all permanently wired luminaires and switched receptacles, except those in the bathroom(s). Suites shall have a control meeting these requirements at the entry to each room or at the primary entry to the suite.
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.

505.2.2 Automatic lighting shutoff. Buildings larger than 5,000 square feet (465 m^2) shall be equipped with an automatic control device to shut off lighting in those areas. This automatic control device shall function on either:

1. A scheduled basis, using time-of-day, with an independent program schedule that controls the interior lighting in areas that do not exceed 25,000 square feet (2323 m^2) and are not more than one floor; or

TABLE 504.2
MINIMUM PERFORMANCE OF WATER-HEATING EQUIPMENT

EQUIPMENT TYPE	SIZE CATEGORY (input)	SUBCATEGORY OR RATING CONDITION	PERFORMANCE REQUIRED[a, b]	TEST PROCEDURE
Electric table top water heaters	≤ 12 kW	Resistance = 20 gal	0.93 - 0.00132V EF	DOE 10 CFR Part 430
Water heaters, Electric	≤ 12 kW	Resistance	0.97 - 0.00132*V*, EF	DOE 10 CFR Part 430
	> 12 kW	Resistance	1.73*V* + 155 SL, Btu/h	Section G.2 of ANSI Z21.10.3
	≤ 24 amps and ≤ 250 volts	Heat pump	0.93 - 0.00132*V*, EF	DOE 10 CFR Part 430
Storage water heaters, Gas	≤ 75,000 Btu/h	≥ 20 gal	0.67 - 0.0019*V*, EF	DOE 10 CFR Part 430
	> 75,000 Btu/h	< 4,000 (Btu/h)/gal	80% E_t $\left(Q / 800 + 110\sqrt{V}\right)$SL, Btu/h	Section G.1 and G.2 of ANSI Z21.10.3
Instantaneous water heaters, Gas	> 50,000 Btu/h and < 200,000 Btu/h[c]	≥ 4,000 (Btu/h)/gal and < 2 gal	0.62 - 0.0019*V*, EF	DOE 10 CFR Part 430
	≥ 200,000 Btu/h	≥ 4,000 Btu/h/gal and < 10 gal	80% E_t	Section G.1 and G.2 of ANSI Z21.10.3
	≥ 200,000 Btu/h	≥ 4,000 Btu/h/gal and ≥ 10 gal	80% E_t $\left(Q / 800 + 110\sqrt{V}\right)$ SL, Btu/h	
Storage water heaters, Oil	≤ 105,000 Btu/h	≥ 20 gal	0.59 - 0.0019*V*, EF	DOE 10 CFR Part 430
	> 105,000 Btu/h	< 4,000 Btu/h/gal	78% E_t $\left(Q / 800 + 110\sqrt{V}\right)$ SL, Btu/h	Section G.1 and G.2 of ANSI Z21.10.3
Instantaneous water heaters, Oil	≤ 210,000 Btu/h	≥ 4,000 Btu/h/gal and < 2 gal	0.59 - 0.0019*V*, EF	DOE 10 CFR Part 430
	> 210,000 Btu/h	≥ 4,000 Btu/h/gal and < 10 gal	80% E_t	Section G.1 and G.2 of ANSI Z21.10.3
	> 210,000 Btu/h	≥ 4,000 Btu/h/gal and ≥ 10 gal	78% E_t $\left(Q / 800 + 110\sqrt{V}\right)$ 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	≥ 300,000 Btu/h and <12,500,000 Btu/h	≥ 4,000 Btu/h/gal and ≥ 10 gal	80% E_t $\left(Q / 800 + 110\sqrt{V}\right)$ SL, Btu/h	
Hot water supply boilers, Oil	> 300,000 Btu/h and <12,500,000 Btu/h	> 4,000 Btu/h/gal and > 10 gal	78% E_t $\left(Q / 800 + 110\sqrt{V}\right)$ SL, Btu/h	
Pool heaters, Gas and Oil	All	—	78% E_t before 4/16/2013 82% E_t after 4/16/2013	ASHRAE 146
Heat pump pool heaters	All	—	4.0 COP At low air temperature	AHRI 1160[d]
Unfired storage tanks	All	—	Minimum insulation requirement R-12.5 (h · ft^2 · °F)/Btu	(none)

For SI: °C = [(°F) - 32]/1.8, 1 British thermal unit per hour = 0.2931 W, 1 gallon = 3.785 L, 1 British thermal unit per hour per gallon = 0.078 W/L.

a. Energy factor (EF) and thermal efficiency (E_t) are minimum requirements. In the EF equation, V is the rated volume in gallons.

b. Standby loss (SL) is the maximum Btu/h based on a nominal 70°F temperature difference between stored water and ambient requirements. In the SL equation, Q is the nameplate input rate in Btu/h. In the SL equation for electric water heaters, V is the rated volume in gallons. In the SL equation for oil and gas water heaters and boilers, V is the rated volume in gallons.

c. 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.

d. Test reports from independent laboratories are required to verify procedure compliance.

