ADOPTED RULE # _____

Administrative Procedures – Adopted Rule Filing

Instructions:

In accordance with Title 3 Chapter 25 of the Vermont Statutes Annotated and the "Rule on Rulemaking" adopted by the Office of the Secretary of State, this filing will be considered complete upon filing and acceptance of these forms with the Office of the Secretary of State, and the Legislative Committee on Administrative Rules.

All forms requiring a signature shall be original signatures of the appropriate adopting authority or authorized person, and all filings are to be submitted at the Office of the Secretary of State, no later than 3:30 pm on the last scheduled day of the work week.

The data provided in text areas of these forms will be used to generate a notice of rulemaking in the portal of "Proposed Rule Postings" online, and the newspapers of record if the rule is marked for publication. Publication of notices will be charged back to the promulgating agency.

PLEASE REMOVE ANY COVERSHEET OR FORM NOT REQUIRED WITH THE CURRENT FILING BEFORE DELIVERY!

Certification Statement: As the adopting Authority of this rule (see 3 V.S.A. § 801 (b) (11) for a definition), I approve the contents of this filing entitled:
Vermont Commercial Building Energy Standards (CBES)

_____, on December 12, 2019.
(signature) (date)

Printed Name and Title:
June Tierney, Commissioner, Vermont Department of Public Service

RECEIVED BY: _____

- ☐ Coversheet
- ☐ Adopting Page
- ☐ Clean text of the rule (Amended text without annotation)
- ☐ Letter regarding changes to the final proposed

1. TITLE OF RULE FILING:
   Vermont Commercial Building Energy Standards (CBES)
2. PROPOSED NUMBER ASSIGNED BY THE SECRETARY OF STATE
   19—P42
3. ADOPTING AGENCY:

   Department of Public Service
4. RECORDS EXEMPTION INCLUDED WITHIN RULE:
   (DOES THE RULE CONTAIN ANY PROVISION DESIGNATING INFORMATION AS CONFIDENTIAL; LIMITING ITS PUBLIC RELEASE; OR OTHERWISE EXEMPTING IT FROM INSPECTION AND COPYING?) No
   IF YES, CITE THE STATUTORY AUTHORITY FOR THE EXEMPTION:

   PLEASE SUMMARIZE THE REASON FOR THE EXEMPTION:

5. LEGAL AUTHORITY / ENABLING LEGISLATION:
   (THE SPECIFIC STATUTORY OR LEGAL CITATION FROM SESSION LAW INDICATING WHO THE ADOPTING ENTITY IS AND THUS WHO THE SIGNATORY SHOULD BE. THIS SHOULD BE A SPECIFIC CITATION NOT A CHAPTER CITATION).

   30 V.S.A. § 53 COMMERCIAL BUILDING ENERGY STANDARDS
6. THE FILING HAS CHANGED SINCE THE FILING OF THE FINAL PROPOSED RULE.
7. THE AGENCY HAS INCLUDED WITH THIS FILING A LETTER EXPLAINING IN DETAIL WHAT CHANGES WERE MADE, CITING CHAPTER AND SECTION WHERE APPLICABLE, INCLUDING CHANGES IN ECONOMIC IMPACT.
8. THE LEGISLATIVE COMMITTEE ON ADMINISTRATIVE RULES DID NOT OBJECT TO THE FINAL PROPOSAL.
9. PROCEDURAL HISTORY OF ADOPTION:

   ICAR Filing: 04/22/2019

   Proposal Filed with Office of the Secretary of State: 04/22/2019

   Notices Posted Online: 05/22/2019

   Notices Published in the Newspapers of Record: 20/30/2019

A Hearing WAS Held.

Hearings Held *(PLEASE USE ADDITIONAL SHEETS TO PROVIDE THE DATE, TIME AND LOCATION OF ALL HEARINGS, IF THIS FORM IS INSUFFICIENT TO LIST ALL HEARINGS HELD)*:

Date: 6/21/2019
Time: 01:00 PM
Street Address: 115 State Street, Montpelier, VT
Zip Code: 05633-5501

Date:
Time: AM
Street Address:
Zip Code:

Date:
Time: AM
Street Address:
Zip Code:

Date:
Time: AM
Street Address:
Zip Code:

Deadline for Public Comment: 7/10/2019

Final Proposal —

Filed with Secretary of State: 08/05/2019

Filed with LCAR: 08/05/2019

Dates of LCAR Review: 09/05/2019, 12/05/2019, , ,

Adopted Rule —

Filed with Secretary of State: 12/18/2019

Filed with LCAR: 12/18/2019

10. EFFECTIVE DATE: 09/01/2020

(A RULE MAY TAKE EFFECT 15 DAYS AFTER ADOPTION IS COMPLETE OR AT A LATER TIME PROVIDED IN THE TEXT OF THE RULE SEE 3 V.S.A. §845(d) FOR DETAILS).

Administrative Procedures – Adopting Page

Instructions:

This form must accompany each filing made during the rulemaking process:

Note: To satisfy the requirement for an annotated text, an agency must submit the entire rule in annotated form with proposed and final proposed filings. Filing an annotated paragraph or page of a larger rule is not sufficient. Annotation must clearly show the changes to the rule.

When possible, the agency shall file the annotated text, using the appropriate page or pages from the Code of Vermont Rules as a basis for the annotated version. New rules need not be accompanied by an annotated text.

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1. TITLE OF RULE FILING:
   Vermont Commercial Building Energy Standards (CBES)
2. ADOPTING AGENCY:
   Department of Public Service
3. TYPE OF FILING (*PLEASE CHOOSE THE TYPE OF FILING FROM THE DROPDOWN MENU BASED ON THE DEFINITIONS PROVIDED BELOW*):

   - **AMENDMENT -** Any change to an already existing rule, even if it is a complete rewrite of the rule, it is considered an amendment as long as the rule is replaced with other text.
   - **NEW RULE -** A rule that did not previously exist even under a different name.
   - **REPEAL** - The removal of a rule in its entirety, without replacing it with other text.

   This filing is **AN AMENDMENT OF AN EXISTING RULE** .

4. LAST ADOPTED (*PLEASE PROVIDE THE SOS LOG#, TITLE AND EFFECTIVE DATE OF THE LAST ADOPTION FOR THE EXISTING RULE*):

   SOS LOG #: 14-045

   Title: Commercial Building Energy Standards (CBES)

   Effective Date: March 1, 2015

2020 Vermont Commercial Building Energy Standard AMENDMENTS

VERMONT
DEPARTMENT OF PUBLIC SERVICE

112 State Street
Montpelier, VT 05620

802-828-2811

https://publicservice.vermont.gov/

These rules are adopted under 30 V.S.A. § 53. This document shall be known and cited as the *2020 Vermont Commercial Building Energy Standard Amendments*. The *2018 International Energy Conservation Code (IECC) (*First Printing: August 2017) and *ANSI/ASHRAE/IES Standard 90.1-2016 Energy Standard for Buildings Except Low-Rise Residential Buildings* published by International Code Council (ICC), Inc., as amended, are incorporated by reference and are available on the ICC website at: www.iccsafe.org. The IECC is amended herein as follows.

PREFACE

delete and replace Preface as follows:

Introduction

The 2020 *Vermont Commercial Building Energy Standards* (CBES) is based on the *International Energy Conservation Code*® (IECC) 2018 edition and incorporates elements of *ANSI/ASHRAE/IES Standard 90.1-2016 Energy Standard for Buildings Except Low-Rise Residential Buildings.*

This comprehensive energy conservation code establishes minimum regulations for energy efficient buildings using prescriptive and performance-related provisions. It is founded on broad-based principles that make possible the use of new materials and new energy efficient designs.

The *International Energy Conservation Code* provisions provide many benefits, among which is the model code development process that offers an international forum for energy professionals to discuss performance and prescriptive code requirements. This model code also encourages international consistency in the application of provisions.

Development

This 2020 CBES is founded on principles intended to establish provisions consistent with the scope of an energy conservation code that adequately conserves energy; provisions that do not unnecessarily increase construction costs; provisions that do not restrict the use of new materials, products or methods of construction; and provisions that do not give preferential treatment to particular types or classes of materials, products or methods of construction.

Background

The Vermont Commercial Building Energy Standards (CBES) was adopted by statute (30 V.S.A. § 53) in 2006. This code applies to all commercial buildings and residential building 4 stories or greater above grade in Vermont and took effect January 1, 2007.

Update Process

The Commercial Building Energy Standards statute requires that revisions to the CBES are made promptly after the issuance of updated standards under the International Energy Conservation Code (IECC). The Department of Public Service (PSD) is required to convene stakeholders that include mortgage lenders, builders, building designers, utility representatives, and other persons with experience and expertise prior to the adoption of a revised CBES to provide recommendations.

The 2020 CBES is based on the language in the International Energy Conservation Code® (IECC) 2018 edition and incorporates elements *of ANSI/ASHRAE/IES Standard 90.1-2016 Energy Standard for Buildings Except Low-Rise Residential Buildings*. The 2020 CBES includes a new "Additional Efficiency Package options" section based upon a points approach to code compliance based upon building usage. The addition of "points" provides builders and designers greater flexibility in complying with CBES. The Vermont PSD held a series of stakeholder meetings in 2018 and 2019 to gather feedback on proposed changes to CBES. The revisions presented in this document were modified based on input received from these meetings.

EFFECTIVE USE OF THE 2020 VERMONT COMMERCIAL BUILDING ENERGY STANDARDS

The 2020 *Vermont Commercial Building Energy Standards* (CBES) is a code that regulates minimum energy conservation requirements for new buildings as well as additions, alterations, renovations, and repairs to existing buildings. The 2020 CBES addresses energy conservation requirements for all aspects of energy uses in commercial construction, including heating and ventilating, lighting, water heating, and power usage for appliances and building systems.

The 2020 CBES is a design document. For example, before constructing a building, the designer must determine the minimum insulation *R*-values and fenestration *U*-factors for the building exterior envelope. The CBES sets forth minimum requirements for exterior envelope insulation, window and door *U*-factors and SHGC ratings, duct insulation, lighting and power efficiency, mechanical ventilation, and water distribution insulation.

Arrangement and Format of the 2020 CBES

The 2020 CBES, like other codes published by ICC, is arranged and organized to follow sequential steps that generally occur during a plan review or inspection. The 2020 CBES is divided into six different parts:

Chapters	Subjects
1-2	Scope, Administration and Definitions
3	General Requirements
4	Commercial Energy Efficiency
5	Existing Buildings
6	Referenced Standards

Italicized Terms

Selected terms set forth in Chapter 2: Definitions, are italicized where they appear in code text. Such terms are not italicized where the definition set forth in Chapter 2 does not impart the intended meaning in the use of the term. The terms selected have definitions that the user should read carefully to facilitate better understanding of the code.

The following is a chapter-by-chapter synopsis of the scope and intent of the provisions of the 2020 Vermont Commercial Building Energy Standards:

Chapter 1: Scope and Administration. This chapter contains provisions for the application, enforcement and administration of subsequent requirements of the code. In addition to establishing the scope of the code, Chapter 1 identifies which buildings and structures come under its purview. Chapter 1 is largely concerned with maintaining “due process of law” in enforcing the energy conservation criteria contained in the body of this code. Only through careful observation of the administrative provisions can the code official or other authority having jurisdiction, where one exists, reasonably expect to demonstrate that “equal protection under the law” has been provided.

Chapter 2 Definitions. Chapter 2 is the repository of the definitions of terms used in the body of the code. Codes are technical documents and every word, term and punctuation mark can impact the meaning of the code text and the intended results. The code often uses terms that have a unique meaning in the code and the code meaning can differ substantially from the ordinarily understood meaning of the term as used outside of the code.

The terms defined in Chapter 2 are deemed to be of prime importance in establishing the meaning and intent of the code text. The user of the code should be familiar with and consult this chapter because the definitions are essential to the correct interpretation of the code and the user may not be aware that a term is defined.

Where understanding of a term’s definition is especially key to or necessary for understanding of a particular code provision, the term is shown in *italics* wherever it appears in the code. This is true only for those terms that have a meaning that is unique to the code. In other words, the generally understood meaning of a term or phrase might not be sufficient or consistent with the meaning prescribed by the code; therefore, it is essential that the code-defined meaning be known.

Guidance regarding tense, gender and plurality of defined terms as well as guidance regarding terms not defined in this code is provided.

Chapter 3 General Requirements. Chapter 3 provides interior design conditions that are used as a basis for assumptions in heating and cooling load calculations and provides basic material requirements for insulation materials and fenestration materials and provides standards for commercial mechanical ventilation and combustion safety.

Chapter 4 Commercial Energy Efficiency. Chapter 4 contains the energy-efficiency-related requirements for the design and construction of most types of commercial buildings, and residential buildings greater than three stories in height above grade. This chapter defines requirements for the portions of the building and building systems that impact energy use in new commercial construction and new residential construction greater than three stories in height and promotes the effective use of energy. The provisions within the chapter promote energy efficiency in the building envelope, the heating and cooling system and the service water heating system of the building.

Chapter 5 Existing Buildings. Chapter 5 of each set of provisions contains the technical energy efficiency requirements for existing buildings. Chapter 5 provisions address the maintenance of buildings in compliance with the code as well as how additions, alterations, repairs and changes of occupancy need to be addressed from the standpoint of energy efficiency. Specific provisions are provided for historic buildings.

Chapter 6 Referenced Standards. The code contains numerous references to standards that are used to regulate materials and methods of construction. Chapter 6 contains a comprehensive list of all standards that are referenced in the code. The standards are part of the code to the extent of the reference to the standard. Compliance with the referenced standard is necessary for compliance with this code. By providing specifically adopted standards, the construction and installation requirements necessary for compliance with the code can be readily determined. The basis for code compliance is, therefore, established and available on an equal

basis to the code official, or other authority having jurisdiction, where one exists, contractor, designer and owner.

Chapter 6 is organized in a manner that makes it easy to locate specific standards. It lists all of the referenced standards, alphabetically, by acronym of the promulgating agency of the standard. Each agency's standards are then listed in either alphabetical or numeric order based upon the standard identification. The list also contains the title of the standard; the edition (date) of the standard referenced; any addenda included as part of the ICC adoption; and the section or sections of this code that reference the standard.

Marginal Markings

Solid vertical lines in the margins within the body of the code indicate a technical change from the requirements of the IECC 2015 and 2018 edition. Vermont specific additions and changes are designated through dotted lines in the margin. Deletion indicators in the form of an arrow (➡) are provided in the margin where an entire section, paragraph, exception or table has been deleted or an item in a list of items or a table has been deleted.

Abbreviations and Notations

The following is a list of common abbreviations and units of measurement used in this code. Some of the abbreviations are for terms defined in Chapter 2. Others are terms used in various tables and text of the code.

AFUE	Annual fuel utilization efficiency
bhp	Brake horsepower (fans)
Btu	British thermal unit
Btu/h-ft^2	Btu per hour per square foot
C-factor	See Chapter 2—Definitions
CDD	Cooling degree days
cfm	Cubic feet per minute
cfm/ft^2	Cubic feet per minute per square foot
ci	Continuous insulation
COP	Coefficient of performance
DCV	Demand control ventilation
°C	Degrees Celsius
°F	Degrees Fahrenheit
DWHR	Drain water heat recovery
DX	Direct expansion
E_c	Combustion efficiency
E_v	Ventilation efficiency
E_t	Thermal efficiency
EER	Energy efficiency ratio
EF	Energy factor
ERI	Energy Rating index
F-factor	See Chapter 2—Definitions
FDD	Fault detection and diagnostics
FEG	Fan efficiency grade
FL	Full load

ft^2	Square foot
gpm	Gallons per minute
HDD	Heating degree days
HERS	Home Energy Rating System
hp	Horsepower
HSPF	Heating seasonal performance factor
HVAC	Heating, ventilating and air conditioning
IEER	Integrated energy efficiency ratio
IPLV	Integrated Part Load Value
Kg/m^2	Kilograms per square meter
kW	Kilowatt
LPD	Light power density (lighting power allowance)
L/s	Liters per second
Ls	Liner system
m^2	square meters
MERV	Minimum efficiency reporting value
NAECA	National Appliance Energy Conservation Act
NPLV	Nonstandard Part Load Value
Pa	Pascal
PF	Projection factor
pcf	Pounds per cubic foot
PSD	Department of Public Service (Vermont)
psf	Pounds per square foot
PTAC	Packaged terminal air conditioner
PTHP	Packaged terminal heat pump
R-value	See Chapter 2—Definitions
SCOP	Sensible coefficient of performance
SEER	Seasonal energy efficiency ratio
SHGC	Solar Heat Gain Coefficient
SPVAC	Single packaged vertical air conditioner
SPVHP	Single packaged vertical heat pump
SRI	Solar reflectance index
SWHF	Service water heat recovery factor
U-factor	See Chapter 2—Definitions
VAV	Variable air volume
VRF	Variable refrigerant flow
VT	Visible transmittance
W	Watts
w.c.	Water column
w.g.	Water gauge

Add, amend, delete and replace as follows:

CHAPTER 1
SCOPE AND ADMINISTRATION

- *delete and replace* - **C101.1 Title:**
This code shall be known as the 2020 *Commercial Building Energy Standards* (CBES) of Vermont and shall be cited as such. It is referred to herein as "this code."

- *delete and replace* - **C101.2 Scope:**
This code applies to *commercial buildings* and the buildings' sites and provides the minimum energy-efficient requirements for the design and construction, and a plan for operation and maintenance of:

1. New buildings and their systems,

2. New portions of buildings and their systems,

3. New systems and equipment in existing buildings, and

4. New equipment or building systems specifically identified in the standard that are part of industrial or manufacturing processes.

   Exception: This code shall not apply to farm structures as defined in 24 V.S.A. § 4413.

- *delete and replace* - **C101.3 Intent:**
This code shall regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this objective. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

This code has been designed to minimize any conflict or difference between other adopted codes and standards. Where there is conflict between the codes or codes and standards, the Life Safety Code (NFPA 101), Fire Code (NFPA 1), and the IBC shall apply. Where one code or standard has a requirement and another code or standard does not have a requirement, the code or standard with a requirement shall apply.

- *delete and replace* - **C101.4.1 Mixed occupancy.**
Where a building includes both *residential* and *commercial* occupancies, the following shall apply:

1. With respect to a structure that is three stories or less in height,

   i. The term "residential building" shall include the living spaces in the structure and the nonliving spaces in the structure that serve only the residential users such as common hallways, laundry facilities, residential management offices, community rooms, storage rooms, and foyers.

   ii. The term "commercial building" shall include all commercial uses within the structure and all common areas and facilities that serve both residential and commercial uses.

2. With respect to a structure that is four stories or more in height, the term “commercial building” shall include all uses and areas within the structure.

- *add* - **C101.4.2 Application to existing buildings.**
Existing buildings shall follow the provisions of Chapter 5 of this code.

- *delete and replace* - **C101.5 Compliance.**

Residential buildings shall meet the provisions of the 2020 *Residential Building Energy Standards* (RBES), and *Commercial buildings* shall meet the provisions of the 2020 *Commercial Building Energy Standards* (CBES).

- *delete and replace* - **C101.5.1 Compliance materials.**
The *code official or other authority having jurisdiction* shall be permitted to approve specific computer software, worksheets, compliance manuals and other similar materials that meet the intent of this code.

At the time of application for a construction permit, where required, the designer shall include a statement on the submitted stamped drawings that the design complies with the requirements of the CBES.

- *add* - **C101.5.2 Exempt buildings.**
The following buildings, or portions thereof separated from the remainder of the building by *building thermal envelope* assemblies complying with Section C402 shall be exempt from the *building thermal envelope* provisions of Section C402.

1. **Low energy buildings.** Those with a peak design rate of energy usage less than 3.4 Btu/h · ft^2 (10.7 W/m^2) or 1.0 watt per square foot (10.7 W/m^2) of floor area for space conditioning purposes.

2. **Unconditioned buildings.** Those that do not contain *conditioned space*.

3. ***Greenhouses.***

4. **Inflatable buildings.** Temporary air-supported structures shall be exempt only from the thermal envelope provisions of this code.

5. **Yurt buildings.** A yurt or tent that is not mechanically cooled and is only heated through biomass or other on-site renewable energy.

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

   A. Buildings that are separate buildings with floor area not more than 500 square feet (50 m^2).

   B. Buildings that are intended to house electronic equipment with installed equipment power totaling not less than 7 watts per square foot (75 W/m^2) and not intended for human occupancy.

   C. Buildings that have a heating system capacity not greater than 17,000 Btu/hr (5 kW) and a heating thermostat set point that is restricted to not more than 50°F (10°C).

   D. Buildings that have an average wall and roof *U*-factor less than 0.120.

- *delete and replace* - **C102.1 General.**
The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been *approved*. An alternative material, design or method of construction shall be *approved* where the code official or other authority having jurisdiction finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this code in quality, strength, effectiveness, *fire resistance*, durability and safety. Where the alternative material, design or method of construction is not *approved*, the code official or other authority having jurisdiction shall respond in writing, stating the reasons why the alternative was not *approved*.

- *delete and replace* - **C103.1 General.**
Where required construction documents and other supporting data shall be submitted in one or more sets with each application for a permit. The construction documents shall be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed. Where special conditions exist, the *code official or other authority having jurisdiction* is authorized to require necessary construction documents to be prepared by a registered design professional.

> **Exception:** The *code official or other authority having jurisdiction* is authorized to waive the requirements for construction documents or other supporting data if the *code official or other authority having jurisdiction* determines they are not necessary to confirm compliance with this code.

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

1. Insulation materials and their *R*-values.
2. Fenestration *U*-factors and solar heat gain coefficients (SHGCs).
3. Area-weighted *U*-factor and solar heat gain coefficient (SHGC) calculations.
4. Design ambient temperatures.
5. Interior temperatures for heating and cooling modes.
6. Relative humidity setpoints.
7. Ventilation rates.
8. Mechanical system design criteria.
9. Mechanical and service water heating systems and equipment types, sizes and efficiencies.
10. Economizer description.
11. Equipment and system controls.
12. Fan motor horsepower (hp) and controls.

13. Duct sealing, duct and pipe insulation and location.

14. Lighting fixture schedule with wattage and control narrative.

15. Location of *daylight* zones on floor plans.

16. Air sealing details, a diagram showing the building's pressure boundary in plan(s) and section(s), and a calculation of the area of the pressure boundary as specified in section C402.4.1.3

Mechanical equipment schedules shall be included in the submitted construction documents and shall include, but are not limited to, the following information:

1. Equipment efficiencies.

2. Fan and pump nameplate motor and brake horsepower.

3. Fan efficiency grade (FEG), where applicable.

4. Hydronic system (if applicable) supply and return water design temperatures for boilers and all terminal devices (e.g., baseboards, unit ventilators, etc.).

5. Steam system (if applicable) design pressure for boilers and all terminal devices.

- *delete and replace* - **C103.3 Examination of documents.**
The *code official or other authority having jurisdiction* shall examine or cause to be examined the accompanying construction documents and shall ascertain whether the construction indicated and described is in accordance with the requirements of this code and other pertinent laws or ordinances. The *code official or other authority having jurisdiction* is authorized to utilize a registered design professional, or other *approved* entity not affiliated with the building design or construction, in conducting the review of the plans and specifications for compliance with the code.

- *delete and replace* - **C103.3.1 Approval of construction documents.**
When the *code official or other authority having jurisdiction* issues a permit where construction documents are required, the construction documents shall be endorsed in writing and stamped "Reviewed for Code Compliance." Such *approved* construction documents shall not be changed, modified or altered without authorization from the *code official or other authority having jurisdiction*. Work shall be done in accordance with the *approved* construction documents.

One set of construction documents so reviewed shall be retained by the *code official.* The other set shall be returned to the applicant, kept at the site of work and shall be open to inspection by the *code official or other authority having jurisdiction* or a duly authorized representative.

- *delete* - **C103.3.2 Previous approvals.**
This code shall not require changes in the construction documents, construction or designated occupancy of a structure for which a lawful permit has been heretofore issued or otherwise lawfully authorized, and the construction of which has been pursued in good faith within 180 days after the effective date of this code and has not been abandoned.

- delete and replace - **C103.3.3 Phased approval.**
The *code official or other authority having jurisdiction* shall have the authority to issue a permit for the construction of part of an energy conservation system before the construction documents for the entire system have been submitted or *approved*, provided that adequate information and detailed statements have been filed complying with all pertinent requirements of this code. The holders of such permit shall

proceed at their own risk without assurance that the permit for the entire energy conservation system will be granted.

- *delete and replace* - **C103.5 Retention of construction documents.**
One set of *approved* construction documents shall be retained by the *code official or other authority having jurisdiction* for a period of not less than 180 days from date of completion of the permitted work, or as required by state or local laws.

- *delete and replace* - **C103.6 Building documentation.**
The construction documents shall specify that the documents described in this section be provided to the building owner or owner's authorized agent within 90 days of the date of receipt of the certificate of occupancy.

- *delete and replace* - **C103.6.2 Compliance documentation.**
Energy code compliance documentation and supporting calculations shall be delivered in one document to the building owner as part of the project record documents or manuals, or as a standalone document. This document shall include the specific energy code edition utilized for compliance determination for each system, documentation demonstrating compliance with Section C303.1.3 for each fenestration product installed, and the interior lighting power compliance path, building area or space-by-space, used to calculate the lighting power allowance.

For projects complying with Item 1 of Section C401.2, the documentation shall include:

1. The envelope insulation compliance path.

2. All compliance calculations including those required by Sections C402.1.3, C403.8.1, C405.3 and C405.4.

- *delete* – **SECTION C104 FEES** (C104.1 through C104.5) in its entirety

- *delete and replace* - **C105.1 General.**
Where required, construction or work for which a permit is required shall be subject to inspection by the *code official or other authority having jurisdiction*, his or her designated agent or an approved agency, and such construction or work shall remain visible and able to be accessed for inspection purposes until *approved*. Approval as a result of an inspection shall not be construed to be an approval of a violation of the provisions of this code or of other ordinances of the jurisdiction. Inspections presuming to give authority to violate or cancel the provisions of this code or of other ordinances of the jurisdiction shall not be valid. It shall be the duty of the permit applicant to cause the work to remain visible and able to be accessed for inspection purposes. Neither the *code official or other authority having jurisdiction,* nor the jurisdiction shall be liable for expense entailed in the removal or replacement of any material, product, system or building component required to allow inspection to validate compliance with this code.

- *delete* - **C105.2 Required Inspections** and its subsections (**C105.2.1** through **C105.2.6**) and replace with the following-

C10.2 Required approvals.
Work shall not be done beyond the point indicated in each successive inspection without first obtaining the approval of the *code official or other authority having jurisdiction*. The *code official or other authority having jurisdiction*, upon notification, shall make the requested inspections and shall either indicate the portion of the construction that is satisfactory as completed, or notify the permit holder or his or her agent wherein the same

fails to comply with this code. Any portions that do not comply shall be corrected and such portion shall not be covered or concealed until authorized by the *code official or other authority having jurisdiction*.

C105.2.1 Final inspection.
Where applicable, the building shall have a final inspection and shall not be occupied until *approved*. The final inspection shall include verification of the installation and proper operation of all required building controls, and documentation verifying activities associated with required *building commissioning* have been conducted and findings of noncompliance corrected.

- *delete and replace* - **C105.3 Reinspection.**
A building shall be reinspected where determined necessary by the *code official or other authority having jurisdiction*.

- *delete and replace* - **C105.4 Approved inspection agencies.**
The *code official or other authority having jurisdiction* is authorized to accept reports of third-party inspection agencies not affiliated with the building design or construction, provided that such agencies are *approved* as to qualifications and reliability relevant to the building components and systems that they are inspecting.

- *delete and replace* - **C105.5 Inspection requests.**
It shall be the duty of the holder of the permit or their duly authorized agent to notify the *code official or other authority having jurisdiction* when work is ready for inspection. It shall be the duty of the permit holder to provide access to and means for inspections of such work that are required by this code.

- *delete and replace* - **C105.6 Reinspection and testing.**
Where any work or installation does not pass an initial test or inspection, the necessary corrections shall be made to achieve compliance with this code. The work or installation shall then be resubmitted to the *code official or other authority having jurisdiction* for inspection and testing.

- *delete and replace* - **C105.7 Approval.**
After the prescribed tests and inspections indicate that the work complies in all respects with this code, a notice of approval shall be issued by the *code official or other authority having jurisdiction*.

- *delete and replace* - **C105.7.1 Revocation.**
The *code official or other authority having jurisdiction* is authorized to suspend or revoke, in writing, a notice of approval issued under the provisions of this code wherever the certificate is issued in error, or on the basis of incorrect information supplied, or where it is determined that the *building* or structure, premise, or portion thereof is in violation of any ordinance or regulation or any of the provisions of this code.

- *delete* – **SECTION C108 STOP WORK ORDER** (C108.1 through C108.4) in its entirety

- *delete* – **SECTION C109 BOARD OF APPEALS** (C109.1 through C109.3) in its entirety

CHAPTER 2
DEFINITIONS

SECTION C201
GENERAL

- *delete and replace* - **C201.3 Terms defined in other codes and standards.**
Terms that are not defined in this code but are defined in the *International Building Code, International Fire Code, International Fuel Gas Code, International Mechanical Code, International Plumbing Code, or* ASHRAE Standard 62.1 or by *ANSI/SMACNA* shall have the meanings ascribed to them in those codes and standards.

