SEATTLE CITY COUNCIL

Legislative Summary

CB 118779

Record No.: CB 118779 **Type:** Ordinance (Ord) **Status:** Passed

Version: 1 **Ord. no:** Ord 125159 **In Control:** City Clerk

File Created: 07/28/2016

Final Action: 10/07/2016

Title: AN ORDINANCE relating to the Seattle Energy Code; amending Section 22.700.010 of the Seattle Municipal Code; adopting by reference Chapters 51-11C and 51-11R of the Washington Administrative Code, and amending certain sections of those chapters; and repealing Ordinance 124614 and Sections 2-9 of Ordinance 124284.

Date

Notes:

Filed with City Clerk:

Mayor's Signature:

Sponsors: Johnson

Vetoed by Mayor:

Veto Overridden:

Veto Sustained:

Attachments:

Drafter: duane.jonlin@seattle.gov

Filing Requirements/Dept Action:

History of Legislative File **Legal Notice Published:** ☐ Yes ☐ No

Ver-sion:	Acting Body:	Date:	Action:	Sent To:	Due Date:	Return Date:	Result:
1	Mayor	08/23/2016	Mayor's leg transmitted to Council	City Clerk			
1	City Clerk	08/23/2016	sent for review	Council President's Office			
	Action Text: The Council Bill (CB) was sent for review. to the Council President's Office **Notes:**						
1	Council President's Office	09/01/2016	sent for review	Planning, Land Use, and Zoning Committee			
	Action Text: The Council Bill (CB) was sent for review. to the Planning, Land Use, and Zoning Committee **Notes:**						
1	Full Council	09/06/2016	referred	Planning, Land Use, and Zoning Committee			

1	Planning, Land Use, and Zoning Committee	09/15/2016	pass	Pass

Action Text: The Committee recommends that Full Council pass the Council Bill (CB).

Notes:

In Favor: 2 Chair Johnson, Vice Chair O'Brien

Opposed: 0

Absent(NV): 1 Member Herbold

1	Full Council	10/03/2016	passed	Pass

Action Text: The Council Bill (CB) was passed by the following vote, and the President signed the Bill:

Notes:

In Favor: 7 Councilmember Bagshaw, Councilmember Burgess, Councilmember González , Council President Harrell, Councilmember Johnson, Councilmember Juarez, Councilmember O'Brien

Opposed: 0

1	City Clerk	10/05/2016	submitted for Mayor's signature	Mayor
1	Mayor	10/07/2016	Signed	
1	Mayor	10/07/2016	returned	City Clerk
1	City Clerk	10/07/2016	attested by City Clerk	

Action Text: The Ordinance (Ord) was attested by City Clerk.

Notes:

CITY OF SEATTLE

ORDINANCE 125159

COUNCIL BILL 118779

AN ORDINANCE relating to the Seattle Energy Code; amending Section 22.700.010 of the Seattle Municipal Code; adopting by reference Chapters 51-11C and 51-11R of the Washington Administrative Code, and amending certain sections of those chapters; and repealing Ordinance 124614 and Sections 2-9 of Ordinance 124284.

BE IT ORDAINED BY THE CITY OF SEATTLE AS FOLLOWS:

Section 1. Section 22.700.010 of the Seattle Municipal Code is amended as follows:

22.700.010 Seattle Energy Code ((.))

The Seattle Energy Code consists of: 1) The first printing of Chapter((s)) 51-11C and the second printing of Chapter 51-11R of the Washington Administrative Code (WAC), effective July 1, ((~~2013~~)) 2016, which are adopted by reference; and 2) ((~~the~~)) amendments and additions to Chapters 51-11C and 51-11R of the Washington Administrative Code ((~~set out in this~~)) adopted by the City Council by ordinance. One copy of the first printing of Chapter((s)) 51-11C and the second printing of Chapter 51-11R of the Washington Administrative Code, effective July 1, ((~~2013~~)) 2016, is filed with the City Clerk in ((~~C.F. 313190~~)) Clerk File 319948 .

Section 2. Chapter 1 of WAC 51-11C (Sections 51-11C-10000 through 51-11C-11100) is amended as follows:

C101.1 Title. This code, consisting of Chapter 1 [CE] through Chapter ((5)) 6 [CE] and Appendices A through D, shall be known as the ((~~Washington State Energy Code~~)) "Seattle Commercial Energy Code", and shall be cited as such. It is referred to herein as "this code."

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C101.4.1 Mixed occupancy. Where a building includes both *residential* and *commercial* occupancies, each occupancy shall be separately considered and meet the applicable provisions

of ((~~WSEC~~)) the Seattle Energy Code--Commercial Provisions or ((~~WSEC~~)) the Seattle Energy Code--Residential Provisions.

C101.5 Compliance. *Residential buildings* shall meet the provisions of ((~~WSEC~~)) the Seattle Energy Code--Residential Provisions. *Commercial buildings* shall meet the provisions of ((~~WSEC~~)) the Seattle Energy Code--Commercial Provisions.

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

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C102.1 General. This code does not ((~~is not intended to~~)) prevent the use of any material, method of construction, design or insulating system prohibited by this code or not specifically ((~~prescribed~~)) allowed herein, provided that such construction, design or insulating system has been *approved* by the *code official* ((~~as meeting the intent of this code~~)).

The *code official* may approve an alternate material, method of construction, design or insulating system, provided the *code official* finds that the proposed alternate complies with the provisions of this code, and that the alternate, when considered together with other safety features of the building or other relevant circumstances, will provide at least an equivalent level of strength, effectiveness, fire resistance, durability, safety and sanitation.

The *code official* may require that sufficient evidence or proof be submitted to reasonably substantiate any claims regarding the use or suitability of the alternate. The *code official* may, but is not required to, record the approval of modifications and any relevant information in the files of the building official or on the approved permit plans.

C102.2 Modifications. The *code official* may modify the requirements of this code for individual cases provided the *code official* finds: (1) there are practical difficulties involved in carrying out the provisions of this code; (2) the modification is in conformity with the intent and purpose of this code; (3) the modification will provide a reasonable level of fire protection and structural integrity when considered together with other safety features of the building or other relevant circumstances, and (4) the modification maintains or improves the energy efficiency of the building. The *code official* may, but is not required to, record the approval of modifications and any relevant information in the files of the *code official* or on the approved permit plans.

SECTION C103

Applications and permits ((~~Construction documents.~~))

C103.1 General. A permit for work performed according to this code shall be obtained in accordance with Chapter 1 of the International Building Code, International Mechanical Code or Seattle Electrical Code.

C103.2 Construction documents. Construction documents and other supporting data shall comply with this section and the International Building Code, International Mechanical Code, International Existing Building Code and Seattle Electrical Code. ((~~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 is authorized to require necessary construction documents to be prepared by a registered design professional.~~

~~EXCEPTION: The code official is authorized to waive the requirements for construction documents or other supporting data if the code official determines they are not necessary to confirm compliance with this code.~~))

C103.2.1 Information on construction documents. Construction documents shall be drawn to scale upon suitable material. Electronic media documents are permitted to be submitted when *approved* by the *code official*. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment as herein governed. Details shall include, but are not limited to, as applicable:

1. Insulation materials and their *R*-values;
2. Fenestration *U*-factors and SHGCs;
3. Area-weighted *U*-factor and SHGC calculations;
4. Mechanical system design criteria;
5. Mechanical and service water heating system and equipment types, sizes and efficiencies;
6. Economizer description;
7. Equipment and systems controls;
8. Fan motor horsepower (hp) and controls;
9. Duct sealing, duct and pipe insulation and location;
10. Lighting fixture schedule with wattage and control narrative;
11. Location of daylight zones on floor plan.
12. Air barrier details including all air barrier boundaries and associated square foot calculations on all six sides of the air barrier as applicable.

C103.2.((1))2 Building thermal envelope depiction. The building's thermal envelope shall be represented on the construction documents.

((~~**C103.3 Examination of documents.** The *code official* 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.~~

~~**C103.3.1 Approval of construction documents.** When the *code official* 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*. 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 a duly authorized representative.~~

~~**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.~~

~~**C103.3.3 Phased approval.** The *code official* 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 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.~~

~~**C103.4 Amended construction documents.** Changes made during construction that are not in compliance with the *approved* construction documents shall be resubmitted for approval as an amended set of construction documents.~~

~~**C103.5 Retention of construction documents.** One set of *approved* construction documents shall be retained by the *code official* 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.~~))

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C103.6 Building documentation and close out submittal requirements. The construction documents shall specify that the documents described in this section be provided to the building owner or owner's authorized agent within 180 days of the date of receipt of the certificate of occupancy.

C103.6.1 Record documents. Construction documents shall be updated to convey a record of the alterations to the original design. Such updates shall include mechanical, electrical and control drawings red-lined, or redrawn ((~~if specified,~~)) that show all changes to size, type and locations of components, equipment and assemblies.

C103.6.2 Manuals. An operating and maintenance manual shall be provided for each component, device, piece of equipment, and system ((~~required to be commissioned~~)) governed by this code. The manual shall include all of the following:

1. Submittal data indicating all selected options for each piece of equipment.

2. Manufacturer's operation manuals and maintenance manuals for each device, piece of equipment, and system requiring maintenance, except equipment not furnished as part of the project. Required routine maintenance actions, cleaning and recommended relamping shall be clearly identified.

3. Name and address of at least one service agency.

4. Controls system inspection schedule, maintenance and calibration information, wiring diagrams, schematics, and control sequence descriptions. Desired or field-determined setpoints shall be permanently recorded on control drawings at control devices or, for digital control systems, on the graphic where settings may be changed.

5. A narrative of how each system is intended to operate, including recommended setpoints.

C103.6.3 Compliance documentation. All energy code compliance forms and calculations shall be delivered in one document to the building owner as part of the project record documents, manuals, or as a standalone document. This document shall include the specific energy code year utilized for compliance determination for each system, NFRC certificates for the installed windows, list of total area for each NFRC certificate, and the interior lighting power compliance path (building area, space-by-space) used to calculate the lighting power allowance.

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

1. The envelope insulation compliance path (prescriptive or component performance).

2. All required completed code compliance forms, and all required compliance calculations ((~~including, but not limited to, those required by sections C401.3, C403.2.12.1, C405.4, and C405.5~~)).

For projects complying with Section ((~~C401.2~~)) C402.2, Item 2, the documentation shall include:

1. A list of all proposed envelope component types, areas and *U*-values.

2. A list of all lighting area types with areas, lighting power allowance, and installed lighting power density.

3. A list of each HVAC system modeled with the assigned and proposed system type.

4. Electronic copies of the baseline and proposed model input and output file. The input files shall be in a format suitable for rerunning the model and shall not consist solely of formatted reports of the inputs.

C103.6.4 Systems operation training. Training of the maintenance staff for equipment included in the manuals required by Section C103.6.2 shall include at a minimum:

1. Review of manuals and permanent certificate.

2. Hands-on demonstration of all normal maintenance procedures, normal operating modes, and all emergency shutdown and start-up procedures.

3. Training completion report.

SECTION C104

INSPECTIONS

C104.1 General. Construction or work for which a permit is required shall be subject to inspection by the *code official* or his designated agent in accordance with this section and the International Building Code, International Mechanical Code and Seattle Electrical Code, and such construction or work shall remain accessible and exposed for inspection purposes until *approved*. It shall be the duty of the permit applicant to cause the work to remain accessible and exposed for inspection purposes. Neither the code official 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.

C104.2 Required inspections. The *code official* or his designated agent, upon notification, shall make the inspections set forth in Sections C104.2.1 through C104.2.6.

C104.2.1 Footing and foundation inspection. Inspections associated with footings and foundations shall verify compliance with the code as to *R*-value, location, thickness, depth of burial and protection of insulation as required by the code and *approved* plans and specifications.

C104.2.2 Insulation and fenestration inspection. Inspections shall be made before application of interior finish and shall verify compliance with the code as to types of insulation and corresponding *R*-values and their correct location and proper installation; fenestration properties (*U*-factor, SHGC and VT) and proper installation; and air leakage controls as required by the code and approved plans and specifications.

C104.2.3 Plumbing inspection. Inspections verify compliance as required by the code and *approved* plans and specifications as to types of insulation and corresponding *R*-values and protection, required controls and required heat traps.

C104.2.4 Mechanical inspection. Inspections shall verify compliance as required by the code and *approved* plans and specifications as to installed HVAC equipment type and size, required controls, duct and piping system insulation and corresponding *R*-value, duct system and damper air leakage and required energy recovery and/or economizers.

C104.2.5 Electrical and lighting inspection. Inspections shall verify compliance as required by the code and *approved* plans and specifications as to installed lighting systems, components and controls; motors and installation of an electric meter for each dwelling unit.

C104.2.6 Final inspection. The building shall have a final inspection and not be occupied until *approved.*

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((~~**C104.7 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.*~~

~~**C104.7.1 Revocation.** The *code official* is authorized to, in writing, suspend or revoke 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.~~))

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C106.1 Referenced codes and standards. The codes and standards referenced in this code shall be those listed in Chapter ((~~5~~)) 6, and such codes and standards shall be considered as part of the requirements of this code to the prescribed extent of each such reference and as further regulated in Sections C106.1.1 and C106.1.2.

C106.1.1 References to other codes. Whenever an International, National or Uniform Code is referenced in this code, it means the Seattle edition of that code, which includes local amendments. References to the "Building Code", "Residential Code", "Fire Code", "Electrical Code", "Mechanical Code" and "Plumbing Code" mean the Seattle editions of those codes.

((~~**Conflicts.** Where differences occur between provisions of this code and referenced codes and standards, the provisions of this code shall apply.~~))

C106.1.2 Provisions in referenced codes and standards. Where the extent of the reference to a referenced code or standard includes subject matter that is within the scope of this code, the provisions of this code, as applicable, shall take precedence over the provisions in the referenced code or standard.

C106.2 Application of references. References to chapter or section numbers, or to provisions not specifically identified by number, shall be construed to refer to such chapter, section or provision of this code.

C106.3 Other laws. The provisions of this code shall not be deemed to nullify any provisions of local, state or federal law. ((~~In addition to the requirements of this code, all occupancies shall conform to the provisions included in the State Building Code (chapter 19.27 RCW). In case of conflicts among the codes enumerated in RCW 19.27.031 (1) through (4) and this code, an earlier named code shall govern over those following.~~)) In the case of conflict between the duct sealing and insulation requirements of this code and the ((~~duct insulation~~)) requirements of Sections 603 and 604 of the *International Mechanical Code*, the ((~~duct insulation~~)) requirements of this code((~~, or where applicable, a local jurisdiction's energy code~~)) shall govern.

SECTION C107

FEES

C107.1 Fees. A fee for each permit and for other activities related to the enforcement of this code shall be paid as set forth in the Fee Subtitle, Seattle Municipal Code Title 22, Subtitle IX.

((~~A permit shall not be issued until the fees prescribed in Section C107.2 have been paid, nor shall an amendment to a permit be released until the additional fee, if any, has been paid.~~

~~**C107.2 Schedule of permit fees.** A fee for each permit shall be paid as required, in accordance with the schedule as established by the applicable governing authority.~~

~~**C107.3 Work commencing before permit issuance.** Any person who commences any work before obtaining the necessary permits shall be subject to an additional fee established by the *code official*, which shall be in addition to the required permit fees.~~

~~**C107.4 Related fees.** The payment of the fee for the construction, *alteration*, removal or demolition of work done in connection to or concurrently with the work or activity authorized by a permit shall not relieve the applicant or holder of the permit from the payment of other fees that are prescribed by law.~~

~~**C107.5 Refunds.** The *code official* is authorized to establish a refund policy.~~))

SECTION C108

((~~Stop work order.~~)) Enforcement

C108.1 Authority. The *code official* is authorized to enforce this code in accordance with the International Building Code, International Mechanical Code and Seattle Electrical Code.

((~~Whenever the *code official* finds any work regulated by this code being performed in a manner either contrary to the provisions of this code or dangerous or unsafe, the *code official* is authorized to issue a stop work order.~~

~~**C108.2 Issuance.** The stop work order shall be in writing and shall be given to the owner of the property involved, or to the owner's agent, or to the person doing the work. Upon issuance of a stop work order, the cited work shall immediately cease. The stop work order shall state the reason for the order, and the conditions under which the cited work will be permitted to resume.~~

~~**C108.3 Emergencies.** Where an emergency exists, the *code official* shall not be required to give a written notice prior to stopping the work.~~

~~**C108.4 Failure to comply.** Any person who shall continue any work after having been served with a stop work order, except such work as that person is directed to perform to remove a violation or unsafe condition, shall be liable to a fine as set by the applicable governing authority.~~))

SECTION C109

((~~Board of appeals.~~)) Administrative review

C109.1 Administrative review by the *code official*. Prior to issuance of the building permit, applicants may request administrative review by the *code official* of decisions or actions pertaining to the administration and enforcement of this code. Requests shall be addressed to the *code official*.

C109.2 Administrative review by the Construction Codes Advisory Board. After administrative review and review by the *code official*, and prior to issuance of the building permit, applicants may request review by the Construction Codes Advisory Board of decisions or actions pertaining to the application and interpretation of this code. The review will be performed by a panel of three or more members of the Construction Codes Advisory Board, chosen by the Board Chair. The Chair shall consider the subject of the review and members' expertise when selecting members to conduct a review. The decision of the review panel is advisory only; the final decision is made by the *code official*.

((~~**General.** In order to hear and decide appeals of orders, decisions or determinations made by the *code official* relative to the application and interpretation of this code, there shall be and is hereby created a board of appeals. The *code official* shall be an ex officio member of said board but shall have no vote on any matter before the board. The board of appeals shall be appointed by the governing body and shall hold office at its pleasure. The board shall adopt rules of procedure for conducting its business, and shall render all decisions and findings in writing to the appellant with a duplicate copy to the *code official*.~~

~~**C109.2 Limitations on authority.** An application for appeal shall be based on a claim that the true intent of this code or the rules legally adopted thereunder have been incorrectly interpreted,~~

~~the provisions of this code do not fully apply or an equally good or better form of construction is proposed. The board shall have no authority to waive requirements of this code.~~

~~**C109.3 Qualifications.** The board of appeals shall consist of members who are qualified by experience and training and are not employees of the jurisdiction.~~))

SECTION C110

VIOLATIONS

It shall be unlawful for any person, firm, or corporation to erect or construct any building, or remodel or rehabilitate any existing building or structure in the state, or allow the same to be done, contrary to or in violation of any of the provisions of this code. Violations shall be administered according to the procedures set forth in Section 103 of the International Building Code.

SECTION C111

LIABILITY

Nothing contained in this code is intended to be nor shall be construed to create or form the basis for any liability on the part of any city or county or its officers, employees or agents for any injury or damage resulting from the failure of a building to conform to the provisions of this code, or by reason or as a consequence of any inspection, notice, order, certificate, permission or approval authorized or issued or done in connection with the implementation or enforcement of this code, or by reason of any action or inaction on the part of the City related in any manner to the enforcement of this code by its officers, employees or agents.

This code shall not be construed to relieve or lessen the responsibility of any person owning, operating or controlling any building or structure for any damages to persons or property caused by defects, nor shall the Department of Construction and Inspections or the City of Seattle be

held to have assumed any such liability by reason of the inspections authorized by this code or any permits or certificates issued under this code.

Section 3. Chapter 2 of WAC 51-11C (Sections 51-11C-20000 through 51-11C-20224) is amended as follows:

SECTION C202

GENERAL DEFINITIONS

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ATTIC AND OTHER ROOFS. ((~~All other roofs~~)) Roofs other than roofs with insulation entirely above deck and metal building roofs, including roofs with insulation entirely below (inside of) the roof structure (i.e., attics, cathedral ceilings, and single-rafter ceilings), roofs with insulation both above and below the roof structure, and roofs without insulation ((~~but excluding roofs with insulation entirely above deck and metal building roofs~~)).

***

AUTOMATIC CONTROL DEVICE. A device capable of automatically turning loads off and on without manual intervention.

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BUILDING ENTRANCE. Any door, set of doors, doorway, or other form of portal (including elevator doors such as in parking garages) that is used to gain access to the building from the outside by the public. Where buildings have separate one-way doors to enter and leave, this also includes any doors ordinarily used to leave the building.

***

CERTIFIED COMMISSIONING PROFESSIONAL. An individual who is certified by an ANSI/ISO/IEC 17024:2012 accredited organization to lead, plan, coordinate and manage commissioning teams and implement commissioning processes. The individual's accredited certification required by the referenced standard provides a measured level of experience and competence with the various whole building commissioning processes and the ability to deliver quality service. Accredited organizations include, but are not limited to, ((~~AABC, BCA and NEBB~~)) Building Commissioning Certification Board (BCCB), providers of the Certified Commissioning Professional (CCP) designation, and ASHRAE, providers of the Commissioning Process Management Professional (CPMP) designation. The engineer of record for the project may be considered the *certified commissioning professional* if she/he is qualified to perform commissioning services for the entire commissioning process.

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CODE OFFICIAL. The ((~~officer or other designated authority~~)) Director of the Seattle Department of Construction and Inspections charged with the administration and enforcement of this code, or a duly authorized representative.

***

COMPUTER ROOM. A room whose primary function is to house equipment for the processing and storage of electronic data and that has a design electronic data equipment power density exceeding 20 watts per square foot of conditioned floor area (215 watts/m^2).

***

CONDITIONED SPACE. An area, room or space that is enclosed within the building thermal envelope and that is directly heated or cooled or that is indirectly heated or cooled. 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. Elevator shafts, stair enclosures, enclosed corridors connecting conditioned spaces, and enclosed spaces through which conditioned air is transferred at a rate exceeding three air changes per hour are considered conditioned spaces for the purposes of the *building thermal envelope* requirements.

***

CONTINUOUS INSULATION (CI). Insulating material that is continuous across all structural members without thermal bridges other than fasteners that have a total cross-sectional area not greater than 0.04 percent of the envelope surface through which they penetrate and service openings. It is installed on the interior or exterior or is integral to any opaque surface of the building envelope.

CONTROLLED PLANT GROWTH ENVIRONMENT. Group F and U buildings or spaces that are used exclusively for and specifically controlled to facilitate and enhance plant growth and production by manipulating various indoor environmental conditions. Technologies include indoor agriculture, cannabis growing, hydroponics, aquaculture and aquaponics. Controlled indoor environment variables include, but are not limited to, temperature, air quality, humidity and carbon dioxide.

CONTROLLED RECEPTACLE. An electrical receptacle that is controlled by an automatic control device.

***

DOOR, NONSWINGING. Roll-up, tilt-up, metal coiling and sliding doors, access hatches, and all other doors that are not swinging doors.

DOOR, SWINGING. Doors that are hinged on one side and revolving doors.

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HISTORIC BUILDINGS. ((~~Buildings that are listed in or eligible for listing in the National Register of Historic Places, or designated as historic under an appropriate state or local law.~~)) See Landmark.

***

IT (INFORMATION TECHNOLOGY) ENERGY. Electrical energy consumed by UPS (uninterruptible power supply) units, servers, and associated electronic data storage and data processing equipment, but not by lighting or HVAC equipment.

***

LANDMARK. A building or structure that is subject to a requirement to obtain a certificate of approval from the City Landmarks Preservation Board before altering or making significant changes to specific features or characteristics, that has been nominated for designation or has been designated for preservation by the City Landmarks Preservation Board, that has been designated for preservation by the State of Washington, has been listed or determined eligible to be listed in the National Register of Historic Places, or is located in a landmark or special review district subject to a requirement to obtain a certificate of approval before making a change to the external appearance of the structure.

***

LUMINAIRE-LEVEL LIGHTING CONTROL. A lighting system consisting of one or more luminaire(s) each with embedded lighting control logic, occupancy and ambient light sensors, local or central wireless networking capabilities, and local override switching capability.

MANDATORY. Where "Mandatory" is indicated in a section title, the provisions of that section and its sub-sections cannot be traded as part of a Total Building Performance compliance calculation. See Prescriptive.

***

PRESCRIPTIVE. Where "Prescriptive" is indicated in a section title, the provisions of that section and its sub-sections can be traded as part of a Total Building Performance compliance calculation. See Mandatory.

***

RESIDENTIAL BUILDING. For this code, includes detached one- and two-family dwellings and multiple single-family dwellings (townhouses) as well as Group R-2 and R-3 ((~~and R-4~~)) buildings three stories or less in height above grade plane.

***

SEATTLE DCI, SDCI. The Seattle Department of Construction and Inspections.

SEMI-HEATED SPACE. An enclosed space within a building, including adjacent connected spaces separated by an uninsulated component (e.g., basements, utility rooms, garages, corridors), which:

1. Is heated but not cooled, and has a maximum installed heating system output capacity ((~~of~~)) equal to or greater than 3.4 Btu/(h-ft^2) but not greater than 8 Btu/(h-ft^2);
2. Is not a walk-in or warehouse cooler or freezer space.

***

SOLAR ZONE. A clear area or areas reserved solely for current and future installation of photovoltaic or solar hot water systems.

Section 4. Chapter 3 of WAC 51-11C (Sections 51-11-C-30000 through 51011C-30330) are amended as follows:

SECTION C301

CLIMATE ZONES

C301.1 General. Climate zones from Table C301.1 shall be used in determining the applicable requirements from Chapter 4. Seattle is in Zone 4-C (4-Marine).

***

SECTION C302

DESIGN CONDITIONS

C302.2 Interior design conditions. The interior design temperatures used for heating and cooling load calculations shall be a maximum of 72°F (22°C) for heating and minimum of 75°F (24°C) for cooling.

C302.2 Exterior design conditions. The heating or cooling outdoor design temperatures shall be ((~~selected from Appendix C~~)) 24°F for heating and 86°F dry bulb and 67°F wet bulb for cooling.

***

C303.1.5 Spandrel panels in glass curtain walls. Table C303.1.5 provides default U-factors for the spandrel section of glass and other curtain wall systems. Design factors that affect performance are the type of framing, the type of spandrel panel and the R-value of insulation. Four framing conditions are considered in the table. The first is the common case where standard aluminum mullions are used. Standard mullions provide a thermal bridge through the insulation, reducing its effectiveness. The second case is for metal framing members that have a thermal break. A thermal break frame uses a urethane or other non-metallic element to separate the metal exposed to outside conditions from the metal that is exposed to interior conditions. The third case

is for structural glazing or systems where there are no exposed mullions on the exterior. The fourth case is for the condition where there is no framing or the insulation is continuous and uninterrupted by framing. The columns in the table can be used for any specified level of insulation between framing members installed in framed curtain walls or spandrel panels.

C303.1.5.1 Window wall application. Where "window wall" or similar assembly that is discontinuous at intermediate slab edges is used, the slab edge U-value shall be as listed in Appendix Table A103.3.7.1(3) or as determined using an approved calculation.

C303.1.5.2 Table value assumptions. In addition to the spandrel panel assembly, the construction assembly U-factors assume an air gap between the spandrel panel and one layer of 5/8-inch gypsum board that provides the interior finish. The gypsum board is assumed to span between the window sill and a channel at the floor. For assemblies that differ from these assumptions, custom U-factors can be calculated to account for any amount of continuous insulation or for unusual construction assemblies using Equations 1, 2, or 3 where appropriate. Spandrel panel U-factors for assemblies other than those covered by this table or Equations 1-3 may be determined using an alternate approved methodology. Equations 1-3 do not calculate the value of any insulation inboard of the curtain wall assembly.

Aluminum without thermal break (Equation 1)

$$U_{gypsum}=\frac{1}{\left[(R_{Gypsum}+R_{AirGap})+\left[\frac{1}{\left(0.2798+0.8929\,x\left(\left(\frac{1}{R_{AddedInsulation}}\right)+U_{CenterofGlass}\right)\right)}\right]\right]}$$

Aluminum with thermal break (Equation 2)

$$U_{Overall} = \frac{1}{\left[(R_{Gypsum} + R_{AirGap}) + \left[\frac{1}{\left(0.1808+0.8874\ x\left(\left(\frac{1}{R_{AddedInsulation}}\right)+U_{CenterofGlass}\right)\right)}\right]\right]}$$

Structural glazing (Equation 3)

$$U_{Overall} = \frac{1}{\left[(R_{Gypsum} + R_{AirGap}) + \left[\frac{1}{\left(0.1151+0.9487\ x\left(\left(\frac{1}{R_{AddedInsulation}}\right)+U_{CenterofGlass}\right)\right)}\right]\right]}$$

***

TABLE C303.1.3(5)

SMALL BUSINESS COMPLIANCE TABLE

DEFAULT *U*-FACTORS FOR VERTICAL FENESTRATION

(Table unchanged – title correction only)

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Table C303.1.5 for 22.700.010
U-factors for Spandrel Panels and Glass Curtain Walls

			Rated R-value of Insulation between Framing Members							
			None	R-4	R-7	R-10	R-15	R-20	R-25	R-30
Frame Type	**Spandrel Panel**		**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**
Aluminum without Thermal Break	Single glass pane, stone, or metal panel	1	0.360	0.242	0.222	0.212	0.203	0.198	0.195	0.193
	Double glass with no low-e coatings	2	0.297	0.233	0.218	0.209	0.202	0.197	0.194	0.192
	Triple or low-e glass	3	0.267	0.226	0.214	0.207	0.200	0.196	0.194	0.192

Aluminum with Thermal Break	Single glass pane, stone, or metal panel	**4**	0.350	0.211	0.186	0.173	0.162	0.155	0.151	0.149
	Double glass with no low-e coatings	**5**	0.278	0.200	0.180	0.170	0.160	0.154	0.151	0.148
	Triple or low-e glass	**6**	0.241	0.191	0.176	0.167	0.159	0.153	0.150	0.148
Structural Glazing	Single glass pane, stone, or metal panel	**7**	0.354	0.195	0.163	0.147	0.132	0.123	0.118	0.114
	Double glass with no low-e coatings	**8**	0.274	0.180	0.156	0.142	0.129	0.122	0.117	0.114
	Triple or low-e glass	**9**	0.231	0.169	0.150	0.138	0.127	0.121	0.116	0.113
No framing, or Insulation is Continuous	Single glass pane, stone, or metal panel	**10**	0.360	0.148	0.102	0.078	0.056	0.044	0.036	0.031
	Double glass with no low-e coatings	**11**	0.297	0.136	0.097	0.075	0.054	0.043	0.035	0.030
	Triple or low-e glass	**12**	0.267	0.129	0.093	0.073	0.053	0.042	0.035	0.030

Section 5. Chapter 4 of WAC 51-11C (Sections 51-11C-40000 through 51-11C-41000) is amended as follows:

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

1. Prescriptive Path. The requirements of all of Chapter 4, other than Sections C401.3 and C407. ((~~Sections C402, C403, C404, C405, C406, C408, C409, and C410, C411 and C412.~~))

2. Total Building Performance Path. The requirements of Section C407 as well as ((~~Section~~)) Sections C402.5, C403.2, C404, C405.2, C405.3, ((~~C405.4~~)) C405.5, C405.6, ((~~and~~)) C405.7, C405.8, C405.9, C405.10, C405.13, C408, C409, C410, and C412. The building energy consumption shall be equal to or less than 87, 90 or 93 percent of the standard reference design building, depending on the option selected per Section C407.3.

3. Target Performance Path. The requirements of C401.3.

C401.2.1 Application to existing buildings. Work on existing buildings shall comply with Chapter 5, in addition to the applicable provisions of Chapter 4.

C401.3 Target Performance Path.

C401.3.1 Scope. Buildings of the following occupancy types are permitted to conform to the Target Performance Path and are not required to comply with Seattle Energy Code requirements other than the mandatory measures listed in Section C401.3.3.

1. Group B office
2. Group B medical office
3. Group R-2 multi-family over three stories
4. Group S-1 & S-2 warehouse (non-refrigerated)
5. Group E school
6. Group M retail
7. Group I-2 hospital
8. Other occupancy type, where specific permission is granted by the *code official*. Any such permission, if granted, shall be made either on the basis of an energy use target approved by the *code official* for that occupancy based on the best-performing local examples of that occupancy, or by provision of a metering system that segregates and separately reports the energy loads for the additional occupancy from those of the occupancies listed in 1 – 7 above.
9. Mixed use: A mixed use building is any building containing more than one of the occupancies listed in 1 – 8 above.

C401.3.2 Energy use targets. Buildings, including their initial tenant improvements, using the Target Performance Path shall be designed to use less energy than the weighted sum of

the following energy use targets, as demonstrated by approved energy modeling. Energy use targets are expressed in terms of thousand BTU per square foot of conditioned floor area per year (kBTU/ft^2/yr).

1. Group B office: 40 kBTU/ ft^2/yr
2. Group B medical office: 50 kBTU/ ft^2/yr
3. Group R-2 multi-family: 35 kBTU/ ft^2/yr
4. Group S-1 & S-2 warehouse: 25 kBTU/ ft^2/yr
5. Group E school: 45 kBTU/ ft^2/yr
6. Group M retail: 60 kBTU/ ft^2/yr
7. Group I-2 hospital: 150 kBTU/ ft^2/yr
8. Parking garages, including unconditioned and conditioned spaces, within the above occupancies shall be calculated separately at: 10 kBTU/ ft^2/yr for enclosed garages and 6 kBTU/ ft^2/yr for open garages.

C401.3.2.1 Data Center Energy. Anticipated total data center energy use is permitted to be added to the overall building energy usage target in accordance with this section. The anticipated *IT energy* usage shall be multiplied by a factor of 1.45 to determine the anticipated total data center energy use. The *IT energy* usage shall be separately sub-metered in a secure manner approved by the *code official* and automatically exported to the *code official* showing daily, monthly and annual totals during the operational energy use demonstration period set forth in Section C401.3.6. Actual *IT energy* shall be adjusted in accordance with Section C401.3.7.

C401.3.3 Mandatory Measures. Buildings using the Target Performance Path shall:

1. Meet their assigned building energy use targets;

2. Have an area-weighted average U-value less than 0.40 for all *fenestration*; and

3. Comply with the following portions of the Seattle Energy Code. Each of the code chapters and sections listed below includes all of its sub-sections.

3.1. Chapters 1, 2 and 3 (Scope and Administration, Definitions, and General Requirements) of the Seattle Energy Code, commercial section

3.2. C402.5 Air Leakage

3.3. C403.2.4 HVAC System Controls

3.4. C404.9 Domestic hot water meters

3.5. C408 System Commissioning

3.6. C409 Energy Metering and Energy Consumption Management

3.7. C410 Refrigeration System Requirements

3.8. C412 Solar Readiness

C401.3.4 Energy Modeling Methodology. Energy use shall be modeled according to the following procedures from Section C407, Total Building Performance:

1. C407.1 Scope

2. C407.4 Documentation (requirements for "Standard Reference Design" are not applicable)

3. C407.5.2 Thermal Blocks

4. C407.6 Calculation Software Tools

Schedules, internal loads and other assumptions related to the operation of the building are permitted to be developed at the discretion of the design team and the energy modeler. For occupancy types listed in Appendix B of this code, where any of the following operating loads or schedules of operating hours used in modeling calculations is less than 80 percent of that listed in

Appendix B, or where the occupant density in square feet per occupant is more than 120 percent of that listed in Appendix B, such deviations shall be clearly documented in the final analysis report and are subject to approval by the *code official.*

1. Occupant density and schedule

2. Lighting operation schedule

3. Receptacle loads and schedule

4. Elevator and escalator schedule

5. Water heating quantity and schedule

In addition to documenting modeling assumptions, the compliance report required by Section C407.4.1 shall include the following:

1. Summary of principal building characteristics that are above or below prescriptive energy code requirements.

2. Sensitivity analysis of principal internal load and other building operational assumptions that demonstrate a range of expected energy performance in the context of typical meteorological year (TMY) conditions. The following sensitivity analyses shall be reported, in tabular format:

2.1. Occupant density +/- 20 percent (except residential occupancies)

2.2. Lighting Power Density +/- 20 percent

2.3. Miscellaneous Load Power Density +/- 20 percent

2.4. Infiltration Rates +/- 20 percent

2.5. Temperature Setpoints +/- 2 degrees F

Table C401.3.4 for 22.700.010 Example of Sensitivity Analysis Report Format		
Allowable EUI: 45 kBTU/ft^2		
Predicted EUI: 40 kBTU/ft^2		

Input	EUI (Low Range)	EUI (High Range)
Occupant Density	35	42
Lighting Power Density	38	41
Misc. Load Power Density	35	45
Infiltration	38	44
Temperature Setpoints	36	48

The annual modeled building site energy use, under nominal conditions, shall be lower than the building's assigned energy performance target.

C401.3.5 Energy Modeler Qualifications. Energy models shall be created only by persons qualified by education and training to perform such work and who have at least two years' experience modeling buildings of similar scale and complexity. The modeling documentation submitted shall be signed either by a licensed professional engineer who is qualified by training and experience to perform energy modeling or by an individual with an active certification from ASHRAE as a Building Energy Modeling Professional (BEMP).

C401.3.6 Demonstration of Operating Energy Use. Metered energy data shall be supplied directly via automated reporting from utilities to the *code official* using Portfolio Manager, and adjusted for the percentage of floor area occupied. While at least 75 percent occupied, the building shall operate at or below its assigned energy use target established in Section C401.3.2 or item 8 of Section C401.3.1 for any recording period of 12 consecutive months that is completed within three years of the date of the Certificate of Occupancy, as adjusted under this Section C401.3. The owner shall notify the *code official* when this 12-month period has been successfully completed.

C401.3.6.1 Extension of Demonstration Period. For good cause, including conditions where less than 75 percent of the building is occupied, the *code official* may extend the three-year period for one additional year, but in no case for more than three additional one-

year periods. If the building is not at least 75 percent occupied after three additional one-year periods, the *code official* shall evaluate compliance with Section C401.3.6 based on the most recent one-year period and adjusted for the actual occupancy rate during that period.

C401.3.7 Adjustment for Data Center Energy Usage. Where data center *IT energy* usage during the demonstration period, multiplied by a factor of 1.45, is higher than the total data center energy use as calculated according to Section C401.3.2.1, that additional energy shall be added to the total allowable energy use. Where data center *IT energy* use, multiplied by a factor of 1.45, is lower than the total data center energy use as calculated according to Section C401.3.2.1, that shortfall shall be subtracted from the total allowable energy use.

C401.3.8 Adjustment for Change in Occupancy. When the occupancy of the building or a portion of the building changes from that assumed in the permit submittal, the assigned energy performance target shall be adjusted to reflect the new occupancy. If the new occupancy is not listed in Section C401.3.2, either the *code official* shall assign it an energy use target based on the best-performing local examples of that occupancy type, or a metering system shall be provided that excludes the energy loads for the additional occupancy.

C401.3.9 Adjustment for Unusually Cold Years. If the heating degree days (HDD) recorded by the National Weather Service for the Seattle-Tacoma International Airport exceeds 4885 HDD for the 12-month demonstration period (4 percent above the average 4697 HDD at 65° F base), the assigned energy performance target is permitted to be increased by 1 percent for that period.

