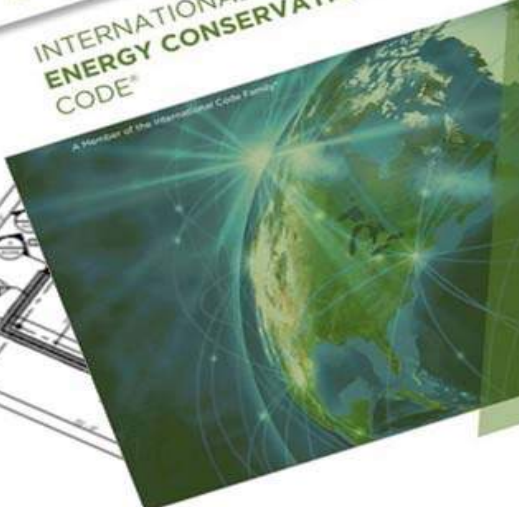


IECC

INTERNATIONAL
ENERGY CONSERVATION
CODE

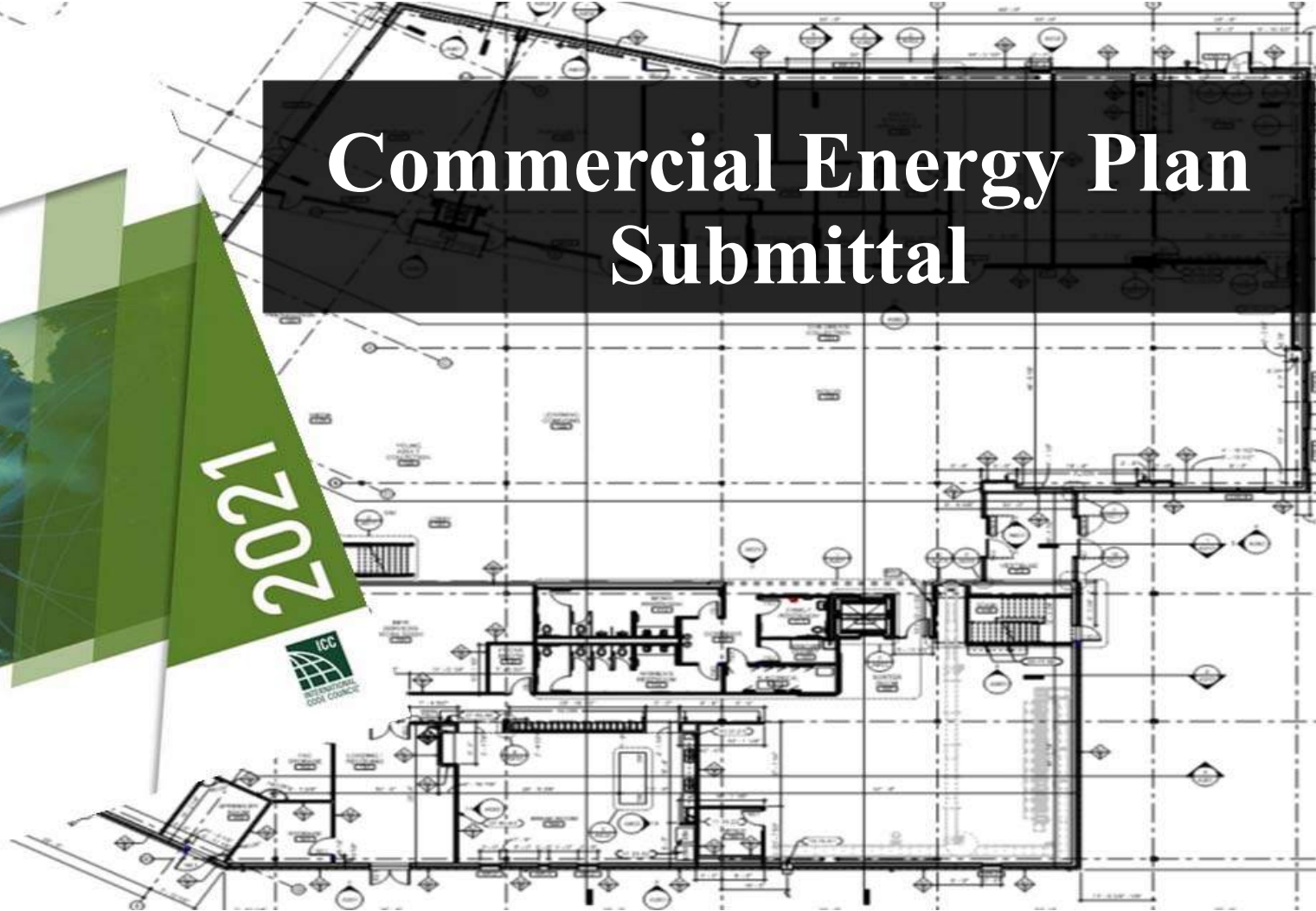
A Member of the International Code Family

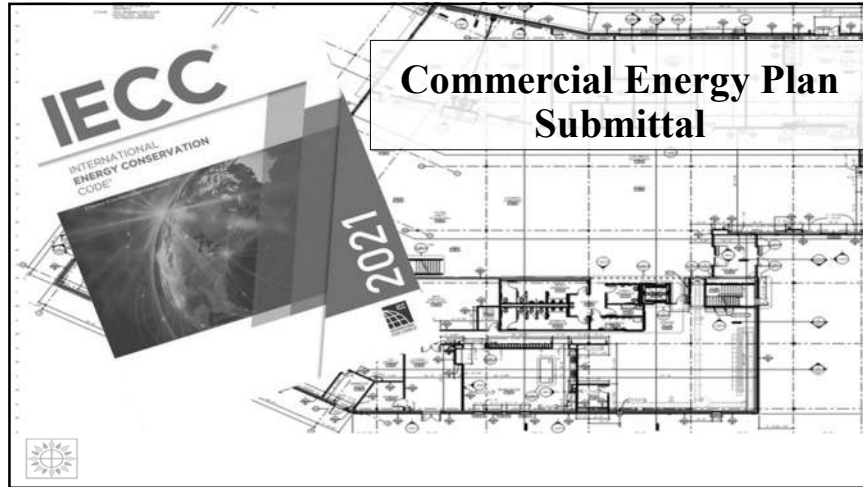


2021



Commercial Energy Plan Submittal







Commercial Energy Plan Submittal

1

New Commercial Definitions to Note:

CHANGE OF OCCUPANCY. A change in the use of a building or a portion of a building that results in any of the following:

1. A change of occupancy classification.
2. A change from one group to another group within an occupancy classification.
3. Any change in use within a group for which there is a change in the application of the requirements of this code.





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2

New Commercial Definitions to Note:

- **COMPUTER ROOM.** A room whose primary function is to house equipment for the processing and storage of electronic data and that has a design electronic data equipment power density of less than 20 watts per square foot (20 watts per 0.092 m²) of conditioned floor area or a connected design electronic data equipment load of less than 10 kW.



- To differ from data centers

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3

New Commercial Definitions to Note:

DATA CENTER. A room or series of rooms that share data center systems, whose primary function is to house equipment for the processing and storage of electronic data and that has a design total ITE equipment power density exceeding 20 watts per square foot (20 watts per 0.092 m²) of conditioned area and a total design ITE equipment load greater than 10 kW.

DATA CENTER SYSTEMS. HVAC systems and equipment, or portions thereof, used to provide cooling or ventilation in a data center

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4

New Commercial Definitions to Note:

GREENHOUSE. A structure or a thermally isolated area of a building that maintains a specialized sunlit environment exclusively used for, and essential to, the cultivation, protection or maintenance of plants. Greenhouses are those that are erected for a period of 180 days or more



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5

5

New Commercial Definitions to Note:

INTERNAL CURTAIN SYSTEM. A system consisting of movable panels of fabric or plastic film used to cover and uncover the space enclosed in a greenhouse on a daily basis



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6

6

New Commercial Definitions to Note:

TESTING UNIT ENCLOSURE AREA. The area sum of all the boundary surfaces that define the dwelling unit, sleeping unit or occupiable conditioned space including top/ceiling, bottom/floor and all side walls. This does not include interior partition walls within the dwelling unit, sleeping unit, or occupiable conditioned space. Wall height shall be measured from the finished floor of the conditioned space to the finished floor or roof/ceiling air barrier above



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7

7

New Commercial Definitions to Note:

THERMAL DISTRIBUTION EFFICIENCY (TDE). The resistance to changes in air heat as air is conveyed through a distance of air duct. TDE is a heat loss calculation evaluating the difference in the heat of the air between the air duct inlet and outlet caused by differences in temperatures between the air in the duct and the duct material. TDE is expressed as a percent difference between the inlet and outlet heat in the duct



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8

8

New Commercial Definitions to Note:

WALL, ABOVE-GRADE. A wall associated with the building thermal envelope that is more than 15 percent above grade and is on the exterior of the building or any wall that is associated with the building thermal envelope that is not on the exterior of the building. This includes, but is not limited to, between-floor spandrels, peripheral edges of floors, roof knee walls, dormer walls, gable end walls, walls enclosing a mansard roof and skylight shafts



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9

9

C103.2 Information On Construction Documents.



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

10

C401.2.1 International Energy Conservation Code.

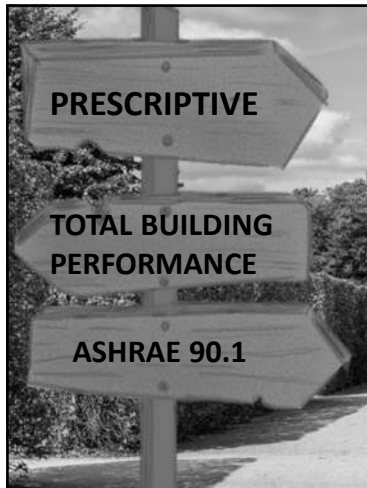
Commercial buildings shall comply with one of the following:

1. Prescriptive Compliance. The Prescriptive Compliance option requires compliance with Sections C402 through C406 and Section C408. Dwelling units and sleeping units in Group R-2 buildings without systems serving multiple units shall be deemed to be in compliance with this chapter, provided that they comply with Section R406.
2. Total Building Performance. The Total Building Performance option requires compliance with Section C407.

Exception: Additions, alterations, repairs and changes of occupancy to existing buildings complying with Chapter 5.

C401.2.2 ASHRAE 90.1.

Commercial buildings shall comply with the requirements of ANSI/ASHRAE/IESNA 90.1.



11

C402.1.3 Insulation component R-value-based method

CLIMATE ZONE	0 AND 1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8		
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	
Roofs																	
Insulation entirely above roof deck	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal buildings ^b	R-19 +R-11 LS	R-19 +R-11 LS	R-19 +R-11 LS	R-19 +R-11 LS	R-19 +R-11 LS	R-19 +R-11 LS	R-19 +R-11 LS	R-19 +R-11 LS	R-19 +R-11 LS	R-19 +R-11 LS	R-19 +R-11 LS	R-19 +R-11 LS	R-19 +R-11 LS	R-19 +R-11 LS	R-19 +R-11 LS	R-19 +R-11 LS	R-25 +R-11* R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-49	R-49	R-49	R-49	R-49	R-49	R-49	R-60	R-60	R-60	R-60
Walls, above grade																	
Mass ^a	R-5.7ci ^c	R-5.7ci ^c	R-5.7ci ^c	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11.4ci	R-11.4ci	R-13.3ci	R-13.3ci	R-15.2ci	R-15.2ci	R-15.2ci	R-15.2ci	R-25ci	R-25ci
Metal building	R-13 +R-6.5ci	R-13 +R-6.5ci	R-13 +R-6.5ci	R-13 +R-13ci	R-13 +R-6.5ci	R-13 +R-13ci	R-13 +R-13ci	R-13 +R-14ci	R-13 +R-14ci	R-13 +R-14ci	R-13 +R-14ci	R-13 +R-14ci	R-13 +R-14ci	R-13 +R-17ci	R-13 +R-19.5ci	R-13 +R-19.5ci	R-13 +R-19.5ci
Metal framed	R-13 +R-5ci	R-13 +R-5ci	R-13 +R-5ci	R-13 +R-7.5ci	R-13 +R-7.5ci	R-13 +R-7.5ci	R-13 +R-7.5ci	R-13 +R-7.5ci	R-13 +R-7.5ci	R-13 +R-10ci	R-13 +R-10ci	R-13 +R-12.5ci	R-13 +R-12.5ci	R-13 +R-12.5ci	R-13 +R-15.6ci	R-13 +R-18.8ci	R-13 +R-18.8ci
Wood framed and other	R-13 +R-3.8ci or R-20	R-13 +R-3.8ci or R-20	R-13 +R-3.8ci or R-20	R-13 +R-3.8ci or R-20	R-13 +R-3.8ci or R-20	R-13 +R-3.8ci or R-20	R-13 +R-3.8ci or R-20	R-13 +R-3.8ci or R-20	R-13 +R-3.8ci or R-20	R-13 +R-3.8ci or R-20	R-13 +R-3.8ci or R-20	R-13 +R-3.8ci or R-20	R-13 +R-3.8ci or R-20	R-13 +R-3.8ci or R-20	R-13 +R-3.8ci or R-20	R-13 +R-3.8ci or R-20	R-13 +R-3.8ci or R-20

12

Roof R-Value Metal Buildings

Liner System includes the following:

- Continuous vapor barrier liner membrane that is installed below the purlins and that is uninterrupted by framing members
- An uncompressed, unfaced insulation resting on top of the liner membrane and located between purlins
- Multilayer installations, the last rated R-value of insulation is for unfaced insulation draped over purlins and compressed when the metal roof panes are attached

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C402.1.3 Insulation component R-value-based method

TYPICAL ROOF TYPE

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C402.1.3 Insulation component R-value-based method

B. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, comply with ASTM C1289.

