

Composite Mock Up of C406 Points Option with CE218 Modifications

A complete mock-up of the new C406 Points Option approach is outlined in the following code language. This includes CE218 and all associated proposals that passed through the public comment hearing, including the following which are highlighted throughout:

CE218	C406	Base Proposal that Converts Packages to Points
CE224	C406.2.5	Additional HVAC savings > 10%
CE226	C406.3.2 and 3.3	Lighting points >15% LPD reduction; res. efficacy
CE237	C406.10	Energy Monitoring
CE239	C406.11	Fault Detection
CE240	C406.12	Efficient Kitchen Equipment

Add the following definitions:

LUMEN MAINTENANCE CONTROLS: A lighting control strategy that adjusts luminaire power over time to maintain constant light output as luminaires age, dirt accumulates or both. This strategy allows for energy savings in the life of the system then increases power as the system ages.

HIGH END TRIM: A lighting control strategy that sets the required maximum light level for each space.

SECTION C406

Post 3/26 errata; Floor Modifications

SECTION C406

ADDITIONAL EFFICIENCY REQUIREMENTS PACKAGE OPTIONS

C406.1 Additional energy efficiency credit requirements. ~~Buildings shall comply~~ New buildings shall achieve a total of 10 credits from Tables C406.1(1) through C406.1(5) where the table is selected based on the use group of the building and from credit calculations as specified in relevant subsections of C406. Where a building contains multiple use groups, credits from each use group shall be weighted by the floor area of each group to determine the weighted average building credit. Alternatively, credits shall be calculated in accordance with the relevant subsection of C406. Credits from the tables or calculation shall be achieved where a building complies with one or more of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power 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.
7. Enhanced envelope performance in accordance with Section C406.8.
8. Reduced air infiltration in accordance with Section C406.9

9. Where not required by Section C405.10 include an energy monitoring system in accordance with C406.10

10. Where not required by Section C403.2.3 include a fault detection and diagnostics (FDD) system in accordance with Section C406.11.

11. Efficient Kitchen Equipment in accordance with Section C406.12.

Add new text as follows:

Table C406.1(1)
Additional Energy Efficiency Credits for Group B Occupancies

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% Heating	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1	1	NA	1
C406.2.2: 5% Cooling	6	6	5	5	4	4	3	3	3	2	2	2	1	2	2	2	1
C406.2.3: 10% Heating	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	2	1	1	2	2	NA	1
C406.2.4: 10% Cooling	11	12	10	9	7	7	6	5	6	4	4	5	3	4	3	3	3
C406.3.1: 10% LPA	9	8	9	9	9	9	10	8	9	9	7	8	8	6	7	7	6
C406.3.3: Lamp Efficacy	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.4: Digital Lt Ctrl	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	1
C406.5: Renewable	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
C406.6: DOAS	4	4	4	4	4	3	2	5	3	2	5	3	2	7	4	5	3
C406.7.1: SWH HR	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.2: SWH NG eff	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.3: SWH HP	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.8: 85% UA	1	4	2	4	4	3	NA	7	4	5	10	7	6	11	10	14	16
C406.9: Low Leakage Env.	2	1	1	2	4	1	NA	8	2	3	1 1	4	1	1 5	8	1 1	6
C406.10: Energy Monitoring	4	4	4	4	3	3	3	3	3	3	2	3	2	2	2	2	2
C406.11: Fault Detection	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1

Table C406.1(2)
Additional Energy Efficiency Credits for Group R and I Occupancies