C401.3.10 Adjustment for Retail Operating Hours. If the annual number of hours that a retail occupancy is open to the public during the 12-month recording period exceeds the hours assumed in the energy model by more than 4 percent, the annual energy use target for the retail

space use only is permitted to be increased by 1 percent for each 4 percent increase in such hours. This claim shall be documented by publicly-available published hours of operation.

C401.3.11 Financial Security. The applicant shall provide a financial security to be used as a penalty for failing to achieve an operating energy use lower than the building's energy use target according to Section C401.3.6. The penalty shall be administered as provided in Section C110, except that the amount of the penalty shall be determined using Table C401.3.12 and not Section C107. The financial security shall be submitted to and approved by the *code official* prior to issuance of the building's Certificate of Occupancy. The financial security requirement shall be fulfilled by one of the following methods:

1. An irrevocable letter of credit from a financial institution authorized to do business in Seattle, in an amount equal to $4.00 per square foot of gross floor area.

2. A bond secured by the applicant to ensure compliance with this section, in an amount equal to $4.00 per square foot of gross floor area.

3. A binding pledge that within 3 years of receipt of the Certificate of Occupancy, adjusted as allowed under Section C401.3.6.1, the applicant will comply with the requirements of this section.

3.1 A binding pledge pursuant to item 3 of this subsection shall be recorded as a covenant in the land records of King County between the applicant and the City of Seattle in a form that is satisfactory to the Seattle City Attorney. The covenant shall bind the applicant and any successors in title to pay any fines levied pursuant to this section. A lien will be placed on the property in cases of non-payment.

If the owner provides evidence that the building has operated at or below its target energy performance level as provided in Section C401.3.6, the financial security provided by the

applicant shall be returned to the applicant, or the pledge and covenant shall be released, and the applicant will have no further obligations under this section.

C401.3.12 Procedure for non-compliance. If the owner fails to provide evidence that the building has operated as required under Section C401.3.6, the *code official* shall, as applicable, either:

1. Draw down on a financial security provided in the form of an irrevocable letter of credit or a bond, in whole, or in part, or

2. Levy a fine against an applicant that provided a financial security in the form of a binding pledge as set forth in Section C401.3.11(3). The fine shall be issued as a civil penalty.

The amount of the fine levied or the amount drawn down from a financial security shall be determined according to Table C401.3.12.

Table C401.3.12 for 22.700.010
Financial Security and Energy Efficiency Reimbursements

Energy use exceeding target	Amount of fine or draw-down from financial security, per square foot	Maximum reimbursement per square foot for work approved under Section C401.3.12
Less than 10%	$1.00	$0.50
10% to less than 20%	$2.00	$1.00
20% to less than 30%	$3.00	$1.50
30% or greater	$4.00	$2.00

C401.3.13 Reimbursements. Where a financial security has been drawn down pursuant to item 1 in Section C401.3.12, or a fine has been levied pursuant to item 2 in Section C401.3.12, the *code official* shall reimburse the owner for documented expenses incurred to lower the operating energy use of the building, including commissioning, repairs or improvements to the existing energy-consuming systems, or provision of additional energy efficiency measures, up to

the maximum reimbursement amounts listed in Table C401.3.12. Such expenditures shall be approved in advance by the *code official*, and the work shall be fully completed within one year of the date when a financial security has been drawn down pursuant to item 1 in Section C401.3.12, or a fine has been levied pursuant to item 2 in Section C401.3.12.

***

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

1. Those that are heated and/or cooled 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/ft^2 (10.7 W/m^2) of floor area for space conditioning purposes.
2. Those that do not contain conditioned space.
3. Greenhouses where cooling does not include a condensing unit and that are isolated from any other conditioned space.
4. Unstaffed equipment shelters or cabinets used solely for personal wireless service facilities.

C402.1.1.1 Semi-heated spaces. The building envelope of *semi-heated* buildings, or portions thereof, shall comply with the same requirements as that for conditioned spaces in Section C402, except as modified by this section. Building envelope assemblies separating conditioned space from *semi-heated* space shall comply with the exterior envelope insulation requirements. *Semi-heated* spaces heated by mechanical systems that do not include electric resistance heating equipment are not required to comply with the opaque wall insulation provisions of Section C402.2.3 for walls that separate *semi-heated* spaces from the exterior or

low energy spaces. *Fenestration* shall comply with building thermal envelope requirements. *Semi-heated* spaces shall be calculated separately from other conditioned spaces for compliance purposes. Opaque walls in *semi-heated* spaces shall be calculated as fully code compliant opaque walls for both the target and proposed for the Target UA calculations for the component performance alternative in Section C402.1.5, and for the Standard Reference Design for Total Building Performance compliance per Section C407.

***

C402.1.3 Insulation component *R*-value method. *Building thermal envelope* opaque assemblies shall meet the requirements of Section C402.2 based on the climate zone specified in Chapter 3. For opaque portions of the *building thermal envelope* intended to comply on an insulation component *R-value* basis, the *R-values* for insulation in framing areas, where required, and for continuous insulation, where required, shall not be less than that specified in Table C402.1.3. Commercial buildings or portions of commercial buildings enclosing Group R occupancies shall use the *R*-values from the "Group R" column of Table C402.1.3. Commercial buildings or portions of commercial buildings enclosing occupancies other than Group R shall use the *R*-values from the "All other" column of Table C402.1.3. The thermal resistance or *R*-value of the insulating material installed in, or continuously on, below grade exterior walls of the building envelope required in accordance with Table C402.1.3 shall extend to the lowest floor of the conditioned space enclosed by the below grade wall. Doors having less than 50 percent opaque glass area shall be considered opaque doors. Opaque swinging doors shall comply with the Table C402.1.4 and opaque nonswinging doors shall comply with Table C402.1.3 or C402.1.4.

Exception. For stair and elevator shafts located within enclosed garages or other enclosed non-conditioned spaces and without conditioned supply air or cooling or heating appliances rated higher than 2 kW in any shaft, walls enclosing the shafts are permitted to be:

1. Concrete or masonry with minimum R-5 continuous insulation;

2. Metal studs with R-15 cavity insulation and without continuous insulation; or

3. Other assemblies with a maximum U-value of 0.120.

Additionally, slab floors, intermediate mass floor edges and elevator pits within shafts using this exception are excluded from envelope insulation requirements. Surfaces using this exception shall not be included in the gross exterior wall area for purposes of maximum fenestration area calculations in Section C402.4.1, component performance calculations in Section C402.1.5, or for total building performance calculation of Section C407.

***

C402.1.4 Assembly *U*-factor, *C*-factor or *F*-factor based method. Building thermal envelope assemblies intended to comply on an assembly *U*-, *C*-, or *F*-factor basis shall have a *U*-, *C*-, or *F*-factor not greater than that specified in Table C402.1.4. Commercial buildings or portions of commercial buildings enclosing Group R occupancies shall use the *U*-, *C*-, or *F*-factor from the "Group R" column of Table C402.1.4. Commercial buildings or portions of commercial buildings enclosing occupancies other than Group R shall use the *U*-, *C*-, or *F*-factor from the "All Other" column of Table C402.1.4. The ((~~C~~)) U-factor for the below-grade exterior walls of the building envelope, as required in accordance with Table C402.1.4, shall extend to the level of the lowest conditioned floor. Opaque swinging doors shall comply with Table C402.1.4 and opaque nonswinging doors shall comply with Table C402.1.3 or C402.1.4. The *U*-

factors for typical construction assemblies are included in Appendix A. These values shall be used for all calculations. Where proposed construction assemblies are not represented in Appendix A, values shall be calculated in accordance with the ASHRAE *Handbook -- Fundamentals* using the framing factors listed in Appendix A where applicable and shall include the thermal bridging effects of framing materials.

C402.1.4.1 Thermal resistance of cold-formed steel stud walls. *U*-factors of walls with cold-formed steel studs shall be permitted to be determined either by using the values in Table C402.1.4.1, or in accordance with Equation 4-1:

$$U = 1/[Rs + (ER)] \quad \textbf{(Equation 4-1)}$$

where:

Rs = The cumulative *R*-value of the wall components along the path of heat transfer, excluding the cavity insulation and steel studs.

ER = The effective *R*-value of the cavity insulation with steel studs.

TABLE C402.1.3 for 22.700.010
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD[a, g]

CLIMATE ZONE	5 AND MARINE 4	
	All Other	Group R
Roofs		
Insulation entirely above deck	R-38ci	R-38ci
Metal buildings[b]	R-25 + R-((~~11~~)) 22 LS	R-25 + R-((~~11~~)) 22 LS
Attic and other	R-49	R-49
Walls, Above Grade		
Mass	((~~R-9.5 c.i.~~[e])) Exterior: R-16 c.i. Interior: R-13 + R-6 ci wood stud, or R-13 + R-10 ci metal stud	((~~R-13.3~~)) Exterior: R-16 c.i. Interior: R-13 + R-6 ci wood stud, or R-13 + R-10 ci metal stud
Metal building	R-19 ci, or R-13 + R-13ci	R-19 ci, or R-13 + R-13ci

Steel framed	R-13 + R-10ci	R-19 + R-8.5ci
Wood framed and other	((~~R-21 int~~)) R-13 + R-7.5 ci	R-21 int
Walls, Below Grade		
Below-grade wall[d]	((~~Same as above grade~~)) Exterior: R-10 ci Interior: R-19 wood stud, or R-13 + R-6 ci metal stud	((~~Same as above grade~~)) Exterior: R-10 ci Interior: R-19 wood stud, or R-13 + R-6 ci metal stud
Floors		
Mass	R-30ci	R-30ci
Joist/framing	((~~R-30[e]~~)) Steel frame: R-38 +R-4 ci Wood frame: R-38	((~~R-30[e]~~)) Steel frame: R-38 +R-4 ci Wood frame: R-38
Slab-on-Grade Floors		
Unheated slabs	R-10 for 24" below	R-10 for 24" below
Heated slabs[d]	R-10 perimeter & under entire slab	R-10 perimeter & under entire slab
Opaque Doors		
Swinging	U-0.37	U-0.37
Nonswinging	U-0.34	U-0.34

Keys for Table C402.1.3 for 22.700.010
For SI: 1 inch = 25.4 mm.
ci = Continuous insulation.
NR = No requirement.
LS = 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.

Footnotes for Table C402.1.3 for 22.700.010

a. Assembly descriptions can be found in Chapter 2 and Appendix A.

b. Where using *R*-value compliance method, a thermal spacer block with a minimum R-value of 3.5 shall be provided, otherwise use the *U*-factor compliance method in Table C402.1.2.

c. (Reserved) ((~~Exception: Integral insulated concrete block walls complying with ASTM C90 with all cores filled and meeting both of the following:~~

~~1. At least 50 percent of cores must be filled with vermiculite or equivalent fill insulation; and~~

~~2. The building thermal envelope encloses one or more of the following uses: Warehouse (storage and retail), gymnasium, auditorium, church chapel, arena, kennel, manufacturing plant, indoor swimming pool, pump station, water and waste water treatment facility, storage facility, storage area, motor vehicle service facility. Where additional uses not listed (such as office, retail, etc.) are contained within the building, the exterior walls that enclose these areas may not utilize this exception and must comply with the appropriate mass wall R-value from Table C402.1.3/U-factor from Table C402.1.4.~~))

d. Where heated slabs are below grade, ((~~below-grade walls~~)) they shall comply with the ((~~exterior~~)) insulation requirements for heated slabs.

e. (Reserved) ((~~Steel floor joist systems shall be insulated to R-38 + R-10ci.~~))

f. "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.

g. For roof, wall or floor assemblies where the proposed assembly would not be continuous insulation, ((~~an~~)) alternate nominal *R*-value compliance ((~~option~~)) options for assemblies with isolated metal ((~~penetrations of~~)) fasteners that penetrate otherwise continuous insulation ((~~is~~)) are as shown in Columns B and C of Table C402.1.3(g):

Table C402.1.3(g) for 22.700.010
Continuous insulation equivalents

Column A **Assemblies with continuous insulation (see definition)**	**Column B** **Alternate option for assemblies with metal penetrations, greater than 0.04% but less than 0.08%**	**Column C** **Alternate option for assemblies with metal penetrations, greater than or equal to 0.08% but less than 0.12%**
R-9.5ci	R-11.9ci	R-13ci
R-11.4ci	R-14.3ci	R-15.7ci
R-13.3ci	R-16.6ci	R-18.3ci
R-15.2ci	R-19.0ci	R-21ci

R-30ci	R-38ci	R-42ci
R-38ci	R-48ci	R-53ci
R-13 + R-7.5ci	R-13 + R-9.4ci	R-13 + R-10.3ci
R-13 + R-10ci	R-13 + R-12.5ci	R-13 + R-13.8ci
R-13 + R-12.5ci	R-13 + R-15.6ci	R-13 + R-17.2ci
R-13 + R-13ci	R-13 + R-16.3ci	R-13 + R-17.9ci
R-19 + R-8.5ci	R-19 + R-10.6ci	R-19 + R-11.7ci
R-19 + R-14ci	R-19 + R-17.5ci	R-19 + R-19.2ci
R-19 + R-16ci	R-19 + R-20ci	R-19 + R-22ci
R-20 + R-3.8ci	R-20 + R-4.8ci	R-20 + R-5.3ci
R-21 + R-5ci	R-21 + R-6.3ci	R-21 + R-6.9ci

Footnotes for Table C402.1.3(g) for 22.700.010

((~~This~~)) These alternate nominal R-value compliance ((~~option is~~)) options are allowed for projects complying with all of the following:

1. The ratio of the cross-sectional area, as measured in the plane of the surface, of metal penetrations of otherwise continuous insulation to the opaque surface area of the assembly is greater than 0.0004 (0.04%), but less than 0.0008 (0.08%), for use of Column B equivalents, and greater than or equal to 0.0008 (0.08%), but less than 0.0012 (0.12%), for use of Column C equivalents.
2. The metal penetrations of otherwise continuous insulation are isolated or discontinuous (e.g., brick ties or other discontinuous metal attachments, offset brackets supporting shelf angles that allow insulation to go between the shelf angle and the primary portions of the wall structure). No continuous metal elements (e.g., metal studs, z-girts, z-channels, shelf angles) penetrate the otherwise continuous portion of the insulation.
3. Building permit drawings shall contain details showing the locations and dimensions of all the metal penetrations (e.g., brick ties or other discontinuous metal attachments, offset brackets, etc.) of otherwise continuous insulation. In addition, calculations shall be provided showing the ratio of the cross-sectional area of metal penetrations of otherwise continuous insulation to the overall opaque wall area.

For other cases where the proposed assembly is not continuous insulation, see Section C402.1.4 for determination of U-factors for assemblies that include metal other than screws and nails.

TABLE C402.1.4 for 22.700.010
OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, *U*-FACTOR METHOD[a, f]

	CLIMATE ZONE 5 AND MARINE 4	
	All Other	**Group R**
Roofs		
Insulation entirely above deck	U-0.027	U-0.027
Metal buildings	((~~U-0.031~~)) U-0.027	((~~U-0.031~~)) U-0.027

Attic and other	U-0.021	U-0.021
Joist or single rafter	U-0.027	U-0.027
Walls, Above Grade		
Mass	((~~U-0.104~~ [d])) U-0.057	((~~U-0.078~~ [d])) U-0.057
Mass transfer deck slab edge	U-0.20	U-0.20
Metal building	U-0.052	U-0.052
Steel framed	U-0.055	U-0.055
Wood framed and other	((~~U-0.55~~)) U-0.051	U-0.054
Walls, Below Grade		
Below-grade wall [b]	((~~Same as above grade~~)) U-0.070	((~~Same as above grade~~)) U-0.070
Floors		
Mass[e]	((~~U-0.031~~)) U-0.029	((~~U-0.031~~)) U-0.029
Joist/framing	((~~U-0.029~~)) U-0.029 steel joist U-0.025 wood joist	((~~U-0.029~~)) U-0.029 steel joist U-0.025 wood joist
Slab-on-Grade Floors		
Unheated slabs	F-0.54	F-0.54
Heated slabs[c]	F-0.55	F-0.55
Opaque Doors		
Swinging	U-0.37	U-0.37
Nonswinging	U-0.34	U-0.34

Footnotes for Table C402.1.4 for 22.700.010

a. Use of opaque assembly *U*-factors, *C*-factors, and *F*-factors from Appendix A is required unless otherwise allowed by Section C402.1.4.

b. (Reserved) ((~~Where heated slabs are below grade, below-grade walls shall comply with the F-factor requirements for heated slabs.~~))

c. Heated slab *F*-factors shall be determined specifically for heated slabs. Unheated slab factors shall not be used.

d. (Reserved) ((~~Exception: Integral insulated concrete block walls complying with ASTM C90 with all cores filled and meeting both of the following:~~
~~1. At least 50 percent of cores must be filled with vermiculite or equivalent fill insulation; and~~
~~2. The building thermal envelope encloses one or more of the following uses: Warehouse (storage and retail), gymnasium, auditorium, church chapel, arena, kennel, manufacturing plant, indoor swimming pool, pump station, water and waste water treatment facility, storage facility, storage area, motor vehicle service facility. Where additional uses not listed (such as office, retail, etc.) are contained within the building, the exterior walls that enclose these areas may not utilize this exception and must comply with the appropriate mass wall R-value from Table C402.1.3/U-factor from Table C402.1.4.~~))

e. "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.

f. 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 or subtracted from the original test design.

C402.1.5 Component performance alternative. Building envelope values and fenestration areas determined in accordance with Equation 4-2 shall be permitted in lieu of compliance with the *U*-factors and *F*-factors in Tables C402.1.4 and C402.4 and the maximum allowable fenestration areas in Section ((~~C402.4~~)) C402.4.1.

$A + B + C + D \leq \text{Zero}$ **(Equation 4-2)**

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 x Area

UA Table = (U-factor from Tables C402.1.4 or C402.4 ~~or Section C402.1.3~~) x 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 x Perimeter length

FL Table = (F-factor specified in Table C402.1.4) x Perimeter length

The maximum allowed prescriptive vertical fenestration area, identified as "Vertical Fenestration Area allowed" in factor CA below, as a percent of the gross above-grade wall area ratio is either:

1. 30%;

2. 40% if the building complies with Section C402.4.1.1 or C402.4.1.4; or

3. 40% if the *U*-values used in calculating A for vertical fenestration are taken from Section C402.4.1.3 rather than Table C402.4

Where the proposed vertical fenestration area is less than or equal to the maximum allowed prescriptive vertical fenestration area, the value of C (Excess Vertical Glazing Value) shall be zero. Otherwise:

C = (CA x UV) – (CA x UWall), but not less than zero

CA = (Proposed Vertical Fenestration Area) – (Vertical Fenestration Area allowed)

UA Wall = Sum of the (UA Proposed) values for each opaque assembly of the exterior wall

UAW = Sum of the (UA Proposed) values for each above-grade

U_{Wall} = UAW/sum of wall area (excludes vertical fenestration area)

UAV = Sum of the (UA Proposed) values for each vertical fenestration assembly

UV = UAV/total vertical fenestration area

Where the proposed skylight area is less than or equal to the skylight area allowed by Section C402.4.1, the value of D (Excess Skylight Value) shall be zero. Otherwise:

$D = (DA \times US) - (DA \times U_{Roof})$, but not less than zero

DA = (Proposed Skylight Area) – (Allowable Skylight Area from Section C402.4.1)

UAR = Sum of the (UA Proposed) values for each roof assembly

U_{Roof} = UAR/sum of roof area (excludes skylight area)

UAS = Sum of the (UA Proposed) values for each skylight assembly

US = UAS/total skylight area

C402.1.5.1 Component *U*-factors and *F*-factors. The *U*-factors and *F*-factors for typical construction assemblies ((~~are~~)) included in Chapter 3 and Appendix A ((~~. These values~~)) shall be used for all calculations. Where proposed construction assemblies are not represented in Chapter 3 or Appendix A, values shall be calculated in accordance with the ASHRAE Handbook - Fundamentals, using the framing factors listed in Appendix A.

For envelope assemblies containing metal framing, the *U*-factor shall be determined by one of the following methods:

1. Results of laboratory measurements according to acceptable methods of test.

2. ASHRAE Handbook - Fundamentals where the metal framing is bonded on one or both sides to a metal skin or covering.

3. The zone method as provided in ASHRAE Handbook - Fundamentals.

4. Effective framing/cavity *R*-values as provided in Appendix A. When return air ceiling

plenums are employed, the roof/ceiling assembly shall:

For thermal transmittance purposes, not include the ceiling proper nor the plenum space as part of the assembly; and

For gross area purposes, be based upon the interior face of the upper plenum surface.

5. Tables in ASHRAE 90.1, Normative Appendix A.

C402.1.5.2 SHGC rate calculations. Solar heat gain coefficient shall comply with Table C402.4. The target $SHGCA_t$ and the proposed $SHGCA_p$ shall be calculated using Equations 4-3 and 4-4 and the corresponding areas and SHGCs from Table C402.4.

EQUATION 4-3

TARGET $SHGCA_T$

$SHGCA_t = SHGCt\ (Aogt) + SHGCvgt\ (Avgt + Avgmt + Avgmot + Avgdt)$

Where:

$SHGCAt$ = The target combined specific heat gain of the target fenestration area.

$SHGCogt$ = The solar heat gain coefficient for skylight fenestration found in Table C402.4

$Aogt$ = The proposed skylight area

$SHGCvgt$ = The solar heat gain coefficient for fenestration found in Table C402.4 which corresponds to the proposed total fenestration area as a percent of gross exterior wall area.

$Avgt$ = The proposed vertical fenestration area with nonmetal framing

$Avgmt$ = The proposed vertical fenestration area with fixed metal framing

$Avgmot$ = The proposed vertical fenestration area with operable metal framing

$Avgdt$ = The proposed entrance door area

EQUATION 4-4

PROPOSED $SHGCA_P$

$SHGCA_p = SHGC_{og}A_{og} + SHGC_{vg}A_{vg}$

Where:

$SHGCA_t$ = The combined proposed specific heat gain of the proposed fenestration area.

$SHGC_{og}$ = The solar heat gain coefficient of the skylights.

A_{og} = The skylight area.

$SHGC_{vg}$ = The solar heat gain coefficient of the vertical fenestration.

A_{vg} = The vertical fenestration area.

((~~**NOTE:** The vertical fenestration area does not include opaque doors and opaque spandrel panels.~~))

C402.2 Specific building thermal envelope insulation requirements (Prescriptive). Insulation in building thermal envelope opaque assemblies shall comply with Sections C402.2.1 through ((~~C402.2.6~~)) C402.2.8 and Table C402.1.3. Where this section refers to installing insulation levels as specified in Table C402.1.3, assemblies complying with Section C402.1.4 and buildings complying with Section C402.1.5 are permitted to provide alternate levels of insulation provided that the U-factor of the insulated assembly is less than or equal to the U-factor required by the selected compliance path.

C402.2.1 Multiple layers of continuous insulation.

Where two or more layers of continuous insulation board are used in a construction assembly, the continuous insulation boards shall be installed in accordance with Section C303.2. If the continuous insulation board manufacturer's installation instructions do not address installation of two or more layers, the edge joints between each layer of continuous insulation boards shall be staggered.

C402.2.2 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 C402.1.3, based on construction materials used in the roof assembly. Skylight curbs shall be insulated to the level of roofs with insulation entirely above deck or R-5, whichever is less.

Exceptions:

1. Continuously insulated roof assemblies where the thickness of insulation varies 1 inch (25 mm) or less and where the area-weighted *U*-factor is equivalent to the same assembly with the *R*-value specified in Table C402.1.3.

2. (Reserved) ((~~Where tapered insulation is used with insulation entirely above deck, the *R*-value where the insulation thickness varies 1 inch (25 mm) or less from the minimum thickness of tapered insulation shall comply with the *R*-value specified in Table C402.1.3.~~))

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

Insulation installed on a suspended ceiling with removable ceiling tiles shall not be considered part of the minimum thermal resistance of the roof insulation.

C402.3 Reserved.

((~~C403.4~~)) C402.4 Fenestration (Prescriptive). Fenestration shall comply with Sections C402.4 through C402.4.4 ((~~and Table C402.4.~~)) Daylight responsive controls shall comply with this section and Section ((~~C405.2.4.1~~)) C405.2.4.

Fenestration shall comply with Table C402.4. U-values from Column A shall be used in buildings where the HVAC heating energy is provided by electric resistance or fossil fuel combustion appliances. Electric resistance HVAC heating appliances include but are not limited

to electric baseboard, electric resistance fan coil and VAV electric resistance terminal reheat units, as well as heat pump systems that use electric resistance as the heating energy for the condenser water loop when the outside air temperature is above 32°F (0°C). Fossil fuel combustion HVAC heating appliances include but are not limited to appliances burning natural gas, heating oil, propane, or other fossil fuels, as well as heat pump systems that use fossil fuel as the heating energy for the condenser water loop when the outside air temperature is above 32°F (0°C).

Exceptions.

1. *U*-values from Column B are permitted to be used under any of the following conditions:

1.1. Building permits for which a completed application has been accepted by SDCI prior to January 1, 2018.

1.2. Buildings or areas of buildings that meet the interior temperature requirements of IBC Chapter 12 with a total installed HVAC heating capacity of 6 BTU/h per square foot or less. For purposes of this exception, overhead or wall-mounted radiant heating panels insulated in compliance with Section C402.2.8 and controlled by occupant sensing devices in compliance with Section C403.2.12 need not be included as part of the HVAC heating energy calculation.

1.3. Group R-2 or R-3 occupancy areas of buildings

1.4. Buildings with less than 2,500 square feet of conditioned floor area that is not Group R-2 or R-3 occupancy area.

1.5. Buildings in which electric resistance or fossil fuel auxiliary heating is provided only when the outdoor temperature is below 32°F (0°C) or when a defrost cycle is

required. Such systems shall be sized and configured to lock out electric resistance or fossil fuel heating from operation when the outdoor temperature is above 32 °F (0°C) unless the system is in defrost operation.

1.6. Buildings in which electric resistance or fossil fuel appliances, including decorative appliances, either provide less than 5 percent of the total building HVAC system heating capacity or serve less than 5 percent of the conditioned floor area. The calculation of these percentages shall exclude Group R-2 and R-3 areas of buildings and HVAC heating system capacity serving those areas.

1.7. Buildings or portions of buildings that require fossil fuel or electric resistance heating for research, health care, process or other specific needs that cannot practicably be provided by other heating systems.

1.8. Make-up air for commercial kitchen exhaust systems that is required to be tempered according to Section 508.1.1 of the International Mechanical Code is permitted to be heated with electric resistance or fossil fuel.

1.9. Steam or hot water supply systems that utilize fossil fuels as their primary source of heat energy, that serve multiple buildings, and that were already in existence prior to the effective date of this code, including more energy-efficient upgrades to such existing systems, are permitted to serve as the primary heating energy source.

1.10. Hot water supply systems that utilize waste heat, renewable energy or other energy sources other than electric resistance or fossil fuel as their source of heat energy when the outside air temperature is above 32°F (0°C).are permitted to utilize electric resistance or fossil fuel as their secondary source of heat energy.

2. Single-pane glazing is permitted for security purposes and for revolving doors, not to exceed 1 percent of the gross exterior wall area. Where Section C402.1.5, component performance alternative, is used, the single glazing shall be included in the percentage of the total glazing area, U-factor and SHGC requirements.

TABLE C402.4 for 22.700.010
BUILDING ENVELOPE FENESTRATION MAXIMUM U-FACTOR AND SHGC REQUIREMENTS

CLIMATE ZONE	**5 AND MARINE 4**			
Vertical Fenestration				
***U*-factor**				
	Column A Electric Resistance or Fossil Fuel Heating System, and does not comply with C402.4, Ex 1		Column B Other Heating System, or complies with C402.4, Exception 1	
Nonmetal framing (all)[a]	0.26		0.30	
Metal framing (fixed)[b]	0.31		0.38	
Metal framing (operable)[c]	0.38		0.40	
Metal framing (entrance doors)[d]	0.60		0.60	
SHGC				
Orientation	SEW	N	SEW	N
PF < 0.2	((~~0.40~~)) 0.35	0.53	((~~0.40~~)) 0.35	0.53
0.2 ≤ PF < 0.5	((~~0.48~~)) 0.45	0.58	((~~0.48~~)) 0.45	0.58
PF ≥ 0.5	((~~0.65~~)) 060	0.64	((~~0.65~~)) 060	0.64
Skylights				
***U*-factor**	((~~0.50~~)) 0.45			
SHGC	((~~0.35~~)) 0.32			
Keys for Table C402.4 for 22.700.010 NR = No requirement.				

Footnotes for Table C402.4 for 22.700.010

a. "Nonmetal framing" includes framing materials other than metal, with or without metal reinforcing or cladding.
b. "Metal framing" includes metal framing, with or without thermal break. "Fixed" includes curtain wall, storefront, picture windows, and other fixed windows.
c. "Metal framing" includes metal framing, with or without thermal break. "Operable" includes openable fenestration products other than "entrance doors."
d. "Metal framing" includes metal framing, with or without thermal break. "Entrance door" includes glazed swinging entrance doors and automatic glazed sliding entrance doors. Other doors which are not entrance doors, including sliding glass doors, are considered "operable."

C402.4.1 Maximum area. The vertical fenestration area (not including opaque doors and opaque spandrel panels) shall not exceed 30 percent of the gross above-grade wall area. The skylight area shall not exceed ((~~3~~)) 5 percent of the gross roof area.

EXCEPTION: For vertical *fenestration* at street level retail or for other occupancies where the Seattle Land Use Code requires street-level transparency, the *fenestration* area shall not exceed 75 percent of the area of the street-level wall that faces the street or that adjoins other pedestrian areas used for retail access. For the purposes of this exception, the street-level wall shall be measured from the street-level floor to the interior ceiling level or to 20 feet above floor level, whichever is lowest. When this exception is used, separate calculations shall be performed for these sections of the building envelope, and these values shall not be averaged with any others for compliance purposes. On the street level the 75 percent *fenestration* area is permitted to be exceeded, if the additional *fenestration* area is deducted from *fenestration* allowances from other areas of the building.

***

C402.4.1.1 Increased vertical fenestration area with daylight zone area ((~~responsive controls~~)). A maximum of 40 percent of the gross above-grade wall area shall be permitted

to be vertical fenestration for the purpose of prescriptive compliance with Section C402.1.4 or for the component performance alternative in Section C402.1.5, provided all of the following requirements are met:

1. In buildings not greater than two stories above grade, no less than 50 percent of the conditioned 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 ((~~C405.2.4.1~~)) C405.2.4 are installed in *daylight zones*.

4. Visible transmittance (VT) of vertical fenestration is greater than or equal to 1.1 times solar heat gain coefficient (SHGC).

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

C402.4.1.2 (Reserved.)

C402.4.1.3 Increased vertical *fenestration* area with high-performance *fenestration*. For buildings that are permitted to use the Column B values in Table C402.4, the vertical *fenestration* area (not including opaque doors and opaque spandrel panels) is permitted to exceed 30% but shall not exceed 40% of the gross above grade wall area, for the purpose of prescriptive compliance with Section ((~~C402.1.3~~)) C402.4.1 provided that each of the following conditions are met:

1. The vertical *fenestration* shall have the following maximum U-factors:

a. Non-metal framing (all) = 0.28

b. Metal framing (fixed) = 0.34

c. Metal framing (operable) = 0.36

d. Metal framing (entrance doors) = 0.60

2. The SHGC of the vertical fenestration shall be less than or equal to 0.35 ((~~, adjusted for projection factor in compliance with C402.4.3~~)).

An area-weighted average shall be permitted to satisfy the U-factor requirement for each fenestration product category listed in Item 1 of this section. Individual fenestration products from different fenestration product categories shall not be combined in calculating the area-weighted average *U*-factor.

The compliance path described in this section is not permitted to be used for the Total Building Performance compliance path in Section C407. The compliance path described in this section is permitted to be used for the component performance alternative in Section C402.1.5, provided that the requirements of Section C402.1.5 are met.

C402.4.1.4 Increased vertical fenestration area with high-performance mechanical systems. The vertical fenestration area (not including opaque doors and opaque spandrel panels) is permitted to exceed 30 percent but shall not exceed 40 percent of the gross above-grade wall area, for the purpose of prescriptive compliance with Section ((~~C402.1.4~~)) C402.4.1 or for the component performance alternative in Section C402.1.5, provided that the mechanical system complies with all requirements of Section C403.6, dedicated outdoor air systems (DOAS) without utilizing the exceptions to Section C403.6. This increased glazing fraction is not permitted to be used to establish the reference case for the Total Building Performance compliance path in Section C407.

C402.4.2 Minimum skylight fenestration area. For single story buildings only, 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 heights greater than 15 feet (4572 mm), and used as an office, lobby, atrium, concourse, corridor, gymnasium/exercise center, convention center, automotive service, manufacturing, nonrefrigerated warehouse, retail store, distribution/sorting area, transportation, or workshop, skylights are required to provide a total toplight *daylight zone* area not less than half the floor area and shall provide one of the following:

1. A minimum ratio of skylight area to toplight *daylight zone* area under skylights of not less than 3 percent where all skylights have a VT of at least 0.40 as determined in accordance with Section C303.1.3
2. A minimum skylight effective aperture of at least 1 percent determined in accordance with Equation 4-5.

Skylight Effective Aperture =

(0.85 x Skylight Area x Skylight VT x WF) / Daylight zone under skylight **(Equation 4-5)**

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. Reserved.

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

3. Areas where it is documented that existing structures or natural objects block direct beam sunlight on at least 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.

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

5. Spaces where the total floor area minus the sidelight daylight zone area is less than 2,500 square feet (232 m^2), and where the lighting in the daylight zone is controlled in accordance with Section ((~~C405.2.3.1~~)) C405.2.4.

C402.4.2.1 Lighting controls in daylight zones under skylights. Daylight responsive controls complying with Section ((~~C405.2.4.1~~)) C405.2.4 shall be provided to control all electric lights within daylight zones.

C402.4.2.2 Haze factor. Skylights in office, storage, automotive service, manufacturing, nonrefrigerated warehouse, retail store, and distribution/sorting area spaces shall have a glazing material or diffuser with a haze factor greater than 90 percent when tested in accordance with ASTM D 1003.

Exception: Skylights designed and installed to exclude direct sunlight entering the occupied space by the use of fixed or automated baffles, or the geometry of skylight and light well.

***

C402.4.4 Doors. *Opaque doors* shall comply with the applicable requirements for doors as specified in Tables C402.1.3 and C402.1.4 and be considered 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 C402.4.3 for vertical fenestration, and the entire door area, including frame, shall be considered part of the fenestration area of the building thermal envelope.

C402.5 Air leakage – thermal envelope (Mandatory). The thermal envelope of buildings shall comply with Sections C402.5.1 through C402.5.8.

C402.5.1 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 comply with Sections C402.5.1.1 and C402.5.1.2.

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

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

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. Joints and seals associated with penetrations shall be sealed in the same manner or taped or covered with moisture vapor-permeable wrapping material. Sealing materials shall be appropriate to the construction materials being sealed and shall be securely installed around the penetrations 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 C402.5.8. Where similar objects are installed which 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.

C402.5.1.2 Building test. The completed building shall be tested and the air leakage rate of the *building envelope* shall not exceed ((~~0.40~~)) 0.30 cfm/ft^2 at a pressure differential of 0.3 inches water gauge (((~~2.0 L/s x m^2 at 75 Pa~~))) (1.5 L/s x m^2 at 75 Pa) at the upper 95 percent confidence interval in accordance with ASTM E 779 or an equivalent method approved by the code official. A report that includes the tested surface area, floor area, air by volume, stories above grade, and leakage rates shall be submitted to the building owner and the Code Official. If the tested rate exceeds that defined here, a visual inspection of the air barrier shall be conducted and any leaks noted shall be sealed to the extent practicable. An additional report identifying the corrective actions taken to seal air leaks shall be submitted to the building owner and the Code Official and any further requirement to meet the leakage air rate will be waived.

1. Test shall be accomplished using either (1) both pressurization and depressurization or (2) pressurization alone, but not depressurization alone. The test results shall be plotted

against the correct P for pressurization in accordance with Section 9.4 of ASTM E779.

2. The test pressure range shall be from 25 Pa to 80 Pa per Section 8.10 of ASTM E779, but the upper limit shall not be less than 50 Pa, and the difference between the upper and lower limit shall not be less than 25 Pa.

3. If the pressure exponent n is less than 0.45 or greater than 0.85 per Section 9.6.4 of ASTM E779, the test shall be rerun with additional readings over a longer time interval.

C402.5.1.2.1 Building test for mixed-use buildings. Where a building is three or fewer stories above grade plane and contains both commercial and residential uses, the air barrier of the R-2 and R-3 occupancy areas of the building is permitted to be separately tested according to Section R402.4.1.2. Alternatively, it is permissible to test the air barrier of the entire building according to Section C402.5.1.2, provided that the tested air leakage rate does not exceed the rate specified in Section C402.5.1.2.

***

C402.5.4 Doors and access openings to shafts, chutes, stairways, and elevator lobbies. Doors and access openings from conditioned space to shafts, chutes, stairways and elevator lobbies shall be gasketed, weatherstripped or sealed.

Exceptions:

1. Door openings required to comply with Section ((~~715 or 715.4~~)) 716 of the *International Building Code.*

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

***

C402.5.7 Vestibules. All 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. For the purposes of this section, "building entrances" shall include exit-only doors in buildings where separate doors for entering and exiting are provided.

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. The building lobby is not considered a vestibule.

Exceptions:

1. Doors not intended to be used as building entrances.
2. Unfinished ground-level space greater than 3,000 square feet (298 m^2) if a note is included on the permit documents at each exterior entrance to the space stating "Vestibule required at time of tenant build-out if entrance serves a space greater than 3,000 square feet in area."
3. Doors opening directly from a *sleeping unit* or dwelling unit.
4. Doors between a space smaller than 3,000 square feet (298 m2) in area and the exterior of the building or the building entrance lobby, where those doors do not comprise one of the primary entrance paths to the remainder of the building.
5. Revolving doors.

6. Doors used primarily to facilitate vehicular movement or material handling and adjacent personnel doors.

7. In buildings less than three stories above grade or in spaces that do not directly connect with the building elevator lobby, doors that have an air curtain with a velocity of not less than 6.56 feet per second (2 m/s) at the floor that have been tested in accordance with ANSI/AMCA 220 and installed in accordance with the manufacturer's instructions. Manual or automatic controls shall be provided that will operate the air curtain with the opening and closing of the door. Air curtains and their controls shall comply with Section C408.2.3.

8. Building entrances in buildings that are less than four stories above grade and less than 10,000 square feet in area.

9. Elevator doors in parking garages provided that the elevators have an enclosed lobby at each level of the garage.

10. Entrances to semi-heated spaces.

11. Doors that are used only to access outdoor seating areas that are separated from adjacent walking areas with a fence or other barrier.

***

C403.2 Provisions applicable to all mechanical systems (Mandatory). Mechanical systems and equipment serving the building heating, cooling or ventilating needs shall comply with Sections C403.2.1 through ((~~C403.2.13~~)) C403.2.14.