1. Classifications:
 - a. Type I: Faced with glass fiber reinforced aluminum foil on both major surfaces of the core foam. Heavy embossed 12 mil facer with aluminum reflective surface on exposed side.
 - 1) Class 2 - Glass fiber reinforced or non-reinforced core foam.
 - 2) Compressive Strength: 25 psi, minimum.
 - 3) Thermal Resistance: R-6.5 minimum at thickness of 1 inch and R-13.1 minimum at thickness of 2 inches.
2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
4. Water Vapor Permeance: 0.03 perm, maximum, at 1 inch thickness, and when tested in accordance with ASTM E96/E96M, desiccant method.
5. Board Size: 48 inch by 96 inch.
6. Board Thickness: 3.0 inch.
7. Board Edges: Shiplap.
8. Products:
 - a. Rmax Inc; ECOMAXci FR Air Barrier: www.rmax.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

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C402.2.1.1 Tapered, above-deck insulation based on thickness

Where used as a component of a roof/ceiling assembly R-value calculation, the sloped roof insulation R-value contribution to that calculation shall use the average thickness in inches along with the material R-value-per-inch solely for R-value compliance as prescribed in Section 402.1.3

TYPICAL ROOF TYPE

16

Table C402.1.4 Opaque thermal envelope assembly maximum requirements, u-factor method ^{a, b}


CLIMATE ZONE	0 AND 1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs																
Insulation entirely above roof deck	U-0.048	U-0.039	U-0.039	U-0.039	U-0.039	U-0.039	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.028	U-0.028	U-0.028	U-0.028
Metal buildings	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.031	U-0.029	U-0.029	U-0.029	U-0.026	U-0.026
Attic and other	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021	U-0.017	U-0.017	U-0.017	U-0.017
Walls, above grade																
Mass ^f	U-0.151	U-0.151	U-0.151	U-0.123	U-0.123	U-0.104	U-0.104	U-0.090	U-0.090	U-0.080	U-0.080	U-0.071	U-0.071	U-0.071	U-0.037	U-0.037
Metal building	U-0.079	U-0.079	U-0.079	U-0.079	U-0.079	U-0.052	U-0.052	U-0.050	U-0.050	U-0.050	U-0.050	U-0.044	U-0.044	U-0.039	U-0.039	U-0.039
Metal framed	U-0.077	U-0.077	U-0.077	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.055	U-0.055	U-0.049	U-0.049	U-0.049	U-0.042	U-0.037	U-0.037
Wood framed and other ^e	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.051	U-0.051	U-0.051	U-0.051	U-0.051	U-0.051	U-0.032	U-0.032

17

TABLE C402.1.4 Opaque thermal envelope assembly maximum requirements, u-factor method ^{a, b}

a. Where assembly U-factors, C-factors and F-factors are established in ANSI/ASHRAE/IESNA 90.1 Appendix A, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table, and provided that the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.


b. Where U-factors have been established by testing in accordance with ASTM C1363, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table. The R-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design



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TABLE A2.2.3 Assembly U-Factors for Roofs with Insulation Entirely Above Deck


Rated R-Value of Insulation Alone	Overall U-Factor for Entire Assembly
R-0	U-1.202
R-1	U-0.562
R-2	U-0.360
R-3	U-0.265
R-4	U-0.209
R-5	U-0.173
R-6	U-0.147
R-7	U-0.129
R-8	U-0.114
R-9	U-0.102
R-10	U-0.093
R-11	U-0.085
R-12	U-0.078
R-13	U-0.073
R-14	U-0.068
R-15	U-0.063
R-16	U-0.060
R-17	U-0.056
R-18	U-0.053
R-19	U-0.051
R-20	U-0.048
R-21	U-0.046
R-22	U-0.044
R-23	U-0.042



19


C402.1.5 Component performance alternative

Building envelope values and fenestration areas determined in accordance with Equation 4-2 shall be an alternative to compliance with the U-, F- and C-factors in Tables C402.1.4 and C402.4 and the maximum allowable fenestration areas in Section C402.4.1. Fenestration shall meet the applicable SHGC requirements of Section C402.4.3.



Project Information

Energy Code:	2021 IECC
Project Title:	
Location:	
Climate Zone:	5b
Project Type:	New Construction
Vertical Glazing / Wall Area:	51%



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COMcheck Software Version COMcheckWeb
Envelope Compliance Certificate

Project title is helpful

Verify Correct Location. If not in COMcheck will use a nearby location

Verify Climate Zone

No limitation on vertical glazing area. See section C402.1.5

Verify Code Year and either IECC or ASHRAE 90.1

Choices are New Construction, Addition or Alteration

Must indicate Additional Efficiency Package

Must indicate uses. Can select and enter several if needed.

Note the high lighting credit. This is a Shell building and COMcheck requires that the 10 needed credits be entered. This can be difficult for a shell building when the tenants are not known. Jurisdictions may need to have a process to track the needed additional efficiency at tenant finish stage.

Another option would be to have the designer use Addition for the project type. This would allow the thermal envelope to be entered, and show compliance, without the need for mechanical or lighting entries.

Project Information
 Energy Code: 2021 IECC
 Project Title: Test office 2021 Parker Parker, Colorado
 Location: 5b
 Climate Zone: New Construction
 Project Type: 7%
 Vertical Glazing / Wall Area:
 Construction Site: New Address
 New Address: Denver
 Owner/Agent: Joe Smith
 Designer/Contractor: Bob Builder

Additional Efficiency Package(s)
 Credits: 10.0 Required 31.0 Proposed
 15% heating efficiency improvement, 1.0 credit
 10% cooling efficiency improvement, 0.0 credit
 Reduced lighting power, 30.0 credit

Building Area
 1-Office - Nonresidential

Floor Area
 6000

21

COMcheck Software Version COMcheckWeb
Envelope Compliance Certificate

Project Information
 Energy Code: 2021 IECC
 Project Title: Test office 2021 Parker Parker, Colorado
 Location: 5b
 Climate Zone: Addition
 Project Type: 7%
 Vertical Glazing / Wall Area:
 Construction Site: New Address
 New Address: Denver
 Owner/Agent: Joe Smith
 Designer/Contractor: Bob Builder

Same Project the only change was from new construction to Addition. Likely the best way to do a shell building. Just remember to track the needed additional efficiency package at tenant finish stage.

Building Area
 1-Office - Nonresidential

Floor Area
 6000

22

All entries are gross areas in square feet. COMcheck knows to subtract the doors and windows from the gross wall area. Except slab on grade which is the perimeter in linear feet.

Designer would enter the proposed assembly values

Proposed U-factor can be from the designer in this case the window and doors

The assemblies with insulation is calculated by the software

Used for calculation only. See footnote a

Envelope Assemblies

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U-Factor _{min}
Roof: Insulation Entirely Above Deck, [Bldg. Use 1 - Office]	12500	---	40.0	0.025	0.032
Ext. Wall: Steel-Framed, 24in. o.c., [Bldg. Use 1 - Office]	6000	21.0	5.0	0.062	0.055
Window: Metal Frame with Thermal Break: Fixed, Perf. Specs.: Product ID Pending, SHGC 0.30, [Bldg. Use 1 - Office] (b)	384	---	---	0.290	0.360
Door: Glass (over 50% glazing): Metal Frame, Entrance Door, Perf. Specs.: Product ID Pending, SHGC 0.30, [Bldg. Use 1 - Office] (b)	63	---	---	0.290	0.630
Door: Insulated Metal, Swinging, [Bldg. Use 1 - Office]	63	---	---	0.380	0.370
Floor: Unheated Slab-On-Grade, Vertical 4 ft., [Bldg. Use 1 - Office] (c)	600	---	10.0	0.480	0.520

(a) Budget U-factors are used for software baseline calculations ONLY, and are not code requirements.
 (b) Fenestration product performance must be certified in accordance with NFRC and requires supporting documentation.
 (c) Slab-On-Grade proposed and budget U-factors shown in table are F-factors.

23

Roof: Insulation Entirely Above Deck, [Bldg. Use 1 - Office]	12500	---	40.0	0.025	0.032
Ext. Wall: Steel-Framed, 24in. o.c., [Bldg. Use 1 - Office]	6000	21.0	5.0	0.062	0.055
Window: Metal Frame with Thermal Break: Fixed, Perf. Specs.: Product ID Pending, SHGC 0.30, [Bldg. Use 1 - Office] (b)	384	---	---	0.290	0.360
Door: Glass (over 50% glazing): Metal Frame, Entrance Door, Perf. Specs.: Product ID Pending, SHGC 0.30, [Bldg. Use 1 - Office] (b)	63	---	---	0.290	0.630
Door: Insulated Metal, Swinging, [Bldg. Use 1 - Office]	63	---	---	0.380	0.370
Floor: Unheated Slab-On-Grade, Vertical 4 ft., [Bldg. Use 1 - Office] (c)	600	---	10.0	0.480	0.520

(a) Budget U-factors are used for software baseline calculations ONLY, and are not code requirements.
 (b) Fenestration product performance must be certified in accordance with NFRC and requires supporting documentation.
 (c) Slab-On-Grade proposed and budget U-factors shown in table are F-factors.

Project Notes
 Envelope PASSED: Design 10% better than code

Envelope Compliance Statement
 Compliance Statement: The proposed envelope design represented in this document is consistent with the building plans, specifications, and other calculations submitted with this permit application. The proposed envelope systems have been designed to meet the 2021 IECC requirements in COMcheck Version COMcheckWeb and to comply with any applicable mandatory requirements listed in the Inspection Checklist.

The designer has the option to group all like assemblies together. Like the example. They could also choose to show by the direction. North, South, East and West. Either is acceptable. The caveat to no direction is the window SHGC. Without the direction the lowest SHGC is needed. In this case 0.33. See Table C402.4

In the example you can see the roof insulation was increased from the minimum R-30 to R-40

The steel framed exterior walls include a higher cavity insulation (R-21) and lower continuous insulation (R-5) than required. Minimum would be R-13 cavity R-10 continuous

The windows is where this example makes up some ground. The problem is that the U-0.29 shown is very likely a center of glass value and not the assembly value. The NFRC document for commercial windows must be part of the submittal.

The example passes by 10%. This will change as the actual window value is likely around U-0.34 to 0.42

24

- Code analysis
 - List compliance path
 - List additional efficiency package(s)

25

C103.2 Information Construction Documents.

- Energy compliance path. (2021 IECC addition) ✓
- Insulation materials and their R-values.
- Fenestration U-factors and solar heat gain coefficients (SHGCs).
- Area-weighted U-factor and solar heat gain coefficient (SHGC) calculations.
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- Mechanical and service water-heating systems and equipment types, sizes and efficiencies.
- Economizer description.
- Equipment and system controls.
- Fan motor horsepower (hp) and controls.
- Duct sealing, duct and pipe insulation and location.
- Lighting fixture schedule with wattage and control narrative.
- Location of daylight zones on floor plans.
- Air barrier and air sealing details, including the location of the air barrier. (Revised in 2021 IECC, but still required in other editions)

Thermal Envelope Depiction ✓

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Fiberglass Batts R- 3.0 - 3.8	Fiberglass Blown in R- 2.2 - 3.5	Polyisocyanurate R- 6.2 - 7.2
Expanded Polystyrene Insulation (EPS) R-3.4 - 3.9	INSULATION	Extruded Polystyrene (XPS) R- 4.7
Open-cell Spray Foam R- 3.5 - 4.2	Cellulose Blown in R- 3.2 - 3.8	Closed-cell Spray Foam R- 6.0 - 7.0

High Average of R-Values for Various Insulation Types

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Missing the minimum 2 layers

Should list the R-value of insulation

INSULATION MINIMUM VALUES	
ROOF	R=25 ci
WALLS	R=25 ci
2" POLYISOCYANURATE (CONT.)	R=11.4ci
SLAB	R=10
2" RIGID INSUL (EDGE)	R=10
2" RIGID INSUL (PERIMETER)	R=10
GLAZING U-FACTOR	U=.38
FIXED FENESTRATION	U=.45
OPERABLE FENESTRATION	U=.45
ENTRANCE DOORS	U=.77
SHGC	SHGC=.40
OPAQUE DOORS	U=.37
SWINGING	U=.21
ROLL-UP	U=.21

28

C103.2 Information On Construction Documents.



1. Energy compliance path. (2021 IECC addition) ✓
2. Insulation materials and their R-values. ✓
3. Fenestration U-factors and solar heat gain coefficients (SHGCs).
4. Area-weighted U-factor and solar heat gain coefficient (SHGC) calculations.
5. Mechanical system design criteria.
6. Mechanical and service water-heating systems and equipment types, sizes and efficiencies.
7. Economizer description.
8. Equipment and system controls.
9. Fan motor horsepower (hp) and controls.
10. Duct sealing, duct and pipe insulation and location.
11. Lighting fixture schedule with wattage and control narrative.
12. Location of daylight zones on floor plans.
13. Air barrier and air sealing details, including the location of the air barrier. (Revised in 2021 IECC, but still required in other editions)

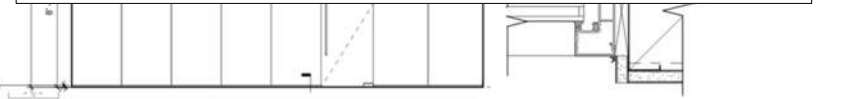
Thermal Envelope Depiction ✓

29

WINDOW SCHEDULE

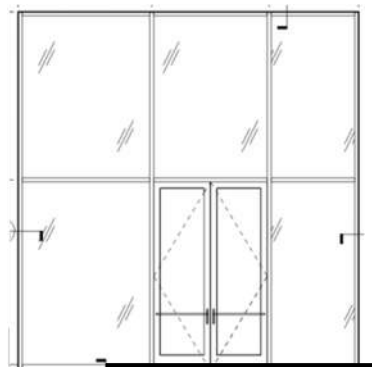
WIN #	WIDTH	HEIGHT	SILL HEIGHT	FRAME TYPE	GLAZING	JAMB DETAIL	SILL DETAIL	HEAD DETAIL
A	3'-10"	6'-8 1/2"	1 1/2"	DARK BRONZE ANOD ALUM	1" CLEAR INSUL	30A & 30RA/5.4	3/A3.7	4/A3.4
B	4'-8"	6'-8 1/2"	1 1/2"	DARK BRONZE ANOD ALUM	1" CLEAR INSUL	3/A3.4 sim	3/A3.7	3/A3.4
C	6'-0"	6'-6"	2'-6"	DARK BRONZE ANOD ALUM	1" CLEAR INSUL	3/A3.4 sim	3/A3.5	3/A3.4
D	10'-0"	9'-0"	0"	DARK BRONZE ANOD ALUM	1" CLEAR INSUL	2/A3.5	1/A3.5	1/A3.4
E	10'-0"	9'-0"	0"	DARK BRONZE ANOD ALUM	1" CLEAR INSUL	2/A3.5	1/A3.5	1/A3.4
F	4'-0"	9'-0"	0"	DARK BRONZE ANOD ALUM	1" CLEAR INSUL	2/A3.5	1/A3.5	1/A3.4
G	7'-2"	7'-2"	0"	DARK BRONZE ANOD ALUM	1/4" CLEAR TEMPERED	26/A3.4 sim	-	26/A3.4 sim
H	9'-4 7/8"	7'-2"	0"	DARK BRONZE ANOD ALUM	1/4" CLEAR TEMPERED	26/A3.4 sim	-	26/A3.4 sim

INFORMATION NOT USUALLY PLACED ON PLANS, BUT SHOULD BE



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SECTION 08 4313 ALUMINUM-FRAMED STOREFRONTS



- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 1. Glazing Rabbit: For 1 inch insulating glazing.
 2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.
 3. Finish: The design intent is to match existing aluminum storefront finish.
 - a. Factory finish all surfaces that will be exposed in completed assemblies.
 - b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
 4. Finish Color: As selected by Architect from manufacturer's standard line.
 5. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured, prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 6. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 7. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
 8. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
 9. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
 10. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
 11. Maintain continuous air barrier and/or vapor retarder seal throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel, and heel bead of glazing compound.
- B. Performance Requirements
 1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - a. Design Wind Loads: Comply with requirements of ASCE 7.
 - b. Member Deflection: Limit member deflection to 1/175 in any direction, with full recovery of glazing materials.
 2. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 10 psf.
 3. Air Leakage: Without interior seal: 0.06 cfm/sq ft maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.6 psf pressure difference. With interior seal, air leakage rate shall not exceed 0.09 cfm/sq ft (0.3 l/s · m²) at a static air pressure differential of 6.2 psf (300 Pa).
 4. Condensation Resistance Factor of Framing: 60, minimum, measured in accordance with AAMA 1503.
 5. Overall U-value Including Glazing: 0.36 Btu/(hr sq ft deg F), maximum.

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CERTIFICATE OF COMPLIANCE

Certificate Authorization		OVERALL RATING	
Name:	Company:	U-Factor: (Btu·h/ft ² ·°F)	0.33
		SHGC:	0.25

CERTIFIES THAT THE MATERIALS LISTED ON THIS CERTIFICATE WERE INSTALLED ON THE PROJECT IDENTIFIED

FOR PLAN REVIEW


Compliance certificate typically from the frame manufacturer.