2. An occupant sensor that shall turn lighting off within 30 minutes of an occupant leaving a space; or
3. A signal from another control or alarm system that indicates the area is unoccupied.

Exception: The following shall not require an automatic control device:

1. *Sleeping unit* (see Section 505.2.1.3).
2. Lighting intended for 24-hour operation.
3. Lighting in spaces where patient care is directly provided.
4. Spaces where an automatic shutoff would endanger occupant safety or security.

505.2.2.1 Occupant override. Where an automatic time switch control device is installed to comply with Section 505.2.2, Item 1, it shall incorporate an override switching device that:

1. Is readily *accessible*.
2. Is located so that a person using the device can see the lights or the area controlled by that switch, or so that the area being lit is annunciated.
3. Is manually operated by an occupant or automatically by sensing an occupant.
4. Meets the requirements of Section 505.2.1.2.

505.2.2.2 Holiday scheduling. If an automatic time switch control device is installed in accordance with Section 505.2.2, Item 1, it shall incorporate an automatic holiday scheduling feature that turns off all loads for at least 24 hours, then resumes the normally scheduled operation.

Exception: Retail stores and associated malls, restaurants, grocery stores, places of religious worship and theaters.

505.2.3 Daylight zone control. Daylight zones, as defined by this code, shall be provided with individual controls that control the lights independent of general area lighting. Contiguous daylight zones adjacent to vertical fenestration are allowed to be controlled by a single controlling device provided that they do not include zones facing more than two adjacent cardinal orientations (i.e., north, east, south, west). Daylight zones under skylights more than 15 feet (4572 mm) from the perimeter shall be controlled separately from daylight zones adjacent to vertical fenestration.

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

505.2.4 Exterior lighting controls. Lighting for all exterior applications not exempted in Section 505.1 shall have automatic controls capable of turning off exterior lighting when sufficient daylight is available or when the lighting is not required during nighttime hours. Lighting not designated for dusk-to-dawn operation shall be controlled by either a combination of a photosensor and a time switch, or an astronomical time switch.

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

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

505.3 Tandem wiring (Mandatory). Luminaires designed for use with one or three linear fluorescent lamps greater than 30 W each shall be tandem wired 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 three-lamp high-frequency electronic or three-lamp electromagnetic ballasts.
4. Recessed luminaires more than 10 feet (3048 mm) apart measured center to center.
5. Surface-mounted or pendant luminaires that are not continuous.
6. Luminaires using three-lamp high-frequency electronic or three-lamp electromagnetic ballasts.

505.4 Exit signs (Mandatory). Internally illuminated exit signs shall not exceed 5 watts per side.

505.5 Interior lighting power requirements (Prescriptive).

505.5.1 Shell buildings, renovations and alterations. A building, or part of a building, complies with this section if its total connected lighting power calculated under Section 505.5.2 is no greater than the interior lighting power calculated under Section 505.5.3.

Table 505.5.2 Interior Lighting Power Allowances. Reserved.

505.5.*2* Total connected interior lighting power. The total connected interior lighting power (watts) shall be the sum of the watts of all interior lighting equipment as determined in accordance with Sections 505.5.2.1 through 505.5.2.5.

Exceptions:

1. The connected power associated with the following lighting equipment is not included in calculating total connected lighting power.
   1.1. Professional sports arena playing field lighting.
   1.2. *Sleeping unit* lighting in hotels, motels, boarding houses or similar buildings.
   1.3. Emergency lighting automatically off during normal building operation.
   1.4. Lighting in spaces specifically designed for use by occupants with special lighting needs including the visually impaired visual impairment and other medical and age-related issues.