***

C403.2.3.1 Water-cooled centrifugal chilling packages. 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 x kW) condenser water flow shall have maximum full-load kW/ton (*FL*) and part-load ratings adjusted using Equations 4-7 and 4-8.

Exception. Centrifugal chillers designed to operate outside of these ranges are not covered by this section.

***

C403.2.3.3 Packaged and split system electric heating and cooling equipment. Packaged and split system electric equipment providing both heating and cooling, and cooling only equipment with electric heat in the main supply duct before VAV boxes, in each case with a total cooling capacity greater than 6,000 Btu/h shall be a heat pump.

Exception: Unstaffed equipment shelters or cabinets used solely for personal wireless service facilities.

***

TABLE C403.2.3(7) for 22.700.010
MINIMUM EFFICIENCY REQUIREMENTS – WATER CHILLING PACKAGES[a]

EQUIPMENT TYPE	SIZE CATEGORY	UNITS	AS OF 1/1/2015[b]				TEST PROCEDURE[c]
			PATH A		PATH B		
			FULL LOAD	IPLV	FULL LOAD	IPLV	
Air-cooled chillers	< 150 tons	EER	≥□10.100	≥□13.700	≥9.700	≥15.800	AHRI 550/590
	≥150 tons	EER	≥□10.100	≥14.000	≥9.700	≥16.100	
Air cooled without condenser, electrical operated	All capacities	EER	Air-cooled chillers without condensers shall be rated with matching condensers and comply with the air-cooled chiller efficiency requirements				
Water cooled, electrically operated, reciprocating	All capacities	kW/ton	Reciprocating units shall comply with water cooled positive displacement efficiency requirements				
Water cooled, electrically	< 75 tons	kW/ton	≤□0.750	≤□0.600	≤□0.780	≤0.500	

operated, positive displacement	≥75 tons and < 150 tons	kW/ton	≤□0.720	≤□0.560	≤□0.750	≤□0.490	
	≥□150 tons and < 300 tons	kW/ton	≤□0.660	≤0.540	≤□0.680	≤□0.440	
	≥□300 tons and < 600 tons	kW/ton	≤□0.610	≤□0.520	≤□0.625	≤□0.410	
	≥□600 tons	kW/ton	≤□0.560	≤□0.500	≤□0.585	≤□0.380	
Water cooled, electrically operated, centrifugal	< 150 tons	kW/ton	≤□0.610	≤□0.550	≤□0.695	≤□0.440	
	≥□150 tons and < 300 tons	kW/ton					
	≥300 tons and < 600 tons	kW/ton	≤□0.560	≤□0.520	≤□0.595	≤□0.390	
	≥600 tons	kW/ton	≤0.560	≤□0.500	≤□0.585	≤0.380	
Air cooled, absorption single effect	All capacities	COP	≥□0.600	NR	NA	NA	AHRI 560
Water cooled, absorption single effect	All capacities	COP	≥□0.700	NR	NA	NA	
Absorption double effect, indirect fired	All capacities	COP	≥1.000	≥□1.050	NA	NA	
Absorption double effect, direct fired	All capacities	COP	≥□1.000	≥□1.000	NA	NA	

Keys for Table C403.2.3(7) for 22.700.010
For SI: 1 ton = 3517 W, 1 British thermal unit per hour = 0.2931 W, °C = [(°F) - 32]/1.8.
NA = Not applicable, not to be used for compliance;
NR = No requirement.

Footnotes for Table C403.2.3(7) for 22.700.010
a. ((~~The centrifugal chiller equipment requirements, after adjustment in accordance with Section C403.2.3.1 or Section C403.2.3.2, do not apply to chillers used in low-temperature applications where the design leaving fluid temperature is less than 36°F. The requirements do not apply to positive displacement chillers with leaving fluid temperatures less than or equal to 32°F. The requirements do not apply to absorption chillers with design leaving fluid temperatures less than 40°F.~~)) The requirements for air-cooled, water-cooled positive displacement and absorption chillers are at standard rating conditions defined in the reference test procedure. The requirements for centrifugal chillers shall be adjusted for nonstandard rating conditions per Section C403.2.3.1 and are only applicable for the range of conditions listed there.

b. Compliance with this standard can be obtained by meeting the minimum requirements of Path A or B. However, both the full load and IPLV shall be met to fulfill the requirements of Path A or B.
c. Chapter 6 of the referenced standard contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

***

C403.2.4.1 Thermostatic controls. The supply of heating and cooling energy to each *zone* shall be controlled by individual thermostatic controls capable of responding to temperature within the *zone*. Controls in the same zone or in neighboring zones connected by openings larger than 10 percent of the floor area of either zone shall not allow for simultaneous heating and cooling. At a minimum, each floor of a building shall be considered as a separate zone. Controls on systems required to have economizers and serving single zones shall have multiple cooling stage capability and activate the economizer when appropriate as the first stage of cooling. See Section C403.3.1 for further economizer requirements. Where humidification or dehumidification or both is provided, at least one humidity control device shall be provided for each humidity control system.

Exceptions:

1. Independent perimeter systems that are designed to offset only building envelope heat losses or gains or both serving one or more perimeter *zones* also served by an interior system provided:

1.1. The perimeter system includes at least one thermostatic control *zone* for each building exposure having exterior walls facing only one orientation (within +/-45 degrees) (0.8 rad) for more than 50 contiguous feet (15,240 mm);

1.2. The perimeter system heating and cooling supply is controlled by a thermostat located within the *zones* served by the system; and

1.3. Controls are configured to prevent the perimeter system from operating in a

different heating or cooling mode from the other equipment within the zones or from neighboring zones connected by openings larger than 10 percent of the floor area of either zone.

2. ((~~Any nonperimeter zones not separated from perimeter zones by an interior wall with openings no larger than 10 percent of the perimeter floor zone area shall have setpoints and deadbands coordinated so that cooling in adjacent zones shall not operate until the adjacent zone temperature is 5°F (2.8°C) higher than the perimeter zone temperature.~~)) Where an interior zone is open to a perimeter zone with permanent openings that are larger than 10 percent of the floor area of either zone, cooling in the interior zone is permitted to operate at times when the perimeter zone is in heating and the interior zone temperature is at least 5°F (2.8°C) higher than the perimeter zone temperature.

C403.2.4.1.1 Heat pump supplementary heat. Unitary air cooled heat pumps shall include microprocessor controls that minimize supplemental heat usage during start-up, set-up, and defrost conditions. These controls shall anticipate need for heat and use compression heating as the first stage of heat. Controls shall indicate when supplemental heating is being used through visual means (e.g., LED indicators). Heat pumps equipped with supplementary heaters shall be installed with controls that prevent supplemental heater operation above 40°F. At final inspection, the lock out control shall be set to 32° F (0°C) or less.

Exception: Packaged terminal heat pumps (PTHPs) of less than 2 tons (24,000 Btu/hr) cooling capacity provided with controls that prevent supplementary heater operation above 40°F.

C403.2.4.1.2 Deadband. Where used to control both heating and cooling, zone thermostatic controls shall be configured to provide a temperature range or Deadband of at least 5°F (2.8°C) within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum.

Exceptions:

1. Thermostats requiring manual changeover between heating and cooling modes.

2. Occupancies or applications requiring precision in indoor temperature control as *approved* by the code official.

C403.2.4.1.3 Setpoint overlap restriction. Where a *zone* has a separate heating and a separate cooling thermostatic control located within the zone, a limit switch, mechanical stop or direct digital control system with software programming shall be configured to prevent the heating set point from exceeding the cooling setpoint and to maintain a deadband in accordance with Section C403.2.4.1.2.

C403.2.4.2 Off-hour controls. For all occupancies other than Group R and for conditioned spaces other than dwelling units within Group R occupancies, each *zone* shall be provided with thermostatic setback controls that are controlled by either an automatic time clock or programmable control system.

***

C403.2.4.3 Shutoff dampers. Outdoor air supply, exhaust openings and relief outlets and stairway and shaft vents shall be provided with Class I motorized dampers.

Return air openings used for airside economizer operation shall be equipped with Class I motorized dampers.

Class I dampers shall have a maximum leakage rate of 4 cfm/ft^2 (20.3 L/s x m^2) at 1.0 inch water gauge (w.g.) (249 Pa) when tested in accordance with AMCA 500D and shall be labeled by an approved agency for such purpose.

Exception: Motorized dampers on return air openings in unitary packaged equipment that have the minimum leakage rate available from the manufacturer shall be deemed to comply.

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 the International Mechanical Code 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.

Exceptions:

1. Gravity (nonmotorized) dampers shall be permitted to be used as follows:

   1.1 Relief dampers serving systems less than ((~~5,000~~)) 300 cfm total supply shall be permitted ((~~in buildings less than three stories in height in height~~)).

   1.2 Gravity (nonmotorized) dampers in Group R occupancies where the design outdoor air intake or exhaust capacity does not exceed ((~~400~~)) 300 cfm (189 L/s).

2. Combustion air intakes.

3. Systems serving areas which require continuous operation.

4. Type I kitchen exhaust hoods.

Gravity (nonmotorized) dampers shall have an air leakage rate not greater than 20 cfm/ft^2 (101.6 L/s x m^2) where not less than 24 inches (610 mm) in either dimension and 40 cfm/ft^2 (203.2 L/s x m^2) where less than 24 inches in either dimension. The rate of air leakage shall be determined at 1.0 inch w.g. (249 Pa) when tested in accordance with AMCA 500D for such purpose. The dampers shall be labeled by an approved agency. Gravity dampers for ventilation air intakes shall be protected from direct exposure to wind.

C403.2.4.4 Zone isolation. HVAC systems serving ((~~zones~~)) areas that are over 25,000 square feet (2323 m^2) in floor area or that span more than one floor and are designed to operate or be occupied nonsimultaneously shall be divided into isolation areas. Each isolation area shall be equipped with isolation devices and controls configured to automatically shut off the supply of conditioned air and outdoor air to and exhaust air from the isolation area. Each isolation area shall be controlled independently by a device meeting the requirements of Section C403.2.4.2.2. Central systems and plants shall be provided with controls and devices that will allow system and equipment operation for any length of time while serving only the smallest isolation area served by the system or plant.

Exceptions:

1. Exhaust air and outdoor air connections to isolation areas where the fan system to which they connect is not greater than 5,000 cfm (2360 L/s).
2. Exhaust airflow from a single isolation area of less than 10 percent of the design airflow of the exhaust system to which it connects.
3. Isolation areas intended to operate continuously or intended to be inoperative only when all other isolation areas in a zone are inoperative.

***

C403.2.4.13 Pressure Independent Control Valves. Where design flow rate of heating water and chilled water coils is 10 GPM or higher, modulating pressure independent control valves shall be provided.

***

C403.2.6.4 Enclosed loading dock, motor vehicle repair garage and parking garage exhaust ventilation system control. Mechanical ventilation systems for enclosed loading docks, motor vehicle repair garages and parking garages shall be designed to exhaust the airflow rates (maximum and minimum) determined in accordance with the *International Mechanical Code*.

Ventilation systems shall be equipped with a control device that operates the system automatically by means of carbon monoxide detectors applied in conjunction with nitrogen dioxide detectors. Controllers shall be configured to shut off fans or modulate fan speed to 50 percent or less of design capacity, or intermittently operate fans less than 20 percent of the occupied time or as required to maintain acceptable contaminant levels in accordance with the *International Mechanical Code* provisions.

Gas sensor controllers used to activate the exhaust ventilation system shall stage or modulate fan speed upon detection of specified gas levels. All equipment used in sensor controlled systems shall be designed for the specific use and installed in accordance with the manufacturer's recommendations. The system shall be arranged to operate automatically by means of carbon monoxide detectors applied in conjunction with nitrogen dioxide detectors. ((~~Garage~~)) Garages, repair garages and loading docks shall be equipped with a controller and a full array of carbon monoxide (CO) sensors set to maintain levels of carbon monoxide below 35 parts per million (ppm). Additionally, a full array of nitrogen dioxide detectors

shall be connected to the controller set to maintain the nitrogen dioxide level below the OSHA standard for eight hour exposure. Spacing and location of the sensors shall be installed in accordance with manufacturer recommendations.

C403.2.6.4.1 System activation devices for enclosed loading docks. Ventilation systems for enclosed loading docks shall operate continuously during unoccupied hours at the minimum ventilation rate required by Section C404.2.2 of the International Mechanical Code and shall be activated to the full required ventilation rate by one of the following:

1. Gas sensors installed in accordance with the *International Mechanical Code*; or
2. Occupant detection sensors used to activate the system that detects entry into the loading area along both the vehicle and pedestrian pathways.

C403.2.6.4.2 System activation devices for enclosed parking garages. Ventilation systems for enclosed parking garages shall be activated by gas sensors.

Exception: A parking garage ventilation system having a total design capacity under 8,000 cfm may use occupant sensors to activate the full required ventilation rate.

***

C403.2.8.3 Duct construction. Ductwork shall be constructed and erected in accordance with the *International Mechanical Code*. For the purposes of this section, longitudinal seams are joints oriented in the direction of airflow. Transverse joints are connections of two duct sections oriented perpendicular to airflow. Duct wall penetrations are openings made by any screw, fastener, pipe, rod or wire. All other connections are considered transverse joints, including but not limited to spin-ins, taps and other branch connections, access door frames and jambs, and duct connections to equipment.

C403.2.8.3.1 Low-pressure duct systems. All 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.) (500 Pa) shall be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus embedded-fabric systems or tapes installed in accordance with the manufacturer's installation instructions. Pressure classifications specific to the duct system shall be clearly indicated on the construction documents in accordance with the *International Mechanical Code*.

Exception: Continuously welded and locking-type longitudinal joints and seams on ducts operating at static pressures less than 2 inches water gauge (w.g.) (500 Pa) pressure classification.

C403.2.8.3.2 Medium-pressure duct systems. All ducts and plenums designed to operate at a static pressure greater than 2 inches water gauge (w.g.) (500 Pa) but less than 3 inches w.g. (750 Pa) shall be insulated and sealed in accordance with Section C403.2.8. Pressure classifications specific to the duct system shall be clearly indicated on the construction documents in accordance with the *International Mechanical Code*.

C403.2.8.3.3 High-pressure <u>and exterior</u> duct systems. Ducts designed to operate at static pressures in excess of 3 inches water gauge (w.g.) (750 Pa) <u>and all supply and return ductwork located outside the building envelope that serves a conditioned space</u> shall be insulated and sealed in accordance with Section C403.2.8. 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 4-9.

$$CL = F/P^{0.65} \qquad \textbf{(Equation 4-9)}$$

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 at least 25 percent of the duct area have been tested and that all tested sections meet the requirements of this section.

***

C403.2.9.1 Protection of piping insulation. Piping insulation exposed to weather shall be protected from damage, including that due to sunlight, moisture, equipment maintenance and wind, and shall provide shielding from solar radiation that can cause degradation of the material. ((~~Adhesives~~)) Adhesive tape shall not be permitted.

***

C403.2.10 Mechanical systems commissioning and completion requirements. Mechanical systems shall be commissioned and completed in accordance with Section C408.

C403.2.11 Air system design and control. Each HVAC system having a total fan system motor nameplate horsepower (hp) exceeding 5 hp (3.7 kW) shall comply with the provisions of Sections C403.2.11.1 through C403.2.11.3. All motors less than 1 horsepower shall meet the provisions of Section C405.8.

The air flow requirements of Section C403.2.11.5 shall apply to all fan motors. Group R occupancy exhaust fans shall also comply with Section C403.2.11.4. In addition to the other requirements of this section, variable-air-volume systems shall comply with Sections C403.2.11.6 through C403.2.11.8.

***

TABLE ((~~C403.2. 4.11.5~~)) C403.2.11.4 for 22.700.010 MECHANICAL VENTILATION SYSTEM FAN EFFICACY			
Fan location	**Air Flow Rate Minimum (cfm)**	**Minimum Efficacy (cfm/watt)**	**Air Flow Rate Minimum (cfm)**
Exhaust fan: Bathroom, utility room, whole house	10	1.4 cfm/watt	< 90
Exhaust fan: Bath	90	2.8 cfm/watt	Any

TABLE ((~~C403.2. 4.11.5~~)) C403.2.11.5 for 22.700.010 FAN CONTROL		
Cooling System Type	**Fan Motor Size**	**Mechanical Cooling Capacity**
DX cooling	Any	≥65,000 Btu/h
Chilled water and evaporative cooling	((~~≥ 5 hp~~))	((~~Any~~))
	≥ ¼ hp	Any

***

C403.2.11.6 Single Zone Variable-Air-Volume Controls. HVAC systems shall have variable airflow controls as follows:

1. Supply fans for air handling and fan coil units with chilled-water cooling coils and supply fans with motors greater than or equal to 5 hp shall be controlled by variable-speed drives or electronically-commutated motors. At cooling demands less than or equal to 50 percent, the supply fan controls shall be able to reduce the airflow to no greater than the larger of the following:

    1.1. One half of the full fan speed; or

    1.2. The volume of outdoor air required to meet the ventilation requirements of the *International Mechanical Code*.

2. Supply fans for air conditioning equipment and air handling units with direct expansion cooling and a cooling capacity greater than or equal to 110,000 Btu/h that serve single zones shall be controlled by variable-speed drives or electronically-commutated motors. Cooling

capacity shall be determined at the rating conditions in the AHRI standard appropriate to the equipment, At cooling demands less than or equal to 50 percent, the supply fan controls shall be able to reduce the airflow to no greater than the larger of the following:

2.1. Two-thirds of the full fan speed; or

2.2. The volume of outdoor air required to meet the ventilation requirements of the *International Mechanical Code*.

C403.2.11.7 Multiple-zone Variable Air Volume (VAV) System Ventilation Optimization Control. Multiple-zone VAV systems with direct digital control (DDC) of individual zone boxes reporting to a central control panel shall include means to automatically reduce outdoor air intake flow below design rates in response to changes in system ventilation efficiency as set out in ASHRAE 62.1, Appendix A.

Exceptions. The following systems are exempt from this section:

1. VAV Systems with zonal transfer fans that recirculate air from other zones without directly mixing it with outdoor air.

2. Dual-duct dual-fan VAV systems.

3. VAV systems with fan-powered terminal units.

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

C403.2.11.8 Multiple-zone VAV System Outdoor Airflow Control. Multiple-zone VAV systems with a minimum outside air requirement of 5,000 CFM or greater shall be equipped with a device capable of measuring outdoor airflow intake under all load conditions. The system shall be capable of increasing or reducing the outdoor airflow intake based on feedback from zonal systems as required by Sections C403.2.11.7 and C403.2.6.2.

Exceptions

1. Systems that meet all of the following are exempt from this section:

1.1 No spaces served by the system require demand control ventilation per Section C403.2.6.2.

1.2 The system meets the one of the exceptions to Section C403.2.11.7.

1.3 The system complies with Section 403.3.1.4 of the International Mechanical Code.

2. Systems where total design exhaust airflow is more than 70 percent of the total design outdoor air intake flow requirements are exempt from this section.

C403.2.12 Heating outside a building. Systems installed to provide heat outside a building shall be radiant systems.

Such heating systems shall be controlled by an occupancy sensing device or a timer switch, so that the system is automatically deenergized when no occupants are present in the area heated by each individual device for a period not to exceed one hour.

C403.2.13 Variable flow capacity. For fan and pump motors 7.5 hp and greater including motors in or serving custom and packaged air handlers serving variable air volume fan systems, constant volume fans, parking garage ventilation fans, heating and cooling hydronic pumping systems, pool and service water pumping systems, domestic water pressure boosting systems, cooling tower fan, and other pump or fan motors where variable flows are required, there shall be:

1. Variable speed drives; or

2. Other controls and devices that will result in fan and pump motor demand of no more

than 30 percent of design wattage at 50 percent of design air volume for fans when static pressure set point equals 1/3 the total design static pressure, and 50 percent of design water flow for pumps, based on manufacturer's certified test data. Variable inlet vanes, throttling valves (dampers), scroll dampers or bypass circuits shall not be allowed.

Exception: Variable speed devices are not required for motors that serve:

1. Fans or pumps in packaged equipment where variable speed drives are not available as a factory option from the equipment manufacturer.
2. Fans or pumps that are required to operate only for emergency fire-life-safety events (e.g., stairwell pressurization fans, elevator pressurization fans, fire pumps, etc.).

C403.2.13.1 Heat rejection equipment. The requirements of this section apply to heat rejection equipment used in comfort cooling systems such as air-cooled condensers, open cooling towers, closed-circuit cooling towers, and evaporative condensers.

Exception: Heat rejection devices included as an integral part of equipment listed in Tables C403.2.3(1) through C403.2.3(3).

Heat rejection equipment shall have a minimum efficiency performance not less than values specified in Table C403.2.3(8). These requirements apply to all propeller, axial fan and centrifugal fan cooling towers. Table C403.2.3(8) specifies requirements for air-cooled condensers that are within rating conditions specified within the table.

Cooling towers serving chilled water systems shall be selected to maintain a return condenser water temperature to the tower of 86° F (30° C) or less at peak design conditions.

EXCEPTION. In existing buildings where physical constraints preclude a change from

the original design, replacement cooling towers of the same or smaller capacity are exempt from this requirement.

Single-pass water cooling systems that use domestic water only one time before dumping it to waste shall not be used for hydronic heat pump and other cooling and refrigeration equipment, including but not limited to icemakers and walk-in coolers.

EXCEPTIONS.

1. Replacement of existing icemakers is exempt from this requirement.

2. Use of single-pass cooling for medical and dental equipment during power outages and other emergencies is exempt from this requirement.

C403.2.13.1.1 Variable flow controls. Cooling tower fans 7.5 hp and greater shall have control devices that vary flow by controlling the leaving fluid temperature or condenser temperature/pressure of the heat rejection device.

C403.2.13.1.2 Limitation on centrifugal fan cooling towers. Open cooling towers with a combined rated capacity of 1,100 gpm and greater at 95°F condenser water return, 85°F condenser water supply and 75°F outdoor wet-bulb temperature shall meet the energy efficiency requirement for axial fan open circuit cooling towers.

EXCEPTION: Open circuit cooling towers that are ducted (inlet or discharge) ((~~or have external sound attenuation that requires~~)) and require external static pressure capability or open circuit cooling towers that have external sound attenuation.

C403.2.14 Electric motor efficiency. Electric motors, including fractional hp motors, shall comply with the provisions of Section C405.8.

C403.3 Economizers (Prescriptive). Air economizers shall be provided on all new systems including those serving computer server rooms, electronic equipment, radio equipment, and telephone switchgear. Economizers shall comply with Sections C403.3.1 through C403.3. 4.

Exception: Economizers are not required for the systems listed below:

1. Systems complying with Section C403.6 Dedicated outdoor air systems (DOAS) with year-round cooling loads from lights and equipment of less than 5 watts per square foot.

2. Unitary or packaged systems serving one zone with dehumidification ((~~that affect other systems so as to~~)) where an economizer would increase the overall building energy consumption. New humidification equipment shall comply with Section C403.2.3.4

3. Unitary or packaged systems serving one zone where the cooling efficiency meets or exceeds the efficiency requirements in Table C403.3(3).

TABLE C403.3(3) for 22.700.010
EQUIPMENT EFFICIENCY PERFORMANCE EXCEPTION FOR ECONOMIZERS

Climate Zone	Efficiency Improvement[a]
4C	64%
5B	59%

a. If a unit is rated with an IPLV, IEER or SEER then to eliminate the required air or water economizer, the minimum cooling efficiency of the HVAC unit must be increased by the percentage shown. If the HVAC unit is only rated with a full load metric like EER or COP cooling, then these must be increased by the percentage shown.

4. Water-cooled refrigeration equipment serving chilled beams and chilled ceiling space cooling systems only which are provided with a water economizer meeting the requirements of Section C403.3.4.

5. Systems complying with all of the following criteria:

5.1 Consist of multiple water source heat pumps connected to a common water loop.

5.2 Have a minimum of 60 percent air economizer.

5.3 Have water source heat pumps with an EER at least 15 percent higher for cooling

and a COP of at least 15 percent higher for heating than that specified in Section C403.2.3.

5.4 Where provided with a dedicated boiler or furnace for that building, have a central boiler or furnace efficiency of 90 percent minimum for units up to 199,000 Btu/h.

5.5 Provide heat recovery with a minimum 50 percent heat recovery effectiveness as defined in Section C403.5 to preheat the outside air supply.

6. For Group R occupancies, cooling units installed outdoors or in a mechanical room adjacent to outdoors with a total cooling capacity less than 20,000 Btu/h and other cooling units with a total cooling capacity less than 54,000 Btu/h provided that these are high-efficiency cooling equipment with IEER, SEER, and EER values more than 15 percent higher than minimum efficiencies listed in Tables C403.2.3 (1) through (3), in the appropriate size category, using the same test procedures. PTAC and PTHP units with capacities no greater than 8,300 Btu/h are permitted for the purposes of this exception if they have EER values a minimum of 4 percent higher the minimum efficiencies listed in Table C403.2.3(3), in the appropriate size category, using the same test procedures. Equipment shall be listed in the appropriate certification program to qualify for this exception. For split systems, compliance is based on the cooling capacity of individual fan coil units.

7. Variable refrigerant flow (VRF) systems, multiple-zone split-system heat pumps, consisting of multiple, individually metered indoor units with multi-speed fan motors, served on a single common refrigeration circuit with an exterior reverse-cycle heat pump with variable speed compressor(s) and variable speed condenser fan(s). These systems shall also be capable of providing simultaneous heating and cooling operation, where in all

rooms with VRF units recovered energy from the indoor units operating in one mode can be transferred to one or more perimeter zones (as determined by conditioned floor area) and the outdoor unit shall be at least 65,000 Btu/h in total capacity. Systems utilizing this exception shall have 50 percent heat recovery effectiveness as defined by Section C403.5 on the outside air. For the purposes of this exception, dedicated server rooms, electronic equipment rooms or telecom switch rooms are not considered perimeter zones and shall not exceed 20 percent of the floor area served by the VRF system.

8. Equipment used to cool *Controlled Plant Growth Environments* provided these are high-efficiency cooling equipment with SEER, EER and IEER values a minimum of 20 percent greater than the values listed in Tables C403.2.3(1), (3) and (7).

9. Equipment used to cool any spaces with year-round cooling loads from lights and equipment of greater than 5 watts per square foot, where it can be demonstrated through calculations, to the satisfaction of the code official, that the heat rejection load of the equipment will be recovered and used for on-site space heating or service water heating demands such that the energy use of the building is decreased in comparison to a baseline of the same equipment provided with an air economizer complying with Section C403.3.

10. Equipment used to cool any dedicated server room, electronic equipment room, elevator machine room or telecom switch room provided the system complies with Option a, b , ((~~or~~)) c, d or e in ((~~the table~~)) Table C403.3(10) below. The total capacity of all systems qualifying under this exception without economizers shall not exceed 240,000 Btu/h per building or 10 percent of its air economizer capacity, whichever is greater. This exception shall not be used for Total Building Performance.

Table C403.3(10) for 22.700.010
Server room, electronic equipment room or telecom room cooling equipment

	Equipment Type	Higher Equipment Efficiency	Part-Load Control	Economizer
Option a	Tables C403.2.3(1) and C403.2.3(2)[a]	+15%[b]	Required over 85,000 Btu/h[c]	None Required
Option b	Tables C403.2.3(1) and C403.2.3(2)[a]	+5%[d]	Required over 85,000 Btu/h[c]	Waterside Economizer[e]
Option c	ASHRAE Standard 127[f]	+10%[g]	Required over 85,000 Btu/h[c]	Waterside Economizer[e]
Option d	Table C403.2.3(7) [h]	+ 25% [i]	Required for all chillers [j]	None Required
Option e	Table C403.2.3(7) [h]	+ 10/15% [k]	Required over 85,000 Btu/h[c]	Dedicated waterside economizer[e]

Footnotes for Table C403.3(10) for 22.700.010:

a. For a system where all of the cooling equipment is subject to the AHRI standards listed in Tables C403.2.3(1) and C403.2.3(2), the system shall comply with ((~~all of the following~~)) the higher equipment efficiency, part-load control and economizer requirements of the row in which this footnote is located, including the assiociated footnotes (note that if the system contains any cooling equipment that exceeds the capacity limits in Table C403.2.3(1) or C403.2.3(2), or if the system contains any cooling equipment that is not included in Table C403.2.3(1) or C403.2.3(2), then the system is not allowed to use this option).

b. The cooling equipment shall have an SEER/EER value and an IEER/IPLV value that each is a minimum of 15 percent greater than the value listed in Tables C403.2.3(1) and C403.2.3(2).

c. For units with a total cooling capacity over 85,000 Btu/h, the system shall utilize part-load capacity control schemes that are able to modulate to a part-load capacity of 50 percent of the load or less that results in the compressor operating at the same or higher EER at part loads than at full load (e.g., minimum of two-stages of compressor unloading such as cylinder unloading, two-stage scrolls, dual tandem scrolls, but hot gas bypass is not credited as a compressor unloading system).

d. The cooling equipment shall have an SEER/EER value and an IEER/IPLV value that each is a minimum of 5 percent greater than the value listed in Tables C403.2.3(1) and C403.2.3(2).

e. The system shall include a water economizer in lieu of air economizer. Water economizers shall meet the requirements of Sections C403.3.1 and C403.3.2 and be capable of providing the total concurrent cooling load served by the connected terminal equipment lacking airside economizer, at outside air temperatures of 50°F dry-bulb/45°F wet-bulb and below. For this calculation, all factors including solar and internal load shall be the same as those used for peak load calculations, except for the outside temperatures. The equipment shall be served by a dedicated condenser water system unless a nondedicated condenser water system exists that can provide appropriate water temperatures during hours when waterside economizer cooling is available.

f. For a system where all cooling equipment is subject to ASHRAE Standard 127, the system shall comply with the higher equipment efficiency, part-load control and economizer requirements of the row in which this footnote is located, including the assiociated footnotes.

g. The cooling equipment subject to the ASHRAE Standard 127 shall have an SCOP ((~~EER value and an IPLV~~)) value that is ((~~equal or~~)) a minimum of 10 percent greater than the value listed in Tables C403.2.3(1) and C403.2.3(2) (1.10 x values in these tables) when determined in accordance with the rating conditions ASHRAE Standard 127 (i.e., not the rating conditions in AHRI Standard 210/240 or 340/360). This information shall be provided by an independent third party.

h. For a system with chillers subject to the AHRI standards listed in Table C403.2.3(7) (e.g. a chilled water system with fan coil units), the system shall comply with the higher equipment efficiency, part-load control and economizer requirements of the row in which this footnote is located, including the associated footnotes.

i. The cooling equipment shall have an full-load EER value and an IPLV value that is a minimum of 25 percent greater than the value listed in Table C403.2.3(7) (1.25 x value in

Table C403.2.3(7) or a full-load and IPLV kW/ton that is at least 25 percent lower than the value listed in Table C403.2.3(7) (0.75 x value in Table C403.2.3(7)).
j. For all chillers, the system shall utilize part-load capacity control schemes that are able to modulate to a part-load capacity of 50 percent of the load or less and that result in the compressor operating at the same or higher EER at part loads than at full load (e.g., minimum of two-stages of compressor unloading such as cylinder unloading, two-stage scrolls, or dual tandem scrolls, but hot gas bypass is not a qualifying compressor unloading system).
k. For air-cooled chillers, the cooling equipment shall have an IPLV EER value that is a minimum of 10 percent greater than the IPLV EER value listed in Table C403.2.3(7) (1.10 x values in Table C403.2.3(7). For water-cooled chillers, the cooling equipment shall have an IPLV kW/ton that is at least 15 percent lower than the IPLV kW/ton value listed in Table C403.2.3(7) (0.85 x values in Table C403.2.3(7)).

11. Medical and laboratory equipment that is directly water-cooled and is not dependent upon space air temperature.

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C403.4.2.3.3 Isolation valve. Each hydronic heat pump on the hydronic system having a total pump system power exceeding 10 horsepower (hp) (7.5 kW) shall have a two-way (but not three-way) valve. For the purposes of this section, pump system power is the sum of the nominal power demand (i.e., nameplate horsepower at nominal motor efficiency) of motors of all pumps that are required to operate at design conditions to supply fluid from the heating or cooling source to all heat transfer devices (e.g., coils, heat exchanger) and return it to the source. This converts the system into a variable flow system and, as such, the primary circulation pumps shall comply with the variable flow requirements in Section ((~~C403.4.2.6~~)) C403.4.2.7.

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C403.4.7 Hydronic System Design: All chilled water and condenser water piping shall be designed such that the design flow rate in each pipe segment shall not exceed the values listed in Table C403.4.7 for the appropriate total annual hours of operation. Pipe size selections for

systems that operate under variable flow conditions (e.g. modulating 2- way control valves at coils) and that contain variable speed pump motors are allowed to be made from the "Variable Flow/ Variable Speed" columns. All others shall be made from the "Other" columns.

EXCEPTION: Design flow rates exceeding the values in Table C403.4.7 are allowed in specific sections of pipe if the pipe is not in the critical circuit at design conditions and is not predicted to be in the critical circuit during more than 30 percent of operating hours.

TABLE C403.4.7 for 22.700.010
PIPING SYSTEM DESIGN MAXIMUM FLOW RATE IN GPM[1]

	<=2000 hours/yr		>2000 and <=4400 hours/year		> 4400 hours/year	
Pipe Size (in)	Other	Variable Flow/ Variable Speed	Other	Variable Flow/ Variable Speed	Other	Variable Flow/ Variable Speed
2 ½	120	180	85	130	68	110
3	180	270	140	210	110	170
4	350	530	260	400	210	320
5	410	620	310	470	250	370
6	740	1100	570	860	440	680
8	1200	1800	900	1400	700	1100
10	1800	2700	1300	2000	1000	1600
12	2500	3800	1900	2900	1500	2300

1 There are no requirements for pipe sizes smaller than the minimum shown in the table or larger than the maximum shown in the table.

C403.5 Energy recovery.

C403.5.1 Energy recovery ventilation systems. Any system with minimum outside air requirements at design conditions greater than 5,000 cfm or any system where the system's supply airflow rate exceeds the value listed in Tables C403.5.1(1) and C403.5.1(2) based on the climate zone and percentage of outdoor airflow rate at design conditions, shall include an energy recovery system. Table C403.5.1(1) shall be used for all ventilation systems that operate less than 8,000 hours per year, and Table C403.5.1(2) shall be used for all ventilation systems that operate 8,000 hours or more per year. The energy recovery system shall have the

capability to provide a change in the enthalpy of the outdoor air supply of not less than 50 percent of the difference between the outdoor air and return air enthalpies, at design conditions. Where an air economizer is required, the energy recovery system shall include a bypass or controls which permit operation of the economizer as required by Section C403.3. Where a single room or space is supplied by multiple units, the aggregate ventilation (cfm) of those units shall be used in applying this requirement. The return/exhaust air stream temperature for heat recovery device selection shall be 70°F (21°C) at 30 percent relative humidity, or as calculated by the registered design professional.

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

1. Where energy recovery systems are restricted per Section 514 of the *International Mechanical Code* to sensible energy, recovery shall comply with one of the following:

1.1 Kitchen exhaust systems where they comply with Section C403.2.7.1.

1.2 Laboratory fume hood systems where they comply with Exception 2 of Section C403.5.1.

1.3 Other sensible energy recovery systems with the capability to provide a change in dry bulb temperature of the outdoor air supply of not less than 50 percent of the difference between the outdoor air and the return air dry bulb temperatures, at design conditions.

2. Laboratory fume hood systems that include at least one of the following features and also comply with Section C403.2.7.2:

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

2.2 Direct makeup (auxiliary) air supply equal to at least 75 percent of the exhaust rate, heated no warmer than 2°F (1.1°C) above room setpoint, cooled to no cooler than 3°F (1.7°C) below room setpoint, 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 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 exhausting toxic, flammable, paint or corrosive fumes or dust.

6. Cooling energy recovery in Climate Zones 3C, 4C, 5B, 5C, 6B, 7 and 8.

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

8. Multi-zone systems where the supply airflow rate is less than the values specified in Tables C403.5.1(1) and C403.5.1(2) for the corresponding percent of outdoor air. Where a value of NR is listed, energy recovery shall not be required.

9. Systems serving Group R dwelling or sleeping units where the largest source of air exhausted at a single location at the building exterior is less than 25 percent of the design outdoor air flow rate.

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C403.5.2 Condensate systems. On-site steam heating systems shall have condensate water ((~~heat~~)) recovery. On-site includes a system that is located within or adjacent to one or more buildings within the boundary of a contiguous area or campus under one ownership and which serves one or more of those buildings.

Buildings using steam generated off-site with steam heating systems which do not have condensate water recovery shall have condensate water heat recovery.

C403.5.3 Condenser heat recovery. Facilities having food service, meat or deli departments and having 500,000 Btu/h or greater of remote refrigeration condensers shall have condenser waste heat recovery from freezers and coolers and shall use the waste heat for service water heating, space heating or for dehumidification reheat. Facilities having a gross conditioned floor area of 40,000 ft^2 or greater and 1,000,000 Btu/h or greater of remote refrigeration shall have condenser waste heat recovery from freezers and coolers and shall use the waste heat for service water heating, and either for space heating or for dehumidification reheat for maintaining low space humidity. The required heat recovery system shall have the capacity to provide the smaller of:

1. 60 percent of the peak heat rejection load at design conditions; or

2. 50 percent of the sum of the service water heating load plus space heating load.

***

C403.6 Dedicated outdoor air systems (DOAS). (This section is Optional through 6/30/2017; it becomes Prescriptive as of 7/1/2017). For office, retail, education, libraries and fire stations, outdoor air shall be provided to each occupied space by a dedicated outdoor air system (DOAS) which delivers 100 percent outdoor air without requiring operation of the heating and cooling system fans for ventilation air delivery.

Exceptions:

1. Occupied spaces that are not ventilated by a mechanical ventilation system and are only ventilated by a natural ventilation system per Section 402 of the *International Mechanical Code*.

2. High efficiency variable air volume (VAV) systems complying with Section C403.7. This exception shall not be used as a substitution for a DOAS per Section C406.6 or as a modification to the requirements for the Standard Reference Design per Section C407.

3. Spaces that are within building types not covered by Section C403.6 and that qualify as accessory occupancies according to Section 508.2 of the *International Building Code* are not required to comply with this section.

C403.6.1 Energy recovery ventilation with DOAS. The DOAS shall include *energy recovery ventilation* that complies with the minimum energy recovery efficiency and energy recovery bypass requirements, where applicable, of Section C403.5.1.

Exceptions:

1. Occupied spaces under the threshold of Section C403.5 with an average occupant load greater than 25 people per 1000 square feet (93 m^2) of floor area (as established in Table 403.3.1.1 of the *International Mechanical Code*) that include demand control ventilation configured to reduce outdoor air by at least 50% below design minimum ventilation rates when the actual occupancy of the space served by the system is less than the design occupancy.

2. Systems installed for the sole purpose of providing makeup air for systems exhausting toxic, flammable, paint, or corrosive fumes or dust, dryer exhaust, or commercial kitchen hoods used for collecting and removing grease vapors and smoke.