PROJECT INFORMATION:	
GLAZING CONTRACTOR/INSTALLER: T.B.D.	Contact Person:
Street Address:	Phone Number:
City:	State:
	Zip:
GLAZING MATERIAL SUPPLIER:	
GUARDIAN GLASS	
Street Address:	Contact Person:
City:	
Glass and Spacer Type: GLASS 1: SUNGUARD SNX 6227 ON CLEAR 100% AIR GLASS 2: SUNGUARD IS 20 INTERIOR SURFACE ON CLEAR GLASS	
Color of glass (C.O.G.): 1.0 (clear) Color of glass (C.O.G.): 0.01 (SHGC)	
0.23 (WINTER NIGHT) U-Factor: 0.26	

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FOR PLAN REVIEW

Compliance certificate typically from the frame manufacturer.



U-factor Matrix (Btu/h·ft²·°F)		SHGC Matrix	
C.O.G. U-factor	OVERALL U-factor	C.O.G. SHGC	OVERALL SHGC
0.17	0.63	0.75	0.68
0.46	0.52	0.70	0.64
0.44	0.50	0.65	0.59
0.42	0.49	0.60	0.55
0.40	0.47	0.55	0.50
0.38	0.45	0.50	0.46
0.36	0.44	0.45	0.41
0.34	0.42	0.40	0.37
0.32	0.40	0.35	0.32
0.30	0.39	0.30	0.28
0.28	0.37	0.25	0.24
0.26	0.35	0.20	0.19
0.24	0.34	0.15	0.15
0.22	0.32	0.10	0.10
0.20	0.31	0.05	0.06
0.18	0.29		
0.16	0.27		
0.14	0.25		
0.12	0.23		
0.10	0.22		


APRIL 2021 COCC090B 95516-073

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NFRF CERTIFICATE

FOR PLAN REVIEW

Compliance certificate typically from the frame manufacturer.



**NATIONAL FENESTRATION RATING COUNCIL
LABEL CERTIFICATE**

PRODUCT LISTING

FOR CODE COMPLIANCE

Label Certificate ID: JYZ2-097 Issuance Date: 02/02/2022

NFRF CERTIFIED PRODUCT RATING INFORMATION:
The NFRF Certified Product Rating Information listed here is to be used to verify that the ratings meet applicable energy code requirements.

PRODUCT LISTING:

CPS ID	Total Area	U-Factor	SHGC	CERTIFIED Performance Rating at NFRF	
				U-Factor	SHGC
PA-PL-010	99.40	PA-PL-010	PA-PL-010	0.47	0.63
PA-PL-010	99.47	PA-PL-010	PA-PL-010	0.47	0.63
PA-PL-010	99.52	PA-PL-010	PA-PL-010	0.47	0.63
PA-PL-010	99.57	PA-PL-010	PA-PL-010	0.47	0.63
PA-PL-010	99.62	PA-PL-010	PA-PL-010	0.47	0.63
PA-PL-010	99.67	PA-PL-010	PA-PL-010	0.47	0.63
PA-PL-010	99.72	PA-PL-010	PA-PL-010	0.47	0.63
PA-PL-010	99.77	PA-PL-010	PA-PL-010	0.47	0.63
PA-PL-010	99.82	PA-PL-010	PA-PL-010	0.47	0.63
PA-PL-010	99.87	PA-PL-010	PA-PL-010	0.47	0.63
PA-PL-010	99.92	PA-PL-010	PA-PL-010	0.47	0.63
PA-PL-010	99.97	PA-PL-010	PA-PL-010	0.47	0.63
PA-PL-010	100.00	PA-PL-010	PA-PL-010	0.47	0.63

FRAMING LISTING:

FRAMING REF	SUPPLIER ID	DESCRIPTION
PA-PL-010		Single Channel Thermal Break Aluminum
PA-PL-010		Flashing Channel Thermal Break Aluminum
PA-PL-010		Vertical Sill Thermal Break Aluminum
PA-PL-010		Base Thermal Break Aluminum

GLAZING LISTING:

GLAZING REF	SUPPLIER ID	DESCRIPTION
GA-PL-010		7 Double Glazed, 1/2" IGU, Low-E, 1/2" Clear Argon (80%), 1/2" gap
GA-PL-010		7 Triple Glazed, 1/2" IGU, Low-E, 1/2" Clear Argon (80%), 1/2" gap
GA-PL-010		7 Double Glazed, 1/2" IGU, Low-E, 1/2" Clear Argon (80%), 1/2" gap

SPACER LISTING:

SPACER REF	SUPPLIER ID	DESCRIPTION
SA-SP-010		SSP 800 Series Aluminum Low profile (1/2")
SA-SP-010		100 Polymer Spacer (201)

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DOOR & WINDOW SCHEDULE NOTES

- PROVIDE TEMPER PANELS NEXT TO OPENINGS, STAIRS, RAMPS, FULL HEIGHT GLASS PANELS, OPERABLE WINDOWS & ANY AREA REQUIRING SAFETY GLAZING.
- PROVIDE TEMPERED GLASS PER IBC SECTION 2406 AS REQ'D.
- CONTRACTOR TO V.L.F. DIMS PRIOR TO SUBMITTAL OF SHOP DRAWINGS.
- ALL DOOR DIMENSIONS TO REMAIN AS SHOWN.
- IT IS THE CONTRACTOR'S RESPONSIBILITY TO VERIFY ALL WALL WIDTHS BEFORE ORDERING DOOR FRAMES. ALL DOOR FRAMES SHOULD WRAP FINISH MATERIALS UNLESS SHOWN OTHERWISE.
- DO NOT SCALE DRAWINGS: DIMENSIONS GOVERN, LARGE SCALE DETAILS GOVERN OVER SMALL SCALE.
 - STOREFRONT WINDOW WALLS ARE DIMENSIONED FROM EDGE OF MULLION TO EDGE OF MULLION.
 - WINDOW ASSEMBLY SIZES SHOWN ON DRAWINGS ARE NOMINAL, ACTUAL SIZES WILL BE SMALLER. CONTRACTOR TO VERIFY IN FIELD.
- TEMPERED 1" INSULATED GLASS AT ALL DOORS.
- WHERE NECESSARY PROVIDE STOREFRONT INFILL PANEL, COLOR TO MATCH STOREFRONT.
- COORD. DOOR UNDERCUTS W/ MECH. DWGS.

10. U-factor .32 SHGC max .32

	U-factor	SHGC
	.32	.32




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c103.2 Information On Construction Documents.

- Energy compliance path. (2021 IECC addition) ✓
- Insulation materials and their R-values. ✓
- Fenestration U-factors and solar heat gain coefficients (SHGCs). ✓
- Area-weighted U-factor and solar heat gain coefficient (SHGC) calculations. ✓
- Mechanical system design criteria.
- Mechanical and service water-heating systems and equipment types, sizes and efficiencies.
- Economizer description.
- Equipment and system controls.
- Fan motor horsepower (hp) and controls.
- Duct sealing, duct and pipe insulation and location.
- Lighting fixture schedule with wattage and control narrative.
- Location of daylight zones on floor plans.
- Air barrier and air sealing details, including the location of the air barrier. (Revised in 2021 IECC, but still required in other editions) ✓

Thermal Envelope Depiction ✓




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Mechanical Load Calculations C403.1.1

Design loads associated with heating, ventilating and air conditioning of the building shall be determined in accordance with ANSI/AIAA Standard 183 or by an approved equivalent procedure in Chapter 3. Design loads shall be adjusted to account for load reductions that are achieved where energy recovery systems are utilized in the HVAC system in accordance with the ASHRAE HVAC Systems and Equipment Handbook by an approved equivalent computational procedure.

ALSO REQUIRED OUT OF THE IMC SECTION 312



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Design Weather Parameters & MSHGs

Design Parameters:

City Name	Denver
Location	Colorado
Latitude	39.8 Deg.
Longitude	104.9 Deg.
Elevation	5331.0 ft
Summer Design Dry-Bulb	93.0 °F
Summer Coincident Wet-Bulb	60.0 °F
Summer Daily Range	26.9 °F
Winter Design Dry-Bulb	-3.0 °F
Winter Design Wet-Bulb	-4.6 °F
Atmospheric Clearness Number	1.05
Average Ground Reflectance	0.20
Soil Conductivity	0.800 BTU/(hr-ft ² ·°F)
Local Time Zone (GMT +/- N hours)	7.0 hours
Consider Daylight Savings Time	Yes
Daylight Savings Begins	March, 9
Daylight Savings Ends	November, 2
Simulation Weather Data	(TM2)
Current Data is	2001 ASHRAE Handbook
Design Cooling Months	January to December

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System Checksums

AHU-1 (FIRST FLOOR)

COOLING COIL PEAK				CLG SPACE PEAK				HEATING COIL PEAK				TEMPERATURES			
Peak at Time				Multi: 7:17				Multi: Heating Design				Multi: Cooling			
Outside Air				CADSW/SHR: 88/10/49				CADSW: 77				CADSW: 1			
Space	Plenum	Heat	Percent	Space	Plenum	Cool Peak	Percent	Space	Plenum	Cool Peak	Percent	Space	Plenum	Heat	Percent
Area, °F Lat	Area, °F Lat	Area, °F Lat	OF Total	Area, °F Lat	Area, °F Lat	Area, °F Lat	OF Total	Area, °F Lat	Area, °F Lat	Area, °F Lat	OF Total	Area, °F Lat	Area, °F Lat	Area, °F Lat	OF Total
Envelope Loads	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shade Solar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shade Cond	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heat Cond	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glass Solar	103,902	0	103,902	10	103,902	16	103,902	0	0	0	0	0	0	0	0
Glass Cond	13,476	0	13,476	1	13,476	21	13,476	0	0	0	0	0	0	0	0
Wall Cond	8,473	2,413	8,465	1	8,465	1	8,465	0	0	0	0	0	0	0	0
Partition/Door	8,961	0	8,961	1	8,961	1	8,961	0	0	0	0	0	0	0	0
Floor	-10,243	0	-10,243	-1	-10,243	17	-10,243	0	0	0	0	0	0	0	0
Advanced Floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Infiltration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub Total ***	117,269	20,284	137,389	14	137,389	16	137,389	0	0	0	0	0	0	0	0
Internal Loads															
Lights	71,169	0	71,169	7	71,169	0	71,169	0	0	0	0	0	0	0	0
People	402,436	0	402,436	40	402,436	0	402,436	0	0	0	0	0	0	0	0
Misc	313,981	0	313,981	32	313,981	41	313,981	0	0	0	0	0	0	0	0
Sub Total ***	807,586	0	807,586	84	807,586	81	807,586	0	0	0	0	0	0	0	0
Cooling Load	2,414	-3,414	0	0	2,094	0	2,094	-10,467	0	0	0	0	0	0	0
Ventilation Load	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aid-Air Trans Heat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Exhaust Sens	19,438	0	19,438	2	21,029	0	21,029	0	0	0	0	0	0	0	0
Exhaust Heat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub Total ***	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total ***	977,713	16,870	994,383	100.00	761,241	100.00	761,241	-108,333	-385,000	100.00	100.00	0	0	0	0

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System Checksums

AHU-1 (FIRST FLOOR)

COOLING COIL PEAK				CLG SPACE PEAK				HEATING COIL PEAK				TEMPERATURES			
Peak at Time				Multi: 7:17				Multi: Heating Design				Multi: Cooling			
Outside Air				CADSW/SHR: 88/10/49				CADSW: 77				CADSW: 1			
Space	Plenum	Heat	Percent	Space	Plenum	Cool Peak	Percent	Space	Plenum	Cool Peak	Percent	Space	Plenum	Heat	Percent
Area, °F Lat	Area, °F Lat	Area, °F Lat	OF Total	Area, °F Lat	Area, °F Lat	Area, °F Lat	OF Total	Area, °F Lat	Area, °F Lat	Area, °F Lat	OF Total	Area, °F Lat	Area, °F Lat	Area, °F Lat	OF Total
Envelope Loads	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shade Solar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shade Cond	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heat Cond	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glass Solar	103,902	0	103,902	10	103,902	16	103,902	0	0	0	0	0	0	0	0
Glass Cond	13,476	0	13,476	1	13,476	21	13,476	0	0	0	0	0	0	0	0
Wall Cond	8,473	2,413	8,465	1	8,465	1	8,465	0	0	0	0	0	0	0	0
Partition/Door	8,961	0	8,961	1	8,961	1	8,961	0	0	0	0	0	0	0	0
Floor	-10,243	0	-10,243	-1	-10,243	17	-10,243	0	0	0	0	0	0	0	0
Advanced Floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Infiltration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub Total ***	117,269	20,284	137,389	14	137,389	16	137,389	0	0	0	0	0	0	0	0
Internal Loads															
Lights	71,169	0	71,169	7	71,169	0	71,169	0	0	0	0	0	0	0	0
People	402,436	0	402,436	40	402,436	0	402,436	0	0	0	0	0	0	0	0
Misc	313,981	0	313,981	32	313,981	41	313,981	0	0	0	0	0	0	0	0
Sub Total ***	807,586	0	807,586	84	807,586	81	807,586	0	0	0	0	0	0	0	0
Cooling Load	2,414	-3,414	0	0	2,094	0	2,094	-10,467	0	0	0	0	0	0	0
Ventilation Load	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aid-Air Trans Heat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Exhaust Sens	19,438	0	19,438	2	21,029	0	21,029	0	0	0	0	0	0	0	0
Exhaust Heat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub Total ***	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total ***	977,713	16,870	994,383	100.00	761,241	100.00	761,241	-108,333	-385,000	100.00	100.00	0	0	0	0

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Review interior lighting areas

ZONE LOADS	DESIGN COOLING			DESIGN HEATING		
	Details	Sensibile (BTU/hr)	Latent (BTU/hr)	Details	Sensibile (BTU/hr)	Latent (BTU/hr)
Windows & Skylight Solar Loads	2800 Bt	14,000	0	2800 Bt	0	0
Wall Transmission	3686 Bt	7372	0	3686 Bt	24147	0
Roof Transmission	0 Bt	0	0	0 Bt	0	0
Window Transmission	2800 Bt	15227	0	2800 Bt	85643	0
Skylight Transmission	0 Bt	0	0	0 Bt	0	0
Door Loads	0 Bt	0	0	0 Bt	0	0
Floor Transmission	17700 Bt	0	0	17700 Bt	21300	0
Partitions	0 Bt	0	0	0 Bt	0	0
Ceiling	0 Bt	0	0	0 Bt	0	0
Overhead Lighting	14514 W	45622	0	0	0	0
Traffic Lighting	0 W	0	0	0	0	0
Electric Equipment	12390 W	40790	0	0	0	0
People	270	65107	72900	0	0	0
Infiltration	0	0	0	0	0	0
Miscellaneous	0	0	0	0	0	0
Safety Factor	10% / 10%	35587	7290	10%	13130	0
Total Zone Loads		391460	80190		144426	0
Zone Conditioning		402979	80190		143696	0
Plenum Wall Load	0%	0	0	0	0	0
Plenum Roof Load	0%	0	0	0	0	0
Plenum Lighting Load	0%	0	0	0	0	0
Plenum Fan Load	25154 CFM	0	0	25154 CFM	0	0
Ventilation Load	6395 CFM	84424	-80190	6395 CFM	410037	0
Supply Fan Load	25154 CFM	18647	0	25154 CFM	-18647	0
Space Fan Coil Fans	0	0	0	0	0	0
Duct Heat Gain / Loss	2%	7839	0	2%	14881	0
Total System Loads		513863	-3		538877	0
Central Cooling Coil	-	513863	0	-	0	0
Central Heating Coil	-	0	0	-	538877	0
Total Conditioning		513863	0		538877	0

Key: Positive values are cog loads
Negative values are cog loads

Cooling load should closely match equipment schedule
Heating load should closely match equipment schedule

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C103.2 Information On Construction Documents.

