



DPS OPEN HOUSE

2015 INTERNATIONAL ENERGY CONSERVATION CODE
(IECC)

SIGNIFICANT CHANGES – COMMERCIAL PROVISIONS
Adopted August 3, 2015

Mandatory compliance begins Monday October 5, 2015

Re-organization and additions to the code

2015 LOCATION	2012 LOCATION
C501	C101.4.1
C501.6	C101.4.2
C502 through C504	C101.4.3
C505	C101.4.4
C503.2	C101.4.5
C402.1.1	C101.5.2
C402.3	C402.2.1.1

Chapters	Subjects
1-2	Administration and definitions
3	Climate zones and general materials requirements
4	Energy efficiency requirements
5	Existing buildings
6	Referenced standards



C103.2 Information on construction documents. Construction documents shall be drawn to scale upon suitable material. Electronic media documents are permitted to be submitted where approved by the code official. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment as herein governed. Details shall include, but are not limited to the following as applicable:

1. Insulation materials and their R-values.
2. Fenestration U-factors and solar heat gain coefficients (SHGCs).
3. Area-weighted U-factor and solar heat gain coefficient (SHGC) calculations.
4. Mechanical system design criteria.
5. Mechanical and service water heating system and equipment types, sizes and efficiencies.
6. Economizer description.
7. Equipment and system controls.
8. Fan motor horsepower (hp) and controls.
9. Duct sealing, duct and pipe insulation and location.
10. Lighting fixture schedule with wattage and control narrative.
11. Location of daylight zones on floor plans.
12. Air sealing details.



C401.2 Application. Commercial buildings shall comply with one of the following:

1. The requirements of ANSI/ASHRAE/IESNA 90.1. [In its entirety]
2. The requirements of Sections C402 through C405. In addition, commercial buildings shall comply with Section C406 and tenant spaces shall comply with Section C406.1.1.
3. The requirements of Sections C402.5, C403.2, C404, C405.2, C405.3, C405.4, C405.6 and C407. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.



SECTION C402

BUILDING ENVELOPE REQUIREMENTS C402.1 General (Prescriptive).

Previously C101.5.2

Building thermal envelope assemblies for buildings that are intended to comply with the code on a prescriptive basis, in accordance with the compliance path described in Item 2 of Section C401.2, shall comply with the following:

1. The opaque portions of the building thermal envelope shall comply with the specific insulation requirements of Section C402.2 and the thermal requirements of either the R-value-based method of Section C402.1.3; the U-, C- and F-factor-based method of Section C402.1.4; or the component performance alternative of Section 402.1.5.
2. Roof solar reflectance and thermal emittance shall comply with Section C402.3.
3. Fenestration in building envelope assemblies shall comply with Section C402.4.
4. Air leakage of building envelope assemblies shall comply with Section C402.5.

Alternatively, where buildings have a vertical fenestration area or skylight area exceeding that allowed in Section C402.4, the building and building thermal envelope shall comply with Section C401.2, Item 1 or Section C401.2, Item 3. Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.2.15 or C403.2.16.



C402.1.1 Low-energy buildings. The following low-energy buildings, or portions thereof separated from the remainder of the building by building thermal envelope assemblies complying with this section, shall be exempt from the building thermal envelope provisions of Section C402.

1. Those with a peak design rate of energy usage less than 3.4 Btu/h ft² (10.7 W/m² or 1.0 watt per square foot (10.7 W/m² of floor area for space conditioning purposes.
2. Those that do not contain conditioned space.
3. Greenhouses.

C402.1.2 Equipment buildings. Buildings that comply with the following shall be exempt from the building thermal envelope provisions of this code:

1. Are separate buildings with floor area not more than 500 square feet (50 m²
2. Are intended to house electronic equipment with installed equipment power totaling not less than 7 watts per square foot (75 W/m² and not intended for human occupancy.
3. Have a heating system capacity not greater than (17,000 Btu/hr) (5 kW) and a heating thermostat set point that is restricted to not more than 50°F (10°C).
4. Have an average wall and roof U-factor less than 0.200 in Climate Zones 1 through 5 and less than 0.120 in Climate Zones 6 through 8.
5. ~~Comply with the roof solar reflectance and thermal emittance provisions for Climate Zone~~
4. Not applicable.

C402.1.3 Insulation component R-value-based method. Building thermal envelope opaque assemblies shall meet the requirements of Sections C402.2 and C402.4 based on the climate zone specified in Chapter 3. For opaque portions of the building thermal envelope intended to comply on an insulation component R-value basis, the R-values for insulation in framing cavities, where required, and for continuous insulation, where required, shall be not less than that specified in Table C402.1.3, based on the climate zone specified in Chapter 3. Commercial buildings or portions of commercial buildings enclosing Group R occupancies shall use the R-values from the "Group R" column of Table C402.1.3. Commercial buildings or portions of commercial buildings enclosing occupancies other than Group R shall use the R-values from the "All other" column of Table C402.1.3.

The thermal resistance or R-value of the insulating material installed continuously within or on the below-grade exterior walls of the building envelope required in accordance with Table C402.1.3 shall extend to a depth of not less than 10 feet (3048 mm) below the outside finished ground level, or to the level of the lowest floor of the conditioned space enclosed by the below grade wall, whichever is less. Opaque swinging doors shall comply with Table C402.1.4 and opaque roll-up or sliding doors shall comply with Table C402.1.3.

C402.1.4 Assembly U-factor, C-factor or F-factor-based method. Building thermal envelope opaque assemblies intended to comply on an assembly U-, C- or F-factor basis shall have a U-, C- or F-factor not greater than that specified in Table C402.1.4. Commercial buildings or portions of commercial buildings enclosing Group R occupancies shall use the U-, C- or F-factor from the “Group R” column of Table C402.1.4. Commercial buildings or portions of commercial buildings enclosing occupancies other than Group R shall use the U-, C- or F-factor from the “All other” column of Table C402.1.4. The C-factor for the below-grade exterior walls of the building envelope, as required in accordance with Table C402.1.4, shall extend to a depth of 10 feet (3048 mm) below the outside finished ground level, or to the level of the lowest floor, whichever is less. Opaque swinging doors shall comply with Table C402.1.4 and opaque roll-up or sliding doors shall comply with Table C402.1.3.

C402.1.4.1 Thermal resistance of cold-formed steel walls. U-factors of walls with cold-formed steel studs shall be permitted to be determined in accordance with Equation 4-1: $U = 1/[R_s (ER)]$ (Equation 4-1) where: R_s The cumulative R-value of the wall components along the path of heat transfer, excluding the cavity insulation and steel studs. ER The effective R-value of the cavity insulation with steel studs.

**TABLE C402.1.4.1
EFFECTIVE R-VALUES FOR STEEL STUD WALL ASSEMBLIES**

NOMINAL STUD DEPTH (inches)	SPACING OF FRAMING (inches)	CAVITY R-VALUE (insulation)	CORRECTION FACTOR (F_c)	EFFECTIVE R-VALUE (ER) (Cavity R-Value $\times F_c$)
3½	16	13	0.46	5.98
		15	0.43	6.45
3½	24	13	0.55	7.15
		15	0.52	7.80
6	16	19	0.37	7.03
		21	0.35	7.35
6	24	19	0.45	8.55
		21	0.43	9.03
8	16	25	0.31	7.75
	24	25	0.38	9.50



C402.4.1.1 Increased vertical fenestration area with daylight responsive controls. In Climate Zones 1 through 6, not more than 40 percent of the gross above-grade wall area shall be permitted to be vertical fenestration, provided all of the following requirements are met:

1. In buildings not greater than two stories above grade, not less than 50 percent of the net floor area is within a daylight zone.
2. In buildings three or more stories above grade, not less than 25 percent of the net floor area is within a daylight zone.
3. Daylight responsive controls complying with Section C405.2.3.1 are installed in daylight zones.
4. Visible transmittance (VT) of vertical fenestration is not less than 1.1 times solar heat gain coefficient (SHGC).
Exception: Fenestration that is outside the scope of NFRC 200 is not required to comply with Item 4.

C402.4.1.2 Increased skylight area with daylight responsive controls. The skylight area shall be permitted to be not more than 5 percent of the roof area provided daylight responsive controls complying with Section C405.2.3.1 are installed in daylight zones under skylights.

C402.4.2 Minimum skylight fenestration area. In an enclosed space greater than 2,500 square feet (232 m² in floor area, directly under a roof with not less than 75 percent of the ceiling area with a ceiling height greater than 15 feet (4572 mm), and used as an office, lobby, atrium, concourse, corridor, storage space, gymnasium/exercise center, convention center, automotive service area, space where manufacturing occurs, non-refrigerated warehouse, retail store, distribution/sorting area, transportation depot or workshop, the total daylight zone under skylights shall be not less than half the floor area and shall provide one of the following:

1. A minimum skylight area to daylight zone under skylights of not less than 3 percent where all skylights have a VT of at least 0.40 as determined in accordance with Section C303.1.3.
2. A minimum skylight effective aperture of at least 1 percent, determined in accordance with Equation 4-4



C402.4.3.1 Increased skylight SHGC. In Climate Zones 1 through 6, skylights shall be permitted a maximum SHGC of 0.60 where located above daylight zones provided with daylight responsive controls.

C402.4.3.2 Increased skylight U-factor. Where skylights are installed above daylight zones provided with daylight responsive controls, a maximum U-factor of 0.9 shall be permitted in Climate Zones 1 through 3 and a maximum U-factor of 0.75 shall be permitted in Climate Zones 4 through 8.

C402.4.3.3 Dynamic glazing. Where dynamic glazing is intended to satisfy the SHGC and VT requirements of Table C402.4, the ratio of the higher to lower labeled SHGC shall be greater than or equal to 2.4, and the dynamic glazing shall be automatically controlled to modulate the amount of solar gain into the space in multiple steps. Dynamic glazing shall be considered separately from other fenestration, and area-weighted averaging with other fenestration that is not dynamic glazing shall not be permitted.

Exception: Dynamic glazing is not required to comply with this section where both the lower and higher labeled SHGC already comply with the requirements of Table C402.3.



C402.5.3 Rooms containing fuel-burning appliances. In Climate Zones 3 through 8, where open combustion air ducts provide combustion air to open combustion space conditioning fuel-burning appliances, the appliances and combustion air openings shall be located outside of the building thermal envelope or enclosed in a room isolated from inside the thermal envelope. Such rooms shall be sealed and insulated in accordance with the envelope requirements of Table C402.1.3 or C402.1.4, where the walls, floors and ceilings shall meet the minimum of the below-grade wall R-value requirement. The door into the room shall be fully gasketed, and any water lines and ducts in the room insulated in accordance with Section C403. The combustion air duct shall be insulated, where it passes through conditioned space, to a minimum of R-8.

Exceptions:

1. Direct vent appliances with both intake and exhaust pipes installed continuous to the outside.
2. Fireplaces and stoves complying with Sections 901 through 905 of the International Mechanical Code, and Section 2111.13 of the International Building Code. C402.5.4 Doors and access openings to shafts, chutes, stairways and elevator lobbies. Doors and access openings from conditioned space to shafts, chutes stairways and elevator lobbies not within the scope of the fenestration assemblies covered by Section C402.5.2 shall be gasketed, weatherstripped or sealed.

Exceptions:

1. Door openings required to comply with Section 716 or 716.4 of the International Building Code.
2. Doors and door openings required by comply with UL 1784 by the International Building Code.



C402.5.7 Vestibules. Building entrances shall be protected with an enclosed vestibule, with all doors opening into and out of the vestibule equipped with self-closing devices. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior doors to open at the same time. The installation of one or more revolving doors in the building entrance shall not eliminate the requirement that a vestibule be provided on any doors adjacent to revolving doors.