C403.6.2 Heating/cooling system fan controls. Heating and cooling equipment fans, heating and cooling circulation pumps, and terminal unit fans shall cycle off and terminal unit primary cooling air shall be shut off when there is no call for heating or cooling in the zone.

Exception: Fans used for heating and cooling using less than 0.12 watts per cfm may operate when space temperatures are within the setpoint deadband (Section C403.2.4.1.2) to provide destratification and air mixing in the space.

C403.6.3 Impracticality. Where the *code official* determines full compliance with all of the requirements of Section C403.6.1 and C403.6.2 would be impractical, it is permissible to provide an approved alternate means of compliance that achieves a comparable level of energy efficiency. For the purposes of this section, impractical means that an HVAC system complying with Section C403.6 cannot effectively be utilized due to an unusual use or configuration of the building.

C403.7 High efficiency variable air volume (VAV) systems. For HVAC systems subject to the requirements of Section C403.6 but utilizing Exception 2 of that section, a high efficiency VAV system may be provided without a separate parallel DOAS when the system is designed, installed, and configured to comply with all of the following criteria in addition to the applicable requirements of Sections C403.2.11.6 through C403.2.11.8 (this exception shall not be used as a substitution for a DOAS per Section C406.6 or as a modification to the requirements for the Standard Reference Design per Section C407):

1. The VAV systems are provided with airside economizer per Section 403.3 without exceptions.
2. A direct-digital control (DDC) system is provided to control the VAV air handling units and associated terminal units per Section C403.2.4.12 regardless of sizing thresholds of Table C403.2.4.12.1.
3. Multiple-zone VAV systems with a minimum outdoor air requirement of 2,500 CFM (1180 L/s) or greater shall be equipped with a device capable of measuring outdoor airflow intake under all load conditions. The system shall be capable of increasing or reducing the outdoor

airflow intake based on feedback from the VAV terminal units as required by Section C403.4.4.3, without exceptions, and Section C403.2.6.2 demand controlled ventilation.

4. Multiple-zone VAV systems with a minimum outdoor air requirement of 2,500 CFM (1180 L/s) or greater shall be equipped with a device capable of measuring supply airflow to the VAV terminal units under all load conditions.

5. In addition to meeting the zone isolation requirements of C403.2.4.4 a single VAV air handling unit shall not serve more than 50,000 square feet (2323 m2) unless a single floor is greater than 50,000 square feet (2323 m2) in which case the air handler is permitted to serve the entire floor.

6. The primary maximum cooling air for the VAV terminal units serving interior cooling load driven zones shall be sized for a supply air temperature that is a minimum of 5°F greater than the supply air temperature for the exterior zones in cooling.

7. Air terminal units with a minimum primary airflow setpoint of 50% or greater of the maximum primary airflow setpoint shall be sized with an inlet velocity of no greater than 900 feet per minute.

8. DDC systems be designed and configured per the guidelines set by High Performance Sequences of Operation for HVAC Systems (ASHRAE GPC 36, RP-1455).

9. Allowable fan motor horsepower shall not exceed 90% of the allowable HVAC *fan system bhp* (Option 2) as defined by Section C403.2.11.1.

10. All fan powered VAV terminal units (series or parallel) shall be provided with electronically commutated motors. The DDC system shall be configured to vary the speed of the motor as a function of the heating and cooling load in the space. Minimum speed shall not be greater than 66 percent of design airflow required for the greater of heating or cooling operation. Minimum

speed shall be used during periods of low heating and cooling operation and ventilation-only operation.

Exception: For series fan powered terminal units where the volume of primary air required to deliver the ventilation requirements at minimum speed exceeds the air that would be delivered at the speed defined above, the minimum speed setpoint shall be configured to exceed the value required to provide the required ventilation air.

11. Fan-powered VAV terminal units shall only be permitted at perimeter zones with an envelope heating load requirement. All other VAV terminal units shall be single duct terminal units.

12. When in occupied heating or in occupied deadband between heating and cooling all fan powered VAV terminal units shall be configured to reset the primary air supply setpoint, based on the VAV air handling unit outdoor air vent fraction, to the minimum ventilation airflow required per *International Mechanical Code* without utilizing the exceptions 2, 3, or 4 of Section C403.4.4.

13. Spaces that are larger than 150 square feet (14 m^2) and with an occupant load greater than or equal to 25 people per 1000 square feet (93 m^2) of floor area (as established in Table 403.3.1.1 of the *International Mechanical Code*) shall be provided with all of the following features:

13.1 A dedicated VAV terminal unit capable of controlling the space temperature and minimum ventilation shall be provided.

13.2. Demand control ventilation (DCV) shall be provided that utilizes a carbon dioxide sensor to reset the ventilation setpoint of the VAV terminal unit from the design minimum to design maximum ventilation rate as required by Chapter 4 of the *International Mechanical Code*.

13.3. Occupancy sensors shall be provided that are configured to reduce the minimum ventilation rate to zero and setback room temperature setpoints by a minimum of 5°F, for both cooling and heating, when the space is unoccupied.

14. Dedicated server rooms, electronic equipment rooms, telecom rooms, or other similar spaces with cooling loads greater than 5 watts/sf shall be provided with separate, independent HVAC systems to allow the VAV air handlers to turn off during unoccupied hours in the office space and to allow the supply air temperature reset to occur.

Exception: The VAV air handling unit and VAV terminal units may be used for secondary backup cooling when there is a failure of the primary HVAC system.

Additionally, server rooms, electronic equipment rooms, telecom rooms, or other similar spaces shall be provided with airside economizer per Section C403.3 without using the exceptions to Section C403.3.

Exception: Heat recovery per exception 9 of Section C403.3 may be in lieu of airside economizer for the separate, independent HVAC system.

15. HVAC system central heating or cooling plant will include a minimum of one of the following options:

15.1. VAV terminal units with hydronic heating coils connected to systems with hot water generation equipment limited to the following types of equipment: gas-fired hydronic boilers with a thermal efficiency, E_t, of not less than 90 percent, air-to-water heat pumps or heat recovery chillers.

15.2. Chilled water VAV air handing units connected to systems with chilled water generation equipment with IPLV values more than 25 percent higher than the minimum part load efficiencies listed in Table C403.2.3(7), in the appropriate size category, using

the same test procedures. Equipment shall be listed in the appropriate certification program to qualify. The smallest chiller or compressor in the central plant shall not exceed 20% of the total central plant cooling capacity or the chilled water system shall include thermal storage sized for a minimum of 20% of the total central cooling plant capacity.

16. The DDC system shall include a fault detection and diagnostics (FDD) system complying with the following:

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

16.1.1. Outside air.

16.1.2. Supply air.

16.1.3. Return air.

16.2. 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).

16.3. The VAV air handling unit controller shall be configured to provide system status by indicating the following:

16.3.1. Free cooling available.

16.3.2. Economizer enabled.

16.3.3. Compressor enabled.

16.3.4. Heating enabled.

16.3.5. Mixed air low limit cycle active.

16.3.6. The current value of each sensor.

16.4. The VAV air handling 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.

16.5. The VAV air handling unit shall be configured to report faults to a fault management application accessible by day-to-day operating or service personnel or annunciated locally on zone thermostats.

16.6. The VAV terminal unit shall be configured to report if the VAV inlet valve has failed by performing the following diagnostic check at a maximum interval of once a month:

16.6.1 Command VAV terminal unit primary air inlet valve closed and verify that primary airflow goes to zero or other *approved* means to verify that the VAV terminal unit damper actuator and flow ring are operating properly.

16.6.2. Command VAV thermal unit primary air inlet valve to design airflow and verify that unit is controlling to with 10% of design airflow.

16.7. The VAV terminal unit shall be configured to report and trend when the zone is driving the following VAV air handling unit reset sequences. The building operator shall have the capability to exclude zones used in the reset sequences from the DDC control system graphical user interface:

16.7.1. Supply air temperature setpoint reset to lowest supply air temperature setpoint for cooling operation.

16.7.2. Supply air duct static pressure setpoint reset for the highest duct static pressure setpoint allowable.

16.8. The FDD system shall be configured to detect the following faults:

16.8.1. Air temperature sensor failure/fault.

16.8.2. Not economizing when the unit should be economizing.

16.8.3. Economizing when the unit should not be economizing.

16.8.4. Outdoor air or return air damper not modulating.

16.8.5. Excess outdoor air.

16.8.6. VAV terminal unit primary air valve failure.

C403.8 Compressed air and vacuum air. Compressed air and vacuum air systems shall comply with all of the following:

EXCEPTION: Compressed air and vacuum air systems used for medical purposes are exempt from this section.

1. Air Compressors (50-150 PSI), General: Air compressors operating at 50-150 PSI shall comply with the following:

a. All water drains shall be "no loss" drains.

b. Timed unheated desiccant air driers shall not be allowed.

2. Rotary Screw Air Compressors over 10 hp (50-150 PSI): Rotary screw air compressors over 10 hp operating at 50-150 PSI shall not rely on modulation control and shall have one of the following:

a. Receiver capacity greater than three gallons per cfm to allow efficient load/unload control;

b. Variable speed drive controlled air compressor; or

c. Multiple air compressors using a smaller trim-air compressor to trim. The trim compressor shall use variable speed drive control, or shall use load/unload control with greater than three gallon receiver capacity per cfm for the trim air compressor.

C403.9 Commercial food service.

The following types of equipment within the scope of the applicable Energy Star program shall comply with the energy-efficiency and water-efficiency criteria required to achieve the Energy Star label:

a. Commercial fryers: Energy Star Program Requirements for Commercial Fryers.

b. Commercial hot food holding cabinets: Energy Star Program Requirements for Hot Food Holding Cabinets.

c. Commercial steam cookers: Energy Star Program Requirements for Commercial Steam Cookers.

d. Commercial dishwashers: Energy Star Program Requirements for Commercial Dishwashers.

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C404.8 Demand recirculation controls. A water distribution system having one or more recirculation pumps that pump water from a heated-water supply pipe back to the heated-water source through a cold-water supply pipe are not permitted. ((~~shall be a *demand recirculation water system*. Pumps shall have controls that comply with both of the following:~~

~~1. The control shall start the pump upon receiving a signal from the action of a user of a fixture or appliance, sensing the presence of a user of a fixture or sending the flow of hot or tempered water to a fixture fitting or appliance.~~

~~2. The control shall limit the temperature of the water entering the cold water piping to 104°F (40°C).~~))

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C404.11 Energy consumption of pools and permanent spas (Mandatory). The energy consumption of pools and permanent spas shall be controlled by the requirements in Sections C404.11.1 through C404.11.4.

C404.11.1 Heaters. Pool water heaters using electric resistance heating as the primary source of heat are prohibited for pools over 2,000 gallons. Heat pump pool heaters shall have a minimum COP of 4.0 at 50°F db, 44.2°F wb outdoor air and 80°F entering water, determined in accordance with ((~~ASHRAE Standard 146, Method of Testing for Rating Pool Heaters~~)) AHRI Standard 1160, Performance Rating of Heat Pump Pool Heaters. Other pool heating equipment shall comply with the applicable efficiencies in Section C404.2.

The electric power to all heaters shall be controlled by a readily accessible on-off switch that is an integral part of the heater, mounted on the exterior of the heater, or external to and within 3 feet of the heater. Operation of such switch shall be in addition to a circuit breaker for the power to the heater. Gas fired heaters shall not be equipped with constant burning pilot lights.

C404.11.2 Time switches. Time switches or other control methods that can automatically turn off and on heaters and pump motors according to a preset schedule shall be installed for heaters and pump motors. Heaters and pump motors that have built in time switches shall be in compliance with this section.

Exceptions:

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

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C404.14 Conservation of water pumping energy. Pumps for domestic water systems shall comply with Section C403.2.13. Water pressure booster systems shall comply with the

following:

1. One or more pressure sensors shall be used to vary pump speed or to start and stop pumps, or for both purposes. Either the sensor(s) shall be located near the critical fixtures(s) that determine the pressure required, or logic shall be employed that adjusts the setpoint to simulate operation of remote sensors(s).

2. No device shall be installed for the purpose of reducing the pressure of all of the water supplied by any booster system pump or booster system, except for safety devices.

3. No booster system pumps shall operate when there is no service water flow.

***

C405.1 General (mandatory). This section covers lighting system controls, the maximum lighting power for interior and exterior applications, electrical energy consumption, vertical and horizontal transportation systems, and minimum efficiencies for motors and transformers. Receptacles shall be controlled according to Section C405.10. Controlled receptacles and lighting systems shall be commissioned according to Section C405.13. Solar readiness shall be provided according to Section C412.

Exception: Dwelling units within commercial buildings shall not be required to comply with Sections C405.2 through C405.5 provided that they comply with Section R404.1.

C405.2 Lighting controls (Mandatory). Lighting systems shall be provided with controls as specified in Sections C405.2.1 through C405.2.8.

Exception: Except for specific application controls required by Section C405.2.5:

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

5. Luminaire-level lighting controls (LLLC) that control interior lighting. The LLLC luminaire shall be independently configured to:

5.1. Monitor occupant activity to brighten or dim its lighting when occupied or unoccupied, respectively.

5.2. Monitor ambient light (both electric light and daylight) and brighten or dim electric light to maintain desired light level.

5.3. Configuration and reconfiguration of performance parameters, including bright and dim setpoints, time-outs, dimming, fade rates, sensor sensitivity adjustments, and wireless zoning configurations, for each control strategy.

5.4. Meet the operational and commissioning requirements of Sections C405.2.1, C405.2.2, C405.2.3, C405.2.4, and C408.

6. Stairwells and parking garages are not permitted to use wall-mounted manual switches.

C405.2.1 Occupancy sensor controls. Occupancy sensors shall be installed to control lights in the following space types:

1. Classrooms/lecture/training rooms.

2. Conference/ meeting/multipurpose rooms.

3. Copy/print rooms.

4. Lounges.

5. Employee lunch and break rooms.

6. Private offices.

7. Restrooms.

8. Storage rooms.

9. Janitorial closets.

10. Locker rooms.

11. Other spaces 300 square feet (28 m^2) or less that are enclosed by floor-to- ceiling height partitions.

12. Warehouses.

C405.2.1.1 Occupant sensor control function. Occupant sensor controls shall comply with the following:

1. Automatically turn off lights within 30 minutes of all occupants leaving the space. At initial installation, occupancy sensor controls shall be set to turn lights off after 15 minutes unless other thresholds required for safety, security or operational considerations are specifically set out in the approved construction documents.

2. Be manual on or shall be controlled to automatically turn the lighting on to not more than 50 percent power.

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

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

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

occupancy sensor shall control lighting in each aisleway independently, and shall not control lighting beyond the aisleway being controlled by the sensor.

C405.2.2 Time switch controls. Each area of the building that is not provided with occupant sensor controls complying with Section C405.2.1.1 or digital timer switch controls complying with Section C405.2.6 shall be provided with time switch controls complying with Section C405.2.2.1.

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

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

C405.2.2.1 Time switch control function. Each space provided with time switch controls shall also be provided with a manual control for light reduction in accordance with Section C405.2.2.2. Time switch controls shall comply with the following:

1. Have a minimum 7 day clock.
2. Be capable of being set for 7 different day types per week.
3. Incorporate an automatic holiday "shut-off" feature, which turns off all loads for at least 24 hours and then resumes normally scheduled operations.
4. Have program back-up capabilities, which prevent the loss of program and time settings for at least 10 hours, if power is interrupted.
5. Include an override switching device 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~~)) 2,500 square feet (((~~465~~)) 232 m^2).

Exceptions:

1. Within malls, arcades, auditoriums, single tenant retail spaces, industrial facilities, pools, gymnasiums, skating rinks and arenas:

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

1.2. The area controlled by the override switch is permitted to be greater than 5,000 square feet (465 m^2), but shall not be greater 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 100 watts.

2.2. Spaces that use less than 0.6 watts per square foot (6.5 W/m^2).

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

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 at least 50 percent. Lighting reduction shall be achieved by one of the following *approved* methods:

1. Controlling all lamps or luminaires.

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

3. Switching the middle lamp in three-lamp luminaires independently of the outer lamps.

4. Switching each luminaire or each lamp.

Exception: Light reduction controls are not required in daylight zones with *daylight responsive controls* complying with Section C405.2.4.

C405.2.3 Manual controls. Manual controls for lights shall comply with the following:

1. Shall be readily accessible to occupants.

2. Shall be located where the controlled lights are visible, or shall identify the area served by the lights and indicate their status.

3. Where manual controls are required, at least one separate manual control shall be provided for each area enclosed by walls or floor-to-ceiling partitions.

C405.2.4 Daylight responsive controls. Daylight responsive controls complying with Section C405.2.4.1 shall be provided to control the lighting with daylight zones in the following spaces:

1. Sidelight daylight zones as defined in Section C405.2.4.2 with more than two general lighting fixtures within the primary and secondary sidelight daylight zones.

2. Toplight daylight zones as defined in Section C405.2.4.3 with more than two general lighting fixtures within the daylight zone.

Exception: *Daylight responsive controls* are not required for the following:

1. Spaces in health care facilities where patient care is directly provided.

2. Dwelling units and sleeping units.

3. Lighting that is required to have specific application control in accordance with Section ((~~C405.2.4~~)) C405.2.5.

4. Sidelight daylight zones on the first floor above grade in Group A-2 and Group M occupancies where the *fenestration* adjoins a sidewalk or other outdoor pedestrian area,

provided that the light fixtures are controlled separately from the general area lighting.

5. Daylight zones where the total proposed lighting power density is less than 35 percent of the lighting power allowance per Section C405.4.2.

C405.2.4.1 Daylight responsive controls 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 primary sidelight daylight zones shall be controlled independently of lights in secondary sidelight daylight zones in accordance with Section C405.2.4.2.

Exception: Spaces enclosed by walls or ceiling height partitions no more than three general lighting fixtures may have combined daylight zone control of primary and secondary daylight zones provided *uniform illumination* can be achieved.

2. Lights in toplight daylight zones in accordance with Section C405.2.4.3 shall be controlled independently of lights in sidelight daylight zones in accordance with Section C405.2.4.2.

3. Daylight responsive controls within each space shall be configured so that they can be calibrated from within that space by authorized personnel.

4. Calibration mechanisms shall be readily accessible.

5. Daylight responsive controls shall be configured to completely shut off all controlled lights in that zone.

6. Lights in sidelight daylight zones in accordance with Section C405.2.4.2 facing different cardinal orientations (i.e., within 45 degrees of due north, east, south, west) shall be controlled independently of each other.

Exception: Up to two light fixtures in each space are permitted to be controlled together with lighting in a daylight zone facing a different cardinal orientation.

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 m^2) and no more than 60 lineal feet (18.3 m) of façade.

9. Occupant override capability of daylight dimming controls is not permitted, other than a reduction of light output from the level established by the daylighting controls.

10. Be set initially at 30 footcandles (323 lux) or not more than 110 percent of the illuminance level specified on the construction documents.

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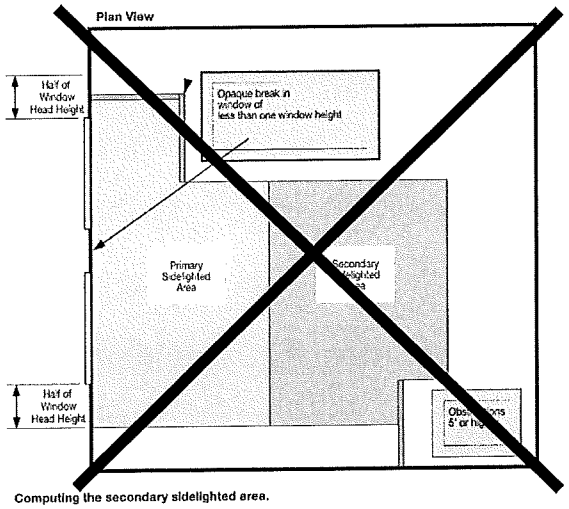
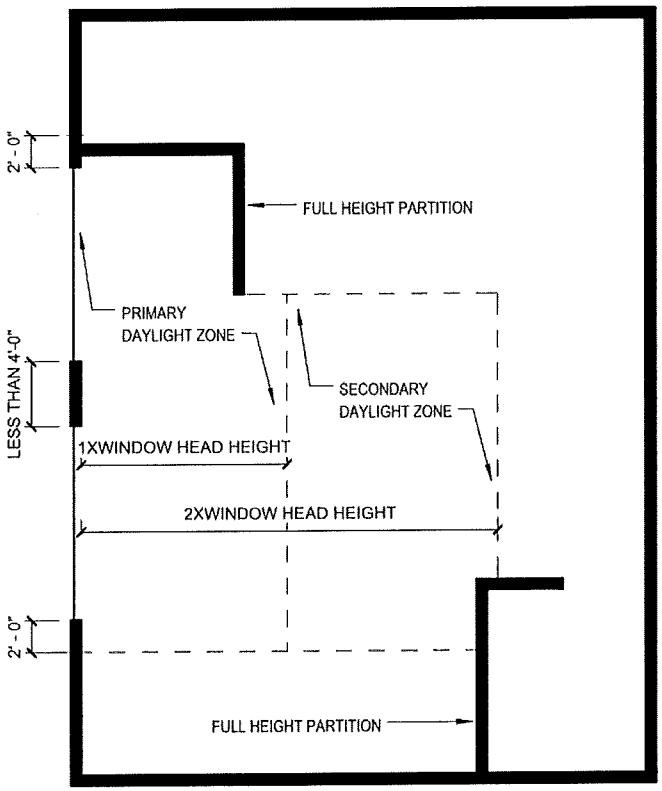
FIGURE C405.2.4.2(1) for 22.700.010

DAYLIGHT ZONE ADJACENT TO FENESTRATION IN A WALL



Computing the secondary sidelighted area.



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C405.2.5 Additional lighting controls. Specific application lighting shall be provided with controls, in addition to controls required by other sections, for the following:

1. Display and accent light shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.

2. Lighting in cases used for display case purposes shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.

3. Hotel and motel sleeping units and guest suites shall have control devices configured to automatically switch off all installed luminaires and switched receptacles within 20 minutes after all occupants leave the room.

Exception: Lighting and switched receptacles controlled by captive key systems.

4. Supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting, shall be automatically shut off whenever that space is unoccupied and shall have a control device integral to the luminaires or be controlled by a wall-mounted control device provided that the control device is readily accessible.

5. Lighting for nonvisual applications, such as plant growth and food warming, shall be controlled by a dedicated control which is independent of the controls for other lighting within the room or space. ((~~Each control zone shall be no greater than the area served by a single luminaire or 4,000 square feet, whichever is larger.~~))

6. Lighting equipment that is for sale or for demonstrations in lighting education shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.

7. Luminaires serving the exit access and providing means of egress illumination required by Section 1006.1 of the *International Building Code*, including luminaires that function as both normal and emergency means of egress illumination shall be controlled by a combination of listed emergency relay and occupancy sensors, or signal from another building control system, that automatically shuts off the lighting when the areas served by that illumination are unoccupied.

Exception: Means of egress illumination serving the exit access that does not exceed 0.02 watts per square foot of building area is exempt from this requirement.

8. Each stairway shall have one or more control devices to automatically reduce lighting power by not less than 50 percent when no occupants have been detected in the stairway for a period not exceeding 15 minutes, and restore lighting to full power when occupants enter the stairway. All portions of stairways shall remain illuminated to meet the requirements of

Seattle Building Code Section 1009 or Code Alternate CA1009.2 when the lighting power is reduced.

9. Lighting in parking garages shall have one or more control devices to automatically reduce lighting power in any one controlled zone by not less than 50 percent when no occupants have been detected in that zone for a period not exceeding 30 minutes, and restore lighting to full power when occupants enter or approach the zone. Each lighting zone controlled by occupancy sensors shall be no larger than 7,200 square feet. Pedestrian occupancy sensors controlling any lighting zone are permitted to be configured to detect pedestrians no more than 30 feet outside of that zone. Vehicle occupancy sensors controlling any lighting zone are permitted to be configured to detect vehicles no more than 60 feet outside of that zone.

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C405.2.7 Exterior lighting controls. Lighting for exterior applications other than emergency lighting that is intended to be automatically off during building operation, lighting specifically required to meet health and life safety requirements or decorative gas lighting systems shall:

1. Be provided with a control that automatically turns off the lighting as a function of available daylight.

2. Where lighting the building façade or landscape, the lighting shall have controls that automatically shut off the lighting ((~~as a function of dawn/dusk and a set opening and closing time.~~)) between midnight or business/facility closing, whichever is later, and 6a.m. or business/facility opening, whichever is earlier.

3. Where not covered in Item 2, the lighting shall have controls configured to automatically reduce the connected lighting power by at least 30 percent from no later than 12 midnight to 6 a.m. or from one hour after business closing to one hour before business opening or during

any period when no activity has been detected for a time of no longer than 15 minutes. All time switches shall be able to retain programming and the time setting during loss of power for a period of at least 10 hours.

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

((~~C405.2.5~~)) **C405.2.8 Area controls.** The maximum lighting power that may be controlled from a single switch or automatic control shall not exceed that which is provided by a 20 ampere circuit loaded to not more than 80 percent. A master control may be installed provided the individual switches retain their capability to function independently. Circuit breakers may not be used as the sole means of switching.

Exception: Areas less than 5 percent of the building footprint for footprints over 100,000 ft^2.

C405.3 Exit signs (Mandatory). Internally illuminated exit signs shall not exceed 5 watts per side.

C405.4 Interior lighting power requirements (Prescriptive). A building complies with this section if its total connected lighting power calculated under Section C405.4.1 is no greater than the interior lighting power calculated under Section C405.4.2.

C405.4.1 Total connected interior lighting power. The total connected interior lighting power shall be determined in accordance with Equation 4-10.

As an option, in areas of the building where all interior lighting equipment is fed from dedicated lighting branch circuits, the total connected interior lighting power is permitted to be calculated as the sum of the capacities of the lighting branch circuits serving those areas. For the purposes of this section, the connected interior lighting power of a 20-ampere circuit is

considered to be 16 amperes, and that of a 15-ampere circuit is 12 amperes. Use of this alternative and the boundaries of the applicable areas shall be clearly documented on the electrical construction documents.

$$TCLP = [SK + LV + LTPB + \text{Other}]$$

(Equation 4-10)

Where:

TCLP = Total connected lighting power (watts)

SL = Labeled wattage of luminaires for screw-in lamps.

LV = Wattage of the transformer supplying low voltage lighting.

TLPB = Wattage of line-voltage lighting tracks and plug-in busways as the specified wattage of the luminaires but at least 50 W/lin. ft., or the wattage limit of the system's circuit breaker, or the wattage limit of other permanent current limiting devices on the system.

Other = The wattage of all other luminaires and lighting, sources not covered above and associated with interior lighting verified by data supplied by the manufacturer or other *approved* sources.

Exceptions:

1. The connected power associated with the following lighting equipment is not included in calculating total connected lighting power.

1.1. Professional sports arena playing field lighting.

1.2. Emergency lighting automatically off during normal building operation.

1.3. Lighting in spaces specifically designed for use by occupants with special lighting needs including the visually impaired and other medical and age-related issues.

1.4. Casino gaming areas.

1.5. General area lighting power in industrial and manufacturing occupancies dedicated to the inspection or quality control of goods and products.

1.6. Lighting in sleeping units, provided that the lighting complies with Section R404.1.

1.7. Mirror lighting in dressing rooms.

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

2.1. Task lighting for medical and dental purposes.

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

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

4. Lighting for photographic processes.

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

6. ((~~Task lighting~~)) Lighting for plant growth or maintenance where the lamp ((~~efficacy is not less than 90 lumens per watt~~)) has a tested photosynthetic photon flux (PPF) per watt of not less than 1.20 micromoles per joule.

7. Advertising signage or directional signage.

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

9. Lighting equipment that is for sale.

10. Lighting demonstration equipment in lighting education facilities.

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

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

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

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

15. Lighting used for aircraft painting.

C405.4.2 Interior lighting power. The total interior lighting power allowance (watts) is determined according to Table C405.4.2(1) using the Building Area Method, or Table C405.4.2(2) using the Space-by-Space Method, for all areas of the building covered in this permit. Dates indicated in the column headers refer to the date that a completed building permit application has been accepted by SDCI.

C405.4.2.1 Building area method. For the Building Area Method, the interior lighting power allowance is the floor area for each building area type listed in Table C405.4.2(1) times the value from Table C405.4.2(1) for that area. For the purposes of this method, an "area" shall be defined as all contiguous spaces that accommodate or are associated with a single building area type as listed in Table C405.4.2(1). Where this method is used to calculate the total interior lighting power for an entire building, each building area type shall be treated as a separate area.

C405.4.2.2 Space-by-space method. For the Space-by-Space Method, the interior lighting power allowance is determined by multiplying the floor area of each space times the value for the space type in Table C405.4.2(2) that most closely represents the proposed use of the space, and then summing the lighting power allowances for all spaces. Tradeoffs among spaces other than covered parking areas are permitted.

Each area enclosed by partitions that are 80 percent of the ceiling height or taller shall be considered a separate space and assigned the appropriate space type from Table C405.4.2(2). If a space has multiple functions where more than one space type is applicable, that space shall be broken up into smaller subspaces, each using their own space type. Any of these subspaces that are smaller in floor area than 20 percent of the enclosed space and less than 1,000 square feet need not be broken out separately.

C405.4.2.2.1 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 for lighting equipment to be installed in sales areas specifically to highlight merchandise. The additional lighting power shall we determined in accordance with Equation 4-11:

Additional interior lighting power allowance = 500 watts + (Retail Area 1 x 0.6 W/ft^2) + (Retail Area 2 x 0.6 W/ft^2) + (Retail Area 3 x 1.4 W/ft^2) + (Retail Area 4 x 2.5 W/ft^2)

(Equation 4-11)

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 requirement is *approved* by the code official.

TABLE C405.4.2(1) for 22.700.010
INTERIOR LIGHTING POWER ALLOWANCES: BUILDING AREA METHOD

Building Area Type	LPD (w/ft²) Before Jan 1 2018	LPD (w/ft²) After Jan 1 2018
Automotive facility	0.64	0.58
Convention center	0.81	0.73
Court house	0.81	0.73
Dining: Bar lounge/leisure	0.79	0.71
Dining: Cafeteria/fast food	0.72	0.65
Dining: Family	0.71	0.64
Dormitory	0.46	0.41
Exercise center	0.67	0.60
Fire station	0.54	0.49
Gymnasium	0.75	0.68
Health care clinic	0.70	0.70
Hospital	0.84	0.84
Hotel	0.70	0.63
Library	0.94	0.85
Manufacturing facility	0.89	0.80
Motion picture theater	0.61	0.55
Multifamily	0.41	0.37
Museum	0.80	0.72
Office	0.66	0.59
Parking garage	0.16	0.14
Penitentiary	0.65	0.59
Performing arts theater	1.00	0.90
Police station	0.70	0.63

Post office	0.70	0.63
Religious building	0.80	0.72
Retail	1.01	0.91
School/university	0.70	0.63
Sports arena	0.62	0.56
Town hall	0.71	0.64
Transportation	0.56	0.50
Warehouse	0.40	0.36
Workshop	0.95	0.90

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TABLE C405.4.2(2) for 22.700.010
INTERIOR LIGHTING POWER ALLOWANCES: SPACE BY SPACE METHOD

COMMON SPACE-BY-SPACE TYPES[a]	**LPD (w/ft²) [d]** **Before Jan 1 2018**	**LPD (w/ft²) [d]** **After Jan 1 2018**
Atrium - First 40 feet in height[e]	((0.02)) 0.024 per ft. ht.	0.024 per ft. ht.
Atrium - Above 40 feet in height[e]	((0.03 + 0.02)) 0.32 + 0.016 per total ft. ht.	0.32 + 0.016 per total ft. ht.
Audience/seating area - Permanent		
In an auditorium	0.50	0.45
In a convention center	0.66	0.59
In a gymnasium	0.34	0.31
In an motion picture theater	0.91	0.82
In a penitentiary	((0.22)) 0.34	0.31
In an performing arts theater	1.94	1.75
In a religious building	1.22	1.10
In a sports arena	0.34	0.31
Otherwise	0.34	0.31
Banking activity area	0.81	0.73
Breakroom (see Lounge/breakroom)		-
Classroom/lecture/training		-
In a penitentiary	1.07	0.96
In an performing arts theater	1.00	0.90
Conference/meeting/multipurpose	0.98	0.88

Copy/print room	0.58	0.52
Corridor		
In a facility for the visually impaired (and not used primarily by the staff)[b]	0.74	0.74
In a hospital	0.63	0.63
In a manufacturing facility	0.33	0.30
Otherwise	0.53	0.48
Courtroom	1.38	1.24
Computer room	1.37	1.23
Dining area		-
In a penitentiary	0.77	0.69
In a facility for the visually impaired (and not used primarily by the staff)[b]	1.52	1.52
In a bar/lounge or leisure dining	0.86	0.77
In a family dining area	0.71	0.64
Otherwise	0.52	0.47
Electrical/mechanical	0.76	0.68
Emergency vehicle garage	0.45	0.41
Food preparation	0.79	0.71
Guest room	0.38	0.34
Laboratory		-
In or as a classrooms	1.02	0.92
Otherwise	1.45	1.31
Laundry/washing area	0.48	0.43
Loading dock, interior	0.38	0.34
Lobby[c]		
In a facility for the visually impaired (and not used primarily by the staff)[b]	1.44	1.44
For an elevator	0.51	0.46
In a hotel	0.85	0.77
In a motion picture theater	0.42	0.38
In a performing arts theater	1.60	1.44
Otherwise	0.72	0.65
Locker room	0.60	0.54
Lounge /breakroom		-
In a health care facility	0.74	0.67

Otherwise	0.58	0.52
Office[f]		-
Enclosed	0.89	0.80
Open plan	0.78	0.70
Parking area, interior	0.15	0.14
Pharmacy area	0.91	0.82
Restroom		
In a facility for the visually impaired (and not used primarily by the staff)[b]	0.97	0.97
Otherwise	0.78	0.70
Sales area	1.27	1.14
Seating area, general	0.43	0.39
~~Stairway (See space containing stairway)~~		-
Stairwell	0.55	0.50
Storage room	0.50	0.45
Vehicular maintenance	0.54	0.49
Workshop	1.27	1.14

BUILDING SPECIFIC SPACE-BY-SPACE TYPES[a]	**LPD (w/ft²)[d] Before Jan 1 2018**	**LPD (w/ft²)[d] After Jan 1 2018**
Automotive - Service/repair		
Convention center - Exhibit space	1.16	1.04
Dormitory living quarters	0.30	0.27
Facility for the visually impaired		-
In a chapel (and not used primarily by the staff)[b]	1.77	1.59
In a recreation room (and not used primarily by the staff)[b]	1.93	1.74
Fire stations		
Engine rooms	0.45	0.45
Sleeping quarters	0.18	0.18
Gymnasium/fitness center		-
In an exercise area	0.58	0.52
In a playing area	0.96	0.86
Health care facility		

In an exam/treatment room	1.33	1.33
In an imaging room	1.06	1.06
In a medical supply room	0.59	0.59
In a nursery	0.70	0.70
In a nurse's station	0.57	0.57
In an operating room	1.51	1.51
In a patient room	0.50	0.50
In a physical therapy room	0.73	0.73
In a recovery room	0.92	0.92
Library[f]		
In a reading area	0.74	0.67
In the stacks	1.37	1.23
Manufacturing facility		-
In a detailed manufacturing area	1.03	0.93
In an equipment room	0.59	0.53
In an extra high bay area (> 50-foot floor-ceiling height)	0.84	0.76
In a high bay area (25 - 50-foot floor-ceiling height)	0.98	0.88
In a low bay area (< 25-foot floor-ceiling height)	0.95	0.86
Museum		-
In a general exhibition area	0.84	0.76
In a restoration room	0.82	0.74
Performing arts theater dressing/fitting room	0.32	0.29
Post office—Sorting area	0.75	0.68
Religious building		-
In a fellowship hall	0.51	0.46
In a worship pulpit/choir area	1.22	1.10
Retail		-
In a dressing/fitting room	0.57	0.51
In a mall concourse	0.88	0.79
Sports arena—Playing area		-
For a Class 1 facility	2.41	2.17
For a Class 2 facility	1.54	1.39
For a Class 3 facility	0.96	0.86
For a Class 4 facility	0.58	0.52

Transportation		
In a baggage/carousel area	0.42	0.38
In an airport concourse	0.29	0.26
At a terminal ticket counter	0.64	0.58
Warehouse—Storage area		-
For medium to bulky palletized items	0.46	0.41
For smaller, hand-carried items	0.76	0.68

Keys for Table C405.4.2(2) for 22.700.010
For SI: 1 foot = 304.8 mm
1 watt per square foot = 11 W/m^2.

Footnotes for Table C405.4.2(2) for 22.700.010
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. For spaces in which lighting is specified to be installed in addition to, and controlled separately from, the general lighting for the purposed of highlighting art or exhibits, provided that the additional lighting power shall not exceed 0.5 W/ft^2 of such spaces.
d. The watts per square foot may be increased by 2 percent per foot of ceiling height above 20 feet, unless specifically directed otherwise by subsequent footnotes.
e. Footnote d may not be used for these occupancy types.
f. The watts per square foot may be increased by 2 percent per foot of ceiling height above 9 feet. G. Footnote d may not be used for these occupancy types.

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

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

C405.5.1 Exterior building grounds lighting. All exterior building grounds luminaires that operate at greater than 100 watts shall have a minimum efficacy of 80 lumens per watt unless

the luminaire is controlled by a motion sensor or qualifies for one of the exceptions under Section C405.5.2.

C405.5.2 Exterior building lighting power. The total exterior lighting power allowance for all exterior building applications is the sum of the base site allowance plus the individual allowances for areas that are to be illuminated and are permitted in Table C405.5.2(2) for the applicable lighting zone. Tradeoffs are allowed only among exterior lighting applications listed in Table C405.5.2(2), Tradable Surfaces section. Parking garage lighting cannot be traded with exterior lighting or with other interior lighting. The lighting zone for the building exterior is determined from Table C405.5.2(1) unless otherwise specified by the local jurisdiction.

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

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

TABLE C405.5.2(1) for 22.700.010 EXTERIOR LIGHTING ZONES	
LIGHTING ZONE	**DESCRIPTION**
1	Developed areas of national parks, state parks, forest land, and rural areas
2	Areas predominantly consisting of residential zoning, neighborhood business districts, light industrial with limited nighttime use and residential mixed use areas
3	All other areas not classified as lighting zone 1, 2 or 4
4 (not used)	((~~High-activity commercial districts in major metropolitan areas as designated by the local land-use planning authority~~))

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C405.5.3 Full cutoff luminaires. For open parking and outdoor areas and roadways, luminaires mounted more than 15 feet above the ground shall have a luminaire light distribution in which zero candela intensity occurs at an angle of 90 degrees above nadir, and all greater angles from nadir.

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C405.9 Vertical and horizontal transportation systems and equipment (Mandatory). Vertical and horizontal transportation systems and equipment shall comply with this section.