1.5. Lighting in interior spaces that have been specifically designated as a registered interior historic landmark.

1.6. Casino gaming areas.

2. Lighting equipment used for the following shall be exempt provided that it is in addition to general lighting and is controlled by an independent control device:

2.1. Task lighting for medical and dental purposes.

2.2. Display lighting for exhibits in galleries, museums and monuments.

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

4. Lighting for photographic processes.

5. Lighting integral to equipment or instrumentation and is installed by the manufacturer.

6. Task lighting for plant growth or maintenance.

7. Advertising signage or directional signage.

8. In restaurant buildings and areas, lighting for food warming or integral to food preparation equipment.

9. Lighting equipment that is for sale.

10. Lighting demonstration equipment in lighting education facilities.

11. Lighting *approved* because of safety or emergency considerations, inclusive of exit lights.

12. Lighting integral to both open and glass-enclosed refrigerator and freezer cases.

13. Lighting in retail display windows, provided the display area is enclosed by ceiling-height partitions.

14. Furniture mounted supplemental task lighting that is controlled by automatic shutoff.

505.5.2.1 Screw lamp holders. The wattage shall be the maximum *labeled* wattage of the luminaire.

505.5.2.2 Low-voltage lighting. The wattage shall be the specified wattage of the transformer supplying the system.

505.5.2.3 Other luminaires. The wattage of all other lighting equipment shall be the wattage of the lighting equipment verified through data furnished by the manufacturer or other *approved* sources.

505.5.2.4 Line-voltage lighting track and plug-in busway. The wattage shall be:

1. The specified wattage of the luminaires included in the system with a minimum of 30 W/lin ft. (98 W/lin. m);
2. The wattage limit of the system's circuit breaker; or
3. The wattage limit of other permanent current limiting device(s) on the system.

505.5.2.5 Luminaire wattage. Luminaire wattage incorporated into the installed interior lighting power shall be determined in accordance with the following criteria:

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

505.5.3 Interior lighting power. The total interior lighting power (watts) shall be the sum of all interior lighting powers for all areas in the building covered in the permit. The interior lighting power is the floor area for each building area type listed in Table 505.5.3 times the value from Table 505.5.3 for that area. For the purposes of this method, an "area" shall be defined as all contiguous spaces that accommodate or are associated with a single building area type as *listed* in Table 505.5.3. Each building area type shall be treated as a separate area.

505.5.3.1 Standard reference design, interior lighting power. The lighting power densities listed in Table 505.5.3 constitute the interior lighting power Standard Reference Design for Section 506.

505.6 Exterior lighting. (Mandatory). All exterior lighting, other than low-voltage landscape lighting, shall comply with Sections 505.6.1 and 505.6.2.

Exception: Where *approved* because of historical, safety, signage or emergency considerations.

505.6.1 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 lumens per watt unless the luminaire is controlled by a motion sensor or qualifies for one of the exceptions under Section 505.6.2.

Table 505.6.2 Lighting Power Densities for Building Exteriors. Reserved.

505.6.2 Exterior building lighting power. The total exterior lighting power allowance for all exterior building applications is the sum of the base site allowance plus the individual allowances for areas that are to be illuminated and are permitted in Table 505.6.2(2) for the applicable lighting *zone*. Tradeoffs are allowed only among exterior lighting applications listed in Table 505.6.2(2), Tradable Surfaces section. The lighting zone for the building exterior is determined from Table 505.6.2(1) unless otherwise specified by the local jurisdiction. Exterior lighting for all applications (except those included in the exceptions to Section 505.6.2) shall comply with the requirements of Section 505.6.1.

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

1. Specialized signal, directional and marker lighting associated with transportation;
2. Advertising signage or directional signage;
3. Integral to equipment or instrumentation and is installed by its manufacturer;
4. Theatrical purposes, including performance, stage, film production and video production;
5. Athletic playing areas;
6. Temporary lighting;
7. Industrial production, material handling, transportation sites and associated storage areas;
8. Theme elements in theme/amusement parks; and
9. Used to highlight features of public monuments and registered historic landmark structures or buildings.

TABLE 505.6.2(1)
EXTERIOR LIGHTING ZONES

LIGHTING ZONE	DESCRIPTION
1	Developed areas of national parks, state parks, forest land, and rural areas
2	Areas predominantly consisting of residential zoning, neighborhood business districts, light industrial with limited nighttime use and residential mixed use areas
3	All other areas
4	High-activity commercial districts in major metropolitan areas as designated by the local land use planning authority

505.7 Electrical power (Mandatory)

505.7.1 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.

505.7.2 Electrical metering. In buildings having individual dwelling units, provisions shall be made to determine the electrical energy consumed by each tenant by separately metering individual dwelling units.