Exceptions:

Vestibules are not required for the following:

1. ~~Buildings in Climate Zones 1 and 2.~~ Not applicable
2. Doors not intended to be used by the public, such as doors to mechanical or electrical equipment rooms, or intended solely for employee use.
3. Doors opening directly from a sleeping unit or dwelling unit.
4. Doors that open directly from a space less than 3,000 square feet (298 m² in area).
5. Revolving doors.
6. Doors that have an air curtain with a velocity of not less than 6.56 feet per second (2 m/s) at the floor that have been tested in accordance with ANSI/AMCA 220 and installed in accordance with the manufacturer's instructions.

Manual or automatic controls shall be provided that will operate the air curtain with the opening and closing of the door. Air curtains and their controls shall comply with Section C408.2.3.

C402.5.8 Recessed lighting. Recessed luminaires installed in the building thermal envelope shall be all of the following:

1. IC-rated.
2. Labeled as having an air leakage rate of not more 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E 283 at a 1.57 psf (75 Pa) pressure differential.
3. Sealed with a gasket or caulk between the housing and interior wall or ceiling covering.



SECTION C403 BUILDING MECHANICAL SYSTEMS

C403.1 General. Mechanical systems and equipment serving the building heating, cooling or ventilating needs shall comply with **Section C403.2** and shall comply with Sections C403.3 and C403.4 based on the equipment and systems provided. **Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.2.15 or C403.2.16.**



C403.2.3 HVAC equipment performance requirements.

Equipment shall meet the minimum efficiency requirements of Tables C403.2.3(1), C403.2.3(2), C403.2.3(3), C403.2.3(4), C403.2.3(5), C403.2.3(6), C403.2.3(7), C403.2.3(8) and C403.2.3(9) when tested and rated in accordance with the applicable test procedure. Plate-type liquid-to-liquid heat exchangers shall meet the minimum requirements of Table C403.2.3(10). The efficiency shall be verified through certification under an approved certification program or, where a certification program does not exist, 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.

TABLE C403.2.3(1)
MINIMUM EFFICIENCY REQUIREMENTS:
ELECTRICALLY OPERATED UNITARY AIR CONDITIONERS AND CONDENSING UNITS

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY		TEST PROCEDURE ^a
				Before 1/1/2016	As of 1/1/2016	
Air conditioners, air cooled	< 65,000 Btu/h ^b	All	Split System	13.0 SEER	13.0 SEER	AHRI 210/240
			Single Package	13.0 SEER	14.0 SEER ^c	
Through-the-wall (air cooled)	≤ 30,000 Btu/h ^b	All	Split system	12.0 SEER	12.0 SEER	
			Single Package	12.0 SEER	12.0 SEER	
Small-duct high-velocity (air cooled)	< 65,000 Btu/h ^b	All	Split System	11.0 SEER	11.0 SEER	
Air conditioners, air cooled	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.2 EER 11.4 IEER	11.2 EER 12.8 IEER	
			All other	Split System and Single Package	11.0 EER 11.2 IEER	11.0 EER 12.6 IEER
	Electric Resistance (or None)	Split System and Single Package		11.0 EER 11.2 IEER	11.0 EER 12.4 IEER	
		All other	Split System and Single Package	10.8 EER 11.0 IEER	10.8 EER 12.2 IEER	
	≥ 240,000 Btu/h and < 760,000 Btu/h		Electric Resistance (or None)	Split System and Single Package	10.0 EER 10.1 IEER	10.0 EER 11.6 IEER
		All other		Split System and Single Package	9.8 EER 9.9 IEER	9.8 EER 11.4 IEER
	≥ 760,000 Btu/h		Electric Resistance (or None)	Split System and Single Package	9.7 EER 9.8 IEER	9.7 EER 11.2 IEER
		All other		Split System and Single Package	9.5 EER 9.6 IEER	9.5 EER 11.0 IEER
Air conditioners, water cooled	< 65,000 Btu/h ^b		All	Split System and Single Package	12.1 EER 12.3 IEER	12.1 EER 12.3 IEER
		Electric Resistance (or None)		Split System and Single Package	12.1 EER 12.3 IEER	12.1 EER 13.9 IEER
	All other		Split System and Single Package	11.9 EER 12.1 IEER	11.9 EER 13.7 IEER	
		≥ 135,000 Btu/h and < 240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	12.5 EER 12.5 IEER	12.5 EER 13.9 IEER
	All other			Split System and Single Package	12.3 EER 12.5 IEER	12.3 EER 13.7 IEER
		≥ 240,000 Btu/h and < 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	12.4 EER 12.6 IEER	12.4 EER 13.6 IEER
	All other			Split System and Single Package	12.2 EER 12.4 IEER	12.2 EER 13.4 IEER
		≥ 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	12.2 EER 12.4 IEER	12.2 EER 13.5 IEER
	All other			Split System and Single Package	12.0 EER 12.2 IEER	12.0 EER 13.3 IEER



C403.2.4.7 Economizer fault detection and diagnostics (FDD). Air-cooled unitary direct-expansion units listed in Tables C403.2.3(1) through C403.2.3(3) and variable refrigerant flow (VRF) units that are equipped with an economizer in accordance with Section C403.3 shall include a fault detection and diagnostics (FDD) system complying with the following:

1. The following temperature sensors shall be permanently installed to monitor system operation:
 - 1.1. Outside air.
 - 1.2. Supply air.
 - 1.3. Return air.
2. Temperature sensors shall have an accuracy of $\pm 2^{\circ}\text{F}$ (1.1°C) over the range of 40°F to 80°F (4°C to 26.7°C).
3. Refrigerant pressure sensors, where used, shall have an accuracy of ± 3 percent of full scale.
4. The unit controller shall be capable of providing system status by indicating the following:
 - 4.1. Free cooling available.
 - 4.2. Economizer enabled.
 - 4.3. Compressor enabled.
 - 4.4. Heating enabled.
 - 4.5. Mixed air low limit cycle active.
 - 4.6. The current value of each sensor.
5. The unit controller shall be capable of manually initiating each operating mode so that the operation of compressors, economizers, fans and the heating system can be independently tested and verified.
6. The unit shall be capable of reporting faults to a fault management application accessible by day- to-day operating or service personnel, or annunciated locally on zone thermostats.
7. The FDD system shall be capable of detecting the following faults:
 - 7.1. Air temperature sensor failure/fault.
 - 7.2. Not economizing when the unit should be economizing.
 - 7.3. Economizing when the unit should not be economizing.
 - 7.4. Damper not modulating.
 - 7.5. Excess outdoor air.



C403.2.6.2 Enclosed parking garage ventilation controls.

Enclosed parking garages used for storing or handling automobiles operating under their own power shall employ contamination-sensing devices and automatic controls configured to stage fans or modulate fan average airflow rates to 50 percent or less of design capacity, or intermittently operate fans less than 20 percent of the occupied time or as required to maintain acceptable contaminant levels in accordance with International Mechanical Code provisions. Failure of contamination sensing devices shall cause the exhaust fans to operate continuously at design airflow.

Exceptions:

1. Garages with a total exhaust capacity less than 22,500 cfm (10 620 L/s) with ventilation systems that do not utilize heating or mechanical cooling.
2. Garages that have a garage area to ventilation system motor nameplate power ratio that exceeds 1125 cfm/hp (710 L/s/kW) and do not utilize heating or mechanical cooling.

C403.2.7 Energy recovery ventilation systems. Where the supply airflow rate of a fan system exceeds the values specified in Tables C403.2.7(1) and C403.2.7(2), the system shall include an energy recovery system. The energy recovery system shall have the capability to provide a change in the enthalpy of the outdoor air supply of not less than 50 percent of the difference between the outdoor air

TABLE C403.2.7(1)
ENERGY RECOVERY REQUIREMENT
(Ventilation systems operating less than 8,000 hours per year)

CLIMATE ZONE	PERCENT (%) OUTDOOR AIR AT FULL DESIGN AIRFLOW RATE							
	≥ 10% and < 20%	≥ 20% and < 30%	≥ 30% and < 40%	≥ 40% and < 50%	≥ 50% and < 60%	≥ 60% and < 70%	≥ 70% and < 80%	≥ 80%
	DESIGN SUPPLY FAN AIRFLOW RATE (cfm)							
3B, 3C, 4B, 4C, 5B	NR	NR	NR	NR	NR	NR	NR	NR
1B, 2B, 5C	NR	NR	NR	NR	≥ 26,000	≥ 12,000	≥ 5,000	≥ 4,000
6B	≥ 28,000	≥ 26,500	≥ 11,000	≥ 5,500	≥ 4,500	≥ 3,500	≥ 2,500	≥ 1,500
1A, 2A, 3A, 4A, 5A, 6A	≥ 26,000	≥ 16,000	≥ 5,500	≥ 4,500	≥ 3,500	≥ 2,000	≥ 1,000	> 0
7, 8	≥ 4,500	≥ 4,000	≥ 2,500	≥ 1,000	> 0	> 0	> 0	> 0

For SI: 1 cfm = 0.4719 L/s.
NR = Not Required.

TABLE C403.2.7(2)
ENERGY RECOVERY REQUIREMENT
(Ventilation systems operating not less than 8,000 hours per year)

CLIMATE ZONE	PERCENT (%) OUTDOOR AIR AT FULL DESIGN AIRFLOW RATE							
	≥ 10% and < 20%	≥ 20% and < 30%	≥ 30% and < 40%	≥ 40% and < 50%	≥ 50% and < 60%	≥ 60% and < 70%	≥ 70% and < 80%	≥ 80%
	Design Supply Fan Airflow Rate (cfm)							
3C	NR	NR	NR	NR	NR	NR	NR	NR
1B, 2B, 3B, 4C, 5C	NR	≥ 19,500	≥ 9,000	≥ 5,000	≥ 4,000	≥ 3,000	≥ 1,500	> 0
1A, 2A, 3A, 4B, 5B	≥ 2,500	≥ 2,000	≥ 1,000	≥ 500	> 0	> 0	> 0	> 0
4A, 5A, 6A, 6B, 7, 8	> 0	> 0	> 0	> 0	> 0	> 0	> 0	> 0

For SI: 1 cfm = 0.4719 L/s.
NR = Not required.



C403.2.8 Kitchen exhaust systems. Replacement air introduced directly into the exhaust hood cavity shall not be greater than 10 percent of the hood exhaust airflow rate. Conditioned supply air delivered to any space shall not exceed the greater of the following:

1. The ventilation rate required to meet the space heating or cooling load.
2. The hood exhaust flow minus the available transfer air from adjacent space where available transfer air is considered that portion of outdoor ventilation air not required to satisfy other exhaust needs, such as restrooms, and not required to maintain pressurization of adjacent spaces.

Where total kitchen hood exhaust airflow rate is greater than 5,000 cfm (2360 L/s), each hood shall be a factory built commercial exhaust hood listed by a nationally recognized testing laboratory in compliance with UL 710. Each hood shall have a maximum exhaust rate as specified in Table C403.2.8 and shall comply with one of the following:

1. Not less than 50 percent of all replacement air shall be transfer air that would otherwise be exhausted.
2. Demand ventilation systems on not less than 75 percent of the exhaust air that are capable of not less than a 50-percent reduction in exhaust and replacement air system airflow rates, including controls necessary to modulate airflow in response to appliance operation and to maintain full capture and containment of smoke, effluent and combustion products during cooking and idle.
3. Listed energy recovery devices with a sensible heat recovery effectiveness of not less than 40 percent on not less than 50 percent of the total exhaust airflow.

Where a single hood, or hood section, is installed over appliances with different duty ratings, the maximum allowable flow rate for the hood or hood section shall be based on the requirements for the highest appliance duty rating under the hood or hood section.

Exception:

Where not less than 75 percent of all the replacement air is transfer air that would otherwise be exhausted.