C405.9.1 Elevator cabs. For the luminaires in each elevator cab, not including signals and displays, the sum of the lumens divided by the sum of the watts shall be no less than 35 lumens per watt. Ventilation fans in elevators that do not have their own air conditioning system shall not consume more than 0.33 watts/cfm at the maximum rated speed of the fan. Controls shall be provided that will de-energize ventilation fans and lighting systems when the elevator is stopped, unoccupied and with its doors closed for over 15 minutes.

C405.9.2 Escalators and moving walks. Escalators and moving walks shall comply with ASME A17.1/CSA B44 and shall have automatic controls configured to reduce speed to the

minimum permitted speed in accordance with ASME A17.1/CSA B44 or applicable local code when not conveying passengers.

Exception: A power factor controller that reduces operating voltage in response to light loading conditions ((~~may~~)) is permitted to be provided in ((~~place~~)) lieu of the variable speed function.

C405.9.3 Regenerative drive. An escalators designed either for one-way down operation only or for reversible split shall have a variable frequency regenerative drive that supplies electrical energy to the building electrical system when the escalator is loaded with passengers whose combined weight exceeds 750 pounds.

C405.10 Controlled receptacles (Mandatory). 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. ((~~In rooms larger than 200 square feet (19 m^2),~~)) Either split receptacles shall be provided, with the top receptacle(s) controlled, or a controlled receptacle shall be located within ((~~72~~)) 12 inches (((~~1.8~~)) 0.3 m) of each uncontrolled receptacle. Controlled receptacles shall be visibly differentiated from standard receptacles using the standard symbol required by the *Seattle Electrical Code* 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 m^2) 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 m^2).

Exceptions:

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 ((~~72~~)) 12 inches of a controlled receptacle.

2. Within a single modular office workstation, non-controlled receptacles are permitted to be located more than 12 inches, but not more than 72 inches, from the controlled receptacles serving that workstation.

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C405.13 Controlled receptacles and lighting systems commissioning and completion requirements (Mandatory). Controlled receptacles and lighting systems shall be commissioned and completed in accordance with Section C408.

***

C406.2 More efficient HVAC equipment and fan performance. Buildings shall comply with Sections C406.2.1 through C406.2.3.

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 C403.2.3(1) through C403.2.3(9) or a combination thereof.

Exception: Air-to-water heat pumps or heat recovery chillers are also permitted to be utilized for Option C406.2.

C406.2.2 Minimum equipment efficiency. Equipment shall exceed the minimum efficiency requirements listed in Tables C403.2.3(1) through C403.2.3(9) 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. Where exception 1 for Section C411 is also being used, the equipment shall exceed all requirements by 25 percent.

Exception: Equipment that is larger than the maximum capacity range indicated in Tables C403.2.3(1) through C403.2.3(9) shall utilize the values listed for the largest capacity equipment for the associated equipment type shown in the table.

***

C406.4 Enhanced digital lighting controls. Interior lighting shall be located, scheduled and operated in accordance with Section C405.2 and ((~~no~~)) not 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. Each luminaire shall be individually addressed.

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 single daylight responsive control.

4. Luminaires shall be controlled by 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.

6. These control functions shall be commissioned in accordance with Sections C408.1 and C408.3.

C406.5 On-site renewable energy. In addition to the renewable energy required by Section C411 and to renewable energy used to comply with any other requirements of this code, buildings ((~~Buildings~~)) shall be provided with on-site renewable energy systems with a total peak system rating per square foot of conditioned floor area of the building of not less than 0.25 watts (or 0.85 BTU/h) per square foot of conditioned space ((~~the value specified in Table C406.5~~)).

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((~~TABLE C406.5 ON-SITE RENEWABLE ENERGY SYSTEM RATING (PER SQUARE FOOT)~~))		
((~~Building Area Type~~	~~kBTU~~	~~kWh~~
~~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~~))

***

C406.7 Reduced energy use in service water heating. Buildings shall comply with Sections C406.7.1 and C406.7.2.

C406.7.1 Building type. Not less than 90 percent of the 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: Buildings with residential occupancies.
6. Group A-3: Health clubs and spas.
7. Buildings with a service hot water load of 10 percent or more of total building energy loads, as shown with an energy analysis as described in Section C407.

C406.7.2 Load fraction. Not less than 60 percent of the annual building service hot water heating 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 C403.5.4, shall be provided by one or more of the following:

1. Service hot water system delivering heating requirements using heat pump technology with a minimum COP of 3.0.
2. Waste heat recovery from service hot water, heat recovery chillers, building equipment, process equipment, a combined heat and power system, or other *approved* system.
3. Solar water-heating systems, where those systems are in addition to the renewable energy required by Section C411 or renewable energy used to comply with any other requirements of this code.

C406.8 Enhanced envelope performance. The total UA of the building thermal envelope shall be 15 percent lower than the maximum allowable UA for a building of identical configuration and fenestration area in accordance with Section C402.1.5 and Equation 4-2, where UA equals the sum of the *U*-values of each distinct envelope assembly multiplied by the area in square feet of that assembly. Where exception 1 for Section C411 is also being used, the .UA shall be 30 percent lower than the maximum allowable UA.

C406.9 Reduced air ((~~infiltration~~)) leakage. Air ((~~infiltration~~)) leakage shall be verified by whole building pressurization testing conducted in accordance with ASTM E779 or ASTM E1827, or an equivalent method approved by the code official, by an independent third party. The measured air leakage rate of the *building envelope* shall not exceed 0.25 cfm/ft^2 (((~~2.0 L/s•m2~~))) (1.2 L/s•m^2) for Group R occupancy buildings and 0.22 cfm/ft^2 (1.1 L/s•m^2) for all other occupancies under a pressure differential of 0.3 in. water (75 Pa), with the calculated surface area being the sum of the above and below grade *building envelope*. A report that

includes the tested surface area, floor area, air by volume, stories above grade, and leakage rates shall be submitted to the code official and the building owner.

((~~**Exception:** Where the *conditioned floor area* of the building is not less than 250,000 ft^2 (25,000 m^2), air leakage testing shall be permitted to be conducted on representative above grade sections of the building provided the *conditioned floor area* of tested areas is no less than 25 percent of the *conditioned floor area* of the building and are tested in accordance with this section.~~))

SECTION C407

TOTAL BUILDING PERFORMANCE

C407.1 Scope. This section establishes criteria for compliance using total building performance. All systems and loads shall be included in determining the total building performance including, but not limited to: Heating systems, cooling systems, service water heating, fan systems, lighting power, receptacle loads and process loads.

C407.2 Mandatory requirements. Compliance with ((~~this section~~)) Section C407 also requires that the criteria of Sections C402.5, C403.2, C404, ((~~and~~)) C405.2, C405.3, C405.5, C405.6, C405.7, C405.8, C405.9, C405.10, C408, C409, C410 and C412 be met.

The building permit application for projects utilizing this method shall include in one submittal all building and mechanical drawings and all information necessary to verify that the building envelope and mechanical design for the project corresponds with the annual energy analysis. If credit is proposed to be taken for lighting energy savings, then an electrical permit application shall also be submitted and approved prior to the issuance of the building permit. If credit is proposed to be taken for energy savings from other components, then the corresponding permit application (e.g., plumbing, boiler, etc.) shall also be submitted and approved prior to the

building permit application. Otherwise, components of the project that would not be approved as part of a building permit application shall be modeled the same in both the proposed building and the *standard reference design* and shall comply with the requirements of this code.

C407.2.1 Cap on vertical fenestration area. Vertical fenestration area shall not exceed 45 percent of the above-grade wall area.

Exceptions:

1. This cap shall not apply to projects for which the complete building permit application was submitted prior to January 1, 2018.

2. Vertical fenestration area may exceed 45 percent of the above-grade wall area, where the annual energy consumption of the *proposed design* is 0.33 percent lower than that permitted by the selected option in Section C407.3, for each 1 percent increase in vertical fenestration area above 45 percent of the above-grade wall area.

C407.3 Performance-based compliance. Compliance based on total building performance requires that a proposed building (*proposed design*) be shown to have an annual energy consumption based on site energy expressed in Btu and Btu per square foot of *conditioned floor area* that complies with one of the following three options:

1. Is less than or equal to 87 percent of the annual energy consumption of the *standard reference design*.

2. Is less than or equal to 90 percent of the annual energy consumption of the *standard reference design* and the project complies with one additional energy efficiency package option in Section C406. The standard reference design shall include the selected Section C406 additional efficiency package option unless the option selected is DOAS per Section C406.6, in which case the HVAC system used in the standard reference design shall be one

of the following:

2.1. For office, retail, education, libraries and fire stations that comply with the DOAS requirements in Section C403.6 with or without exceptions, the standard reference design shall select the HVAC system per Table C407.5.1(2).

2.2. Other buildings occupancy types that comply with the DOAS requirements in Section C403.6 shall select the standard reference design for the HVAC system from Table C407.5.1(3).

3. Is less than or equal to 93 percent of the annual energy consumption of the standard reference design and the project complies with two additional efficiency package options in Section C406. The standard reference design shall include ((~~the~~)) both selected Section C406 additional efficiency package options, unless one of the options selected is DOAS per Section C406.6, in which case the HVAC system used in the standard reference design shall be one of the following:

3.1 For office, retail, education, libraries and fire stations that comply with the DOAS requirements in Section C403.6 with or without exceptions, the standard reference design shall select the HVAC system per Table C407.5.1(2).

3.2 Other buildings occupancy types that comply with the DOAS requirements in Section C403.6 shall select the standard reference design for the HVAC system from Table C407.5.1(3).

C407.4 Documentation. Documentation verifying that the methods and accuracy of compliance software tools conform to the provisions of this section shall be provided to the *code official.*

C407.4.1 Compliance report. Building permit submittals shall include a report that documents that the *proposed design* has annual energy consumption less than or equal to the annual energy

consumption of the *standard reference design*. The compliance documentation shall include the information listed in Appendix ((~~D~~))E ((~~following information:~~

~~1. Address of the building;~~

~~2. An inspection checklist documenting the building component characteristics of the proposed design as listed in Table C407.5.1(1). The inspection checklist shall show the estimated annual energy consumption for both the standard reference design and the proposed design;~~

~~3. Name of individual completing the compliance report; and~~

~~4. Name and version of the compliance software tool.~~

~~**C407.4.2 Additional documentation.** The *code official* shall be permitted to require the following documents:~~

~~1. Documentation of the building component characteristics of the standard reference design;~~

~~2. Thermal zoning diagrams consisting of floor plans showing the thermal zoning scheme for standard reference design and proposed design;~~

~~3. Input and output report(s) from the energy analysis simulation program containing the complete input and output files, as applicable. The output file shall include energy use totals and energy use by energy source and end-use served, total hours that space conditioning loads are not~~

~~met and any errors or warning messages generated by the simulation tool as applicable;~~

~~4. An explanation of any error or warning messages appearing in the simulation tool output; and~~

~~5. A certification signed by the builder providing the building component characteristics of the proposed design as given in Table C407.5.1(1).~~))

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C407.5.3 Equipment efficiencies. All HVAC equipment in the standard reference design shall be modeled at the minimum efficiency levels, both part load and full load, in accordance with Section C403.2.3. Chillers shall use Path A efficiencies as shown in Table C403.2.3(7). Where efficiency ratings include supply fan energy, the efficiency rating shall be adjusted to remove the supply fan energy. For Baseline Systems HVAC Systems 3, 4, 6, 8, 9, 10 and 11, calculate the minimum COPnfcooling and COPnfheating using the equation for the applicable performance rating as indicated in Tables C403.2.3(1) through C403.2.3(3). Where a full- and part-load efficiency rating is provided in Tables C403.2.3(1) through C403.2.3(3), use Equation 4-12.

(Equation 4-12)

$$COPnfcooling = 7.84E\text{-}8 \times EER \times Q + 0.338 \times EER$$

$$COPnfcooling = -0.0076 \times SEER^2 + 0.3796 \times SEER$$

$$COPnfheating = 1.48E\text{-}7 \times COP_{47} \times Q + 1.062 \times COP_{47}$$

(applies to heat pump heating efficiency only)

$$COPnfheating = -0.0296 \times HSPF^2 + 0.7134 \times HSPF$$

Where:

COPnfcooling = The packaged HVAC equipment cooling energy efficiency

COPnfheating = The packaged HVAC equipment heating energy efficiency

Q = The AHRI-rated cooling capacity in Btu/h.

COP_{47} = Heat pump COP with 47°F db outdoor air rating condition in Tables C403.2.3(1) through C403.2.3(3).

EER, SEER, COP and HSPF shall be at AHRI test conditions. Fan energy shall be modeled separately according to Table C407.5.1(1).

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TABLE C407.5.1(1) for 22.700.010
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Building Component Characteristics	Standard Reference Design	Proposed Design
Space use classification	Same as proposed	The space use classification shall be chosen in accordance with Table C405.4.2 for all areas of the building covered by this permit. Where the space use classification for a building is not known, the building shall be categorized as an office building.
Roofs	Type: Insulation entirely above deck Gross area: Same as proposed *U*-factor: From Table C402.1.4 Solar absorptance: 0.75 Emittance: 0.90	As proposed As proposed As proposed As proposed As proposed
Walls, above-grade	Type: Mass wall if proposed wall is mass; otherwise steel-framed wall Gross area: Same as proposed *U*-factor: From Table C402.1.4 Solar absorptance: 0.75 Emittance: 0.90	As proposed As proposed As proposed As proposed As proposed
Walls, below-grade	Type: Mass wall Gross area: Same as proposed U-Factor: From Table C402.1.4 with insulation layer on interior side of walls	As proposed As proposed As proposed
Floors, above-grade	Type: Joist/framed floor Gross area: Same as proposed *U*-factor: From Table C402.1.4	As proposed As proposed As proposed

Floors, slab-on-grade	Type: Unheated *F*-factor: From Table C402.1.4	As proposed As proposed
Opaque Doors	Type: Swinging Area: Same as proposed *U*-factor: From Table C402.1.4	As proposed As proposed As proposed
Vertical Fenestration Other than opaque doors	Area 1. The proposed vertical fenestration area; where the proposed vertical fenestration area is less than 30 percent of above-grade wall area. 2. 30 percent of above-grade wall area; where the proposed vertical fenestration area is 30 percent or more of the above-grade wall area. *U*-factor: From Table C402.4 for the same framing material as proposed SHGC: From Table C402.4 except that for climates with no requirement (NR) SHGC = 0.40 shall be used External shading and PF: None	As proposed As proposed As proposed As proposed
Skylights	Area 1. The proposed skylight area; where the proposed skylight area is less than 3 percent of gross area of roof assembly. 2. 3 percent of gross area of roof assembly; where the proposed skylight area is 3 percent or more of gross area of roof assembly. *U*-factor: From Table C402.4	As proposed As proposed
	SHGC: From Table C402.4 except that for climates with no requirement (NR) SHGC .= 0.40 shall be used	As proposed

Air Leakage	For infiltration, the air leakage rate as determined below shall be modeled at 100% when the building fan system is off, and at 25% when the building fan system is on, unless otherwise approved by the building official for unusually pressurized buildings. Per PNNL Report 18898, Infiltration Modeling Guidelines for Commercial Building Energy Analysis, the building air leakage rates as determined in accordance with Section C402.5.1.2 at 0.30 in. w.g. (75 Pa) shall be converted for modeling in annual energy analysis programs by being multiplied by 0.112 unless other multipliers are approved by the building official (e.g., a tested air leakage of 0.40 cfm/ft^2 of total building envelope area at 0.30 in. w.g. (75 Pa) would be calculated at 0.045 cfm/ft^2 of building envelope area). The calculated infiltration rate shall be normalized to the input required by the modeling software.	The Proposed Design air-leakage shall be the same as the Standard Design.
Lighting, interior	The interior lighting power shall be determined in accordance with Table C405.4.2. As proposed when the occupancy of the space is not known. Automatic lighting controls (e.g., programmable controls or automatic controls for daylight utilization) shall be modeled in *the standard reference design* as required by Section C405.	As proposed; where the occupancy of the space is not known, the lighting power density shall be based on the space classification as offices in Table C405.4.2(1).
Lighting, exterior	The lighting power shall be determined in accordance with Table C405.5.2(2). Areas and dimensions of tradable and nontradable surfaces shall be the same as proposed.	As proposed

Internal gains	Same as proposed	Receptacle, motor and process loads shall be modeled and estimated based on the space use classification. All end-use load components within and associated with the building shall be modeled to include, but not be limited to, the following: Exhaust fans, parking garage ventilation fans, exterior building lighting, swimming pool heaters and pumps, elevators, escalators, refrigeration equipment and cooking equipment.
Schedules	Same as proposed	Operating schedules shall include hourly profiles for daily operation and shall account for variations between weekdays, weekends, holidays and any seasonal operation. Schedules shall model the time-dependent variations in occupancy, illumination, receptacle loads, thermostat settings, mechanical ventilation, HVAC equipment availability, service hot water usage and any process loads. The schedules shall be typical of the proposed building type as determined by the designer and approved by the jurisdiction.
Building Component Characteristics	**Standard Reference Design**	**Proposed Design**
Outdoor airflow rates	Same as proposed, or no higher than those allowed by Section C403.2.6 (without exception 1), whichever is less. Demand Control Ventilation: Shall be modeled as required by Section ((~~C403.6~~)) C403.2.6.2 including reduction to the minimum ventilation rate when unoccupied.	As proposed, in accordance with Section C403.2.6. As proposed
Heating systems	Fuel type: Same as proposed design	As proposed

	Equipment type[a]: From Tables C407.5.1(2), C407.5.1(3) and C407.5.1(4)	As proposed
	Efficiency: From Tables C403.2.3(1)C, C403.2.3(2), C403.2.3(3), C403.2.3(4) and C403.2.3(5)	As proposed
	Preheat coils: For HVAC system numbers 1 through 4, a preheat coil shall be modeled controlled to a fixed setpoint 20°F less than the design room heating temperature setpoint.	
	Capacity[b]: Sized proportionally to the capacities in the proposed design based on sizing runs, i.e., the ratio between the capacities used in the annual simulations and the capacities determined by the sizing runs shall be the same for both the proposed design and *standard reference design*, and shall be established such that no smaller number of unmet heating load hours and no larger heating capacity safety factors are provided than in the proposed design.	As proposed
	Weather conditions used in sizing runs to determine *standard reference design* equipment capacities may be based either on hourly historical weather files containing typical peak conditions or on design days developed using 99.6% heating design temperatures and 1% dry-bulb and 1% wet-bulb cooling design temperatures.	
Cooling systems	Fuel type: Same as proposed design	As proposed
	Equipment type[c]: From Tables C407.5.1(2), C407.5.1(3) and C407.5.1(4)	As proposed
	Efficiency: From Tables C403.2.3(1), C403.2.3(2) and C403.2.3(3). Chillers shall use Path A efficiency.	As proposed

	Capacity[b]: Sized proportionally to the capacities in the proposed design based on sizing runs, i.e., the ratio between the capacities used in the annual simulations and the capacities determined by the sizing runs shall be the same for both the proposed design and standard reference design, and shall be established such that no smaller number of unmet cooling load hours and no larger cooling capacity safety factors are provided than in the proposed design.	As proposed
	Economizer[d]: ((~~Same as proposed, in~~)) In accordance with Section C403.3. The high-limit shutoff shall be a dry-bulb switch with a setpoint as determined by Table C403.3.3.3.	As proposed
Energy recovery	*Standard reference design* systems shall be modeled where required in Section C403.5.	As proposed
Fan systems	Airflow rate: System design supply airflow rates for the *standard reference design* shall be based on a supply-air-to-room-air temperature difference of 20°F or the required ventilation air or makeup air, whichever is greater. If return or relief fans are specified in the proposed design, the *standard reference design* shall also be modeled with fans serving the same functions and sized for the *standard reference design* system supply fan air quantity less the minimum outdoor air, or 90% of the supply fan air quantity, whichever is larger.	As proposed

	Motor brake horsepower: System fan electrical power for supply, return, exhaust, and relief (excluding power to fan-powered VAV boxes) shall be calculated using the following formulas: For systems 5, 6, 7, 8 and 10 in Table C407.5.1(4), Pfan = $CFM_S \times 0.3$ For all other systems, including DOAS, Pfan = bhp × 746/Fan Motor Efficiency Where: Pfan = Electric power to fan motor (watts) bhp = Brake horsepower of *standard reference design* fan motor from Table ((~~C403.2.12.1(1)~~)) C403.2.11.1(1) – Option 2 Fan motor .= The efficiency from Tables C405.8(1) through C405.8(4) for the efficiency of the next motor size greater than the bhp using the enclosed motor at 1800 rpm CFM_S = The *standard reference design* system maximum design supply fan airflow rate in cfm ((~~DOAS fan power shall be calculated separately from the brake horsepower allowance.~~)) Fan efficiency, including that of fractional horsepower fans, shall conform to the requirements of Section C405.8.	As proposed
On-site renewable energy	No on-site renewable energy shall be modeled in the standard reference design, except that required by Section C411, without the exceptions.	As proposed.

Shading from adjacent structures/terrain	Same as proposed.	For the standard reference design and the proposed building, shading by permanent structures and terrain shall be taken into account for computing energy consumption whether or not these features are located on the building site. A permanent fixture is one that is likely to remain for the life of the proposed design.
Service water heating	Fuel type: Same as proposed Efficiency: From Table C404.2 and per Section C404.2.1 Capacity: Same as proposed Demand: Same as proposed Where no service water hot water system exists or is specified in the proposed design, no service hot water heating shall be modeled.	As proposed As proposed Service hot-water energy consumption shall be calculated explicitly based upon the volume of service hot water required and the entering makeup water and the leaving service hot water temperatures. Entering (municipal cold) water temperatures shall be ((~~estimated based upon the location~~)) specified using the following monthly temperature schedule (in degrees Fahrenheit): J-54, F-53, M-54, A-56, M-59, J-62, J-64, A-65, S-65, O-63, N-60, D-57. Leaving temperatures shall be based upon the end-use requirements. Service water loads and usage shall be the same for both the *standard reference design* and the proposed design and shall be documented by the calculation procedures recommended by the manufacturer's specifications or generally accepted engineering methods. As proposed

	Drain water heat recovery: Not required.	As proposed. Drain water heat recovery modeling shall take into account manufacturer's rated efficiencies per ((~~C404.9~~)) C404.10, quantity of connected drains, the proportional flow rates between the waste stream and the preheated stream. Reductions in service water heating energy use for drain water heat recovery shall be demonstrated by calculations.

a. Where no heating system exists or has been specified, the heating system shall be modeled as fossil fuel. The system characteristics shall be identical in both the standard reference design and proposed design.
b. The ratio between the capacities used in the annual simulations and the capacities determined by sizing runs shall be the same for both the standard reference design and proposed design.
c. Where no cooling system exists or no cooling system has been specified, the cooling system shall be modeled as an air-cooled single-zone system, one unit per thermal zone. The system characteristics shall be identical in both the standard reference design and proposed design.
d. If an economizer is required in accordance with Section C403.3 and where no economizer exists or is specified in the proposed design, then an air economizer shall be provided in the standard reference design in accordance with Section C403.3.

1

TABLE C407.5.1(2) for 22.700.010
HVAC SYSTEMS MAP FOR BUILDINGS GOVERNED BY SECTION C403.6[d]

CONDENSER COOLING SOURCE[a]	HEATING SYSTEM CLASSIFICATION[b]	STANDARD REFERENCE DESIGN HVAC SYSTEM TYPE~~c~~	
		((~~Single-zone Residential System~~	~~All Other~~))
Water/ground	Electric resistance	((~~System 5~~	System 5
	Heat pump	~~System 6~~	System 6
	Fossil fuel	~~System 7~~	System 7
Air/none	Electric resistance	~~System 8~~	System 9
	Heat pump	~~System 8~~	System 9
	Fossil fuel	~~System 10~~))	System 11

a. Select "water/ground" if the proposed design system condenser is water or evaporatively cooled; select "air/none" if the condenser is air cooled. Closed-circuit dry coolers shall be considered air cooled. Systems utilizing district cooling shall be treated as if the condenser water type were "water." If no mechanical cooling is specified or the mechanical cooling system in the proposed design does not require heat rejection, the system shall be treated as if the condenser water type were "Air." For proposed designs with ground-source or groundwater-source heat pumps, the standard reference design HVAC system shall be water-source heat pump (System 6).

b. Systems utilizing district heating (steam or hot water) or district cooling and systems with no heating capability shall be treated as if the heating system type were "fossil fuel" for the purpose of Standard Reference Design HVAC system selection. Otherwise, select the path that corresponds to the proposed design heat source: Electric resistance, heat pump (including air source and water source), or fuel fired. For systems with mixed fuel heating sources, the system or systems that use the secondary heating source type (the one with the smallest total installed output capacity for the spaces served by the system) shall be modeled identically in the standard reference design and the primary heating source type shall be used to determine *standard reference design* HVAC system type.

c. (Reserved) ((~~Select the *standard reference design* HVAC system category: The system under "single-zone residential system" shall be selected if the HVAC system in the proposed design is a single-zone system and serves a residential space. The system under "all other" shall be selected for all other cases.~~))

d. This table covers those building types required by Section C403.6 to install Dedicated Outdoor Air Systems: office, retail, education, libraries and fire stations.

TABLE C407.5.1(3) for 22.700.010
HVAC SYSTEMS MAP

CONDENSER COOLING SOURCE[a]	HEATING SYSTEM CLASSIFICATION[b]	STANDARD REFERENCE DESIGN HVAC SYSTEM TYPE[c]		
		Single-zone Residential System (Groups R-2, R-3)	Single-zone Nonresidential System (Other occupancies)	All Other
Water/ground	Electric resistance	System 5	System 5	System 1
	Heat pump	System 6	System 6	System 6
	Fossil fuel	System 7	System 7	System 2
Air/none	Electric resistance	System 8	System 9	System 3
	Heat pump	System 8	System 9	System 3
	Fossil fuel	System 10	System 11	System 4

a. Select "water/ground" if the proposed design system condenser is water or evaporatively cooled; select "air/none" if the condenser is air cooled. Closed-circuit dry coolers shall be considered air cooled. Systems utilizing district cooling shall be treated as if the condenser water type were "water." If no mechanical cooling is specified or the mechanical cooling system in the proposed design does not require heat rejection, the system shall be treated as if the condenser water type were "Air." For proposed designs with ground-source or groundwater-source heat pumps, the standard reference design HVAC system shall be water-source heat pump (System 6).

b. Select the path that corresponds to the proposed design heat source: electric resistance, heat pump (including air source and water source), or fuel fired. Systems utilizing district heating (steam or hot water) and systems with no heating capability shall be treated as if the heating system type were "fossil fuel." For systems with mixed fuel heating sources, the system or systems that use the secondary heating source type (the one with the smallest total installed output capacity for the spaces served by the system) shall be modeled identically in the standard reference design and the primary heating source type shall be used to determine *standard* reference design HVAC system type.

c. Select the standard reference design HVAC system category: The system under "single-zone residential system" shall be selected if the HVAC system in the proposed design is a single-zone system and serves a residential space. The system under "single-zone nonresidential system" shall be selected if the HVAC system in the proposed design is a single-zone system and serves other than residential spaces. The system under "all other" shall be selected for all other cases.

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TABLE C407.5.1(4) for 22.700.010
SPECIFICATIONS FOR THE STANDARD REFERENCE DESIGN HVAC SYSTEM DESCRIPTIONS

SYSTEM NO.	SYSTEM TYPE	FAN CONTROL	COOLING TYPE	HEATING TYPE Column A[m]	HEATING TYPE Column B[n]

1	Variable air volume with parallel fan-powered boxes[a]	VAV[d]	Chilled water[e]	Electric resistance	Hot water with electric heat pump[o]
2	Variable air volume with reheat[b]	VAV[d]	Chilled water[e]	Hot water fossil fuel boiler[f]	Hot water with electric heat pump[o]
3	Packaged variable air volume with parallel fan-powered boxes[a]	VAV[d]	Direct expansion[c]	Electric resistance	Hot water with electric heat pump[o]
4	Packaged variable air volume with reheat[b]	VAV[d]	Direct expansion[c]	Hot water fossil fuel boiler[f]	Hot water with electric heat pump[o]
5[k]	Two-pipe fan coil	Constant volume[i, j]	Chilled water[e]	Electric resistance	Hot water with electric heat pump[o]
6[k]	Water-source heat pump	Constant volume[i, j]	Direct expansion[c]	Electric heat pump and boiler[g]	Electric heat pump and boiler[g]
7[k]	Four-pipe fan coil	Constant volume[i, j]	Chilled water[e]	Hot water fossil fuel boiler[f]	Hot water with electric heat pump[o]
8[k]	Packaged terminal heat pump	Constant volume[i, j]	Direct expansion[c]	Electric heat pump[h]	Electric heat pump[h]
9[k]	Packaged rooftop heat pump	Constant volume[i, j]	Direct expansion[c]	Electric heat pump[h]	Electric heat pump[h]
10[k]	Packaged terminal air conditioner	Constant volume[i, j]	Direct expansion	Hot water fossil fuel boiler[f]	Hot water with electric heat pump[o]
11[k]	Packaged rooftop air conditioner	Constant volume[i, j]	Direct expansion	Fossil fuel furnace	Hot water with electric heat pump[o]

Keys for Table C407.5.1(4) for 22.700.010
For SI: 1 foot = 304.8 mm, 1 cfm/ft2 = 0.0004719
1 Btu/h = 0.293/W, °C = [(°F) -32/1.8].

Footnotes for Table C407.5.1(4) for 22.700.010

a. VAV with parallel boxes: Fans in parallel VAV fan-powered boxes shall be sized for 50 percent of the peak design flow rate and shall be modeled with 0.35 W/cfm fan power. Minimum volume setpoints for fan-powered boxes shall be equal to the minimum rate for the space required for ventilation consistent with Section C403.4.4, Exception 4. Supply air temperature shall be reset based on zone demand. Design airflow rates shall be sized for the maximum reset supply air temperature. The air temperature for cooling shall be reset higher by 5°F under the minimum cooling load conditions.

b. VAV with reheat: Minimum volume setpoints for VAV reheat boxes shall be 0.4 cfm/ft^2 of floor area. Supply air temperature shall be reset based on zone demand. Design airflow rates shall be sized for the maximum reset supply air temperature. The air temperature for cooling shall be reset higher by 5°F under the minimum cooling conditions.

c. Direct expansion: The fuel type for the cooling system shall match that of the cooling system in the proposed design.

d. VAV: When the proposed design system has a supply, return or relief fan motor horsepower (hp) requiring variable flow controls as required by Section C403.2.11.5, the corresponding fan in the VAV system of the standard reference design shall be modeled assuming a variable speed drive. For smaller fans, a forward-curved centrifugal fan with inlet vanes shall be modeled. If the proposed design's system has a direct digital control system at the zone level, static pressure setpoint reset based on zone requirements in accordance with Section C403.4.1 shall be modeled.

e. Chilled water: For systems using purchased chilled water, the chillers are not explicitly modeled. Otherwise, the standard reference design's chiller plant shall be modeled with chillers having the number as indicated in Table C407.5.1(5) as a function of standard reference building chiller plant load and type as indicated in Table C407.5.1(6) as a function of individual chiller load. Where chiller fuel source is mixed, the system in the standard reference design shall have chillers with the same fuel types and with capacities having the same proportional capacity as the proposed design's chillers for each fuel type. Chilled water supply temperature shall be modeled at 44°F design supply temperature and 56°F return temperature. Piping losses shall not be modeled in either building model. Chilled water supply water temperature shall be reset in accordance with Section C403.4.2.4. Pump system power for each pumping system shall be the same as the proposed design; if the proposed design has no chilled water pumps, the standard reference design pump power shall be 22 W/gpm (equal to a pump operating against a 75-foot head, 65-percent combined impeller and motor efficiency). The chilled water system shall be modeled as primary-only variable flow with flow maintained at the design rate through each chiller using a bypass. Chilled water pumps shall be modeled as riding the pump curve or with variable-speed drives when required in Section C403.4.2.4. The heat rejection device shall be an axial fan cooling tower with variable speed fans if required in Section C403.4.3. Condenser water design supply temperature shall be 85°F or 10°F approach to design wet-bulb temperature, whichever is lower, with a design temperature rise of 10°F. The tower shall be controlled to maintain a 70°F leaving water temperature where weather permits, floating up to leaving water temperature at design conditions. Pump system power for each pumping system shall be the same as the proposed design; if the proposed design has no condenser water pumps, the standard reference design pump power shall be 19 W/gpm (equal to a pump operating against a 60-foot head, 60-percent combined impeller and motor efficiency). Each chiller shall be modeled with separate condenser water and chilled water pumps interlocked to operate with the associated chiller.

f. Fossil fuel boiler: For systems using purchased hot water or steam, the boilers are not explicitly modeled. Otherwise, the boiler plant shall use the same fuel as the proposed design and shall be natural draft. The standard reference design boiler plant shall be

modeled with a single boiler if the standard reference design plant load is 600,000 Btu/h and less and with two equally sized boilers for plant capacities exceeding 600,000 Btu/h. Boilers shall be staged as required by the load. Hot water supply temperature shall be modeled at 180°F design supply temperature and 130°F return temperature. Piping losses shall not be modeled in either building model. Hot water supply water temperature shall be reset in accordance with Section C403.4.2.4. Pump system power for each pumping system shall be the same as the proposed design; if the proposed design has no hot water pumps, the standard reference design pump power shall be 19 W/gpm (equal to a pump operating against a 60-foot head, 60-percent combined impeller and motor efficiency). The hot water system shall be modeled as primary only with continuous variable flow. Hot water pumps shall be modeled as riding the pump curve or with variable speed drives when required by Section C403.4.2.4.

g. Electric heat pump and boiler: Water-source heat pumps shall be connected to a common heat pump water loop controlled to maintain temperatures between 60°F and 90°F. Heat rejection from the loop shall be provided by an axial fan closed-circuit evaporative fluid cooler with variable speed fans if required in Section C403.4.2.1 or Section C403.2.13. Heat addition to the loop shall be provided by a boiler that uses the same fuel as the proposed design and shall be natural draft. If no boilers exist in the proposed design, the standard reference building boilers shall be fossil fuel. The standard reference design boiler plant shall be modeled with a single boiler if the standard reference design plant load is 600,000 Btu/h or less and with two equally sized boilers for plant capacities exceeding 600,000 Btu/h. Boilers shall be staged as required by the load. Piping losses shall not be modeled in either building model. Pump system power shall be the same as the proposed design; if the proposed design has no pumps, the standard reference design pump power shall be 22 W/gpm, which is equal to a pump operating against a 75-foot head, with a 65-percent combined impeller and motor efficiency. Loop flow shall be variable with flow shutoff at each heat pump when its compressor cycles off as required by Section C403.4.2.3. Loop pumps shall be modeled as riding the pump curve or with variable speed drives when required by Section C403.4.2.4.

h. Electric heat pump: Electric air-source heat pumps shall be modeled with electric auxiliary heat and an outdoor air thermostat. The system shall be controlled to energize auxiliary heat only when outdoor air temperature is less than 40°F. The air-source heat pump shall be modeled to continue to operate while auxiliary heat is energized. The air-source heat pump shall be modeled to operate down to a minimum outdoor air temperature of 35°F for System No. 8 or 0°F for System No. 9. If the Proposed Design utilizes the same system type as the Standard Design (PTHP or PSZ-HP), the Proposed Design shall be modeled with the same minimum outdoor air temperature for heat pump operation as the Standard Design. For temperatures below the stated minimum outdoor air temperatures, the electric auxiliary heat shall be controlled to provide the full heating load.

i. Constant volume: For building types governed by Section C403.6, fans shall be controlled to cycle with load, i.e., fan operation cycled on calls for heating and cooling. If the fan is modeled as cycling and the fan energy is included in the energy efficiency rating of the equipment, fan energy shall ((~~not be modeled explicitly~~)) be modeled per C407.5.3.

For all other buildings, fans shall be controlled in the same manner as in the proposed design, i.e., fan operation whenever the space is occupied or fan operation cycled on calls for heating and cooling. If the ((~~man~~)) fan is modeled as cycling and the fan energy is included in the energy efficiency rating of the equipment, fan energy shall ((~~not be modeled explicitly~~)) be modeled per C407.5.3.

j. Fan speed control: Fans shall operate as one- or two-speed as required by Section C403.2.11.5, regardless of the fan speed control used in the proposed building.

k. Outside air: For building types governed by Section C403.6, outside air shall be supplied by a separate dedicated outside air system (DOAS) operating in parallel with terminal equipment. The terminal equipment fan system cycle calls for heating and cooling. DOAS shall include an Energy Recovery Ventilation System with a minimum effectiveness in accordance with Section C403.5.

l. (reserved)

m. Heating type Column A: Used for buildings with area-weighted average fenestration U-values that comply with Column A of Table C402.4, or buildings that comply with exception 1 to Section C402.4.

n. Heating type Column B: Used for buildings with area-weighted average fenestration U-values that do not comply with the values in Column A of Table C402.4, and that do not comply with exception 1 to Section C402.4.

o. Air-to-water Heat pump: For systems using purchased hot water or steam, the heat pumps are not explicitly modeled. The standard reference design heat pump plant shall be modeled with a single air-to-water heat pump and an auxiliary electric boiler. The heat pump capacity shall be equal to 50% of the building's heating load at design conditions, and modeled such that 100% of the design capacity is available under all conditions. The heat pump energy consumption shall be modeled such that coefficient of performance (COP) only varies as a function of outdoor air temperature, per the following: 20°F & less: COP=2.0, 30°F: COP=2.25, 40°F: COP=2.5, 50°F: COP= 3.0, 60°F & greater: COP=3.5. The heating plant equipment shall be staged such that the heat pump is used first to meet the heating load, with the auxiliary electric boiler only used when the plant load exceeds the heat pump capacity. Hot water supply temperature shall be modeled at 120°F design supply temperature and 105°F return temperature. Piping losses shall not be modeled in either building model. Hot water supply water temperature shall be reset in accordance with Section C403.4.2.4. Pump system power for each pumping system shall be the same as the proposed design; if the proposed design has no hot water pumps, the standard reference design pump power shall be 19 W/GPM (equal to a pump operating against a 60-foot head, 60-percent combined impeller and motor efficiency). The hot water system shall be modeled as primary only with continuous variable flow. Hot water pumps shall be modeled as riding the pump curve or with variable speed drives when required by Section C403.4.2.4.

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C408.1 General. A building commissioning process led by a *certified commissioning professional* shall be completed for mechanical systems in Section C403, service water heating systems in Section C404, ((~~electrical power~~)) controlled receptacles and lighting systems in Section C405, ((~~and~~)) energy metering in Section C409, and refrigeration in Section C410.

Exception: Buildings, or portions thereof, which are exempt from Sections C408.2 through C408.6 may be excluded from the commissioning process.

C408.1.1 Commissioning in construction documents. 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.