1. Energy compliance path. (2021 IECC addition) ✓
2. Insulation materials and their R-values. ✓
3. Fenestration U-factors and solar heat gain coefficients (SHGCs). ✓
4. Area-weighted U-factor and solar heat gain coefficient (SHGC) calculations. ✓
5. Mechanical system design criteria. ✓
6. Mechanical and service water-heating systems and equipment types, sizes and efficiencies. ✓
7. Economizer description. ✓
8. Equipment and system controls. ✓
9. Fan motor horsepower (hp) and controls. ✓
10. Duct sealing, duct and pipe insulation and location. ✓
11. Lighting fixture schedule with wattage and control narrative. ✓
12. Location of daylight zones on floor plans. ✓
13. Air barrier and air sealing details, including the location of the air barrier. (Revised in 2021 IECC, but still required in other editions) ✓

Thermal Envelope Depiction

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COMcheck Software Version 4.0.7.2 Review
Mechanical Compliance Certificate

Project Type: New Construction

Construction Site: [] Owner/Agent: [] Designer/Contractor: []

ADDITIONAL EFFICIENCY PACKAGE MUST MATCH ON ALL DOCUMENTS

INCLUDE BOTH HVAC AND WATER HEATING SYSTEMS

Additional Efficiency Package
Reduced interior lighting power. Requirements are implicitly enforced within interior lighting allowance calculations.

Mechanical Systems List

Quantity: 1 System Type & Description

1 HVAC System 1 (Single Zone)
Heating: 1 each - Central Furnace, Gas, Capacity = 300 kBtu/h
Proposed Efficiency = 80.00% E1, Required Efficiency = 80.00% E1
Cooling: 1 each - Single Package DX Unit, Capacity = 150 kBtu/h, Air-Cooled Condenser, Air Economizer
Proposed Efficiency = 12.10 SEER, Required Efficiency = 10.80 SEER + 12.2 SEER
Fan System: FAN SYSTEM 1 - Compliance (Motor nameplate HP method) - Passes
Fans:
FAN 1 Supply, Constant Volume, 6000 CFM, 5.0 motor nameplate hp, 5.0 fan efficiency grade

1 HVAC System 1 copy 1 (Single Zone)
Heating: 1 each - Central Furnace, Gas, Capacity = 300 kBtu/h
Proposed Efficiency = 80.00% E1, Required Efficiency = 80.00% E1
Cooling: 1 each - Single Package DX Unit, Capacity = 150 kBtu/h, Air-Cooled Condenser, Air Economizer
Proposed Efficiency = 12.10 SEER, Required Efficiency = 11.00 SEER + 12.0 SEER
Fan System: FAN SYSTEM 2 - Compliance (Motor nameplate HP method) - Passes
Fans:
FAN 2 Supply, Constant Volume, 5400 CFM, 5.0 motor nameplate hp, 5.0 fan efficiency grade

2 HVAC System 1 copy 2 (Single Zone)
Heating: 1 each - Central Furnace, Gas, Capacity = 150 kBtu/h
Proposed Efficiency = 80.00% E1, Required Efficiency = 80.00% E1
Cooling: 1 each - Single Package DX Unit, Capacity = 30 kBtu/h, Air-Cooled Condenser, Air Economizer
Proposed Efficiency = 17.50 SEER, Required Efficiency = 14.00 SEER
Fan System: FAN SYSTEM 3 - Compliance (Motor nameplate HP method) - Passes
Fans:
FAN 3 Supply, Single-Zone VAV, 1200 CFM, 0.8 motor nameplate hp, 0.8 fan efficiency grade

1 Water Heater 1:
Electric Storage Water Heater, Capacity: 20 gallons
No efficiency requirement applies

1 Water Heater 2:
Electric Instantaneous Water Heater, Capacity: 1 gallons
No efficiency requirement applies

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GAS FIRED PACKAGE ROOFTOP H.V.A.C. UNIT SCHEDULE

PLAN CODE	MFG	MODEL #	COOLING DATA			HEATING DATA		FAN DATA			ELECTRICAL			WT (lbs)	NOTES:		
			ARI TONS	MBH TOTAL	MBH SENSIBLE	EER	MBH INPUT HE-HEAT	AFUE %	CFM	E.S.P. * WC	OSA INTAKE MIN SETTING CFM	VOLTS	Phase			MCA	MAX. FUSE
10	CARRIER	48TNG-D12	10	120	-	-	200	80	4000	1.0	1200	208	1	-	60	-	
15	CARRIER	48TNG-D16	15	180	-	-	350	80	6000	1.0	2000	208	1	-	60	-	

* ALL UNIT DATA SHOWN IS BASED ON THE FOLLOWING ASSUMPTIONS: 1. 100% outdoor air intake. 2. 100% outdoor air intake. 3. 100% outdoor air intake. 4. 100% outdoor air intake. 5. 100% outdoor air intake. 6. 100% outdoor air intake. 7. 100% outdoor air intake. 8. 100% outdoor air intake. 9. 100% outdoor air intake. 10. 100% outdoor air intake. 11. 100% outdoor air intake. 12. 100% outdoor air intake. 13. 100% outdoor air intake. 14. 100% outdoor air intake. 15. 100% outdoor air intake. 16. 100% outdoor air intake. 17. 100% outdoor air intake. 18. 100% outdoor air intake. 19. 100% outdoor air intake. 20. 100% outdoor air intake.

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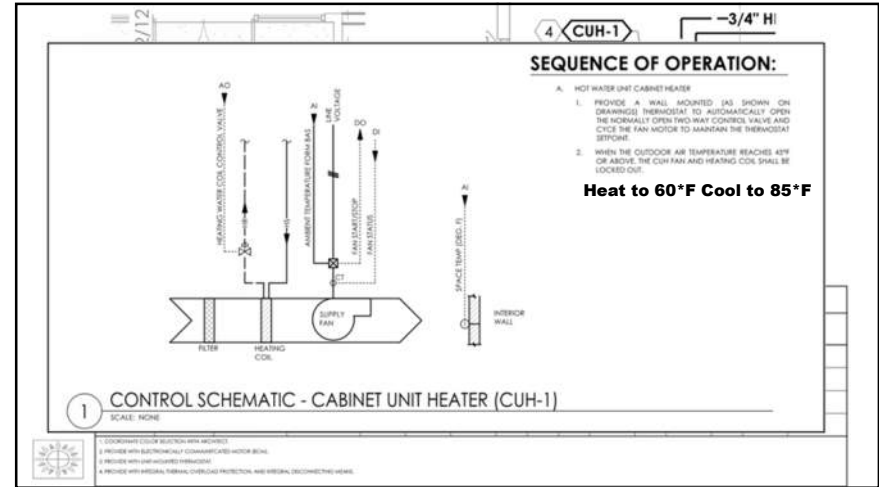
C103.2 Information On Construction Documents.



1. Energy compliance path. (2021 IECC addition) ✓
2. Insulation materials and their R-values. ✓
3. Fenestration U-factors and solar heat gain coefficients (SHGCs). ✓
4. Area-weighted U-factor and solar heat gain coefficient (SHGC) calculations. ✓
5. Mechanical system design criteria. ✓
6. Mechanical and service water-heating systems and equipment types, sizes and efficiencies. ✓
7. Economizer description. ✓
8. Equipment and system controls. ✓
9. Fan motor horsepower (hp) and controls. ✓
10. Duct sealing, duct and pipe insulation and location. ✓
11. Lighting fixture schedule with wattage and control narrative. ✓
12. Location of daylight zones on floor plans. ✓
13. Air barrier and air sealing details, including the location of the air barrier. (Revised in 2021 IECC, but still required in other editions) ✓


Thermal Envelope Depiction ✓

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C103.2 Information On Construction Documents.




1. Energy compliance path. (2021 IECC addition) ✓
2. Insulation materials and their R-values. ✓
3. Fenestration U-factors and solar heat gain coefficients (SHGCs). ✓
4. Area-weighted U-factor and solar heat gain coefficient (SHGC) calculations. ✓
5. Mechanical system design criteria. ✓
6. Mechanical and service water-heating systems and equipment types, sizes and efficiencies. ✓
7. Economizer description. ✓
8. Equipment and system controls. ✓
9. Fan motor horsepower (hp) and controls. ✓
10. Duct sealing, duct and pipe insulation and location. ✓
11. Lighting fixture schedule with wattage and control narrative. ✓
12. Location of daylight zones on floor plans. ✓
13. Air barrier and air sealing details, including the location of the air barrier. (Revised in 2021 IECC, but still required in other editions) ✓

Thermal Envelope Depiction ✓

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Supply & Return Ducts and Plenums

- Unconditioned spaces or outside of building \geq R-12



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TABLE C403.12.3 MINIMUM PIPE INSULATION THICKNESS (in inches)

FLUID OPERATING TEMPERATURE RANGE AND USAGE (°F)	INSULATION CONDUCTIVITY		NOMINAL PIPE OR TUBE SIZE (inches)				
	Conductivity Btu × in./(h × ft ² × °F) ^a	Mean Rating Temperature, °F	< 1	1 to < 1½	1½ to < 4	4 to < 8	> 8
> 350	0.32–0.34	250	4.5	5.0	5.0	5.0	5.0
251–350	0.29–0.32	200	3.0	4.0	4.5	4.5	4.5
201–250	0.27–0.30	150	2.5	2.5	2.5	3.0	3.0
141–200	0.25–0.29	125	1.5	1.5	2.0	2.0	2.0
105–140	0.21–0.28	100	1.0	1.0	1.5	1.5	1.5
40–60	0.21–0.27	75	0.5	0.5	1.0	1.0	1.0
< 40	0.20–0.26	50	0.5	1.0	1.0	1.0	1.5

k-value is the rate of heat flow through a homogeneous material

Simple conversion from K to R value
Insulation thickness divided by your k-value at 75°F Mean Temperature

Mean Temperature °F	k*	Mean Temperature °C	k*
50	0.22	10	0.032
75	0.23	25	0.034
100	0.24	50	0.037
150	0.27	100	0.043
200	0.29	125	0.047
250	0.32	150	0.051
300	0.35	175	0.056
350	0.39	200	0.062
400	0.43	225	0.068
450	0.48	250	0.075
500	0.54	275	0.082

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http://commercial.enr.coming.com/assets/0/321/401/401080767-c03e-4ada-8a95-9a8b0b63541.pdf

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C404.5 Heated water supply piping.
Heated water supply piping shall be in accordance with [Section C404.5.1](#) or [C404.5.2](#).

TABLE C404.5.1 PIPING VOLUME AND MAXIMUM PIPING LENGTHS

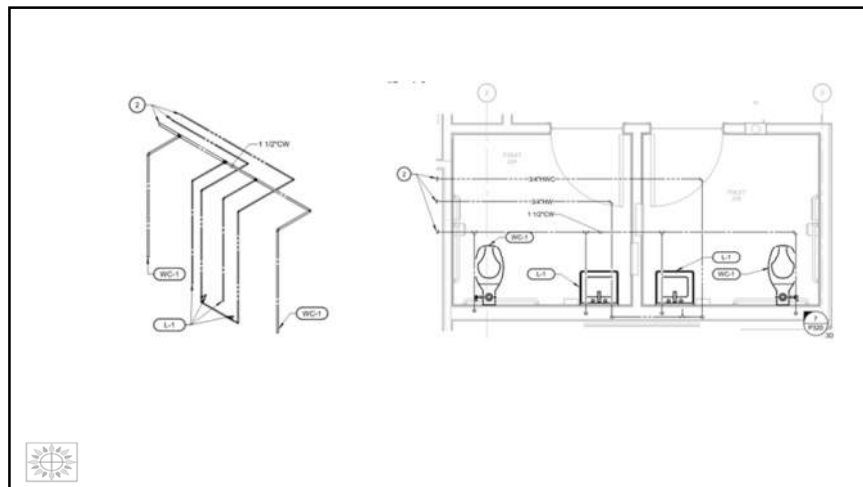
NOMINAL PIPE SIZE (inches)	VOLUME (liquid ounces per foot length)	MAXIMUM PIPING LENGTH (feet)	
		Public lavatory faucets	Other fixtures and appliances
¼	0.33	6	50
⅜	0.5	4	50
½	0.75	3	50
¾	1.5	2	43
1	2	1	32
1¼	3	0.5	21
1½	4	0.5	16
1	5	0.5	13
1¼	8	0.5	8
1½	11	0.5	6
2 or larger	18	0.5	4

For 5/8" 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 liquid ounce = 0.001 L, 1 gallon = 128 ounces

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](#).

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 to be sources of heated water.

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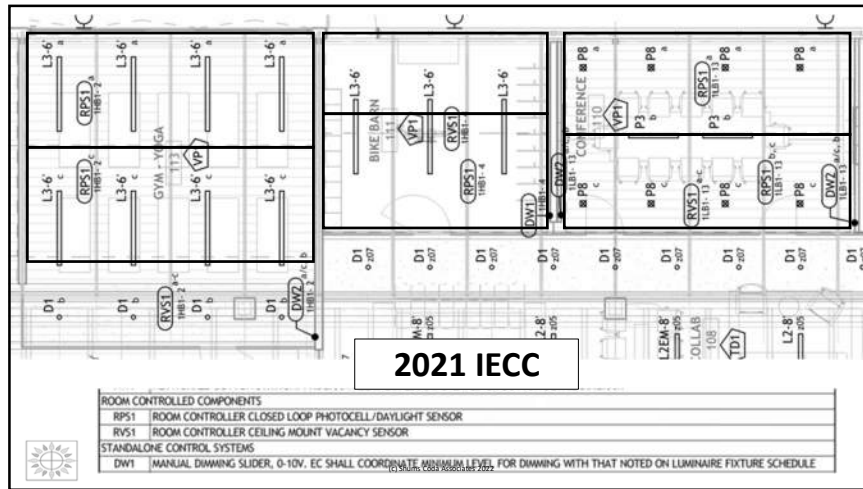
51

C103.2 Information On Construction Documents.

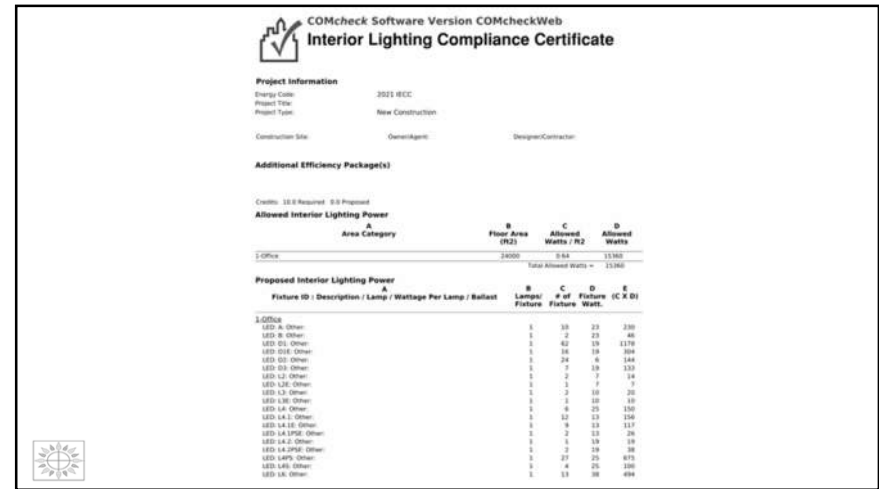
1. Energy compliance path. (2021 IECC addition) ✓
2. Insulation materials and their R-values. ✓
3. Fenestration U-factors and solar heat gain coefficients (SHGCs). ✓
4. Area-weighted U-factor and solar heat gain coefficient (SHGC) calculations. ✓
5. Mechanical system design criteria. ✓
6. Mechanical and service water-heating systems and equipment types, sizes and efficiencies. ✓
7. Economizer description. ✓
8. Equipment and system controls. ✓
9. Fan motor horsepower (hp) and controls. ✓
10. Duct sealing, duct and pipe insulation and location. ✓
11. Lighting fixture schedule with wattage and control narrative. ✓
12. Location of daylight zones on floor plans. ✓
13. Air barrier and air sealing details, including the location of the air barrier. (Revised in 2021 IECC, but still required in other editions) ✓

Thermal Envelope Depiction ✓

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A Fixture ID : Description / Lamp / Wattage Per Lamp / Ballast	B Lamps / Fixture	C # of Fixture (C X D)	D Total Proposed Watts
LED L6.1: Other	1	1	20
LED L6.1E: Other	1	1	20
LED L6.2: Other	1	4	38
LED L6S: Other	1	18	604
LED L6S: Other	1	3	38
LED L8: Other	1	18	26
LED L8E: Other	1	10	26
LED L8PS: Other	1	1	26
LED L10: Other	1	9	49
LED L10PS1: Other	1	7	49
LED L10SE: Other	1	1	33
LED L14: Other	1	3	46
LED L14PS1: Other	1	3	46
LED L16: Other	1	1	52
LED L16PS: Other	1	1	53
LED P1: Other	1	11	40
LED S71: Other	1	12	26
LED S71E: Other	1	9	26
LED T1: Other	1	4	88
LED TP: Other	1	2	6
LED W1: Other	1	5	6
LED W2: Other	1	18	6
LED W3: Other	1	4	27
LED X1: Other	1	22	3
LED X2: Other	1	4	3
Total Proposed Watts =			8477

Interior Lighting PASSES: Design 45% better than code

Interior Lighting Compliance

Statement
 Compliance Statement: The proposed interior lighting design represented in this document is consistent with the building plans, specifications, and other calculations submitted with this permit application. The proposed interior lighting systems have been designed to meet the 2021 IECC requirements in COMcheck Version COMcheckWeb and to comply with any applicable.