SECTION C202
GENERAL DEFINITIONS

- *delete and replace* - **AIR CURTAIN.** A device, installed at the building entrance, that generates and discharges a laminar air stream intended to prevent or reduce the infiltration of external, unconditioned air into the conditioned spaces, or the loss of interior, conditioned air to the outside.

- *delete and replace* - **APPROVED.** Approval by the *code official or other authority having jurisdiction* as a result of investigation and tests conducted by him or her, or by reason of accepted principles or tests by nationally recognized organizations.

- *delete and replace* - **APPROVED AGENCY.** An established and recognized agency that is regularly engaged in conducting tests or furnishing inspection services, or furnishing product certification research reports, where such agency has been approved by the *code official or other authority having jurisdiction*.

- *add* - **BIODIESEL.** Mono alkyl esters derived from plant or animal matter that meet the registration requirements for fuels and fuel additives established by the Environmental Protection Agency under section 211 of the Clean Air Act (42 U.S.C. § 7545), and the requirements of ASTM D6751.

- *add* - **BIOMASS.** The vegetation removed from the forest, usually logging slash, small-diameter trees, tops, limbs, or trees. This includes wood logs, wood pellets and wood chips.

- *add* - **CIRCADIAN RHYTHM SYSTEMS.** Lighting systems meant to mimic natural daylight by having different color correlated temperature (CCT) settings at different times of day. This may be accomplished by a single light source that can change CCT electronically or by using multiple light sources, each with a different CCT.

- *add* - **CLERESTORY.** An outside wall of a room or building that rises above an adjoining roof and contains fenestration.

- *delete and replace* - **CODE OFFICIAL.** The officer or other designated authority charged with the administration and enforcement of this code, or a duly authorized representative. The Vermont Public Service Department is not the *code official* and shall not be required to conduct inspections of construction or construction documents.

- *add* - **COLD-CLIMATE HEAT PUMP.** An air source heat pump with an inverter-driven, variable capacity compressor that is designed to provide full heating heat pump capacity and having a minimum COP of 1.75 or

greater at maximum operating capacity at an outside air temperature of 5°F. The indoor and outdoor units must be part of an AHRI matched system.

- *add* - **COMMERCIAL BUILDING ENERGY STANDARDS (CBES).** The Vermont non-residential Energy Code, based on the 2018 IECC, but modified substantially.

- *delete and replace* - **CONDITIONED SPACE.** An area, room or space that is enclosed within the building thermal envelope and is directly or indirectly heated by a heating system whose output capacity is greater than 14 Btu/h·ft^2 of floor area or directly or indirectly cooled by a cooling system whose sensible output capacity is greater than or equal to 3.4 Btu/h·ft^2 of floor area. Spaces are indirectly heated or cooled where they communicate through openings with conditioned spaces, where they are separated from conditioned spaces by uninsulated walls, floors or ceilings, or where they contain uninsulated ducts, piping or other sources of heating or cooling.

- *add* - **DC Fast Charge,** DC Fast Charge uses a 480V, direct-current (DC) plug, sometimes knows as Level 3.

- *add* - **DESIGN PROFESSIONAL/AGENCY.** An individual or group of individuals who are registered, licensed or experienced to practice their respective design profession as defined by the laws of the state or jurisdiction in which the project is to be constructed.

- *add* - **DUCT FURNACE.** A furnace normally installed in distribution ducts of air-conditioning systems to supply warm air for heating and which depends on a blower not furnished as part of the duct furnace for air circulation.

- *add* - **FULLY SHIELDED FIXTURE.** A fixture constructed and installed in such a manner that all light emitted by it, either directly from the lamp (bulb) or a diffusing element, or indirectly by reflection or refraction from any part of the fixture, is projected below the horizontal.

- *add* - **FURNACE, WARM AIR.** A self-contained, indirect-fired or electrically heated furnace that supplies heated air through ducts to spaces that require it.

- *add* - **GROSS AREA OF EXTERIOR WALLS.** The normal projection of all exterior walls, including the edge area of above grade floors and the area of all windows and doors installed therein (see “Exterior wall”).

- *add* - **HIGH-EFFICACY LAMPS/LIGHTING.** Compact fluorescent lamps, light-emitting diode (LED) lamps, T-8 or smaller diameter linear fluorescent lamps, or other lamps with an efficacy of not less than 65 lumens per watt; or light fixtures of not less than 55 lumens per watt.

- *delete and replace* - **HIGH SPEED DOOR.** A door used primarily to facilitate vehicular access or material transportation, with a minimum opening rate of 32 inches (813 mm) per second, a minimum closing rate of 24 inches (610 mm) per second and that includes an automatic-closing device.

- *add* - **LEVEL 1 ELECTRIC VEHICLE CHARGING.** Level 1 charging uses a standard alternating current 120V outlet.

- *add* - **LEVEL 2 ELECTRIC VEHICLE CHARGING.** Level 2 uses a 240V alternating current outlet. , also known as DC Fast Charge.

- *add* - **LEVEL 3 ELECTRIC VEHICLE CHARGING.** Level 3 uses a 480V, direct-current (DC) plug.

- *delete and replace* - **LISTED.** Equipment, materials, products or services included in a list published by an organization acceptable to the *code official or other authority having jurisdiction* and concerned with evaluation of products or services that maintains periodic inspection of production of *listed* equipment or materials or

periodic evaluation of services and whose listing states either that the equipment, material, product or service meets identified standards or has been tested and found suitable for a specified purpose.

- *add* - **METAL BUILDING.** A complete integrated set of mutually dependent components and assemblies that form a building, which consists of a steel-framed superstructure and metal skin.

- *add* - **METAL BUILDING ROOF.** A roof that:

a. is constructed with a metal, structural, weathering surface;

b. has no ventilated cavity; and

c. has the insulation entirely below deck (i.e., does not include composite concrete and metal deck construction nor a roof framing system that is separated from the superstructure by a wood substrate) and whose structure consists of one or more of the following configurations:

1. metal roofing in direct contact with the steel framing members;

2. metal roofing separated from the steel framing members by insulation; or

3. insulated metal roofing panels installed as described in sub items (a) or (b).

- *add* - **METAL BUILDING WALL.** A wall whose structure consists of metal spanning members supported by steel structural members (i.e., does not include spandrel glass or metal panels in curtain wall systems).

- *add* - **MULTIFAMILY DWELLING.** A building containing three or more dwelling units where the occupants are primarily permanent in nature and which are adjacent vertically or horizontally. If built side-by-side, at least one of the following is true: (1) they do not have a wall that extends from ground to roof, (2) they share a heating system, or (3) they have interstructural public utilities such as water supply/sewage disposal.

- *add* - **OCCUPANCY CLASSIFICATIONS.** Building occupancies shall be defined by the 2018 International Building Code, which is summarized here. Discrepancies in the summary or further clarifications shall defer to the 2018 International Building Code.

Assembly Group A is the occupancy group used for buildings that are for the gathering of persons for purposes such as civic, social or religious functions; recreation, food or drink consumption or awaiting transportation.

The first occupancy group is A-1. The group is for the production and viewing of the performing arts, motion pictures, or television and radio studios admitting an audience.

The next occupancy group is A-2. The group includes assembly uses intended for food and/or drink consumption, such as: banquet halls, casino gambling areas, nightclubs, restaurants, cafeterias, taverns, and bars.

A-3 includes assembly uses intended for worship, recreation or amusement and other assembly uses not classified elsewhere in Group A such as: community halls, courtrooms, gymnasiums, and waiting areas in transportation terminals.

A-4 includes assembly uses intended for viewing of indoor sporting events and activities with spectator seating.

A-5 includes assembly uses intended for participation in or viewing outdoor activities.

Business Group B is the occupancy group used for office, professional or service-type transactions, including storage or records and accounts.

Educational Group E is the occupancy group used by six or more persons at any one time for educational purposes through the 12th grade.

Factory Industrial Group F is the occupancy group used for disassembling, fabricating, finishing, manufacturing, packaging, repair or processing operation that are not classified as Group H or Group S.

High-hazard Group H is the occupancy group used for manufacturing, processing, generation or storage of materials that constitute a physical or health hazard.

Institutional Group I is the occupancy group used for more than 16 persons, excluding staff, who reside on a 24-hour basis in a supervised environment and receive custodial care.

Mercantile Group M is the occupancy group used for the display and sale of merchandise, and involves stocks of goods, wares or merchandise.

Residential Group R is the occupancy group used for buildings that include sleeping rooms and are not institutional. There are four different occupancy groups within R.

The first occupancy group is R-1. This group is for transient uses like hotels, motels and boarding houses.

R-2 is occupancies containing sleeping units or more than two dwelling units where the occupants are primarily permanent. This includes apartments, dormitories, fraternities and sororities. It also includes vacation timeshares (with more than two units) and convents and monasteries. Boarding houses or congregate living facilities with 16 or fewer occupants go into group R-3.

R-3 is for permanent occupancies that are not R-1, R-2, or R-4.

R-4 is for occupancies for more than five but not more than 16 persons, excluding staff, who reside on a 24-hour basis in a supervised residential environment and receive custodial care.

Storage Group S is the occupancy group used for storage that is not classified as a hazardous occupancy.

- *delete and replace* - **ON-SITE RENEWABLE ENERGY.** Energy derived from solar radiation, wind, waves, tides, landfill gas, biogas, biomass or the internal heat of the earth. The energy system providing on-site renewable energy shall be located on the project site (see “Renewable Energy”).

- *add* - **RENEWABLE ENERGY.** Energy produced using a technology that relies on a resource that is being consumed at a harvest rate at or below its natural regeneration rate including, but not limited to, solar hot water, solar hot air, solar photovoltaics, wind, and hydro.

A. Methane gas and other flammable gases produced by the decay of sewage treatment plant wastes or landfill wastes and anaerobic digestion of agricultural products, byproducts, or wastes shall be considered renewable energy resources, but no form of solid waste, other than agricultural or silvicultural waste, shall be considered renewable.

B. The only portion of electricity produced by a system of generating resources that shall be considered renewable is that portion generated by a technology that qualifies as renewable.

C. The following fuels shall not be considered renewable energy supplies: coal, oil, propane, and natural gas.

D. Biomass is considered renewable.

- *delete and replace* - **RESIDENTIAL BUILDING.** For this code, includes detached one- and two-family dwellings and multiple single-family dwellings (townhouses) and *Group R*-2, R-3 and R-4 (see Occupancy Classifications) buildings three stories or less in height above grade plane.

- *add* - **RESIDENTIAL BUILDING ENERGY STANDARDS (RBES).** The Vermont Residential Energy Code based on the 2015 IECC.

- *add* - **SEMI-CONDITIONED SPACE.** An enclosed space within a building that is directly or indirectly heated by a heating system whose output capacity is less than or equal to 14 Btu/h·ft^2 of floor area; or if the space is directly or indirectly cooled and the cooling system's sensible output capacity is less than 3.4 Btu/h·ft^2 of floor area.

CHAPTER 3
GENERAL REQUIREMENTS

SECTION C301
CLIMATE ZONES

- *delete* – **Section C301 CLIMATE ZONES (C301.1** through **C301.4)** in its entirety.

- *add* – **C301.1 General**
The State of Vermont, in its entirety, is classified as climate zone 6A

SECTION C302
DESIGN CONDITIONS

- *add* - **C302.2 Climatic data[1].**

- Heating Design Temperature, 99.6%: -9°F
  (ASHRAE Standard 169)

- Cooling Design Temperature Dry-Bulb, 1.0%: 84°F
  (ASHRAE Standard 169)

- Cooling Design Temperature Wet-Bulb, 1.0%: 69°F
  (ASHRAE Standard 169)

- Heating Degree Days, 65° Base: 7,626
  (ASHRAE Standard 169)

- Cooling Degree Days, 50° Base: 2,183
  (ASHRAE Standard 169)

Adjustments may be made only in the following cases:

1. Winter heating design temperatures for projects either:

   i. Located at an elevation of 1,500 feet or higher, or

   ii. Located in Caledonia, Essex or Orleans counties.

   iii. Adjustments shall be made as listed in the National Climate Data Center for the specific weather station: http://www.ncdc.noaa.gov/cdo-web/.

2. As approved by the *code official or other authority having jurisdiction*.

SECTION C303
MATERIALS, SYSTEMS AND EQUIPMENT

- *delete and replace* – **TABLE C303.1.3(1)**

TABLE C303.1.3(1)
DEFAULT GLAZED WINDOW, GLASS DOOR AND SKYLIGHT *U*-FACTORS

FRAME TYPE	WINDOW AND GLASS DOOR		SKYLIGHT	
	Single	Double	Single	Double
Metal	1.20	0.80	2.00	1.30
Metal with Thermal Break	1.10	0.65	1.90	1.10
Nonmetal or Metal Clad	0.95	0.55	1.75	1.05
Glazed Block	0.60			

Metal Thermal Break.= A metal thermal break framed window shall incorporate the following minimum design characteristics:
a) The thermal conductivity of the thermal break material shall be not more than 3.6 Btu-in/h/ft2/°F;
b) The thermal break material must produce a gap in the frame material of not less than 0.210 inches; and
c) All metal framing members of the products exposed to interior and exterior air shall incorporate a thermal break meeting the criteria in a) and b) above.

CHAPTER 4
COMMERCIAL ENERGY EFFICIENCY

SECTION C401
GENERAL

- *delete and replace* – **C401.2 Application.**
Commercial buildings shall comply with one of the following:

1. The requirements of Sections C402 through C405 and C407. In addition, commercial buildings shall comply with Section C406 and tenant spaces shall comply with Section C406.1.

2. The requirements of ANSI/ASHRAE/IESNA 90.1-2016. New buildings using ANSI/ASHRAE/IESNA 90.1-2016 compliance paths (a) or (b) (see ANSI/ASHRAE/IESNA 90.1-2016 section 4.2.1.1 *New Buildings*) shall comply with Section C406 in the 2020 CBES and tenant spaces shall comply with Section C406.1.1 in the 2020 CBES. Commercial building projects utilizing the alternative compliance path of ANSI/ASHRAE/IESNA 90.1-2016 must follow all applicable provisions listed in Section 401.2.1.

- *delete and replace* – **C401.2.1 Applicable provisions to Standard 90.1-2016.**

1. All instances of the term building official in ASHRAE/IESNA 90.1-2016 shall be replaced with the terms *code official or other authority having jurisdiction.*

2. ASHRAE/IESNA 90.1-2016 *Section 4.2.1.1 New Buildings.*
Delete the equation for Performance Cost Index Target (PCI_t) and replace with:

$$PCI_t = [BPF \times (BBUEC + BBREC)] / BBP.$$

Delete Table 4.2.1.1 *Building* Performance Factor (BPF) and replace with:

TABLE 4.2.1.1 *Building* Performance Factor (BPF)

Building Area Type[a]	Vermont BPF
Multifamily	.62
Healthcare/hospital	.46
Hotel/motel	.48
Office	.43
Restaurant	.50
Retail	.44
School	.39
Warehouse	.53
All Others	.45

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

3. ASHRAE/IESNA 90.1-2016 *Section 5.1.4.1 United States Locations*. Delete the exception clause and replace with the following:

Adjustments may be made only in the following cases:

a. Winter heating design temperatures for projects either:

   i. Located at an elevation of 1,500 feet or higher, or

   ii. Located in Caledonia, Essex or Orleans counties.

   iii. Adjustments shall be made as listed in the National Climate Data Center for the specific weather station: http://www.ncdc.noaa.gov/cdo-web/.

b. As approved by *code official or other authority having jurisdiction*

4. ASHRAE/IESNA 90.1-2016 *Section 5 Building Envelope*. All envelope requirements shall comply with the following tables in the 2020 *Vermont Commercial Building Energy Standards* (CBES):

   i. *Table C402.1(1), Building Envelope Requirements—Opaque Assemblies and Elements.* Any spaces that qualify as *Semiheated* in ASHRAE/IESNA 90.1-2016 need only comply with the *Semiconditioned* requirement in Table C402.1(1),

   ii. *Table C402.1(2), Building Envelope Requirements—Metal Building Assembly Descriptions, and*

   iii. *Table C402.3, Building Envelope Fenestration Maximum U-Factor and SHGC Requirements.*

5. ASHRAE/IESNA 90.1-2016 *Section 5.4.3 Air Leakage.* Delete section in its entirety and replace *with Section C402.4 Air leakage—thermal envelope of the 2020 Vermont CBES.*

6. ASHRAE/IESNA 90.1-2016 *Section 5.5.3.1 Roof Insulation.* Delete section in its entirety and replace with *Section C402.2.1 Roof assembly of the 2020 Vermont CBES.*

7. ASHRAE/IESNA 90.1-2016 *Section 5.5.3.3 Below-Grade Wall Insulation.* Delete section in its entirety and replace with *Section C402.2.3 Below-grade walls of the 2020 Vermont CBES.*

8. ASHRAE/IESNA 90.1-2016 *Section 5.5.3.5 Slab-on-Grade Floor Insulation.* Add to the end of this section the requirements of section *C402.2.6 Slabs-on-grade perimeter insulation of the 2020 Vermont CBES.*

9. ASHRAE/IESNA 90.1-2016 *Section 6.2 Compliance Path(s)*. Add new section as follows:

   a. *Section 6.2.3 Electric Resistance Space Heating.* Building heating with electrical resistance units, including baseboard radiation, heat pump reheat coils, duct coils, boilers, domestic hot water heaters, and coils in terminal units and air systems is prohibited.

   Exceptions to Section 6.2.3:

   a. Areas, such as stairways, that are not permitted to be penetrated with piping or duct and no other method of heating is possible.

   b. Replacement of existing electrical resistance unit.

   c. Special conditions of occupancy or use that require electrical resistance heat to maintain health, safety or environmental conditions.

d. Limited areas where a practical application of resistance electrical heat is demonstrated (e.g., small interior space, such as a rest room, which is distant from the distribution system, hazardous material storerooms, stairwell or other means of emergency egress).

e. Domestic hot water heaters less than or equal to 7.5 kW in total unit input capacity.

f. Multifamily buildings with heating loads ≤ 6.0 Btu/hour/square foot at design temperature.*

g. Cold-Climate Heat Pump where:*

a. the full heating demand can be met with the heat pump at an outside air temperature of 5°F; and

b. the building *thermal envelope* shall be tested in accordance with ASTM E 779 at a pressure differential of 0.3 inch water gauge (75 Pa) and deemed to comply with the provisions of Section C402.4.1 when the tested air leakage rate of the building thermal envelope is not greater than 0.20 cfm/ft^2 (including the areas of the slab and below grade walls).

*Buildings served by the City of Burlington Electric (BED) must also receive approval from BED before installing electric resistance heating equipment.

10. ASHRAE/IESNA 90.1-2016 *Section 6.3.2(e) Criteria.* Delete "an electric resistance heater."

11. ASHRAE/IESNA 90.1-2016 *Section 6.4.3.5 Heat Pump Auxiliary Heat Control. Delete section in its entirety and replace with Section C403.4.1.1 Heat pump supplementary heat of the 2020 Vermont CBES.*

12. ASHRAE/IESNA 90.1-2016 *Section 6.4.3.8 Ventilation Controls for High-Occupancy Areas. Add exception (6)*: Ventilation needs for process loads.

13. ASHRAE/IESNA 90.1-2016 *Section 6.4.3.9 Heated or Cooled Vestibules*. Delete section in its entirety and replace with *Section C403.4.1.4 Duct and plenum insulation and sealing of the 2020 Vermont CBES.*

14. ASHRAE/IESNA 90.1-2016 *Section 6.4.4.1.2 Duct and Plenum Insulation*. Delete section in its entirety and replace with *Section C403.11.1 Duct and plenum insulation and sealing of the 2020 Vermont CBES.*

15. Add new Section 6.4.7 to ASHRAE/IESNA 90.1-2016, titled Economizer *Fault Detection and Diagnostics (FDD). Insert Section C403.5.5 Economizer fault detection and diagnostics (FDD) of the 2020 Vermont CBES.*

16. ASHRAE/IESNA 90.1-2016 Section 6.5.1 *Economizers.* Delete section in its entirety and replace with *Section C403.5 Economizers of the 2020 Vermont CBES.*

17. ASHRAE/IESNA 90.1-2016 Table 6.5.6.1-1 and 6.5.6.1-2 Exhaust Air Energy Recovery Requirements for Ventilation Systems. Both tables shall be greater than or equal to 3000 hours per year rather than 8000 hours.

18. ASHRAE/IESNA 90.1-2016 Table 6.5.6.1-1 and Table 6.5.6.1-2 *Exhaust Air Energy Recovery Requirements*, delete requirement for systems with ≥ 10% and < 20% outdoor air (second column of tables).

19. ASHRAE/IESNA 90.1-2016 *Section 6.5.6.2 Heat Recovery for Service Water Heating, 6.5.6.2.2.* Add exception (3): If compliance with Section 6.5.6.2 will be detrimental to chiller operating

efficiency due to conflicts with optimized chiller head pressure control.

20. ASHRAE/IESNA 90.1-2016 *Section 6.7.2.4 System Commissioning.* Delete section in its entirety and replace with Section C407System Commissioning of the 2020 Vermont CBES.

21. ASHRAE/IESNA 90.1-2016 *Section 7.1 General.* Add new section as follows:

    a. *Section 7.1.1.4 Electrical Water Heating Limitation.* Individual electric service water heating units shall be limited to a maximum of 5 kW total power input.

        Exception: Instantaneous electric water heaters used to serve emergency showers and emergency eye wash stations.

22. ASHRAE/IESNA 90.1-2016 *Table 7.8 Performance Requirements for Water Heating Equipment.*
    a. Change first row (Electric tabletop water heaters) size category to < 5 kW, and
    b. Change second row (Electric water heaters) size category to < 5 kW, and
    c. Delete entire third row for electric water heaters > 12 kW.

23. ASHRAE/IESNA 90.1-2016 *Section 9 Lighting*. All lighting power density (LPD) requirements shall comply with the following tables in the 2020 *Vermont Commercial Building Energy Standards* (CBES):

    i. *Table C405.3.2(1), Interior Lighting Power Allowances: Building Area Method.*

    ii. *Table C405.3.2(2), Interior Lighting Power Allowances: Space-by-Space Method, and*

    iii. *Table C405.4.2(2), Individual Lighting Power Allowances for Building Exteriors.* Note that Vermont does not have any exterior lighting zone 4 areas.

    Exception: E*xterior lighting zone 0 shall follow LPD requirements given by* ASHRAE/IESNA 90.1-2016 Table 9.4.4-2.

24. ASHRAE/IESNA 90.1-2016 *Section 9.4.1.3 Special Applications.* At the end of the section add the following wording:
    d. Luminaires providing means of egress illumination where the means of egress shall be illuminated at all times the room or space is occupied shall be controlled by occupancy sensors, or a signal from another building control system, that automatically reduces the lighting power by at least 50% when unoccupied for a period longer than 15 minutes.

    <u>Exceptions:</u>

    1. Means of egress illumination that does not exceed 0.02 watts per square foot of building area is exempt from this requirement.

    2. Emergency lighting designated to meet Section 1008.3 of the *International Building Code*

25. ASHRAE/IESNA 90.1-2016 *Section 9.4.1.4 Exterior Lighting Control.* Add the following requirement:

    e. Exterior lighting shall be *full cut off* fixtures, limiting the light output to less than 10% at and below 10 degrees below the horizontal. Fixtures shall be independently certified by manufacturer as full cut off or meet the definition of a *fully shielded* light fixture.

26. ASHRAE/IESNA 90.1-2016 *Section 9.4.4 Dwelling Units.* Delete section in its entirety and replace *with:* Not less than 90% of the *permanently installed* lighting fixtures shall use lamps with an *efficacy*

of at least 65 lm/W or have a total *luminaire efficacy* of at least 55 lm/W.

27. ASHRAE/IESNA 90.1-2016 *Section 9.6.2 Additional Interior Lighting Power.* Amend the exception in part (a) to read that the power shall not exceed 0.6 W/ft2 of such *spaces* instead of 0.75 W/ft2. In part (b) Delete the equation for Additional Interior Lighting Power Allowance and replace with:

Additional interior lighting power allowance	=	250 W + (Retail Area 1 × 0.20 W/ft^2) + (Retail Area 2 × 0.20 W/ft^2) + (Retail Area 3 × 0.50 W/ft^2) + (Retail Area 4 × 0.90 W/ft^2)

28. ASHRAE/IESNA 90.1-2016 *Section 10.4 Mandatory Provisions*. Add the following sections

    i. *10.4.6, Renewable energy systems,* which will meet the requirements of section *C405.10 Renewable energy systems* in the 2020 Vermont CBES.

    ii. *10.4.7 Electric Vehicle Charging Stations,* which will meet the requirements of section *C405.11 Electric Vehicle Charging Stations* in the 20 Vermont CBES.

- *add* – **C401.2.2 Application to replacement fenestration products.**
Where some or all of an existing *fenestration* unit is replaced with a new *fenestration* product, including sash and glazing, the replacement *fenestration* unit shall meet the applicable requirements for *U*-factor and *SHGC* in Table C402.3.

Exception: An area-weighted average of the *U*-factor of replacement fenestration products being installed in the building for each fenestration product category listed in Table C402.3 shall be permitted to satisfy the *U*-factor requirements for each fenestration product category listed in Table C402.3. Individual fenestration products from different product categories listed in Table C402.3 shall not be combined in calculating the area-weighted average *U*-factor.

- *add* **- C401.3 Certificate of compliance.**
30 V.S.A. §53 requires certification that both the design and the construction of a commercial building is in compliance with the CBES.

Certification shall be issued by completing and signing a certificate permanently and affixing it to the outside of the heating or cooling equipment, to the electrical service panel and located inside the building, or in a visible location in the immediate vicinity of one of these three areas. Copies of the signed certification documents shall be sent to the local town clerk and to the Vermont Public Service Department.

SECTION C402
BUILDING ENVELOPE REQUIREMENTS

- *delete and replace* – **C402.1 General (Prescriptive).**
In addition to the envelope requirements of Section C402, envelope enhancements may be needed to meet the requirements of Section C406, Additional Efficiency Package Options. See Section C406.

Building thermal envelope assemblies for buildings that are intended to comply with the code on a prescriptive basis in accordance with the compliance path described in Item 1 of Section C401.2, shall comply with the following:

1. The opaque portions of the building thermal envelope shall comply with the specific insulation requirements of Section C402.2 and the thermal requirements of either the *R*-value-based method of Section C402.1.1; the *U*-, *C*-and *F*-factor-based method of Section C402.1.2; the component performance alternative of Section C402.1.3; or the building above-grade performance alternative of Section C402.1.4. Building assemblies between conditioned and semi-conditioned spaces shall comply with the semi-conditioned requirements.

2. Fenestration in building envelope assemblies shall comply with Section C402.3.

   Exception: Semi-conditioned spaces do not have fenestration requirements.

3. Air leakage of building envelope assemblies shall comply with Section C402.4. Buildings with both conditioned and semi-conditioned spaces shall independently comply with the requirements of Section C402.4.

Alternatively, where buildings have a vertical fenestration area or skylight area exceeding that allowed in Section C402.3, the building and building thermal envelope shall comply with Section C401.2, Item 2.

Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.10.1.

- *delete* - **C402.1.1 Low-energy buildings.**

- *delete* - **C402.1.2 Equipment buildings.**

- *add* - **C402.1.1 Insulation component R-value-based method.**
Building thermal envelope opaque assemblies shall comply with the requirements of Sections C402.2 and C402.3. For opaque portions of the *building thermal envelope* intended to comply on an insulation component *R-value* basis, the *R*-values for insulation shall be not less than that specified in the "*Minimum R-values*" columns of Table C402.1(1). Commercial buildings or portions of commercial buildings enclosing *conditioned spaces* shall use the *R*-values from the "*Conditioned Space*" column of Table C402.1(1). Commercial buildings or portions of commercial buildings enclosing semi-conditioned spaces shall use the *R*-values from the "Semi-conditioned Space" column of Table C402.1(1). Walls between conditioned and semi-conditioned spaces shall use the *R*-values from the "Semi-conditioned Space" column of Table C402.1(1).

- add - **C402.1.2 Assembly U-factor, C-factor or F-factor-based method.**
Building thermal envelope opaque assemblies shall meet the requirements of Sections C402.2 and C402.3. Building thermal envelope opaque assemblies intended to comply on an assembly *U*-, *C*- or *F*-factor basis shall have a *U*-, *C*- or *F*-factor not greater than that specified in the "*Maximum Overall U-factor*" columns of Table C402.1(1). Commercial buildings or portions of commercial buildings enclosing *conditioned spaces* shall use the *U*-, *C*- or *F*-factor from the "*Conditioned Space*" column of Table

C402.1(1). Commercial buildings or portions of commercial buildings enclosing semi-conditioned spaces shall use the *U*-, *C*- or *F*-factor from the "Semi-conditioned Space" column of Table C402.1(1). Walls between conditioned and semi-conditioned spaces shall use the *R*-values from the "Semi-conditioned Space" column of Table C402.1(1).