C408.1.2 Commissioning plan. A commissioning plan shall be developed by the project's *certified commissioning professional* and shall outline the organization, schedule, allocation of resources, and documentation requirements of the commissioning process. Items 1 through 4 shall be included with the construction documents, and items 5 through 8 shall be submitted prior to the first mechanical inspection. For projects where no mechanical inspection is required, items 5 through 8 shall be submitted prior to the first electrical inspection.

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. Roles and responsibilities of the commissioning team, including statement of qualifications of the *certified commissioning professional*.
3. A schedule of activities including systems testing and balancing, functional performance testing, and verification of the building documentation requirements in Section C103.6.

4. Where the *certified commissioning professional* is an employee of one of the registered design professionals of record or an employee or subcontractor of the project contractor, an In-House Commissioning Disclosure and Conflict Management Plan shall be submitted with the commissioning plan. This plan shall disclose the *certified commissioning professional's* contractual relationship with other team members and provide a conflict management plan demonstrating that the *certified commissioning professional* is free to identify any issues discovered and report directly to the owner.

5. A listing of the specific equipment, appliances or systems to be tested and a description of the tests to be performed.

6. Functions to be tested.

7. Conditions under which the test will be performed.

8. Measurable criteria for performance.

C408.1.3 Final commissioning report. A final commissioning report shall be completed and certified by the *certified commissioning professional* and delivered to the building owner or owner's authorized agent. The report shall be organized with mechanical, lighting, controlled receptacles, service water heating and metering findings in separate sections to allow independent review. The report shall record the activities and results of the commissioning process and be developed from the final commissioning plan with all of its attached appendices. The report shall include:

1. Results of functional performance tests.

2. Disposition of deficiencies found during testing, including details of corrective measures used or proposed.

3. Functional performance test procedures used during the commissioning process including measurable criteria for test acceptance, provided herein for repeatability.

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

C408.1.4. Commissioning process completion requirements. Prior to the final mechanical, plumbing and electrical inspections or obtaining a certificate of occupancy, the *certified commissioning professional* ((~~or approved agency~~)) shall provide evidence of systems commissioning and completion in accordance with the provisions of this section. Copies of all documentation shall be given to the owner and made available to the code official upon request in accordance with Section C408.1.4.3.

C408.1.4.1 Commissioning progress report for code compliance. A ((~~preliminary~~)) report of commissioning test procedures and results shall be completed and certified by the *certified commissioning professional* ((~~or approved agency~~)) and provided to the building owner or owner's authorized agent. The report shall be organized with mechanical, lighting, service water heating and metering findings in separate sections to allow independent review. The report shall be identified as "((~~Preliminary~~)) Commissioning Report" and shall identify:

1. Itemization of deficiencies found during testing required by this code 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, with anticipated date of completion.

3. Climatic conditions required for performance of the deferred tests.

4. Status of the project's record documents, manuals and systems operation training with respect to requirements in Section C103.6.

5. List and description of any deferred tests which cannot be completed at the time of report preparation because of climatic conditions, including anticipated date of completion, climatic conditions required for performance of the deferred tests, including timeframe for completion and parties to be involved, in checklist format.

6. List and description of any unresolved deficiencies found in the course of the commissioning work or incomplete commissioning tasks, in checklist format.

7. A copy of a Commissioning Permit issued for the completion and resolution of items identified in the lists required by Items 5 and 6 above. The permit shall stipulate that all such work shall be completed within one year of issuance of the certificate of occupancy.

Exception. If there are no deferred tests, unresolved deficiencies or incomplete tasks to be listed under Items 5 and 6, the Commissioning Permit is not required.

8. Completed Commissioning Compliance Checklist (Figure C408.1.4.2).

5. Other information required by the code official.

C408.1.4.2 Acceptance of report. Buildings, or portions thereof, shall not be considered acceptable for a final inspection pursuant to Section C104.2 until the code official has received a letter of transmittal from the building owner acknowledging that the building owner or owner's authorized agent has received the ((~~Preliminary~~)) Commissioning Report. Completion of the Commissioning Compliance Checklist (Figure C408.1.4.2) is deemed to satisfy this requirement.

C408.1.4.3 Copy of report. The code official shall be permitted to require that a copy of the ((~~Preliminary~~)) Commissioning Report be made available for review by the code official.

Informative Note: An *approved* Commissioning Compliance Checklist is available on the SDCI Seattle Energy Code web site, to replace the state code checklist that is stricken below.

((~~FIGURE C408.1.4.2~~

~~COMMISSIONING COMPLIANCE CHECKLIST~~

~~**Project Information**~~	~~**Project Name:**~~
	~~**Project Address:**~~
	~~**Certified Commissioning Professional:**~~
	~~**Certifying Body:**~~
~~**Commissioning Plan**~~ ~~(Section C408.1.2)~~	☐ ~~**Commissioning Plan was used during construction**~~
~~**Commissioned Systems**~~ ~~(Section C408.2, C408.3, C408.4 and C408.6)~~	☐ ~~**Mechanical Systems were included in the Commissioning Process** (Section C408.2)~~ • ~~Building mechanical systems have been tested to demonstrate the installation and operation of components, systems and system-to-system interfacing relationships in accordance with approved plans and specifications~~ ☐~~There are unresolved deficiencies with the mechanical systems. These are described in the Preliminary Commissioning Report submitted to the owner. The following items are not in compliance with the energy code.~~
~~**Functional Testing**~~ ~~(Section C408.2, C408.3, C408.4 and C408.6)~~	☐ ~~**Electrical Power or Lighting Systems were included in the Commissioning Process** (Section C408.4)~~ ~~Electrical Power and automatic lighting controls have been tested to demonstrate the installation and operation of components, systems and system-to-system interfacing relationships in accordance with approved plans and specifications.~~ ☐ ~~There are unresolved deficiencies with the Electrical Power Controlled receptacles and/or automatic lighting controls. These are described in the Preliminary Commissioning Report submitted to the owner. The following items are not in compliance with the energy code.~~
	☐ ~~**Service Water Heating Systems were included in the Commissioning Process** (Section C408.((5))4)~~ ~~Service water heating systems have been tested to demonstrate that control devices, components, equipment and systems are calibrated, adjusted and operate in accordance with approved plans and specifications.~~ ☐ ~~There are unresolved deficiencies with the service water heating systems. These are described in the Preliminary Commissioning Report submitted to the owner. The following items are not in compliance with the energy code:~~
	☐ ~~**Additional Systems included in the Commissioning Process** (Section C408.5)~~

	☐ There are unresolved deficiencies with systems required by Section C406 or Section C407. These are described in the Preliminary Commissioning Report submitted to the owner. The following items are not in compliance with the energy code:
	☐ **Metering Systems were included in the Commissioning Process** (Section C408.6) ☐ There are unresolved deficiencies with the metering system. These are described in the Preliminary Commissioning Report submitted to the owner. The following items are not in compliance with the energy code:
Supporting Documents (Section C103.6)	☐ **Manuals, record documents and training have been completed or are scheduled** ☐ System documentation has been provided to the owner or scheduled date: _____ ☐ Record documents have been submitted to owner or scheduled date: _____ ☐ Training has been completed or scheduled date: _____
Preliminary Commissioning Report (Section C408.1.4.1)	☐ **Preliminary Commissioning Report submitted to Owner and includes items below:** ☐ Itemization of deficiencies found during testing that are part of the energy code and that have not been corrected at the time of report preparation ☐ Deferred tests, which cannot be performed at the time of report preparation, with anticipated date of completion ☐ Status of the project's record documents, manuals and systems operation training with respect to requirements in Section C103.6
Certification	☐ I hereby certify that all requirements for Commissioning have been completed in accordance with the Washington State Seattle Energy Code, including all items above. _____ _____ Building Owner or Owner's Representative _____ Date))

C408.2 Mechanical and refrigeration systems commissioning. Mechanical equipment and controls subject to Section C403 and Section C410 shall be included in the commissioning process required by Section C408.1. ((The commissioning process shall minimally include all energy code requirements for which the code states that equipment or controls shall "be capable of" or "configured to" perform specific functions.)) The configuration and function of

mechanical systems required by this code shall be tested and shall comply with Section C408.2. Walk-in coolers, walk-in freezers, refrigerated warehouse coolers, and refrigerated warehouse freezers shall comply with Section C408.2.

EXCEPTION: Mechanical systems are exempt from the commissioning process where the building's total mechanical equipment capacity is less than 240,000 Btu/h cooling capacity and less than 300,000 Btu/h heating capacity.

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C408.3 ((~~Electrical power~~)) Controlled receptacles and lighting systems commissioning. ((~~Electrical power~~)) Controlled receptacles and lighting systems subject to Section C405 shall be included in the commissioning process required by Section C408.1. ((~~The commissioning process shall minimally include all energy code requirements for which the code requires specific daylight responsive controls, "control functions," and where the code states that equipment shall be "configured to" perform specific functions.~~)) The configuration and function of controlled receptacles and lighting control systems required by this code shall be tested and shall comply with Section C408.3.1.

EXCEPTION: Lighting control systems and controlled receptacles are exempt from the commissioning process in buildings where:

1. The total installed lighting load is less than 20 kW; and
2. Where the lighting load controlled by occupancy sensors or automatic daylighting controls is less than 10 kW.

C408.3.1 Functional testing. Prior to passing final inspection, the *certified commissioning professional* shall provide evidence that the controlled receptacles and 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. Written procedures which clearly describe the individual systematic test procedures, the expected systems' response or acceptance criteria for each procedure, the actual response or findings, and any pertinent discussion shall be followed. Functional testing shall comply with Section C408.3.1.1 through C408.3.1.3. for the applicable control type.

C408.3.1.1 Occupant sensor controls. Where occupancy sensors are provided for lighting and controlled receptacles, the following procedures shall be performed:

1. Certify that the occupancy sensor has been located and aimed in accordance with manufacturer recommendations.

2. For projects with seven or fewer occupancy sensors, each sensor shall be tested. For projects with more than seven occupancy sensors, testing shall be done for each unique combination of sensor type and space geometry. Where multiples of each unique combination of sensor type and space geometry are provided, no fewer than the greater of one or 10 percent of each combination shall be tested unless the code official or design professional requires a higher percentage to be tested. Where 30 percent or more of the tested controls fail, all remaining identical combinations shall be tested.

3. For each occupancy sensor to be tested, verify the following:

3.1. Where occupancy sensors include status indicators, verify correct operation.

3.2. The controlled lights and receptacles turn off or down to the permitted level within the required time.

3.3. For auto-on occupancy sensors, the lights turn on to the permitted level within the required time.

3.4. For manual on sensors, the lights turn on only when manually activated.

3.5. The controlled lights and receptacles are not incorrectly turned on by movement in adjacent areas or by HVAC operation.

C408.3.1.2 Time switch controls. Where automatic time switches are provided for lighting and controlled receptacles, the following procedures shall be performed:

1. Confirm that the automatic time switch control is programmed with accurate weekday, weekend and holiday schedules, and set-up and preference program settings.

2. Provide documentation to the owner of automatic time switch programming, including weekday, weekend, holiday schedules and set-up and preference program settings.

3. Verify the correct time and date in the time switch.

4. Verify that any battery backup is installed and energized.

5. Verify that the override time limit is set to not more than two hours.

6. Simulate occupied conditions. Verify and document the following:

6.1. All lights can be turned on and off by their respective area control switch.

6.2. The switch only operates lighting in the enclosed space in which the switch is located.

7. Simulate unoccupied condition. Verify the following:

7.1. All nonexempt lighting and controlled receptacles ((~~turns~~)) turn off.

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

8. Additional testing as specified by the *certified commissioning professional*.

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

1. All control devices have been properly located, field-calibrated and set for accurate setpoints and threshold light levels.

2. Daylight controlled lighting loads adjusted to light level setpoints in response to available daylight.

3. The locations of calibration adjustment equipment are readily accessible only to authorized personnel.

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

C408.4 Service water heating systems commissioning requirements. Service water heating equipment and controls subject to Section C404 shall be included in the commissioning process required by Section C408.1. ((~~The commissioning process shall minimally include all energy code requirements for which the code states that equipment or controls shall "be capable of" or "configured to" perform specific functions.~~)) The configuration and function of service water heating systems required by this code shall be tested and shall comply with Section C408.4.

Exception: Service water heating systems are exempt from the commissioning process in buildings where the largest service water heating system capacity is less than 200,000 Btu/h (58.6 W) and where there are no pools or permanent spas.

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C408.5 Systems installed to meet Section C406 or C407. Equipment, components, controls or configuration settings for mechanical, service water heating, ((~~electrical power or~~)) controlled receptacles and lighting systems which are included in the project to comply with Section C406 or C407 shall be included in the commissioning process required by Section C408.1.

C408.6 Metering system commissioning. Energy metering systems required by Section C409 shall comply with Section C408.6 and be included in the commissioning process required by Section C408.1. The configuration and function of metering and monitoring systems required by this code shall be tested. ((~~The commissioning process shall include all energy metering equipment and controls required by Section C409.~~))

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SECTION C409

ENERGY METERING AND ENERGY CONSUMPTION MANAGEMENT

C409.1 General. New buildings and additions with a gross conditioned floor area over ((~~50,000~~)) 20,000 square feet shall comply with Section C409. Buildings shall be equipped to measure, monitor, record and display energy consumption data for each energy source and end use category per the provisions of this section, to enable effective energy management. For Group R-2 ((~~multi-family~~)) buildings, the floor area of dwelling units and sleeping units shall be excluded from the total conditioned floor area for the purposes of determining the 20,000 square foot threshold. Alterations and additions to existing buildings shall conform to Section C506.

Exceptions:

1. Tenant spaces smaller than ((~~50,000~~)) 20,000 square feet within buildings if the tenant space has its own utility service and utility meters.
2. Buildings in which there is no gross conditioned floor area over ((~~25,000~~)) 10,000 square

feet, including building common area, that is served by its own utility services and meters.

C409.1.1 Alternate metering methods. Where approved by the building official, energy use metering systems may differ from those required by this section, provided that they are permanently installed and that the source energy measurement, end use category energy measurement, data storage and data display have similar accuracy to and are at least as effective in communicating actionable energy use information to the building management and users, as those required by this section.

C409.1.2 Conversion factor. Any threshold stated in kW or kVA shall include the equivalent BTU/h heating and cooling capacity of installed equipment at a conversion factor of 3,412 Btu per kW or 2,730 Btu per kVA ((~~at 50 percent demand~~)).

C409.2 Energy source metering. Buildings shall have a meter at each energy source. For each energy supply source listed in Section C409.2.1 through C409.2.4, meters shall collect data for the whole building or for each separately metered portion of the building where not exempted by the exceptions to Section C409.1.

Exceptions:

1. Energy source metering is not required where end use metering for an energy source accounts for all usage of that energy type within a building, and the data acquisition system accurately totals the energy delivered to the building or separately metered portion of the building.

2. Solid fuels such as coal, firewood or wood pellets that are delivered via mobile transportation do not require metering.

C409.2.1 Electrical energy. This category shall include all electrical energy supplied to the building and its associated site, including site lighting, parking, recreational facilities, and other areas that serve the building and its occupants.

EXCEPTION: Where site lighting and other exterior non-building electrical loads are served by an electrical service and meter that are separate from the building service and meter, the metering data from those loads is permitted to be either combined with the building's electrical service load data or delivered to a separate data acquisition system.

C409.2.2 Gas and liquid fuel supply energy. This category shall include all natural gas, fuel oil, propane and other gas or liquid fuel energy supplied to the building and site.

C409.2.3 District energy. This category shall include all net energy extracted from district steam systems, district chilled water loops, district hot water systems, or other energy sources serving multiple buildings.

C409.2.4 Site-generated renewable energy. This category shall include all net energy generated from on-site solar, wind, geothermal, tidal or other natural sources, and waste heat reclaimed from sewers or other off-site sources.

C409.3 End-use metering. Meters shall be provided to collect energy use data for each end-use category listed in Sections C409.3.1 through ((~~C409.3.2~~)) C409.3.6. These meters shall collect data for the whole building or for each separately metered portion of the building where not exempted by the exception to Section C409.1. Multiple meters may be used for any end-use category, provided that the data acquisition system totals all of the energy used by that category. Not more than 10 percent of the total connected load of any of the end-use metering categories C409.3.1 through C409.3.5 is permitted to be excluded from that end-use data collection. Not more than 10 percent of the total connected load of any of the end-use metering categories

C409.3.1 through C409.3.5 is permitted to consist of loads not part of that category. Multiple meters may be used for any end-use category, provided that the data acquisition system totals all of the energy used by that category. Full-floor tenant space sub-metering data shall be provided to the tenant in accordance with Section C409.3.6, and the data shall not be required to be included in other end-use categories.

Exceptions:

1. HVAC and water heating equipment serving only an individual dwelling unit or sleeping unit does not require end-use metering.

2. Separate metering is not required for fire pumps, stairwell pressurization fans or other life safety systems that operate only during testing or emergency.

3. End use metering is not required for individual tenant spaces not exceeding 2,500 square feet in floor area when a dedicated source meter meeting the requirements of Section C409.4.1 is provided for the tenant space.

4. Healthcare facilities with loads in excess of 150 kVA are permitted to have submetering that measures electrical energy usage in accordance with the normal and essential electrical systems identified in Article 517 of the Seattle Electrical Code, except that submetering is required for the following load categories:

4.1. HVAC system energy use per the requirements of Section C409.3.1.

4.2. Water heating energy use per the requirements of Section C409.3.2.

4.3. Process load system energy per the requirements of Section C409.3.5 for each significant facility not used in direct patient care, including but not limited to food service, laundry and sterile processing facilities, where the total connected load of that facility exceeds 100 kVA.

5. End-use metering is not required for electrical circuits serving only sleeping rooms and guest

suites within Group R-1 occupancies. This exception does not apply to common areas or to equipment serving multiple sleeping rooms.

C409.3.1 HVAC system energy use. This category shall include all energy including electrical, gas, liquid fuel, district steam and district chilled water that is used by boilers, chillers, pumps, fans and other equipment used to provide space heating, space cooling, dehumidification and ventilation to the building, but not including energy that serves process loads, water heating or miscellaneous loads as defined in Section C409.3. Multiple HVAC energy sources, such as gas, electric and steam, are not required to be summed together.

Exceptions:

This category shall not be required to include electrical energy consumed by:

1. ((~~All~~)) 120 volt equipment.

2. An HVAC branch circuit where the total MCA of equipment served equates to less than 10 kVA. ((~~208/120 volt equipment in a building where the main service is 480/277 volt power.~~))

3. Individual fans or pumps that are not on a VFD. ((~~Electrical energy fed through variable frequency drives that are connected to the energy metering data acquisition center.~~))

C409.3.2 Water heating energy use. This category shall include all energy used for heating of domestic and service hot water, but not energy used for space heating.

Exception: Water heating energy use less than 50 ((~~kW~~)) kVA does not require end-use metering.

C409.3.3 Lighting system energy use. This category shall include all energy used by interior and exterior lighting, including lighting in parking structures and lots, but not including plug-in task lighting.

C409.3.4 Plug load system energy use. This category shall include all energy used by appliances, computers, plugged-in task lighting, and other equipment and devices, but not including vertical transportation equipment or equipment covered by other end-use metering categories listed in C409.3. In a building where the main service is 480/277 volt, each 208/120 volt panel is permitted to be assumed to serve only plug load for the purpose of Section C409, unless it serves nonresidential refrigeration or cooking equipment.

Exception: Where the total connected load of all plug load circuits is less than 50 kVA, end-use metering is not required.

C409.3.5 Process load system energy use. This category shall include all energy used by any non-building process load, including but not limited to nonresidential refrigeration and cooking equipment, laundry equipment, industrial equipment and stage lighting.

Exception: Where process load energy use is less than 50 kVA, end-use metering is not required.

C409.3.6 Full-floor tenant space electrical sub-metering. In a multi-tenant building, where more than 90 percent of the leasable area of a floor is occupied by a single tenant, an electrical energy use display shall be provided to the tenant in accordance with the requirements of Section C409.4.3. Electrical loads from areas outside of the tenant space or from equipment that serves areas outside of the tenant space shall not be included in the tenant space sub-metering. A single display is permitted to serve multiple floors occupied by the same tenant.

C409.4 Measurement devices, data acquisition system and energy display.

C409.4.1 Meters. Meters and other measurement devices required by this section shall have local displays or be configured to automatically communicate energy data to a data acquisition system. Source meters may be any digital-type meters. Current sensors or flow meters are

allowed for end use metering, provided that they have an accuracy of +/- 5%. All required metering systems and equipment shall provide at least hourly data that is fully integrated into the data acquisition and display system per the requirements of Section C409.

C409.4.2 Data acquisition system. The data acquisition system shall store the data from the required meters and other sensing devices for a minimum of 36 months. For each energy supply and end use category required by C409.2 and C409.3, it shall provide real-time energy consumption data and logged data for any hour, day, month or year.

C409.4.3 Energy display. For each building subject to Section C409.2 and C409.3, either a readily accessible and visible display, or a web page or other electronic document accessible to building management or to a third-party energy data analysis service shall be provided in the building accessible by building operation and management personnel. The display shall graphically provide the current energy consumption rate for each whole building energy source, plus each end use category, as well as the ((~~average~~)) total and ((~~peak~~)) maximum hourly consumption values for any day, week, month or year.

The display shall be capable of and configured to graphically display the energy use data for any source or end use category or any combination of sources and end uses for any selected daily, weekly, monthly or annual time period, and to view the selected time period simultaneously with another selected time period or a reference benchmark time period. The display shall be capable of weather-normalizing data in the comparison time periods, and facilitate display of energy use trends and identification of anomalies.

C409.4.4 Commissioning. The entire system shall be commissioned in accordance with Section ((~~C408~~)) C408.6. Deficiencies found during testing shall be corrected and retested and

the commissioning report shall be updated to confirm that the entire metering and data acquisition and display system is fully functional.

((~~**C409.5 Existing buildings that were constructed subject to the requirements of this section.** Where new or replacement systems or equipment are installed in an existing building that was constructed subject to the requirements of this section, metering shall be provided for such new or replacement systems or equipment so that their energy use is included in the corresponding end-use category defined in Section C409.2. This includes systems or equipment added in conjunction with additions or alterations to existing buildings.~~

~~**C506.1.1 Small existing buildings.** Metering and data acquisition systems shall be provided for additions over 25,000 square feet to buildings that were constructed in accordance with the requirements of sections C409.2 and C409.3.~~))

Informative Note: Section C409.5 relating to existing buildings is relocated to Section C506.1.

SECTION C410

REFRIGERATION SYSTEM REQUIREMENTS

C410.1 General (prescriptive). Walk-in coolers, walk-in freezers, refrigerated warehouse coolers, refrigerated warehouse freezers, and refrigerated display cases shall comply with this Section.

C410.1.1 Refrigeration equipment performance. Refrigeration equipment shall have an energy use in kWh/day not greater than the values of Tables ((~~C410.2(1) and C410.2(2)~~)) C410.1.1(1) and C410.1.1(2) when tested and rated in accordance with AHRI Standard 1200. The energy use shall be verified through certification under an approved certification program or, where a certification program does not exist, the energy use shall be supported by data furnished by the equipment manufacturer.

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C410.2 Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers. *Refrigerated warehouse coolers* and *refrigerated warehouse freezers* shall comply with this section and shall comply with Section C402, using the *R*-values or *U*-values listed in this section. Section C402.1.5 component performance alternative may be used if *approved* by the code official. *Walk-in coolers* and *walk-in freezers* that are not either site assembled or site constructed shall comply with the following:

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

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

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

3. *Walk-in coolers* and *refrigerated warehouse coolers* shall contain wall, ceiling, and door insulation of not less than R-25 or have wall, ceiling and door assembly *U*-factors no greater than *U*-0.039. *Walk-in freezers* and *refrigerated warehouse freezers* shall contain wall, ceiling and door insulation of not less than R-32 or have wall, ceiling and door assembly *U*-factors no greater than *U*-0.030.

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

4. The floor of *walk-in freezers* shall contain floor insulation of not less than R-28 or have a floor assembly *U*-factor no greater than *U*-0.035.

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

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

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

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

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

10. Where antisweat heater controls are provided, they shall 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 either use light sources with an efficacy of not less than 40 lumens per watt, including ballast losses, or shall use light sources with an efficacy of not less than 40 lumens per watt, including ballast losses, in conjunction with a device that turns off the lights within 15 minutes when the space is not occupied.

12. Evaporator fans in refrigerated warehouses shall be variable speed, and the speed shall be controlled in response to space conditions.

EXCEPTION. Evaporators served by a single compressor without unloading

capability.

C410.2.1 Walk-in coolers and walk-in freezers. Site-assembled or site-constructed *walk-in coolers* and *walk-in freezers* shall comply with the following:

1. Automatic door closers shall be provided that fully close walk-in doors that have been closed to within 1 inch (25 mm) of full closure.

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

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

3. Walk-in cooler walls, ceilings and doors shall be provided with insulation having a thermal resistance of not less than R-25 or have wall, ceiling and door assembly *U*-factors no greater than *U*-0.039. *Walk-in freezers* walls, ceilings and doors shall be provided with insulation having a thermal resistance of not less than R-32 or have wall, ceiling, door and slab assembly *U*-factors no greater than *U*-0.030.

Exception: Insulation is not required for glazed portions of doors or at structural members associated with the walls, ceiling or door frame.

4. The floor of *walk-in freezers* shall be provided with insulation having a thermal resistance of not less than R-28 or have a floor assembly *U*-factor no greater than *U*-0.035.

5. Transparent reach-in doors for and windows in opaque *walk-in freezer* doors shall be provided with triple-pane glass having the interstitial spaces filled with inert gas or provided with heat-reflective treated glass.

6. Transparent reach-in doors, walk-in doors ((~~for~~)) and windows in opaque *walk-in cooler* doors shall be double-pane heat-reflective treated glass having the interstitial space gas filled.

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

8. Condenser fan motors that are less than 1 hp (0.746 kW) in capacity shall be of the electronically commutated or permanent split capacitor-type or shall be 3-phase motors.

Exception: Fan motors in *walk-in coolers* and *walk-in freezers* combined in a single enclosure greater than 3,000 square feet (279 m2) in floor area are exempt.

9. Antisweat heaters that are not provided with antisweat heater controls shall have a total door rail, glass and frame heater power draw not greater than 7.1 W/ft2 (76 W/m2) of door opening for *walk-in freezers*, and not greater than 3.0 W/ft2 (32 W/m2) of door opening for *walk-in coolers*.

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

C410.2.2 Refrigerated display cases. Site-assembled or site-constructed refrigerated display cases shall comply with the following:

1. Lighting and glass doors in refrigerated display cases shall be controlled by one of the following:

1.1. Time switch controls to turn off lights during nonbusiness hours. Timed overrides for display cases shall turn the lights on for up to 1 hour and shall automatically time out to turn the lights off.

1.2. Motion sensor controls on each display case section that reduce lighting power by at least 50 percent within 3 minutes after the area within the sensor range is vacated.

2. Low-temperature display cases shall incorporate temperature-based defrost termination control with a time-limit default. The defrost cycle shall terminate first on an upper temperature limit breach and second upon a time limit breach.

3. Antisweat heater controls shall 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.

C410.3 Refrigeration systems. Refrigerated display cases, *walk-in coolers* or *walk-in freezers* that are served by remote ((~~compressor~~)) compressors and remote condensers not located in a *condensing unit*, shall comply with Sections ((~~C410.4.1 and C410.4.2~~)) C410.3.1, C410.3.2 and C403.5.3.

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

C410.3.1 Condensers serving refrigeration systems. Fan-powered condensers shall comply with the following:

1. The design *saturated condensing temperatures* for air-cooled condensers shall not exceed the design dry-bulb temperature plus 10°F (5.6°C) for low-*temperature refrigeration systems*, and the design dry-bulb temperature plus 15°F (8°C) for *medium temperature refrigeration systems* where the *saturated condensing temperature* for blend refrigerants shall be determined using the average of liquid and vapor temperatures as converted from the condenser drain pressure.

2. Condenser fan motors that are less than 1 hp (0.75 kW) shall use electronically commutated motors, permanent split-capacitor-type motors or 3-phase motors.

3. Condenser fans for air-cooled condensers, evaporatively cooled condensers, air- or water-cooled fluid coolers or cooling towers shall reduce fan motor demand to not more than 30 percent of design wattage at 50 percent of design air volume, and incorporate one of the following continuous variable speed fan control approaches:

3.1. Refrigeration system condenser control for air-cooled condensers shall use variable setpoint control logic to reset the condensing temperature setpoint in response to ambient dry-bulb temperature.

3.2. Refrigeration system condenser control for evaporatively cooled condensers shall use variable setpoint control logic to reset the condensing temperature setpoint in response to ambient wet-bulb temperature.

4. Multiple fan condensers shall be controlled in unison.

5. The minimum condensing temperature setpoint shall be not greater than 70°F (21°C).

C410.3.2 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 subcooled liquid temperature shall be controlled at a maximum temperature setpoint of 50°F (10°C) at the exit of the subcooler using either compressor economizer (interstage) ports or a separate compressor suction group operating at a saturated suction temperature of 18°F (-7.8°C) or higher.

2.1. Insulation for liquid lines with a fluid operating temperature less than 60°F (15.6°C) shall comply with Table ((~~C403.2.10~~)) C403.2.9.

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

4. Compressor systems utilized in refrigerated warehouses shall conform to the following:

4.1. Compressors shall be designed to operate at a minimum condensing temperature of 70°F or less.

4.2. The compressor speed of a screw compressor greater than 50 hp shall be controllable in response to the refrigeration load or the input power to the compressor shall be controlled to be less than or equal to 60 percent of full load input power when operated at 50 percent of full refrigeration capacity.

EXCEPTION. Refrigeration plants with more than one dedicated compressor per suction group.

Section C411

Renewable energy

C411.1 On-site renewable energy systems. Each new building or addition larger than 5,000 square feet of gross conditioned floor area shall include a renewable energy generation system consisting of at least 70 Watts rated peak photovoltaic energy production, or 240 BTU of annual solar water heating energy production, per 1,000 square feet of conditioned space or fraction thereof. For buildings over 5 stories in height, the conditioned area for this calculation shall be based on the conditioned area of the largest 5 above-grade stories in the building. Renewable energy used to comply with this section shall be in addition to any renewable energy used to comply with other provisions of this code. This system is permitted to be mounted either within the allocated *solar zone* required by Section C412.1, or elsewhere on the building or site.

Exceptions.

1. Higher-efficiency mechanical equipment is permitted to be provided in lieu of on-site renewable energy systems, where the capacity-weighted equipment efficiency for the total capacity of the space heating and space cooling equipment is a minimum of 1.10 times the corresponding minimum efficiency in Tables C403.2.3(1) through C403.2.3(9) for both part load and full load. For the purposes of this calculation, the efficiency of water-cooled chillers shall be defined as the inverse of the corresponding minimum efficiency listed in Table C403.2.3(7) in units of kW/ton. All factors used in the calculation shall first be converted to like units. The minimum efficiency for this exception shall be in excess of that required elsewhere in this code, including Section C403.3 (economizers). The Standard Reference Design determination from Section C407 shall be used to establish the baseline case for determination of the 1.10 factor.
2. Additional heat recovery systems beyond those required by this code are permitted to be provided in lieu of on-site renewable energy systems, where the calculated net annual

energy savings from the heat recovery systems exceed the calculated net annual energy production of the required on-site renewable energy systems. Acceptable heat recovery systems include but are not limited to: exhaust air heat recovery in excess of that required by this code, waste water or sewer heat recovery, ground source heating and cooling, or heat recovered from other on-site or off-site sources that would otherwise be lost into the sewer or atmosphere.

3. Buildings that are primarily served by electric resistance heating, and that are not primarily served by a central HVAC system, are permitted to provide a higher-performing building envelope in lieu of the renewable energy required by Section C410.1. To qualify for this alternative compliance pathway, the building envelope must have a total Design UA value that is at least 15 percent below the Target UA value, using the component performance calculation methodology in Section C402.1.5.

Section C412

Solar Readiness (Mandatory)

C412.1 General. In addition to the requirements of C411, a *solar zone* shall be provided on non-residential buildings that are 20 stories or less in height above grade plane. The *solar zone* shall be located on the roof of the building or on another structure elsewhere on the site. The *solar zone* shall be in accordance with Sections C412.2 through C412.8 and the *International Fire Code*.

EXCEPTION. A *solar zone* is not required where the solar exposure of the building's roof area is less than 75 percent of that of an unshaded area, as defined in Section C412.5, in the same location, as measured by one of the following:

a. Incident solar radiation expressed in kWh/ft²-yr using typical meteorological year

(TMY) data;

b. Annual sunlight exposure expressed in cumulative hours per year using TMY data;

c. Shadow studies indicating that the roof area is more than 25 percent in shadow, on September 21 at 10am, 11am, 12pm, 1pm, and 2pm solar time.

C412.2 Minimum Area. The minimum area of the *solar zone* shall be determined by one of the following methods, whichever results in the smaller area:

1. 40 percent of roof area. The roof area shall be calculated as the horizontally-projected gross roof area less the area covered by skylights, occupied roof decks and planted areas.

2. 20 percent of electrical service size. The electrical service size is the rated capacity of the total of all electrical services to the building, and the required *solar zone* size shall be based upon 10 peak watts of photovoltaic per square foot.

EXCEPTION. Subject to the approval of the *code official*, buildings with extensive rooftop equipment that would make full compliance with this section impractical shall be permitted to reduce the size of the *solar zone* required by Section C412.2 to the maximum practicable area.

Example: A building with a 10,000 SF total roof area, 1,000 SF skylight area, and a 400 Amp, 240 volt single phase electrical service is required to provide a solar zone area of the smaller of the following:

1. [40% x (10,000 SF roof area – 1,000 SF skylights)] = 3,600 SF; or

2. [400 Amp x 240 Volts x 20% / 10 watts per SF] = 1,920 SF

Therefore, a solar zone of 1,920 square feet is required.

C412.3 Contiguous area. The *solar zone* is permitted to be comprised of separated sub-zones. Each sub-zone shall be at least 5 feet wide in the narrowest dimension.

C412.4 Obstructions. The *solar zone* shall be free of pipes, vents, ducts, HVAC equipment, skylights and other obstructions, except those serving photovoltaic or solar water heating systems within the *solar zone*. Photovoltaic or solar water heating systems are permitted to be installed within the *solar zone*. The *solar zone* is permitted to be located above any such obstructions, provided that the racking for support of the future system is installed at the time of construction, the elevated *solar zone* does not shade other portions of the *solar zone*, and its height is permitted by the *International Building Code* and the Seattle Land Use Code.

C412.5 Shading. The *solar zone* shall be set back from any existing or new object on the building or site that is located south, east, or west of the *solar zone* a distance at least two times the object's height above the nearest point on the roof surface. Such objects include but are not limited to taller portions of the building itself, parapets, chimneys, antennas, signage, rooftop equipment, trees and roof plantings. No portion of the *solar zone* shall be located on a roof slope greater than 2:12 that faces within 45° of true north.

C412.6 Access. Areas contiguous to the *solar zone* shall provide access pathways and provisions for emergency smoke ventilation as required by the *International Fire Code*.

C412.7 Structural integrity. The as-designed dead load and live load for the *solar zone* shall be clearly marked on the record drawings, and shall accommodate future photovoltaic or solar water heating systems arrays at an assumed dead load of 4 pounds per square foot in addition to other required live and dead loads. For photovoltaics, a location for future inverters shall be designated either within or adjacent to the *solar zone*, with a minimum area of 2 square feet for each 1000 square feet of *solar zone* area, and shall accommodate an assumed dead load of 175 pounds per square foot. Where photovoltaic or solar water heating systems are installed in the solar zone, structural analysis shall be based upon calculated loads, not upon these assumed loads.

C412.8 Photovoltaic or solar water heating interconnection provisions. Buildings shall provide for the future interconnection of either photovoltaics in accordance with Section C412.8.1 or solar water heating in accordance with Section C412.8.2.

C412.8.1 Photovoltaic interconnection. A capped roof penetration sleeve shall be provided in the vicinity of the future inverter, sized to accommodate the future photovoltaic system conduit. The capped roof penetration shall be sized to accommodate a conductor and conduit for 10 peak watts per square foot of the required *solar zone* area. Interconnection of the future photovoltaic system shall be provided for at the main service panel, either ahead of the service disconnecting means or at the end of the bus opposite the service disconnecting means, in one of the following forms:

a. A space for the mounting of a future overcurrent device, sized to accommodate the largest standard rated overcurrent device that is less than 20 percent of the bus rating.

b. Lugs sized to accommodate conductors with an ampacity of at least 20 percent of the bus rating, to enable the mounting of an external overcurrent device for interconnection.

The electrical construction documents shall indicate the following:

a. *Solar zone* boundaries and access pathways;

b. Location for future inverters and metering equipment; and

c. Route for future wiring between the photovoltaic panels and the inverter, and between the inverter and the main service panel.

C412.8.2 Solar water heating interconnection. Two capped pipe tees shall be provided upstream of the domestic water heating equipment to provide plumbing interconnections between a future solar water heating system and the domestic water heating system. Two roof penetration sleeves shall be provided in the vicinity of the *solar zone*, capable of accommodating

supply and return piping for a future solar water heating system.

The plumbing construction documents shall indicate the following:

a. *Solar zone* boundaries and access pathways;

b. Location for future hot water storage tanks; and

c. Route for future piping between the *solar zone* and the plumbing interconnection point, following the shortest feasible pathway.

Section 6. Chapter 5 of WAC 51-11C (Sections 51-11C-50000 through 51-11C-50500) is amended as follows:

C501.4 Compliance. *Alterations*, *repairs*, *additions* and changes of occupancy to, or relocation of, existing buildings and structures shall comply with the provisions for *alterations*, *repairs*, *additions* and changes of occupancy or relocation, respectively, in the *International Building Code*, *International Fire Code*, *International Fuel Gas Code*, *International Mechanical Code*, *Uniform Plumbing Code*, and ((~~NFPA 70~~)) Seattle Electrical Code.

C501.5 New and replacement materials. Except as otherwise required or permitted by this code, materials permitted by the applicable code for new construction shall be used. Like materials shall be permitted for repairs, provided no hazard to life, health or property is created. Hazardous materials shall not be used where the code for new construction would not permit their use in buildings of similar occupancy, purpose and location.

C501.6 ((~~Historic buildings~~)) *Landmarks*. The ((~~building official~~)) *code official* may modify the specific requirements of this code for ((~~historic buildings~~)) *landmarks* and require in lieu thereof alternate requirements ((~~which~~)) that the *code official* determines will not have an adverse effect on the designated historic features of the building and will result in a reasonable degree of energy efficiency. ((~~This modification may be allowed for those buildings or structures that are listed in~~

~~the state or national register of historic places; designated as a historic property under local or state designation law or survey; certified as a contributing resource with a national register listed or locally designated historic district; or with an opinion or certification that the property is eligible to be listed on the national or state registers of historic places either individually or as a contributing building to a historic district by the state building, building system or portion thereof shall conform to the provisions of this code as they relate to new construction without requiring the unaltered portion(s) of the existing building or building system to comply with this code.~~))

SECTION C502

ADDITIONS

C502.1 General. *Additions* to an existing building, building system or portion thereof shall conform to the provisions of this code as they relate to new construction without requiring the unaltered portion of the existing building or building system to comply with this code. *Additions* shall not create an unsafe or hazardous condition or overload existing building systems. An *addition* shall be deemed to comply with this code if the *addition* alone complies or if the existing building and *addition* comply with this code as a single building. *Additions* ((~~shall~~)) using the prescriptive path in Section C401.2, item 1, shall also comply with Section C502.2.