C403.2.14 Refrigeration equipment performance. Refrigeration equipment shall have an energy use in kWh/day not greater than the values of Tables C403.2.14(1) and C403.2.14(2) when tested and rated in accordance with AHRI Standard 1200. The energy use shall be verified through certification under an approved certification program or, where a certification program does not exist, the energy use shall be supported by data furnished by the equipment manufacturer.

TABLE C403.2.14(1)
MINIMUM EFFICIENCY REQUIREMENTS: COMMERCIAL REFRIGERATION

EQUIPMENT TYPE	APPLICATION	ENERGY USE LIMITS (kWh per day) ^a	TEST PROCEDURE
Refrigerator with solid doors	Holding Temperature	$0.10 \cdot V + 2.04$	AHRI 1200
Refrigerator with transparent doors		$0.12 \cdot V + 3.34$	
Freezers with solid doors		$0.40 \cdot V + 1.38$	
Freezers with transparent doors		$0.75 \cdot V + 4.10$	
Refrigerators/freezers with solid doors		the greater of $0.12 \cdot V + 3.34$ or 0.70	
Commercial refrigerators	Pulldown	$0.126 \cdot V + 3.51$	

a. V = volume of the chiller or frozen compartment as defined in AHAM-IRF-1.

TABLE C403.2.14(2)
MINIMUM EFFICIENCY REQUIREMENTS: COMMERCIAL REFRIGERATORS AND FREEZERS

EQUIPMENT TYPE				ENERGY USE LIMITS (kWh/day) ^a	TEST PROCEDURE
Equipment Class ^b	Family Code	Operating Mode	Rating Temperature		
VOP.RC.M	Vertical open	Remote condensing	Medium	$0.82 \cdot TDA + 4.07$	AHRI 1200
SVO.RC.M	Semivertical open	Remote condensing	Medium	$0.83 \cdot TDA + 3.18$	
HZO.RC.M	Horizontal open	Remote condensing	Medium	$0.35 \cdot TDA + 2.88$	
VOP.RCL	Vertical open	Remote condensing	Low	$2.27 \cdot TDA + 6.85$	
HZO.RCL	Horizontal open	Remote condensing	Low	$0.57 \cdot TDA + 6.88$	
VCT.RC.M	Vertical transparent door	Remote condensing	Medium	$0.22 \cdot TDA + 1.95$	
VCT.RCL	Vertical transparent door	Remote condensing	Low	$0.56 \cdot TDA + 2.61$	
SOC.RC.M	Service over counter	Remote condensing	Medium	$0.51 \cdot TDA + 0.11$	
VOP.SC.M	Vertical open	Self-contained	Medium	$1.74 \cdot TDA + 4.71$	
SVO.SC.M	Semivertical open	Self-contained	Medium	$1.73 \cdot TDA + 4.59$	
HZO.SC.M	Horizontal open	Self-contained	Medium	$0.77 \cdot TDA + 5.55$	
HZO.SCL	Horizontal open	Self-contained	Low	$1.92 \cdot TDA + 7.08$	
VCT.SC.I	Vertical transparent door	Self-contained	Ice cream	$0.67 \cdot TDA + 3.29$	
VCS.SC.I	Vertical solid door	Self-contained	Ice cream	$0.38 \cdot V + 0.88$	
HCT.SC.I	Horizontal transparent door	Self-contained	Ice cream	$0.56 \cdot TDA + 0.43$	
SVO.RCL	Semivertical open	Remote condensing	Low	$2.27 \cdot TDA + 6.85$	
VOP.RCI	Vertical open	Remote condensing	Ice cream	$2.89 \cdot TDA + 8.7$	
SVO.RCI	Semivertical open	Remote condensing	Ice cream	$2.89 \cdot TDA + 8.7$	
HZO.RCI	Horizontal open	Remote condensing	Ice cream	$0.72 \cdot TDA + 8.74$	
VCT.RCI	Vertical transparent door	Remote condensing	Ice cream	$0.66 \cdot TDA + 3.05$	
HCT.RC.M	Horizontal transparent door	Remote condensing	Medium	$0.16 \cdot TDA + 0.13$	



C403.2.15 Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers. Refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with this section. Walk-in coolers and walk-in freezers that are not either site assembled or site constructed shall comply with the following:

1. Be equipped with automatic door closers that firmly close walk-in doors that have been closed to within 1 inch (25 mm) of full closure.

Exception: Automatic closers are not required for doors more than 45 inches (1143 mm) in width or more than 7 feet 2134 mm) in height.

2. Doorways shall have strip doors, curtains, spring- hinged doors or other method of minimizing infiltration when doors are open.

3. Walk-in coolers and refrigerated warehouse coolers shall contain wall, ceiling, and door insulation of not less than R-25 and walk-in freezers and refrigerated warehouse freezers shall contain wall, ceiling and door insulation of not less than R-32.

Exception: Glazed portions of doors or structural members need not be insulated.

4. Walk-in freezers shall contain floor insulation of not less than R-28.

5. Transparent reach-in doors for walk-in freezers and windows in walk-in freezer doors shall be of triple-pane glass, either filled with inert gas or with heat-reflective treated glass.

6. Windows and transparent reach-in doors for walk- in coolers doors shall be of double-pane or triple pane, inert gas-filled, heat-reflective treated glass.

7. Evaporator fan motors that are less than 1 hp (0.746 kW) and less than 460 volts shall use electronically commutated motors, brushless direct- current motors, or 3-phase motors.

8. Condenser fan motors that are less than 1 hp (0.746 kW) shall use electronically commutated motors, permanent split capacitor-type motors or 3-phase motors.

9. Where anti-sweat heaters without anti-sweat heater controls are provided, they shall have a total door rail, glass and frame heater power draw of not more than 7.1 W/ft² (76 W/m² of door opening for walk-in freezers and 3.0 W/ft² (32 W/m² of door opening for walk-in coolers.

10. Where anti-sweat heater controls are provided, they shall reduce the energy use of the anti-sweat heater as a function of the relative humidity in the air out- side the door or to the condensation on the inner glass pane.

11. Lights in walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated ware- house freezers shall either use light sources with an efficacy of not less than 40 lumens per watt, including ballast losses, or shall use light sources



(continued) with an efficacy of not less than 40 lumens per watt, including ballast losses, in conjunction with a device that turns off the lights within 15 minutes when the space is not occupied.

C403.2.16 Walk-in coolers and walk-in freezers. Site- assembled or site-constructed walk-in coolers and walk-in freezers shall comply with the following:

1. Automatic door closers shall be provided that fully close walk-in doors that have been closed to within 1 inch (25 mm) of full closure.
Exception: Closers are not required for doors more than 45 inches (1143 mm) in width or more than 7 feet (2134 mm) in height.
2. Doorways shall be provided with strip doors, curtains, spring-hinged doors or other method of minimizing infiltration when the doors are open.
3. Walls shall be provided with insulation having a thermal resistance of not less than R-25, ceilings shall be provided with insulation having a thermal resistance of not less than R-25 and doors of walk- in coolers and walk-in freezers shall be provided with insulation having a thermal resistance of not less than R-32.
Exception: Insulation is not required for glazed portions of doors or at structural members associated with the walls, ceiling or door frame.
4. The floor of walk-in freezers shall be provided with insulation having a thermal resistance of not less than R-28.
5. Transparent reach-in doors for and windows in opaque walk-in freezer doors shall be provided with triple-pane glass having the interstitial spaces filled with inert gas or provided with heat reflective treated glass.
6. Transparent reach-in doors for and windows in opaque walk-in cooler doors shall be double-pane heat-reflective treated glass having the interstitial space gas filled.
7. Evaporator fan motors that are less than 1 hp (0.746 kW) and less than 460 volts shall be electronically commutated motors or 3-phase motors.
8. Condenser fan motors that are less than 1 hp (0.746 kW) in capacity shall be of the electronically commutated or permanent split capacitor- type or shall be 3-phase motors.
Exception: Fan motors in walk-in coolers and walk-in freezers combined in a single enclosure greater than 3,000 square feet (279 m² in floor area are exempt.
9. Anti-sweat heaters that are not provided with anti- sweat heater controls shall have a total door rail, glass and frame heater power draw not greater than 7.1 W/ft² (76 W/m² of door opening for walk-in freezers, and not greater than 3.0 W/ft² (32 W/m² of door opening for walk-in coolers.



(continued)

10. Anti-sweat heater controls shall be capable of reducing the energy use of the anti-sweat heater as a function of the relative humidity in the air outside the door or to the condensation on the inner glass pane.

11. Light sources shall have an efficacy of not less than 40 lumens per Watt, including any ballast losses, or shall be provided with a device that automatically turns off the lights within 15 minutes of when the walk-in cooler or walk-in freezer was last occupied.

C403.2.17 Refrigerated display cases. Site-assembled or site-constructed refrigerated display cases shall comply with the following:

1. Lighting and glass doors in refrigerated display cases shall be controlled by one of the following:
 - 1.1. Time switch controls to turn off lights during nonbusiness hours. Timed overrides for display cases shall turn the lights on for up to 1 hour and shall automatically time out to turn the lights off.
 - 1.2. Motion sensor controls on each display case section that reduce lighting power by at least 50 percent within 3 minutes after the area within the sensor range is vacated.
2. Low-temperature display cases shall incorporate temperature-based defrost termination control with a time-limit default. The defrost cycle shall terminate first on an upper temperature limit breach and second upon a time limit breach.
3. Anti-sweat heater controls shall reduce the energy use of the anti-sweat heater as a function of the relative humidity in the air outside the door or to the condensation on the inner glass pane.



C403.3 Economizers (Prescriptive). Each cooling system that has a fan shall include either an air or water economizer complying with Sections C403.3.1 through C403.3.4

Exceptions: Economizers are not required for the systems listed below.

1. In cooling systems for buildings located in Climate Zones 1A and 1B.
2. In climate zones other than 1A and 1B, where individual cooling units have a capacity of less than 54,000 Btu/h (15.8 kW) and meet one of the following:
 - 2.1. Have direct expansion cooling coils.
 - 2.2. The total chilled water system capacity less the capacity of fan units with air economizers is less than the minimum specified in Table C403.3(1). The total supply capacity of all fan-cooling units not provided with economizers shall not exceed 20 percent of the total supply capacity of all fan-cooling units in the building or 300,000 Btu/h (88 kW), whichever is greater.
3. Where more than 25 percent of the air designed to be supplied by the system is to spaces that are designed to be humidified above 35°F (1.7°C) dew point temperature to satisfy process needs.
4. Systems that serve residential spaces where the system capacity is less than five times the requirement listed in Table C403.3(1).
5. Systems expected to operate less than 20 hours per week.
6. Where the use of outdoor air for cooling will affect supermarket open refrigerated casework systems.
7. Where the cooling efficiency meets or exceeds the efficiency requirements in Table C403.3(2).
8. Chilled-water cooling systems that are passive (without a fan) or use induction where the total chilled water system capacity less the capacity of fan units with air economizers is less than the minimum specified in Table C403.3(1).
9. Systems that include a heat recovery system in accordance with Section C403.4.7.



C403.3.1 Integrated economizer control. Economizer systems shall be integrated with the mechanical cooling system and be capable of providing partial cooling even where additional mechanical cooling is required to provide the remainder of the cooling load. Controls shall not be capable of creating a false load in the mechanical cooling systems by limiting or disabling the economizer or any other means, such as hot gas bypass, except at the lowest stage of mechanical cooling.

TABLE C403.3(1)
MINIMUM CHILLED-WATER SYSTEM COOLING CAPACITY FOR DETERMINING ECONOMIZER COOLING REQUIREMENTS

CLIMATE ZONES (COOLING)	TOTAL CHILLED-WATER SYSTEM CAPACITY LESS CAPACITY OF COOLING UNITS WITH AIR ECONOMIZERS	
	Local Water-cooled Chilled-water Systems	Air-cooled Chilled-water Systems or District Chilled-Water Systems
1a	No economizer requirement	No economizer requirement
1b, 2a, 2b	960,000 Btu/h	1,250,000 Btu/h
3a, 3b, 3c, 4a, 4b, 4c	720,000 Btu/h	940,000 Btu/h
5a, 5b, 5c, 6a, 6b, 7, 8	1,320,000 Btu/h	1,720,000 Btu/h

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



C403.4 Hydronic and multiple-zone HVAC systems controls and equipment. (Prescriptive). Hydronic and multiple-zone HVAC system controls and equipment shall comply with this section.