Name: _____ Signature: _____ Date: 2024.01.12

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- C103.2 Information On Construction Documents.**
1. Energy compliance path. (2021 IECC addition) ✓
 2. Insulation materials and their R-values. ✓
 3. Fenestration U-factors and solar heat gain coefficients (SHGCs). ✓
 4. Area-weighted U-factor and solar heat gain coefficient (SHGC) calculations. ✓
 5. Mechanical system design criteria. ✓
 6. Mechanical and service water-heating systems and equipment types, sizes and efficiencies. ✓
 7. Economizer description. ✓
 8. Equipment and system controls. ✓
 9. Fan motor horsepower (hp) and controls. ✓
 10. Duct sealing, duct and pipe insulation and location. ✓
 11. Lighting fixture schedule with wattage and control narrative. ✓
 12. Location of daylight zones on floor plans. ✓
 13. Air barrier and air sealing details, including the location of the air barrier. Thermal Envelope Depiction ✓

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COMcheck Software Version 4.0.7.0
Exterior Lighting Compliance Certificate

Project Information
 Energy Code: 2015 IECC
 Project Title: New construction
 Project Type: 2 Residential mixed use area
 Exterior Lighting Zone: []
 Construction Site: []
 Owner/Agent: []
 Designer/Contractor: []

Allowed Exterior Lighting Power

Area/Surface Category	Quantity	Allowed Watts / Unit	Tractable Wattage	Non-Tractable Wattage	Allowed Watts (B X C)
Parking area	4000 sq	0.09	Yes	360	360
Total Tractable Watts (a) =					360
Total Allowed Watts =					360
Total Allowed Supplemental Watts (b) =					0

(a) Wattage tradeoffs are only allowed between tractable areas/surfaces.
 (b) A supplemental allowance equal to 60% watts may be applied toward compliance of both non-tractable and tractable areas/surfaces.

Proposed Exterior Lighting Power

Fixture ID / Description / Lamp / Wattage Per Lamp / Ballast	B / Lamps / Fixture	C / # of Fixture	D / Watt	E / (C X D)
Parking area (4000 sq): Tractable Wattage				360
LED 1: 8W Other	1	10	20	200
LED 2: 8W Other	1	3	30	90
LED 3: 8W Other	1	2	5	10
LED 4: 8W Other	1	4	24	24
LED 5: 8W Other	1	1	64	64
LED 6: 8W Other	1	3	2	6
LED 7: 8W Other	1	1	12	12
LED 8: 8W Other	1	1	12	12
Total Tractable Proposed Watts =				360

Exterior Lighting PASSES: Design 70% better than code

Exterior Lighting Compliance Statement
 Compliance Statement: The proposed exterior lighting design represented in this document is consistent with the building codes, specifications, and other calculations submitted with this permit application. The proposed exterior lighting systems have been designed to meet the 2015 IECC requirements as COMcheck version 4.0.7.0 and to comply with any applicable mandatory requirements listed in the inspection checklist.

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COMcheck Software Version 4.1.5.4
Exterior Lighting Compliance Certificate

Project Information
 Energy Code: 2015 IECC
 Project Title: STORAGE BUILDING
 Project Type: New Construction
 Exterior Lighting Zone: 2 Light industrial area with limited nighttime use (L22)
 Construction Site: []
 Owner/Agent: []
 Designer/Contractor: []

Allowed Exterior Lighting Power

Area/Surface Category	Quantity	Allowed Watts / Unit	Tractable Wattage	Non-Tractable Wattage	Allowed Watts (B X C)
Parking area	11372 sq	0.06	Yes	682	682
Total Tractable Watts (a) =					682
Total Allowed Watts =					682
Total Allowed Supplemental Watts (b) =					0

(a) Wattage tradeoffs are only allowed between tractable areas/surfaces.
 (b) A supplemental allowance equal to 60% watts may be applied toward compliance of both non-tractable and tractable areas/surfaces.

Proposed Exterior Lighting Power

Fixture ID / Description / Lamp / Wattage Per Lamp / Ballast	B / Lamps / Fixture	C / # of Fixture	D / Watt	E / (C X D)
Parking area (11372 sq): Tractable Wattage				682
LED 1: 8W/8W Other	1	10	20	200
LED 2: 8W/2 Other	1	1	24	24
LED 3: 8W/2 Other	1	3	113	339
LED 4: 8W/4 Other	1	2	34	68
Total Tractable Proposed Watts =				621

Exterior Lighting PASSES: Design 89% better than code

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Table 3 Inspection Checklist for Proposed Design - Envelope

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN	SHEET LOCATION	CONFIRMED
Above-grade Walls	Type: Wood framed R-20 or R-13 + R-5 continuous	Type: Wood framed R-21 insulation	A4-10	
	Gross area: Same as proposed	Gross area: 133,167 SF		
	U-factor: 0.060	U-factor: 0.059		
Basement and Crawl Space Walls	Type: NA	Type: NA	N/A	N/A
	Gross Area: NA	Gross Area: NA		
	U-factor: NA	U-factor: NA		
Above-grade floor	Type: wood framed R-30 (or enough to fill framing cavity)	Type: wood framed with fiber insulation R-30 (or enough to fill framing cavity)	A0-40	
	Gross area: Same as proposed	Gross area: 218,523		
	U-factor: 0.033	U-factor: N0.033		
Ceilings	Type: wood frame R-49	Type: wood frame R-49	A4-10	
	Gross Area: Same as proposed	Gross Area: Same as proposed		
	U-factor: 0.026	U-factor: 0.026		

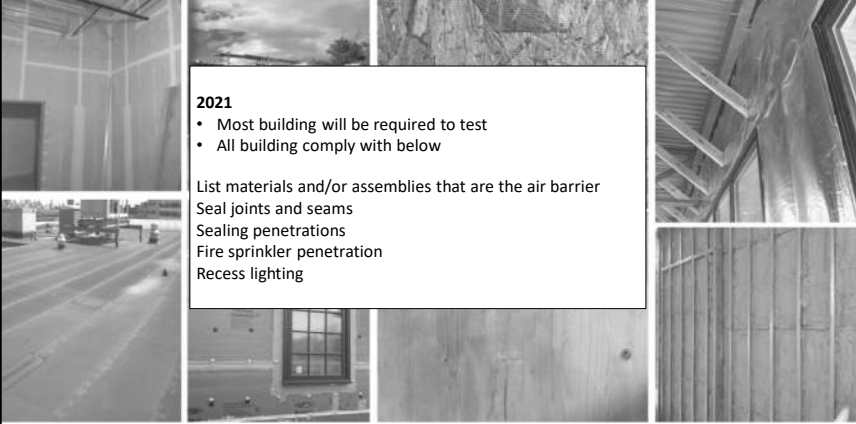
1 or [2015.13] A prescriptive covering is installed to protect exposed exterior insulation and extends a minimum 6 in. below grade.
 Requirement resolution:
 Requirement will be met.
 Requirement is not applicable.
 Plans reference page / section:
 P. 5

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- c103.2 Information On Construction Documents.**
1. Energy compliance path. (2021 IECC addition) ✓
 2. Insulation materials and their R-values. ✓
 3. Fenestration U-factors and solar heat gain coefficients (SHGCs). ✓
 4. Area-weighted U-factor and solar heat gain coefficient (SHGC) calculations. ✓
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 13. Air barrier and air sealing details, including the location of the air barrier. Thermal Envelope Depiction

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2021

- Most building will be required to test
- All building comply with below

List materials and/or assemblies that are the air barrier

- Seal joints and seams
- Sealing penetrations
- Fire sprinkler penetration
- Recess lighting




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WHY DON'T WE GET A TABLE?

COMPONENT	AIR BARRIER SYSTEMS	INSULATION INSTALLATION SYSTEMS
General requirements	A continuous air barrier shall be provided in the building envelope. The exterior thermal envelope contains a continuous air barrier. Details at joints in the air barrier shall be sealed.	Insulation installation shall not be used as a sealing measure.
Colligations	Shoe or lap joints in any exterior siding or wall shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, such as those for pipes and ducts, in exterior thermal envelopes shall be sealed.	The insulation and sheath materials shall be aligned with the air barrier.
Walls	The junction of the foundation and all joints shall be sealed. The junction of the top plates and the top of exterior walls shall be sealed. Frame walls shall be sealed.	Carries shall cover and protect all frame walls and be installed in accordance with the manufacturer's instructions. Thickness of all face shall be 1/2 inch.
Windows, skylights and doors	The space between framing and all joints, and the joints of windows and doors, shall be sealed.	Provide thermal envelope insulation for frame walls shall be installed in accordance with the manufacturer's instructions and shall be aligned with the air barrier.

- C402.5 Air leakage—thermal envelope.
- C402.5.1 Air barriers.
- C402.5.1.1 Air barrier construction.
- C402.5.1.2 Air barrier compliance.
- C402.5.1.3 Materials.
- C402.5.1.4 Assemblies.
- C402.5.4 Air leakage of fenestration.
- And Other Sections



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2021 IECC – Air Leakage

C402.5 Air leakage—thermal envelope


- Comply with Sections C402.5.1 through C402.5.11.1

OR


- Test in accordance with Section C402.5.2 or C402.5.3
- Where testing then also comply with Sections C402.5.7, C402.5.8 and C402.5.9



Testing Approach



<https://www.buildings.com/features/articles/2022/03/air-leakage-testing-a-hot-button-or-hot-air>





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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1

C402.5.1 Air barriers.
A continuous air barrier shall be provided throughout the building thermal envelope. The continuous air barriers shall be located on the inside or outside of the building thermal envelope, located within the assemblies composing the building thermal envelope, or any combination thereof. The air barrier shall comply with Sections C402.5.1.1, and C402.5.1.2.

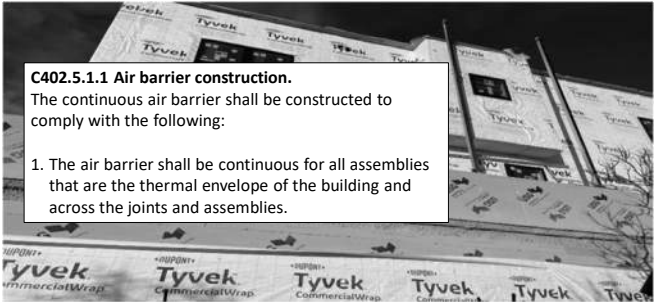
Exception: Air barriers are not required in buildings located in Climate Zone 2B.



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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1



C402.5.1.1 Air barrier construction.
The continuous air barrier shall be constructed to comply with the following:

1. The air barrier shall be continuous for all assemblies that are the thermal envelope of the building and across the joints and assemblies.




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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1

Prescriptive Approach



C402.5.1.1 Air barrier construction.
The continuous air barrier shall be constructed to comply with the following:

1. The air barrier shall be continuous for all assemblies that are the thermal envelope of the building and across the joints and assemblies.

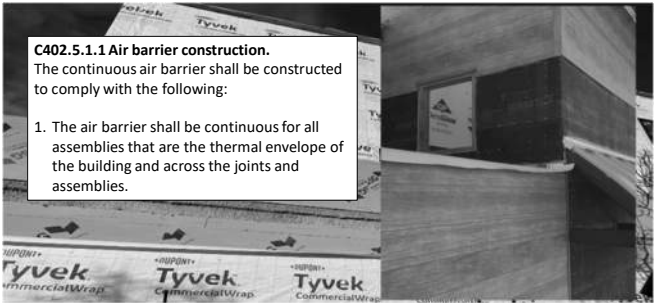


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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1

2021 Approach



C402.5.1.1 Air barrier construction.
The continuous air barrier shall be constructed to comply with the following:

1. The air barrier shall be continuous for all assemblies that are the thermal envelope of the building and across the joints and assemblies.

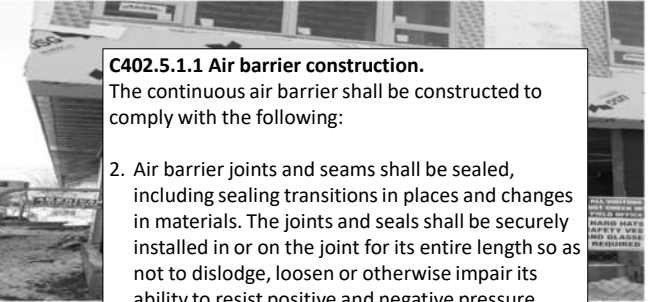


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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1

2021 Approach



C402.5.1.1 Air barrier construction.
The continuous air barrier shall be constructed to comply with the following:

2. Air barrier joints and seams shall be sealed, including sealing transitions in places and changes in materials. The joints and seals shall be securely installed in or on the joint for its entire length so as not to dislodge, loosen or otherwise impair its ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation.




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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1

C402.5.1.1 Air barrier construction.
The continuous air barrier shall be constructed to comply with the following

3. Penetrations of the air barrier shall be caulked, gasketed or otherwise sealed in a manner compatible with the construction materials and location. Sealing shall allow for expansion, contraction and mechanical vibration. Joints and seams associated with penetrations shall be sealed in the same manner or taped. Sealing materials shall be securely installed around the penetration so as not to dislodge, loosen or otherwise impair the penetrations' ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation.





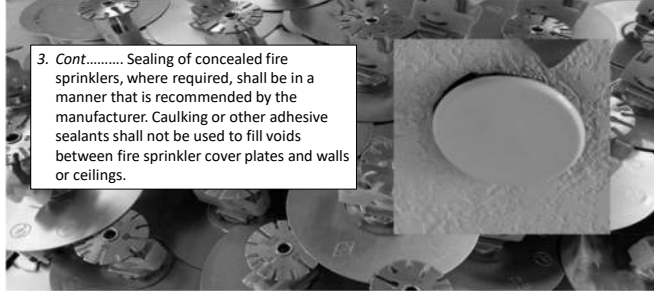
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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1

3. *Cont.....* Sealing of concealed fire sprinklers, where required, shall be in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.