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% Heating	NA	NA	NA	NA	1	NA	NA	1	NA	1	1	1	1	2	1	2	2
C406.2.2: 5% Cooling	3	3	2	2	1	1	1	1	1	NA	1	1	NA	1	1	1	NA
C406.2.3: 10% Heating	NA	NA	NA	NA	1	NA	NA	1	1	1	2	2	1	3	2	3	4
C406.2.4: 10% Cooling	5	5	4	3	2	3	1	2	2	1	1	1	1	1	1	1	1
C406.3.1: 10% LPA	2	2	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2
C406.3.3: Lamp Efficacy	2	2	2	2	1	2	2	1	1	1	1	1	1	1	1	1	1
C406.4: Digital Lt Ctrl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.5: Renewable	8	8	8	8	7	8	8	7	7	7	7	7	7	7	7	7	7
C406.6: DOAS	3	4	3	3	4	2	NA	6	3	4	8	5	5	10	7	11	12
C406.7.1: SWH HR	10	9	11	10	13	12	15	14	14	15	14	14	16	14	15	15	15
C406.7.2: SWH NG eff	5	5	6	6	8	7	8	8	8	9	9	9	10	10	9	10	11
C406.7.3: SWH HP	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
C406.8: 85% UA	3	6	3	5	4	4	1	4	3	3	4	5	3	5	4	6	6
C406.9: Low Leak Env.	6	5	3	11	6	4	NA	7	3	3	9	5	1	13	6	8	3
C406.10 Energy Monitoring	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C406.11: Fault Detection	1	1	1	1	1	1	NA	1	1	NA	1	1	NA	1	1	1	1

Table C406.1(3)
Additional Energy Efficiency Credits for Group E Occupancies

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% Heating	NA	NA	NA	NA	1	1	1	1	1	2	1	2	1	2	2	3	4
C406.2.2: 5% Cooling	4	4	3	3	2	2	2	2	1	1	1	1	NA	1	1	1	NA
C406.2.3: 10% Heating	NA	NA	NA	1	1	1	1	2	3	4	3	4	3	4	3	5	7
C406.2.4: 10% Cooling	7	8	7	6	5	4	3	4	3	1	2	2	1	2	2	2	1
C406.3.1: 10% LPA	8	8	8	9	8	9	9	8	9	9	8	9	8	7	8	7	7
C406.3.3: Lamp Efficacy	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.4: Digital Lt Ctrl	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	1
C406.5: Renewable	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	5
C406.6: DOAS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.1: SWH HR ^a	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C406.7.2: SWH NG eff ^a	NA	1	1	1	1	1	1	2	2	3	2	3	2	3	3	3	5
C406.7.3: SWH HPWH ^a	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1	1	NA	1	1	1	1
C406.8: 85% UA	3	7	3	4	2	4	1	1	3	1	2	3	NA	4	3	6	9
C406.9: Low Leak Env.	1	1	1	2	NA	NA	NA	NA	NA	NA	1	NA	NA	4	1	4	3
C406.10 Energy Monitoring	3	3	3	3	3	3	3	3	3	2	2	3	2	2	2	2	2
C406.11: Fault Detection	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2

^a for schools with full service kitchens or showers

**Table C406.1(4)
Additional Energy Efficiency Credits for Group M Occupancies**

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% Heating	NA	NA	NA	NA	1	1	NA	1	1	2	2	2	2	3	2	3	4
C406.2.2: 5% Cooling	5	6	4	4	3	3	1	2	2	1	1	2	NA	1	1	1	NA
C406.2.3: 10% Heating	NA	NA	NA	1	1	1	1	2	2	4	3	4	5	5	3	6	8
C406.2.4: 10% Cooling	9	12	9	8	6	6	3	4	4	1	2	3	NA	2	2	2	1
C406.3.1: 10% LPA	13	13	15	14	16	14	17	15	15	14	12	14	14	16	16	14	12
<u>C406.3.3: Lamp Efficacy</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>
C406.4: Digital Lt Ctrl	3	3	4	3	4	3	4	4	4	3	3	3	3	4	4	3	3
C406.5: Renewable	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	6
C406.6: DOAS	3	4	3	3	3	3	1	3	2	2	2	3	2	4	3	4	4
C406.7.1: SWH HR	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.2: SWH NG eff	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.3: SWH HP	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.8: 85% UA	4	6	3	4	3	3	1	6	4	4	4	5	4	6	5	8	9
C406.9: Low Leak Env.	1	1	1	2	1	1	NA	3	1	1	3	2	1	7	3	6	3
<u>C406.10 Energy Monitoring</u>	<u>4</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>4</u>	<u>4</u>	<u>4</u>	<u>4</u>	<u>3</u>	<u>3</u>	<u>4</u>	<u>3</u>	<u>4</u>	<u>4</u>	<u>4</u>	<u>3</u>
<u>C406.11: Fault Detection</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>2</u>	<u>2</u>