C403.4.1 Fan control. Controls shall be provided for fans in accordance with Sections C403.4.1.1 through C403.4.1.3.

C403.4.1.1 Fan airflow control. Each cooling system listed in Table C403.4.1.1 shall be designed to vary the indoor fan airflow as a function of load and shall comply with the following requirements:

1. Direct expansion (DX) and chilled water cooling units that control the capacity of the mechanical cooling directly based on space temperature shall have not fewer than two stages of fan control. Low or minimum speed shall not be greater than 66 percent of full speed. At low or minimum speed, the fan system shall draw not more than 40 percent of the fan power at full fan speed. Low or minimum speed shall be used during periods of low cooling load and ventilation-only operation.
2. Other units including DX cooling units and chilled water units that control the space temperature by modulating the airflow to the space shall have modulating fan control. Minimum speed shall be not greater than 50 percent of full speed. At minimum speed the fan system shall draw not more than 30 percent of the power at full fan speed. Low or minimum speed shall be used during periods of low cooling load and ventilation-only operation.
3. Units that include an airside economizer in accordance with Section C403.3 shall have not fewer than two speeds of fan control during economizer operation.

Exceptions:

1. Modulating fan control is not required for chilled water and evaporative cooling units with fan motors of less than 1 hp (0.746 kW) where the units are not used to provide ventilation air and the indoor fan cycles with the load.
2. Where the volume of outdoor air required to comply with the ventilation requirements of the International Mechanical Code at low speed exceeds the air that would be delivered at the speed defined in Section C403.4.1, the minimum speed shall be selected to provide the required ventilation air.

**TABLE C403.4.1.1
EFFECTIVE DATES FOR FAN CONTROL**

COOLING SYSTEM TYPE	FAN MOTOR SIZE	MECHANICAL COOLING CAPACITY
DX cooling	Any	≥ 75,000 Btu/h (before 1/1/2016)
		≥ 65,000 Btu/h (after 1/1/2016)
Chilled water and evaporative cooling	≥ 5 hp	Any
	≥ 1/4 hp	Any

For SI: 1 British thermal unit per hour = 0.2931 W; 1 hp = 0.746 kW.



C403.4.2.4 Part-load controls. Hydronic systems greater than or equal to 500,000 Btu/h (146.5 kW) in design output capacity supplying heated or chilled water to comfort conditioning systems shall include controls that have the capability to do all of the following:

1. Automatically reset the supply-water temperatures in response to varying building heating and cooling demand using coil valve position, zone-return water temperature, building-return water temperature or outside air temperature. The temperature shall be capable of being reset by not less than 25 percent of the design supply-to- return water temperature difference.
2. Automatically vary fluid flow for hydronic systems with a combined motor capacity of 10 hp (7.5 kW) or larger with three or more control valves or other devices by reducing the system design flow rate by not less than 50 percent by percent, utilizing adjustable speed drives on pumps, or multiple-staged pumps where not less than one-half of the total pump horsepower is capable of being automatically turned off. Pump flow shall be controlled to maintain one control valve nearly wide open or to satisfy the minimum differential pressure.

Exceptions:

1. Supply-water temperature reset for chilled-water systems supplied by off-site district chilled water or chilled water from ice storage systems.
 2. Minimum flow rates other than 50 percent as required by the equipment manufacturer for proper operation of equipment where using flow bypass or end-of-line 3-way valves.
 3. Variable pump flow on dedicated equipment circulation pumps where configured in primary/secondary design to provide the minimum flow requirements of the equipment manufacturer for proper operation of equipment. designed valves that modulate or step open and close, or pumps that modulate or turn on and off as a function of load.
3. Automatically vary pump flow on chilled-water systems and heat rejection loops serving water-cooled unitary air conditioners with a combined motor capacity of 10 hp (7.5 kW) or larger by reducing pump design flow by not less than 50



C403.5 Refrigeration systems. Refrigerated display cases, walk-in coolers or walk-in freezers that are served by remote compressors and remote condensers not located in a condensing unit, shall comply with Sections C403.5.1 and C403.5.2.

Exception: Systems where the working fluid in the refrigeration cycle goes through both subcritical and supercritical states (transcritical) or that use ammonia refrigerant are exempt.

C403.5.1 Condensers serving refrigeration systems. Fan-powered condensers shall comply with the following:

1. The design saturated condensing temperatures for air-cooled condensers shall not exceed the design dry-bulb temperature plus 10°F (5.6°C) for low-temperature refrigeration systems, and the design dry-bulb temperature plus 15°F (8°C) for medium temperature refrigeration systems where the saturated condensing temperature for blend refrigerants shall be determined using the average of liquid and vapor temperatures as converted from the condenser drain pressure.
2. Condenser fan motors that are less than 1 hp (0.75 kW) shall use electronically commutated motors, permanent split-capacitor-type motors or 3-phase motors.
3. Condenser fans for air-cooled condensers, evaporatively cooled condensers, air or water-cooled fluid coolers or cooling towers shall reduce fan motor demand to not more than 30 percent of design wattage at 50 percent of design air volume, and incorporate one of the following continuous variable speed fan control approaches:
 - 3.1. Refrigeration system condenser control for air-cooled condensers shall use variable setpoint control logic to reset the condensing temperature setpoint in response to ambient dry-bulb temperature.
 - 3.2. Refrigeration system condenser control for evaporatively cooled condensers shall use variable setpoint control logic to reset the condensing temperature setpoint in response to ambient wet-bulb temperature.
4. Multiple fan condensers shall be controlled in unison.
5. The minimum condensing temperature setpoint shall be not greater than 70°F (21°C).



C403.5.2 Compressor systems. Refrigeration compressor systems shall comply with the following:

1. Compressors and multiple-compressor system suction groups shall include control systems that use floating suction pressure control logic to reset the target suction pressure temperature based on the temperature requirements of the attached refrigeration display cases or walk-ins.

Exception: Controls are not required for the following:

1. Single-compressor systems that do not have variable capacity capability.

2. Suction groups that have a design saturated suction temperature of 30°F (-1.1°C) or higher, suction groups that comprise the high stage of a two-stage or cascade system, or suction groups that primarily serve chillers for secondary cooling fluids.

2. Liquid subcooling shall be provided for all low-temperature compressor systems with a design cooling capacity equal to or greater than 100,000 Btu/hr (29.3 kW) with a design-saturated suction temperature of -10°F (-23°C) or lower. The sub-cooled liquid temperature shall be controlled at a maximum temperature setpoint of 50°F (10°C) at the exit of the subcooler using either compressor economizer (interstage) ports or a separate compressor suction group operating at a saturated suction temperature of 18°F (-7.8°C) or higher.

2.1. Insulation for liquid lines with a fluid operating temperature less than 60°F (15.6°C) shall comply with Table C403.2.10.

3. Compressors that incorporate internal or external crankcase heaters shall provide a means to cycle the heaters off during compressor operation.



SECTION C404 SERVICE WATER HEATING (MANDATORY) C404.1 General. This section covers the minimum efficiency of, and controls for, service water-heating equipment and insulation of service hot water piping.

C404.2 Service water-heating equipment performance efficiency. Water-heating equipment and hot water storage tanks shall meet the requirements of Table C404.2. The efficiency shall be verified through data furnished by the manufacturer of the equipment or through certification under an approved certification program. Water-heating equipment also intended to be used to provide space heating shall meet the applicable provisions of Table C404.2.

C404.2.1 High input-rated service water-heating systems. Gas-fired water-heating equipment installed in new buildings shall be in compliance with this section. Where a singular piece of water-heating equipment serves the entire building and the input rating of the equipment is 1,000,000 Btu/h (293 kW) or greater, such equipment shall have a thermal efficiency, E_t of not less than 90 percent. Where multiple pieces of water-heating equipment freezing external

C404.5 Efficient heated water supply piping. Heated water supply piping shall be in accordance with Section C404.5.1 or C404.5.2. The flow rate through 1/4 -inch (6.4 mm) piping shall be not greater than 0.5 gpm (1.9 L/m). The flow rate through 5/16 -inch (7.9 mm) piping shall be not greater than 1 gpm (3.8 L/m). The flow rate through 3/8 -inch (9.5 mm) piping shall be not greater than 1.5 gpm (5.7 L/m).

C404.5.1 Maximum allowable pipe length method. The maximum allowable piping length from the nearest source of heated water to the termination of the fixture supply pipe shall be in accordance with the following. Where the piping contains more than one size of pipe, the largest size of pipe within the piping shall be used for determining the maximum allowable length of the piping in Table C404.5.1. 1. For a public lavatory faucet, use the “Public lavatory faucets” column in Table C404.5.1. 2. For all other plumbing fixtures and plumbing appliances, use the “Other fixtures and appliances” column in Table C404.5.1.

C404.5.2 Maximum allowable pipe volume method. The water volume in the piping shall be calculated in accordance with Section C404.5.2.1. Water heaters, circulating water systems and heat trace temperature maintenance systems shall be considered sources of heated water. The volume from the nearest source of heated water to the termination of the fixture supply pipe shall be as follows:

1. For a public lavatory faucet: not more than 2 ounces (0.06 L).
 2. For other plumbing fixtures or plumbing appliances; not more than 0.5 gallon (1.89 L).
- C404.5.2.1 Water volume determination. The volume shall be the sum of the internal volumes of pipe, fittings, valves, meters and manifolds between the nearest source of heated water and the termination of the fixture supply pipe.



(continued)

The volume in the piping shall be determined from the “Volume” column in Table C404.5.1. The volume contained within fixture shutoff valves, within flexible water supply connectors to a fixture fitting and within a fixture fitting shall not be included in the water volume determination. Where heated water is supplied by a recirculating system or heat-traced piping, the volume shall include the portion of the fitting on the branch pipe that supplies water to the fixture.

C404.6 Heated-water circulating and temperature maintenance systems. Heated-water circulation systems shall be in accordance with Section C404.6.1. Heat trace temperature maintenance systems shall be in accordance with Section C404.6.2. Controls for hot water storage shall be in accordance with Section C404.6.3. Automatic controls, temperature sensors and pumps shall be accessible. Manual controls shall be readily accessible.

C404.6.1 Circulation systems. Heated-water circulation systems shall be provided with a circulation pump. The system return pipe shall be a dedicated return pipe or a cold water supply pipe. Gravity and thermo-syphon circulation systems shall be prohibited. Controls for circulating hot water system pumps shall start the pump based on the identification of a demand for hot water within the occupancy. The controls shall automatically turn off the pump when the water in the circulation loop is at the desired temperature and when there is no demand for hot water.

C404.6.2 Heat trace systems. Electric heat trace systems shall comply with IEEE 515.1. Controls for such systems shall be able to automatically adjust the energy input to the heat tracing to maintain the desired water temperature in the piping in accordance with the times when heated water is used in the occupancy. Heat trace shall be arranged to be turned off automatically when there is no hot water demand.



C404.9 Energy consumption of pools and permanent spas. (Mandatory).

The energy consumption of pools and permanent spas shall be controlled by the requirements in Sections C404.9.1 through C404.9.3.

C404.9.1 Heaters. The electric power to all heaters shall be controlled by a readily accessible on-off switch that is an integral part of the heater, mounted on the exterior of the heater, or external to and within 3 feet (914 mm) of the heater. Operation of such switch shall not change the setting of the heater thermostat. Such switches shall be in addition to a circuit breaker for the power to the heater. Gas-fired heaters shall not be equipped with continuously burning ignition pilots.