C502.1.1 Additional efficiency package options. *Additions* shall comply with Section C406, either for the addition only or for the total of the existing building plus addition.

Exception: Additions smaller than 500 square feet of conditioned floor area are not required to comply with Section C406.

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

C502.2.1 Vertical fenestration. Additions with *vertical fenestration* that results in a total building vertical fenestration area less than or equal to that specified in Section C402.4.1 shall comply with Section ((~~C402.4~~)) C402. *Additions* with *vertical fenestration* that results in a total building vertical fenestration area greater than that specified in Section C402.4.1 shall comply with one of the following:

1. Vertical fenestration alternate per Section C402.4.1.1, ((~~or~~)) C402.4.1.3 or C402.4.1.4 for the *addition* only.
2. Component performance option with target area adjustment per Section C402.1.5 ((~~or the total building performance option in Section C407 for the whole building~~)).

C502.2.2 Skylight area. *Additions* with *skylights* that result in a total building skylight area less than or equal to that specified in Section C402.4.1 shall comply with Section ((~~C402.4~~)) C402. Additions with skylights that result in a total building skylight area greater than that specified in Section C402.4.1 shall comply with the component performance option with the target area adjustment per Section C402.1.5 ((~~or the total building performance option in Section C407 for the whole building~~)).

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C502.2.6 Lighting and power systems. New lighting systems that are installed as part of the addition shall comply with Section C405.

C502.2.6.1 Interior lighting power. The total interior lighting power for the addition shall comply with Section C405.4.2 for the addition alone, or the existing building and the addition shall comply as a single building.

C502.2.6.2 Exterior lighting power. The total exterior lighting power for the addition shall comply with Section ((~~C405.5.1~~)) C405.5.2 for the addition alone, or the existing building and the addition shall comply as a single building.

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SECTION C503

ALTERATIONS

C503.1 General. Alterations to any building or structure shall comply with the requirements of the code for new construction. Alterations shall be such that the existing building or structure is no less conforming with 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 they 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. *Substantial alterations* and repairs shall comply with Section C503.8.

Exceptions:

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

1. Storm windows installed over existing fenestration.

2. Surface applied window film installed on existing single pane fenestration assemblies to reduce solar heat gain provided the code does not require the glazing fenestration to be replaced.

3. Existing ceiling, wall or floor cavities exposed during construction provided that these cavities are insulated to full depth with insulation having a minimum nominal value of R-3.0 per inch installed per Section C402.

4. Construction where the existing roof, wall or floor cavity is not exposed.

5. *Roof recover*.

6. *Air barriers* shall not be required for *roof recover* and roof replacement where the *alterations* or renovations to the building do not include *alterations*, renovations or *repairs* to the remainder of the building envelope.

7. Replacement of existing doors that separate conditioned space from the exterior shall not require the installation of a vestibule or revolving door, provided however that an existing vestibule that separates a conditioned space from the exterior shall not be removed.

2. Alterations are not required to comply with Section C406 except where specifically noted in Sections C503.2, C503.8.3 and C505.1.

C503.2 Change in space conditioning. Any nonconditioned space that is altered to become *conditioned space* or *semi-heated* space shall be required to be brought into full compliance with this code. Any semi-heated space that is altered to become conditioned space, or any heated but not cooled space that is altered to become both heated and cooled, shall be required to be brought into full compliance with this code. Compliance shall include the provisions of Section C406, applied only to the portion of the building undergoing a change in space conditioning.

Exceptions:

1. Where the component performance building envelope option in Section C402.1.5 is used to comply with this Section, the Proposed UA is allowed to be up to 110 percent of the Target UA.

2. Where the total building performance option in Section C407 is used to comply with this section, the annual energy consumption of the proposed design is allowed to be 110 percent of the annual energy consumption otherwise allowed by Section C407.3.

3. The addition of cooling equipment serving rooms or spaces totaling less than 2000 square feet in floor area does not trigger the requirement to comply with this section.

C503.3 Building envelope. New building envelope assemblies that are part of the alteration shall comply with Sections C402.1 through C402.5 as applicable. Where an opaque envelope assembly is altered or replaced, the new assembly shall in no case have a higher overall U-value than the existing.

Exception: Air leakage testing is not required for alterations and repairs, unless the project includes a change in space conditioning according to Section C503.2 or a change of occupancy or use according to Section C505.1.

C503.3.1 Roof replacement. *Roof replacements* shall comply with Table C402.1.3 or C402.1.4 where the existing roof assembly is part of the *building thermal envelope* and contains insulation entirely above the roof deck.

C503.3.2 Vertical fenestration. The addition of *vertical fenestration* that results in a total building vertical fenestration area less than or equal to that specified in Section C402.4.1 shall comply with Section C402.4. Alterations that result in a total building vertical fenestration area greater than specified in Section C402.4.1 shall comply with one of the following:

1. Vertical fenestration alternate per Section ((~~C402.1.3~~)) C402.4.1.3 for the new vertical fenestration added, where the calculation of vertical fenestration area and gross above-grade wall area shall include only those areas in the addition.

2. (Reserved) ((~~Vertical fenestration alternate per Section C402.4.1.1 for the area adjacent to the new vertical fenestration added.~~))

3. Component performance option with target area adjustment per Section C402.1.5 or the total building performance option in Section C407 for the whole building.

C503.3.2.1 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 C402.4. In addition, the overall *U*-value of the new fenestration shall be equal to or lower than the *U*-value of the existing fenestration.

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 C402.4 shall be permitted to satisfy the *U*-factor requirements for each fenestration product category listed in Table C402.4. Individual fenestration products from different product categories listed in Table C402.4 shall not be combined in calculating the area-weighted average *U*-factor.

C503.3.3 Skylight area. The addition of *skylights* that results in a total building skylight area less than or equal to that specified in Section C402.4.1 shall comply with Section C402.4. *Alterations* that result in a total building skylight area greater than that specified in Section C402.4.1 shall comply with the component performance option with target area adjustment per Section C402.1.5 or the total building performance option in Section C407 for the whole building.

C503.4 Mechanical systems. Those parts of systems which are altered or replaced shall comply with Section C403. Additions or alterations shall not be made to an existing mechanical system that will cause the existing mechanical system to become out of compliance.

Exception: Existing mechanical systems which are altered or where parts of the system are replaced are not required to be modified to comply with Section C403.6 as long as mechanical cooling is not added to the system.

C503.4.1 New mechanical systems. All new systems in existing buildings, including packaged unitary equipment and packaged split systems, shall comply with Section C403.

C503.4.2 New cooling systems. Where mechanical cooling is added to a space that was not previously cooled, the mechanical system shall comply with either Section C403.6 or C403.3.

Exceptions:

1. Alternate designs that are not in full compliance with this code may be approved when the code official determines that existing building constraints including, but not limited to, available mechanical space, limitations of the existing structure, or proximity to adjacent air intakes/exhausts make full compliance impractical. Alternate designs shall provide alternate energy savings strategies including, but not limited to, Demand Control Ventilation or increased mechanical cooling or heating efficiency above that required by Tables C403.2.3(1) through C403.2.3(10).

2. Qualifying small equipment: ((~~This exception shall not be used for unitary cooling equipment installed outdoors or in a mechanical room adjacent to the outdoors. This exception is allowed to be used for other~~)) Economizers are not required for cooling units and split systems serving one zone with a total cooling capacity rated in accordance with Section C403.2.3 of less than 33,000 Btu/h (hereafter referred to as qualifying small systems)

provided that these are high-efficiency cooling equipment with SEER and EER values more than 15 percent higher than minimum efficiencies listed in Tables C403.2.3 (1) through (3), in the appropriate size category, using the same test procedures. Equipment shall be listed in the appropriate certification program to qualify for this exception. The total capacity of all qualifying small equipment without economizers shall not exceed 72,000 Btu/h per building, or 5 percent of its air economizer capacity, whichever is greater.

Notes and exclusions for exception 2.

2.1. That portion of the equipment serving residential occupancies is not included in determining the total capacity of all units without economizers in a building.

2.2. Redundant units are not counted in the capacity limitations.

2.3. This exception shall not be used for the shell-and-core permit, for the initial tenant improvement, for Total Building Performance.

2.4 This exception shall not be used for unitary cooling equipment installed outdoors or in a mechanical room adjacent to the outdoors.

3. Chilled water terminal units connected to systems with chilled water generation equipment with IPLV values more than 25 percent higher than minimum part load efficiencies listed in Table C403.2.3(7), in the appropriate size category, using the same test procedures. Equipment shall be listed in the appropriate certification program to qualify for this exception. The total capacity of all systems without economizers shall not exceed ((~~480,000~~)) 72,000 Btu/h (141 kW) per building, or 20 percent of its air economizer capacity, whichever is greater.

Notes and exclusions for exception 3.

3.1. That portion of the equipment serving Group R occupancy is not included in determining the total capacity of all units without economizers in a building.

3.2 This exception shall not be used for the initial permit (this includes any initial permit for the space including, but not limited to, the shell-and-core permit, built-to-suit permit, and tenant improvement permit) or for Total Building Performance Method.

C503.4.3 Alterations to existing cooling systems. Alterations to existing mechanical cooling systems shall not decrease economizer capacity unless the system complies with either Section ((~~C403.2.6~~)) C403.6 or C403.3. ((~~In addition, for~~)) Alterations shall comply with Table C503.4 where neither the individual unit size limits nor the total building capacity limits on units without economizer of the existing mechanical cooling systems ((~~that do not~~)) comply with ((~~either~~)) Sections C403.6 or C403.3. ((~~including both the individual unit size limits and the total building capacity limits on units without economizer; other alterations shall comply with Table C503.4.~~))

ECONOMIZER COMPLIANCE OPTIONS FOR MECHANICAL ALTERATIONS[17]

Unit Type	Option A	Option B (alternate to A)	Option C (alternate to A)	Option D (alternate to A)
	Any alteration with new or replacement equipment	Replacement unit of the same type with the same or smaller output capacity	Replacement unit of the same type with a larger output capacity	New equipment added to existing system or replacement unit of a different type
1. Packaged Units	Efficiency: min.[1] Economizer: C403.3[2]	Efficiency: min.[1] Economizer: C403.3[2,3]	Efficiency: min.[1] Economizer: C403.3[2,3]	Efficiency: min.[1] Economizer: C403.3[2,4]
2. Split Systems	Efficiency: min.[1] Economizer: C403.3[2]	Efficiency: + 10/5%[5] Economizer: shall not decrease existing economizer capability	Only for new units < 54,000 Btuh replacing unit installed prior to 1991 (one of two): Efficiency: + 10/5%[5] Economizer: 50%[6] For units > 54,000 Btuh or any units installed after 1991: Option A	Efficiency: min.[1] Economizer: C403.3[2,4]
3. Water Source Heat Pump	Efficiency: min.[1] Economizer: C403.3[2]	(two of three): Efficiency: + 10/5%[5] Flow control valve[7] Economizer: 50%[6]	(three of three): Efficiency: + 10/5%[5] Flow control valve[7] Economizer: 50%[6] (except for certain pre-1991 systems[8])	Efficiency: min.[1] Economizer: C403.3[2,4] (except for certain pre-1991 systems[8])
4. Hydronic Economizer using Air-Cooled Heat Rejection Equipment (Dry Cooler)	Efficiency: min.[1] Economizer: C403.3[2]	Efficiency: + 10/5%[5] Economizer: shall not decrease existing economizer capacity	Option A	Efficiency: min.[1] Economizer: C403.3[2,4]
5. Air-Handling Unit (including fan coil units) where the	Efficiency: min.[1] Economizer: C403.3[2]	Economizer: shall not decrease existing economizer capacity	Option A (except for certain pre-1991 systems[8])	Option A (except for certain pre-1991 systems[8])

system has an air-cooled chiller				
6. Air-Handling Unit (including fan coil units) and Water-cooled Process Equipment, where the system has a water-cooled chiller[10]	Efficiency: min.[1] Economizer: C403.3[2]	Economizer: shall not decrease existing economizer capacity	Option A (except for certain pre-1991 systems[8] and certain 1991-2004 systems[9].)	Efficiency: min.[1] Economizer: C403.3[2,4] (except for certain pre-1991 systems[8] and certain 1991-2004 systems[9])
7. Cooling Tower	Efficiency: min.[1] Economizer: C403.3[2]	No requirements	Option A	Option A
8. Air-Cooled Chiller	Efficiency: min.[1] Economizer: C403.3[2]	Efficiency: + 5%[11] Economizer: shall not decrease existing economizer capacity	Efficiency (two of two): (1) + 10%[12] and (2) multistage Economizer: shall not decrease existing economizer capacity	Efficiency: min.[1] Economizer: C403.3[2,4]
9. Water-Cooled Chiller	Efficiency: min.[1] Economizer: C403.3[2]	Efficiency (one of two): (1) – 10%[13]or (2) plate frame heat exchanger[15] Economizer: shall not decrease existing economizer capacity	Efficiency (two of two): (1) – 15%[14] and (2) plate-frame heat exchanger[15] Economizer: shall not decrease existing economizer capacity	Efficiency: min.[1] Economizer: C403.3[2,4]
10. Boiler	Efficiency: min.[1] Economizer: C403.3[2]	Efficiency: + 8%[16] Economizer: shall not decrease existing economizer capacity	Efficiency: + 8%[16] Economizer: shall not decrease existing economizer capacity	Efficiency: min.[1] Economizer: C403.3[2,4]

1. Minimum equipment efficiency shall comply with Section C403.2.3 and Tables C403.2.3(1) through C403.2.3(9).
2. System and building shall comply with Section ((~~C403.4.1~~)) C403.3 (including both the individual unit size limits and the total building capacity limits on units without economizer). It is acceptable to comply using one of the exceptions to Section ((~~C403.4.1~~)) C403.3.
3. All equipment replaced in an existing building shall have air economizer complying with Sections ((~~C403.3.1 and C403.4.1~~)) C403.3 unless both the individual unit size and the total capacity of units without air economizer in the building is less than that allowed in Exception ((~~1~~)) 4 to Section ((~~C403.4.1~~)) C403.3.
4. All separate new equipment added to an existing building shall have air economizer complying with Sections ((~~C403.3.1 and C403.4.1~~)) C403.3 unless both the individual unit size and the total capacity of units without air economizer in the building is less than that allowed in Exception 1 to Section ((~~C403.4.1~~)) C403.3.
5. Equipment shall have a capacity-weighted average cooling system efficiency:
   a. for units with a cooling capacity below 54,000 Btuh, a minimum of 10% greater than the requirements in Tables C403.2.3(1) and C403.2.3(2)(1.10 x values in Tables C403.2.3(1) and C403.2.3(2)).
   b. for units with a cooling capacity of 54,000 Btuh and greater, a minimum of 5% greater than the requirements in Tables C403.2.3(1) and C403.2.3(2) (1.05 x values in Tables C403.2.3(1) and C403.2.3(2)).
6. Minimum of 50% air economizer that is ducted in a fully enclosed path directly to every heat pump unit in each zone, except that ducts may terminate within 12 inches of the intake to an HVAC unit provided that they are physically fastened so that the outside air duct is directed into the unit intake. If this is an increase in the amount of outside air supplied to this unit, the outside air supply system shall be capable of providing this additional outside air and equipped with economizer control.
7. Have flow control valve to eliminate flow through the heat pumps that are not in operation with variable speed pumping control complying with Section ((~~C403.4.3~~)) C403.4.2 for that heat pump.
   – When the total capacity of all units with flow control valves exceeds 15% of the total system capacity, a variable frequency drive shall be installed on the main loop pump.
   – As an alternate to this requirement, have a capacity-weighted average cooling system efficiency that is 5% greater than the requirements in note 5 (i.e. a minimum of 15%/10% greater than the requirements in Tables C403.2.3(1) and C403.2.3(2) (1.15/1.10 x values in Tables C403.2.3(1) and C403.2.3(2)).
8. Systems installed prior to 1991 without fully utilized capacity are allowed to comply with Option B, provided that the individual unit cooling capacity does not exceed 90,000 Btuh.
9. Economizer not required for systems installed with water economizer plate and frame heat exchanger complying with previous codes between 1991 and June 2013, provided that the total fan coil load does not exceed the existing or added capacity of the heat exchangers.
10. For water-cooled process equipment where the manufacturers specifications require colder temperatures than available with waterside economizer, that portion of the load is exempt from the economizer requirements.

11. The air-cooled chiller shall have an IPLV efficiency that is a minimum of 5% greater than the IPLV requirements in EER in Table C403.2.3(7)(1.05 x IPLV values in EER in Table C403.2.3(7)).
12. The air-cooled chiller shall:
    a. have an IPLV efficiency that is a minimum of 10% greater than the IPLV requirements in EER in Table C403.2.3(7) (1.10 x IPLV values in EER in Table C403.2.3(7)), and
    b. be multistage with a minimum of two compressors.
13. The water-cooled chiller shall have an IPLV ((~~efficiency~~)) value that is a minimum of ((~~10% greater~~)) 10 percent lower than the IPLV requirements in kW/ton in Table C403.2.3(7) (((~~1.10~~)) 0.90 x IPLV values in kW/ton in Table C403.2.3(7)). Water cooled centrifugal chillers designed for non-standard conditions shall have an NPLV ((~~efficiency~~)) value that is at least 10 percent ((~~greater~~)) lower than the adjusted maximum NPLV rating in kW/ton defined in Section C403.2.3.1 (1.10 x NPLV).
14. The water-cooled chiller shall have an IPLV ((~~efficiency~~)) value that is a minimum of ((~~15% greater~~)) 15 percent lower than the IPLV requirements in Table C403.2.3(7), (1.15 x IPLV values in Table C403.2.3(7)).
15. Economizer cooling shall be provided by adding a plate-frame heat exchanger on the waterside with a capacity that is a minimum of 20% of the chiller capacity at standard AHRI rating conditions.
16. The replacement boiler shall have an efficiency that is a minimum of 8% higher than the value in Table C403.2.3(5) (1.08 x value in Table C403.2.3(5)), except for electric boilers.

C503.4.4 Controls for cooling equipment replacement. When space cooling equipment is replaced, controls shall comply with all requirements under Section C403.6 and related subsections or provide for integrated operation with economizer in accordance with Section C403.3.1.

C503.4.5 Cooling equipment relocation. Existing equipment currently in use may be relocated within the same floor or same tenant space if removed and reinstalled within the same permit.

C503.4.6 New and replacement HVAC heating system equipment. For substantial alterations as defined in Section C503.8.1, or where a building's central HVAC heating system equipment is added or replaced, either the building's fenestration U-values shall meet the Column A values in Table C402.4, or the heating equipment shall be some type other than electric resistance or fossil fuel fired equipment.

Exceptions.

1. Fenestration meeting Column B values in Table C402.4 is permitted to be used where allowed by Section C402.4, Exception 1.

2. Existing fenestration at ground level is permitted to remain.

3. Where only one heating appliance is replaced by another having the same or lesser heating capacity and the same or higher efficiency, this provision does not apply.

C503.5 Service hot water systems. New service hot water systems that are part of the alteration shall comply with Section C404.

C503.6 Lighting, controlled receptacles and motors. Alterations and additions of lighting, controlled receptacles and motors shall comply with Sections 503.6.1 through C503.6.6.

C503.6.1 Luminaire additions and alterations. Alterations that add, alter or replace ((~~50~~)) 20 percent or more of the luminaires or of the lamps plus ballasts alone in a space enclosed by walls or ceiling-height partitions replace 50 percent or more of parking garage luminaires, or replace 50 percent or more of the total installed wattage of exterior luminaires shall comply with Sections C405.4 and C405.5. Where less than ((~~50~~)) 20 percent of the fixtures in an interior space enclosed by walls or ceiling-height partitions or parking garage are new, or ((~~50~~)) less than 20 percent ~~or more~~ of the installed exterior wattage is altered, the installed lighting wattage shall be maintained or reduced.

C503.6.2 Rewiring and recircuiting. Where new wiring is being installed to serve added fixtures and/or fixtures are being relocated to a new circuit, controls shall comply with Sections C405.2.1, C405.2.3, C405.2.4, C405.2.5, C405.2.7, C405.3, and as applicable C408.3. ((~~In addition, office areas less than 300 ft2 enclosed by walls or~~

~~ceiling-height partitions, and all meeting and conference rooms, and all school classrooms, shall be equipped with occupancy sensors that comply with Section C405.2.1 and C408.3.~~)) New lighting control devices shall comply with the requirements of Section C405.2.

C503.6.3 New or moved lighting panel. Where a new lighting panel (or a moved lighting panel) with all new raceway and conductor wiring from the panel to the fixtures is being installed, controls shall, in addition to the requirements of Section C503.6.2, also comply with the other requirements in Sections C405.2 and C408.3.

C503.6.4 Newly-created rooms. Where new walls or ceiling-height partitions are added to an existing space and create a new enclosed space, but the lighting fixtures are not being changed, other than being relocated, the new enclosed space shall have controls that comply with Sections C405.2.1, C 405.2.2, C405.2.3, C405.2.4, C405.2.5 and C408.3.

C503.6.5 Motors. Those motors which are altered or replaced shall comply with Section C405.8. In no case shall the energy efficiency of the building be decreased.

C503.6.6 *Controlled receptacles*. Where electric receptacles are added or replaced, *controlled receptacles* shall be provided according to Section C405.10.

Exceptions. 1. Where an alteration project impacts an area smaller than 5,000 square feet, controlled receptacles area not required.

2. Where existing systems furniture or partial-height relocatable office cubicle partitions are reconfigured or relocated within the same area, controlled receptacles are not required in the existing systems furniture or office cubicle partitions.

3. Where new or altered receptacles meet exception 1 to Section C405.10, they are not required to be controlled receptacles or be located within ((~~72~~)) 12 inches of non-controlled receptacles.

C503.7 Refrigeration systems. Those parts of systems which are altered or replaced shall comply with Section C410. Additions or alterations shall not be made to an existing refrigerated space or system that will cause the existing mechanical system to become out of compliance. All new refrigerated spaces or systems in existing buildings, including refrigerated display cases, shall comply with Section C410.

C503.8 Substantial alterations or repairs. In addition to meeting the applicable requirements of this code, any building or structure to which substantial alterations or repairs are made shall comply with the requirements of this section.

Exceptions:

1. Alterations and repairs to *landmark* buildings shall comply with this section to the extent that the *code official* determines that such compliance does not have an adverse effect on the designated historic features of the building. The energy use allowed by subsections 2, 3 or 4 of Section C503.8.3 is permitted to be increased in proportion to the additional energy use required for preservation of such designated features.

2. A project that is defined as a substantial alteration primarily due to the seismic retrofitting of a building's unreinforced masonry walls is exempt from the requirements of this section.

3. A building constructed in compliance with the 2003 or more recent edition of the Seattle Building Code that would be classified as a substantial alteration only due to

being reoccupied after being substantially vacant for more than 24 months is exempt from the requirements of this section.

C503.8.1 Definition. For the purposes of this section, substantial alterations or repairs means items 1, 2 or 4, or any combination thereof, of the definition of substantial alterations or repairs in Chapter 3 of the Seattle amendments to the IEBC, as determined by the *code official*.

Informative Note: Definitions 1, 2 and 4 of "substantial alterations or repairs" in the Seattle Existing Building Code are as follows:

1. Repair of a building with a damage ratio of 60 percent or more.

2. Remodeling or additions that substantially extend the useful physical and/or economic life of the building or a significant portion of the building, other than typical tenant remodeling.

4. Re-occupancy of a building that has been substantially vacant for more than 24 months in occupancies other than Group R-3.

C503.8.2 Pre-submittal conference. The applicant shall attend a pre-submittal conference to discuss the selected compliance path. Prior to this conference, the applicant shall meet with each energy utility serving the building to determine whether technical assistance or financial incentives are available for energy efficiency upgrades, and shall submit documentation of these meetings.

C503.8.3 Energy Efficiency. Buildings undergoing substantial alterations shall comply with Section C503.4.6 and one of the following:

1. Full code compliance. Fully comply with the requirements of this code for new construction, including Section C406.

2. Envelope thermal performance within 15 percent of code. Demonstrate that heat loss through the building envelope is no more than 15 percent greater than allowed by the Seattle Energy Code, using the Component Performance Building Envelope Option in Section C402.1.5, and meet all other prescriptive requirements of the Seattle Energy Code for new construction.

2.1. Default U-values. The values listed in Appendix A and Section C303 shall be used as the default U-values for existing building envelope components. For buildings whose original construction permits were applied for after January 1, 1992, existing building envelope components are deemed to meet the minimum U-values required by the edition of the Seattle Energy Code in effect at the time of permit application, where visual inspection by the *code official* reveals that those components appear to be equal to or better than code-compliant components.

2.2. Disproportionality. Where approved by the code official, the cost of required thermal improvements to the building envelope are not required to exceed 20 percent of the valuation of the substantial alterations project, determined in accordance with the Fee Subtitle, when using this envelope thermal performance compliance method. Envelope improvement costs shall be documented using standard cost estimating software and methodology.

3. Total building performance within 10 percent of code. Demonstrate that the building energy consumption will be less than 10 percent higher than that of the standard reference design (SRD) using the Total Building Performance methodology in Section C407 of the Seattle Energy Code, as follows.

1. Less than 97 percent of SRD when no C406 options are included in the project and the Proposed Design.

2. Less than 100 percent of SRD when one C406 option is included in the project and the Proposed Design.

3. Less than 103 percent of SRD when two C406 options are included in the project and the Proposed Design.

4. Operating energy alternative. The *code official* is permitted to allow calculated building energy consumption 20 percent greater than the standard reference design calculated in accordance with the Total Building Performance methodology in Section C407, provided that:

a. The applicant demonstrates that constructability, economic, or historic preservation considerations preclude conformance with any of the above options; and

b. The owner agrees to operate the building at or below the annual energy use level predicted for that calculated energy performance during a period of 12 consecutive months, concluding no later than three years after issuance of the certificate of occupancy, adjusted as allowed by Sections C401.3.6 through C401.3.10, and to meet the requirements of Sections C401.3.11 through C401.1.5.13, substituting the energy consumption standard in option 4 of this Section C503.8.3 for the energy consumption targets set out in Section C401.3.2.

4.1. Reporting. The building owner shall report the energy consumption in kBTU/square foot using automated reporting directly from utilities via Energy Star Portfolio Manager, and shall authorize the *code official* to view the reports directly in Portfolio Manager during the demonstration period.

C503.8.4 Impracticality. In cases where full compliance with all the requirements of Section C503.8 is impractical, the applicant is permitted to arrange a pre-design conference with the design team and the *code official* to seek modifications. The applicant shall identify specific requirements that are impractical, and shall identify design solutions and modifications that

achieve a comparable level of energy efficiency. The *code official* is authorized to waive specific requirements in this code to the extent that the *code official* determines those requirements to be impractical.

SECTION C504

REPAIRS

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

C504.2 Application. For the purposes of this code, the following shall be considered repairs.

1. Glass only replacements in an existing sash and frame.
2. *Roof repairs*.

((~~3. Air barriers shall not be required for *roof repair* where the repairs to the building do not include *alterations*, renovations or *repairs* to the remainder of the building envelope.~~

~~4. Replacement of existing doors that separate conditioned space from the exterior shall not require the installation of a vestibule or revolving door, provided however that an existing vestibule that separates a conditioned space from the exterior shall not be removed.~~))

Informative Note: Exceptions 3 and 4 appear in the exceptions to Section C503.1.

SECTION C505

CHANGE OF OCCUPANCY OR USE

C505.1 General. Spaces undergoing a change in occupancy shall be brought up to full compliance with this code in the following cases:

1. Any space that is converted from an F, S or U occupancy to an occupancy other than F, S or U.
2. Any space that is converted to a Group R dwelling unit or portion thereof, from another use or occupancy.
3. Any Group R dwelling unit or portion thereof permitted prior to July 1, 2002, that is converted to a commercial use or occupancy.

Compliance shall include the provisions of Section C406, applied only to the portion of the building undergoing a change of occupancy or use. Where the use in a space changes from one use in Table C405.4.2 (1) or (2) to another use in Table C405.4.2 (1) or (2), the installed lighting wattage shall comply with Section C405.4.

Exceptions:

1. Where the component performance alternative in Section C402.1.5 is used to comply with this section, the proposed UA is allowed to be up to 110 percent of the target UA.
2. Where the total building performance option in Section C407 is used to comply with this section, the annual energy consumption of the proposed design is allowed to be 110 percent of the annual energy consumption otherwise allowed by Section C407.3.

SECTION C506

METERING FOR EXISTING BUILDINGS

C506.1.1 Small existing buildings. In buildings that were constructed subject to Section C409, metering and data acquisition systems shall be provided for additions over 10,000 square feet in

accordance with the requirements of sections C409.2, C409.3 and C409.4.

C506.2 Metering for the addition or replacement of HVAC equipment in existing buildings. Where HVAC equipment is added or replaced, metering shall be provided according to Sections C506.2.1 or C506.2.2, as applicable.

C506.2.1 Addition or replacement of individual HVAC equipment pieces. Where HVAC equipment is added or replaced, but compliance with Section C506.2.2 is not required, metering shall be provided as follows, and the data from these meters is permitted to either be stored locally using a manual totalizing meter or other means at the meter or fed into a central data collection system.

1. Electrical metering shall be provided for all of the following:

   a. Each new or existing branch circuit serving a new piece of HVAC equipment with minimum circuit ampacity (MCA) that equates to 50 kVA or more. A single meter is permitted to serve multiple circuits of the same sub-metering category from Section C409.3.

   b. Each new or existing branch circuit supplied by a new electrical panel that is dedicated to serving HVAC equipment. It shall be permitted to meter the circuits individually or in aggregate.

   c. Each new HVAC fan or pump on a variable speed drive, where the fan, pump, or variable speed drive are new, unless the variable speed drive is integral to a packaged HVAC unit or the existing variable speed drive does not have the capability to provide electric metering output.

2. Natural gas metering shall be provided for each new natural gas connection that is rated at 1,000 kBTUs or higher. A single meter is permitted to serve multiple

equipment pieces of the same sub-metering category from Section C409.3; HVAC, water heating or process.

C506.2.2 Addition or replacement of the majority of HVAC equipment in a building. Where permits are issued for new or replacement HVAC equipment that has a total heating and cooling capacity greater than 1,200 kBTU/hour and greater than 50 percent of the building's existing HVAC heating and cooling capacity, within any 12-month period, the following shall be provided for the building:

1. Energy source metering required by Section C409.2.

2. HVAC system end-use metering required by Section C409.3.1

3. Data acquisition and display system per the requirements of Section C409.4.

Each of the building's existing HVAC chillers, boilers, cooling towers, air handlers, packaged units and heat pumps that has a capacity larger than 5 tons or that represents more than 10 percent of the total heating and cooling capacity of the building shall be included in the calculation of the existing heating and cooling capacity of the building. Where heat pumps are configured to deliver both heating and cooling, the heating and cooling capacities shall both be included in the calculation of the total capacity.

Each of the building's existing and new HVAC chillers, boilers, cooling towers, air handlers, packaged units and heat pumps that has a heating or cooling capacity larger than 5 tons or that represents more than 10 percent of the total heating and cooling capacity of the building shall be included in the HVAC system end-use metering.

Construction documents for new or replacement heating and cooling equipment projects shall indicate the total heating and cooling capacity of the building's existing HVAC equipment and the total heating and cooling capacity of the new or replacement equipment. Where permits have

been issued for new or replacement heating and cooling equipment within the 12 month period prior to the permit application date, the heating and cooling capacity of that equipment shall also be indicated. For the purpose of this tabulation, heating and cooling capacities of all equipment shall be expressed in kBTU / hour.

C506.3 Tenant space electrical sub-metering for existing buildings. For tenant improvements in which a single tenant will occupy a full floor of a building, the electrical consumption for the tenant space on that floor shall be separately metered, and the metering data provided to the tenant with a display system per the requirements of Section C409.4.3. For the purposes of this section, separate end use categories need not be segregated.

EXCEPTION: Where an existing branch circuit electrical panel serves tenant spaces on multiple full floors of a building, the floors served by that panel are not required to comply with this section.

C506.4 Metering for complete electrical system replacement. If all, or substantially all, of the existing electrical system is replaced under a single electrical permit or within a 12-month period, all of the provisions of Section C409 shall be met.

***

Section 7. The following sections of Appendix A of WAC 51-11C (Sections 51-11C-60000 through 51-11C-61081) are amended as follows:

Section A103--Above grade walls.

A103.1 General. The tables in this section list heat loss coefficients for the opaque portion of above-grade wood stud frame walls, metal stud frame walls and concrete masonry walls (Btu/h · ft^2 · °F) respectively. They are derived from procedures listed in the ASHRAE Fundamentals Handbook. For intermediate floor slabs which penetrate the insulated wall, use the concrete

((~~wall~~)) peripheral edge U-factors in Table A103.3.7.2.

Insulation is assumed to uniformly fill the entire cavity and to be installed as per manufacturer's directions. All walls are assumed to be finished on the inside with 1/2 inch gypsum wallboard, and on the outside with either beveled wood siding over 1/2 inch plywood sheathing or with 5/8 inch T1-11 siding. Insulated sheathing (either interior or exterior) is assumed to cover the entire opaque wall surface, except where modified in accordance with footnote g to Table C402.1.3.

Metal building walls have a different construction and are addressed in Table A103.3.6.3.

***

A103.3.7.1 Concrete masonry walls. The nominal R-values in Table A103.3.7.1(1) or Table A103.3.7.1(3) may be used for purposes of calculating concrete masonry wall section U-factors in lieu of the ASHRAE isothermal planes calculation method as provided in Chapter 27 of the ASHRAE Fundamentals Handbook. The nominal U-values in Table A103.3.7.1(2) are permitted to be used for purposes of calculating concrete wall U-factors.

	Table A105.3.7.1(1) for 22.700.010 Default U-Factors for Concrete Masonry (CMU) Walls								
	8-inch Medium-Weight (115 lb/CF) CMU								
	All Cells Grouted	Grout @ 16-inches OC		Grout @ 32 inches OC		Grout @ 48 inches OC		No Grout (unreinforced)	
Additional Insulation		Cores Empty	Cores Filled	Cores Empty	Cores Filled	Cores Empty	Cores Filled	Cores Empty	Cores Filled
None	0.58	0.52	0.43	0.48	0.35	0.46	0.27	0.43	0.21
R-5 continuous insulation	0.15	0.14	0.14	0.14	0.13	0.14	0.12	0.14	0.10
R-10 continuous insulation	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.07

R-15 continuous insulation	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05
R-19 continuous insulation	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04
R-13 insulation 2x4 wood studs	0.08	0.08	0.08	0.08	0.08	0.08	0.07	0.08	0.07
R-21 insulation 2x6 wood studs	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.06	0.05
R-13 insulation 3-5/8" metal studs	0.16	0.15	0.14	0.14	0.13	0.15	0.13	0.14	0.11
R-15 insulation 3-5/8" metal studs @24 inches	0.11	0.10	0.09	0.10	0.09	0.10	0.07	0.10	0.07
R-19 insulation 5.5" metal studs	0.11	0.11	0.11	0.11	0.10	0.11	0.10	0.11	0.09
R-21 insulation 6" metal studs	0.11	0.11	0.10	0.11	0.10	0.11	0.09	0.11	0.08
R-21 insulation 6" metal studs	0.09	0.09	0.09	0.09	0.08	0.09	0.08	0.09	0.07

1

	12-inch Medium-Weight (115 lb/CF) CMU								
	All Cells Grouted	Grout @ 16 inches OC		Grout @ 32 inches OC		Grout @ 48 inches OC		No Grout (unreinforced)	
Additional Insulation	Cores Filled	Cores Empty	Cores Filled	Cores Empty	Cores Filled	Cores Empty	Cores Filled	Cores Empty	Cores Filled
None	0.47	0.44	0.34	0.42	0.28	0.42	0.25	0.40	0.15
R-5 continuous insulation	0.14	0.14	0.13	0.14	0.12	0.14	0.11	0.13	0.09
R-10 continuous insulation	0.08	0.08	0.08	0.08	0.07	0.08	0.07	0.08	0.06

R-15 continuous insulation	0.06	0.06	0.06	0.06	0.05	0.06	0.05	0.06	0.05
R-19 continuous insulation	0.05	0.05	0.05	0.05	0.04	0.05	0.04	0.05	0.04
R-13 insulation 2x4 wood studs	0.08	0.08	0.08	0.08	0.07	0.08	0.07	0.08	0.06
R-21 insulation 2x6 wood studs	0.06	0.06	0.05	0.06	0.05	0.06	0.05	0.06	0.04
R-13 insulation 3-5/8" metal studs	0.15	0.14	0.13	0.14	0.12	0.14	0.11	0.14	0.09
R-15 insulation 3-5/8" metal studs @ 24 inches	0.11	0.11	0.10	0.10	0.08	0.10	0.08	0.10	0.06
R-19 insulation 6" metal studs	0.11	0.11	0.10	0.11	0.09	0.11	0.09	0.11	0.07
R-21 insulation 6" metal studs	0.10	0.10	0.09	0.10	0.09	0.10	0.08	0.10	0.07
R-21 insulation 6" metal studs @ 24 inches	0.09	0.09	0.08	0.09	0.08	0.09	0.08	0.09	0.06

Footnotes for Table A105.3.7.1(1) for 22.700.010:
1. Interpolation is allowed between 8-inch and 12-inch CMU values (for 10-inch CMU).
2. Interpolation is allowed between 16 and 32-inch grout spacing (for 24-inch spacing)
3. Interpolation is allowed between 32 and 48-inch grout spacing (for 40-inch spacing)
4. "Cores filled" means that all cores not grouted are filled with perlite or vermiculite insulation.
5. Values are based on stud spacing of 16 inches on center
6. Values are based on horizontal grout spacing of 48 inches OC
7. Stud wall values include one layer of gypsum board on the interior.