- *delete* – **TABLE C402.1.3 OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD**

- delete - **TABLE C402.1.4 OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, U-FACTOR METHOD**

- *add* – **Table C402.1 (1) BUILDING ENVELOPE REQUIREMENTS—OPAQUE ASSEMBLIES AND ELEMENTS**

TABLE C402.1(1)
BUILDING ENVELOPE REQUIREMENTS—OPAQUE ASSEMBLIES AND ELEMENTS[a,b]

COMPONENT	MAXIMUM OVERALL *U*-FACTOR[a]		MINIMUM *R*-VALUES	
	Conditioned Space	Semi-conditioned Space	Conditioned Space	Semi-conditioned Space
Roofs				
Insulation entirely above deck	U-0.025	U-0.039	R-40ci	R-25ci
Metal buildings[a]	U-0.026	U-0.037	R-25+R-11+R-11 LS	R-19 + R-11 LS or R-25 + R-8 LS
Attic and Other	U-0.021	U-0.034	R-49	R-30
Walls, Above grade				
Mass	U-0.048	U-0.104	R-19ci	R-9.5ci
Metal building[a]	U-0.044	U-0.060	R-13 + R-17ci or R-22.1ci	R-15.8ci
Metal-framed	U-0.044	U-0.064	R-13 + R-15ci or R-20ci	R-13 + R-7.5ci
Wood-framed and other	U-0.042	U-0.064	R-13 + R-12ci or R-19 + R-8ci or R-20ci	R-13 + R-3.8ci
Walls, Below Grade[c]				
Below-grade wall	C-0.063	C-0.119	R-15ci	R-7.5ci
Floors				
Mass[d]	U-0.051	U-0.087	R-16.7ci	R-8.3ci
Joist/Framing—Metal	U-0.032	U-0.052	R-38	R-19
Joist/Framing—Wood and Other	U-0.033	U-0.051	R-30	R-19
Slab-on-Grade Floors				
Unheated slabs	F-0.36	F-0.54	R-10 for entire slab and around perimeter	R-10 for 24 in.
Heated slabs[e]	F-0.373	F-0.55	R-20 for entire slab and around perimeter	R-10 for entire slab and around perimeter
Opaque Doors				
Swinging	U-0.37		N/A	
Non-Swinging	N/A		R-4.75	

Upward-acting, Sectional	N/A	R-10
Garage door <14% glazing	U-0.31	N/A

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m^2, 1 pound per cubic foot = 16 kg/m^3.
ci = Continuous insulation, NR = No Requirement, LS = Liner System.

a. For all envelope categories the use of opaque assembly U-factors, C-factors, and F-factors from ANSI/ASHRAE/IESNA 90.1-2016 Appendix A shall be permitted, provided the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/IESNA 90.1-2016 Appendix A. Alternatively, Table C402.1(2) for metal building assembly descriptions, Table C402.1(3) for metal building roof assembly U-factors, Table 402.1(4) for attic roofs with wood joists U-factors, Table 402.1(5) for metal building wall assembly U-factors, Table 402.1(6) for metal-framed wall assembly U-factors, and Table 402.1(7) for wood-framed wall assembly U-factors may be used in lieu of ANSI/ASHRAE/IESNA 90.1-2016 Appendix A.
b. Opaque assembly *U*-factors based on designs tested in accordance with ASTM C1363 shall be permitted. The *R*-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design.
c. Where heated slabs are below grade, below-grade walls shall comply with the *F*-factor requirements for heated slabs.
d. “Mass floors” shall include floors weighing not less than:
   1. 35 pounds per square foot of floor surface area; or
   2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.
e. Evidence of compliance with the F-factors indicated in the table for heated slabs shall be demonstrated by the application of the unheated slab *F*-factors and *R*-values derived from ASHRAE 90.1-2016 Appendix A.

- *add* - **TABLE C402.1(2) BUILDING ENVELOPE REQUIREMENTS—METAL BUILDING ASSEMBLY DESCRIPTIONS**

TABLE C402.1(2)
BUILDING ENVELOPE REQUIREMENTS—METAL BUILDING ASSEMBLY DESCRIPTIONS

BUILDING ENVELOPE REQUIREMENTS—METAL BUILDING ASSEMBLY DESCRIPTIONS	DESCRIPTION	REFERENCE
ROOFS		
Liner system	A continuous membrane installed below the purlins and uninterrupted by framing members. Uncompressed, unfaced insulation rests on top of the membrane between the purlins. For multilayer installations, the last rated R-Value of insulation is for unfaced insulation draped over purlins and then compressed when the metal roof panels are attached. A minimum R-5 thermal spacer block between the purlins and the metal roof panels is required unless compliance is shown by the overall assembly U-factor.	ANSI/ASHRAE/IESNA 90.1-2016
Filled Cavity (Fc)	The first *rated R-value of insulation* represents faced or unfaced insulation installed between the purlins. The second *rated R-value of insulation* represents unfaced insulation installed above the first layer, perpendicular to the purlins and compressed when the metal *roof* panels are attached. A supporting structure retains the bottom of the first layer at the prescribed depth required for the full thickness of insulation. A minimum R-5 thermal spacer block between the purlins and the metal *roof* panels is required unless compliance is shown by the overall assembly *U-factor*.	ANSI/ASHRAE/IESNA 90.1-2016
WALLS		
R-13 + R-17ci	The first rated *R*-value of insulation is for insulation compressed between metal building wall panels and the steel structure. The second rated *R*-value is for continuous insulation (e.g., insulation boards). It is assumed that the insulation boards are installed on the inside of the girts and uninterrupted by the framing members. Insulation exposed to the conditioned space or semi-heated space shall have a facing, and all insulation seams shall be continuously sealed to pro- vide a continuous air barrier.	ANSI/ASHRAE/IESNA 90.1-2016
R-22.1ci	The rated *R*-value is for continuous insulation (e.g., insulation boards). It is assumed that the insulation boards are installed on the inside of the girts and uninterrupted by the framing members. Insulation exposed to the conditioned space or semi-heated space shall have a facing, and all insulation seams shall be continuously sealed to provide a continuous air barrier.	ANSI/ASHRAE/IESNA 90.1-2016

- *add* - TABLE C402.1(3) ASSEMBLY U-FACTORS FOR METAL BUILDING ROOFS

TABLE C402.1(3)
ASSEMBLY *U*-FACTORS FOR METAL BUILDING ROOFS

INSULATION SYSTEM	RATED *R*-VALUE OF INSULATION	OVERALL *U*-FACTOR FOR ENTIRE BASE ROOF ASSEMBLY	OVERALL *U*-FACTOR FOR ASSEMBLY OF BASE ROOF PLUS CONTINUOUS INSULATION (UNINTERRUPTED BY FRAMING)					
			Rated *R*-Value of Continuous Insulation					
Standing Seam Roofs with Thermal Spacer Blocks[a]			**R-15.8**	**R-19**	**R-22.1**	**R-25**	**R-32**	**R-38**
Single layer[b]	None	1.280					0.031	0.026
	R-10	0.115		0.036	0.032	0.030	0.025	0.021
	R-11	0.107		0.035	0.032	0.029	0.024	0.021
	R-13	0.101		0.035	0.031	0.029	0.024	0.021
	R-16	0.096		0.034	0.031	0.028	0.024	0.021
	R-19	0.082	0.036	0.032	0.029	0.027	0.023	0.020
Double layer[b]	R-10 + R-10	0.088	0.037	0.033	0.030	0.028	0.023	0.020
	R-10 + R-11	0.086	0.036	0.033	0.030	0.027	0.023	0.020
	R-11 + R-11	0.085	0.036	0.033	0.030	0.027	0.023	0.020
	R-10 + R-13	0.084	0.036	0.032	0.029	0.027	0.023	0.020
	R-11 + R-13	0.082	0.036	0.032	0.029	0.027	0.023	0.020
	R-13 + R-13	0.075	0.034	0.031	0.028	0.026	0.022	0.019
	R-10 + R-19	0.074	0.034	0.031	0.028	0.026	0.022	0.019
	R-11 + R-19	0.072	0.034	0.030	0.028	0.026	0.022	0.019
	R-13 + R-19	0.068	0.033	0.030	0.027	0.025	0.021	0.019
	R-16 + R-19	0.065	0.032	0.029	0.027	0.025	0.021	0.019
	R-19 + R-19	0.060	0.031	0.028	0.026	0.024	0.021	0.018
Liner system[c]	R-25+R-11+R-11 LS	0.026						
Filled cavity[c]	R-10 + R-19 Fc	0.041	0.025	0.023	0.022	0.020	0.018	0.016
Thru-fastened Roofs without Thermal Spacer Blocks								
	R-10	0.184			0.036	0.033	0.027	0.023
	R-11	0.182			0.036	0.033	0.027	0.023
	R-13	0.174			0.036	0.033	0.026	0.023
	R-16	0.157			0.035	0.032	0.026	0.023
	R-19	0.151			0.035	0.032	0.026	0.022

(Multiple *R*-values are listed in order from inside to outside)
Shaded areas comply with minimum requirements for semi-conditioned spaces but not conditioned spaces.

a. A standing seam roof clip that provides a minimum 1.5 inch distance between the top of the purlins and the underside of the metal building roof panels is required.
b. A minimum R-3 thermal spacer block is required.
c. A minimum R-5 thermal spacer block is required.

- *add* - **TABLE C402.1(4) ASSEMBLY U-FACTORS FOR ATTIC ROOFS WITH WOOD JOISTS**

TABLE C402.1(4)
ASSEMBLY *U*-FACTORS FOR ATTIC ROOFS WITH WOOD JOISTS

RATED R-VALUE OF INSULATION ALONE	OVERALL U-FACTOR FOR ENTIRE ROOF ASSEMBLY[a]
Wood-Framed Attic, Standard Framing	
R-30	U-0.034
R-38	U-0.027
R-49	U-0.021
R-60	U-0.017
R-71	U-0.015
R-82	U-0.013
R-93	U-0.011
R-104	U-0.010
R-115	U-0.009
R-126	U-0.008
Wood-Framed Attic, Advanced Framing	
R-30	U-0.032
R-38	U-0.026
R-49	U-0.020
R-60	U-0.016
R-71	U-0.014
R-82	U-0.012
R-93	U-0.011
R-104	U-0.010
R-115	U-0.009
R-126	U-0.008
Wood Joists, Single-Rafter Roof[b]	
R-30	U-0.036
R-38	U-0.029
R-38 + R-15ci	U-0.020

a. Shaded areas comply with minimum requirements for semi-conditioned spaces but not conditioned spaces.

b. The first R-value is the cavity insulation, while the second value is the continuous insulation uninterrupted by framing.

- *add* - **TABLE C402.1(5) ASSEMBLY U-FACTORS FOR METAL BUILDING WALLS**

TABLE C402.1(5)
ASSEMBLY *U*-FACTORS FOR METAL BUILDING WALLS

RATED *R*-VALUE OF INSULATION	OVERALL U-FACTOR FOR BASE WALL ASSEMBLY	OVERALL *U*-FACTORS FOR ASSEMBLY OF BASE WALL PLUS CONTINUOUS INSULATION (UNINTERRUPTED BY FRAMING)								
		R-6.5	R-9.8	R-13	R-15.8	R-19	R-22.1	R-25	R-32	R-38
Continuous Insulation Only										
R-0	1.180				0.060	0.050	0.044	0.039	0.030	0.026
Single Compressed Layer										
R-10	0.186			0.054	0.047	0.041	0.036	0.033	0.027	0.023
R-11	0.185			0.054	0.047	0.041	0.036	0.033	0.027	0.023
R-13	0.162			0.052	0.046	0.040	0.035	0.032	0.026	0.023
R-16	0.155			0.051	0.045	0.039	0.035	0.032	0.026	0.022
R-19	0.147		0.060	0.050	0.044	0.039	0.035	0.031	0.026	0.022
Single Layer in Cavity										
R-25[a]	0.059	0.044	0.039	0.035	0.032	0.029	0.027	0.025	0.021	0.019
R-30[b]	0.052	0.042	0.037	0.033	0.031	0.028	0.026	0.024	0.021	0.019
Double Layer										
R-25 + R-10	0.047									
R-25 + R-16	0.042									
R-25 + R-10[c]	0.039									
R-30 + R-16	0.039									
Shaded areas comply with minimum requirements for semi-conditioned spaces but not conditioned spaces.										

a. A minimum R-0.375 thermal spacer block or thermal break strip is required when installed without continuous insulation.
b. A minimum R-0.75 thermal spacer block or thermal break strip is required when installed without continuous insulation.
c. A minimum R-3 thermal spacer block is required.

- *add* - **TABLE C402.1(6) ASSEMBLY U-FACTORS FOR METAL-FRAMED WALLS**

TABLE C402.1(6)
ASSEMBLY *U*-FACTORS FOR METAL-FRAMED WALLS

RATED *R*-VALUE OF CAVITY INSULATION (EFFECTIVE INSTALLED)	OVERALL U-FACTOR FOR BASE WALL ASSEMBLY	OVERALL *U*-FACTORS FOR ASSEMBLY OF BASE WALL PLUS CONTINUOUS INSULATION (UNINTERRUPTED BY FRAMING)								
		R-12	R-13	R-14	R-15	R-20	R-25	R-30	R-35	R-40
Steel Framing at 16 in. on Center and 3.5 in. Depth										
R-0 (0.0)	0.352		0.063	0.059	0.056	0.044	0.036	0.030	0.026	0.023
R-11 (5.5)	0.132	0.051	0.049	0.046	0.044	0.036	0.031	0.027	0.024	0.021
R-13 (6.0)	0.124	0.050	0.048	0.045	0.043	0.036	0.030	0.026	0.023	0.021
R-15 (6.4)	0.118	0.049	0.047	0.045	0.043	0.035	0.030	0.026	0.023	0.021
Steel Framing at 16 in. on Center and 6.0 in. Depth										
R-19 (7.1)	0.109	0.047	0.045	0.043	0.041	0.034	0.029	0.026	0.023	0.020
R-21 (7.4)	0.106	0.047	0.045	0.043	0.041	0.034	0.029	0.025	0.022	0.020
Steel Framing at 24 in. on Center and 3.5 in. Depth										
R-0 (0.0)	0.338		0.063	0.059	0.056	0.044	0.036	0.030	0.026	0.023
R-11 (6.6)	0.116	0.048	0.046	0.044	0.042	0.035	0.030	0.026	0.023	0.021
R-13 (7.2)	0.108	0.047	0.045	0.043	0.041	0.034	0.029	0.025	0.023	0.020
R-15 (7.8)	0.102	0.046	0.044	0.042	0.040	0.034	0.029	0.025	0.022	0.020
Steel Framing at 24 in. on Center and 6.0 in. Depth										
R-19 (8.6)	0.094	0.044	0.042	0.041	0.039	0.033	0.028	0.025	0.022	0.020
R-21 (9.0)	0.090	0.043	0.042	0.040	0.038	0.032	0.028	0.024	0.022	0.020
Shaded areas comply with minimum requirements for semi-conditioned spaces but not conditioned spaces.										

- *add* - **TABLE C402.1(7) ASSEMBLY U-FACTORS FOR WOOD-FRAMED WALLS**

TABLE C402.1(7)
ASSEMBLY *U*-FACTORS FOR WOOD-FRAMED WALLS

RATED *R*-VALUE OF CAVITY INSULATION (EFFECTIVE INSTALLED)	OVERALL U-FACTOR FOR BASE WALL ASSEMBLY	OVERALL *U*-FACTORS FOR ASSEMBLY OF BASE WALL PLUS CONTINUOUS INSULATION (UNINTERRUPTED BY FRAMING)								
		R-6	R-9	R-12	R-15	R-20	R-25	R-30	R-35	R-40
Wood Studs at 16 in. on Center and 3.5 in. Depth										
R-0 (0.0)	0.292			0.064	0.053	0.042	0.035	0.030	0.026	0.023
R-11 (11.0)	0.096	0.059	0.050	0.044	0.038	0.032	0.028	0.024	0.022	0.020
R-13 (13.0)	0.089	0.056	0.047	0.041	0.037	0.031	0.027	0.024	0.021	0.019
R-15 (15.0)	0.083	0.053	0.045	0.039	0.035	0.030	0.026	0.023	0.020	0.019
Wood Studs at 16 in. on Center and 5.5 in. Depth										
R-19 (18.0)	0.067	0.046	0.040	0.036	0.032	0.027	0.024	0.021	0.019	0.018
R-21 (21.0)	0.063	0.043	0.038	0.034	0.030	0.026	0.023	0.021	0.019	0.017
Wood Studs at 16 in. on Center and R-10 Headers										
R-19 (18.0)	0.063	0.045	0.039	0.035	0.031	0.027	0.024	0.021	0.019	0.017
R-21 (21.0)	0.059	0.042	0.037	0.033	0.030	0.026	0.023	0.020	0.018	0.017
Wood Studs at 24 in. on Center and 3.5 in. Depth										
R-0 (0.0)	0.298			0.064	0.054	0.042	0.035	0.030	0.026	0.023
R-11 (11.0)	0.094	0.059	0.050	0.043	0.038	0.032	0.027	0.024	0.022	0.019
R-13 (13.0)	0.086	0.055	0.047	0.041	0.036	0.031	0.026	0.023	0.021	0.019
R-15 (15.0)	0.080	0.052	0.044	0.039	0.035	0.029	0.026	0.023	0.020	0.018
Wood Studs at 24 in. on Center and 5.5 in. Depth										
R-19 (18.0)	0.065	0.045	0.039	0.035	0.032	0.027	0.024	0.021	0.019	0.018
R-21 (21.0)	0.060	0.042	0.037	0.033	0.030	0.026	0.023	0.020	0.018	0.017
Wood Studs at 24 in. on Center and R-10 Headers										
R-19 (18.0)	0.062	0.044	0.039	0.034	0.031	0.027	0.024	0.021	0.019	0.017
R-21 (21.0)	0.057	0.041	0.036	0.032	0.029	0.025	0.023	0.020	0.018	0.017
Shaded areas comply with minimum requirements for semi-conditioned spaces but not conditioned spaces.										

- *delete* - **C402.1.4.1 Thermal resistance of cold-formed steel walls.**

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

- *delete* - **C402.1.5 Component performance alternative.**

- *add* - **C402.1.3 Component performance alternative.**
Building envelope values and fenestration areas determined in accordance with Equation 4-1 shall be an alternative to compliance with the *U*-, *F*- and *C*-factors in Tables C402.1(1) and C402.3 and the maximum allowable fenestration areas in Section C402.3.1. *Fenestration* shall meet the applicable SHGC requirements of Section C402.3.3.

A + B + C + D + E ≤ Zero **(Equation 4-1)**

where:

A = Sum of the (UA Dif) values for each distinct assembly type of the building thermal envelope, other than slabs on grade and below-grade walls.

UA Dif = UA Proposed - UA Table.

UA Proposed	=	Proposed *U*-value × Area.
UA Table	=	(*U*-factor from Table C402.1(1) or C402.3) × Area.
B	=	Sum of the (FL Dif) values for each distinct slab on-grade perimeter condition of the building thermal envelope.
FL Dif	=	FL Proposed - FL Table.
FL Proposed	=	Proposed *F*-value × Perimeter length.
FL Table	=	(*F*-factor specified in Table C402.1(1)) × Perimeter length.
C	=	Sum of the (CA Dif) values for each distinct below-grade wall assembly type of the building thermal envelope.
CA Dif	=	CA Proposed - CA Table.
CA Proposed	=	Proposed *C*-value × Area.
CA Table	=	(Maximum allowable C-factor specified in Table C402.1(1)) × Area.

Where the proposed vertical glazing area is less than or equal to the maximum vertical glazing area allowed by Section C402.3.1, the value of D (Excess Vertical Glazing Value) shall be zero. Otherwise:

D	=	(DA × UV) - (DA × U Wall), but not less than zero.
DA	=	(Proposed Vertical Glazing Area) - (Vertical Glazing Area allowed by Section C402.3.1).
UA Wall	=	Sum of the (UA Proposed) values for each opaque assembly of the exterior wall.
U Wall	=	Area-weighted average *U*-value of all above-grade wall assemblies.
UAV	=	Sum of the (UA Proposed) values for each vertical glazing assembly.
UV	=	UAV/total vertical glazing area.

Where the proposed skylight area is less than or equal to the skylight area allowed by Section C402.3.1, the value of E (Excess Skylight Value) shall be zero. Otherwise:

E	=	(EA × US) - (EA × U Roof), but not less than zero.
EA	=	(Proposed Skylight Area) - (Allowable Skylight Area as specified in Section C402.3.1).
U Roof	=	Area-weighted average *U*-value of all roof assemblies.
UAS	=	Sum of the (UA Proposed) values for each skylight assembly.
US	=	UAS/total skylight area.

- *add* - **C402.1.4 Building above-grade performance alternative.**
Above-grade building envelope values determined in accordance with Equation 4-2 shall be an alternative to compliance with the *U*-factors in Tables C402.1(1) and C402.3 and the maximum allowable fenestration areas in Section C402.3.1. Below-grade walls, floors, and slabs shall meet the applicable requirements of Section C402.1.1 or C402.1.2. *Fenestration* shall meet the applicable SHGC requirements of Section C402.3.3.

UA-Total / Area ≤ 0.035 **(Equation 4-2)**

where:

UA-Total	=	Sum of the (UA) values for each distinct above-grade assembly type of the building thermal envelope including above-grade walls, roofs, doors, vertical fenestration, and skylights.
UA	=	Proposed *U*-value × Area.
Area	=	Surface area in square feet of the above-grade thermal barrier (above-grade wall area plus roof area).

- *delete and replace* - **C402.2 Specific building thermal envelope insulation requirements (Prescriptive).** Insulation in building thermal envelope opaque assemblies shall comply with Sections C402.2.1 through C402.2.8 and Table C402.1(1).

- *delete and replace* - **C402.2.1 Roof assembly.**
The minimum thermal resistance (*R*-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table C402.1(1), based on construction materials used in the roof assembly. Insulation installed on a suspended ceiling having removable ceiling tiles shall not be considered as part of the minimum thermal resistance of the roof insulation. Continuous insulation board shall be installed in not less than 2 layers and the edge joints between each layer of insulation shall be staggered. Mechanical curbs shall be insulated to R-12.

Exceptions:

1. Continuously insulated roof assemblies where the R-value is at least R-12 over the entire roof assembly and where the average, area-weighted R-value is equivalent to the *R*-value specified in Table C402.1(1).

2. A minimum of 60% of the required R-value from Table C402.1(1) must be maintained in area where the roof insulation tapers, such as at roof drains.

- *delete and replace* - **C402.2.1.1 Skylight curbs.**
Skylight curbs shall be insulated to the level of roofs with insulation entirely above the deck or R-10, whichever is less.

Exception: Unit skylight curbs included as a component of a skylight listed and labeled in accordance with NFRC 100 shall not be required to be insulated.

- *delete and replace* - **C402.2.2 Above-grade walls.**
The minimum thermal resistance (*R*-value) of materials installed in the wall cavity between framing members and continuously on the walls shall be as specified in Table C402.1(1), based on framing type and construction materials used in the wall assembly. The *R*-value of integral insulation installed in concrete masonry units shall not be used in determining compliance with Table C402.1(1) except as otherwise noted in the table. In determining compliance with Table C402.1(1), the use of the *U*-factor of concrete masonry units with integral insulation shall be permitted.

"Mass walls" where used as a component in the thermal envelope of a building shall comply with one of the following:

1. Weigh not less than 35 pounds per square foot (171 kg/m^2) of wall surface area.

2. Weigh not less than 25 pounds per square foot (122 kg/m^2) of wall surface area where the material weight is not more than 120 pcf (1900 kg/m^3).

3. Have a heat capacity exceeding 7 Btu/ft^2 • °F (144 kJ/m^2 • K).

4. Have a heat capacity exceeding 5 Btu/ft^2 • °F (103 kJ/m^2 • K), where the material weight is not more than 120 pcf (1900 kg/m^3).

-delete - **C402.2.3 Floors.**- *add* - **C402.2.3 Floors over outdoor air or unconditioned space.**
The minimum thermal resistance (R-value) of the insulating material installed either between the floor framing, continuously above the floor assembly, or continuously below the floor assembly shall be as specified in Table C402.1(1), based on construction materials used in the floor assembly.

- *delete and replace* - **C402.2.4 Slabs-on-grade perimeter insulation.**
Where the slab on grade is in contact with the ground and insulation is not required for the entire slab, the minimum thermal resistance (*R*-value) of the insulation around the perimeter of unheated or heated slab-on-grade floors designed in accordance with the *R*-value method of Section C402.1.1 shall be as specified in Table C402.1(1). The perimeter insulation shall be placed on the outside of the foundation or on the inside of the foundation wall. The perimeter insulation shall extend downward from the top of the slab for the minimum distance shown in the table. Insulation extending away from the building shall be protected by pavement or by not less than of 10 inches (254 mm) of soil.

Exception: Where the slab-on-grade floor is greater than 48 inches (122 mm) below the finished exterior grade, perimeter insulation is not required.

- *delete and replace* - **C402.2.5 Below-grade walls.**
The *C*-factor for the below-grade exterior walls shall be in accordance with Table C402.1(1). The *R*-value of the insulating material installed continuously within or on the below-grade exterior walls of the building envelope shall be in accordance with Table C402.1(1). The *C*-factor or *R*-value required shall extend to a depth of not less than 10 feet (3048 mm) below the outside finished ground level, or to the level of the lowest floor of the conditioned space enclosed by the below-grade wall, whichever is less.

- *delete and replace* - **C402.2.6 Insulation of radiant heating systems.**
Radiant heating system panels, and their associated components that are installed in interior or exterior assemblies shall be insulated to an *R*-value of not less than R-3.5 on all surfaces not facing the space being heated. *Radiant heating system* panels that are installed in the *building thermal envelope* shall be separated from the exterior of the building or unconditioned or exempt spaces by not less than the *R*-value

of insulation installed in the opaque assembly in which they are installed or the assembly shall comply with Section C402.1.2.

Exception: Heated slabs on grade insulated in accordance with the "*Heated slabs*" row of Table 402.1(1).

- *delete* - **C402.3 Roof solar reflectance and thermal emittance.**

- *delete* - **TABLE C402.3 MINIMUM ROOF REFLECTANCE AND EMITTANCE OPTIONS**

- *delete* - **C402.4 Fenestration (Prescriptive).**

- *add* - **C402.3 Fenestration (Prescriptive).**
Fenestration shall comply with Sections C402.3.1 through C402.3.5 and Table C402.3. Daylight responsive controls shall comply with this section and Section C405.2.3.1.

- *add* - TABLE C402.3 BUILDING ENVELOPE FENESTRATION MAXIMUM U-FACTOR AND SHGC REQUIREMENTS

TABLE C402.3
BUILDING ENVELOPE FENESTRATION MAXIMUM U-FACTOR AND SHGC REQUIREMENTS

Vertical fenestration		
***U*-factor**		
Fixed fenestration	0.29	
Operable fenestration	0.37	
Entrance doors	0.68	
SHGC		
Orientation[a]	SEW	N
PF < 0.2	0.40	0.53
0.2 ≤ PF < 0.5	0.48	0.58
PF≥0.5	0.64	0.64
Skylights		
U-factor	0.48	
SHGC	0.38	

NR = No requirement, PF = Projection factor.
a. "N" indicates vertical fenestration oriented within 45 degrees of true north.
"SEW" indicates orientations other than "N."

- *delete* - **TABLE C402.4 BUILDING ENVELOPE FENESTRATION MAXIMUM U-FACTOR AND SHGC REQUIREMENTS**

- *modify* - **C402.4.1 Maximum area** to **C402.3.1 Maximum area**

- *delete* - **C402.4.1.1 Increased vertical fenestration area with daylight responsive controls.**

- *add* - **C402.34.1.1 Increased vertical fenestration area with daylight responsive controls (see Section C405.2.3).**
Not more than 40 percent of the gross above-grade wall area shall be vertical fenestration, provided that all of the following requirements are met:

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

   Exception: Fenestration that is outside the scope of NFRC 200 is not required to comply with Item 4.

- *modify* - **C402.4.1.2 Increased skylight area with daylight responsive controls** to **C402.3.1.2 Increased skylight area with daylight responsive controls.**

- *delete* - **C402.4.2 Minimum skylight fenestration area.**

- *add* - **C402.3.2 Minimum skylight fenestration area.**

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

1. A minimum skylight area to *toplit daylight zone* of not less than 3 percent where all skylights have a VT of not less than 0.40 as determined in accordance with Section C303.1.3.

2. A minimum skylight effective aperture of not less than 1 percent, determined in accordance with Equation 4-3.

Skylight Effective Aperture =

$$\frac{0.85 \times \text{Skylight Area} \times \text{Skylight VT} \times \text{WF}}{\text{Toplit Zone}} \qquad \textbf{(Equation 4-3)}$$

where:

Skylight area	=	Total fenestration area of skylights.
Skylight VT	=	Area weighted average visible transmittance of skylights.
WF	=	Area weighted average well factor, where well factor is 0.9 if light well depth is less than 2 feet (610 mm), or 0.7 if light well depth is 2 feet (610 mm) or greater.
Light well depth	=	Measure vertically from the underside of the lowest point of the skylight glazing to the ceiling plane under the skylight.

Exception: Skylights above *daylight zones* of enclosed spaces are not required in:

1. Spaces where the designed *general lighting* power densities are less than 0.5 W/ft^2 (5.4 W/m^2).

2. Areas where it is documented that existing structures or natural objects block direct beam sunlight on not less than half of the roof over the enclosed area for more than 1,500 daytime hours per year between 8 a.m. and 4 p.m.

3. Spaces where the *daylight zone* under rooftop monitors is greater than 50 percent of the enclosed space floor area.

4. Spaces where the total area minus the area of sidelight *daylight zones* is less than 2,500 square feet (232 m^2), and where the lighting is controlled in accordance with Section C405.2.3.