**Table C406.1(5)
Additional Energy Efficiency Credits for Other^a Occupancies**

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% Heating	NA	NA	NA	NA	1	1	1	1	1	2	1	2	1	2	2	3	3
C406.2.2: 5% Cooling	5	5	4	4	3	3	2	2	2	1	1	2	1	1	1	1	1
C406.2.3: 10% Heating	NA	NA	NA	1	1	1	1	2	2	3	3	3	3	4	3	5	5
C406.2.4: 10% Cooling	8	9	8	7	5	5	3	4	4	2	2	3	2	2	2	2	2
C406.3.1: 10% LPA	8	8	9	9	9	9	10	8	9	9	7	8	8	8	8	8	7
<u>C406.3.3: Lamp Efficacy</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>
C406.4: Enh. Digital Light Control	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	1
C406.5: Renewable	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	7
C406.6: DOAS	3	4	3	3	4	3	2	5	3	3	5	4	3	7	5	7	6
C406.7.1: SWH HR ^b	10	9	11	10	13	12	15	14	14	15	14	14	16	14	15	15	15
C406.7.2: SWH FF eff ^b	5	5	6	6	8	7	8	8	8	9	9	9	10	10	9	10	11
C406.7.3: SWH HPWH ^b	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
C406.8: 85% UA	3	6	3	4	3	4	1	5	4	3	5	5	4	7	6	9	10
C406.9: Low Leak Env.	3	2	2	4	4	2	NA	6	2	2	6	4	1	10	5	7	4
<u>C406.10 Energy Monitoring</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>2</u>	<u>3</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>3</u>	<u>2</u>
<u>C406.11: Fault Detection</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>

^a Other occupancy groups include all Groups except for Groups B, R, I, E, and M.

^b for occupancy groups listed in C406.7.1

C406.1.1 Tenant spaces. Tenant spaces shall comply with sufficient options from Tables C406.1(1) through C406.1(5) to achieve a minimum number of 5 credits, where credits are selected from 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 complies using credits from Section C406.5, C406.8 or C406.9, tenant spaces within the building shall be deemed to comply with this section. is in compliance.~~

Exception: Previously occupied tenant spaces that comply with this code in accordance with Section C501.

C406.2 More efficient HVAC equipment performance.

Equipment shall exceed the minimum efficiency requirements listed in Tables C403.3.2(1) through C403.3.2(97) ~~by 10 percent, in addition to the requirements of Section C403. Where multiple performance requirements are provided, the equipment shall exceed all requirements by 10 percent. and Variable refrigerant flow systems shall exceed listed in the energy efficiency provisions of ANSI/ASHRAE/IESNA 90.1 by 10 percent.~~ in accordance with Sections C406.2.1, C406.2, C406.2.3 or C406.4. Equipment shall also meet applicable requirements of Section C403. Energy efficiency credits for heating shall be selected from C406.2.1 or C406.2.3 and energy efficiency credits for cooling shall be selected from C406.2.2 or C406.2.4. Selected credits shall include a heating or cooling energy efficiency credit or both. Equipment not listed in Tables C403.3.2(1) through C403.3.2(97) and Variable refrigerant flow systems not listed in the energy efficiency provisions of ANSI/ASHRAE/IES 90.1 shall be limited to 10 percent of the total building system capacity for heating equipment where selecting C406.2.1 or C406.2.3 and cooling equipment where selecting C406.2.2 or C406.2.4.

C406.2.1 More efficient HVAC heating performance. Equipment shall exceed the minimum heating efficiency requirements by 5 percent.

C406.2.2 More efficient HVAC cooling performance. Equipment shall exceed the minimum cooling and heat rejection efficiency requirements by 5 percent. Where multiple cooling performance requirements are provided, the equipment shall exceed the annual energy requirement, including IEER, SEER, and IPLV.

C406.2.3 High efficiency HVAC heating performance. Equipment shall exceed the minimum heating efficiency requirements by 10 percent.