C404.9.2 Time switches. Time switches or other control methods that can automatically turn off and on heaters and pump motors according to a preset schedule shall be installed for heaters and pump motors. Heaters and pump motors that have built-in time switches shall be in compliance with this section.

Exceptions:

1. Where public health standards require 24-hour pump operation.
2. Pumps that operate solar and waste heat recovery pool heating systems.

C404.9.3 Covers. Outdoor heated pools and outdoor permanent spas shall be provided with a vapor-retardant cover or other approved vapor-retardant means.

Exception: Where more than 70 percent of the energy for heating, computed over an operating season, is from site recovered energy such as from a heat pump or solar energy source, covers or other vapor-retardant means shall not be required.

C404.10 Energy consumption of portable spas (Mandatory). The energy consumption of electric-powered portable spas shall be controlled by the requirements of APSP 14.

C404.11 Service water heating system commissioning and completion requirements. Service water heating systems, swimming pool water heating systems, spa water heating systems and the controls for those systems shall be commissioned and completed in accordance with Section C408.2.

C405.2.1.1 Occupant sensor control function. Occupant sensor controls in spaces other than warehouses specified in Section C405.2.1 shall comply with the following:

1. Automatically turn off lights within 30 minutes of all occupants leaving the space.
2. Be manual on or controlled to automatically turn the lighting on to not more than 50 percent power.

Exception: Full automatic-on controls shall be permitted to control lighting in public corridors, stairways, restrooms, primary building entrance areas and lobbies, and areas where manual-on operation would endanger the safety or security of the room or building occupants.

3. Shall incorporate a manual control to allow occupants to turn lights off.

C405.2.1.2 Occupant sensor control function in warehouses. In warehouses, the lighting in aisleways and open areas shall be controlled with occupant sensors that automatically reduce lighting power by not less than 50 percent when the areas are unoccupied. The occupant sensors shall control lighting in each aisleway independently and shall not control lighting beyond the aisleway being controlled by the sensor.

C405.2.2 Time-switch controls. Each area of the building that is not provided with occupant sensor controls complying with Section C405.2.1.1 shall be provided with time switch controls complying with Section C405.2.2.1.

Exception: Where a manual control provides light reduction in accordance with Section C405.2.2.2, automatic controls shall not be required for the following:

1. Sleeping units.
2. Spaces where patient care is directly provided.
3. Spaces where an automatic shutoff would endanger occupant safety or security.
4. Lighting intended for continuous operation.

5. Shop and laboratory classrooms. C405.2.2.1 Time-switch control function. Each space provided with time-switch controls shall also be provided with a manual control for light reduction in accordance with Section C405.2.2.2. Time-switch controls shall include an override switching device that complies with the following:

1. Have a minimum 7-day clock.
2. Be capable of being set for seven different day types per week.
3. Incorporate an automatic holiday "shutoff" feature, which turns off all controlled lighting loads for at least 24 hours and then resumes normally scheduled operations.
4. Have program backup capabilities, which prevent the loss of program and time settings for at least 10 hours, if power is interrupted.



C405.2.3 Daylight-responsive controls. Daylight-responsive controls complying with Section C405.2.3.1 shall be provided to control the electric lights within daylight zones in the following spaces:

1. Spaces with a total of more than 150 watts of general lighting within sidelight daylight zones complying with Section C405.2.3.2. General lighting does not include lighting that is required to have specific application control in accordance with Section C405.2.4.
2. Spaces with a total of more than 150 watts of general lighting within toplight daylight zones complying with Section C405.2.3.3.

Exceptions: Daylight responsive controls are not required for the following:

1. Spaces in health care facilities where patient care is directly provided.
2. Dwelling units and sleeping units.
3. Lighting that is required to have specific application control in accordance with Section C405.2.4.
4. Sidelight daylight zones on the first floor above grade in Group A-2 and Group M occupancies.

C405.2.3.1 Daylight-responsive control function. Where required, daylight-responsive controls shall be provided within each space for control of lights in that space and shall comply with all of the following:

1. Lights in toplight daylight zones in accordance with Section C405.2.3.3 shall be controlled independently of lights in sidelight daylight zones in accordance with Section C405.2.3.2.
2. Daylight responsive controls within each space shall be configured so that they can be calibrated from within that space by authorized personnel.
3. Calibration mechanisms shall be readily accessible.
4. Where located in offices, classrooms, laboratories and library reading rooms, daylight responsive controls shall dim lights continuously from full light output to 15 percent of full light output or lower.
5. Daylight responsive controls shall be capable of a complete shutoff of all controlled lights.
6. Lights in sidelight daylight zones in accordance with Section C405.2.3.2 facing different cardinal orientations [i.e., within 45 degrees (0.79 rad) of due north, east, south, west] shall be controlled independently of each other.

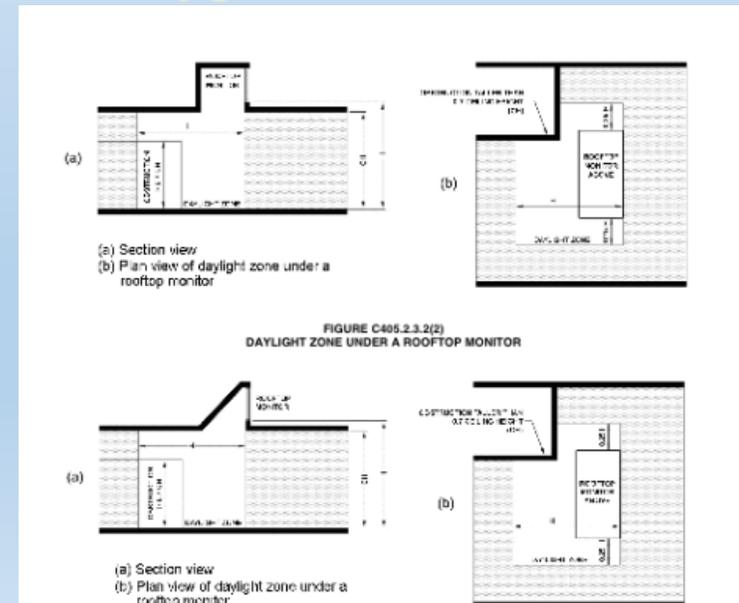
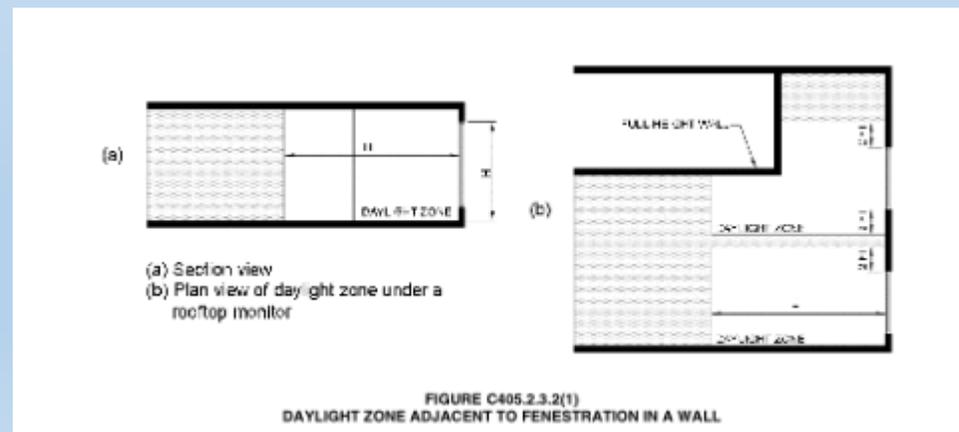
Exception: Up to 150 watts of lighting in each space is permitted to be controlled together with lighting in a daylight zone facing a different cardinal orientation.

C405.2.3.2 Sidelight daylight zone. The sidelight daylight zone is the floor area adjacent to vertical fenestration which complies with all of the following:

1. Where the fenestration is located in a wall, the daylight zone shall extend laterally to the nearest full-height wall, or up to 1.0 times the height from the floor to the top of the fenestration, and longitudinally from the edge of the fenestration to the nearest full-height wall, or up to 2 feet (610 mm), whichever is less, as indicated in Figure C405.2.3.2(1).
2. Where the fenestration is located in a rooftop monitor, the daylight zone shall extend laterally to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 1.0 times the height from the floor to the bottom of the fenestration.

C405.2.3.3 Toplight daylight zone. The toplight daylight zone is the floor area underneath a roof fenestration assembly which complies with all of the following:

1. The daylight zone shall extend laterally and longitudinally beyond the edge of the roof fenestration assembly to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 0.7 times the ceiling height, whichever is less, as indicated in Figure C405.2.3.3.
2. No building or geological formation blocks direct sunlight from hitting the roof fenestration assembly at the peak solar angle on the summer solstice.
3. Where located in existing buildings, the product of the visible transmittance of the roof fenestration assembly and the area of the rough opening of the roof fenestration assembly divided by the area of the daylight zone is not less than 0.008.



C405.5 Exterior lighting (Mandatory). Where the power for exterior lighting is supplied through the energy service to the building, all exterior lighting shall comply with Section C405.5.1.

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

C405.5.1 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 C405.5.2(2) for the applicable lighting zone. Trade-offs are allowed only among exterior lighting applications listed in Table C405.5.2(2), in the Tradable Surfaces section. The lighting zone for the building exterior is determined from Table C405.5.2(1) unless otherwise specified by the local jurisdiction.

Exception: Lighting used for the following exterior applications is exempt where 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.
9. Used to highlight features of public monuments and registered historic landmark structures or buildings.

**TABLE C405.5.2(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 not classified as lighting zone 1, 2 or 4
4	High-activity commercial districts in major metropolitan areas as designated by the local land use planning authority

**TABLE C405.5.2(2)
INDIVIDUAL LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS**

	LIGHTING ZONES				
	Zone 1	Zone 2	Zone 3	Zone 4	
Base Site Allowance (Base allowance is usable 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 are tradable.)	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			
	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	0.075 W/ft ² of gross above-grade wall area	0.113 W/ft ² of gross above-grade wall area	0.15 W/ft ² of gross above-grade wall area
	Automated teller machines (ATM) 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			
	Parking near 24-hour retail entrances	800 W per main entry			

For SI: 1 foot = 304.8 mm, 1 watt per square foot = W/0.0929 m².
W = watts.



C405.6 Electrical energy consumption (Mandatory). Each dwelling unit located in a Group R-2 building shall have a separate electrical meter.

C405.8 Electrical motors (Mandatory). Electric motors shall meet the minimum efficiency requirements of Tables C405.8(1) through C405.8(4) when tested and rated in accordance with the DOE 10 CFR 431. The efficiency shall be verified through certification under an approved certification program or, where a certification program does not exist, the equipment efficiency ratings shall be supported by data furnished by the motor manufacturer.



C405.9 Vertical and horizontal transportation systems and equipment.

Vertical and horizontal transportation systems and equipment shall comply with this section.

C405.9.1 Elevator cabs. For the luminaires in each elevator cab, not including signals and displays, the sum of the lumens divided by the sum of the watts shall be not less than 35 lumens per watt. Ventilation fans in elevators that do not have their own air-conditioning system shall not consume more than 0.33 watts/cfm at the maximum rated speed of the fan. Controls shall be provided that will de-energize ventilation fans and lighting systems when the elevator is stopped, unoccupied and with its doors closed for over 15 minutes.

C405.9.2 Escalators and moving walks. Escalators and moving walks shall comply with ASME A17.1/CSA B44 and shall have automatic controls configured to reduce speed to the minimum permitted speed in accordance with ASME A17.1/CSA B44 or applicable local code when not conveying passengers.

C405.9.2.1 Regenerative drive. An escalator designed either for one-way down operation only or for reversible operation shall have a variable frequency regenerative drive that supplies electrical energy to the building electrical system when the escalator is loaded with passengers whose combined weight exceeds 750 pounds (340 kg).