- *modify* - **C402.4.2.1 Lighting controls in toplit daylight zones** to **C402.3.2.1 Lighting controls in toplit daylight zones.**

- *modify* - **C402.4.2.2 Haze factor to C402.3.2.2 Haze factor**

- *delete* – **C402.4.3 Maximum U-factor and SHGC.**

- *add* - **C402.3.3 Maximum U-factor and SHGC.**
The maximum *U*-factor and solar heat gain coefficient (SHGC) for fenestration shall be as specified in Table C402.3.

The window projection factor shall be determined in accordance with Equation 4-4.

PF = *A/B* **(Equation 4-4)**

where:

PF	=	Projection factor (decimal).
A	=	Distance measured horizontally from the farthest continuous extremity of any overhang, eave or permanently attached shading device to the vertical surface of the glazing.
B	=	Distance measured vertically from the bottom of the glazing to the underside of the overhang, eave or permanently attached shading device.

Where different windows or glass doors have different *PF* values, they shall each be evaluated separately.

- *delete* – **C402.4.3.1 Increased skylight SHGC.**

- *add* - **C402.3.3.1 Increased skylight SHGC.**
Skylights shall be permitted a maximum SHGC of 0.57 where located above *daylight zones* provided with *daylight responsive controls*.

- *delete* – **C402.4.3.2 Increased skylight U-factor.**

- *add* - **C402.3.3.2 Increased skylight U-factor.**
Where skylights are installed above *daylight zones* provided with *daylight responsive controls*, a maximum U-factor of 0.72 shall be permitted.

- *delete* – **C402.4.3.3 Dynamic glazing.**

- *add* - **C402.3.3.3 Dynamic glazing.**
Where dynamic glazing is intended to satisfy the SHGC and VT requirements of Table C402.3, the ratio of the higher to lower labeled SHGC shall be greater than or equal to 2.4, and the *dynamic glazing* shall be automatically controlled to modulate the amount of solar gain into the space in multiple steps. Dynamic glazing shall be considered separately from other fenestration, and area-weighted averaging with other fenestration that is not dynamic glazing shall not be permitted.

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

- *delete* – **C402.4.3.4 Area-weighted U-factor.**

- *add* - **C402.3.3.4 Area-weighted U-factor.**
An area-weighted average shall be permitted to satisfy the *U*-factor requirements for each fenestration product category listed in Table C402.3. Individual fenestration products from different fenestration product categories listed in Table C402.3 shall not be combined in calculating area-weighted average *U*-factor.

- *delete* – **C402.4.4 Daylight zones.**

- *add* - **C402.3.4 Daylight zones.**
Daylight zones referenced in Sections C402.3.1.1 through C402.3.3.2 shall comply with Sections C405.2.3.2 and C405.2.3.3, as applicable. Daylight zones shall include *toplit zones* and sidelit zones.

- *delete* – **C402.4.5 Doors.**

- *add* - **C402.3.5 Doors.**
Opaque swinging doors shall comply with Table C402.1(1). Opaque nonswinging doors shall comply with Table C402.1(1). Opaque doors shall be considered as part of the gross area of above-grade walls that are part of the building *thermal envelope*. Other doors shall comply with the provisions of Section C402.3.3 for vertical fenestration.

- *delete* – **C402.5 Air leakage—thermal envelope (Mandatory).**

- *add* - **C402.4 Air leakage—thermal envelope (Mandatory).**
The *thermal envelope* of buildings shall comply with Sections C402.4.1 through C402.4.5.

- *delete* – **C402.5.1 Air barriers.**

- *add* - **C402.4.1 Air barriers.**
A continuous air barrier shall be provided throughout the building thermal envelope. The air barriers shall be permitted to be located on the inside or outside of the building envelope, located within the assemblies composing the envelope, or any combination thereof. The air barrier shall either comply with Section C402.4.1.1 or Sections C402.4.1.2 through C402.4.1.8.

- *add* - **C402.4.1.1 Air Barrier Performance Testing**

The building *thermal envelope* shall be tested in accordance with ASTM E 779 at a pressure differential of 0.3 inch water gauge (75 Pa) or an equivalent method approved by the code official or authority having jurisdiction and deemed to comply with the provisions of this section when the tested air leakage rate of the building thermal envelope is not greater than 0.30 cfm/ft^2 (including the areas of the slab and below grade walls).

Exceptions:

1. For buildings having over 50,000 ft2 of gross conditioned floor area, air leakage testing shall be permitted to be conducted on less than the whole building, provided the following portions of the building are tested and their measured air leakage is area-weighted by the surface areas of the building envelope:
    a. The entire floor area of all stories that have any spaces directly under a roof.
    b. The entire floor area of all stories that have a building entrance or loading dock.
    c. Representative above-grade wall sections of the building totaling at least 25% of the wall area enclosing the remaining conditioned space; floor area tested per (a) and (b) shall not be included in the 25%.
2. Where the measured air leakage rate exceeds 0.30 cfm/ft2 but does not exceed 0.40 cfm/ft2, a diagnostic evaluation, such as a smoke tracer or infrared imaging shall be conducted while the building is pressurized, and any leaks noted shall be sealed if such sealing can be made without destruction of existing building components. In addition, a visual inspection of the air barrier shall be conducted, and any leaks noted shall be sealed if 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 satisfy the requirements of this section.

- *add* - **C402.4.1.2 Continuous Air Barrier Commissioning**

Prior to the final inspection, a design professional/Agency shall provide evidence of commissioning of the continuous air barrier by an approved agency. A final commissioning report shall be delivered to the building owner or the owner's representative, and shall include at a minimum:

1. A field inspection checklist showing the requirements necessary for proper installation of the continuous air barrier.

2. Reports from field inspections during project construction showing compliance with continuous air barrier requirements including but not limited to proper material handling and storage, use of approved materials and approved substitutes, proper material and surface preparation, air barrier continuity at building thermal envelope penetrations.

- *add* - **C402.4.1.2.1 Building Envelope Commissioning Guideline**

In addition to complying with C402.4.1.2, projects shall follow all applicable items in Table C402.4.1.2.1.

- add - **TABLE C402.4.1.2.1 BUILDING ENVELOPE COMMISIONING CHECKLIST**

TABLE C402.4.1.2.1
BUILDING ENVELOPE COMMISIONING CHECKLIST

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
Foundations subsoil drainage system	Verify compliance with approved plans, specifications and construction documents.
Foundation damp-proofing and waterproofing	
Flashing at: exterior doors, skylights, wall flashing and drainage systems	
Exterior wall coverings	
Moisture envelopes	Where applicable meet owner's project requirements (OPR), Basis of Design (BOD), Cx Specifications.
Exterior below-grade walls	Check for proper drainage system at exterior wall perimeter to keep water from entering building.
External floor and soffits, slab-on grade	Check for thermal resistance or insulation when required. Slabs: Check drainage for moisture penetration.
Exterior walls	Check drawings for wall assembly requirements.
Exterior glazed window fenestration: windows, glazed doors and skylights	Drawing reviews and contractor submittal reviews: • Check that fenestration products are labeled with a U-factor (see NFRC 100) and a solar heat gain coefficient (SHGC) (see NFRC 200), and certification for the air infiltration requirement. • Check for proper flashing and caulking at walls and roof assemblies. Glazed doors: • Check for proper flashing, and seals and gaskets; and proper pull force, if provided with a closer. • Check for proper door swing.
Site-built fenestration: curtain walls and store-front systems, and atrium roof systems	Check for a label certificate issued by the National Fenestration Rating Council (NFRC) or a label certificate issued by the glazing fabricator that meets the default U-factor and SHGC; or an NFRC component modeling approach (CMA) label certificate or another approved standard. • Check for proper door swing.
Field-fabricated fenestrations: fenestration made at the site, not preformed or cut	Check for compliance with the default U-factor and the default SHGC.

Exterior doors	Check for proper flashing installation at header, walls and floor. • Check for U-factor requirements for swinging and nonswinging doors. • Check for appropriate manufacturer's referenced standard [American Architectural Manufacturer's Association (AAMA); Canadian Standards Association (CSA); and Window and Door Manufacturer's Association (WDMA) or other approved standard] product data sheets.
Sealants, control joints and flashing (stationary and moveable)	Check for proper installation in accordance with the manufacturer's written instructions
Shading devices	Check for proper anchoring to building with proper flashing at wall connections.
Structural systems	Check for proper anchoring in accordance with construction documents, including metal connectors and beam supports.

- *delete* – **C402.5.1.1 Air barrier construction.**

- *add* - **C402.4.1.3 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.

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.

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. 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.

4. Recessed lighting fixtures shall comply with Section C402.4.1.8. Where similar objects are installed that penetrate the air barrier, provisions shall be made to maintain the integrity of the air barrier.

5. Construction documents shall contain a diagram showing the building's pressure boundary in plan(s) and section(s) and a calculation of the area of the pressure boundary to be considered in the test.

- *delete* – **C402.5.1.2 Air barrier compliance options.**

- *add* - **C402.4.1.4 Air barrier compliance options.**
A continuous air barrier for the opaque building envelope shall comply with Section C402.4.1.4.1 or C402.4.1.4.2.

- *modify* - **C402.5.1.2.1 Materials** to **C402.4.1.4.1 Materials**

- *delete* – **C402.5.1.2.2 Assemblies.**

- *add* - **C402.4.1.4.2 Assemblies.**
Assemblies of materials and components with an average air leakage not greater than 0.04 cfm/ft^2(0.2 L/s • m^2) under a pressure differential of 0.3 inch of water gauge (w.g.) (75 Pa) when tested in accordance with ASTM E2357, ASTM E1677 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 C402.4.1.3 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 (102 mm) or more.

3. A Portland cement/sand parge, stucco or plaster not less than $^1/_2$ inch (12.7 mm) in thickness.

- *delete* – **C402.5.2 Air leakage of fenestration.**

- *add* - **C402.4.1.5 Air leakage of fenestration.**
The air leakage of fenestration assemblies shall meet the provisions of Table C402.4.1.5. Testing shall be in accordance with the applicable reference test standard in Table C402.4.1.5 by an accredited, independent testing laboratory and *labeled* by the manufacturer.

Exception: Field-fabricated fenestration assemblies that are sealed in accordance with Section C402.4.1.

- *modify* - **TABLE C402.5.2 MAXIMUM AIR LEAKAGE RATE FOR FENESTRATION ASSEMBLIES** to **TABLE C402.4.1.5 MAXIMUM AIR LEAKAGE RATE FOR FENESTRATION ASSEMBLIES**

- *delete* – **C402.5.3 Rooms containing fuel-burning appliances**

- *add* - **C402.4.1.6 Rooms containing fuel-burning appliances that are not direct vented.**
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:

1. The room or space containing the appliance shall be located outside of the *building thermal envelope.*

2. 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:

    2.1. 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(1).

    2.2. The walls, floors and ceilings that separate the enclosed room or space from conditioned spaces shall be sealed in accordance with Section C402.4.1.3.

    2.3. The doors into the enclosed room or space shall be fully gasketed.

    2.4. Water lines and ducts in the enclosed room or space shall be insulated in accordance with Section C403.

    2.5. 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-10.

    Exception: Fireplaces and stoves complying with Section 2111.14 of the *International Building Code.*

- *delete* – **C402.5.4 Doors and access openings to shafts, chutes, stairways and elevator lobbies.**

- *add* - **C402.4.1.7 Doors and access openings to shafts, chutes, stairways and elevator lobbies.**
Doors and *access* openings from conditioned space to shafts, chutes stairways and elevator lobbies not within the scope of the fenestration assemblies covered by Section C402.4.1.5 shall be gasketed, weatherstripped or sealed.

Exceptions:

1. Door openings required to comply with Section 716 of the *International Building Code.*

2. Doors and door openings required to comply with UL 1784 by the *International Building Code.*

- *add* - **C402.4.1.8 Recessed lighting.**
Recessed luminaires and any other building component installed in the *building thermal envelope* shall be all of the following:

1. IC-rated.

2. Labeled as having an air leakage rate of not more 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E283 at a 1.57 psf (75 Pa) pressure differential.

3. Sealed with a gasket or caulk between the housing and interior wall or ceiling covering.

- *add* - **C402.4.2 Dwelling unit air infiltration.**
A sampling of dwelling units shall be tested in accordance with ASTM E 779 at a pressure differential of 0.3

inch water gauge (75 Pa) or an equivalent method approved by the code official or authority having jurisdiction and deemed to comply when the tested air leakage rate of each dwelling unit is not greater than 0.35 cfm/ft^2. For purposes of this section, enclosure surface area of a unit means the total surface area of all walls, floors, and ceiling, even if below grade. Testing and inspection shall be conducted by a third-party design professional/agency. A written report of the test results shall be signed by the party conducting the test and provided to the building owner or owner's representative. Testing shall be performed at any time after completion of all penetrations of the dwelling unit's thermal envelope. The sampling of dwelling units tested shall include at least 10 percent of the dwelling units in each building, at least one unit per floor, at least one corner unit, and approximately an equal number of units on each floor level. Each of these units must be tested and pass without a failure. If a failure occurs, items causing the failure must be diagnosed, and corrected, and the unit retested until it passes. A minimum of at least two additional units in the same building must also be tested and pass. During testing:

1. The tested units will be randomly selected, and the construction contractor will not have prior knowledge as to which units will be tested.
2. Exterior windows and doors, fireplace doors and stove doors shall be closed, but not sealed beyond the intended weather stripping or other infiltration control measures.
3. Dampers, including exhaust, intake, makeup air, backdraft and flue dampers, shall be closed, but not sealed beyond intended infiltration control measures.
4. Interior doors, if installed at the time of the test, shall be open.
5. Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed.
6. Heating and cooling systems, if installed at the time of the test, shall be turned off.
7. Supply and return registers, if installed at the time of the test, shall be fully open.

- *modify* - **C402.5.5 Air intakes, exhaust openings, stairways and shafts to 402.4.3 Air intakes, exhaust openings, stairways and shafts**

- *delete* – **C402.5.6 Loading dock weatherseals.**

- *add* - **C402.4.4 Loading dock weatherseals.**
Cargo door openings and loading door openings shall be equipped with weatherseals that restrict infiltration and provide direct contact along the top and sides of vehicles that are parked in the opening. If equipped with an interior dock leveler, the deck of the leveler and rear pit wall shall be insulated with a minimum of 1.5 inches of sprayed closed cell foam. The side pit walls and pit slab shall be insulated per the slab ASTM E283 on grade standard in Table C402.1(1). The spaces between the pit wall and the deck skirts for the leveler shall be weather-stripped.

- *delete* – **C402.5.7 Vestibules.**

- *add* - **C402.4.5 Vestibules.**
Building entrances shall be protected with an enclosed vestibule, with all doors opening into and out of the vestibule equipped with self-closing devices. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior doors to open at the same time. The installation of one or more revolving doors in the building entrance shall not eliminate the requirement that a vestibule be provided on any doors adjacent to revolving doors. Interior and exterior doors shall have a minimum distance between them of not less than 7 feet. The exterior envelope of conditioned vestibules shall comply with the requirements for a conditioned space. Either the interior or exterior envelope of unconditioned vestibules shall comply with the requirements for a conditioned space.

Exceptions: Vestibules are not required for the following:

1. Doors not intended to be used by the public or common occupants of the building, such as doors to mechanical or electrical equipment rooms.
2. Doors opening directly from a *sleeping unit* or dwelling unit.
3. Doors that open directly from a space less than 3,000 square feet (298 m^2) in area.
4. Revolving doors, where a required adjacent accessible entry has a complying vestibule enclosure.
5. Doors used primarily to facilitate vehicular movement or material handling and adjacent personnel doors.
6. Doors that have an air curtain with a velocity of not less than 6.56 feet per second (2 m/s) at the floor that have been tested in accordance with ANSI/AMCA 220 and installed in accordance with the manufacturer's instructions. Manual or automatic controls shall be provided that will operate the air curtain with the opening and closing of the door. Air curtains and their controls shall comply with Section C407.2.3.
7. Elevator doors in parking garages provided that the elevators have an enclosed lobby at each level of the garage.
8. Doors opening directly from a semi-conditioned space.

- add - **C402.4.5.1 Vestibule tempering.**
Where vestibule space tempering is included, a maximum temperature setting of 55°F (13°C) for heating mode shall be utilized. Mechanical cooling of vestibules is prohibited.

- add - **C402.4.5.2 Vestibule thermostatic controls.**
Vestibules meeting the requirements of Section C402.4.5.1 shall be zoned separately from the conditioned building. Thermostats located inside vestibules shall be programmable, and

1. Tamper-proof, or
2. Placed in a location inaccessible to the general public.

Exception: Vestibule spaces served by radiant floor heating may utilize a non-programmable thermostat.

- delete – **C402.5.8 Recessed lighting.**

SECTION C403
BUILDING MECHANICAL SYSTEMS

- delete and replace - **C403.1 General.**
In addition to the mechanical requirements of Section C403, mechanical enhancements may be needed to meet the requirements of Section C406, Additional Efficiency Package Options. See Section C406.

Mechanical systems and equipment serving the building heating, cooling, ventilating or refrigerating needs shall comply with this section.

- delete and replace - **C403.2 System design (Mandatory).**
Mechanical systems shall be designed to comply with Sections C403.2.1 through C403.2.4. Where elements of a building's mechanical systems are addressed in Sections C403.3 through C403.12, such elements shall comply with the applicable provisions of those sections.

- delete and replace - **C403.2.2 Ventilation (Mandatory).**
Ventilation, shall be provided in accordance with ASHRAE Standard 62.1. Where mechanical ventilation is provided, the system shall provide the capability to reduce the outdoor air supply to the minimum required by ASHRAE Standard 62.1. The design professional shall utilize ventilation rates based on the expected occupancy level of the space. Life safety maximum allowable occupancy density shall not be used as a ventilation basis of design.

Exception:

1. All Residential occupancies. See the ventilation requirements of Section 304 of the Vermont Residential Building Energy Standards.

- add - **C403.2.3 Electric resistance space heating.**
Building heating with electrical resistance units, including baseboard radiation, heat pump reheat coils, duct coils, boilers, outdoor air intake grids, and coils in terminal units and air systems, is prohibited.

Exceptions:

1. Areas, such as stairways, that are not permitted to be penetrated with piping or duct and no other method of heating is possible.

2. Special conditions of occupancy or use that require electrical resistance heat to maintain health, safety or environmental conditions.

3. Limited areas where a practical application of resistance electrical heat is demonstrated (e.g., small interior space such as a restroom which is distant from the distribution system, hazardous material storerooms, stairwell or other means of emergency egress).

4. Multifamily buildings with heating loads ≤ 6.0 Btu/hour/square foot at design temperature.*

5. *Cold-Climate Heat Pump* where*:

    i. the full heating demand can be met with the heat pump at an outside air temperature of 5°F; and
    ii. the building thermal envelope shall be tested in accordance with ASTM E 779 at a pressure differential of 0.3 inch water gauge (75 Pa) and deemed to comply with the

provisions of Section C402.4.1 when the tested air leakage rate of the building thermal envelope is not greater than 0.20 cfm/ft2 (including the areas of the slab and below grade walls).

*Buildings served by the City of Burlington Electric (BED) must also receive approval from BED before installing electric resistance heating equipment.

- *add* - **C403.2.4 Mechanical systems commissioning and completion requirements**. Mechanical systems shall be commissioned and completed in accordance with Section C407.
- *delete and replace* - **C403.3.1 Equipment sizing (Mandatory).**
The output capacity of heating and cooling equipment shall be not greater than that of the smallest available equipment size that exceeds the loads calculated in accordance with Section C403.1.1. A single piece of equipment providing both heating and cooling shall satisfy this provision for one function with the capacity for the other function as small as possible, within available equipment options. Heating and cooling equipment sizing is permitted to be up to ten percent greater (to the next nearest available size) than the calculated peak heating and cooling loads to allow for building pickup and cool down after temperature setback conditions.

Exceptions:

1. Required standby equipment and systems provided with controls and devices that allow such systems or equipment to operate automatically only when the primary equipment is not operating.

2. Multiple units of the same equipment type with combined capacities exceeding the design load and provided with controls that are configured to sequence the operation of each unit based on load.

- *delete and replace* - **C403.3.2 HVAC equipment performance requirements (Mandatory).**
Equipment shall meet the minimum efficiency requirements of Tables C403.3.2(1) through C403.3.2(11) when tested and rated in accordance with the applicable test procedure. Plate-type liquid-to-liquid heat exchangers shall meet the minimum requirements of Table C403.3.2(12). The efficiency shall be verified through certification under an approved certification program or, where a certification program does not exist, the equipment efficiency ratings shall be supported by data furnished by the manufacturer. Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all stated requirements. Where components, such as indoor or outdoor coils, from different manufacturers are used, calculations and supporting data shall be furnished by the designer that demonstrates that the combined efficiency of the specified components meets the requirements herein.

- delete and replace - **TABLE C403.3.2(1) MINIMUM EFFICIENCY REQUIREMENTS: ELECTRICALLY OPERATED UNITARY AIR CONDITIONERS AND CONDENSING UNITS**

TABLE C403.3.2(1)
MINIMUM EFFICIENCY REQUIREMENTS:
ELECTRICALLY OPERATED UNITARY AIR CONDITIONERS AND CONDENSING UNITS

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE[a]
Air conditioners, air cooled	< 65,000 Btu/h[b]	All	Split System	13.0 SEER	AHRI 210/240
			Single Package	14.0 SEER	
Through-the-wall (air cooled)	≤ 30,000 Btu/h[b]	All	Split system	12.0 SEER	
			Single Package	12.0 SEER	
Small-duct high-velocity (air cooled)	< 65,000 Btu/h[b]	All	Split System	11.0 SEER	
Air conditioners, air cooled	≥ 65,000 Btu/h and < 135,000 Btu/h	None	Split System and Single Package	11.2 EER 12.8 IEER	AHRI 340/360
		Non-Electric[c]	Split System and Single Package	11.0 EER 12.6 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	None	Split System and Single Package	11.0 EER 12.4 IEER	
		Non-Electric[c]	Split System and Single Package	10.8 EER 12.2 IEER	
	≥ 240,000 Btu/h and < 760,000 Btu/h	None	Split System and Single Package	10.0 EER 11.6 IEER	
		Non-Electric[c]	Split System and Single Package	9.8 EER 11.4 IEER	
	≥ 760,000 Btu/h	None	Split System and Single Package	9.7 EER 11.2 IEER	
		Non-Electric[c]	Split System and Single Package	9.5 EER 11.0 IEER	
Air conditioners, water cooled	< 65,000 Btu/h[b]	All	Split System and Single Package	12.1 EER 12.3 IEER	AHRI 210/240
	≥ 65,000 Btu/h and < 135,000 Btu/h	None	Split System and Single Package	12.1 EER 13.9 IEER	AHRI 340/360
		Non-Electric[c]	Split System and Single Package	11.9 EER 13.7 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	None	Split System and Single Package	12.5 EER 13.9 IEER	
		Non-Electric[c]	Split System and Single Package	12.3 EER 13.7 IEER	
	≥ 240,000 Btu/h and < 760,000 Btu/h	None	Split System and Single Package	12.4 EER 13.6 IEER	
		Non-Electric[c]	Split System and Single Package	12.2 EER 13.4 IEER	
	≥ 760,000 Btu/h	None	Split System and Single Package	12.2 EER 13.5 IEER	
		Non-Electric[c]	Split System and Single Package	12.0 EER 13.3 IEER	

(continued)

TABLE C403.3.2(1)—continued
MINIMUM EFFICIENCY REQUIREMENTS:
ELECTRICALLY OPERATED UNITARY AIR CONDITIONERS AND CONDENSING UNITS

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUB-CATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE[a]
Air conditioners, evaporatively cooled	< 65,000 Btu/h[b]	All	Split System and Single Package	12.1 EER 12.3 IEER	AHRI 210/240
	≥ 65,000 Btu/h and < 135,000 Btu/h	None	Split System and Single Package	12.1 EER 12.3 IEER	AHRI 340/360
		Non-Electric[c]	Split System and Single Package	11.9 EER 12.1 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	None	Split System and Single Package	12.0 EER 12.2 IEER	
		Non-Electric[c]	Split System and Single Package	11.8 EER 12.0 IEER	
	≥ 240,000 Btu/h and < 760,000 Btu/h	None	Split System and Single Package	11.9 EER 12.1 IEER	
		Non-Electric[c]	Split System and Single Package	11.7 EER 11.9 IEER	
	≥760,000 Btu/h	None	Split System and Single Package	11.7 EER 11.9 IEER	
		Non-Electric[c]	Split System and Single Package	11.5 EER 11.7 IEER	
Condensing units, air cooled	≥ 135,000 Btu/h	—	—	10.5 EER 11.8 IEER	AHRI 365
Condensing units, water cooled	≥ 135,000 Btu/h	—	—	13.5 EER 14.0 IEER	
Condensing units, evaporatively cooled	≥ 135,000 Btu/h	—	—	13.5 EER 14.0 IEER	

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

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

b. Single-phase, air-cooled air conditioners less than 65,000 Btu/h are regulated by NAECA. SEER values are those set by NAECA.

c. Electric resistance space heating is prohibited per Section C403.2.3. Use “None” Heating Section Type category for exceptions to Section C403.2.3.

- delete and replace - **TABLE C403.3.2(2) MINIMUM EFFICIENCY REQUIREMENTS: ELECTRICALLY OPERATED UNITARY AND APPLIED HEAT PUMPS**

TABLE C403.3.2(2)
MINIMUM EFFICIENCY REQUIREMENTS:
ELECTRICALLY OPERATED UNITARY AND APPLIED HEAT PUMPS

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE[a]
Air cooled (cooling mode)	< 65,000 Btu/h[b]	All	Split System	14.0 SEER	AHRI 210/240
			Single Package	14.0 SEER	
Through-the-wall, air cooled	≤ 30,000 Btu/h[b]	All	Split System	12.0 SEER	
			Single Package	12.0 SEER	
Single-duct high-velocity air cooled	< 65,000 Btu/h[b]	All	Split System	11.0 SEER	
Air cooled (cooling mode)	≥ 65,000 Btu/h and < 135,000 Btu/h	None	Split System and Single Package	11.0 EER 12.0 IEER	AHRI 340/360
		Non-Electric[c]	Split System and Single Package	10.8 EER 11.8 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	None	Split System and Single Package	10.6 EER 11.6 IEER	
		Non-Electric[c]	Split System and Single Package	10.4 EER 11.4 IEER	
	≥ 240,000 Btu/h	None	Split System and Single Package	9.5 EER 10.6 IEER	
		Non-Electric[c]	Split System and Single Package	9.3 EER 9.4 IEER	
Water to Air: Water Loop (cooling mode)	< 17,000 Btu/h	All	86°F entering water	12.2 EER	ISO 13256-1
	≥ 17,000 Btu/h and < 65,000 Btu/h	All	86°F entering water	13.0 EER	
	≥ 65,000 Btu/h and < 135,000 Btu/h	All	86°F entering water	13.0 EER	
Water to Air: Ground Water (cooling mode)	< 135,000 Btu/h	All	59°F entering water	18.0 EER	ISO 13256-1
Brine to Air: Ground Loop (cooling mode)	< 135,000 Btu/h	All	77°F entering water	14.1 EER	ISO 13256-1
Water to Water: Water Loop (cooling mode)	< 135,000 Btu/h	All	86°F entering water	10.6 EER	ISO 13256-2
Water to Water: Ground Water (cooling mode)	< 135,000 Btu/h	All	59°F entering water	16.3 EER	
Brine to Water: Ground Loop (cooling mode)	< 135,000 Btu/h	All	77°F entering fluid	12.1 EER	

(continued)

TABLE C403.3.2(2)—continued
MINIMUM EFFICIENCY REQUIREMENTS: ELECTRICALLY OPERATED UNITARY AND APPLIED HEAT PUMPS

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE[a]
Air cooled (heating mode)	< 65,000 Btu/h[b]	—	Split System	10.0 HSPF	AHRI 210/240
		—	Single Package	10.0 HSPF	
Through-the-wall, (air cooled, heating mode)	≤ 30,000 Btu/h[b] (cooling capacity)	—	Split System	10.0 HSPF	
		—	Single Package	10.0 HSPF	
Small-duct high velocity (air cooled, heating mode)	< 65,000 Btu/h[b]	—	Split System	10.0 HSPF	
Air cooled (heating mode)	≥ 65,000 Btu/h and < 135,000 Btu/h (cooling capacity)	—	47ºF db/43ºF wb outdoor air	3.3 COP	AHRI 340/360
			17ºF db/15ºF wb outdoor air	2.25 COP	
	≥ 135,000 Btu/h (cooling capacity)	—	47ºF db/43ºF wb outdoor air	3.2 COP	
			17ºF db/15ºF wb outdoor air	2.05 COP	
Water to Air: Water Loop (heating mode)	< 135,000 Btu/h (cooling capacity)	—	68°F entering water	4.3 COP	ISO 13256-1
Water to Air: Ground Water (heating mode)	< 135,000 Btu/h (cooling capacity)	—	50°F entering water	3.7 COP	
Brine to Air: Ground Loop (heating mode)	< 135,000 Btu/h (cooling capacity)	—	32°F entering fluid	3.2 COP	
Water to Water: Water Loop (heating mode)	< 135,000 Btu/h (cooling capacity)	—	68°F entering water	3.7 COP	ISO 13256-2
Water to Water: Ground Water (heating mode)	< 135,000 Btu/h (cooling capacity)	—	50°F entering water	3.1 COP	
Brine to Water: Ground Loop (heating mode)	< 135,000 Btu/h (cooling capacity)	—	32°F entering fluid	2.5 COP	

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

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

b. Single-phase, air-cooled heat pumps less than 65,000 Btu/h are regulated by NAECA. SEER and HSPF values are those set by NAECA.

c. Electric resistance space heating is prohibited per Section C403.2.3. Use “None” Heating Section Type category for exceptions to Section C403.2.3.