C406.2.4 High efficiency HVAC cooling performance. Equipment shall exceed the minimum cooling and heat rejection efficiency requirements by 10 percent. Where multiple cooling performance requirements are provided, the equipment shall exceed the annual energy requirement, including IEER, SEER, and IPLV.

C406.2.5 More than ten percent cooling efficiency improvement. Where equipment exceeds the minimum annual cooling and heat rejection efficiency requirements by more than 10 percent, energy efficiency credits for cooling may be determined using Equation 4-1, rounded to the nearest whole number. Where multiple cooling performance requirements are provided, the equipment shall exceed the annual energy requirement, including IEER, SEER, and IPLV.

$$EEC_{HEC} = EEC_{10} \times [1 + ((CEI - 10 \text{ percent}) \div 10 \text{ percent})] \quad \text{(Equation 4-1)}$$

Where:

EEC_{HEC} = energy efficiency credits for cooling efficiency improvement

EEC_{10} = C406.2.4 credits from Tables C406.1(1) through C406.1(5)

CEI = the lesser of: the improvement above minimum cooling and heat rejection efficiency requirements, or 15 percent

C406.3 Reduced lighting power. Buildings shall comply with Section C406.3.1 or C406.3.2 and dwelling units and sleeping units within the building shall comply with C406.3.3.

C406.3.1 Reduced lighting power by more than 10%. The total connected interior lighting power calculated in accordance with Section C405.3.1 shall be less than 90 percent of the total lighting power allowance calculated in accordance with Section C405.3.2.

C406.3.2 Reduced lighting power by more than 15 percent. Where the total connected interior lighting power calculated in accordance with Section C405.3.1 is less than 85 percent of the total lighting power allowance calculated in accordance with Section C405.3.2, additional energy efficiency credits shall be determined based on Equation 4-12, rounded to the nearest whole number.

$$AEEC_{LPA} = AEEC_{10} \times 10 \times (LPA - LPD) / LPA \quad (\text{Equation 4-12})$$

Where:

$AEEC_{LPA}$ = C406.3.2 additional energy efficiency credits

LPD = total connected interior lighting power calculated in accordance with Section C405.3.1

LPA = total lighting power allowance calculated in accordance with Section C405.3.2

$AEEC_{10}$ = C406.3.1 credits from Tables C406.1(1) through C406.1(5)

C406.3.3 Lamp efficacy. Not less than 95 percent of the interior lighting power (watts) from lamps in permanently installed light fixtures in dwelling units and sleeping units shall be provided by lamps with a minimum efficacy of 65 lumens per watt.

C406.4 Enhanced digital lighting controls. Interior lighting in the building shall have the following enhanced lighting controls, that shall be located, scheduled and operated in accordance with Section C405.2.2.

1. Luminaires shall be configured for continuous dimming.
2. Luminaires shall be addressed individually. Where individual addressability is not available for the luminaire class type, a controlled group of not more than four luminaries shall be allowed.
3. Not more than eight luminaires shall be controlled together in a *daylight zone*.
4. Fixtures shall be controlled through a digital control system that includes the following function:
 - 4.1. Control reconfiguration based on digital addressability.
 - 4.2. Load shedding.
 - 4.3. Individual user control of overhead general illumination in open offices.
 - 4.4. Occupancy sensors shall be capable of being reconfigured through the digital control system.
5. Construction documents shall include submittal of a Sequence of Operations, including a specification outlining each of the functions in Item 4.
6. Functional testing of lighting controls shall comply with Section C408.

C406.5 On-site renewable energy. Buildings shall comply with Section C406.5.1 or C406.5.2.

C406.5.1 Basic Renewable Credit. The total minimum ratings of on-site renewable energy systems shall be one of the following:

1. Not less than ~~1.71~~ 0.86 Btu/h per square foot (~~5.4~~ 2.7 W/m²) or ~~0.50~~ 0.25 watts per square foot (~~5.4~~ 2.7 W/m²) of conditioned floor area.
2. Not less than ~~3~~ 2 percent of the annual energy used within the building for building mechanical and service water heating equipment and lighting regulated in Chapter 4.