505.7.3 Voltage drop.

505.7.3.1 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.

505.7.3.2 Branch Circuits. Branch circuit conductors shall be sized for a maximum voltage drop of 3 percent at design load.

505.7.4 Completion requirements.

505.7.4.1 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.

505.7.4.2 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.

505.7.5 Electric motors. Electric motors shall comply with the requirements of the Energy Policy Act of 1992 where applicable, as shown in Table 505.7.5. Motors that are not included in the scope of the Energy Policy Act have no performance requirements in this section.

SECTION 506
TOTAL BUILDING PERFORMANCE

506.1 Scope. This section establishes criteria for compliance using total building performance. It may be employed for evaluating the compliance of all proposed designs, except designs with no mechanical system. The following systems and loads shall be included in determining the total building perfor-

TABLE 505.5.3
INTERIOR LIGHTING POWER DENSITIES (LPD) USING THE SPACE-BY-SPACE METHOD

Common Space Types[a]	LPD (W/ft^2)	Building Specific Space Types	LPD (W/ft^2)
Office—enclosed	1.1	Gymnasium/Exercise center	
Office—open plan	1.1	Playing area	1.4
Conference/Meeting/Multipurpose	1.3	Exercise area	0.9
Classroom/Lecture/Training	1.4	Courthouse/Police station/Penitentiary	
for Penitentiary	1.3	Courtroom	1.9
Lobby	1.3	Confinement cells	0.9
for Hotel	1.1	Judges chambers	1.3
for Performing arts theater	3.3	Fire stations	0.8
for Motion picture theater	1.1	Fire station engine room	0.8
Audience/seating area	0.9	Sleeping quarters	0.3
for Gymnasium	0.4	Post Office—sorting area	1.2
for Exercise center	0.3	Convention center—exhibit space	1.3
for Convention center	0.7	Library	
for Penitentiary	0.7	Card file & cataloging	1.1
for Religious buildings	1.7	Stacks	1.7
for Sports arena	0.4	Reading area	1.2
for Performing arts theater	2.6	Hospital	
for Motion picture theater	1.2	Emergency	2.7
for Transportation	0.5	Recovery	0.8
Atrium—first three floors	0.6	Nurse station	1.0
Atrium—each additional floor	0.2	Exam/Treatment	1.5
Lounge/Recreation	1.2	Pharmacy	1.2
for Hospital	0.8	Patient room	0.7
Dining area	0.9	Operating room	2.2
for Penitentiary	1.3	Nursery	0.6
for Hotel	1.3	Medical supply	1.4
for Motel	1.2	Physical therapy	0.9
for Bar lounge/Leisure dining	1.4	Radiology	0.4
for Family dining	2.1	Laundry/Washing	0.6
Food preparation	1.2	Automotive—Service/Repair	0.7
Laboratory	1.4	Manufacturing	
Restrooms	0.9	Low bay (< 25 ft floor to ceiling height)	1.2
Dressing/Locker/Fitting room	0.6	High bay (> 25 ft floor to ceiling height)	1.7
Corridor/Transition	0.5	Detailed manufacturing	2.1
for Hospital	1.0	Equipment room	1.2
for Manufacturing facility	0.5	Control room	0.5
Stairs—active	0.6	Hotel/Motel guest rooms	1.1
Active storage	0.8	Dormitory—Living quarters	1.1
for Hospital	0.9	Museum	
Inactive storage	0.3	General exhibition	1.0
for Museum	0.8	Restoration	1.7
Electrical/mechanical	1.5	Bank/Office—banking activity area	1.5
Workshop	1.9	Religious buildings	
		Worship—pulpit, choir	2.4
		Fellowship hall	0.9

(continued)

TABLE 505.5.3—continued
INTERIOR LIGHTING POWER DENSITIES (LPD) USING THE SPACE-BY-SPACE METHOD

Common Space Types[a]	LPD (W/ft^2)	Building Specific Space Types (Continued)	LPD (W/ft^2)
		Retail[b]	
		Sales area[b]	1.7
		Mall concourse	1.7
		Sports arena	
		Ring sports area	2.7
		Court sports area	2.3
		Indoor playing field area	1.4
		Warehouse	
		Fine material storage	1.4
		Medium/bulky material storage	0.9
		Parking garage—garage area	0.2
		Transportation	
		Airport—concourse	0.6
		Air/Train/Bus—Baggage area	1.0
		Terminal—Ticket counter	1.5

For SI: 1 foot = 304.8 mm, 1 watt per square foot = W/0.0929 m^2.