- delete and replace - **TABLE C403.3.2(7) WATER CHILLING PACKAGES – EFFICIENCY REQUIREMENTS**

TABLE C403.3.2(7)
WATER CHILLING PACKAGES – EFFICIENCY REQUIREMENTS[a, b, d]

EQUIPMENT TYPE	SIZE CATEGORY	UNITS	Path A	Path B	TEST PROCEDURE[c]
Air-cooled chillers	< 150 Tons	EER (Btu/W)	≥ 10.100 FL	≥ 9.700 FL	AHRI 550/590
			≥ 13.700 IPLV	≥ 15,800 IPLV	
	≥ 150 Tons		≥ 10.100 FL	≥ 9.700 FL	
			≥ 14.000 IPLV	≥ 16.100 IPLV	
Air cooled without condenser, electrically operated	All capacities	EER (Btu/W)	Air-cooled chillers without condenser shall be rated with matching condensers and complying with air-cooled chiller efficiency requirements.		
Water cooled, electrically operated positive displacement	< 75 Tons	kW/ton	≤ 0.750 FL	≤ 0.780 FL	
			≤ 0.600 IPLV	≤ 0.500 IPLV	
	≥ 75 tons and < 150 tons		≤ 0.720 FL	≤ 0.750 FL	
			≤ 0.560 IPLV	≤ 0.490 IPLV	
	≥ 150 tons and < 300 tons		≤ 0.660 FL	≤ 0.680 FL	
			≤ 0.540 IPLV	≤ 0.440 IPLV	
	≥ 300 tons and < 600 tons		≤ 0.610 FL	≤ 0.625 FL	
			≤ 0.520 IPLV	≤ 0.410 IPLV	
	≥ 600 tons		≤ 0.560 FL	≤ 0.585 FL	
			≤ 0.500 IPLV	≤ 0.380 IPLV	
Water cooled, electrically operated centrifugal	< 150 Tons	kW/ton	≤ 0.610 FL	≤ 0.695 FL	
			≤ 0.550 IPLV	≤ 0.440 IPLV	
	≥ 150 tons and < 300 tons		≤ 0.610 FL	≤ 0.635 FL	
			≤ 0.550 IPLV	≤ 0.400 IPLV	
	≥ 300 tons and < 400 tons		≤ 0.560 FL	≤ 0.595 FL	
			≤ 0.520 IPLV	≤ 0.390	

				IPLV	
	≥ 400 tons and < 600 tons		≤ 0.560 FL	≤ 0.585 FL	
			≤ 0.500 IPLV	≤ 0.380 IPLV	
	≥ 600 Tons		≤ 0.560 FL	≤ 0.585 FL	
			≤ 0.500 IPLV	≤ 0.380 IPLV	
Air cooled, absorption, single effect	All capacities	COP	≥ 0.600 FL	NA[c]	AHRI 560
Water cooled absorption, single effect	All capacities	COP	≥ 0.700 FL	NA[c]	
Absorption, double effect, indirect fired	All capacities	COP	≥ 1.000 FL	NA[c]	
			≥ 1.050 IPLV		
Absorption double effect direct fired	All capacities	COP	≥ 1.000 FL	NA[c]	
			≥ 1.050 IPLV		

a. The requirements for centrifugal chiller shall be adjusted for nonstandard rating conditions in accordance with Section C403.3.2.1 and are only applicable for the range of conditions listed in Section C403.3.2.1. The requirements for air-cooled, water-cooled positive displacement and absorption chillers are at standard rating conditions defined in the reference test procedure.
b. Both the full-load and IPLV requirements shall be met or exceeded to comply with this standard. Where there is a Path B, compliance can be with either Path A or Path B for any application.
c. NA means the requirements are not applicable for Path B and only Path A can be used for compliance.
d. FL represents the full-load performance requirements and IPLV the part-load performance requirements.

- *add* - TABLE C403.3.2(10) MINIMUM EFFICIENCY ELECTRICALLY OPERATED VARIABLE-REFRIGERANT-FLOW AIR CONDITIONERS

TABLE C403.3.2(10)
MINIMUM EFFICIENCY
ELECTRICALLY OPERATED VARIABLE-REFRIGERANT-FLOW AIR CONDITIONERS

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE
VRF air conditioners, air cooled	< 65,000 Btu/h	All	VRF multisplit system	13.0 SEER	AHRI 1230
	□ 65,000 Btu/h and < 135,000 Btu/h	None	VRF multisplit system	11.2 EER 15.5 EER	
	□ 135,000 Btu/h and < 240,000 Btu/h	None	VRF multisplit system	11.0 EER 14.9 IEER	
	□ 240,000 Btu/h	None	VRF multisplit system	10.0 EER 13.9 IEER	

- add - TABLE C403.3.2(11) MINIMUM EFFICIENCY ELECTRICALLY OPERATED VARIABLE-REFRIGERANT-FLOW AIR-TO-AIR AND APPLIED HEAT PUMPS

TABLE C403.3.2(11)
MINIMUM EFFICIENCY
ELECTRICALLY OPERATED VARIABLE-REFRIGERANT-FLOW AIR-TO-AIR AND APPLIED HEAT PUMPS

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE
VRF air cooled (cooling mode)	< 65,000 Btu/h	All	VRF multisplit system	13.0 SEER	AHRI 1230
	≥ 65,000 Btu/h and < 135,000 Btu/h	None	VRF multisplit system	11.0 EER 14.6 IEER	
	≥ 65,000 Btu/h and < 135,000 Btu/h	None	VRF multisplit system with heat recovery	10.8 EER 14.4 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	None	VRF multisplit system	10.6 EER 13.9 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	None	VRF multisplit system with heat recovery	10.4 EER 13.7 EER	
	≥ 240,000 Btu/h	None	VRF multisplit system	9.5 EER 12.7 IEER	
	≥ 240,000 Btu/h	None	VRF multisplit system with heat recovery	9.3 EER 12.5 IEER	
VRF water source (cooling mode)	< 65,000 Btu/h	All	VRF multisplit system 86°F entering water	12.0 EER 16.0 IEER	AHRI 1230
	< 65,000 Btu/h	All	VRF multisplit system with heat recovery 86°F entering water	11.8 EER 15.8 IEER	
	≥ 65,000 Btu/h and < 135,000 Btu/h	All	VRF multisplit system 86°F entering water	12.0 EER 16.0 IEER	
	≥ 65,000 Btu/h and < 135,000 Btu/h	All	VRF multisplit system with heat recovery 86°F entering water	11.8 EER 15.8 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	All	VRF multisplit system 86°F entering water	10.0 EER 14.0 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	All	VRF multisplit system with heat recovery 86°F entering water	9.8 EER 13.8 IEER	
	≥ 240,000 Btu/h	All	VRF multisplit system 86°F entering water	10.0 EER 12.0 IEER	

	≥ 240,000 Btu/h	All	VRF multisplit system with heat recovery 86°F entering water	9.8 EER 11.8 IEER	
VRF groundwater source (cooling mode)	< 135,000 Btu/h	All	VRF multisplit system 59°F entering water	16.2 EER	AHRI 1230
	< 135,000 Btu/h	All	VRF multisplit system with heat recovery 59°F entering water	16.0 EER	
	≥ 135,000 Btu/h	All	VRF multisplit system 59°F entering water	13.8 EER	
	≥ 135,000 Btu/h	All	VRF multisplit system with heat recovery 59°F entering water	13.6 EER	
VRF ground source (cooling mode)	< 135,000 Btu/h	All	VRF multisplit system 77°F entering water	13.4 EER	AHRI 1230
	< 135,000 Btu/h	All	VRF multisplit system with heat recovery 77°F entering water	13.2 EER	
	≥ 135,000 Btu/h	All	VRF multisplit system 77°F entering water	11.0 EER	
	≥ 135,000 Btu/h	All	VRF multisplit system with heat recovery 77°F entering water	10.8 EER	
VRF air cooled (heating mode)	< 65,000 Btu/h (cooling capacity)	—	VRF multisplit system	10.0 HSPF	AHRI 1230
	≥ 65,000 Btu/h and < 135,000 Btu/h	—	VRF multisplit system 47°F db/43°F wb outdoor air	3.3 COP_H	
			17°F db/15°F wb outdoor air	2.25 COP_H	
	≥ 135,000 Btu/h (cooling capacity)	—	VRF multisplit system 47°F db/43°F wb outdoor air	3.2 COP_H	
			17°F db/15°F wb outdoor air	2.05 COP_H	
VRF water source (heating mode)	< 135,000 Btu/h	—	VRF multisplit system 68°F entering water	4.3 COP_H	AHRI 1230
	≥ 135,000 Btu/h	—	VRF multisplit system 68°F entering water	4.0 COP_H	
VRF groundwater source (heating mode)	< 135,000 Btu/h	—	VRF multisplit system 50°F entering water	3.6 COP_H	AHRI 1230
	≥ 135,000 Btu/h	—	VRF multisplit system 50°F entering water	3.3 COP_H	
VRF groundwater source (heating mode)	< 135,000 Btu/h	—	VRF multisplit system 32°F entering water	3.1 COP_H	AHRI 1230
	≥ 135,000 Btu/h	—	VRF multisplit system 32°F entering water	2.8 COP_H	

- *modify* - **TABLE C403.3.2(10) HEAT TRANSFER EQUIPMENT** to **TABLE C403.3.2(12) HEAT TRANSFER EQUIPMENT**

- delete and replace - **C403.3.2.1 Water-cooled centrifugal chilling packages (Mandatory).** Equipment not designed for operation at AHRI Standard 550/590 test conditions of 44°F (7°C) leaving chilled-water temperature and 2.4 gpm/ton evaporator fluid flow and 85°F (29°C) entering condenser water temperature with 3 gpm/ton (0.054 l/s • kW) condenser water flow shall have maximum full-load kW/ton (FL) and part-load ratings requirements adjusted using Equations 4-5 and 4-6.

$FL_{adj} = FL/K_{adj}$ **(Equation 4-5)**

$PLV_{adj} = IPLV/K_{adj}$ **(Equation 4-6)**

where:

K_{adj}	=	A × B
FL	=	Full-load kW/ton value as specified in Table C403.3.2(7).
FL_{adj}	=	Maximum full-load kW/ton rating, adjusted for nonstandard conditions.
$IPLV$	=	Value as specified in Table C403.3.2(7).
PLV_{adj}	=	Maximum *NPLV* rating, adjusted for nonstandard conditions.
A	=	$0.00000014592 \times (LIFT)^4$ $0.0000346496 \times (LIFT)^3 +$ $0.00314196 \times (LIFT)^2 -$ $0.147199 \times (LIFT) + 3.9302$
B	=	$0.0015 \times L_{vg}E_{vap} + 0.934$
$LIFT$	=	$L_{vg}Cond - L_{vg}E_{vap}$
$L_{vg}Cond$	=	Full-load condenser leaving fluid temperature (°F).
$L_{vg}E_{vap}$	=	Full-load evaporator leaving temperature (°F).

The FL_{adj} and PLV_{adj} values are only applicable for centrifugal chillers meeting all of the following full-load design ranges:

1. Minimum evaporator leaving temperature: 36°F.

2. Maximum condenser leaving temperature: 115°F.

3. 20°F ≤ LIFT ≤ 80°F.

- delete and replace - **C403.3.3 Hot gas bypass.**
The use of hot gas bypass is prohibited in all systems.

- delete - **TABLE C403.3.3 MAXIMUM HOT GAS BYPASS CAPACITY**

- delete and replace - **C403.4.1.1 Heat pump supplementary heat (Mandatory).**
Heat pumps having supplementary electric resistance heat shall be certified *cold-climate heat pumps* meeting the requirements of section C403.2.3.

*- delete and replace -***C403.4.1.4 Heated vestibules (Mandatory).**
The heating system for heated vestibules and air curtains with integral heating shall be provided with controls configured to shut off the source of heating when the outdoor air temperature is greater than 55°F (16°C). Vestibule heating systems shall be controlled by a thermostat located in the vestibule configured to limit heating to a temperature not greater than 55°F (16°C). Cooling of the vestibule is prohibited.

Exception: Control of heating or cooling provided by site-recovered energy or transfer air that would otherwise be exhausted.

- delete and replace - **C403.4.1.5 Hot water boiler outdoor temperature setback control (Mandatory).**
Hot water boilers that supply heat to the building through one- or two-pipe heating systems shall have a setback control that lowers the boiler water temperature based on the outdoor temperature or based on building terminal loads.

- delete and replace - **C403.4.2.1 Thermostatic setback (Mandatory).**
Thermostatic setback controls shall be configured to set back or temporarily operate the system to maintain zone temperatures down to 60°F (13°C) or up to 80°F (29°C).

Exceptions:

1. Zones served exclusively by cold-climate heat pumps.

- delete and replace - **C403.4.3.3.2 Heat rejection.**
The following shall apply to hydronic water loop heat pump systems:

1. Where a closed-circuit cooling tower is used directly in the heat pump loop, either an automatic valve shall be installed to bypass the flow of water around the closed-circuit cooling tower, except for any flow necessary for freeze protection, or low-leakage positive-closure dampers shall be provided.

2. Where an open-circuit cooling tower is used directly in the heat pump loop, an automatic valve shall be installed to bypass all heat pump water flow around the open-circuit cooling tower.

3. Where an open-circuit cooling tower is used in conjunction with a separate heat exchanger to isolate the open-circuit cooling tower from the heat pump loop, heat loss shall be controlled by shutting down the circulation pump on the cooling tower loop.

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

- delete and replace - **C403.4.3.3.3 Two-position valve.**
Each hydronic heat pump on the hydronic system shall have a two-position valve.

- delete and replace - **C403.4.4 Part-load controls.**
Hydronic systems greater than or equal to 300,000 Btu/h (146.5 kW) in design output capacity supplying heated or chilled water to comfort conditioning systems shall include controls that are configured to do all of the following:

1. Automatically reset the supply-water temperatures in response to varying building heating and cooling demand using coil valve position, zone-return water temperature, building-return water temperature or outside air temperature. The temperature shall be reset by not less than 25 percent of the design supply-to-return water temperature difference.

2. Automatically vary fluid flow for hydronic systems with a combined pump motor capacity of 2 hp (1.5 kW) or larger with three or more control valves or other devices by reducing the system design flow rate by not less than 50 percent or the maximum reduction allowed by the equipment manufacturer for proper operation of equipment by valves that modulate or step open and close, or pumps that modulate or turn on and off as a function of load.

3. Automatically vary pump flow on heating-water systems, chilled-water systems and heat rejection loops serving water-cooled unitary air conditioners as follows:

    3.1. Where pumps operate continuously or operate based on a time schedule, pumps with nominal output motor power of 1 hp or more shall have a variable speed drive.

    3.2. Where pumps have automatic direct digital control configured to operate pumps only when zone heating or cooling is required, a variable speed drive shall be provided. for pumps with nominal output motor power of 2 hp or more.

4. Where a variable speed drive is required by Item 3 of this Section, pump motor power input shall be not more than 30 percent of design wattage at 50 percent of the design water flow. Pump flow shall be controlled to maintain one control valve nearly wide open. In systems where pump speed is controlled by a differential pressure setpoint, that setpoint shall be incrementally indexed down to maintain at least one valve nearly wide open. There shall be no lower limit to the differential pressure except to remain within the tolerances and accuracy of the controlling sensor.

Exceptions:

1. Supply-water temperature reset is not required for chilled-water systems supplied by off-site district chilled water or chilled water from ice storage systems.

2. Variable pump flow is not required on dedicated coil circulation pumps where needed for freeze protection.

3. Variable pump flow is not required on dedicated equipment circulation pumps where configured in primary/secondary design to provide the minimum flow requirements of the equipment manufacturer for proper operation of equipment.

4. For renovations, variable speed drives are not required on heating water pumps where more than 50 percent of annual heat is generated by a pre-existing electric boiler.

- delete - **TABLE C403.4.4 VARIABLE SPEED DRIVE (VSD) REQUIREMENTS FOR DEMAND-**

CONTROLLED PUMPS

- *delete and replace* - **C403.5 Economizers (Prescriptive).**
Economizers shall comply with Sections C403.5.1 through C403.5.5.

An air or water economizer shall be provided for the following cooling systems:

1. Chilled water systems with a total cooling capacity, less cooling capacity provided with air economizers, as specified in Table C403.5.

2. Individual fan systems with cooling capacity greater than or equal to 54,000 Btu/h (15.8 kW) in buildings having other than a *Group R* occupancy,

3. Individual fan systems with cooling capacity greater than or equal to 270,000 Btu/h (79.1 kW) in buildings having a *Group R* occupancy.

Exceptions: Economizers are not required for the following systems.

1. In hospitals and ambulatory surgery centers, where more than 75% of the air designed to be supplied by the system is to spaces that are required to be humidified above 35°F (1.7°C) dew-point temperature to comply with applicable codes or accreditation standards.

2. Where more than 25 percent of the air designed to be supplied by the system is to spaces that are designed to be humidified above 35°F (1.7°C) dew-point temperature to satisfy process needs.

3. Systems expected to operate less than 20 hours per week.

4. Systems that include a heat recovery system in accordance with Section C403.9.5.

- *delete* - **TABLE C403.5 (1) MINIMUM CHILLED-WATER SYSTEM COOLING CAPACITY FOR DETERMINING ECONOMIZER COOLING REQUIREMENTS**

- *delete* - **TABLE C403.5(2) EQUIPMENT EFFICIENCY PERFORMANCE EXCEPTION FOR ECONOMIZERS**

- *add* - **TABLE C403.5 MINIMUM CHILLED-WATER SYSTEM COOLING CAPACITY FOR DETERMINING ECONOMIZER COOLING REQUIREMENTS**

TABLE C403.5

MINIMUM CHILLED-WATER SYSTEM COOLING CAPACITY FOR DETERMINING ECONOMIZER COOLING REQUIREMENTS

TOTAL CHILLED-WATER SYSTEM CAPACITY LESS CAPACITY OF COOLING UNITS WITH AIR ECONOMIZERS	
Local Water-cooled Chilled-water Systems	**Air-cooled Chilled-water Systems or District Chilled-Water Systems**
1,320,000 Btu/h	1,720,000 Btu/h

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

- *delete and replace* - **C403.5.1 Integrated economizer control.**
Economizer systems shall be integrated with the mechanical cooling system and be configured to provide partial cooling even where additional mechanical cooling is required to provide the remainder of the cooling

load. Controls shall not be capable of creating a false load in the mechanical cooling systems by limiting or disabling the economizer or any other means, except at the lowest stage of mechanical cooling.

Units that include an air economizer shall comply with the following:

1. Unit controls shall have the mechanical cooling capacity control interlocked with the air economizer controls such that the outdoor air damper is at the 100-percent open position when mechanical cooling is on and the outdoor air damper does not begin to close to prevent coil freezing due to minimum compressor run time until the leaving air temperature is less than 45°F (7°C).

2. Direct expansion (DX) units that control 75,000 Btu/h (22 kW) or greater of rated capacity of the capacity of the mechanical cooling directly based on occupied space temperature shall have not fewer than three stages (off / 1st stage / 2nd stage) of mechanical cooling capacity.

3. Other DX units, including those that control space temperature by modulating the airflow to the space, shall be in accordance with Table C403.5.1.

   Exception: Direct expansion (DX) units with one variable displacement compressor can have fewer than three stages provided the constant displacement compressor is no more than the percent of full load in accordance with Table C403.5.1.

- delete and replace - **TABLE C403.5.1 DX COOLING STAGE REQUIREMENTS FOR MODULATING AIRFLOW UNITSTABLE C403.5.1**
DX COOLING STAGE REQUIREMENTS FOR MODULATING AIRFLOW UNITS

RATING CAPACITY	MINIMUM NUMBER OF MECHANICAL COOLING STAGES	MINIMUM COMPRESSOR DISPLACEMENT[a]
≥ 75,000 Btu/h and < 240,000 Btu/h	3 stages	≤ 35% of full load
≥ 240,000 Btu/h	4 stages	≤ 25% full load

For SI: 1 British thermal unit per hour = 0.2931 W.
a. For mechanical cooling stage control that does not use variable compressor displacement, the percent displacement shall be equivalent to the mechanical cooling capacity reduction evaluated at the full load rating conditions for the compressor.

- delete and replace - **TABLE C403.5.3.3 HIGH-LIMIT SHUTOFF CONTROL SETTING FOR AIR ECONOMIZERSbTABLE C403.5.3.3**
HIGH-LIMIT SHUTOFF CONTROL SETTING FOR AIR ECONOMIZERS[b]

DEVICE TYPE	REQUIRED HIGH LIMIT (ECONOMIZER OFF WHEN):	
	Equation	Description
Fixed dry bulb	T_{OA} > 70°F	Outdoor air temperature exceeds 70°F
Differential dry bulb	$T_{OA} > T_{RA}$	Outdoor air temperature exceeds return air temperature
Fixed enthalpy with fixed dry-bulb temperatures	h_{OA} > 28 Btu/lb[a] or T_{OA} > 75°F	Outdoor air enthalpy exceeds 28 Btu/lb of dry air[a] or Outdoor air temperature exceeds 75°F
Differential enthalpy with	$h_{OA} > h_{RA}$ or	Outdoor air enthalpy exceeds return air enthalpy or

fixed dry-bulb temperature	T_{OA} > 75°F	Outdoor air temperature exceeds 75°F

For SI: 1 foot = 305 mm, °C = (°F - 32)/1.8, 1 Btu/lb = 2.33 kJ/kg.

a. At altitudes substantially different than sea level, the fixed enthalpy limit shall be set to the enthalpy value at 75°F and 50-percent relative humidity. As an example, at approximately 6,000 feet elevation, the fixed enthalpy limit is approximately 30.7 Btu/lb.

b. Devices with selectable setpoints shall be capable of being set to within 2°F and 2 Btu/lb of the setpoint listed.

- delete and replace - **C403.5.5 Economizer fault detection and diagnostics (Mandatory).**

Air-cooled unitary direct-expansion units listed in Tables C403.3.2(1) through C403.3.2(3) and Tables C403.3.2(10) through C403.3.2(11) that are 15 tons (180,000 Btu/h) or greater and equipped with an economizer in accordance with Section C403.5 shall include a fault detection and diagnostics system complying with the following:

1. 1. The following temperature sensors shall be permanently installed to monitor system operation:

    1.1. Outside air.

    1.2. Supply air.

    1.3. Return air.

2. Indoor temperature sensors shall have an accuracy of ±2°F (1.1°C) over the range of 40°F to 80°F (4°C to 26.7°C). Outdoor temperature sensors shall have an accuracy of ±2°F (1.1°C) over the range of -40°F to 100°F (-40°C to 37.8°C).

3. Refrigerant pressure sensors, where used, shall have an accuracy of ±3 percent of full scale.

4. The unit controller shall be configured to provide system status by indicating the following:

    4.1. Free cooling available.

    4.2. Economizer enabled.

    4.3. Compressor enabled.

    4.4. Heating enabled.

    4.5. Mixed air low limit cycle active.

    4.6. The current value of each sensor.

5. The unit controller shall be capable of manually initiating each operating mode so that the operation of compressors, economizers, fans and the heating system can be independently tested and verified.

6. The unit shall be configured to report faults to a fault management application available for *access* by day-to-day operating or service personnel or annunciated locally on zone thermostats.

7. The fault detection and diagnostics system shall be configured to detect the following faults:

    7.1. Air temperature sensor failure/fault.

    7.2. Not economizing when the unit should be economizing.

7.3. Economizing when the unit should not be economizing.

7.4. Damper not modulating.

7.5. Excess outdoor air.

- *delete and replace* - **C403.6.1 Variable air volume and multiple-zone systems.**
Supply air systems serving multiple zones shall be variable air volume (VAV) systems that have zone controls configured to reduce the volume of air that is reheated, recooled or mixed in each zone to one of the following:

1. Twenty percent of the zone design peak supply for systems with DDC and 30 percent for other systems.

2. Systems with DDC where all of the following apply:

   2.1. The airflow rate in the deadband between heating and cooling does not exceed 20 percent of the zone design peak supply rate or higher allowed rates under Items 3, 4 and 5 of this section.

   2.2. The first stage of heating modulates the zone supply air temperature setpoint up to a maximum setpoint while the airflow is maintained at the deadband flow rate.

   2.3. The second stage of heating modulates the airflow rate from the deadband flow rate up to the heating maximum flow rate that is less than 50 percent of the zone design peak supply rate.

3. The outdoor airflow rate required to meet the minimum ventilation requirements of ASHRAE Standard 62.1.

4. Any higher rate that can be demonstrated to reduce overall system annual energy use by offsetting reheat/recool energy losses through a reduction in outdoor air intake for the system as approved by the code official.

5. The airflow rate required to comply with applicable codes or accreditation standards such as pressure relationships or minimum air change rates.

6. Zones where special humidity levels are required to satisfy process needs.

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

5.1 *Zones* or supply air systems where not less than 75 percent of the energy for reheating or for providing warm air in mixing systems is provided from a site-recovered, including condenser heat, or site-solar energy source.

5.2 Systems that prevent reheating, recooling, mixing or simultaneous supply of air that has been previously cooled, either mechanically or through the use of economizer systems, and air that has been previously mechanically heated.

- *delete* - **C403.6.3 Dual-duct and mixing VAV systems, terminal devices.**- *delete* - **C403.6.4 Single-fan dual-duct and mixing VAV systems, economizers.**

- *modify* - **C403.6.5 Supply-air temperature reset controls to C403.6.3 Supply-air temperature reset controls**

- *delete* – **C403.6.6 Multiple-zone VAV system ventilation optimization control.**

- *add* - **C403.6.4 Multiple-zone VAV system ventilation optimization control.**
Multiple-zone VAV systems with direct digital control of individual zone boxes reporting to a central control panel shall have automatic controls configured to reduce outdoor air intake flow below design rates in response to changes in system *ventilation* efficiency (E_v).

Exceptions:

1. VAV systems with zonal transfer fans that recirculate air from other zones without directly mixing it with outdoor air, dual-duct dual-fan VAV systems, and VAV systems with fan-powered terminal units.

2. Systems where total design exhaust airflow is more than 70 percent of total design outdoor air intake flow requirements.

- *modify* - **C403.6.7 Parallel-flow fan-powered VAV air terminal control** to **C403.6.5 Parallel-flow fan-powered VAV air terminal control**

- *modify* - **C403.6.8 Setpoints for direct digital control** to **C403.6.6 Setpoints for direct digital control**

- *delete* – **C403.6.9 Static pressure sensor location.**

- *add* - **C403.6.7 Static pressure sensor location.**
Static pressure sensors used to control VAV fans shall be located such that the controller setpoint is not greater than 1.2 inches w.g. (299 Pa), or 1.7 w.g. (432.4 Pa) in systems with HEPA or ULPA filters. Where this results in one or more sensors being located downstream of major duct splits, not less than one sensor shall be located on each major branch to ensure that static pressure can be maintained in each branch. Location of the static pressure sensor near the supply fan discharge would result in non-compliance.

- *delete and replace* - **C403.7.1 Demand control ventilation (Mandatory).**
Demand control ventilation (DCV) shall be provided for spaces larger than 500 square feet (46.5 m^2) and with an average occupant load of 25 people or greater per 1,000 square feet (93 m^2) of floor area, as established in Table 6.1 of ASHRAE 62.1, and served by systems with one or more of the following:

1. An air-side economizer.

2. Automatic modulating control of the outdoor air damper.

3. A design outdoor airflow greater than 3,000 cfm (1416 L/s).

Exceptions:

1. Systems with energy recovery complying with Section C403.7.4.

2. Multiple-zone systems without direct digital control of individual zones communicating with a central control panel.

3. Spaces where the supply airflow rate minus any makeup or outgoing transfer air requirement is less than 1,200 cfm (566 L/s).

4. Ventilation provided only for process loads.

- delete and replace - **C403.7.2 Enclosed parking garage ventilation controls (Mandatory).**
Enclosed parking garages used for storing or handling automobiles operating under their own power shall employ contamination-sensing devices and automatic controls configured to stage fans or modulate fan average airflow rates as stipulated in the Vermont Fire & Building Safety Code enforced by the Vermont Department of Public Safety's Division of Fire Safety. Failure of contamination-sensing devices shall cause the exhaust fans to operate continuously at design airflow.

- delete and replace - **C403.7.3 Ventilation air heating control (Mandatory).**
Units that provide ventilation air to multiple zones and operate in conjunction with zone heating and cooling systems shall not use heating to warm supply air to a temperature greater than 60°F (16°C) when representative building loads or outdoor air temperatures indicate that the majority of zones require cooling.

- delete and replace - **C403.7.4 Energy recovery systems (Mandatory).**
Where the supply airflow rate of an air system exceeds the values specified in Table C403.7.4, the system shall include an energy recovery system. The energy recovery system shall be configured to provide a change in the enthalpy of the outdoor air supply of not less than 50 percent of the difference between the outdoor air and return air enthalpies, at design conditions. Where an air economizer is required, the energy recovery system shall include a bypass or controls that permit operation of the economizer as required by Section C403.5.

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

1. Where energy recovery systems are prohibited by ASHRAE Standard 62.1.

2. Laboratory fume hood systems that include not fewer than one of the following features:

   2.1. Variable-air-volume hood exhaust and room supply systems configured to reduce exhaust and makeup air volume to 50 percent or less of design values.