C406.5.2 Enhanced Renewable Credits. Where the total minimum ratings of on-site renewable energy systems exceeds the rating in C406.5.1(1), additional energy efficiency credits shall be determined based on Equation 4-13, rounded to the nearest whole number.

$$AEEC_{RRa} = AEEC_{2.5} \times RRa / RR_1 \quad \text{(Equation 4-13)}$$

Where:

AEEC_{RRa} = C406.5.2 additional energy efficiency credits

RRa = actual total minimum ratings of on-site renewable energy systems in Btu/h W/ft², or W/m²

RR₁ = minimum ratings of on-site renewable energy systems required by C406.5.1(1) in Btu/h, W/ft², or W/m²

AEEC_{2.5} = C406.5.1 credits from Tables C406.1(1) through C406.1(5)

C406.6 Dedicated outdoor air system. Buildings containing equipment or systems regulated by Section C403.3.4, C403.4.3, C403.4.4, C403.4.5, C403.6, C403.8.4, C403.8.5, C403.8.5.1, C403.9.1, C403.9.2, C403.9.3 or C403.9.4 shall be equipped with an independent ventilation system designed to provide not less than the minimum 100-percent outdoor air to each individual occupied space, as specified by the *International Mechanical Code*. The ventilation system shall be capable of total energy recovery. The HVAC system shall include supply-air temperature controls that automatically reset the supply-air temperature in response to representative building loads, or to outdoor air temperatures. The controls shall reset the supply-air temperature not less than 25 percent of the difference between the design supply-air temperature and the design room-air temperature.

C406.7 Reduced energy use in service water heating. Buildings shall comply with Sections C406.7.1 and either C406.7.2, C406.7.3 or C406.7.4.

C406.7.1 Building type. To qualify for this credit, the building shall contain one of ~~shall be of the~~ following use groups and the additional energy efficiency credit shall be prorated by conditioned floor area of the portion of the building comprised of the following use groups.
~~types to use this compliance method:~~

1. *Group R-1:* Boarding houses, hotels or motels.
2. *Group I-2:* Hospitals, psychiatric hospitals and nursing homes.
3. *Group A-2:* Restaurants and banquet halls or buildings containing food preparation areas.
4. *Group F:* Laundries.
5. *Group R-2.*
6. *Group A-3:* Health clubs and spas.
7. *Group E:* Schools with full-service kitchens or locker rooms with showers.

8. Buildings showing a service hot water load of 10 percent or more of total building energy loads, as shown with an energy analysis as described in Section C407.

C406.7.21 Recovered or renewable water heating Load fraction. The building service water-heating system shall have one or more of the following that are sized to provide not less than ~~60~~ 30 percent of the building's annual hot water requirements, or sized to provide ~~100~~ 70 percent of the building's annual hot water requirements if the building is required to ~~shall otherwise~~ comply with Section C403.9.5:

1. Waste heat recovery from service hot water, heat recovery chillers, building equipment, or process equipment.
2. *On-site renewable energy* water-heating systems.

Add new text as follows:

C406.7.3 Efficient fossil fuel water heater. The combined input-capacity-weighted-average equipment rating of all fossil fuel water heating equipment in the building shall be not less than 95% Et or 0.95 EF. This option shall receive only half the listed credits for buildings required to comply with C404.2.1.

C406.7.4 Heat pump water heater. Where electric resistance water heaters are allowed, all service hot water system heating requirements shall be met using heat pump technology with a combined input-capacity-weighted-average EF of 3.0. Air-source heat pump water heaters shall not draw conditioned air from within the building, except exhaust air that would otherwise be exhausted to the exterior.

C406.8 Enhanced envelope performance. The total UA of the building thermal envelope as designed shall be not less than 15 percent below the total UA of the building thermal envelope in accordance with Section C402.1.5.

C406.9 Reduced air infiltration. Air infiltration shall be verified by whole-building pressurization testing conducted in accordance with ASTM E779 or ASTM E1827 by an independent third party. The measured air-leakage rate of the building envelope shall not exceed 0.25 cfm/ft² (2.0 L/s × m²) under a pressure differential of 0.3 inches water column (75 Pa), with the calculated surface area being the sum of the above- and below-grade building envelope. A report that includes the tested surface area, floor area, air by volume, stories above grade, and leakage rates shall be submitted to the code official and the building owner.