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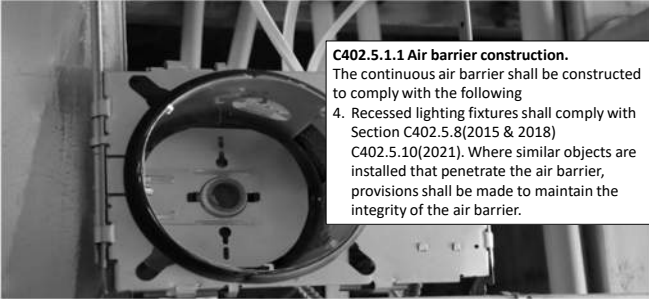
70


70

C402.5 - Comply with Sections C402.5.1 through C402.5.11.1

C402.5.1.1 Air barrier construction.
The continuous air barrier shall be constructed to comply with the following

4. Recessed lighting fixtures shall comply with Section C402.5.8(2015 & 2018) C402.5.10(2021). Where similar objects are installed that penetrate the air barrier, provisions shall be made to maintain the integrity of the air barrier.





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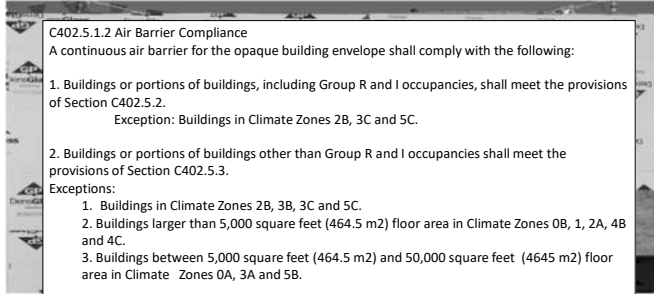
71


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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1

C402.5.1.2 Air Barrier Compliance
A continuous air barrier for the opaque building envelope shall comply with the following:

1. Buildings or portions of buildings, including Group R and I occupancies, shall meet the provisions of Section C402.5.2.
Exception: Buildings in Climate Zones 2B, 3C and 5C.
2. Buildings or portions of buildings other than Group R and I occupancies shall meet the provisions of Section C402.5.3.
Exceptions:
 1. Buildings in Climate Zones 2B, 3B, 3C and 5C.
 2. Buildings larger than 5,000 square feet (464.5 m2) floor area in Climate Zones 0B, 1, 2A, 4B and 4C.
 3. Buildings between 5,000 square feet (464.5 m2) and 50,000 square feet (4645 m2) floor area in Climate Zones 0A, 3A and 5B.
3. Buildings or portions of buildings that do not complete air barrier testing shall meet the provisions of Section C402.5.1.3 or C402.5.1.4 in addition to Section C402.5.1.5.



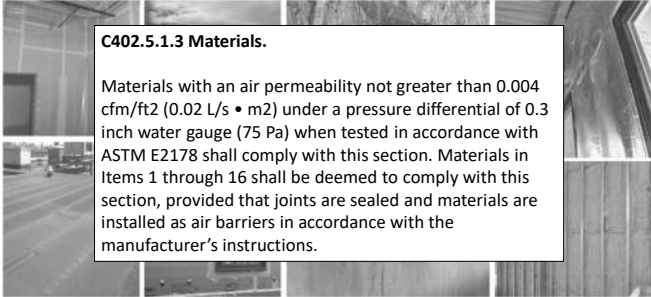


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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1



C402.5.1.3 Materials.

Materials with an air permeability not greater than 0.004 cfm/ft² (0.02 L/s • m²) under a pressure differential of 0.3 inch water gauge (75 Pa) when tested in accordance with ASTM E2178 shall comply with this section. Materials in Items 1 through 16 shall be deemed to comply with this section, provided that joints are sealed and materials are installed as air barriers in accordance with the manufacturer's instructions.



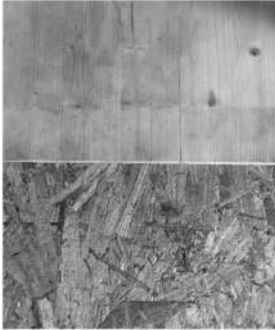

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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1

C402.5.1.3 Materials.

1. Plywood with a thickness of not less than 3/8 inch
2. Oriented strand board having a thickness of not less than 3/8 inch



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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1

C402.5.1.3 Materials.

1. Plywood with a thickness of not less than 3/8 inch
2. Oriented strand board having a thickness of not less than 3/8 inch
3. Extruded polystyrene insulation board having a thickness of not less than 1/2 inch



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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1

C402.5.1.3 Materials.

1. Plywood with a thickness of not less than 3/8 inch
2. Oriented strand board having a thickness of not less than 3/8 inch
3. Extruded polystyrene insulation board having a thickness of not less than 1/2 inch
4. Foil-back polyisocyanurate insulation board having a thickness of not less than 1/2 inch



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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1

C402.5.1.3 Materials.

1. Plywood with a thickness of not less than 3/8 inch
2. Oriented strand board having a thickness of not less than 3/8 inch
3. Extruded polystyrene insulation board having a thickness of not less than 1/2 inch
4. Foil-back polyisocyanurate insulation board having a thickness of not less than 1/2 inch
5. Closed-cell spray foam having a minimum density of 1.5 pcf (2.4 kg/m³) and having a thickness of not less than 1 1/2 inches



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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1

C402.5.1.3 Materials.

1. Plywood with a thickness of not less than 3/8 inch
2. Oriented strand board having a thickness of not less than 3/8 inch
3. Extruded polystyrene insulation board having a thickness of not less than 1/2 inch
4. Foil-back polyisocyanurate insulation board having a thickness of not less than 1/2 inch
5. Closed-cell spray foam having a minimum density of 1.5 pcf (2.4 kg/m³) and having a thickness of not less than 1 1/2 inches
6. Open-cell spray foam with a density between 0.4 and 1.5 pcf (0.6 and 2.4 kg/m³) and having a thickness of not less than 4.5 inches



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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1

C402.5.1.3 Materials.

1. Plywood with a thickness of not less than 3/8 inch
2. Oriented strand board having a thickness of not less than 3/8 inch
3. Extruded polystyrene insulation board having a thickness of not less than 1/2 inch
4. Foil-back polyisocyanurate insulation board having a thickness of not less than 1/2 inch
5. Closed-cell spray foam having a minimum density of 1.5 pcf (2.4 kg/m³) and having a thickness of not less than 1 1/2 inches
6. Open-cell spray foam with a density between 0.4 and 1.5 pcf (0.6 and 2.4 kg/m³) and having a thickness of not less than 4.5 inches
7. Exterior or interior gypsum board having a thickness of not less than 1/2 inch
8. Cement board having a thickness of not less than 1/2 inch



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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1

C402.5.1.3 Materials.

1. Plywood with a thickness of not less than 3/8 inch
2. Oriented strand board having a thickness of not less than 3/8 inch
3. Extruded polystyrene insulation board having a thickness of not less than 1/2 inch
4. Foil-back polyisocyanurate insulation board having a thickness of not less than 1/2 inch
5. Closed-cell spray foam having a minimum density of 1.5 pcf (2.4 kg/m³) and having a thickness of not less than 1 1/2 inches
6. Open-cell spray foam with a density between 0.4 and 1.5 pcf (0.6 and 2.4 kg/m³) and having a thickness of not less than 4.5 inches
7. Exterior or interior gypsum board having a thickness of not less than 1/2 inch
8. Cement board having a thickness of not less than 1/2 inch
9. Built-up roofing membrane
10. Modified bituminous roof membrane
11. Fully adhered single-ply roof membrane (2015/2018)
11. Single-ply roof membrane (2021)



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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1

C402.5.1.3 Materials.

1. Plywood with a thickness of not less than 3/8 inch
2. Oriented strand board having a thickness of not less than 3/8 inch
3. Extruded polystyrene insulation board having a thickness of not less than 1/2 inch
4. Foil-back polyisocyanurate insulation board having a thickness of not less than 1/2 inch
5. Closed-cell spray foam having a minimum density of 1.5 pcf (2.4 kg/m³) and having a thickness of not less than 1 1/2 inches
6. Open-cell spray foam with a density between 0.4 and 1.5 pcf (0.6 and 2.4 kg/m³) and having a thickness of not less than 4.5 inches
7. Exterior or interior gypsum board having a thickness of not less than 1/2 inch
8. Cement board having a thickness of not less than 1/2 inch
9. Built-up roofing membrane
10. Modified bituminous roof membrane
11. Single-ply membrane
12. A Portland cement/sand parge, or gypsum plaster having a thickness of not less than 5/8 inch



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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1

C402.5.1.3 Materials.

1. Plywood with a thickness of not less than 3/8 inch
2. Oriented strand board having a thickness of not less than 3/8 inch
3. Extruded polystyrene insulation board having a thickness of not less than 1/2 inch
4. Foil-back polyisocyanurate insulation board having a thickness of not less than 1/2 inch
5. Closed-cell spray foam having a minimum density of 1.5 pcf (2.4 kg/m³) and having a thickness of not less than 1 1/2 inches
6. Open-cell spray foam with a density between 0.4 and 1.5 pcf (0.6 and 2.4 kg/m³) and having a thickness of not less than 4.5 inches
7. Exterior or interior gypsum board having a thickness of not less than 1/2 inch
8. Cement board having a thickness of not less than 1/2 inch
9. Built-up roofing membrane
10. Modified bituminous roof membrane
11. Fully adhered single-ply roof membrane or Single-ply membrane
12. A Portland cement/sand parge, or gypsum plaster having a thickness of not less than 5/8 inch
13. Cast-in-place and precast concrete



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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1

C402.5.1.3 Materials.

1. Plywood with a thickness of not less than 3/8 inch
2. Oriented strand board having a thickness of not less than 3/8 inch
3. Extruded polystyrene insulation board having a thickness of not less than 1/2 inch
4. Foil-back polyisocyanurate insulation board having a thickness of not less than 1/2 inch
5. Closed-cell spray foam having a minimum density of 1.5 pcf (2.4 kg/m³) and having a thickness of not less than 1 1/2 inches
6. Open-cell spray foam with a density between 0.4 and 1.5 pcf (0.6 and 2.4 kg/m³) and having a thickness of not less than 4.5 inches
7. Exterior or interior gypsum board having a thickness of not less than 1/2 inch
8. Cement board having a thickness of not less than 1/2 inch
9. Built-up roofing membrane
10. Modified bituminous roof membrane
11. Single-ply membrane
12. A Portland cement/sand parge, or gypsum plaster having a thickness of not less than 5/8 inch
13. Cast-in-place and precast concrete
14. Fully grouted concrete block masonry

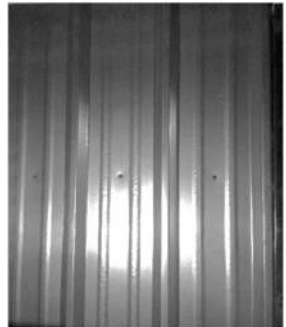

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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1

C402.5.1.3 Materials.

1. Plywood with a thickness of not less than 3/8 inch
2. Oriented strand board having a thickness of not less than 3/8 inch
3. Extruded polystyrene insulation board having a thickness of not less than 1/2 inch
4. Foil-back polyisocyanurate insulation board having a thickness of not less than 1/2 inch
5. Closed-cell spray foam having a minimum density of 1.5 pcf (2.4 kg/m³) and having a thickness of not less than 1 1/2 inches
6. Open-cell spray foam with a density between 0.4 and 1.5 pcf (0.6 and 2.4 kg/m³) and having a thickness of not less than 4.5 inches
7. Exterior or interior gypsum board having a thickness of not less than 1/2 inch
8. Cement board having a thickness of not less than 1/2 inch
9. Built-up roofing membrane
10. Modified bituminous roof membrane
11. Single-ply roof membrane
12. A Portland cement/sand parge, or gypsum plaster having a thickness of not less than 5/8 inch
13. Cast-in-place and precast concrete
14. Fully grouted concrete block masonry
15. Sheet steel or aluminum

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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1

C402.5.1.3 Materials.

1. Plywood with a thickness of not less than 3/8 inch
2. Oriented strand board having a thickness of not less than 3/8 inch
3. Extruded polystyrene insulation board having a thickness of not less than 1/2 inch
4. Foil-back polyisocyanurate insulation board having a thickness of not less than 1/2 inch
5. Closed-cell spray foam having a minimum density of 1.5 pcf (2.4 kg/m³) and having a thickness of not less than 1 1/2 inches
6. Open-cell spray foam with a density between 0.4 and 1.5 pcf (0.6 and 2.4 kg/m³) and having a thickness of not less than 4.5 inches
7. Exterior or interior gypsum board having a thickness of not less than 1/2 inch
8. Cement board having a thickness of not less than 1/2 inch
9. Built-up roofing membrane
10. Modified bituminous roof membrane
11. Single-ply roof membrane
12. A Portland cement/sand parge, or gypsum plaster having a thickness of not less than 5/8 inch
13. Cast-in-place and precast concrete
14. Fully grouted concrete block masonry
15. Sheet steel or aluminum
16. Solid or hollow masonry constructed of clay or shale masonry units



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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1

C402.5.1.4 Assemblies.

Assemblies of materials and components with an average air leakage not greater than 0.04 cfm/ under a pressure differential of 0.3 inch of water gauge (w.g.) (75 Pa) when tested in accordance with ASTM E2357, ASTM E1677, ASTM D8052 or ASTM E283 shall comply with this section. Assemblies listed in Items 1 through 3 shall be deemed to comply, provided that joints are sealed and the requirements of Section C402.5.1.1 are met.



1. Concrete masonry walls coated with either one application of block filler or two applications of a paint or sealer coating.
2. Masonry walls constructed of clay or shale masonry units with a nominal width of 4 inches or more.
3. A Portland cement/sand parge, stucco or plaster not less than 1/2 inch in thickness.



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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1



C402.5.1.5 Building envelope performance verification.

The installation of the continuous air barrier shall be verified by the *code official*, a *registered design professional* or *approved agency* in accordance with the following:

1. A review of the construction documents and other supporting data shall be conducted to assess compliance with the requirements in [Section C402.5.1](#).
2. Inspection of continuous air barrier components and assemblies shall be conducted during construction while the air barrier is still accessible for inspection and repair to verify compliance with the requirements of [Sections C402.5.1.3](#) and [C402.5.1.4](#).
3. A final commissioning report shall be provided for inspections completed by the *registered design professional* or *approved agency*. The commissioning report shall be provided to the building owner or owner's authorized agent and the *code official*. The report shall identify deficiencies found during the review of the construction documents and inspection and details of corrective measures taken.



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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1

C402.5.1.2 Air Barrier Compliance
A continuous air barrier for the opaque building envelope shall comply with the following:

- Buildings or portions of buildings, including Group R and I occupancies, shall meet the provisions of Section C402.5.2.
Exception: Buildings in Climate Zones 2B, 3C and 5C.
- Buildings or portions of buildings other than Group R and I occupancies shall meet the provisions of Section C402.5.3.
Exceptions:
 - Buildings in Climate Zones 2B, 3B, 3C and 5C.
 - Buildings larger than 5,000 square feet (464.5 m²) floor area in Climate Zones 0B, 1, 2A, 4B and 4C.
 - Buildings between 5,000 square feet (464.5 m²) and 50,000 square feet (4645 m²) floor area in Climate Zones 0A, 3A and 5B.
- Buildings or portions of buildings that do not complete air barrier testing shall meet the provisions of Section C402.5.1.3 or C402.5.1.4 in addition to Section C402.5.1.5.