   2.2. Direct makeup (auxiliary) air supply equal to or greater than 75 percent of the exhaust rate, heated not warmer than 2°F (1.1°C) above room setpoint, cooled to not cooler than 3°F (1.7°C) below room setpoint, with no humidification added, and no simultaneous heating and cooling used for dehumidification control.

3. Systems serving spaces that are heated to less than 60°F (15.5°C) and that are not cooled.

4. Where more than 60 percent of the outdoor heating energy is provided from site-recovered or site-solar energy.

5. Systems requiring dehumidification that employ energy recovery in series with the cooling coil.

6. Systems expected to operate less than 20 hours per week at the *outdoor air* percentage covered by Table C403.7.4.

7. Systems exhausting toxic, flammable, paint or corrosive fumes or dust.

8. Commercial kitchen hoods used for collecting and removing grease vapors and smoke.

- *delete* - **TABLE C403.7.4(1) ENERGY RECOVERY REQUIREMENT**

- *add* - **TABLE C403.7.4 ENERGY RECOVERY REQUIREMENT**

TABLE C403.7.4
ENERGY RECOVERY REQUIREMENT
(Air systems operating not less than 3,000 hours per year)

PERCENT (%) OUTDOOR AIR AT FULL DESIGN AIRFLOW RATE							
≥ 10% and < 20%	**≥ 20% and < 30%**	**≥ 30% and < 40%**	**≥ 40% and < 50%**	**≥ 50% and < 60%**	**≥ 60% and < 70%**	**≥ 70% and < 80%**	**≥ 80%**
DESIGN SUPPLY FAN AIRFLOW RATE (cfm)							
≥ 10,500	≥ 6,500	≥ 5,500	≥ 4,500	≥ 3,500	≥ 2,000	≥ 1,000	> 120

For SI: 1 cfm = 0.4719 L/s.

- *delete* - **TABLE C403.7.4(2) ENERGY RECOVERY REQUIREMENT**

- *delete and replace* - **C403.7.5 Kitchen exhaust systems (Mandatory).**

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

1. The ventilation rate required to meet the space heating or cooling load.

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

Where total kitchen hood exhaust airflow rate is greater than 5,000 cfm (2360 L/s), each hood shall be a factory-built commercial exhaust hood listed by a nationally recognized testing laboratory in compliance with UL 710. Each hood shall have a maximum exhaust rate as specified in Table C403.7.5 and shall comply with one of the following:

1. Not less than 50 percent of all replacement air shall be transfer air that would otherwise be exhausted.

2. Demand ventilation systems on not less than 75 percent of the exhaust air that are configured to provide not less than a 50-percent reduction in exhaust and replacement air system airflow rates, including automatic controls necessary to modulate airflow in response to appliance operation and to maintain full capture and containment of smoke, effluent and combustion products during cooking and idle.

3. Listed energy recovery devices with a sensible heat recovery effectiveness of not less than 40 percent on not less than 50 percent of the total exhaust airflow.

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

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

- *delete and replace* - **C403.7.7 Shutoff dampers (Mandatory).**
Outdoor air intake and exhaust openings and stairway and shaft vents shall be provided with Class I motorized dampers. The dampers shall have an air leakage rate not greater than 4 cfm/ft^2 (20.3 L/s • m^2) of damper surface area at 1.0 inch water gauge (249 Pa) and shall be labeled by an approved agency when tested in accordance with AMCA 500D for such purpose.

Outdoor air intake and exhaust dampers shall be installed with automatic controls configured to close when the systems or spaces served are not in use or during unoccupied period warm-up and setback operation, unless the systems served require outdoor or exhaust air in accordance with ASHRAE Standard 62.1 or the dampers are opened to provide intentional economizer cooling.

Stairway and shaft vent dampers shall be installed with automatic controls configured to open upon the activation of any fire alarm initiating device of the building's fire alarm system or the interruption of power to the damper.

Exception: Nonmotorized gravity dampers shall be an alternative to motorized dampers for exhaust and relief openings where the design exhaust capacity is not greater than 300 cfm (142 L/s).

Nonmotorized gravity dampers shall have an air leakage rate not greater than 20 cfm/ft^2 (101.6 L/s • m^2) where not less than 24 inches (610 mm) in either dimension and 40 cfm/ft^2 (203.2 L/s • m^2) where less than 24 inches (610 mm) in either dimension. The rate of air leakage shall be determined at 1.0 inch water gauge (249 Pa) when tested in accordance with AMCA 500D for such purpose. The dampers shall be labeled by an approved agency.

- *delete and replace* - **C403.8.3 Fan efficiency (Mandatory).**
Fans shall have a fan efficiency grade (FEG) of not less than 70, as determined in accordance with AMCA 205 by an *approved*, independent testing laboratory and labeled by the manufacturer. The total efficiency of the fan at the design point of operation shall be within 15 percentage points of the maximum total efficiency of the fan.

Exception: The following fans are not required to have a fan efficiency grade:

1. Fans of 1 hp (0.75 kW) or less as follows:

   1.1. Individual fans with a motor nameplate horsepower of 1 hp (0.75 kW) or less, unless Exception 1.2 applies.

   1.2. Multiple fans in series or parallel that have a combined motor nameplate horsepower of 2 hp (1.5 kW) or less and are operated as the functional equivalent of a single fan

2. Fans that are part of equipment covered in Section C403.3.2.

3. Fans included in an equipment package certified by an *approved agency* for air or energy performance.

4. Powered wall/roof ventilators.

5. Fans outside the scope of AMCA 205.

6. Fans that are intended to operate only during emergency conditions.

- delete and replace - **C403.8.4 Fractional hp fan motors (Mandatory).**

Motors for fans that are not less than $^{1}/_{12}$ hp (0.082 kW) and less than 1 hp (0.746 kW) shall be electronically commutated motors or NEMA Premium efficiency motors rated in accordance with DOE 10 CFR 431. These motors shall have the means to adjust motor speed for either balancing or remote control. The use of belt-driven fans to sheave adjustments for airflow balancing instead of a varying motor speed shall be permitted.

Exceptions: The following motors are not required to comply with this section:

1. Motors that are an integral part of specialized process equipment.

2. Where the motor is integral to a listed piece of equipment for which no complying motor has been approved.

3. Motors in the airstream within fan coils and terminal units that only provide heating to the space served.

4. Motors in space-conditioning equipment that comply with Section C403.3.2 or Sections C403.8.1. through C403.8.3.

5. Motors that comply with Section C405.7.

- delete and replace - **C403.8.5.1 Fan airflow control.**

Each cooling system listed in Table C403.8.5.1 shall be designed to vary the indoor fan airflow as a function of load and shall comply with the following requirements:

1. Direct expansion (DX) and chilled water cooling units that control the capacity of the mechanical cooling directly based on space temperature shall have not fewer than two stages of fan control. Low or minimum speed shall not be greater than 66 percent of full speed. At low or minimum speed, the fan system shall draw not more than 40 percent of the fan power at full fan speed. Low or minimum speed shall be used during periods of low cooling load and ventilation-only operation.

2. Other units including DX cooling units and chilled water units that control the space temperature by modulating the airflow to the space shall have modulating fan control. Minimum speed shall be not greater than 50 percent of full speed. At minimum speed the fan system shall draw not more than 30 percent of the power at full fan speed. Low or minimum speed shall be used during periods of low cooling load and ventilation-only operation.

3. Units that include an air-side economizer in accordance with Section C403.5 shall have modulating fan control during economizer operation.

Exceptions:

1. Modulating fan control is not required for chilled water and evaporative cooling units with fan motors of less than 1 hp (0.746 kW) where the units are not used to provide *ventilation air* and the indoor fan cycles with the load.

2. Where the volume of outdoor air required to comply with the ventilation requirements of ASHRAE Standard 62.1 at low speed exceeds the air that would be delivered at the speed defined in Section C403.8.5, the minimum speed shall be selected to provide the required

ventilation air.

- *delete and replace* - **TABLE C403.8.5.1 COOLING SYSTEMS**

TABLE C403.8.5.1
COOLING SYSTEMS

COOLING SYSTEM TYPE	FAN MOTOR SIZE	MECHANICAL COOLING CAPACITY
DX cooling	Any	≥ 24,000 Btu/h
Chilled water and evaporative cooling	≥ 1/4 hp	Any

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

- *delete and replace* - **C403.9.1 Fan speed control.**
Each fan system powered by an individual motor or array of motors with connected power, including the motor service factor, totaling 2 hp (1.5 kW) or more shall have controls and devices configured to automatically modulate the fan speed to control the leaving fluid temperature or condensing temperature and pressure of the heat rejection device. Fan motor power input shall be not more than 30 percent of design wattage or 50 percent of the design airflow.

Exceptions:

1. Fans serving multiple refrigerant or fluid cooling circuits.

2. Condenser fans serving flooded condensers.

- *delete and replace* - **C403.9.3 Limitation on centrifugal fan open-circuit cooling towers.**
Centrifugal fan open-circuit cooling towers with a combined rated capacity of 550gpm (2032L/m) or greater at 95°F (35°C) condenser water return, 85°F (29°C) condenser water supply, and 75°F (24°C) outdoor air wet-bulb temperature shall meet the energy efficiency requirement for axial fan open-circuit cooling towers listed in Table C403.3.2(8).

Exception: Centrifugal open-circuit cooling towers that are designed with inlet or discharge ducts or require external sound attenuation.

- *delete and replace* - **C403.9.5 Heat recovery for service water heating.**
Condenser heat recovery shall be installed for heating or reheating of service hot water provided that the facility operates 24 hours a day, the total installed heat capacity of water-cooled systems exceeds 6,000,000 Btu/hr (1 758 kW) of heat rejection, and the design service water heating load exceeds 1,000,000 Btu/h (293 kW).

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

1. Sixty percent of the peak heat rejection load at design conditions.

2. The preheating required to raise the peak service hot water draw to 85°F (29°C).

Exceptions:

1. Facilities that employ condenser heat recovery for space heating or reheat purposes with a heat

recovery design exceeding 30 percent of the peak water-cooled condenser load at design conditions.

2. Facilities that provide 60 percent of their service water heating from site solar or site recovered energy or from other sources.

3. If compliance with Section C403.9.5 will be detrimental to chiller operating efficiency due to conflicts with optimized chiller head pressure control.

- delete and replace - **C403.10 Refrigeration equipment performance.**
Refrigeration equipment shall have an energy use in kWh/day not greater than the values of Tables C403.10.1(1) and C403.10.1(5) when tested and rated in accordance with AHRI Standard 1200. The energy use shall be verified through certification under an approved certification program or, where a certification program does not exist, the energy use shall be supported by data furnished by the equipment manufacturer.

- delete and replace - **C403.10.1 Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers (Mandatory).**
Refrigerated warehouse coolers, *refrigerated warehouse freezers*, *walk-in coolers* and *walk-in freezers* shall comply with the following:

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

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

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

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

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

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

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

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

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

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

9. Antisweat heaters shall have a total door rail, glass and frame heater power draw of not more than 7.1 W/ft^2 (76 W/m^2) of door opening for *walk-in freezers* and 3.0 W/ft^2 (32 W/m^2) of door opening for *walk-in coolers*.

10. Antisweat heaters shall have controls that reduce the energy use of the antisweat heater as a function of the relative humidity in the air outside the door or to the condensation on the inner glass pane.

11. Lights in *walk-in coolers*, *walk-in freezers*, *refrigerated warehouse coolers* and *refrigerated warehouse freezers* shall be LED with an efficacy of 90 lpw or more and have occupancy controls that turns off the lights within 15 minutes when the space is not occupied.

- *delete* - **C403.10.2 Walk-in coolers and walk-in freezers (Mandatory).**
- *delete* - **C403.10.2.1 Performance standards (Mandatory).**

- modify - **TABLE C403.10.2.1(1) WALK-IN COOLER AND FREEZER DISPLAY DOOR EFFICIENCY REQUIREMENTS** to **TABLE C403.10.1(3) WALK-IN COOLER AND FREEZER DISPLAY DOOR EFFICIENCY REQUIREMENTS**

- modify - **TABLE C403.10.2.1(2) WALK-IN COOLER AND FREEZER NONDISPLAY DOOR EFFICIENCY REQUIREMENTS** to **TABLE C403.10.1(4) WALK-IN COOLER AND FREEZER NONDISPLAY DOOR EFFICIENCY REQUIREMENTS**

- modify - **TABLE C403.10.2.1(3) WALK-IN COOLER AND FREEZER REFRIGERATION SYSTEM EFFICIENCY REQUIREMENTS** to **TABLE C403.10.1(5) WALK-IN COOLER AND FREEZER REFRIGERATION SYSTEM EFFICIENCY REQUIREMENTS**

- modify - **C403.10.3 Refrigerated display cases (Mandatory)** to **C403.10.2 Refrigerated display cases (Mandatory)**

- delete – **C403.10.4 Refrigeration systems.**

- add – **C403.10.3 Refrigeration systems.**
Refrigerated display cases, *walk-in coolers* or *walk-in freezers* that are served by remote compressors and remote condensers not located in a condensing unit, shall comply with Sections C403.10.3.1 and C403.10.3.2.

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

- modify - **C403.10.4.1 Condensers serving refrigeration systems to C403.10.3.1 Condensers serving refrigeration systems**

- delete – **C403.10.4.2 Compressor systems.**

- add – **C403.10.3.2 Compressor systems.**
Refrigeration compressor systems shall comply with the following:

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

   Exception: Controls are not required for the following:

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

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

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

   2.1. Insulation for liquid lines with a fluid operating temperature less than 60°F (15.6°C) shall comply with Table C403.11.3.

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

- delete and replace - **C403.11.1 Duct and plenum insulation and sealing (Mandatory).**
Supply and return air ducts and plenums shall be insulated with not less than R-8 insulation where located in unconditioned spaces and where located outside the building with not less than R-12 insulation. Where located within a building envelope assembly, the duct or plenum shall be separated from the building exterior or unconditioned or exempt spaces by not less than R-12 insulation. Buried ducts shall be insulated to a minimum of R-6

Exceptions:

1. Where located within equipment.

2. Where the design temperature difference between the interior and exterior of the duct or plenum is not greater than 15°F (8°C).

Ducts, air handlers and filter boxes shall be sealed. Joints and seams shall comply with the ANSI/SMACNA 006 HVAC Duct Construction Standards.

- delete and replace - **C403.11.2 Duct construction (Mandatory).**
Ductwork shall be constructed and erected in accordance with the ANSI/SMACNA 006 HVAC Duct Construction.

- delete and replace - **C403.11.2.1 Low-pressure duct systems (Mandatory).**
Longitudinal and transverse joints, seams and connections of supply and return ducts operating at a static pressure less than or equal to 2 inches water gauge (w.g.) (498 Pa) shall be securely fastened and sealed with welds, gaskets, mastics (adhesives), mas-tic-plus-embedded-fabric systems or tapes installed in accordance with the manufacturer's instructions. Pressure classifications specific to the duct system shall be clearly indicated on the construction documents in accordance with the ANSI/SMACNA 006 HVAC Duct Construction.

Exception: Locking-type longitudinal joints and seams, other than the snap-lock and button-lock types, need not be sealed as specified in this section.

- delete and replace - **C403.11.2.2 Medium-pressure duct systems (Mandatory).**
Ducts and plenums designed to operate at a static pressure greater than 2 inches water gauge (w.g.) (498 Pa) but less than 3 inches w.g. (747 Pa) shall be insulated and sealed in accordance with Section C403.11.1. Pressure classifications specific to the duct system shall be clearly indicated on the

construction documents in accordance with the ANSI/SMACNA 006 HVAC Duct Construction.

- delete and replace - **C403.11.2.3 High-pressure duct systems (Mandatory).**
Ducts and plenums designed to operate at static pressures equal to or greater than 3 inches water gauge (747 Pa) shall be insulated and sealed in accordance with Section C403.11.1. In addition, ducts and plenums shall be leak tested in accordance with the SMACNA HVAC Air Duct Leakage Test Manual and shown to have a rate of air leakage (CL) less than or equal to 4.0 as determined in accordance with Equation 4-7.

$CL = F/P^{0.65}$ **(Equation 4-7)**

where:

F = The measured leakage rate in cfm per 100 square feet of duct surface.
P = The static pressure of the test.

Documentation shall be furnished by the designer demonstrating that representative sections totaling not less than 25 percent of the duct area have been tested and that all tested sections comply with the requirements of this section.

- delete and replace - **C403.11.3 Piping insulation (Mandatory).**
Piping serving as part of a heating or cooling system shall be thermally insulated in accordance with Table C403.11.3.

Exceptions:

1. Factory-installed piping within HVAC equipment tested and rated in accordance with a test procedure referenced by this code.

2. Factory-installed piping within room fan-coils and unit ventilators tested and rated according to AHRI 440 (except that the sampling and variation provisions of Section 6.5 shall not apply) and AHRI 840, respectively.

3. Piping that conveys fluids that have a design operating temperature range between 60°F (15°C) and 85°F (29°C)

4. Strainers, control valves, and balancing valves associated with piping 1 inch (25 mm) or less in diameter.

5. Direct buried piping that conveys fluids at or below 60°F (15°C).

- delete and replace - **TABLE C403.11.3 MINIMUM PIPE INSULATION THICKNESS (in inches)**

TABLE C403.11.3

MINIMUM PIPE INSULATION THICKNESS (in inches)[a, c]

FLUID OPERATING TEMPERATURE RANGE AND USAGE (°F)	INSULATION CONDUCTIVITY		NOMINAL PIPE OR TUBE SIZE (inches)				
	Conductivity Btu • in./(h • ft^2 • °F)[b]	Mean Rating Temperature, °F	< 1	1 to < 1 1/2	1 1/2 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
85– 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

For SI: 1 inch = 25.4 mm, °C = [(°F) - 32]/1.8.

a. For piping smaller than 1 1/2 inches and located in partitions within conditioned spaces, reduction of these thicknesses by 1 inch shall be permitted (before thickness adjustment required in footnote b) but not to a thickness less than 1 inch.

b. For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows:

$$T = r\,[(1 + t/r)^{K/k} - 1]$$

where:

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

c. For direct-buried heating and hot water system piping, reduction of these thicknesses by 1 1/2 inches (38 mm) shall be permitted (before thickness adjustment required in footnote b but not to thicknesses less than 1 inch.

- delete and replace - **C403.11.3.1 Protection of piping insulation (Mandatory).**
Piping insulation exposed to the weather shall be protected from damage, including that caused by sunlight, moisture, equipment maintenance and wind, and shall provide shielding from solar radiation that can cause degradation of the material. Adhesive tape shall not be permitted. Piping insulation shall comply with both of the following requirements:

1. Insulation exposed to weather shall be suitable for outdoor service and shall be protected by aluminum, sheet metal, painted canvas, plastic cover, or other similar materials approved by the building official. Cellular foam insulation shall be protected as above or painted with a coating that is water-retardant and provides shielding from solar radiation; and

2. Unless the insulation is vapor-retardant, insulation covering chilled-water piping or refrigerant suction piping located outside the conditioned space shall include a vapor retardant located outside the insulation. All penetrations and joints shall be sealed

- delete and replace - **C403.12.1 Heating outside a building.**
Systems installed to provide heat outside a building shall be radiant systems. Electric resistance heating is prohibited for heating spaces outside a building.

Such heating systems shall be controlled by an occupancy sensing device or a timer switch, so that the system is automatically de-energized when occupants are not present.

- delete and replace - **C403.12.2 Snow- and ice-melt system controls.**
Snow-and ice-melting systems shall include automatic controls configured to shut off the system when the outdoor temperature is above 40°F (4°C) and the slab temperature as measured not less than 2" below the surface is 50°F (10°C).

SECTION C404
SERVICE WATER HEATING (MANDATORY)

- delete and replace - **C404.1 General.**
In addition to the service water heating requirements of Section C404, service water heating enhancements may be needed to meet the requirements of Section C406, Additional Efficiency Package Options. See Section C406.

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

- add - **C404.1.1 Electrical water heating limitation.**
Individual electric service water heating units shall be limited to a maximum of 7.5 kW total power input.

Exceptions:
1. Instantaneous electric water heaters used to serve emergency showers and emergency eye wash stations.
2. Hybrid heat pump service water heaters which utilize supplemental electric resistance elements and meeting the following requirements:
    a. No less than 60% of maximum heating demand can be met with the heat pump alone.
    b. For new buildings, if serving showers, the shower heads must have a maximum flow rate of no greater than 2.0 gpm.
    c. For new buildings, if serving dishwashing equipment, this equipment must be ENERGY STAR labeled.

- delete and replace - **TABLE C404.2 MINIMUM PERFORMANCE OF WATER-HEATING EQUIPMENT**

TABLE C404.2
MINIMUM PERFORMANCE OF WATER-HEATING EQUIPMENT

EQUIPMENT TYPE	SIZE CATEGORY (input)	SUBCATEGORY OR RATING CONDITION	PERFORMANCE REQUIRED[a, b]	TEST PROCEDURE
Water heaters, electric	≤ 7.5 kW	Tabletop[e] Resistance Grid-enabled[f] > 75 gallons and ≤ 120 gallons	0.93 - 0.00132*V*, EF 0.960 - 0.0003*V*, EF 1.061 - 0.00168*V*, EF	DOE 10 CFR Part 430
	≤ 24 amps and ≤ 250 volts	Heat pump > 55 gallons and ≤ 120 gallons	2.057 - 0.00113*V*, EF	DOE 10 CFR Part 430
Storage water heaters, gas	≤ 75,000 Btu/h	≥ 20 gallons and ≤ 55 gallons > 55 gallons and ≤ 100 gallons	0.675 - 0.0015*V*, EF 0.8012 - 0.00078*V*, EF	DOE 10 CFR Part 430
	> 75,000 Btu/h and ≤ 155,000 Btu/h	< 4,000 Btu/h/gal	80% E_t (Q/800 + 110√V)SL, Btu/h	ANSI Z21.10.3
	> 155,000 Btu/h	< 4,000 Btu/h/gal	80% E_t (Q/800 + 110√V)SL, Btu/h	
Instantaneous water heaters, gas	> 50,000 Btu/h and < 200,000 Btu/h[c]	≥ 4,000 (Btu/h)/gal and < 2 gal	0.82 - 0.00 19*V*, EF	DOE 10 CFR Part 430
	≥ 200,000 Btu/h	≥ 4,000 Btu/h/gal and < 10 gal	80% E_t	ANSI Z21.10.3
	≥ 200,000 Btu/h	≥ 4,000 Btu/h/gal and ≥ 10 gal	80% E_t (Q/800 + 110√V)SL, Btu/h	
Storage water heaters, oil	≤ 105,000 Btu/h	≥ 20 gal and ≤ 50 gallons	0.68 - 0.0019*V*, EF	DOE 10 CFR Part 430
	≥ 105,000 Btu/h	< 4,000 Btu/h/gal	80% E_t (Q/800 + 110√V)SL, Btu/h	ANSI Z21.10.3
Instantaneous water heaters, oil	≤ 210,000 Btu/h	≥ 4,000 Btu/h/gal and < 2 gal	0.59 - 0.0019*V*, EF	DOE 10 CFR Part 430
	> 210,000 Btu/h	≥ 4,000 Btu/h/gal and < 10 gal	80% E_t	ANSI Z21.10.3
	> 210,000 Btu/h	≥ 4,000 Btu/h/gal and ≥ 10 gal	78% E_t (Q/800 + 110√V)SL, Btu/h	
Hot water supply boilers, gas and oil	≥ 300,000 Btu/h and < 12,500,000 Btu/h	≥ 4,000 Btu/h/gal and < 10 gal	80% E_t	ANSI Z21.10.3
Hot water supply boilers, gas	≥ 300,000 Btu/h and < 12,500,000 Btu/h	≥ 4,000 Btu/h/gal and ≥ 10 gal	80% E_t (Q/800 + 110√V)SL, Btu/h	
Hot water supply boilers, oil	> 300,000 Btu/h and < 12,500,000 Btu/h	> 4,000 Btu/h/gal and > 10 gal	78% E_t (Q/800 + 110√V)SL, Btu/h	
Pool heaters, gas and oil	All	—	82% E_t	ASHRAE 146

(continued)

TABLE C404.2—continued
MINIMUM PERFORMANCE OF WATER-HEATING EQUIPMENT

EQUIPMENT TYPE	SIZE CATEGORY (input)	SUBCATEGORY OR RATING CONDITION	PERFORMANCE REQUIRED[a, b]	TEST PROCEDURE
Heat pump pool heaters	All	—	4.0 COP	AHRI 1160
Unfired storage tanks	All	—	Minimum insulation requirement R-12.5 $(h \cdot ft^2 \cdot °F)/Btu$	(none)

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m^2, °C = [(°F) - 32]/1.8, 1 British thermal unit per hour = 0.2931 W, 1 gallon = 3.785 L, 1 British thermal unit per hour per gallon = 0.078 W/L.

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

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

c. Instantaneous water heaters with input rates below 200,000 Btu/h shall comply with these requirements where the water heater is designed to heat water to temperatures 180°F or higher.

d. A tabletop water heater is a water heater that is enclosed in a rectangular cabinet with a flat top surface not more than 3 feet in height.

e. A grid-enabled water heater is an electric resistance water heater that meets all of the following:
   1. Has a rated storage tank volume of more than 75 gallons.
   2. Was manufactured on or after April 16, 2015.
   3. Is equipped at the point of manufacture with an activation lock.
   4. Bears a permanent label applied by the manufacturer that complies with all of the following:
      4.1. Is made of material not adversely affected by water.
      4.2. Is attached by means of nonwater-soluble adhesive.
      4.3. Advises purchasers and end users of the intended and appropriate use of the product with the following notice printed in 16.5 point Arial Narrow Bold font: "IMPORTANT INFORMATION: This water heater is intended only for use as part of an electric thermal storage or demand response program. It will not provide adequate hot water unless enrolled in such a program and activated by your utility company or another program operator. Confirm the availability of a program in your local area before purchasing or installing this product."

- delete and replace - **C404.2.1 High input service water-heating systems.**
Gas-fired water-heating equipment installed in new buildings shall be in compliance with this section. Where a singular piece of water-heating equipment serves the entire building, such equipment shall have a thermal efficiency, Et, of not less than 92 percent. Where multiple pieces of water-heating equipment serve the building and the combined input rating of the water-heating equipment is 1,000,000 Btu/h (293 kW) or greater, the combined input-capacity-weighted-average thermal efficiency, E_t, shall be not less than 92 percent.

Exceptions:

1. Where not less than 25 percent of the annual *service water-heating* requirement is provided by *on-site renewable energy* or site-recovered energy, the minimum thermal efficiency requirements of this section shall not apply.

2. The input rating of water heaters installed in individual dwelling units shall not be required to be included in the total input rating of *service water-heating* equipment for a building.

3. The input rating of water heaters with an input rating of not greater than 100,000 Btu/h (29.3 kW) shall not be required to be included in the total input rating of *service water-heating* equipment for a building.

- *delete and replace* - **C404.3 Heat traps for hot water storage tanks.**
Vertical pipe risers serving storage water heaters and storage tanks not having integral heat traps and serving a nonrecirculating system shall have heat traps on both the inlet and outlet piping as close as practical to the storage tank.

- *delete* - **C404.5.1 Maximum allowable pipe length method.**

- *delete* - **TABLE C404.5.1 PIPING VOLUME AND MAXIMUM PIPING LENGTHS**

- *delete* - **C404.5.2 Maximum allowable pipe volume method.**

- *delete* - **C404.5.2.1 Water volume determination.**

- *delete and replace* - **C404.6.1 Circulation systems.**
Heated-water circulation systems shall be provided with a circulation pump. The system return pipe shall be a dedicated return pipe or a cold water supply pipe. Gravity and thermo-syphon circulation systems shall be prohibited. Systems designed to maintain usage temperatures in hot-water pipes, such as recirculating hot-water systems or heat trace, shall:

1. Be equipped with automatic time switches that can be set to switch off the usage temperature maintenance system during periods when hot water is not required, or

2. Use a modulating pump, controlled by an aquastat at the return side of the pump, to maintain the minimum hot water temperature

Exception: in healthcare and other facilities with immunocompromised populations in accordance with ASHRAE Standard 188 – Legionellosis: Risk Management for Building Water Systems.

- *delete and replace* - **C404.9.3 Covers.**
Outdoor heated pools and outdoor permanent spas shall be provided with a vapor-retardant cover or other *approved* vapor-retardant means. Hot tubs and spas capable of being heated to more than 90°F (32°C) shall be provided with a cover having a minimum insulation value of R-12.

Exception: Where more than 75 percent of the energy for heating, computed over an operating season of not fewer than 3 calendar months, is from site-recovered energy such as from a heat pump or on-site renewable energy system, covers or other vapor-retardant means shall not be required.

- *delete and replace* - **C404.10 Energy consumption of portable spas (Mandatory).**
The energy consumption of electric-powered portable spas shall be controlled by the requirements of the Association of Pool & Spa Professionals (APSP) 14-2014.

- *delete and replace* - **C404.11 Service water-heating system commissioning and completion requirements.**
Service water-heating systems, swimming pool water-heating systems, spa water- heating systems and the controls for those systems shall be commissioned and completed in accordance with Section C407.2.

SECTION C405
ELECTRICAL POWER AND LIGHTING SYSTEMS

- *delete and replace* - **C405.1 General (Mandatory).**
In addition to the electrical power and lighting systems requirements of Section C405, electrical power and lighting enhancements may be needed to meet the requirements of Section C406, Additional Efficiency Package Options. See Section C406.