Exception: For buildings having over 50,000 square feet (5 000 m²) of conditioned floor area, air leakage testing need not be conducted on the whole building where testing is conducted on representative above-grade sections of the building. Tested areas shall total not less than 25 percent of the conditioned floor area and shall be tested in accordance with this section.

C406.10 Energy Monitoring Buildings shall be equipped to measure, monitor, record and report energy consumption data in compliance with Section C406.10.1 through C406.10.5.

C406.10.1 Electrical energy metering. For electrical energy, including all electrical energy supplied to the building and its associated site, including but not limited to site lighting, parking, recreational facilities, and other areas that serve the building and its occupants, meters or other measurement devices shall be provided to collect energy consumption data for each end-use category required by Section C406.10.2.

C406.10.2 End-use metering categories. Meters or other approved measurement devices shall be provided to collect energy use data for each end-use category listed in Table 406.10.2. These meters shall have the capability to collect energy consumption data for the whole building or for each separately metered portion of the building. Where multiple meters are used to measure any end-use category, the data acquisition system shall total all of the energy used by that category. Not more than 5 percent of the measured load for each of the end-use categories listed in Table 406.10.2 is permitted to be from a load not within the category.

Exceptions:

1. HVAC and water heating equipment serving only an individual dwelling unit does not require end-use metering.
2. End-use metering is not required for fire pumps, stairwell pressurization fans or any system that operates only during testing or emergency.

**TABLE 406.10.2
ENERGY USE CATEGORIES**

LOAD CATEGORY	DESCRIPTION OF ENERGY USE
<u>Total HVAC system</u>	<u>Heating, cooling and ventilation including, but not limited to fans, pumps, boilers, chillers and water heating. Energy used by 120 volt equipment, or by 208/120 volt equipment that is located in a building where the main service is 480/277 volt power, is permitted to be excluded from Total HVAC system energy use.</u>
<u>Interior lighting</u>	<u>Lighting systems located within the building.</u>
<u>Exterior lighting</u>	<u>Lighting systems located on the building site but not within the building.</u>
<u>Plug loads</u>	<u>Devices, appliances and equipment connected to convenience receptacle outlets.</u>
<u>Process loads</u>	<u>Any single load that is not included in a HVAC, lighting, or plug load category and that exceeds 5 percent of the peak connected load of the whole building including, but not limited to data centers, manufacturing equipment and commercial kitchens.</u>
<u>Building operations and other miscellaneous loads</u>	<u>The remaining loads not included elsewhere in this table including, but not limited to, vertical transportation systems, automatic doors,</u>

C406.10.3 Meters. Meters or other measurement devices required by this Section shall be configured to automatically communicate energy consumption data to the data acquisition system required by Section C406.10.4. Source meters shall be allowed to be any digital-type meter. Lighting, HVAC, or other building systems that can monitor their energy consumption shall be permitted instead of meters. Current sensors shall be permitted, provided that they have a tested accuracy of +/-2 percent. Required metering systems and equipment shall have the capability to provide at least hourly data that is fully integrated into the data acquisition system and graphical energy report in accordance with Sections 406.10.4 and C406.10.5.

C406.10.4 Data acquisition system. A data acquisition system shall have the capability to store the data from the required meters and other sensing devices for a minimum of 36 months. The data acquisition system shall have the capability to store real-time energy consumption data and provide hourly, daily, monthly, and yearly logged data for each end-use category required by Section C406.10.2.

C406.10.5 Graphical energy report. A permanent and readily accessible reporting mechanism shall be provided in the building that is accessible by building operation and management personnel. The reporting mechanism shall have the capability to graphically provide the energy consumption for each end-use category required by Section C406.10.2 at least every hour, day, month and year for the previous 36 months.

C406.11 Fault detection and diagnostics system. A fault detection and diagnostics system shall be installed to monitor the HVAC system's performance and automatically identify faults. The system shall:

1. Include permanently installed sensors and devices to monitor the HVAC system's performance;
2. Sample the HVAC system performance at least once per 15 minutes;
3. Automatically identify and report HVAC system faults;
4. Automatically notify authorized personnel of identified HVAC system faults;
5. Automatically provide prioritized recommendations for repair of identified faults based on analysis of data collected from the sampling of the HVAC system performance; and
6. Be capable of transmitting the prioritized fault repair recommendations to remotely located authorized personnel.