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C402.5.2 Dwelling and sleeping unit enclosure testing.
The *building thermal envelope* shall be tested in accordance with [ASTM E779](#), [ANSI/RESNET/ICC 380](#), [ASTM E1827](#) or an equivalent method approved by the code official. The measured air leakage shall not exceed 0.30 cfm/ft² of the testing unit enclosure area at a pressure differential of 0.2 inch water gauge (50 Pa). Where multiple dwelling units or sleeping units or other occupiable conditioned spaces are contained within one *building thermal envelope*, each unit shall be considered an individual testing unit, and the building air leakage shall be the weighted average of all testing unit results, weighted by each testing unit's enclosure area. Units shall be tested separately with an unguarded blower door test as follows:

- Where buildings have fewer than eight testing units, each testing unit shall be tested.
- For buildings with eight or more testing units, the greater of seven units or 20 percent of the testing units in the building shall be tested, including a top floor unit, a ground floor unit and a unit with the largest testing unit enclosure area. For each tested unit that exceeds the maximum air leakage rate, an additional two units shall be tested, including a mixture of testing unit types and locations.

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C402.5.3 Building thermal envelope testing.
The *building thermal envelope* shall be tested in accordance with [ASTM E779](#), [ANSI/RESNET/ICC 380](#), [ASTM E3158](#) or [ASTM E1827](#) or an equivalent method approved by the code official. The measured air leakage shall not exceed 0.40 cfm/ft² of the *building thermal envelope* area at a pressure differential of 0.3 inch water gauge (75 Pa). Alternatively, portions of the building shall be tested and the measured air leakages shall be area weighted by the surface areas of the building envelope in each portion. The weighted average test results shall not exceed the whole building leakage limit. In the alternative approach, the following portions of the building shall be tested:

- The entire envelope area of all stories that have any spaces directly under a roof.
- The entire envelope area of all stories that have a building entrance, exposed floor, or loading dock, or are below grade.
- Representative above-grade sections of the building totaling at least 25 percent of the wall area enclosing the remaining conditioned space.

Exception: Where the measured air leakage rate exceeds 0.40 cfm/ft² (2.0 L/s × m²) but does not exceed 0.60 cfm/ft² (3.0 L/s × m²), a diagnostic evaluation using smoke tracer or infrared imaging shall be conducted while the building is pressurized along with a visual inspection of the air barrier. Any leaks noted shall be sealed where such sealing can be made without destruction of existing building components. An additional report identifying the corrective actions taken to seal leaks shall be submitted to the code official and the building owner, and shall be deemed to comply with the requirements of this section.

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C402.5.5 Rooms containing fuel-burning appliances.
In *Climate Zones* 3 through 8, where combustion air is supplied through openings in an exterior wall to a room or space containing a space-conditioning fuel-burning appliance, one of the following shall apply:

- The room or space containing the appliance shall be located outside of the *building thermal envelope*.
- The room or space containing the appliance shall be enclosed and isolated from conditioned spaces inside the *building thermal envelope*. Such rooms shall comply with all of the following:
 - The walls, floors and ceilings that separate the enclosed room or space from conditioned spaces shall be insulated to be not less than equivalent to the insulation requirement of below-grade walls as specified in [Table C402.1.3](#) or [Table C402.1.4](#).
 - The walls, floors and ceilings that separate the enclosed room or space from conditioned spaces shall be sealed in accordance with [Section C402.5.1.1](#).
 - The doors into the enclosed room or space shall be fully gasketed.
 - Water lines and ducts in the enclosed room or space shall be insulated in accordance with [Section C403](#).
 - Where an air duct supplying combustion air to the enclosed room or space passes through *conditioned space*, the duct shall be insulated to an *R*-value of not less than R-8.

Exception:

- Direct vent appliances with both intake and exhaust pipes installed continuous to the outside.
- Fireplaces and stoves complying with Section R402.4.2 and Section R1006 of the International Residential Code

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C402.5.6 Loading dock weatherseals.

Cargo door openings and loading door openings shall be equipped with weather seals that restrict infiltration and provide direct contact along the top and sides of vehicles that are parked in the doorway.



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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1



C402.5.9 Vestibules. P

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.

- All building entrances
- All doors in vestibule must have self-closing devices
- Interior and exterior not open at the same time
- Revolving doors do not exclude vestibule requirement for doors adjacent to revolving doors



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C402.5 - Comply with Sections C402.5.1 through C402.5.11.1



C402.5.9

Exceptions:

1. Buildings in Climate Zones 0 through 2.
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 in area.
5. Revolving doors.
6. Doors used primarily to facilitate vehicular movement or material handling and adjacent personnel doors.
7. Doors that have an air curtain with a velocity of not less than 6.56 feet per second 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.



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C402.5.11 Operable openings interlocking (New)

Where occupancies utilize operable openings to the outdoors that are larger than 40 square feet in area, such openings shall be interlocked with the heating and cooling system so as to raise the cooling setpoint to 90°F and lower the heating setpoint to 55°F whenever the operable opening is open. The change in heating and cooling setpoints shall occur within 10 minutes of opening the operable opening.



Exceptions:

1. Separately zoned areas associated with the preparation of food that contain appliances that contribute to the HVAC loads of a restaurant or similar type of occupancy.
2. Warehouses that utilize overhead doors for the function of the occupancy, where approved by the code official.
3. The first entrance doors where located in the exterior wall and are part of a vestibule system




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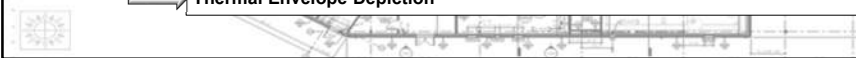
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C103.2 Information On Construction Documents.

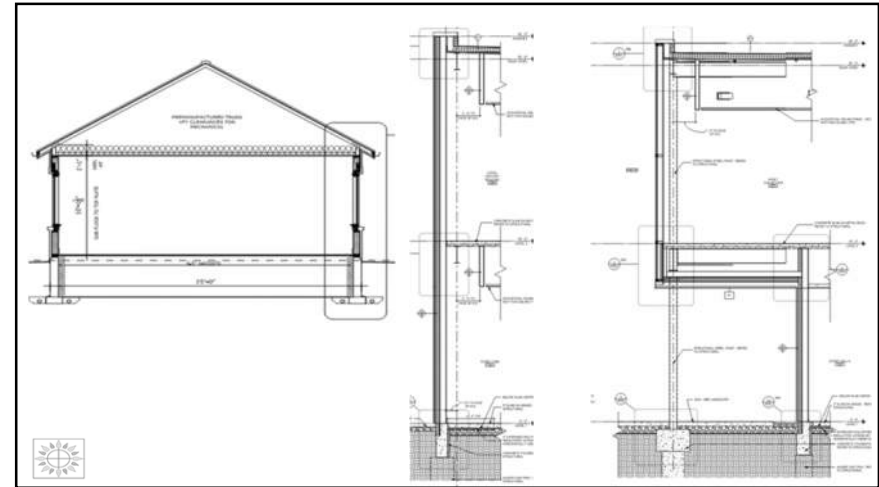


1. Energy compliance path. (2021 IECC addition) ✓
2. Insulation materials and their R-values. ✓
3. Fenestration U-factors and solar heat gain coefficients (SHGCs).
4. Area-weighted U-factor and solar heat gain coefficient (SHGC) calculations.
5. Mechanical system design criteria.
6. Mechanical and service water-heating systems and equipment types, sizes and efficiencies.
7. Economizer description.
8. Equipment and system controls.
9. Fan motor horsepower (hp) and controls.
10. Duct sealing, duct and pipe insulation and location.
11. Lighting fixture schedule with wattage and control narrative.
12. Location of daylight zones on floor plans.
13. Air barrier and air sealing details, including the location of the air barrier.

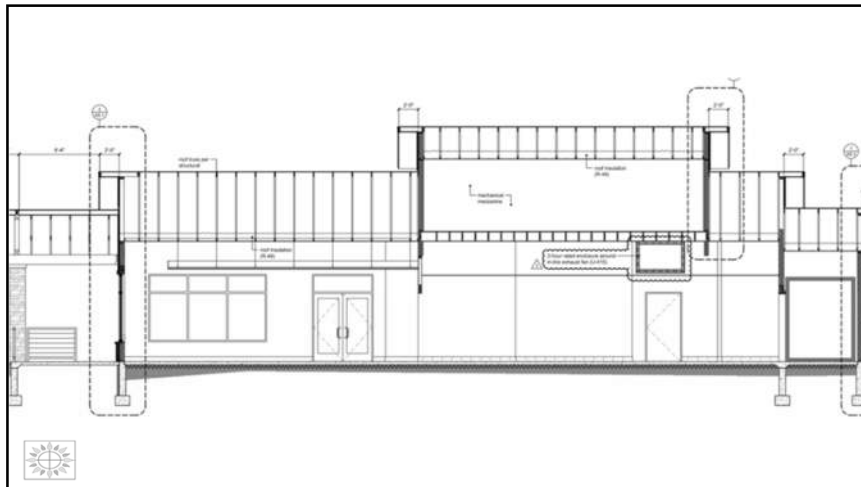
→ Thermal Envelope Depiction



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C406 – Additional Efficiency Requirements
How it works for the 2021 IECC



- More options available
- Required to obtain 10 points for new building
- Required to obtain 5 points for tenant spaces
- Available points are weighted by occupancy and the efficiency provided for the occupancy
- Not all requirements are available for all occupancies
- Most will require multiple requirements to reach the required points
- Will require more planning in the design




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TABLE C406.1(1) ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP B OCCUPANCIES																	
SECTION	CLIMATE ZONE																
	0A & 1A	0B & 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% heating efficiency improvement	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1	1	NA	1
C406.2.2: 5% cooling efficiency improvement	6	6	5	5	4	4	3	3	3	2	2	2	1	2	2	2	1
C406.2.3: 10% heating efficiency improvement	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2	1	1	2	2	NA	1
C406.2.4: 10% cooling efficiency improvement	11	12	10	9	7	7	6	5	6	4	4	5	3	4	3	3	3
C406.3: Reduced lighting power	9	8	9	9	9	9	10	8	9	9	7	8	8	6	7	7	6
C406.4: Enhanced digital lighting controls	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	1
C406.5: On-site renewable energy	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
C406.6: Dedicated outdoor air	4	4	4	4	4	3	2	5	3	2	5	3	2	7	4	5	3
C406.7.2: Recovered or renewable water heating	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.3: Efficient fossil fuel water heater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.4: Heat pump water heater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.8: Enhanced envelope performance	1	4	2	4	4	3	NA	7	4	5	10	7	6	11	10	14	16
C406.9: Reduced air infiltration	2	1	1	2	4	1	NA	8	2	3	11	4	1	15	8	11	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 and diagnostics system	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1

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C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS

More efficient HVAC performance in accordance with Section C406.2



C406.2 More efficient HVAC equipment performance


Equipment shall exceed the minimum efficiency requirements listed in the tables in Section C403.3.2.

Variable refrigerant flow systems listed in the energy efficiency provisions of ANSI/ASHRAE/IES 90.1 in accordance with Section C406.2.1, C406.2.2, C406.2.3 or C406.2.4 shall also meet applicable requirements of Section C403.

Energy efficiency credits for heating shall be selected from Section C406.2.1 or C406.2.3 and energy efficiency credits for cooling shall be selected from Section C406.2.2, C406.2.4 or C406.2.5.

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(9) 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 Section C406.2.1 or C406.2.3 and cooling equipment where selecting Section C406.2.2, C406.2.4 or C406.2.5.



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C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS

Reduced lighting power in accordance with Section C406.3.


Buildings shall comply with Section C406.3.1 or C406.3.2, and dwelling units and sleeping units within the building shall comply with Section C406.3.3.


C406.3.1 Reduced lighting power by more than 10 percent

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 4-13, rounded to the nearest whole number.






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C406.3.3 Lamp efficacy

Not less than 95 percent of the permanently installed lighting, excluding kitchen appliance light fixtures, serving dwelling units and sleeping units shall be provided by lamps with an efficacy of not less than 65 lumens per watt or luminaires with an efficacy of not less than 45 lumens per watt





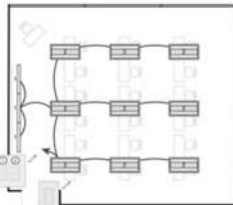
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C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS

Enhanced lighting controls in accordance with Section C406.4.



- Enhanced digital lighting controls per C406.4, controls located and operated in accordance with Sections C405.2.1 through C405.2.3.
- Luminaires configured for continuous dimming
- Luminaires shall be addressed individually OR a controlled group of ≤ 4 luminaires (Where individual addressability is not available for the luminaire class type)
- ≤ 8 luminaires controlled together in a daylight zone
- Fixtures controlled through digital control system that includes the following function:
 - Control reconfiguration based on digital addressability
 - Load shedding
 - Occupancy sensors capable of being reconfigured through the digital control system
- Construction documents including submittal of Sequence of Operations including specs outlining each function of the fixture requirements above
- Functional testing of controls comply with C408



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C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS

On-site supply of renewable energy in accordance with Section C406.5

C406.5.1 Basic renewable credit

The total minimum ratings of on-site renewable energy systems, not including systems used for credits under Sections C406.7.2, shall be one of the following:

1. Not less than 0.86 Btu/h per square foot or 0.25 watts per square foot of conditioned floor area.
2. Not less than 2 percent of the annual energy used within the building for building mechanical and service water-heating equipment and lighting regulated in Section C405.

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C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS

Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.

C406.6 Dedicated outdoor air system

- Be equipped with an independent ventilation system designed to provide $\leq 100\%$ outdoor air to each occupied space
 - Ventilation system capable of total energy recovery
 - HVAC system include supply-air temperature controls that automatically reset the supply-air temp. in response to building loads or outdoor air temperatures
 - Controls reset the supply-air temperature at least 25% of the difference between design supply-air temp. and design room-air temp.





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What is a Dedicated Outdoor Air System?

- Consists of two parallel systems: A dedicated system for delivering outdoor air ventilation that handles both the latent and sensible loads of conditioning the ventilation air and a parallel system to handle mostly sensible loads generated by indoor sources and those that pass through the building enclosure
- Main purposes is to provide dedicated ventilation rather than ventilation as part of conditioned air.
- Improves indoor air quality and thermal comfort
- Provides a dedicated supply of 100% outdoor air rather than mixing it with the return air as is typical with VAV systems.
- Sized to meet ventilation requirements and does not require oversizing as with VAV systems
- Controls latent and sensible loads independently to avoid moisture related indoor air problems.



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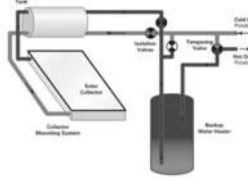

C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS

Reduced energy use in service water heating C406.7

Buildings with the following types allowed to use this compliance method:

- Group R-1: Boarding houses, hotels, or motels
- Group I-2: Hospitals, psychiatric hospitals, and nursing homes
- Group A-2: Restaurants and banquet halls or buildings containing food preparation areas
- Group F: Laundries
- Group R-2
- Group A-3: Health clubs and spas

Buildings showing a service hot water load of >10% of total building energy loads as shown with an energy analysis per C407

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Reduced energy use in service water heating C406.7

C406.7.2 Recovered or renewable water heating

The building service water-heating system shall have one or more of the following that are sized to provide not less than 30 percent of the building's annual hot water requirements, or sized to provide 70 percent of the building's annual hot water requirements if the building is required to comply with Section C403.10.5:

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



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Reduced energy use in service water heating C406.7

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 percent Et or 0.95 EF. This option shall receive only half the listed credits for buildings required to comply with Section C404.2.1.

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Reduced energy use in service water heating C406.7

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.