SECTION C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS C406.1 Requirements. Buildings shall comply with at least one of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power density system in accordance with Section C406.3.
3. Enhanced lighting controls in accordance with Section C406.4.
4. On-site supply of renewable energy in accordance with Section C406.5.
5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.
6. High-efficiency service water heating in accordance with Section C406.7.

C406.1.1 Tenant spaces. Tenant spaces shall comply with Section C406.2, C406.3, C406.4, C406.6 or C406.7. Alternatively, tenant spaces shall comply with Section C406.5 where the entire building is in compliance.



C407.6.3 Exceptional calculation methods. Where the simulation program does not model a design, material or device of the proposed design, an exceptional calculation method shall be used where approved by the code official. Where there are multiple designs, materials or devices that the simulation program does not model, each shall be calculated separately and exceptional savings determined for each. The total exceptional savings shall not constitute more than half of the difference between the baseline building performance and the proposed building performance. Applications for approval of an exceptional method shall include all of the following:

1. Step-by-step documentation of the exceptional calculation method performed, detailed enough to reproduce the results.
2. Copies of all spreadsheets used to perform the calculations.
3. A sensitivity analysis of energy consumption where each of the input parameters is varied from half to double the value assumed.
4. The calculations shall be performed on a time step basis consistent with the simulation program used.
5. The performance rating calculated with and without the exceptional calculation method.



SECTION C408 SYSTEM COMMISSIONING

C408.1 General. This section covers the commissioning of the building mechanical systems in Section C403 and electrical power and lighting systems in Section C405.

C408.2 Mechanical systems and service water-heating systems commissioning and completion requirements. Prior to the final mechanical and plumbing inspections, the registered design professional or approved agency shall provide evidence of mechanical systems commissioning and completion in accordance with the provisions of this section. Construction document notes shall clearly indicate provisions for commissioning and completion requirements in accordance with this section and are permitted to refer to specifications for further requirements. Copies of all documentation shall be given to the owner or owner's authorized agent and made available to the code official upon request in accordance with Sections C408.2.4 and C408.2.5.

Exceptions: The following systems are exempt:

1. Mechanical systems and service water heater systems in buildings where the total mechanical equipment capacity is less than 480,000 Btu/h (140.7 kW) cooling capacity and 600,000 Btu/h (175.8 kW) combined service water-heating and space-heating capacity.
2. Systems included in Section C403.3 that serve individual dwelling units and sleeping units.

C408.2.1 Commissioning plan. A commissioning plan shall be developed by a registered design professional or approved agency and shall include the following items:

1. A narrative description of the activities that will be accomplished during each phase of commissioning, including the personnel intended to accomplish each of the activities.
2. A listing of the specific equipment, appliances or systems to be tested and a description of the tests to be performed.
3. Functions to be tested including, but not limited to, calibrations and economizer controls.
4. Conditions under which the test will be performed. Testing shall affirm winter and summer design conditions and full outside air conditions.
5. Measurable criteria for performance.

C408.2.2 Systems adjusting and balancing. HVAC systems shall be balanced in accordance with generally accepted engineering standards. Air and water flow rates shall be measured and adjusted to deliver final flow rates within the tolerances provided in the product specifications. Test and balance activities shall include air system and hydronic system balancing.

C408.2.2.1 Air systems balancing. Each supply air outlet and zone terminal device shall be equipped with means for air balancing in accordance with the requirements of Chapter 6 of the International Mechanical Code. Discharge dampers used for air-system balancing are prohibited on constant-volume fans and variable-volume fans with motors 10 hp (18.6 kW) and larger. Air systems shall be balanced in a manner to first minimize throttling losses then, for fans with system power of greater than 1 hp (0.746 kW), fan speed shall be adjusted to meet design flow conditions.



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Exception: Fans with fan motors of 1 hp (0.74 kW) or less are not required to be provided with a means for air balancing.

C408.2.2.2 Hydronic systems balancing. Individual hydronic heating and cooling coils shall be equipped with means for balancing and measuring flow. Hydronic systems shall be proportionately balanced in a manner to first minimize throttling losses, then the pump impeller shall be trimmed or pump speed shall be adjusted to meet design flow conditions. Each hydronic system shall have either the capability to measure pressure across the pump, or test ports at each side of each pump.

Exceptions: The following equipment is not required to be equipped with a means for balancing or measuring flow:

1. Pumps with pump motors of 5 hp (3.7 kW) or less.
2. Where throttling results in no greater than 5 percent of the nameplate horsepower draw above that required if the impeller were trimmed.

C408.2.3 Functional performance testing. Functional performance testing specified in Sections C408.2.3.1 through C408.2.3.3 shall be conducted.

C408.2.3.1 Equipment. Equipment functional performance testing shall demonstrate the installation and operation of components, systems, and system-to-system interfacing relationships in accordance with approved plans and specifications such that operation, function, and maintenance serviceability for each of the commissioned systems is confirmed. Testing shall include all modes and sequence of operation, including under full-load, part-load and the following emergency conditions:

1. All modes as described in the sequence of operation.
2. Redundant or automatic back-up mode.
3. Performance of alarms.
4. Mode of operation upon a loss of power and restoration of power.

Exception: Unitary or packaged HVAC equipment listed in Tables C403.2.3(1) through C403.2.3(3) that do not require supply air economizers.

C408.2.3.2 Controls. HVAC and service water-heating control systems shall be tested to document that control devices, components, equipment and systems are calibrated and adjusted and operate in accordance with approved plans and specifications. Sequences of operation shall be functionally tested to document they operate in accordance with approved plans and specifications.



C408.2.4 Preliminary commissioning report. A preliminary report of commissioning test procedures and results shall be completed and certified by the registered design professional or approved agency and provided to the building owner or owner’s authorized agent. The report shall be organized with mechanical and service hot water findings in separate sections to allow independent review. The report shall be identified as “Preliminary Commissioning Report” and shall identify:

1. Itemization of deficiencies found during testing required by this section that have not been corrected at the time of report preparation.
2. Deferred tests that cannot be performed at the time of report preparation because of climatic conditions.
3. Climatic conditions required for performance of the deferred tests.

C408.2.4.1 Acceptance of report. Buildings, or portions thereof, shall not be considered acceptable for a final inspection pursuant to Section C104.3 until the code official has received a letter of transmittal from the building owner acknowledging that the building owner or owner’s authorized agent has received the Preliminary Commissioning Report.

C408.2.4.2 Copy of report. The code official shall be permitted to require that a copy of the Preliminary Commissioning Report be made available for review by the code official.

C408.2.5 Documentation requirements. The construction documents shall specify that the documents described in this section be provided to the building owner or owner’s authorized agent within 90 days of the date of receipt of the certificate of occupancy.

C408.2.5.1 Drawings. Construction documents shall include the location and performance data on each piece of equipment.

C408.2.5.2 Manuals. An operating and maintenance manual shall be provided and include all of the following:

1. Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance.
2. Manufacturer’s operation manuals and maintenance manuals for each piece of equipment requiring maintenance, except equipment not furnished as part of the project. Required routine maintenance actions shall be clearly identified.
3. Name and address of at least one service agency.
4. HVAC and service hot water controls system maintenance and calibration information, including wiring diagrams, schematics and control sequence descriptions. Desired or field-determined set points shall be permanently recorded on control drawings at control devices or,

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For digital control systems, in system programming instructions.

5. Submittal data indicating all selected options for each piece of lighting equipment and lighting controls.
6. Operation and maintenance manuals for each piece of lighting equipment. Required routine maintenance actions, cleaning and recommended relamping shall be clearly identified.
7. A schedule for inspecting and recalibrating all lighting controls.
8. A narrative of how each system is intended to operate, including recommended set points.

C408.2.5.3 System balancing report. A written report describing the activities and measurements completed in accordance with Section C408.2.2.

C408.2.5.4 Final commissioning report. A report of test procedures and results identified as “Final Commissioning Report” shall be delivered to the building owner or owner’s authorized agent. The report shall be organized with mechanical system and service hot water system findings in separate sections to allow independent review. The report shall include the following:

1. Results of functional performance tests.
2. Disposition of deficiencies found during testing, including details of corrective measures used or proposed.
3. Functional performance test procedures used during the commissioning process including measurable criteria for test acceptance, provided herein for repeatability.

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

C408.3 Lighting system functional testing. Controls for automatic lighting systems shall comply with this section.

C408.3.1 Functional testing. Prior to passing final inspection, the registered design professional shall provide evidence that the lighting control systems have been tested to ensure that control hardware and software are calibrated, adjusted, programmed and in proper working condition in accordance with the construction documents and manufacturer’s instructions. Functional testing shall be in accordance with Sections C408.3.1.1 and C408.3.1.2 for the applicable control type.

C408.3.1.1 Occupant sensor controls. Where occupant sensor controls are provided, the following procedures shall be performed:

1. Certify that the occupant sensor has been located and aimed in accordance with manufacturer recommendations.
2. For projects with seven or fewer occupant sensors, each sensor shall be tested.



3. For projects with more than seven occupant sensors, testing shall be done for each unique combination of sensor type and space geometry. Where multiples of each unique combination of sensor type and space geometry are provided, not less than 10 percent, but in no case less than one, of each combination shall be tested unless the code official or design professional requires a higher percentage to be tested. Where 30 percent or more of the tested controls fail, all remaining identical combinations shall be tested. For occupant sensor controls to be tested, verify the following:

- 3.1. Where occupant sensor controls include status indicators, verify correct operation.
- 3.2. The controlled lights turn off or down to the permitted level within the required time.
- 3.3. For auto-on occupant sensor controls, the lights turn on to the permitted level when an occupant enters the space.
- 3.4. For manual-on occupant sensor controls, the lights turn on only when manually activated.
- 3.5. The lights are not incorrectly turned on by movement in adjacent areas or by HVAC operation.

C408.3.1.2 Time-switch controls. Where time-switch controls are provided, the following procedures shall be performed:

1. Confirm that the time-switch control is programmed with accurate weekday, weekend and holiday schedules.
2. Provide documentation to the owner of time-switch controls programming including weekday, weekend, holiday schedules, and set-up and preference program settings.
3. Verify the correct time and date in the time switch.
4. Verify that any battery back-up is installed and energized.
5. Verify that the override time limit is set to not more than 2 hours.
6. Simulate occupied condition. Verify and document the following:
 - 6.1. All lights can be turned on and off by their respective area control switch.
 - 6.2. The switch only operates lighting in the enclosed space in which the switch is located.
7. Simulate unoccupied condition. Verify and document the following:
 - 7.1. Nonexempt lighting turns off.

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7.2. Manual override switch allows only the lights in the enclosed space where the override switch is located to turn on or remain on until the next scheduled shutoff occurs.

8. Additional testing as specified by the registered design professional.

C408.3.1.3 Daylight responsive controls. Where daylight responsive controls are provided, the following shall be verified:

1. Control devices have been properly located, field calibrated and set for accurate setpoints and threshold light levels.
2. Daylight controlled lighting loads adjust to light level set points in response to available daylight.
3. The locations of calibration adjustment equipment are readily accessible only to authorized personnel.

C408.3.2 Documentation requirements. The construction documents shall specify that documents certifying that the installed lighting controls meet documented performance criteria of Section C405 are to be provided to the building owner within 90 days from the date of receipt of the certificate of occupancy.

CHAPTER 5 CE EXISTING BUILDINGS (relocated from Chapter 1 – 2012 IECC)

SECTION C501 GENERAL C501.1 Scope. The provisions of this chapter shall control the alteration, repair, addition and change of occupancy of existing buildings and structures.

C501.2 Existing buildings. Except as specified in this chapter, this code shall not be used to require the removal, alteration or abandonment of, nor prevent the continued use and maintenance of, an existing building or building system lawfully in existence at the time of adoption of this code.