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

b. Where lighting equipment is specified to be installed to highlight specific merchandise in addition to lighting equipment specified for general lighting and is switched or dimmed on circuits different from the circuits for general lighting, the smaller of the actual wattage of the lighting equipment installed specifically for merchandise, or additional lighting power as determined below shall be added to the interior lighting power determined in accordance with this line item.

Calculate the additional lighting power as follows:

Additional Interior Lighting Power Allowance = 1000 watts + (Retail Area 1 × 0.6 W/ft^2) + (Retail Area 2 × 0.6W/ft^2) + (Retail Area 3 × 1.4 W/ft^2) + (Retail Area 4 × 2.5 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 are permitted to 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.

mance: heating systems, cooling systems, service water heating, fan systems, lighting power, receptacle loads and process loads.

506.2 Mandatory requirements. Compliance with this section requires that the mandatory and applicable prescriptive criteria of Sections 502, 503, 504 and 505 be met.

506.2.1 Roof/ceiling thermal envelope. The roof or ceiling which functions as the building's thermal envelope shall be insulated to an *R*-value of at least R-10. Multiple-family residential roofs/ceilings shall be insulated to an *R*-value of at least R-19, space permitting. Where cavities beneath a roof deck are ventilated, the ceiling shall be considered the envelope component utilized in the compliance software tools.

506.3 Performance-based compliance. Compliance based on total building performance requires that a proposed building (*proposed design*) be shown to have an annual energy cost that is less than or equal to the annual energy cost of the *standard reference design*. Energy prices shall be taken from a source *approved* by the Florida Building Commission. Nondepletable energy collected off site shall be treated and priced the same as purchased energy. Energy from nondepletable energy sources collected on site shall be omitted from the annual energy cost of the *proposed design*.

506.3.1 Trade-offs limited to building permit. When the building permit being sought applies to less than the whole building, only the calculation parameters for that part of the building related to the systems to which the permit applies shall be allowed to vary. Where an existing building and addition are calculated to determine compliance in accordance with Section 101.4.3 and one or more existing components are unable to meet current prescriptive code minimum requirements, said component(s) need not meet code if the entire building is brought into compliance with the code. Future building components shall meet the prescriptive requirements of 502, 503, 504 or 505, as applicable.

506.3.2 Envelope limitation. For new buildings or additions, the building energy cost budget method results shall not be submitted for building permit approval to the code official prior to submittal for approval of the building envelope design.

506.3.3 Requirements specific to credit options. Credit may be claimed in the compliance calculation for technologies that meet the criteria for various options specified below.

506.3.3.1 Vegetative roofs. Credit may be claimed in whole building performance method calculations for the area of a proposed building's roof that is covered with a vegetative roof that is designed and installed in accordance with ANSI/SPRI VF-1, with a minimum growth media depth of 4 inches. The credit shall provide a 45% reduction in the heating and cooling roof heat flux rates for the roof area covered with the vegetative roof. Minimum roof/ceiling insulation levels shall be code minimums as per Section 506.2.1.

506.3.3.2 Enthalpy Recovery Ventilation systems (ERVs). Credit may be claimed in the whole building performance method calculations for Enthalpy Recovery Ventilation systems used in the proposed building. This credit is applicable for buildings in which every HVAC system has a design supply air flow of less than 5,000 CFM. The credit shall also be applicable to buildings where one or more HVAC systems in the building have a design supply flow equal to 5,000 CFM or greater but shall have minimum outdoor air supply to be less than 70 percent of the design supply air flow for that HVAC system.

The credit shall provide for a reduction of 6 percent of total HVAC annual energy use for buildings located in Climate Zone 1 and 4 percent of total HVAC annual energy use for buildings located in Climate Zone 2.

506.4 Documentation. Commission approved compliance software tools shall be utilized to conform to the provisions of this section. Compliance software provisions and overall stringency shall be as described in Normative Appendix B.

506.4.1 Compliance report. The compliance software tools shall generate a Form 506 report that documents that the *proposed design* has annual energy costs less than or equal to the annual energy costs of the *standard reference design*. The compliance documentation shall be submitted to the code official before a building permit is issued and shall include the following information:

1. Address of the building;
2. An inspection checklist documenting the building component characteristics of the *proposed design* as *listed* in Table B-2.2 of Appendix B. The inspection checklist shall show the estimated annual energy cost for both the *standard reference design* and the *proposed design*;
3. Name of individual completing the compliance report; and
4. Name and version of the compliance software tool.