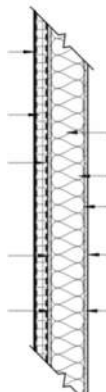

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C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS

Enhanced envelope performance in accordance with Section C406.8

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

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C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS

Reduced air infiltration in accordance with Section C406.9

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 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 250,000 square feet (25 000 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.



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C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS

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

C406.11 Fault detection and diagnostics system



C406.12 Efficient kitchen equipment



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C408 MAINTENANCE INFORMATION AND SYSTEM COMMISSIONING

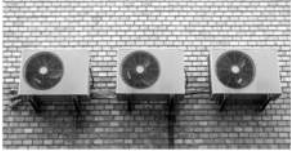





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C408.1 General

This section covers the provision of maintenance information and the commissioning of, and the functional testing requirements for, building systems

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C408.1.1 Building operations and maintenance information

The building operations and maintenance documents shall be provided to the owner and shall consist of:

- manufacturers' information, specifications and recommendations;
- programming procedures and data points; narratives; and other means of illustrating to the owner how the building, equipment and systems are intended to be installed, maintained and operated.
- Required regular maintenance actions for equipment and systems shall be clearly stated on a readily visible label. The label shall include the title or publication number for the operation and maintenance manual for that particular model and type of product

Building Operation and Maintenance Manual

Read this prior to any maintenance!




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C408.2 Mechanical systems and service water-heating systems commissioning and completion requirements

- Prior to the final mechanical and plumbing inspections
- 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
- Copies of all documentation shall be given to the owner or owner's authorized agent and made available to the code official upon request





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C408.2 Mechanical systems and service water-heating systems commissioning and completion requirements

- Exceptions:
- Mechanical systems and service water heater systems in buildings where the total mechanical equipment capacity is less than:
- 480,000 Btu/h cooling capacity and 600,000 Btu/h combined service water-heating and space-heating capacity.
- Systems included in Section C403.5 (Economizers) that serve individual dwelling units and sleeping units

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C408.2.1 Commissioning plan

- A commissioning plan shall be developed by a registered design professional and include the following items:
 - 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
 - A listing of the specific equipment, appliances or systems to be tested and a description of the tests to be performed
 - Functions to be tested including, but not limited to, calibrations and economizer controls
 - Conditions under which the test will be performed. Testing shall affirm winter and summer design conditions and full outside air conditions
 - Measurable criteria for performance



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**SECTION 01 9113
GENERAL COMMISSIONING REQUIREMENTS**

PART 1 GENERAL

1.01 SUMMARY

- A. Commissioning is intended to achieve the following specific objectives; this section specifies the CMGC's responsibilities for commissioning:
 1. Verify that the work is installed in accordance with Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Prefunctional Checklists executed by CMGC are utilized to achieve this.
 2. Verify and document that functional performance is in accordance with Contract Documents: Functional Tests executed by CMGC and witnessed by the Commissioning Authority are utilized to achieve this.
 3. Verify that operation and maintenance manuals submitted to Owner are complete: Detailed operation and maintenance (O&M) data submittals by CMGC are utilized to achieve this.
 4. Verify that the Owner's operating personnel are adequately trained: Formal training conducted by CMGC is utilized to achieve this.
- B. The Commissioning Authority directs and coordinates all commissioning activities; this section describes some but not all of the Commissioning Authority's responsibilities.



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C408.2.2 Systems adjusting and balancing

- HVAC systems shall be balanced
- 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



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C408.2.3 Functional performance testing

C408.2.3.1 Equipment

- Equipment functional performance testing
- Operation of components, systems, and system-to-system interfacing relationships in accordance with approved plans and specifications
- 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 emergency conditions

C408.2.3.2 Controls

- HVAC and service water-heating control systems shall be tested and adjusted and operate in accordance with approved plans and specifications

C408.2.3.3 Economizers

- Air economizers shall undergo a functional test to determine that they operate in accordance with manufacturer's specifications



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C408.2.4 Preliminary commissioning report

- The report shall be identified as “Preliminary Commissioning Report” shall include the completed Commissioning Compliance Checklist, Figure C408.2.4, and shall identify
 - Itemization of deficiencies found during testing that have not been corrected at the time of reporting
 - Deferred tests that cannot be performed at the time of report preparation because of climatic conditions (This would include any climatic conditions required for testing)
 - Report sent to Owner
 - Results of functional performance tests
 - Functional performance test procedures used during the commissioning process, including measurable criteria for test acceptance
 - Building Official can require a copy for their review



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Project Information: _____ Project Name: _____

Project Address: _____

Commissioning Authority: _____

Commissioning Plan (Section C408.2.1)

Commissioning Plan was used during construction and includes all items required by Section C408.2.1

Systems Adjusting and Balancing has been completed.

HVAC Equipment Functional Testing has been executed. If applicable, deferred and follow-up testing is scheduled to be provided on: _____

HVAC Controls Functional Testing has been executed. If applicable, deferred and follow-up testing is scheduled to be provided on: _____

Economizer Functional Testing has been executed. If applicable, deferred and follow-up testing is scheduled to be provided on: _____

Lighting Controls Functional Testing has been executed. If applicable, deferred and follow-up testing is scheduled to be provided on: _____

Service Water Heating System Functional Testing has been executed. If applicable, deferred and follow-up testing is scheduled to be provided on: _____

Manual, record documents and training have been completed or scheduled

Preliminary Commissioning Report submitted to owner and includes all items required by Section C408.2.4

I hereby certify that the commissioning provider has provided me with evidence of mechanical, service water heating and lighting systems commissioning in accordance with the 2018 IECC.

Signature of Building Owner or Owner's Representative _____ Date _____



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C408.3 Lighting system functional testing

- Automatic lighting controls required by this code shall comply with this section



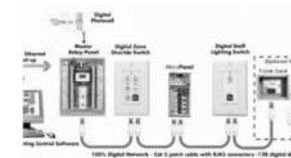
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C408.3.1 Functional testing

- 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 through C408.3.1.3 for the applicable control type.



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C408.3.1.1 Occupant sensor controls

- Where occupant sensor controls are provided, the following procedures shall be performed:
- Certify that the occupant sensor has been located and aimed in accordance with manufacturer recommendations
- For projects with seven or fewer occupant sensors, each sensor shall be tested



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C408.3.1.3 Daylight responsive controls

- Where daylight responsive controls are provided, the following shall be verified
 - Control devices have been properly located, field calibrated and set for accurate setpoints and threshold light levels
 - Daylight controlled lighting loads adjust to light level set points in response to available daylight
 - The locations of calibration adjustment equipment are readily accessible only to authorized personnel



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C408.3.2.2 Manuals

An operating and maintenance manual shall be provided and include the following:

1. Name and address of not less than one service agency for installed equipment.
2. A narrative of how each system is intended to operate, including recommended setpoints.
3. Submittal data indicating all selected options for each piece of lighting equipment and lighting controls.
4. Operation and maintenance manuals for each piece of lighting equipment. Required routine maintenance actions, cleaning and recommended relamping shall be clearly identified.
5. A schedule for inspecting and recalibrating all lighting controls.



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Existing Buildings Chapter 5

Section C501 - General

- ✓ Buildings Designated as Historic
- ✓ Existing buildings
 - ✓ Additions
 - ✓ Alterations
 - ✓ Repairs and Maintenance
- ✓ Change in Occupancy





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Historic Buildings

- **IECC Definition of Historic Building**
- Any building or structure that is one or more of the following:
 - ❖ Listed, or certified as eligible for listing by the State Historic Preservation Officer or the Keeper of the National Register of Historic Places, in the National Register of Historic Places.
 - ❖ Designated as historic under an applicable state or local law.
 - ❖ Certified as a contributing resource within a National Register-listed, state-designated or locally designated historic district.



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C501.5 Historic Buildings

Provisions of this code relating to the construction, repair, alteration, restoration and movement of structures, and change of occupancy shall not be mandatory for historic buildings provided that 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.

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Existing Buildings
Section C502 - Additions

- Addition to:
 - Existing Building
 - Building System
 - Or portion thereof

Must conform to the code as it relates to new construction without requiring the unaltered portion of the existing building or system to comply.

- Shall not create unsafe or hazardous condition
- Shall not overload existing building systems
- Can comply as the addition alone or as a single building with existing building

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Existing Buildings
Section C502.2 – ADDITIONS - Change in space conditioning

Any nonconditioned space that is altered to become conditioned space shall be required to be brought into full compliance with this code

Examples:

- ✓ Converting part of an unconditioned warehouse to office space
- ✓ Shell building tenant build-out ???



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**Existing Buildings
Section C502 - Additions**



C502.3.1 Vertical fenestration area
 Additions shall comply with the following:

1. Where an addition has a new vertical fenestration area that results in a total building fenestration area less than or equal to that permitted by Section C402.4.1, the addition shall comply with Section C402.1.5, C402.4.3 or C407.
2. Where an addition with vertical fenestration that results in a total building fenestration area greater than Section C402.4.1 or an addition that exceeds the fenestration area greater than that permitted by Section C402.4.1, the fenestration shall comply with Section C402.4.1.1 for the addition only.
3. Where an addition has vertical fenestration that results in a total building vertical fenestration area exceeding that permitted by Section C402.4.1.1, the addition shall comply with Section C402.1.5 or C407.



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**Existing Buildings
Section C502 - Additions**



C502.3.2 Skylight area
 Skylights shall comply with the following:

1. Where an addition has new skylight area that results in a total building fenestration area less than or equal to that permitted by Section C402.4.1, the addition shall comply with Section C402.1.5 or C407.
2. Where an addition has new skylight area that results in a total building skylight area greater than permitted by Section C402.4.1 or where additions have skylight area greater than that permitted by Section C402.4.1, the skylight area shall comply with Section C402.4.1.2 for the addition only.
3. Where an addition has skylight area that results in a total building skylight area exceeding that permitted by Section C402.4.1.2, the addition shall comply with Section C402.1.5 or C407.



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**Existing Buildings
Section C502 - Additions**

- Mechanical Systems comply with C403
- SWH – C404
- Pools and inground permanently installed spas – C404.9
- Lighting power and systems comply with Sections C405 and C408
 - Interior comply with addition alone or addition plus existing building
 - Exterior comply with addition alone or addition plus existing



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**Existing Buildings
Section C503.1 - Alterations General**



- Alteration must comply with code as for new construction
- Unaltered portion(s) do not need to comply
- Alteration cannot make existing building less conforming than it may have already been
- Alteration shall not create an unsafe or hazardous condition or overload existing systems.
- Alterations comply with ASHRAE 90.1-2013 do not need to comply with C402 through C405
- Vertical Fenestration and Skylight Area similar to requirements for additions

Exceptions.....





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**Existing Buildings
Section C503 - Alterations Exceptions**

1. Storm windows installed over existing fenestration
2. Surface-applied window film installed on existing single-pane fenestration assemblies reducing solar heat gain, provided that 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




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**Existing Buildings
Section C503.2 – Alterations Building Envelope**

- New building envelope assemblies that are part of the alteration shall comply with Sections C402.1 through C402.5.

Exception: Where the existing building exceeds the fenestration area limitations of Section C402.4.1 prior to alteration, the building is exempt from Section C402.4.1 provided that there is not an increase in fenestration area.

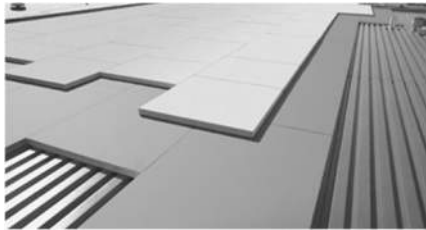



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C503.3.1 Roof replacement.


Roof replacements shall comply with Section C402.1.3, C402.1.4, C402.1.5 or C407 where the existing roof assembly is part of the building thermal envelope and contains insulation entirely above the roof deck. In no case shall the R-value of the roof insulation be reduced or the U-factor of the roof assembly be increased as part of the roof replacement.


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C503.3.2 Vertical fenestration



- The addition of vertical fenestration that results in a total building fenestration area less than or equal to that specified in Section C402.4.1 shall comply with Section C402.1.5, C402.4.3 or C407.
- The addition of vertical fenestration that results in a total building fenestration area greater than Section C402.4.1 shall comply with Section C402.4.1.1 for the space adjacent to the new fenestration only.
- Alterations that result in a total building vertical fenestration area exceeding that specified in Section C402.4.1.1 shall comply with Section C402.1.5 or C407.
- Provided that the vertical fenestration area is not changed, using the same vertical fenestration area in the standard reference design as the building prior to alteration shall be an alternative to using the vertical fenestration area specified in Table C407.5.1(1).




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C503.3.3 Skylight area

- New skylight area that results in a total building skylight area less than or equal to that specified in Section C402.4.1 shall comply with Section C402.1.5, C402.4 or C407.
- The addition of skylight area that results in a total building skylight area greater than Section C402.4.1 shall comply with Section C402.4.1.2 for the space adjacent to the new skylights.
- Alterations that result in a total building skylight area exceeding that specified in Section C402.4.1.2 shall comply with Section C402.1.5 or C407.
- Provided that the skylight area is not changed, using the same skylight area in the standard reference design as the building prior to alteration shall be an alternative to using the skylight area specified in Table C407.5.1(1).



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Existing Buildings Section C503 - Alterations

- Heating and Cooling
 - New HVAC systems and duct systems that are part of the alteration to comply with Section C403
 - Economizers new cooling systems that are part of alteration shall comply with Section C403.5.
- Service hot water systems
 - New SWH systems that are part of the alteration to comply with C404
- Lighting Systems
 - New Lighting systems that are part of the alteration to comply with C405


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Existing Buildings Section C504 - Repairs

REPAIR. The reconstruction or renewal of any part of an existing building for the purpose of its maintenance or to correct damage

- Work on nondamaged components necessary for the required repair or damaged components shall be considered part of the repair and not subject to the alterations requirements
- Repairs considered part of the code
 - Glass-only replacements in an existing sash and frame
 - Roof repairs
 - Replacement of existing doors that separate conditioned space from the exterior do not require the installation of a vestibule or revolving door, provided that an existing vestibule that separate a conditioned space from the exterior shall not be removed
 - Air barriers shall not be required for roof repair where the repairs to the building do not include alterations, renovations or repairs to the remainder of the building envelop

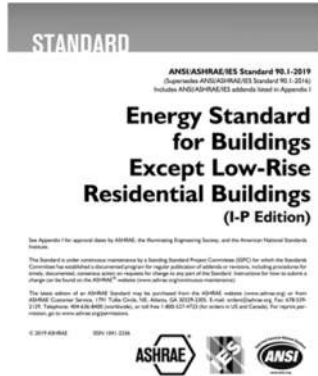


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Existing Buildings Section C504 - Repairs

- Where a building was constructed to comply with ANSI/ASHRAE/IESNA 90.1, repairs shall comply with the standard and need not comply with Sections C402, C403, C404 and C405.



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Section C505 – Change in Occupancy

Spaces undergoing a change in occupancy that would result in an increase in demand for either fossil fuel or electrical energy shall comply with this code

Where the use in a space changes from one use in Table C405.3.2(1) or C405.3.2(2) to another use in Table C405.3.2(1) or C405.3.2(2), the installed lighting wattage shall comply with Section C405.3

Where the space undergoing a change in occupancy or use is in a building with a fenestration area that exceeds the limitations of Section C402.4.1, the space is exempt from Section C402.4.1 provided that there is not an increase in fenestration area.

Exceptions:

1. Where the component performance alternative in Section C402.1.5 is used to comply with this section, the proposed UA shall be not greater than 110 percent of the target UA.
2. Where the total building performance option in Section C407 is used to comply with this section, the annual energy cost of the proposed design shall be not greater than 110 percent of the annual energy cost otherwise permitted by Section C407.3.



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