C501.3 Maintenance. Buildings and structures, and parts thereof, shall be maintained in a safe and sanitary condition. Devices and systems that are required by this code shall be maintained in conformance to the code edition under which installed. The owner or the owner's authorized agent shall be responsible for the maintenance of buildings and structures. The requirements of this chapter shall not provide the basis for removal or abrogation of energy conservation, fire protection and safety systems and devices in existing structures.

C501.4 Compliance. Alterations, repairs, additions and changes of occupancy to, or relocation of, existing buildings and structures shall comply with the provisions for alterations, repairs, additions and changes of occupancy or relocation, respectively, in the International Building Code, International Fire Code (MONTGOMERY COUNTY FIRE CODE), International Fuel Gas Code, International Mechanical Code, International Plumbing Code (WSSC), International Property Maintenance Code, International Private Sewage Disposal Code and NFPA 70.

C501.5 New and replacement materials. Except as otherwise required or permitted by this code, materials permitted by the applicable code for new construction shall be used. Like materials shall be permitted for repairs, provided hazards to life, health or property are not created. Hazardous materials shall not be used where the code for new construction would not permit use of these materials in buildings of similar occupancy, purpose and location.

C501.6 Historic buildings. No provisions of this code relating to the construction, repair, alteration, restoration and movement of structures, and change of occupancy shall be mandatory for historic buildings provided a report has been submitted to the code official and signed by a registered design professional, or a representative of the State Historic Preservation Office or the historic preservation authority having jurisdiction, demonstrating that compliance with that provision would threaten, degrade or destroy the historic form, fabric or function of the building.

SECTION C502 ADDITIONS

C502.1 General. Additions to an existing building, building system or portion thereof shall conform to the provisions of this code as those provisions relate to new construction without requiring the unaltered portion of the existing building or building system to comply with this code. Additions shall not create an unsafe or hazardous condition or overload existing building systems. An addition shall be deemed to comply with this code if the addition alone complies or if the existing building and addition comply with this code as a single building. Additions shall comply with Section C502.2. Additions complying with ANSI/ASHRAE/IESNA 90.1. need not comply with Sections C402, C403, C404 and C405.

C502.2 Prescriptive compliance. Additions shall comply with Sections C502.2.1 through C502.2.6.2.

C502.2.1 Vertical fenestration. New vertical fenestration area that results in a total building fenestration area less than or equal to that specified in Section C402.4.1 shall comply with Section C402.4. Additions with vertical fenestration that result in a total building fenestration area greater than Section C402.4.1 or additions that exceed the fenestration area greater than Section C402.4.1 shall comply with Section C402.4.1.1 for the addition only. Additions that result in a total building vertical glass area exceeding that specified in Section C402.4.1.1 shall comply with Section C407.

C502.2.2 Skylight area. New skylight area that results in a total building fenestration area less than or equal to that specified in Section C402.4.1 shall comply with Section C402.4. Additions with skylight area that result in a total building skylight area greater than C402.4.1 or additions that exceed the skylight area shall comply with Section C402.4.1.2 for the addition only. Additions that result in a total building skylight area exceeding that specified in Section C402.4.1.2 shall comply with Section C407.

C502.2.3 Building mechanical systems. New mechanical systems and equipment that are part of the addition and serve the building heating, cooling and ventilation needs shall comply with Section C403.

C502.2.4 Service water-heating systems. New service water-heating equipment, controls and service water heating piping shall comply with Section C404.

C502.2.5 Pools and inground permanently installed spas. New pools and inground permanently installed spas shall comply with Section C404.9.



SECTION C503

ALTERATIONS C503.1 General. Alterations to any building or structure shall comply with the requirements of the code for new construction. Alterations shall be such that the existing building or structure is no less conforming to the provisions of this code than the existing building or structure was prior to the alteration. Alterations to an existing building, building system or portion thereof shall conform to the provisions of this code as those provisions relate to new construction without requiring the unaltered portions of the existing building or building system to comply with this code. Alterations shall not create an unsafe or hazardous condition or overload existing building systems. Alterations complying with ANSI/ASHRAE/IESNA 90.1. need not comply with Sections C402, C403, C404 and C405.

Exception: The following alterations need not comply with the requirements for new construction, provided the energy use of the building is not increased:

1. Storm windows installed over existing fenestration.
2. Surface-applied window film installed on existing single-pane fenestration assemblies reducing solar heat gain, provided the code does not require the glazing or fenestration to be replaced.
3. Existing ceiling, wall or floor cavities exposed during construction, provided that these cavities are filled with insulation.
4. Construction where the existing roof, wall or floor cavity is not exposed.
5. Roof recover.
6. Air barriers shall not be required for roof recover and roof replacement where the alterations or renovations to the building do not include alterations, renovations or repairs to the remainder of the building envelope.
7. Alterations that replace less than 50 percent of the luminaires in a space, provided that such alterations do not increase the installed interior lighting power.



SECTION C504

REPAIRS C504.1 General. Buildings and structures, and parts thereof, shall be repaired in compliance with Section C501.3 and this section. Work on non-damaged components that is necessary for the required repair of damaged components shall be considered part of the repair and shall not be subject to the requirements for alterations in this chapter. Routine maintenance required by Section C501.3, ordinary repairs exempt from permit and abatement of wear due to normal service conditions shall not be subject to the requirements for repairs in this section.



Highlights of 90.1-2013 Changes from 90.1-2010

This document highlights most of the changes between the 2010 and 2013 ASHRAE 90.1 standard.

ENVELOPE

- Changes references from clerestory to roof monitor (*Chapter 5*)
- Adds low-e requirements for storm window retrofits (*5.1.3*)
- Clarifies roof insulation requirements, differentiating between roof recovering (on top of existing roof covering) and replacement of roof covering (*5.1.3*)
- Relaxes air leakage requirements for high-speed doors for vehicle access and material transport (*5.4.3.2*)
- Adds specific vestibule requirements for large spaces (*5.4.3.4*)
- Requires roof solar reflectance and thermal emittance testing to be in accordance with CRRC-1 Standard (*5.5.3.1*)
- Reduces the area threshold at which skylights and daylighting controls are required (*5.5.4.2.2*)
- Terms - Modifies daylighting definitions

HVAC

- Equipment Efficiencies
- Added commercial refrigerators, freezers, and refrigeration equipment
- Modified minimum efficiency standards for water-to-air heat pumps (water loop, ground water, and ground loop). Proposed cooling EERs and heating COPs are more stringent.
- Increased minimum efficiency standards for single-package vertical air conditioners and single-package vertical heat pumps
- Modified minimum efficiency requirements for evaporatively cooled air conditioners greater than or equal to 240,000 Btu/h and less than 760,000 Btu/h and heating type-other
- Increases the minimum efficiency of open circuit axial fan cooling towers and adds a requirement for all types of cooling towers (minimum efficiency requirements apply to the tower including the capacity effect of accessories which affect thermal performance)

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- Increases SEER and HSPF for air-cooled three-phase commercial air conditioners and heat pumps below 65,000 Btu/h (effective 1/1/2015)
 - Increases cooling efficiency for PTACs
 - Adds efficiency requirements for evaporative condensers with ammonia refrigerants
 - Increases air- and water-cooled chiller efficiencies and exempts water-cooled positive displacement chillers with leaving condenser temperature $\geq 115^{\circ}\text{F}$
 - Increases IEER requirements for air-cooled air conditioners and heat pumps and EER requirements for water and evaporatively cooled air conditioners and heat pumps
 - Re-establishes product class for SDHV air conditioners and heat pumps and adds efficiency requirements at $<65,000$ Btu/h below level of current federal standards
 - Increases boiler efficiency for residential sized (NAECA covered) equipment, $<3,000$ Btu/h
 - Changes optimum start requirement from $> 10,000$ cfm to any DDC system and adds a requirement that outside air temperature be used in optimum algorithms (6.4.3.3)
 - Establishes limits on using electric or fossil fuel to humidify or dehumidify between 30% and 60% RH except certain applications and requires deadband on humidity controls (6.4.3.6)
 - Reduces occupancy threshold for demand controlled ventilation from greater than 40 people per 1000 ft² to equal to or greater than 25 people per 1000 ft² with exemptions for certain occupancies (6.4.3.8)
 - Reduces the system size and outdoor air thresholds at which energy recovery is required
 - Adds control requirements for heating systems in vestibules (6.4.3.9)
 - Eliminates contingency on DDC system existence for setpoint overlap restrictions, humidification and dehumidification controls, VAV fan control setpoint reset, multiple-zone VAV system ventilation optimization control, hydronic system differential pressure reset by valve position. Instead, it specifies for what system types or sizes DDC is required and minimal functional requirements for DDC systems. (6.4.3.10)
 - Adds mandatory and prescriptive requirements for walk-in coolers and freezers and refrigerated display cases (6.4.5 and 6.4.6)
 - Revises high limit shutoff for air economizers (6.5.1.1.3) and adds sensor accuracy requirements (6.5.1.1.6)
 - Relaxes design requirements for waterside economizers for computer rooms (6.5.1.2.1)



- Requires humidifiers mounted in the airstream to have an automatic control valve shutting off preheat when humidification is not required, and insulation on the humidification system dispersion tube surface (6.5.2.4)
- Added new definition (FEG = Fan Efficiency Grade) and requires each fan has an FEG of 67 or higher as defined by AMCA 205-10 (6.5.3.1.3)
- Modified requirement for static pressure sensor location and control requirements for setpoint reset for systems with DDC of individual zones (6.5.3.2.2)
- Requires fractional horsepower motors $\geq 1/12$ hp to be electronically-commutated motors or have a minimum 70% efficiency in accordance with 10 CFR 4321 and requires adjustable speed or other method to balance airflow (6.5.3.5)
- Establishes minimum turndown for boilers and boiler plants with design input power of at least 1,000,000 Btu/h (6.5.4.1)
- Expands the requirements for fan speed control for both chilled water and unitary direct expansion systems and enhances the requirements for integrated economizer control and defines DX unit capacity staging requirements (6.5.4.3)
- Addresses fan power limitation pressure drop adjustment credits and adds deductions from allowed fan power for systems without any central heating or cooling as well as systems with electric resistance heating. (6.5.3.1) Sound attenuation credit is modified to be available only when there are background noise criteria requirements.
- Establishes chiller and boiler fluid flow isolation requirements so there is no flow through the equipment when not in use (6.5.4.3)
- Revises night setback requirements and removes exceptions for climate zones
- Requires VAV dual maximum damper position when DDC system is present and clarifies dual maximum sequence
- Deletes sizing requirements for pipes >24 inches in diameter
- Modified heat rejection equipment (cooling tower) requirements to require that VSD controlled fans operate all fans at the same speed instead of sequencing them, and that open-circuit towers with multiple cells operate all cells in parallel down to 50% of design flow (6.5.5.4)
- Reduces design supply fan air flow rate for which energy recovery is required for systems that operate more than 8000 hours per year (6.5.6.1)
- Reduces the limits on hot gas bypass as a means of cooling capacity control (6.5.9)

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- Adds requirements for door switches to disable or reset mechanical heating or cooling when doors without automatic door closers are left open (6.5.10)
 - Added power usage effectiveness (PUE) as an alternative compliance methodology for data centers (6.6.1)

POWER AND LIGHTING

- Increases the spaces where plug shutoff control is required. Clarifies the application of this requirement for furniture systems, lowers the threshold for turn off from 30 to 20 minutes, states a labeling requirement to distinguish controlled and uncontrolled receptacles and restricts the use of plug-in devices to comply with this requirement (8.4.2)
- Specifies requirements for installation of basic electrical metering of major end uses to provide basic reporting of energy consumption data to building occupant (8.4.3)
- Nominal efficiencies established in accordance with 10 CFR 431 test procedure for low-voltage dry-type transformers (8.4.4)
- Adds control requirements for lighting alterations for interior and exterior applications (9.1.2)
- Eliminates the exception for wattage used in spaces where lighting is specifically designed for those with age-related eye conditions or other medical conditions related to the eye, where special lighting or light levels might be needed (9.2.2.3)
- Changes the criterion for applying automatic daylighting control for sidelighting and toplighting to a controlled lighting power basis and provides characteristics for the required photo controls (9.4.1.1)
- Adds control requirements for secondary sidelighting areas (9.4.1.1)
- Requires the use of certain lighting controls in more space types (9.4.1.1)
- Reduces the amount of time after occupants vacate a space for lights to be automatically reduced or shut off (9.4.1.1)
- Modifies requirements for automatic lighting control for guestroom type spaces. Exceptions to this requirement are lighting and switched receptacles controlled by captive key systems. (9.4.1.3)
- Includes loading docks as a tradable surface (Table 9.4.2.2)
- Adds more specific requirements for the functional testing of lighting controls, specifically occupancy sensors, automatic time switches and daylight controls (9.4.3)



- Updates LPDs in Table 9.5.1 – Building Area Method and Table 9.6.1 – Space-by-Space (*Tables 9.5.1 and 9.6.1*)
- Modifies Table 9.6.2 to include continuous dimming in secondary sidelighted areas, which is now based on an installed wattage rather than area of the space. Eliminates the need for effective aperture calculation. (*Table 9.6.2*)
- Adds a section for submittals (*9.7*)
- *Terms* - Deletes the term clerestory and adds roof monitor and clarifies the definition and changes references from clerestory to roof monitor. Revises several definitions related to daylighting.