This section covers lighting system controls, the maximum lighting power for interior and exterior applications and electrical energy consumption.

Dwelling units and *Sleeping Units* within Group R-2 buildings (see *occupancy classifications in section C202*) shall install lamps or fixtures where not less than 90 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps or not less than 90 percent of the permanently installed lighting fixtures shall be high-efficacy fixtures or contain only high-efficacy lamps. Lighting installed in walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with the lighting requirements of Section C403.10.1.

- *delete and replace* - **C405.2 Lighting controls (Mandatory).**
Lighting systems shall be provided with controls that comply with one of the following.

1. Lighting controls as specified in Sections C405.2.1 through C405.2.6.

2. Luminaire level lighting controls (LLLC) and lighting controls as specified in Sections C405.2.1, C405.2.4 and C405.2.5. The LLLC luminaire shall be independently capable of:

   2.1. Monitoring occupant activity to brighten or dim lighting when occupied or unoccupied, respectively.

   2.2. Monitoring ambient light, both electric light and daylight, and brighten or dim artificial light to maintain desired light level.

   2.3. For each control strategy, configuration and reconfiguration of performance parameters including; bright and dim setpoints, timeouts, dimming fade rates, sensor sensitivity adjustments, and wireless zoning configurations.

Exceptions: Lighting controls are not required for the following:

1. Areas designated as security or emergency areas that are required to be continuously lighted.

2. Interior exit stairways, interior exit ramps and exit passageways.

3. Emergency egress lighting that is normally off.

4. *Dwelling units* and s*leeping units* within Group R-2 buildings (see *occupancy classifications*).

5. *Dwelling units* within buildings other than Group R-2, provided that not less than 90 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps or not less than 90 percent of the permanently installed lighting fixtures shall be high-efficacy fixtures or contain only high-efficacy lamps.

6. Industrial or manufacturing process areas, as may be required for production and safety.

- delete and replace - **C405.2.1.4 Occupant sensor control function for egress illumination.**

Luminaires providing means of egress illumination where the means of egress shall be illuminated at all times the room or space is occupied shall be controlled by occupancy sensors, or a signal from another building control system, that automatically reduces the lighting power by at least 50% when unoccupied for a period longer than 15 minutes.

Exceptions:

1. Egress areas not exceeding 50% of the space-by-space interior lighting power allowance provided in Table C405.3.2(2).

2. Means of egress illumination that does not exceed 0.02 watts per square foot of building area is exempt from this requirement.

3. Emergency lighting designated to meet National Fire Protection Association (NFPA) 1 or NFPA 101.

- delete and replace - **C405.2.2.1 Time-switch control function.**

Each space provided with *time-switch controls* shall be provided with a *manual control* for light reduction in accordance with Section C405.2.2.2. Time-switch con*trols* shall include an override switching device that complies with the following:

1. Have a minimum 7-day clock.

2. Be capable of being set for seven different day types per week.

3. Incorporate an automatic holiday “shutoff” feature, which turns off all controlled lighting loads for not fewer than 24 hours and then resumes normally scheduled operations.

4. Have program backup capabilities, which prevent the loss of program and time settings for not fewer than 10 hours, if power is interrupted.

5. Include an override switch that complies with the following:

   5.1. The override switch shall be a manual control.

   5.2. The override switch, when initiated, shall permit the controlled lighting to remain on for not more than 2 hours.

   5.3. Any individual override switch shall control the lighting for an area not larger than 5,000 square feet (465 m^2).

Exceptions:

1. Within mall concourses, auditoriums, sales areas, manufacturing facilities and sports arenas:

   1.1. The time limit shall be permitted to be greater than 2 hours, provided that the switch is a captive key device.

1.2. The area controlled by the override switch shall not be limited to 5,000 square feet (465 m^2) provided that such area is less than 20,000 square feet (1860 m^2).

2. Where provided with manual control, the following areas are not required to have light reduction control:

2.1. Spaces that have only one luminaire with a rated power of less than 50 watts.

2.2. Spaces that use less than 0.3 watts per square foot (3.2 W/m^2).

2.3. Corridors, lobbies, electrical rooms and or mechanical rooms.

- *delete and replace* - **C405.2.2.2 Light-reduction controls.**
Spaces required to have light-reduction controls shall have a *manual control* that allows the occupant to reduce the connected lighting load in a reasonably uniform illumination pattern by not less than 50 percent. Lighting reduction shall be achieved by one of the following or another *approved* method:

1. Controlling all lamps or luminaires.

2. Dual switching of alternate rows of luminaires, alternate luminaires or alternate lamps.

3. Switching the middle lamp luminaires independently of the outer lamps.

4. Switching each luminaire or each lamp.

Exceptions:

1. Light reduction controls are not required in *daylight zones* with *daylight responsive controls* complying with Section C405.2.3.

2. Where provided with manual control, the following areas are not required to have light reduction control:

2.1. Spaces that have only one luminaire with a rated power of less than 50 watts.

2.2. Spaces that use less than 0.3 watts per square foot (3.2 W/m^2).

2.3. Corridors, equipment rooms, public lobbies, electrical or mechanical rooms.

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

1. Spaces with a total of more than 150 watts of gen*eral lighting* within sidelit zones complying with Section C405.2.3.2 *General lighting* does not include lighting that is required to have specific application control in accordance with Section C405.2.4.

2. Spaces with a total of more than 150 watts of *general lighting* within toplit zones complying with Section C405.2.3.3.

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

1. Spaces in health care facilities where patient care is directly provided.

2. Lighting that is required to have specific application control in accordance with Section C405.2.4.

3. Sidelit zones on the first floor above grade in Group A-2 and Group M occupancies. (See *Occupancy classifications* in Section C202.)

4. Daylight zones where the total proposed lighting power density is less than 35 percent of the lighting power allowance per Section C405.3.2.

5 New buildings where the total connected lighting power calculated in accordance with Section C405.3.1 is not greater than the adjusted interior lighting power allowance (*LPAadj*) calculated in accordance with Equation 4-8:

$$LPA_{adj} = [LPA_{norm} \times (1.0 - 0.4 \times UDZFA / TBFA)] \quad \textbf{(Equation 4-8)}$$

where:

LPA_{adj}	=	Adjusted building interior lighting power allowance in watts.
LPA_{norm}	=	Normal building lighting power allowance in watts calculated in accordance with Section C405.3.2 and reduced in accordance with Section C406.3 where reduced lighting power is used to comply with the requirements of Section C406.
UDZFA	=	Uncontrolled daylight zone floor area is the sum of all sidelit and toplit zones, calculated in accordance with Sections C405.2.3.2 and C405.2.3.3, that do not have daylight responsive controls.
TBFA	=	Total building floor area is the sum of all floor areas included in the lighting power allowance calculation in Section C405.3.2.

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

1. Lights in *toplit* zones in accordance with Section C405.2.3.3 shall be controlled independently of lights in sidelit zones in accordance with Section C405.2.3.2.

2. *Daylight responsive controls* within each space shall be configured so that they can be calibrated from within that space by authorized personnel.

3. Calibration mechanisms shall be in a location with *ready access*.

4. Where located in offices, classrooms, laboratories and library reading rooms, *daylight responsive controls* shall dim lights continuously from full light output to 15 percent of full light output or lower.

5. *Daylight responsive controls* shall be configured to completely shut off all controlled lights.

6. Lights in *sidelit zones* in accordance with Section C405.2.3.2 facing different cardinal orientations [within 45 degrees (0.79 rad) of due north, east, south, west] shall be controlled independently of each other.

7. Incorporate time-delay circuits to prevent cycling of light level changes of less than three minutes.

8. The maximum area a single daylight responsive control device serves shall not exceed 2,500 square feet (232 m2).

9. Occupant permanent override capability of daylight dimming controls is not permitted, other than a reduction of light output from the level established by the daylighting controls. Occupant temporary override capability is allowed as long as the lighting control automatically resets to the original setting within twelve hours.

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

- add - **C405.2.3.1.1 Dimming.**

Daylight responsive controls shall be configured to automatically reduce the power of *general lighting* in the *daylight zone* in response to available daylight, while maintaining *uniform illumination* in the space through one of the following methods:

1. Continuous dimming using dimming ballasts/dimming drivers and daylight-sensing automatic controls. The system shall reduce lighting power continuously to less than 15 percent of rated power at maximum light output.

2. Stepped dimming using multi-level switching and daylight-sensing controls. The system shall provide a minimum of two steps of uniform illumination between 0 and 100 percent of rated power at maximum light output. Each step shall be in equal increments of power, plus or minus 10 percent. General lighting within daylight zones in offices, classrooms, laboratories and library reading rooms shall use the continuous dimming method. Stepped dimming is not allowed as a method of daylight zone control in these spaces.

- delete and replace - **C405.2.3.2 Sidelit zone.**

The sidelit zone is the floor area adjacent to vertical *fenestration* that complies with all of the following:

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

2. The area of the fenestration is not less than 24 square feet (2.23 m^2).

3. The distance from the fenestration to any building or geological formation that would block *access* to daylight is greater than the height from the bottom of the fenestration to the top of the building or geologic formation.

4. The visible transmittance of the fenestration is not less than 0.20.

5. Where *clerestory* fenestration is located in a wall, the sidelight daylight zone includes a lateral area twice the depth of the clerestory fenestration height, projected upon the floor at a 45-degree angle from the center of the clerestory fenestration. The longitudinal width of the daylight zone is calculated the same as for fenestration located in a wall. Where the 45-degree angle is interrupted by an obstruction greater than 0.7 times the ceiling height, the daylight zone shall remain the same lateral area but be located between the clerestory and the obstruction, as indicated in Figure C405.2.3.3(4).

6. If the rough opening area of a vertical fenestration assembly is less than 10 percent of the calculated primary daylight zone area for this fenestration, it does not qualify as a daylight zone.

7. Where located in existing buildings, the visible transmittance of the fenestration is no less than 0.20.

8. In parking garages with floor area adjacent to perimeter wall openings, the daylight zone shall include the area within 20 feet of any portion of a perimeter wall that has a net opening to wall ratio of at least 40 percent.

- delete and replace - **C405.2.3.3 Toplit zone.**
The *toplit* zone is the floor area underneath a roof fenestration assembly that complies with all of the following:

1. The *toplit* zone shall extend laterally and longitudinally beyond the edge of the roof fenestration assembly to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 0.7 times the ceiling height, whichever is less, as indicated in Figure C405.2.3.3(1).
2. Where the fenestration is located in a rooftop monitor, the toplit zone shall extend laterally to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 1.0 times the height from the floor to the bottom of the fenestration, whichever is less, and longitudinally from the edge of the fenestration to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 0.25 times the height from the floor to the bottom of the fenestration, whichever is less, as indicated in Figures C405.2.3.3(2) and C405.2.3.3(3).

3. Direct sunlight is not blocked from hitting the roof fenestration assembly at the peak solar angle on the summer solstice by buildings or geological formations.

4. The product of the visible transmittance of the roof fenestration assembly and the area of the rough opening of the roof fenestration assembly divided by the area of the *toplit* zone is not less than 0.008.

5. Where toplight daylight zones overlap with sidelight daylight zones, lights within the overlapping area shall be assigned to the toplight daylight zone.

- add - **FIGURE C405.2.3.3(4) DAYLIGHT ZONE ADJACENT TO CLERESTORY FENESTRATION IN A WALL**

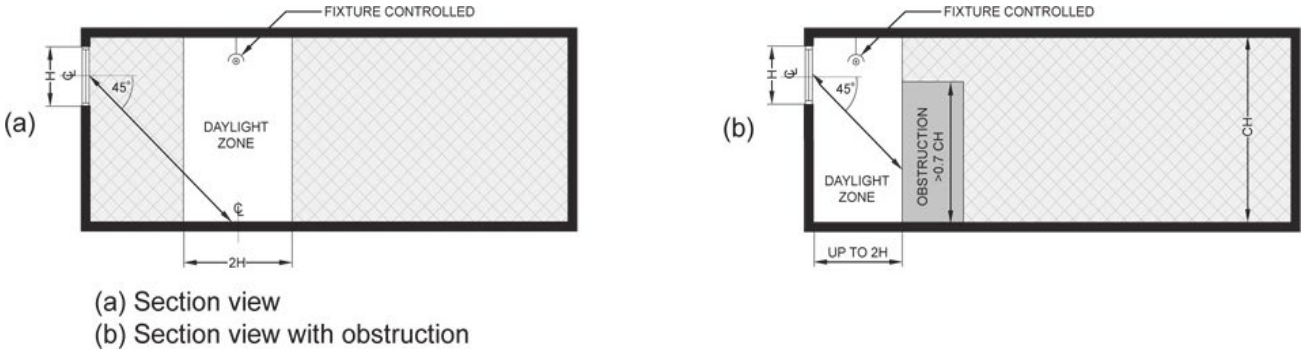

FIGURE C405.2.3.3(4)
DAYLIGHT ZONE ADJACENT TO CLERESTORY FENESTRATION IN A WALL

- *delete and replace* - **C405.3 Interior lighting power requirements (Prescriptive).**
A building complies with this section where its total connected interior lighting power calculated under Section C405.3.1 is not greater than the interior lighting power allowance calculated under Section C405.3.2.

Exceptions: Neither the floor area nor the wattage of lighting is counted in sections C405.3.1 and C405.3.2 for the following spaces:

1. *Dwelling units* and *sleeping units* within Group R-2 buildings (see *occupancy classification*).

2. *Dwelling units* and *sleeping units* within buildings other than Group R-2, provided that not less than 90 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps or not less than 90 percent of the permanently installed lighting fixtures shall be high-efficacy fixtures or contain only high-efficacy lamps.

- *delete and replace* - **C405.3.1 Total connected interior lighting power.**
The total connected interior lighting power shall be determined in accordance with Equation 4-9.

TCLP = [*SL* + *LVL* + *BLL* + *LED* + *TRK* + Other] **(Equation 4-9)**

where:

TCLP	=	Total connected lighting power (watts).
SL	=	Labeled wattage of luminaries for screw-in lamps.
LVL	=	For luminaires with lamps connected directly to building power, such as line voltage lamps, the rated wattage of the lamp.
BLL	=	For luminaires incorporating a ballast or transformer, the rated input wattage of the

ballast or transformer when operating that lamp.

LED = For light-emitting diode luminaires with either integral or remote drivers, the rated wattage of the luminaire.

TRK = For lighting track, cable conductor, rail conductor, and plug-in busway systems that allow the addition and relocation of luminaires without rewiring, the wattage shall be one of the following:

1. The specified wattage of the luminaires, but not less than 8 W per linear foot (25 W/lin m).
2. The wattage limit of the permanent current-limiting devices protecting the system.
3. The wattage limit of the transformer supplying the system.

Other = The wattage of all other luminaires and lighting sources not covered previously and associated with interior lighting verified by data supplied by the manufacturer or other *approved* sources.

The connected power associated with the following lighting equipment and applications is not included in calculating total connected lighting power. Additionally, for multiple systems installed in circadian rhythm systems only include the maximum power that would be on at any one time.

1. Television broadcast lighting for playing areas in sports arenas.

2. Emergency lighting automatically off during normal building operation.

3. Lighting in spaces specifically designed for use by occupants with special lighting needs, including those with visual impairment and other medical and age-related issues.

4. Casino gaming areas.

5. Mirror lighting in dressing rooms.

6. Task lighting for medical and dental purposes that is in addition to general lighting and controlled by an independent control device.

7. Display lighting for exhibits in galleries, museums and monuments that is in addition to general lighting and controlled by an independent control device.

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

9. Lighting for photographic processes.

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

11. Task lighting for plant growth or maintenance provided it is limited to no more than 1.5 W per square foot.

12. Advertising signage or directional signage.

13. Lighting for food warming.

14. Lighting equipment that is for sale.

15. Lighting demonstration equipment in lighting education facilities.

16. Lighting approved because of safety considerations.

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

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

19. Exit signs.

- delete and replace - ***TABLE C405.3.2(1) INTERIOR LIGHTING POWER ALLOWANCES: BUILDING AREA METHOD***

TABLE C405.3.2(1)
INTERIOR LIGHTING POWER ALLOWANCES:
BUILDING AREA METHOD

BUILDING AREA TYPE	LPD (w/ft^2)
Automotive facility	0.60
Convention center	0.70
Courthouse	0.76
Dining: bar lounge/leisure	0.76
Dining: cafeteria/fast food	0.67
Dining: family	0.69
Dormitory[c]	0.47
Exercise center	0.59
Fire station[a]	0.48
Gymnasium	0.64
Health care clinic	0.69
Hospital[a]	0.84
Hotel/Motel[a, b]	0.65
Library	0.78
Manufacturing facility	0.82
Motion picture theater	0.64
Multifamily[c]	0.48
Museum	0.83
Office	0.64
Parking garage	0.14
Penitentiary	0.62
Performing arts theater	1.02
Police station	0.67
Post office	0.61
Religious building	0.77
Retail	0.92
School/university	0.67
Sports arena	0.71
Town hall	0.67
Transportation	0.52
Warehouse	0.43
Workshop	0.83

a. Where sleeping units are excluded from lighting power calculations when 90% of the sleeping units' lamps or fixtures is high-efficacy, neither the area of the sleeping units nor the wattage of lighting in the sleeping units is counted.
b. Where dwelling units are excluded from lighting power calculations when 90% of the sleeping units' lamps or fixtures is high-efficacy, neither the area of the dwelling units nor the wattage of lighting in the dwelling units is counted.
c. Dwelling units and sleeping units are excluded. Neither the area of the dwelling units nor the wattage of lighting in the dwelling units is counted.

- delete and replace - ***TABLE C405.3.2(2) INTERIOR LIGHTING POWER ALLOWANCES: SPACE-BY-SPACE METHOD***

TABLE C405.3.2(2)
INTERIOR LIGHTING POWER ALLOWANCES:
SPACE-BY-SPACE METHOD

COMMON SPACE TYPES[a]	LPD (watts/sq.ft)
Atrium	
Less than 40 feet in height	0.03 per foot in total height
Greater than 40 feet in height	0.40 + 0.02 per foot in total height
Audience seating area	
In an auditorium	0.50
In a convention center	0.66
In a gymnasium	0.52
In a motion picture theater	0.91
In a penitentiary	0.22
In a performing arts theater	1.77
In a religious building	1.22
In a sports arena	0.34
Otherwise	0.34
Banking activity area	0.74
Breakroom (See Lounge/breakroom)	
Classroom/lecture hall/training room	
In a penitentiary	1.07
Otherwise	0.87
Computer room	1.21
Conference/meeting/multipurpose room	0.92
Copy/print room	0.51
Corridor	
In a facility for the elderly or visually impaired (and not used primarily by the staff)[b]	0.92
In a hospital	0.79
In a manufacturing facility	0.29
Otherwise	0.66
Courtroom	1.24
Dining area	
In bar/lounge or leisure dining	0.80
In cafeteria or fast food dining	0.51
In a facility for the visually impaired (and not used primarily by the staff)[b]	1.56
In family dining	0.64
In a penitentiary	0.77
Otherwise	0.51
Electrical/mechanical room	0.43
Emergency vehicle garage	0.38

(continued)

TABLE C405.3.2(2)—continued
INTERIOR LIGHTING POWER ALLOWANCES: SPACE-BY-SPACE METHOD

COMMON SPACE TYPES[a]	LPD (watts/sq.ft)
Food preparation area	0.90
Guestroom[c, d]	0.47
Laboratory	
In or as a classroom	1.05
Otherwise	1.30
Laundry/washing area	0.41
Loading dock, interior	0.42
Lobby	
For an elevator	0.53
In a facility for the elderly or visually impaired (and not used primarily by the staff)[b]	1.54
In a hotel	0.85
In a motion picture theater	0.41
In a performing arts theater	1.47
Otherwise	0.76
Locker room	0.48
Lounge/breakroom	
In a healthcare facility	0.68
Otherwise	0.54
Office	
Enclosed	0.81
Open plan	0.71
Parking area, interior	0.13
Pharmacy area	1.20
Restroom	
In a facility for the elderly or visually impaired (and not used primarily by the staff[b]	0.86
Otherwise	0.73
Sales area	1.11
Seating area, general	0.38
Stairway (see Space containing stairway)	
Stairwell	0.51
Storage room	0.43
Vehicular maintenance area	0.49
Workshop	1.08
BUILDING TYPE SPECIFIC SPACE TYPES[a]	**LPD (watts/sq.ft)**
Automotive (see Vehicular maintenance area)	
Convention Center—exhibit space	0.88
Facility for the elderly or visually impaired	
In a chapel (and not used primarily by the staff)	1.06
In a recreation room (and not used primarily by the staff)	1.67
Fire Station—sleeping quarters[c]	0.17
Gymnasium/fitness center	

In an exercise area	0.48
In a playing area	0.80

(continued)

TABLE C405.3.2(2)—continued
INTERIOR LIGHTING POWER ALLOWANCES:
SPACE-BY-SPACE METHOD

BUILDING TYPE SPECIFIC SPACE TYPES[a]	LPD (watts/sq.ft)
Healthcare facility	
In an exam/treatment room	1.34
In an imaging room	1.02
In a medical supply room	0.51
In a nursery	0.76
In a nurse's station	0.61
In an operating room	1.85
In a patient room[c]	0.50
In a physical therapy room	0.70
In a recovery room	0.87
Library	
In a reading area	0.75
In the stacks	1.15
Manufacturing facility	
In a detailed manufacturing area	0.88
In an equipment room	0.55
In an extra-high-bay area (greater than 50′ floor-to-ceiling height)	0.84
In a high-bay area (25-50′ floor-to-ceiling height)	0.75
In a low-bay area (less than 25′ floor-to-ceiling height)	0.85
Museum	
In a general exhibition area	0.84
In a restoration room	0.74
Performing arts theater—dressing room	0.36
Post office—sorting area	0.64
Religious buildings	
In a fellowship hall	0.47
In a worship/pulpit/choir area	1.22
Retail facilities	
In a dressing/fitting room	0.48
In a mall concourse	0.80
Sports arena—playing area	
For a Class I facility[e]	2.17
For a Class II facility[f]	1.55
For a Class III facility[g]	1.17
For a Class IV facility[h]	0.70

(continued)

TABLE C405.3.2(2)—continued
INTERIOR LIGHTING POWER ALLOWANCES:
SPACE-BY-SPACE METHOD

BUILDING TYPE SPECIFIC SPACE TYPES[a]	LPD (watts/sq.ft)
Transportation facility	
In a baggage/carousel area	0.39
In an airport concourse	0.27
At a terminal ticket counter	0.56
Warehouse—storage area	
For medium to bulky, palletized items	0.35
For smaller, hand-carried items	0.65

a. In cases where both a common space type and a building area specific space type are listed, the building area specific space type shall apply
b. A 'Facility for the Visually Impaired' is a facility that is licensed or will be licensed by local or state authorities for senior long-term care, adult daycare, senior support or people with special visual needs.
c. Where sleeping units are excluded from lighting power calculations when 90% of the sleeping units' lamps or fixtures is high-efficacy, neither the area of the sleeping units nor the wattage of lighting in the sleeping units is counted.
d. Where dwelling units are excluded from lighting power calculations when 90% of the sleeping units' lamps or fixtures is high-efficacy, neither the area of the dwelling units nor the wattage of lighting in the dwelling units is counted.
e. Class I facilities consist of professional facilities; and semiprofessional, collegiate, or club facilities with seating for 5,000 or more spectators.
f. Class II facilities consist of collegiate and semiprofessional facilities with seating for fewer than 5,000 spectators; club facilities with seating for between 2,000 and 5,000 spectators; and amateur league and high-school facilities with seating for more than 2,000 spectators.
g. Class III facilities consist of club, amateur league and high-school facilities with seating for 2,000 or fewer spectators.
h. Class IV facilities consist of elementary school and recreational facilities; and amateur league and high-school facilities without provision for spectators.

- delete and replace - **C405.3.2.2.1 Additional interior lighting power.**
Where using the Space-by-Space Method, an increase in the interior lighting power allowance is permitted for specific lighting functions. Additional power shall be permitted only where the specified lighting is installed and automatically controlled separately from the general lighting, to be turned off during nonbusiness hours. This additional power shall be used only for the specified luminaires and shall not be used for any other purpose. An increase in the interior lighting power allowance is permitted in the following cases:

1. For lighting equipment to be installed in sales areas specifically to highlight merchandise, the additional lighting power shall be determined in accordance with Equation 4-10.

Additional interior lighting power allowance = 250 W + (Retail Area 1 × 0.20 W/ft^2) + (Retail Area 2 × 0.20 W/ft^2) + (Retail Area 3 × 0.50 W/ft^2) + (Retail Area 4 × 0.90 W/ft^2)

SI units:

Additional interior lighting power allowance = 250 W + (Retail Area 1 × 2.13 W/m^2) + (Retail Area 2 × 2.15 W/m2) + (Retail Area 3 × 5.24 W/m^2) + (Retail Area 4 × 9.63 W/m^2) **(Equation 4-10)**

where:

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

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

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

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

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

2.

- delete and replace - **C405.4 Exterior lighting power requirements (Mandatory).**
The total connected exterior lighting power calculated in accordance with Section C405.4.1 shall be not greater than the exterior lighting power allowance calculated in accordance with Section C405.4.2 and C405.4.3. Appropriate exterior lighting designs including maximum exterior illuminance levels may be required by the District Environmental Commission for Act 250 projects.

- delete and replace - ***TABLE C405.4.2(1) EXTERIOR LIGHTING ZONES***

TABLE C405.4.2(1)
EXTERIOR LIGHTING ZONES

LIGHTING ZONE	DESCRIPTION
1	Developed areas of national parks, state parks, forest land, and rural areas
2	Areas predominantly consisting of residential zoning, neighborhood business districts, light industrial with limited nighttime use and residential mixed-use areas
3	All other areas not classified as lighting zone 1 or 2

- delete - ***TABLE C405.4.2(2) LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS***

- add - **TABLE C405.4.2(2) INDIVIDUAL LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS**

TABLE C405.4.2(2)
INDIVIDUAL LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS

	LIGHTING ZONES		
	Zone 1	**Zone 2**	**Zone 3**
Base Site Allowance	250 W	300 W	375 W
Uncovered Parking Areas			
Parking areas and drives	0.02 W/ft2	0.03 W/ft2	0.05 W/ft2
Building Grounds			
Walkways less than 10 feet wide	0.35 W/linear foot	0.35 W/linear foot	0.40 W/linear foot
Walkways 10 feet wide or greater, plaza areas special feature areas	0.07 W/ft2	0.07 W/ft2	0.08 W/ft2
Dining areas	0.50 W/ft2	0.50 W/ft2	0.60 W/ft2
Stairways	0.40 W/ft2	0.50 W/ft2	0.50 W/ft2
Pedestrian tunnels	0.08 W/ft2	0.08 W/ft2	0.10 W/ft2
Landscaping	0.02 W/ft2	0.03 Wft2	0.03 W/ft2
Building Entrances and Exits			
Pedestrian and vehicular entrances and exits	10 W/linear foot of door width	10 W/linear foot of door width	15 W/linear foot of door width
Entry canopies	0.10 W/ft2	0.12 W/ft2	0.20 W/ft2
Loading Docks	0.25 W/ft2	0.25 W/ft2	0.25 W/ft2
Sales Canopies			
Free-standing and attached	0.30 W/ft2	0.30 W/ft2	0.40 W/ft2
Outdoor Sales			
Open areas (including vehicle sales lots)	0.15 W/ft2	0.15 W/ft2	0.25 W/ft2
Street frontage for vehicle sales lots in addition to “open area” allowance	No allowance	5 W/linear foot	5 W/linear foot
Building facades	No allowance	0.075 W/ft2 of gross above-grade wall area	0.113 W/ft2 of gross above-grade wall area
Automated teller machines (ATM) and night depositories	135 W per location plus 45 W per additional ATM per location	135 W per location plus 45 W per additional ATM per location	135 W per location plus 45 W per additional ATM per location
Entrances and gatehouse inspection stations at guarded facilities	0.5 W/ft2 of covered and uncovered area	0.5 W/ft2 of covered and uncovered area	0.5 W/ft2 of covered and uncovered area
Loading areas for law enforcement, fire, ambulance and other emergency service vehicles	0.35 W/ft2 of covered and uncovered area	0.35 W/ft2 of covered and uncovered area	0.35 W/ft2 of covered and uncovered area

Drive-up windows/doors	200 W per drive-through	200 W per drive-through	200 W per drive-through
Parking near 24-hour retail entrances	400 W per main entry	400 W per main entry	400 W per main entry

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

- delete - **TABLE C405.4.2(3) INDIVIDUAL LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS**

- delete - **C405.4.2.1 Additional exterior lighting power.**

- add - **C405.4.3 Exterior fixtures.**
Exterior lighting shall be *full cut off* fixtures, limiting the light output to less than 10% at and below 10 degrees below the horizontal. Fixtures shall be independently certified by manufacturer as full cut off, or meet the definition of a *fully shielded* light fixture.

- modify - **C405.4.3 Gas lighting (Mandatory) to C405.4.4 Gas lighting (Mandatory)**

- *delete and replace* - **C405.8.1 Elevator cabs.**
For the luminaires in each elevator cab, not including signals and displays, the sum of the lumens divided by the sum of the watts shall be not less than 55 lumens per watt. Ventilation fans in elevators that do not have their own air-conditioning system shall not consume more than 0.33 watts/cfm at the maximum rated speed of the fan. Controls shall be provided that will de-energize ventilation fans and lighting systems when the elevator is stopped, unoccupied and with its doors closed for over 15 minutes.