C406.12 Efficient Kitchen Equipment. For buildings and spaces designated as Group A-2, or facilities that include a commercial kitchen with at least one gas or electric fryer, all fryers, dishwashers, steam cookers and ovens shall comply with all of the following:

1. Achieve performance levels in accordance with the equipment specifications listed in Tables C406.12 (1) through (4) when rated in accordance with the applicable test procedure.
2. Be installed prior to the issuance of the Certificate of Occupancy.
3. Have associated performance levels listed on the construction documents submitted for permitting.

Energy efficiency credits for efficient kitchen equipment shall be independent of climate zone and determined based on Equation 4-14, rounded to the nearest whole number.

$$AEEC_K = 20 \times AreaK / AreaB \quad \text{(Equation 4-14)}$$

Where:

- $AEEC_K$ = C406.12 additional energy efficiency credits
- $AreaK$ = Floor area of full service kitchen (ft² or m²)
- $AreaB$ = Gross floor area of building (ft² or m²)

Table C406.12 (1)
Minimum Efficiency Requirements: Commercial Fryers

	<u>Heavy-Load Cooking Energy Efficiency</u>	<u>Idle Energy Rate</u>	<u>Test Procedure</u>
<u>Standard Open Deep-Fat Gas Fryers</u>	<u>≥ 50%</u>	<u>≤ 9,000 Btu/hr</u>	<u>ASTM Standard F1361-07</u>
<u>Standard Open Deep-Fat Electric Fryers</u>	<u>≥ 83%</u>	<u>≤ 800 watts</u>	
<u>Large Vat Open Deep-Fat Gas Fryers</u>	<u>≥ 50%</u>	<u>≤ 12,000 Btu/hr</u>	<u>ASTM Standard F2144-17</u>
<u>Large Vat Open Deep-Fat Electric Fryers</u>	<u>≥ 80%</u>	<u>≤ 1,100 watts</u>	

Table C406.12 (2)

Minimum Efficiency Requirements: Commercial Steam Cookers

<u>Fuel Type</u>	<u>Pan Capacity</u>	<u>Cooking Energy Efficiency^a</u>	<u>Idle Rate</u>	<u>Test Procedure</u> ASTM Standard F1484-18
<u>Electric Steam</u>	<u>3-pan</u>	<u>50%</u>	<u>400 watts</u>	
	<u>4-pan</u>	<u>50%</u>	<u>530 watts</u>	
	<u>5-pan</u>	<u>50%</u>	<u>670 watts</u>	
	<u>6-pan and larger</u>	<u>50%</u>	<u>800 watts</u>	
<u>Gas Steam</u>	<u>3-pan</u>	<u>38%</u>	<u>6,250 Btu/h</u>	
	<u>4-pan</u>	<u>38%</u>	<u>8,350 Btu/h</u>	
	<u>5-pan</u>	<u>38%</u>	<u>10,400 Btu/h</u>	
	<u>6-pan and larger</u>	<u>38%</u>	<u>12,500 Btu/h</u>	

a. Cooking Energy Efficiency is based on heavy load (potato) cooking capacity

Table C406.12 (3)