PART I – GUIDELINES FOR PLAN SUBMITTAL; APPLICABILITY OF THE COMMERCIAL 2015 IECC:

The 2015 IECC Commercial Section is applicable to any *new commercial building with conditioned space and to any residential building four stories and above grade*. A ResCheck compliance form shall be submitted for occupancies covered under the Residential Section of the IECC.

Where a building has mixed use of residential and commercial, the appropriate section of the IECC shall apply with appropriate submittal documents; Residential and Commercial submittals are required as appropriate for the portion of the mixed use building.

For additions to, remodel/alterations to, repairs of, and change of occupancy or change in use of an existing commercial building, Chapter 5 CE (*Existing Buildings*) of the 2015 IECC applies and lists specific requirements and exemptions. Generally a ComCheck is not required unless a building is being “gutted” – brought down to the structural framing and being totally renovated.

PART II – INFORMATION ON CONSTRUCTION DOCUMENTS:

Construction documents shall be drawn to scale. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment as governed by the IECC. Details shall include, but are not limited to, the following as applicable:

1. Insulation materials and their R-values.
2. Fenestration U-factors and solar heat gain coefficients (SHGC).
3. Area-weighted U-factor and solar heat gain coefficient (SHGC) calculations.
4. Mechanical system design criteria.
5. Mechanical and service water heating system and equipment types, sizes and efficiencies.
6. Economizer description.
7. Equipment and system controls.
8. Fan motor horsepower (hp) and controls.
9. Duct sealing, duct and pipe insulation and location.
10. Lighting fixture schedule with wattage and control narrative.
11. Location of daylight zones on floor plans.
12. Air sealing details and narrative explaining how code compliant air will be accomplished.

Building thermal envelope depiction. The building’s thermal envelope shall be represented on the construction drawings.



PART III – ENERGY FORMS/REPORTS TO SUBMIT

A Building Permit Application Package shall include:

REQUIRED – The energy compliance documentation provided to DPS at the time of plan submittal shall, at a minimum, **include on your code analysis sheet(s)** the Method of Energy Compliance being used.

2015 IECC or ASHRAE 90.1-2013?

If 2015 IECC is chosen, which sub-compliance method will be used?

Prescriptive Path (C402 through C406), or Total Building Performance Path (C407)?

Will the Air Barrier Details be provided, or will there be a building pressure test?

If 2013 ASHRAE 90.1 is chosen, which sub-method will be used?

Prescriptive Path (See 5.2.1), or Energy Cost Budget Method (Section 11)?

For the IECC Prescriptive Path, indicate which *Additional Efficiency Package* is chosen and provided in design documents.

A commissioning plan shall be developed by a registered design professional and shall include the following items: Mechanical, service water heating systems (SWH), and electrical systems. This includes requirements for air balancing, list of mechanical electrical and plumbing systems to be included in commissioning and functional testing of controls (mechanical, electrical and plumbing) to be included.

1. A narrative description of the activities that will be accomplished during each phase of *commissioning*, including the personnel intended to accomplish each of the activities.
2. A listing of the specific equipment, appliances or systems to be tested and a description of the tests to be performed.
3. Functions to be tested including, but not limited to, calibrations and economizer controls.
4. Conditions under which the test will be performed. Testing shall affirm winter and summer design conditions and full outside air conditions.
5. Measurable criteria for performance.

Two copies of the commissioning plan shall be provided with the construction drawings. If submitting electronically, one copy shall be with the *drawings folder* and one copy shall be placed in the *documents folder*.



REQUIRED - Provide an **energy analysis for the building design** (software printout showing energy compliance) based on the chosen compliance strategy. *The design itself must utilize the specific energy values indicated by the energy analysis. Mandatory sections of the 2015 IECC or ASHRAE 90.1-2013 must be complied with even if the energy analysis software printout passes without the design in compliance with a mandatory section.* There are energy compliance software options, but the submittal package must include an energy analysis printout. The software used must be a DOE approved software from one of the following options:

ComCheck published by the US Department of Energy (DOE) based on the 2013 ASHRAE Standard 90.1 (ComCheck Windows Version 4.0.0 - Build 4.0.0.3 - Downloadable – not available as the Web version) for the prescriptive path.

ComCheck based on the 2015 IECC (Scheduled for publication at the end of September 2015) for the prescriptive path; inspection checklists shall be provided with the printout.

Other DOE approved/sponsored software based on the 2015 IECC, or ASHRAE Standard 90.1-2013; Based on Whole Building Energy Performance Simulation: DOE-2, EnergyPlus, SPARK, Building Design Advisor, etc.

REQUIRED – *All energy compliance documentation must be signed, sealed, stamped and dated by the appropriate design professional.*

PART IV – RESPONSIBILITIES FOR ENERGY REVIEW/INSPECTION AND SPECIFIC SUBMITTAL REQUIREMENTS:

The project Designer and/or Architect and Engineers (A/E) will perform reviews/quality checks for the building design relating to energy compliance. The Designers and/or A/E will submit a required statement (or multiple statements from the designers, architect and engineers) that the item(s) under their responsibility were reviewed for energy compliance.

Some individual energy related items ask for a number (percent/value) or a narrative be provided with the plans. Narratives must be submitted as a document in the submittal package referencing the appropriate drawing.

PART V – LIST OF MANDATORY REQUIREMENTS OF THE 2015 IECC OR ASHRAE 90.1-2013

If ASHRAE 90.1-2013 is chosen, there is a **Prescriptive Path (Sections 5 through 10)** and a **Energy Cost Budget Method (Section 11)**. Designers must choose one or another;

Mandatory provisions of the **Energy Cost Budget Method (Section 11)** are:

Section 5.4 Thermal Envelope Mandatory Provisions: Insulation, Fenestration, and Air Leakage

Section 6.4 HVAC Mandatory Provisions: Minimum Efficiencies, Equipment Sizing, HVAC Controls, HVAC construction and Insulation, Walk-in Coolers and Freezers

Section 7.4 Service Water Heating Equipment: Load Calculations, Equipment Efficiencies, Insulation, and Controls

Section 8.4 Electrical Mandatory Provisions: Maximum voltage drop, Receptacle Control, Energy Monitoring; Low Voltage Dry Type Distribution Transformers

Section 9.4 Lighting Mandatory Provisions: Lighting Controls (Interior and Exterior), Functional Testing

Section 10.4 Other Mandatory Provisions: Electric Motors, Service Water Pressure Booster Systems, Elevators, Escalators and Moving Walkways, Whole Building Energy Monitoring

Energy Cost Budget less than or equal to the Design Energy Cost (Software for Energy Cost Budget – DOE-2, BLAST, other software that complies with Section 11.4.1.1)

Mandatory Provisions of the ASHRAE 90.1-2013 Prescriptive Path are:

Section 5 Building Envelope; Sections 5.1, 5.2, 5.3, 5.4, 5.7, 5.8 and either Section 5.5 OR Section 5.6

Section 6 HVAC; Sections 6.1, 6.2, 6.7, and either Section 6.3 OR Section 6.4 and 6.5

Section 7 Service Water Heating; All of Section 7

Section 8 Electrical Power; All of Section 8

Section 9 Lighting; Sections 9.1, 9.2, 9.4, 9.7, and either Section 9.5 OR Section 9.6.

If the 2015 IECC path is Chosen, there is a **Prescriptive Path (Sections C402 through C406)** and a **Total Building Performance Path (Section C407)**. Designers must choose one or another.

Mandatory provisions of the Total Building Performance Path (Section C407) are:

Section C402.5 Air Leakage

Section 403.2 HVAC; Minimum Efficiencies, Equipment Sizing, HVAC Controls, Energy Recovery Ventilators, HVAC construction and Insulation, Fan Horsepower and Efficiencies, Walk-in Coolers and Freezers

Section C404 Service Water Heating

Section C405 Electrical Power and Lighting

Section C407 Total Building Performance; Building Energy Costs shall be equal to or less than 85% of the standard reference building design

Section C408 System Commissioning

Mandatory Provisions of the 2015 IEC Prescriptive Path are:

All of Sections C402 through C405; Building Envelope, HVAC, Service Water Heating, Power and Lighting

Commercial Buildings must comply with C406 Additional Efficiency Package (Chose one of 6 options)

Tenant Spaces must comply with C406.1.1 (either one of the following)

Where the shell building is not in compliance, tenant spaces must comply with one of the following additional energy efficiency packages:

C406.2; or C406.3; or C406.4; or C406.6; or C406.7

Where the shell building is in compliance, comply with C406.5 On-Site Renewable Energy



PART VI - COMMISSIONING REQUIREMENTS:

A Maryland State Licensed architect or engineer (*Registered Design Professional*) may perform commissioning and submit the **Preliminary Report of Commissioning** to the building owner or authorized agent.

The preliminary report should include an itemization of deficiencies found that have not been corrected by the time of the report, list of deferred tests not accomplished because of climatic conditions, and conditions necessary for scheduling of deferred tests. The report should address the following in particular:

Mechanical, and service hot water commissioning – Air system balancing, hydronic systems balancing per C408.2.2.

Functional Performance Testing of Equipment and Controls per C408.2.3.

Lighting System Controls Functional Testing per C408.3.

ASHRAE - Duct Leakage Test Results - If applicable to the project. For ducts designed to operate in excess of 3 in water gauge and all ductwork outside conditioned space per Section C403.2.9.

Pressure Testing of the Envelope Test Results (under Section C402.5) (if applicable).

The Preliminary Report of Commissioning shall be submitted by the Architect, Engineer or the certified commissioning agent. The items listed must address all the items in the Commissioning Plan submitted at the time of application. The preliminary commissioning report must be provided to the building owner or owner's agent. A letter of transmittal from the owner or agent verifying receipt of the preliminary commissioning report must be received by DPS prior to any Use & Occupancy inspections.

Final building occupancy approval shall not be granted until DPS receives a letter of transmittal from the building owner verifying receipt of the preliminary commissioning report. The Final Report of Commissioning is to be provided to the owner. **All documentation required by C408.2.5 shall be provided to the building owner or owner's agent within 90 days of occupancy. All reports shall be made available to DPS upon request.*

All reports and letters of transmittal listed above must be e-mailed to: mark.nauman@montgomerycountymd.gov

Thank you for your attendance.

Mark Nauman

mark.nauman@montgomerycountymd.gov

240-777-6270