506.4.2 Additional documentation. The *code official* shall require the following documents:

1. Thermal zoning diagrams consisting of floor plans showing the thermal zoning scheme for the *proposed design*.
2. Input and output report(s) from the energy analysis simulation program containing the complete input and output files, as applicable. The output file shall include energy use totals and energy use by energy source and end-use served, total hours that space conditioning loads are not met and any errors or warning

TABLE 505.6.2(2)
INDIVIDUAL LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS

		Zone 1	Zone 2	Zone 3	Zone 4
Base Site Allowance (Base allowance may be used in tradable or nontradable surfaces.)		500 W	600 W	750 W	1300 W
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 areas and drives	0.04 W/ft^2	0.06 W/ft^2	0.10 W/ft^2	0.13 W/ft^2
	Building Grounds				
	Walkways less than 10 feet wide	0.7 W/linear foot	0.7 W/linear foot	0.8 W/linear foot	1.0 W/linear foot
	Walkways 10 feet wide or greater, plaza areas special feature areas	0.14 W/ft^2	0.14 W/ft^2	0.16 W/ft^2	0.2 W/ft^2
	Stairways	0.75 W/ft^2	1.0 W/ft^2	1.0 W/ft^2	1.0 W/ft^2
	Pedestrian tunnels	0.15 W/ft^2	0.15 W/ft^2	0.2 W/ft^2	0.3 W/ft^2
	Building Entrances and Exits				
	Main entries	20 W/linear foot of door width	20 W/linear foot of door width	30 W/linear foot of door width	30 W/linear foot of door width
	Other doors	20 W/linear foot of door width	20 W/linear foot of door width	20 W/linear foot of door width	20 W/linear foot of door width
	Entry canopies	0.25 W/ft^2	0.25 W/ft^2	0.4 W/ft^2	0.4 W/ft^2
	Sales Canopies				
	Free-standing and attached	0.6 W/ft^2	0.6 W/ft^2	0.8 W/ft^2	1.0 W/ft^2
	Outdoor Sales				
	Open areas (including vehicle sales lots)	0.25 W/ft^2	0.25 W/ft^2	0.5 W/ft^2	0.7 W/ft^2
	Street frontage for vehicle sales lots in addition to "open area" allowance	No allowance	10 W/linear foot	10 W/linear foot	30 W/linear foot
Nontradable Surfaces (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	No allowance	0.1 W/ft^2 for each illuminated wall or surface or 2.5 W/linear foot for each illuminated wall or surface length	0.15 W/ft^2 for each illuminated wall or surface or 3.75 W/linear foot for each illuminated wall or surface length	0.2 W/ft^2 for each illuminated wall or surface or 5.0 W/linear foot for each illuminated wall or surface length
	Automated teller machines and night depositories	270 W per location plus 90 W per additional ATM per location	270 W per location plus 90 W per additional ATM per location	270 W per location plus 90 W per additional ATM per location	270 W per location plus 90 W per additional ATM per location
	Entrances and gatehouse inspection stations at guarded facilities	0.75 W/ft^2 of covered and uncovered area	0.75 W/ft^2 of covered and uncovered area	0.75 W/ft^2 of covered and uncovered area	0.75 W/ft^2 of covered and uncovered area
	Loading areas for law enforcement, fire, ambulance and other emergency service vehicles	0.5 W/ft^2 of covered and uncovered area	0.5 W/ft^2 of covered and uncovered area	0.5 W/ft^2 of covered and uncovered area	0.5 W/ft^2 of covered and uncovered area
	Drive-up windows/doors	400 W per drive-through	400 W per drive-through	400 W per drive-through	400 W per drive-through
	Parking near 24-hour retail entrances	800 W per main entry	800 W per main entry	800 W per main entry	800 W per main entry

For SI: 1 foot = 304.8 mm, 1 watt per square foot = W/0.0929 m^2.

messages generated by the simulation tool as applicable;

3. An explanation of any error or warning messages appearing in the simulation tool output; and

4. A certification signed by the design professionals responsible under Florida law for the design of lighting, electrical, mechanical, and plumbing systems and the building shell providing the building component characteristics of the *proposed design* as given in Table B-2.2 of Appendix B . See Section 103.1 of this code.

506.5 Calculation procedure. See Normative Appendix B.

506.6 Calculation software tools. See Normative Appendix B.

TABLE 505.7.5
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.