Minimum Efficiency Requirements: Commercial Dishwashers

<u>Machine Type</u>	<u>High Temp Efficiency Requirements</u>		<u>Low Temp Efficiency Requirements</u>		<u>Test Procedure</u>
	<u>Idle Energy Rate^a</u>	<u>Water Consumption^b</u>	<u>Idle Energy Rate^a</u>	<u>Water Consumption^b</u>	
<u>Under Counter</u>	<u>≤ 0.50 kW</u>	<u>≤ 0.86 GPR</u>	<u>≤ 0.50 kW</u>	<u>≤ 1.19 GPR</u>	ASTM Standard F1696-18 ASTM Standard F1920-15
<u>Stationary Single Tank Door</u>	<u>≤ 0.70 kW</u>	<u>≤ 0.89 GPR</u>	<u>≤ 0.60 kW</u>	<u>≤ 1.18 GPR</u>	
<u>Pot, Pan, and Utensil</u>	<u>≤ 1.20 kW</u>	<u>≤ 0.58 GPR</u>	<u>≤ 1.00 kW</u>	<u>≤ 0.58 GPSF</u>	
<u>Single Tank Conveyor</u>	<u>≤ 1.50 kW</u>	<u>≤ 0.70 GPR</u>	<u>≤ 1.50 kW</u>	<u>≤ 0.79 GPR</u>	
<u>Multiple Tank Conveyor</u>	<u>≤ 2.25 kW</u>	<u>≤ 0.54 GPR</u>	<u>≤ 2.00 kW</u>	<u>≤ 0.54 GPR</u>	
<u>Single Tank Flight Type</u>	<u>Reported</u>	<u>GPH ≤ 2.975x + 55.00</u>	<u>Reported</u>	<u>GPH ≤ 2.975x + 55.00</u>	
<u>Multiple Tank Flight Type</u>	<u>Reported</u>	<u>GPH ≤ 4.96x + 17.00</u>	<u>Reported</u>	<u>GPH ≤ 4.96x + 17.00</u>	

^a Idle results should be measured with the door closed and represent the total idle energy consumed by the machine including all tank heater(s) and controls. Booster heater (internal or external) energy consumption should not be part of this measurement unless it cannot be separately monitored.

^b GPR = gallons per rack; GPSF = gallons per square foot of rack; GPH = gallons per hour; x = sf of conveyor belt (i.e., W*L) /min (max conveyor speed).

Table C406.12 (4)
Minimum Efficiency Requirements: Commercial Ovens

<u>Fuel Type</u>	<u>Classification</u>	<u>Idle Rate</u>	<u>Cooking-Energy Efficiency, %</u>	<u>Test Procedure</u>
Convection Ovens				
<u>Gas</u>	<u>Full-Size</u>	$\leq 12,000 \text{ Btu/h}$	≥ 46	<u>ASTM F1496 - 13</u>
<u>Electric</u>	<u>Half-Size</u>	$\leq 1.0 \text{ Btu/h}$	≥ 71	
	<u>Full-Size</u>	$\leq 1.60 \text{ Btu/h}$		
Combination Ovens				
<u>Gas</u>	<u>Steam Mode</u>	$\leq 200P^a + 6,511 \text{ Btu/h}$	≥ 41	<u>ASTM F2861 - 17</u>
	<u>Convection Mode</u>	$\leq 150P^a + 5,425 \text{ Btu/h}$	≥ 56	
<u>Electric</u>	<u>Steam Mode</u>	$\leq 0.133P^a + 0.6400 \text{ kW}$	≥ 55	
	<u>Convection Mode</u>	$\leq 0.080P^a + 0.4989 \text{ kW}$	≥ 76	
Rack Ovens				
<u>Gas</u>	<u>Single</u>	$\leq 25,000 \text{ Btu/h}$	≥ 48	<u>ASTM F2093 - 18</u>
	<u>Double</u>	$\leq 30,000 \text{ Btu/h}$	≥ 52	

b. P = Pan Capacity: The number of steam table pans the combination oven is able to accommodate as per the ASTM F – 1495 – 14a standard specification.

ASTM ASTM International

100 Barr Harbor Drive, P.O. Box C700
 West Conshohocken PA 19428-2959

F1361-17: Standard Test Method for Performance of Open Deep Fat Fryers

F2144-17: Standard Test Method for Performance of Large Open Vat Fryers

F1484-18: Standard Test Method for Performance of Steam Cookers

F1696-18: Standard Test Method for Energy Performance of Stationary-Rack, Door-Type Commercial Dishwashing Machines

F1920-15: Standard Test Method for Performance of Rack Conveyor Commercial Dishwashing Machines

F1496-13: Standard Test Method for Performance of Convection Ovens

F2861-17: Standard Test Method for Enhanced Performance of Combination Oven in Various Modes

F2093-18: Standard Test Method for Performance of Rack Ovens

F1495-14a: Standard Specification for Combination Oven Electric or Gas Fired