- add - **C405.10 Electric Vehicle Charging Stations**
New parking lots serving buildings with occupancy groups listed in Table 405.11 shall provide the electrical service capacity to serve the number of Electric Vehicle Charging Parking Spaces in Table C405.11. Electrical service capacity includes use of a listed cabinet, box or enclosure connected to a conduit linking the parking spaces with the electrical service. Parking lots serving multiple occupancy groups shall use the occupancy group with the largest square feet of finished area.

Exception: Parking spaces are not counted in Table 405.11 if one of the following conditions apply:
1. Parking spaces intended exclusively for storage of vehicles for retail sale or vehicle service.
2. Parking spaces are separated from the meter by a public right-of-way.
3. Parking spaces which are limited to parking durations of less than an hour.

50% of the parking spaces indicated in Table C405.11, rounded up to the nearest whole number, is the minimum number of Electric Vehicle Supply Equipment (EVSE) or receptacles necessary to function as available electric vehicle charging upon building occupancy. The number of parking spaces indicated in Table C405.11 minus the number of installed EVSE parking spaces is the minimum number of parking spaces that are required to be pre-wired, allowing for future installations when they are needed for use by customers, employees or other users (EVSE-ready). If level 1 service is provided, the required EV Charging Parking Spaces shall also be “Level 2 ready” as defined below in this Section C405.10. Electrical service capacity includes use of a listed cabinet, box or enclosure connected to a conduit linking the parking spaces with the electrical service. For parking lots with 25 or more parking spaces, Table C405.11 can be satisfied by either Option A or B in the table.

Parking spaces with EVSE shall be marked for EV use only.

Exception:

1. In Group R-2 buildings the number of parking spaces with EVSE that are marked for "EV use only" need not exceed the number of EV cars driven by occupants of the building. This exception does not reduce the number of EVSE spaces, just the number that are marked for EV use only.
2. In structured parking lots ½ of parking spaces, rounded up, with EVSE shall be marked for "EV use only", while the remainder need not be marked for "EV use only". This exception does not reduce the number of EVSE spaces, just the number that are marked for EV use only.

Level 1 Electric Vehicle Charging Parking requires one 120V 20-amp grounded AC receptacle, NEMA 5- 20R or equivalent, within 5 feet of the centerline of each EV Charging Parking Space.

Level 2 Electric Vehicle Charging Parking requires one 208/240V 40-amp grounded connection for electric vehicle charging through dedicated Electric Vehicle Supply Equipment (EVSE) with J1772 connector or AC receptacle, NEMA 14-50, or equivalent, within 5 feet of the centerline for each EV Charging Parking Space.

DC Fast Charging, also referred to as Level 3, Electric Vehicle Charging Parking requires one, direct-current (DC) plug for electric vehicle charging through dedicated Electric Vehicle Supply Equipment (EVSE) with either a CHAdeMO or SAE Combined Charging System (CCS) format connector, within 5 feet of the centerline for each EV Charging Parking Space. Other DC Fast Charging plug standards may be accepted as they are developed.

This section does not stipulate how use of the EVSE is provided.

- add - **TABLE C405.11 ELECTRIC VEHICLE CHARGING PARKING SPACES**

TABLE C405.11 ELECTRIC VEHICLE CHARGING PARKING SPACES

Commercial Building Occupancy[a]	**Minimum Number of EVSE and EVSE-ready Parking Spaces[b]** Whole numbers represent actual number of required spaces. Fractional percentages shall be rounded up to nearest whole number.					
	<25 Parking Spaces in Lot		≥25 Parking Spaces in Lot Option A		≥25 Parking Spaces in Lot Option B	
	Level 1	Level 2 or DC Fast Charge	Level 1	Level 2 or DC Fast Charge	Level 1	Level 2 or DC Fast Charge
Groups A & M[c]	0	0	0%	4%	0%	10
Groups B, E, F, & H	1	1	3%	3%	2%	5
Groups I-1, I-2, I-3, & R-4	1	1	2%	4%	1%	10
Group R-1	0	1	0%	2%	1%	10
Group R-2	1	0	8%	0%	3%	5

a. See *occupancy classification* in section C202. If more than one occupancy type, use the occupancy type with the most square feet of finished building area.

b. 50% of the parking spaces, rounded up to the nearest whole number, shall have EVSE or receptacles necessary to function as available electric vehicle charging upon building occupancy. The remainder shall be EVSE-ready.
c. Motor liquid fuel-dispensing facilities (gas stations) are exempt from the requirement to provide electric vehicle charging parking spaces.
d. Stand-alone retail stores with fewer than 50 spaces are exempt from the requirement to provide electric vehicle charging parking spaces.

If the design intent is to only provide level 2 and/or DC Fact Charge charging stations, then the level 1 and level 2 requirements should be added together.

SECTION C406
ADDITIONAL EFFICIENCY PACKAGE OPTIONS

- *delete* - **C406.1 Requirements.**

- add - **C406.1 Additional Energy Efficiency Credit Requirements.**

New buildings shall comply with sufficient packages from Table C406.1 to achieve a minimum number of 6 credits. Building with more than one commercial building occupancy type shall use the "All Other Groups" column in Table 406.1, unless 65% or more of the finished square footage is one commercial building occupancy type, in which case the dominant commercial building occupancy type will be used.

- *add* – **Table C406.1 Efficiency Package Credits**

Table C406.1
Efficiency Package Credits

Code Section	Commercial Building Occupancy					
	Group R-1	Group R-2	Group B	Group E	Group M	All Other Groups
	Additional Efficiency Credits					
1. More efficient HVAC performance in accordance with Section C406.2.	2	2	5	2	6	3
2.1 Reduced lighting power: Option 1 in accordance with Section C406.3.1.	1	1	3	3	3	2
2.2 Reduced lighting power: Option 2 in accordance with Section C406.3.2.	2	2	5	5	5	4
3. Enhanced lighting controls in accordance with C406.4.	N/A	N/A	2	1	2	1
4. On-site supply of renewable energy in accordance with C406.5.	3	2	2	3	3	3
5. Dedicated outdoor air system in accordance with C406.6[1].	3	1	2	3	4	3
6.1 High-efficiency service water heating in accordance with Section C406.7.1 and C406.7.2.	5	6	N/A	N/A	N/A	3 (Group I only)

6.2 High-efficiency service water heating equipment in accordance with Section C406.7.1 and C406.7.3.	3	3	N/A	N/A	N/A	2 (Group I only)
6.3. Heat pump water heating equipment in accordance with Sections C406.7.1 and C406.7.4.	5	5	N/A	N/A	N/A	2 (Group I only)
7. Enhanced envelope performance in accordance with Section C406.8.	3	4	2	2	2	3
8. Reduced air infiltration in accordance with Section C406.9.	3	5	2	3	4	3
9. Efficient kitchen appliances in accordance with C406.10.[2]	5	5	5	5	5	5 (Group A-2 only)
10. Controlled Receptacles in accordance with C406.11	N/A	N/A	6	2	N/A	N/A
1. This option is only available to building equipped with operable commercial kitchens serving a minimum of 5 meals per week. See C406.10						

- delete and replace- **C406.1.1 Tenant spaces.**
Tenant spaces shall comply with sufficient packages from Table C406.1 to achieve a minimum number of 3 credits from Sections C406.2, C406.3, C406.4, C406.6 or C406.7 where applicable. Where an entire building complies with Section C406.5, C406.8 or C406.9, tenant spaces within the building shall be deemed to comply with this section.

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

- *delete* – **C406.2 More efficient HVAC equipment performance.**

- *add* - **C406.2 More efficient HVAC equipment and fan performance.**
Buildings shall comply with Sections C406.2.1 through C406.2.3.

- *add* - **C406.2.1 HVAC system selection.** No less than 90 percent of the total HVAC capacity serving the building shall be provided by equipment that is listed in Tables C403.3.2(1) through C403.3.2(12).

Exception: Air-to-water heat pumps or heat recovery chillers are also permitted to be utilized for Option C406.2.

- *add* - **C406.2.2 Minimum equipment efficiency.** Equipment shall exceed the minimum efficiency requirements listed in Tables C403.3.2(1) through C403.3.2(12) by 15 percent, in addition to the requirements of Section C403. Where multiple performance requirements are provided, the equipment shall exceed all requirements by 15 percent.

Exception: Equipment that is larger than the maximum capacity range indicated in Tables C403.3.2(1) through C403.3.2(12) shall utilize the values listed for the largest capacity equipment for the associated equipment type shown in the table.

- *add* - **C406.2.3 Minimum fan efficiency.** Stand-alone supply, return and exhaust fans designed for operating with motors over 750 watts (1 hp) shall have a fan efficiency grade of not less than FEG 71 as defined in AMCA 205. The total efficiency of the fan at the design point of operation shall be within 10 percentage points of either the maximum total efficiency of the fan or the static efficiency of the fan.

- delete and replace- **C406.3 Reduced lighting power.**
Buildings shall comply with Sections C406.3.1 or C406.3.2. Dwelling units and sleeping units within the building shall comply with C406.3.3.

- *add* - **C406.3.1 Reduced lighting power option 1.** The total connected interior lighting power calculated in accordance with Section C405.3.1 shall be 90 percent or less of the total interior lighting power value calculated in accordance with Section C405.3.2.1, or by using 90 percent of the total interior lighting power allowance calculated in accordance with Section C405.3.2.2.

- *add* - **C406.3.2 Reduced lighting power option 2.** The total connected interior lighting power calculated in accordance with Section C405.3.1 shall be 80 percent or less of the total interior lighting power value calculated in accordance with Section C405.3.2.1, or by using 80 percent of the total interior lighting power allowance calculated in accordance with Section C405.3.2.2.

- *add* - **C406.3.3 Lamp fraction.** Not less than 95 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps or not less than 95 percent of the permanently installed lighting fixtures shall be high-efficacy fixtures or contain only high-efficacy lamps.

- delete and replace- **C406.4 Enhanced digital lighting controls.**
Interior lighting shall be located, scheduled and operated in accordance with Section C405.2 and no less than 90 percent of the total installed interior lighting power shall be configured with the following enhanced control functions.

1. Luminaires shall be configured for continuous dimming.

2. Luminaires shall be addressed individually.

   Exceptions:
   1. Multiple luminaires mounted on no more than 12 linear feet of a single lighting track and addressed as a single luminaire.

   2. Multiple linear luminaires that are ganged together to create the appearance of a single longer fixture and addressed as a single luminaire, where the total length of the combined luminaires is not more than 12 feet.

3. Not more than eight luminaires within a *daylight zone* are permitted to be controlled by a *daylight* responsive control.

4. Luminaires shall be controlled through a digital control system configured with the following capabilities:

   4.1. Scheduling and illumination levels of individual luminaires and groups of luminaires are capable of being reconfigured through the system.

   4.2. Load shedding.

   4.3. In open and enclosed offices, the illumination level of overhead general illumination luminaires are configured to be individually adjusted by occupants.

   4.4. Occupancy sensors and daylight responsive controls are capable of being reconfigured through the system.

5. Construction documents shall include submittal of a Sequence of Operations, including a specification outlining each of the functions required by this section.

- delete and replace- **C406.5 On-site renewable energy.**
Buildings shall be provided with on-site renewable energy systems with a total system rating per square foot of conditioned floor area of the building of not less than the value specified in Table C406.5.

- add - **TABLE C406.5 ON-SITE RENEWABLE ENERGY SYSTEM RATING**

TABLE C406.5
ON-SITE RENEWABLE ENERGY SYSTEM RATING

(PER SQUARE FOOT) Building Area Type	kBTU per year	kWh per year
Assembly	1.8	0.53
Dining	10.7	3.14
Hospital	3.6	1.06
Hotel/Motel	2.0	0.59
Multi-family residential	0.50	0.15
Office	0.82	0.24
Other	2.02	0.59
Retail	1.31	0.38
School/University	1.17	0.34
Supermarket	5.0	1.47
Warehouse	0.43	0.13

- delete and replace- **C406.6 Dedicated outdoor air system.**
Not less than 90% of the building conditioned floor area, excluding floor area of unoccupied spaces that do not require ventilation per ASHRAE Standard 62.1, shall be served by DOAS. Buildings containing equipment or systems regulated by Section C403.3.4, C403.4.3, C403.4.4, C403.4.5, C403.6, C403.8.4, C403.8.5, C403.8.5.1, C403.9.1, C403.9.2, C403.9.3 or C403.9.4 shall be equipped with an independent ventilation system designed to provide not less than the minimum 100-percent outdoor air to each individual occupied space, as specified by ASHRAE Standard 62.1. The ventilation system shall be capable of total energy recovery. The HVAC system shall include supply-air temperature controls that automatically reset the supply-air temperature in response to representative building loads, or to outdoor air temperatures. The controls shall reset the supply-air temperature not less than 25 percent of the difference between the design supply-air temperature and the design room-air temperature.

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

- add - **C406.7.1 Building type.** To qualify for this credit, not less than 90 percent of the building conditioned floor area shall be of the following types:

1. *Group R*-1: Boarding houses, hotels or motels.

2. Group I-2: Hospitals, psychiatric hospitals and nursing homes.

3. Group A-2: Restaurants and banquet halls or buildings containing food preparation areas.

4. Group F: Laundries.

5. *Group R*-2.

6. Group A-3: Health clubs and spas.

- delete – **C406.7.1 Load fraction.**

- add – **C406.7.2 Load fraction.**
Not less than 60 percent of the annual building service hot water energy use, or not less than 100 percent of the annual building service hot water heating energy use in buildings subject to the requirements of Section C403.9.5, shall be provided by one or more of the following:

1. Waste heat recovery from service hot water, heat-recovery chillers, building equipment, process equipment, or other *approved* system.

2. *On-site renewable energy* water-heating systems.

- add – **C406.7.3 High Performance Water Heating Equipment.** The combined input-capacity-weighted-average equipment rating of all water heating equipment in the building shall be not less than 95% Et or 0.95 EF.

- add – **C406.7.4 Heat pump water heater**. All Service hot water system ~~delivering~~ heating requirements shall be met using heat pump technology with a minimum COP 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.

- delete and replace- **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 for a building of identical configuration and fenestration area in accordance with Section C402.1.3.

If using Section C402.1.4 Building above-grade performance alternative for compliance, UA-Total / Area ≤ 0.030 needs to be met as well as total UA of below-grade walls shall be not less than 15 percent below the total UA of the below-grade thermal envelope in accordance with Section C402.1.3.

- add – **C406.10 Efficient Kitchen Appliances.**
Buildings shall comply with Sections C406.10.1 through C406.10.2 in order to qualify for additional efficiency credits.

- add – **C406.10.1 Building Requirements.** The building shall contain an operable commercial kitchen that serves a minimum of 5 meals per week.

- add – **C406.10.2 Equipment Type.** The following pieces of equipment that fall within the scope of the applicable Energy Star program shall comply with the equivalent criteria required to achieve the Energy Star label if installed prior to the issuance of the Certificate of Occupancy:

1. Commercial Fryers
2. Commercial Hot Food Holding Cabinets
3. Commercial Steam Cookers
4. Commercial Dishwashers
5. Commercial Griddles
6. Commercial Ovens

- add – **C406.11 Controlled receptacles.**
At least 50 percent of all 125 volt 15- and 20-ampere receptacles installed in private offices, open offices, conference rooms, rooms used primarily for printing and/or copying functions, break rooms, individual workstations and classrooms, including those installed in modular partitions and modular office workstation systems, shall be controlled as required by this section. Either split receptacles shall be provided, with the top receptacle(s) controlled, or a controlled receptacle shall be located within 12 inches (0.30 m) of each uncontrolled receptacle. Controlled receptacles shall be visibly differentiated from standard receptacles and shall be controlled by one of the following automatic control devices:

1. An occupant sensor that turns receptacle power off when no occupants have been detected for a maximum of 20 minutes.

2. A time-of-day operated control device that turns receptacle power off at specific programmed times and can be programmed separately for each day of the week. The control device shall be configured to provide an independent schedule for each portion of the building not to exceed 5,000 square feet (465 m2) and not to exceed one full floor. The device shall be capable of being overridden for periods of up to two hours by a timer accessible to occupants.

Any individual override switch shall control the controlled receptacles for a maximum area of 5,000 square feet (465 m2). Override switches for controlled receptacles are permitted to control the lighting within the same area.

Exception:

1. Receptacles designated for specific equipment requiring 24-hour operation, for building maintenance functions, or for specific safety or security equipment are not required to be controlled by an automatic control device and are not required to be located within 12 inches (0.30 m) of a controlled receptacle.

2. Within a single modular office workstation, non-controlled receptacles are permitted to be located not more than 72 inches, from the controlled receptacles serving that workstation.

- delete - SECTION C407 TOTAL BUILDING PERFORMANCE **in its entirety (sections C407.1 through C407.6 and all subsections)**
- modify - **SECTION C408 MAINTENANCE INFORMATION AND SYSTEM COMMISSIONING to SECTION C407 MAINTENANCE INFORMATION AND SYSTEM COMMISSIONING**

SECTION C407
MAINTENANCE INFORMATION
AND SYSTEM COMMISSIONING

- modify - **C408.1 General to C407.1 General.**

- add - **C407.1.1 Qualifications.**
The scope shall be completed by the project commissioning authority. The commissioning authority shall:

1. Have experience as a commissioning authority on at least (3) previous projects each at least 20,000 square feet or greater, and

2. Be an independent third-party entity. The commissioning authority shall not be an employee of the design team, construction team, owner or developer

- *modify* - **C408.1.1 Building operations and maintenance information to C407.1.2 Building operations and maintenance information**

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

- *add* - **C407.2 Mechanical systems and service water-heating systems commissioning and completion requirements.**
Prior to the final mechanical and plumbing inspections, the *design professional/ agency* shall provide evidence of mechanical systems *commissioning* and completion in accordance with the provisions of this section.

Construction document notes shall clearly indicate provisions for *commissioning* and completion requirements in accordance with this section and are permitted to refer to specifications for further requirements. Copies of all documentation shall be given to the owner or owner's authorized agent and made available to the *code official or other authority having jurisdiction*, upon request in accordance with Sections C407.2.4 and C407.2.5.

Exceptions: The following systems are exempt:

1. Mechanical systems and service water heater systems in buildings where the total mechanical equipment capacity is less than 480,000 Btu/h (140.7 kW) cooling capacity and 600,000 Btu/h (175.8 kW) combined service water-heating and space-heating capacity.

2. Systems included in Section C403.5 that serve individual *dwelling units* and *sleeping units.*

- *delete* – **C408.2.1 Commissioning plan.**

- *add* – **C407.2.1 Commissioning plan.**
A *commissioning plan* shall be developed by a *design professional*/*agency* and shall include the following items:

1. A narrative description of the activities that will be accomplished during each phase of *commissioning,* including the personnel intended to accomplish each of the activities.

2. A listing of the specific equipment, appliances or systems to be tested and a description of the tests to be performed.

3. Functions to be tested including, but not limited to, calibrations and economizer controls.

4. Conditions under which the test will be performed. Testing shall affirm winter and summer design conditions and full outside air conditions.

5. Measurable criteria for performance.

- modify - **C408.2.2 Systems adjusting and balancing to C407.2.2 Systems adjusting and balancing**

- delete – **C408.2.2.1 Air systems balancing.**

- add - **C407.2.2.1 Air systems balancing.**
Each supply air outlet and *zone* terminal device shall be equipped with means for air balancing. Discharge dampers used for air-system balancing are prohibited on constant-volume fans and variable-volume fans with motors 10 hp (18.6 kW) and larger. Air systems shall be balanced in a manner to first

minimize throttling losses then, for fans with system power of greater than 1 hp (0.746 kW), fan speed shall be adjusted to meet design flow conditions.

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

- delete – **C408.2.2.2 Hydronic systems balancing.**

- add – **C407.2.2.2 Hydronic systems balancing.**
Individual hydronic heating and cooling coils shall be equipped with means for balancing and measuring flow. Hydronic pump speed shall be adjusted to meet design flow conditions. Each hydronic system shall have either the capability to measure pressure across the pump, or test ports at each side of each pump.

- delete – **C408.2.3 Functional performance testing.**

- add – **C407.2.3 Functional performance testing.**
Functional performance testing specified in Sections C407.2.3.1 through C407.2.3.3 shall be conducted.

- modify – **C408.2.3.1 Equipment** to **C407.2.3.1 Equipment**

- modify – **C408.2.3.2 Controls** to **C407.2.3.2 Controls**

- modify – **C408.2.3.3 Economizers** to **C407.2.3.3 Economizers**

- delete – **C408.2.4 Preliminary commissioning report.**

- add – **C407.2.4 Preliminary commissioning report.**
A preliminary report of *commissioning* test procedures and results shall be completed and certified by the *design professional/agency* and provided to the building owner or owner's authorized agent. The report shall be organized with mechanical and service hot water findings in separate sections to allow independent review. The report shall be identified as "Preliminary Commissioning Report," shall include the completed Commissioning Compliance Checklist, Figure C407.2.4, and shall identify:

1. Itemization of deficiencies found during testing required by this section that have not been corrected at the time of report preparation.

2. Deferred tests that cannot be performed at the time of report preparation because of climatic conditions.

3. Climatic conditions required for performance of the deferred tests.

4. Results of functional performance tests.

5. Functional performance test procedures used during the commissioning process, including measurable criteria for test acceptance.

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_____

- modify – **FIGURE C408.2.4 COMMISSIONING COMPLIANCE CHECKLIST** to **FIGURE C407.2.4 COMMISSIONING COMPLIANCE CHECKLIST**

- *delete* – **C408.2.4.1 Acceptance of report.**

- *delete* – **C408.2.4.2 Copy of report.**

- *modify* – **C408.2.5 Documentation requirements** to **C407.2.5 Documentation requirements.**

- *delete* – **C408.2.5.1 System balancing report.**

- *add* – **C407.2.5.1 System balancing report.**
A written report describing the activities and measurements completed in accordance with Section C407.2.2.

- *modify* – **C408.2.5.2 Final commissioning report** to **C407.2.5.2 Final commissioning report.**

- *modify* – **C408.3 Functional testing of lighting controls** to **C407.3 Functional testing of lighting controls**

- *delete* – **C408.3.1 Functional testing.**

- *add* – **C407.3.1 Functional testing.**
Prior to passing final inspection, the *design professional/agency* 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 C407.3.1.1 through C407.3.1.3 for the applicable control type.

- *modify* – **C408.3.1.1 Occupant sensor controls** to **C407.3.1.1 Occupant sensor controls.**

- *modify* – **C408.3.1.2 Time-switch controls** to **C407.3.1.2 Time-switch controls.**

- *modify* – **C408.3.1.3 Daylight responsive controls** to **C407.3.1.3 Daylight responsive controls.**

- *modify* – **C408.3.2 Documentation requirements** to **C407.3.2 Documentation requirements.**

- *modify* – **C408.3.2.1 Drawings** to **C407.3.2.1 Drawings.**

- *modify* – **C407.3.2.2 Manuals** to **C407.3.2.2 Manuals.**

- *modify* – **C408.3.2.3 Report** to **C407.3.2.3 Report.**

CHAPTER 5 [CE]
EXISTING BUILDINGS

SECTION C501
GENERAL

- delete and replace – **C501.4 Compliance.**
Alterations, *repairs*, *additions* and changes of occupancy to, or relocation of, existing *buildings* and structures shall comply with the provisions for *alterations*, *repairs*, *additions* and changes of occupancy or relocation, respectively, in this code and in the *International Building Code*, *International Existing Building Code, International Fire Code*, *International Fuel Gas Code*, , *International Plumbing Code*, *International Property Maintenance Code*, *International Private Sewage Disposal Code, ANSI/SMACNA 006-HVAC Duct Construction Standards, ASHRAE Standard 62.1,* and NFPA 70.

- delete and replace – **C501.6 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 "Historic Building Exemption Report" obtained from the State Historic Preservation Office, has been submitted to the State Historic Preservation Office and signed by the owner, an owners agent, a *registered design professional*, 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*. The State Historic Preservation Office, upon receipt of the report, will review and validate the exemption request. Upon request, a copy of the report shall be provided to the *code official or other authority having jurisdiction*.

SECTION C502
ADDITIONS

- delete and replace – **C502.2.1 Vertical fenestration.**
New *vertical fenestration* area that results in a total building *fenestration* area less than or equal to that specified in Section C402.3.1 shall comply with Section C402.1.3 or C402.3.3. *Additions* with *vertical fenestration* that result in a total building *fenestration* area greater than Section C402.3.1 or *additions* that exceed the fenestration area greater than Section C402.3.1 shall comply with Section C402.3.1.1 for the *addition* only. *Additions* that result in a total building vertical fenestration area exceeding that specified in Section C402.3.1.1 shall comply with Section C402.1.3.

- delete and replace – **C502.2.2 Skylight area.**
New *skylight* area that results in a total building *fenestration* area less than or equal to that specified in Section C402.3.1 shall comply with Section C402.1.3. *Additions* with *skylight* area that result in a total building *skylight* area greater than C402.3.1 or additions that exceed the *skylight* area shall comply with Section C402.3.1.2 for the *addition* only. *Additions* that result in a total building *skylight* area exceeding that specified in Section C402.3.1.2 shall comply with Section C402.1.3.

SECTION C503
ALTERATIONS

- delete and replace – **C503.1 General.**
Alterations to any *building* or structure shall comply with the requirements of Section C503 and the code for new construction. *Alterations* shall be such that the existing *building* or structure is not less conforming to the provisions of this code than the *existing building* or structure was prior to the *alteration*. *Alterations* to an existing *building*, *building* system or portion thereof shall conform to the provisions of this code as those provisions relate to new construction without requiring the unaltered portions of the existing *building* or *building* system to comply with this code. *Alterations* shall not create an unsafe or hazardous condition or overload existing *building* systems.

Alterations complying with ANSI/ASHRAE/IESNA 90.1. need not comply with Sections C402, C403, C404 and C405.

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

1. Storm windows installed over existing *fenestration*.
2. Surface-applied window film installed on existing single-pane *fenestration* assemblies reducing solar heat gain, provided 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. Replacement of existing electrical resistance unit.
6. *Roof recover*.
7. *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.

- delete and replace – **C503.2 Change in space conditioning.**
Any nonconditioned or low-energy space that is altered to become *conditioned space* shall be required to be brought into full compliance with this code.

Exception: Where the component performance alternative in Section C402.1.3 is used to comply with this section, the proposed UA shall be not greater than 110 percent of the target UA.

- delete and replace – **C503.3 Building envelope.**
New building envelope assemblies that are part of the *alteration* shall comply with Sections C402.1 through C402.4.

Exception: Where the existing building exceeds the fenestration area limitations of Section C402.3.1 prior to alteration, the building is exempt from Section C402.3.1 provided that there is not an increase in fenestration area.

- delete and replace – **C503.3.1 Roof replacement.**
Roof replacements shall comply with Section C402.1.1, C402.1.2 or C402.1.3 where the existing roof assembly is part of the *building thermal envelope* and contains insulation entirely above the roof deck.

- *delete and replace* – **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 C402.3.1 shall comply with Section C402.1.3 or C402.3.3. The addition of *vertical fenestration* that results in a total building *fenestration* area greater than Section C402.3.1 shall comply with Section C402.3.1.1 for the space adjacent to the new fenestration only. *Alterations* that result in a total building *vertical fenestration* area exceeding that specified in Section C402.3.1.1 shall comply with Section C402.1.3.

- *delete and replace* – **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 C402.1.3 or C402.3. The addition of *skylight* area that results in a total building skylight area greater than Section C402.3.1 shall comply with Section C402.3.1.2 for the space adjacent to the new skylights. *Alterations* that result in a total building skylight area exceeding that specified in Section C402.3.1.2 shall comply with Section C402.1.3.

SECTION C505
CHANGE OF OCCUPANCY OR USE

- *delete and replace* – **C505.1 General.**
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 C402.3.1, the space is exempt from Section C402.3.1 provided that there is not an increase in fenestration area.

Exception: Where the component performance alternative in Section C402.1.3 is used to comply with this section, the proposed UA shall be not greater than 110 percent of the target UA.

CHAPTER 6 [CE]
REFERENCED STANDARDS

APSP

The Association of Pool &
Spa Professionals
2111 Eisenhower Avenue,
Suite 580
Alexandria, VA 22314

- delete and replace -

14—2014: American National Standard for Portable Electric Spa Energy Efficiency
C404.10

ASHRAE

ASHRAE
1791 Tullie Circle NE
Atlanta, GA 30329

- add -

ANSI/ASHRAE Standard 62.1-2016 Ventilation for Acceptable Indoor Air Quality
C201.3, C403.2.2, C403.6.1, C403.7.1, C403.7.4, C403.7.7
C403.8.5.1, C406.6, C501.4

ICC

International Code Council,
Inc.
500 New Jersey Avenue
NW
6th Floor
Washington, DC 20001

- delete -

IMC—18: International Mechanical Code®
C403.7.7, C403.2.2, C403.7.1, C403.7.2, C403.7.4, C403.7.5,
C403.11.1, C403.11.2.1, C403.11.2.2, C403.6, C403.6.6, C406.6,
C501.4

APPENDIX CA
SOLAR-READY ZONE—COMMERCIAL

SECTION CA103
SOLAR-READY ZONE

- delete and replace - **CA103.8 Construction documentation certificate.**
A permanent certificate, indicating the solar-ready zone and other requirements of this section, shall be posted near the electrical distribution panel, water heater or other conspicuous location by the builder, registered design professional or design professional.