Table A103.3.7.1(((~~1~~)) 2) for 22.700.010
Default U-factors for Concrete ((~~and Masonry~~)) Walls

((~~8" Concrete Masonry~~ Wall Description	~~CORE TREATMENT~~			
	~~Partial Grout with Ungrouted Cores~~			
	~~Empty~~	~~Loose-fill insulated~~		~~Solid Grout~~
		~~Perlite~~	~~Vermiculite~~	
~~Exposed Block, Both Sides~~	~~0.40~~	~~0.23~~	~~0.24~~	~~0.43~~
~~R-5 Interior Insulation, Wood Furring~~	~~0.14~~	~~0.11~~	~~0.12~~	~~0.15~~
~~R-6 Interior Insulation, Wood Furring~~	~~0.14~~	~~0.11~~	~~0.11~~	~~0.14~~
~~R-10.5 Interior Insulation, Wood Furring~~	~~0.11~~	~~0.09~~	~~0.09~~	~~0.11~~
~~R-8 Interior Insulation, Metal Clips~~	~~0.11~~	~~0.09~~	~~0.09~~	~~0.11~~
~~R-6 Exterior Insulation~~	~~0.12~~	~~0.10~~	~~0.10~~	~~0.12~~
~~R-10 Exterior Insulation~~	~~0.08~~	~~0.07~~	~~0.07~~	~~0.08~~
~~R-9.5 Rigid Polystyrene Integral Insulation, Two Webbed Block~~	~~0.11~~	~~0.09~~	~~0.09~~	~~0.12~~

1

~~12" Concrete Masonry~~ Wall Description	~~CORE TREATMENT~~			
	~~Partial Grout with Ungrouted Cores~~			
	~~Empty~~	~~Loose-fill insulated~~		~~Solid Grout~~
		~~Perlite~~	~~Vermiculite~~	
~~Exposed Block, Both Sides~~	~~0.35~~	~~0.17~~	~~0.18~~	~~0.33~~
~~R-5 Interior Insulation, Wood Furring~~	~~0.14~~	~~0.10~~	~~0.10~~	~~0.13~~
~~R-6 Interior Insulation, Wood Furring~~	~~0.13~~	~~0.09~~	~~0.10~~	~~0.13~~
~~R-10.5 Interior Insulation, Wood Furring~~	~~0.11~~	~~0.08~~	~~0.08~~	~~0.10~~
~~R-8 Interior Insulation, Metal Clips~~	~~0.10~~	~~0.08~~	~~0.08~~	~~0.09~~
~~R-6 Exterior Insulation~~	~~0.11~~	~~0.09~~	~~0.09~~	~~0.11~~
~~R-10 Exterior Insulation~~	~~0.08~~	~~0.06~~	~~0.06~~	~~0.08~~
~~R-9.5 Rigid Polystyrene Integral Insulation, Two Webbed Block~~	~~0.11~~	~~0.08~~	~~0.09~~	~~0.12~~

2

~~8" Clay Brick~~	~~CORE TREATMENT~~	
	~~Partial Grout with Ungrouted Cores~~	
	~~Loose-fill insulated~~	

~~Wall Description~~	~~Empty~~	~~Perlite~~	~~Vermiculite~~	~~Solid Grout~~
~~Exposed Block, Both Sides~~	~~0.50~~	~~0.31~~	~~0.32~~	~~0.56~~
~~R-5 Interior Insulation, Wood Furring~~	~~0.15~~	~~0.13~~	~~0.13~~	~~0.16~~
~~R-6 Interior Insulation, Wood Furring~~	~~0.15~~	~~0.12~~	~~0.12~~	~~0.15~~
~~R-10.5 Interior Insulation, Wood Furring~~	~~0.12~~	~~0.10~~	~~0.10~~	~~0.12~~
~~R-8 Interior Insulation, Metal Clips~~	~~0.11~~	~~0.10~~	~~0.10~~	~~0.11~~
~~R-6 Exterior Insulation~~	~~0.12~~	~~0.11~~	~~0.11~~	~~0.13~~
~~R-10 Exterior Insulation~~	~~0.08~~	~~0.08~~	~~0.08~~	~~0.09))~~

1

6" Concrete Poured or Precast	*CORE TREATMENT*			
	Partial Grout with Ungrouted Cores			
		Loose-fill insulated		
Wall Description	**Empty**	**Perlite**	**Vermiculite**	**Solid Grout**
Exposed Concrete, Both Sides	NA	NA	NA	0.61
R-5 Interior Insulation, Wood Furring	NA	NA	NA	0.16
R-6 Interior Insulation, Wood Furring	NA	NA	NA	0.15
R-10.5 Interior Insulation, Wood Furring	NA	NA	NA	0.12
R-8 Interior Insulation, Metal Clips	NA	NA	NA	0.12
R-6 Exterior Insulation	NA	NA	NA	0.13
R-10 Exterior Insulation	NA	NA	NA	0.09

Footnotes for Table A105.3.7.1(2) for 22.700.010:

((~~1. Grouted cores at 40" x 48" on center vertically and horizontally in partial grouted walls.~~

~~2. Interior insulation values include 1/2" gypsum board on the inner surface.~~

~~3. Furring and stud spacing is 16" on center. Insulation is assumed to fill furring space and is not compressed.~~

~~4. Intermediate values may be interpolated using this table. Values not contained in this table may be computed using the procedures listed in the ASHRAE Fundamentals Handbook.~~

~~5. Concrete Masonry Unit (CMU) assembly U-values are based on local test data for Washington state CMU block material using the ASTM C-236-87 steady state thermal conductance test. Tests included an 8"x8"x16" CMU with all cells filled with vermiculite (1995) and 8"x8"x16" CMU with all cells filled with polymaster foam in place insulation (1996). Refer to ASHRAE Standard 90.1 for additional nationally recognized data on the thermal performance of CMU block walls.~~))

Table ((~~A103.3.7.1(2)~~)) A103.3.7.1(4)

Default U-factors for Concrete and Masonry Walls [a, b, c, d]

(Change to table number only – table not shown)

Section 8. Appendix C of WAC 51-11C (Sections 51-11C-80000 through 51-11C-80100) is amended as follows:

Appendix C--Exterior design conditions. As required by Sections C302.2 and R302.2, the heating or cooling outdoor design temperatures shall be selected from Table C-1.

Table C-1 for 22.70.010
Outdoor Design Temperatures

Location	Outdoor Design Temp. Heating (°F)	Outdoor Design Temp. Cooling (°F)
Aberdeen 20 NNE	25	83
Anacortes	24	72
Anatone	-4	89
Auburn	25	84

Battleground	19	91
Bellevue	24	83
Bellingham 2 N	19	78
Blaine	17	73
Bremerton	29	83
Burlington	19	77
Chehalis	21	87
Chelan	10	89
Cheney	4	94
Chesaw	-11	81
Clarkston	10	94
Cle Elum	1	91
Colfax 1 NW	2	94
Colville AP	-2	92
Concrete	19	83
Connell 4 NNW	6	100
Cougar 5 E	25	93
Dallesport AP	14	99
Darrington RS	13	85
Davenport	5	92
Edmonds	24	82
Ellensburg AP	2	90
Elma	24	88
Ephrata AP	7	97
Everett Paine AFB	21	79
Forks 1 E	23	81
Glacier RS	13	82
Glenoma (Kosmos)	18	89
Goldendale	7	94
Grays River Hatchery	24	86

Greenwater	1.4	84
Grotto	21	84
Hoquiam AP	26	79
Inchelium 2 NW	0	92
John Day Dam	19	100
Kent	21	85
Kirkland	17	83
La Grande	23	88
Leavenworth	-3	93
Little Goose Dam	22	101
Long Beach 3 NNE	25	77
Longview	24	87
Lower Granite Dam	14	98
Lower Monument Dam	18	103
Marysville	23	79
Metaline Falls	-1	89
Methow 2 W	1	89
Nespelem 2 S	-4	93
Newhalem	19	89
Newport	-5	92
Northport	2	92
Oak Harbor	16	74
Odessa	7	100
Olga 2 SE	24	71
Olympia, AP	17	85
Omak 2 NW	3	90
Oroville	5	93
Othello	9	98
Packwood	16	90
Plain	-3	89

Pleasant View	16	98
Pomeroy	3	95
Port Angeles	28	75
Port Townsend	25	76
Prosser	12	97
Puyallup	19	86
Quilcene 2 SW	23	83
Quinault RS	25	84
Rainier, Longmire	15	85
Paradise RS	8	71
Raymond	28	81
Redmond	17	83
Republic	-9	87
Richland	11	101
Ritzville	6	99
Satus Pass	10	90
Seattle: Sea-Tac AP	24	((~~83~~)) <u>82 Dry bulb</u> <u>66 Wet bulb</u>
Sedro Woolley 1 E	19	78
Sequim	23	78
Shelton	23	85
Smyrna	8	102
Snohomish	21	81
Snoqualmie Pass	6	80
Spokane AP	4	92
Spokane CO	10	96
Stampede Pass	7	76
Stehekin 3 NW	12	85
Stevens Pass	6	77
Tacoma CO	29	82

Tatoosh Island	31	63
Toledo AP	17	84
Vancouver	22	88
Vashon Island	28	78
Walla Walla AP	6	96
Waterville	1	88
Wellpinit	1	93
Wenatchee CO	10	92
Whidbey Island	11	71
Willapa Harbor	26	81
Wilson Creek	3	96
Winthrop 1 WSW	-12	91
Yakima AP	11	94

Abbreviations for Table C-1 for 22.70.010:
AFB Air Force Base
AP Airport
CO City Office
RS Ranger Station
Typical: "4(miles)NE"

Section 9. The following new Appendix E is added to WAC 51-11C as follows:

Note – This entire appendix is a Seattle amendment and is not underlined.

The reporting format has been developed to guide both staff and applicants through the energy analysis process. The report (three copies are to be submitted) begins with a text summary including project description, methodology description, and a discussion of the estimated energy consumption differences. These are accompanied by an appendix which has summary forms, calculations to support the inputs, and copies of the computer inputs and outputs (all with numbered pages).

The text and summary forms are among the most important parts of the submittal. This information is read prior to any review of the computer inputs and outputs to give an overall

orientation to the project. The first evaluation of the project is based on a review of the text and summary forms. These indicate what the key energy efficiency strategies are and form the basis for a more detailed review of the drawings and of the computer analysis. Information for statistical summaries or other evaluations is drawn from the text and summary forms. While these may be the last items completed by the applicant prior to submittal, the importance of having the complete and accurate cannot be overemphasized.

REPORTING FORMAT OUTLINE

(See detailed description below)

I. Executive Summary

II. Project Description

III. Methodology Description

IV. Discussion of Estimated Energy Consumption Differences

Appendices (Supporting Material)

A. Energy Analysis Summary Form

    1. Energy Consumption by End-use portion

    2. Design Parameter Comparison portion

B. General Information

    1. Site Plan

    2. HVAC Zoning Diagram

C. Building Envelope

1. Fenestration: NFRC Certification Authorization Report (CAR) or Simulation Report for U-factor and SHGC

2. Opaque Elements: Cross-sections and U-factor Calculations

3. Shading Diagrams

D. Lighting System

1. Lighting for Interior

2. Lighting for Parking and Outdoor Areas

3. Lighting for Façade

E. Space Heating and Space Cooling

1. Equipment Efficiency – Manufacturer's Specifications

F. Ventilation

G. Interior Exhaust Fans

H. Parking Ventilation Fans

I. Service Water Heating

J. Other End-uses

1. Office Equipment

2. Elevators and Escalators

3. Refrigeration

4. Cooking

5. Other

K. Computer Printout of Inputs and Outputs

I. Executive Summary

The executive summary is the condensed version of the text. This is usually several paragraphs long, never more than one page, and includes:

1. A brief description of the project with name, address, number of stories, and total square footage, as well as a listing of the various uses and the square footage of each use.
2. An explanation about why the systems analysis compliance option was chosen (i.e. what elements of the Proposed Design do not comply with the prescriptive option).
3. A listing of the key energy efficiency features that are being used to compensate for the elements that do not comply.
4. The total energy consumption on a Btu-per-conditioned-square-foot-per-year basis for both the Standard Reference Design and the Proposed Design, and the percentage ratio of the Proposed Design to the Standard Reference Design (i.e. what the energy efficiency improvement has been).

II. Project Description

The project description is a detailed summary of the project. First is the name and the street address as well as adjacent cross-streets or streets on all four sides of the building if it is a full-block development. Indicate the number of stories and total square footage. A listing of the various uses and square footage of each use should be done on a floor-by-floor or a system-by-system basis. Thus, for mixed-use floors, specify how much is office and how much is retail, or how much is office and how much is lab. Include parking garage number of floors and area in the listing. The description should also include information on the energy efficiency of the Proposed Design systems.

1. For the building envelope: indicate the glazing area, and how the fenestration U-factor and SHGC compare with the Standard Reference Design requirements; and point out any opaque component U-factors or R-values which are better than the Standard Reference Design requirements.

2. For each HVAC system: provide an explanation of the system including area served, key features, economizer percentage, control strategies, etc. Indicate any differences between the Standard Reference Design and the Proposed Design, such as equipment efficiency.

3. For the lighting: indicate whether any tradeoffs are included in this analysis, and, if so, what they are.

4. For other end-uses: indicate any differences between the Standard Reference Design and the Proposed Design. It is intended that the material in this section be descriptive, supporting calculations are to be included in the appendices.

III. Methodology Description

The methodology description is an explanation of any aspects of the modeling which are unusual or not perfectly clear. (The algorithms in approved analysis programs are generally acceptable and do not need to be explained.) For example:

1. Explain what shading by adjacent buildings has been included in the analysis and how it has been modeled (e.g. either using the program capabilities or as a north-facing wall, etc.).

2. If there are below-grade walls and floors, explain how the heat loss has been modeled for these (e.g. either as an exterior wall with a limited ground temperature variation or as a constant negative load to a zone, etc.)

3. If a program cannot model a system exactly, explain why the modeling assumptions used are the best representation of that system. It is intended that the material in this section provide a heads-up for anything unusual. Again, it is intended that the material in this section be descriptive, supporting calculations are to be included in the appendices.

IV. Discussion of Estimated Energy Consumption Differences

The discussion of estimated energy consumption differences is a summary and explanation of the energy savings.

1. First, list the total energy consumption on a Btu-per-conditioned-square-foot-per-year basis for both the Standard Reference Design and the Proposed Design, and the percentage ratio of the Proposed Design to the Standard Reference Design (i.e. what the energy efficiency improvement would be).

2. Then, review the energy savings by end-use, starting with the end-use which has the largest difference as a percent of the Standard Reference Design total. Attempt to correlate the differences by end-use with the strategies used. While some changes will have a simple, direct correlation with consumption, other end-use differences may have a more complex explanation due to interactive effects. For example:

- Changes in exterior lighting will have a simple, direct correlation with consumption.

- Differences in space heating and space cooling are likely due to a combination of building envelope and HVAC system strategies. (Lacking any better information, the following procedure can provide a rough-cut disaggregation. First, determine the ratio of the design heating load of the Proposed Design to the design heating load of the Standard Reference Design. Multiply the space heating energy consumption of the Standard Reference Design by this ratio and assume that the resulting figure is what the space heating energy consumption would have been for the Proposed Design if only the building envelope had changed. This difference is what could be attributed to the building envelope. Second, determine the ratio of the average equipment efficiency of the Proposed Design to the average equipment efficiency of the Standard Reference Design. Multiply the space heating energy consumption from the first step by this ratio and assume that the resulting figure is what the space heating energy consumption would have been for the Proposed Design if only the building envelope and equipment efficiency had changed. This second difference is what could be attributed to changes in equipment efficiency. Finally, assume that whatever energy consumption differences remain are due to other HVAC system strategies. Follow this same process for space cooling, starting with a comparison of loads, then equipment efficiency, then system type. Differences in economizer cycle, however, add another layer of complexity.)

This section should, at a minimum, provide confirmation that the results of the analysis are reasonable.

Appendices (Supporting Materials)

A. Energy Analysis Summary Form (required)

1. Complete the Energy Consumption by End-use portion of the form for each project. Where a project has multiple buildings which are individually analyzed, complete the form for each building as well as for the overall project. (An automated electronic spreadsheet version of this page is on the DPD Seattle Energy Code website at: www.seattle.gov/dpd/energy.)

2. Complete the Design Parameter Comparison portion of the form for each project. Where a project has multiple HVAC systems, complete the HVAC information for each system. (An electronic version of these pages is on the DPD Seattle Energy Code website at: www.seattle.gov/dpd/energy.)

B. General Information

1. Site Plan (required) – provide site plan (8½ x 11 preferred) showing location and height, in feet or stories, of all adjacent buildings and also any other buildings and topography which would provide significant shading of the proposed building.

2. HVAC zoning diagram used in the modeling process (required) – provide zoning diagram indicating zone lines and with zones labeled to match the modeling, plus takeoff sheets with area inputs for DPD review.)

C. Building Envelope

1. Glazing and opaque doors, including windows, skylights, sliding/swinging/rollup doors, glass block (required):

a. U-factor, with basis for information (NFRC Certification Authorization Report, simulation report or approved alternate source).

b. Solar Heat Gain Coefficient (SHGC), with basis for information (NFRC Certification Authorization Report, simulation report or approved alternate source)

2. Opaque roof, wall, floor (required):

a. provide cross-sections and U-factor calculations for each different assembly where default U-factors from Chapter 3 and Appendix A have not been used;

b. if multiple elements (e.g.. three wall types) are combined into one value for modeling purposes, provide calculations used to determine weighted-average value.

3. Shading diagrams (required):

a. provide information on how shading by adjacent buildings and topography has been modeled,

b. provide wall and roof sections showing overhangs and setbacks for glazing to justify the shading modeled.

4. Building air leakage:

a. the standard reference design building air leakage test rate shall equal that required by Section C402.4.1.2.3,

b. provide calculation showing how the building air leakage test rate at the standard rating conditions in Section C402.4.1.2.3has been converted to an air leakage test rate appropriate for the energy modeling,

c. for modeling, indicate:

i. what percentage of air leakage is modeled for the hours when the building fan system is off and

ii. what percentage of air leakage is modeled for the hours when the building fan system is on.

D. Lighting

1. Interior lighting (as applicable):

a. explain any special assumptions about interior lighting,

b. discuss lighting inputs to account for any exempt lighting (e.g. retail, kitchen).

2. Parking/outdoor areas lighting (as applicable):

a. provide calculation of areas for parking garages, then multiply by allowed Watts/square foot; provide calculation of areas for surface parking, and other lighted outdoor areas, then multiply by allowed Watts/square foot to obtain Standard Reference Design;

b. provide supporting information for Proposed only if different from Standard Reference Design;

c. if program does not list parking/outdoor area lighting energy consumption separately, then provide calculation of annual energy consumption for this end-use.

3. Façade lighting (required):

a. provide calculation of building façade, then multiply by allowed Watts/square foot to obtain Standard Reference Design;

b. provide supporting information for Proposed only if different from Standard Reference Design;

c. if program does not list facade lighting energy consumption separately, then provide calculation of annual energy consumption for this end-use.

E. Space Heating and Space Cooling Equipment and Plant

1. provide manufacturer's specifications for equipment efficiency,

2. provide calculations per AHRI standards for COP, EER, IPLV,

3. provide list of equipment and size and calculations to justify if Proposed Design includes multiple pieces of equipment and a weighted average equipment efficiency is used in the energy analysis,

4. provide calculations to justify the equipment size for the Standard Reference Design

a. provide calculations of ratio of Proposed Design equipment size to Proposed Design design heating load and design cooling load,

b. provide calculations of ratio of Standard Reference Design equipment size to Standard Reference Design design heating load and design cooling load.

F. Ventilation - interior (required):

1. provide W/CFM calculations for the ventilation system for the Proposed Design and for the Standard Reference Design to justify inputs for the Standard Reference Design,

2. if program does not list energy consumption for interior ventilation separately in the output, then provide calculation of annual energy consumption for this end-use.

G. Interior Exhaust Fans (as applicable):

1. where multiple toilet exhaust and relief fans are to be installed, provide listing of capacity for each and total for the interior exhaust fans,

2. if program does not list energy consumption for interior exhaust fans separately in the output, then provide calculation of annual energy consumption for this end-use.

H. Parking Garage Fans (as applicable):

1. where multiple parking garage fans are to be installed, provide listing of capacity for each and total for the parking garage fans,

2. if program does not list energy consumption for parking garage fans separately in the output, then provide calculation of annual energy consumption for this end-use.

I. Service Water Heating (required):

1. provide calculations used to size equipment (see Appendix B, Table B102, for default assumptions for service hot water quantities in Btuh per person),

2. if program does not list energy consumption for service water heating separately in the output, then provide calculation of annual energy consumption for this end-use.

J. Other End-uses

1. Office/miscellaneous equipment (as applicable):

a. if program requires an input of total equipment capacity rather than capacity on a square foot basis, then provide calculations used to size equipment (see Appendix B, Table B102, for default assumptions for service hot water quantities in Watts/square foot),

b. if program does not list energy consumption for office/miscellaneous equipment separately in the output, then provide calculation of annual energy consumption for this end-use.

2. Elevators and escalators (as applicable):

a. where multiple elevators and escalators are to be installed, provide listing of capacity for each and total for the system,

b. if program does not list energy consumption for elevators and escalators separately in the output, then provide calculation of annual energy consumption for this end-use.

3. Refrigeration - food, etc. (as applicable):

a. where multiple units are to be installed for refrigeration other than for comfort cooling, provide listing of capacity for each and total for the system,

b. if program does not list energy consumption for refrigeration other than for comfort cooling separately in the output, then provide calculation of annual energy consumption for this end-use.

4. Cooking (as applicable):

a. where multiple units are to be installed for cooking, provide listing of capacity for each and total for the system,

b. if program does not list energy consumption for cooking separately in the output, then provide calculation of annual energy consumption for this end-use.

5. Other (as applicable):

a. provide supporting data for other end-uses (e.g. commercial washers and dryers, etc.),

b. if program does not list energy consumption for other end-uses separately in the output, then provide calculation of annual energy consumption for these end-uses.

K. Computer Printout of Inputs and Outputs

Provide inputs and outputs with pages numbered so cross-references can be made to the Energy Analysis Summary Form.

ENERGY ANALYSIS SUMMARY FORM

PROJECT INFORMATION

SDCI Project Address:						SDCI Project Number:				
Project Name:						Date of this submittal:				
	Conditioned Space						Unconditioned Space			
Bldg Use	Office	Retail	Group R			Subtotal	Parking		Subtotal	
Area (SF)										

ENERGY CONSUMPTION BY END-USE

		STANDARD REFERENCE DESIGN			PROPOSED DESIGN			DIFFERENCES		
END-USE	FUEL	Total Energy Use Estimate	BTU/ Cond. Sq.Ft.-Year	% of Standard Design Total	Total Energy Use Estimate	BTU/ Cond. Sq.Ft.-Year	% of Standard Design Total	Total Energy Use Estimate	BTU/ Cond. Sq.Ft. -Year	% of Standard Design Total
Lighting - interior				____%			____%			____ %
Lighting - parking				____%			____%			____ %
Lighting - façade				____%			____%			____ %
Space Heating (1)				____%			____%			____ %
Space Heating (2)				____%			____%			____ %
Space Cooling				____%			____%			____ %
Fans – interior ventilation				____%			____%			____ %
Fans – interior exhaust				____%			____%			____ %
Fans – parking garage				____%			____%			____ %
Service water heating				____%			____%			____ %

Office equipment				____%			____%			____ %
Elevators & escalators				____%			____%			____ %
Refrigeration (food, etc.)				____%			____%			____ %
Cooking (commercial)				____%			____%			____ %
_____				____%			____%			____ %
_____				____%			____%			____ %
Total				100%			100%			100%
Percent of Standard Reference Design: 100% = _____ % + _____ % = _____ %										

INSTRUCTIONS:

Electronic Version:

A spreadsheet version is available on the Seattle Energy Code website @

www.seattle.gov/dpd/energy

Project Information:

Enter DPD address, project number, and date of this Energy End-use Summary Form.

Enter the space uses in the building and the gross square footage of each.

(Add/revise headings as necessary.) Spreadsheet automatically calculates subtotals and total.

Energy Consumption by End-use:

Enter fuel source for each end-use (e.g. electric, gas, oil, steam, etc.).

Enter total energy consumption in **BTU** for each end-use for both the Standard Reference Design and Proposed Design.

(Spreadsheet calculates the BTU/conditioned-square-foot-year, percentages, and differences.)

DESIGN PARAMETER COMPARISON

Element	Standard	(Page)	Proposed	(Page)

	Design Value		Design Value	
Building Envelope				
Space heat type (electric resistance vs. other):				
Glazing: total vertical + overhead area (sq. feet):				
Glazing area as a percentage of gross wall (%):				
Overhead: total area (square feet):				
Overhead U-factor (weighted-average):				
Overhead SHGC (weighted-average):				
Vertical: total area (square feet):				
Vertical U-factor (weighted-average):				
Vertical SHGC (weighted-average):				
Roof: total area (square feet):				
Opaque roof: net area (square feet):				
Opaque roof U-factor (weighted-average):				
Wall: total above-grade area (square feet):				
Opaque above-grade wall: net area (square feet):				
Above-grade wall U-factor (weighted-average):				
Below-grade wall: net area (square feet):				
Below-grade wall U-factor (weighted-average):				
Opaque door: area (sq. feet):				
Opaque door U-factor (weighted-average):				
Floor over unconditioned space: area (sq. feet):				
Floor U-factor (weighted-average):				
Slab-on-grade floor: perimeter (lineal feet):				
Slab-on-grade F-factor (weighted-average):				
Below-grade slab floor: net area (square feet):				
Below-grade floor U-factor (weighted-average):				
Infiltration rate:				
Design heating load:				
Design cooling load:				
Lighting				
Interior				
Watts/sq.ft.: Office				
Watts/sq.ft.: Retail				
Watts/sq.ft.:				
Watts/sq.ft.:				

Parking/outdoor: total area (square feet)				
Watts/square foot				
Façade: total area (square feet)				
Watts/square foot				
Space Heating and Space Cooling System				
Space Heating: system type:				
Peak equipment efficiency:				
Output capacity:				
Percent of design heating load:				
Other features:				
Space Cooling: system type:				
Peak equipment efficiency:				
Output capacity:				
Percent of design cooling load:				
Other features:				
Ventilation				
Interior ventilation fans				
Economizer type (air or water):				
Economizer percentage:				
Supply fan: total CFM:				
Fan KW:				
Return fan: total CFM:				
Fan KW:				
Exhaust fan: total CFM:				
Fan KW:				
System Watts/CFM:				
Other features:				
Other features				
Service Water Heating				
Capacity:				
Other End-uses				
Fans – toilet and other exhaust: capacity (KW)				
Fans – parking garage: capacity (KW)				
Elevator and escalator: capacity				
Refrigeration: capacity				
Cooking: capacity				

_____: capacity				
_____: capacity				
_____: capacity				

Section 10. Chapter 1 of WAC 51-11R (Sections 51-11R-10000 through 51-11R-11100) are amended as follows:

CHAPTER 1 SCOPE AND ADMINISTRATION

SECTION R101

SCOPE AND GENERAL REQUIREMENTS.

R101.1 Title. This code, consisting of Chapter 1 [RE] through Chapter 5 [RE] and Appendices A through C, shall be known as the ((~~*Washington State Energy Code*~~)) "Seattle Residential Energy Code," and shall be cited as such. It is referred to herein as "this code."

***

SECTION R101.4

APPLICABILITY.

R101.4 Applicability. Where, in any specific case, different sections of this code specify different materials, methods of construction or other requirements, the most restrictive shall govern. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall govern.

***

R101.4.1 Mixed occupancy. Where a building includes both *residential* and *commercial* occupancies, each occupancy shall be separately considered and meet the applicable provisions of ((~~WSEC~~)) Seattle Energy Code – Commercial and Residential Provisions.

R101.5 Compliance. *Residential buildings* shall meet the provisions of ((~~WSEC~~)) Seattle Energy Code – Residential Provisions. *Commercial buildings* shall meet the provisions of ((~~WSEC~~)) Seattle Energy Code – Commercial Provisions.

***

R101.6 Landmark buildings. The building official may modify the specific requirements of this code for landmarks and require in lieu thereof alternate requirements that the *code official* determines will not have an adverse effect on the designated historic features of the building and will result in a reasonable degree of energy efficiency. A landmark is a building or structure that is subject to a requirement to obtain a certificate of approval from the City Landmarks Preservation Board before altering or making significant changes to specific features or characteristics, that has been nominated for designation or has been designated for preservation by the City Landmarks Preservation Board, that has been designated for preservation by the State of Washington, has been listed or determined eligible to be listed in the National Register of Historic Places, or is located in a landmark or special review district subject to a requirement to obtain a certificate of approval before making a change to the external appearance of the structure.

***

R102.1 Alternate materials, design and methods of construction and equipment. The provisions of this code do not ((~~are not intended to~~)) prevent the installation of any material or to prohibit any design or method of construction prohibited by this code or not specifically ((~~prescribed~~)) allowed by this code, provided that any such alternative has been *approved.* The code official shall be permitted to approve an alternate material, design or method of construction where the code official 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, at least the equivalent of that prescribed in this code.

The *code official* may approve an alternate material, method of construction, design or insulating system, provided the *code official* finds that the proposed alternate complies with the provisions of this code, and that the alternate, when considered together with other safety features of the building or other relevant circumstances, will provide at least an equivalent level of strength, effectiveness, fire resistance, durability, safety and sanitation.

The *code official* may require that sufficient evidence or proof be submitted to reasonably substantiate any claims regarding the use or suitability of the alternate. The *code official* may, but is not required to, record the approval of modifications and any relevant information in the files of the *code official* or on the approved permit plans.

R102.2 Modifications. The *code official* may modify the requirements of this code for individual cases provided the code *official* finds: (1) there are practical difficulties involved in carrying out the provisions of this code; (2) the modification is in conformity with the intent and purpose of this code; (3) the modification will provide a reasonable level of fire protection and structural integrity when considered together with other safety features of the building or other relevant circumstances, and (4) the modification maintains or improves the energy efficiency of the building. The *code official* may, but is not required to, record the approval of modifications and any relevant information in the files of the *code official* or on the approved permit plans.

SECTION R103

APPLICATIONS AND PERMITS ((~~CONSTRUCTION DOCUMENTS.~~))

R103.1 General. A permit for work performed according to this code shall be obtained in accordance with Chapter 1 of the International Residential Code, International Building Code, International Mechanical Code or Seattle Electrical Code.

R103.2 Construction documents. Construction documents, technical reports, and other supporting data shall comply with this section and the International Residential Code, the International Building Code, the International Mechanical Code, the International Existing Buildings Code and the Seattle Electrical Code. ((~~be submitted in one or more sets with each application for a permit. The construction documents and technical reports 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* is authorized to require necessary construction documents to be prepared by a registered design professional.~~

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

R103.2.1 Information on construction documents. Construction documents shall be drawn to scale upon suitable material. Electronic media documents are permitted to be submitted when *approved* by the *code official*. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment as herein governed. Details shall include, but are not limited to, the following as applicable:

1. Insulation materials and their *R*-values.
2. Fenestration *U*-factors and SHGCs.
3. Area-weighted *U*-factor and SHGC calculations.

4. Mechanical system design criteria.
5. Mechanical and service water heating system and equipment types, sizes and efficiencies.
6. Equipment and systems controls
7. Duct sealing, duct and pipe insulation and location.
8. Air sealing details.

R103.2.1 Building thermal envelope depiction. The building's thermal envelope shall be represented on the construction documents.

((~~**R103.3 Examination of documents.** The *code official* 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 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.~~

~~**R103.3.1 Approval of construction documents.** When the *code official* 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*. 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 a duly authorized representative.~~

~~**R103.3.2 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.~~

~~**R103.3.3 Phased approval.** The *code official* 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 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.~~

~~**R103.4 Amended construction documents.** Work shall be installed in accordance with the *approved* construction documents, and any changes made during construction that are not in compliance with the approved construction documents shall be resubmitted for approval as an amended set of construction documents.~~

~~**R103.5 Retention of construction documents.** One set of *approved* construction documents shall be retained by the *code official* 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.~~))

SECTION R104

INSPECTIONS.

R104.1 General. Construction or work for which a permit is required shall be subject to inspection by the *code official* ((~~or his or her designated agent, and such construction or work shall remain accessible and exposed for inspection purposes until *approved*. It shall be the duty of the permit applicant to cause the work to remain accessible and exposed for inspection purposes. Neither the code official 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.~~)) in accordance with this section, the International Residential Code or International Building Code, and the Seattle Electrical Code.

***

((**~~R104.4 Approved inspection agencies.~~** ~~The *code official* is authorized to accept reports of third-party inspection agencies not affiliated with the building design or construction, provided such agencies are approved as to qualifications and reliability relevant to the building components and systems they are inspecting.~~))

***

((**~~R104.7 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*.~~

~~R104.7.1 Revocation.~~ ~~The *code official* is authorized to, in writing, suspend or revoke 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.~~))

***

SECTION R106

REFERENCED STANDARDS.

R106.1 Referenced codes and standards. The codes and standards referenced in this code shall be those listed in Chapter 6, and such codes and standards shall be considered as part of the requirements of this code to the prescribed extent of each such reference and as further regulated in Sections R106.1.1 and R106.1.2.

R106.1.1 ((~~**Conflicts.** Where differences occur between provisions of this code and referenced codes and standards, the provisions of this code shall apply.~~)) **References to other codes.** Whenever an International, National or Uniform Code is referenced in this code, it means the Seattle edition of that code, including local amendments. References to the "Residential Code", "Fire Code", "Electrical Code", "Mechanical Code" and "Plumbing Code" mean the Seattle editions of those codes.

***

R106.3 Other laws. The provisions of this code shall not be deemed to nullify any provisions of local, state or federal law. ((~~In addition to the requirements of this code, all occupancies shall conform to the provisions included in the state building code (chapter 19.27 RCW). In case of conflicts among codes enumerated in RCW 19.27.031 (1) through (4) and this code, an earlier named code shall govern over those following.~~)) In the case of conflict between the duct sealing and insulation requirements of this code and the duct insulation requirements of Sections 603 and 604 of the *International Mechanical Code*, the duct insulation requirements of this code shall govern.

SECTION R107

FEES.

R107.1 Fees. A fee for each permit and for other activities related to the enforcement of this code shall be paid as set forth in the Fee Subtitle, Seattle Municipal Code Title 22, Subtitle IX..

((~~A permit shall not be issued until the fees prescribed in Section R107.2 have been paid, nor shall an amendment to a permit be released until the additional fee, if any, has been paid.~~

~~**R107.2 Schedule of permit fees.** A fee for each permit shall be paid as required, in accordance with the schedule as established by the applicable governing authority.~~

~~**R107.3 Work commencing before permit issuance.** Any person who commences any work before obtaining the necessary permits shall be subject to an additional fee established by the *code official*, which shall be in addition to the required permit fees.~~

~~**R107.4 Related fees.** The payment of the fee for the construction, *alteration*, removal or demolition of work done in connection to or concurrently with the work or activity authorized by a permit shall not relieve the applicant or holder of the permit from the payment of other fees that are prescribed by law.~~

~~**R107.5 Refunds.** The *code official* is authorized to establish a refund policy.~~))

SECTION R108

((~~STOP WORK ORDER.~~)) ENFORCEMENT

R108.1 Authority. The *code official* is authorized to enforce this code in accordance with the International Residential Code, International Building Code, International Mechanical Code and Seattle Electrical Code. ((~~Whenever the *code official* finds any work regulated by this code being performed in a manner either contrary to the provisions of this code or dangerous or unsafe, the *code official* is authorized to issue a stop work order.~~

~~**R108.2 Issuance.** The stop work order shall be in writing and shall be given to the owner of the property involved, or to the owner's authorized agent, or to the person doing the work. Upon issuance of a stop work order, the cited work shall immediately cease. The stop work order shall state the reason for the order, and the conditions under which the cited work will be permitted to resume.~~

~~**R108.3 Emergencies.** Where an emergency exists, the *code official* shall not be required to give a written notice prior to stopping the work.~~

~~**R108.4 Failure to comply.** Any person who shall continue any work after having been served with a stop work order, except such work as that person is directed to perform to remove a violation or unsafe condition, shall be subject to a fine as set by the applicable governing authority.~~))

SECTION R109

((~~BOARD OF APPEALS.~~)) ADMINISTRATIVE REVIEW

R109.1 Administrative review by the *code official*. Applicants may request administrative review by the *code official* of decisions or actions pertaining to the administration and enforcement of this code. Requests shall be addressed to the *code official*.

R109.2 Administrative review by the Construction Codes Advisory Board. Applicants may request review by the Construction Codes Advisory Board of decisions or actions pertaining to the application and interpretation of this code. The review will be performed by a panel of three or more members of the Construction Codes Advisory Board, chosen by the Board Chair. The Chair shall consider the subject of the review and members' expertise when selecting members to conduct a review. The decision of the review panel is advisory only; the final decision is made by the *code official*.

((~~**General.** In order to hear and decide appeals of orders, decisions or determinations made by the *code official* relative to the application and interpretation of this code, there shall be and is hereby created a board of appeals. The *code official* shall be an ex officio member of said board but shall have no vote on any matter before the board. The board of appeals shall be appointed by the governing body and shall hold office at its pleasure. The board shall adopt rules of procedure for~~

~~conducting its business, and shall render all decisions and findings in writing to the appellant with a duplicate copy to the *code official*.~~

~~**R109.2 Limitations on authority.** An application for appeal shall be based on a claim that the true intent of this code or the rules legally adopted thereunder have been incorrectly interpreted, the provisions of this code do not fully apply or an equally good or better form of construction is proposed. The board shall have no authority to waive requirements of this code.~~

~~**R109.3 Qualifications.** The board of appeals shall consist of members who are qualified by experience and training and are not employees of the jurisdiction.~~))

SECTION R110

VIOLATIONS.

It shall be unlawful for any person, firm, or corporation to erect or construct any building, or remodel or rehabilitate any existing building or structure in the state, or allow the same to be done, contrary to or in violation of any of the provisions of this code. Violations shall be administered according to the procedures set forth in Section 103 of the International Building Code or Section R103 the International Residential Code, as applicable.

SECTION R111

LIABILITY.

Nothing contained in this code is intended to be nor shall be construed to create or form the basis for any liability on the part of any city or county or its officers, employees or agents for any injury or damage resulting from the failure of a building to conform to the provisions of this code, or by reason or as a consequence of any inspection, notice, order, certificate, permission or approval authorized or issued or done in connection with the implementation or enforcement of

this code, or by reason of any action or inaction on the part of the City related in any manner to the enforcement of this code by its officers, employees or agents.

This code shall not be construed to relieve or lessen the responsibility of any person owning, operating or controlling any building or structure for any damages to persons or property caused by defects, nor shall the Department of Construction and Inspections or the City of Seattle be held to have assumed any such liability by reason of the inspections authorized by this code or any permits or certificates issued under this code.

Section 11. Ordinance 124614 and Sections 2 – 9 of Ordinance 124284 are repealed.

Section 12. Beginning on the effective date of this ordinance and ending on January 1, 2017, permit applicants who submit a valid and fully complete building permit application during that period may elect to have the application reviewed under the provisions of Ordinances 124284 and 124614 rather than this ordinance.

Section 13. The provisions of this ordinance are declared to be separate and severable. The invalidity of any clause, sentence, paragraph, subdivision, section or portion of this ordinance, or the invalidity of the application thereof to any person, owner, or circumstance shall not affect the validity of the remainder of this ordinance, or the validity of its application to other persons, owners, or circumstances.

Section 14. Section 11 of this ordinance shall take effect January 1, 2017.

Section 15. This ordinance shall take effect and be in force 30 days after its approval by the Mayor, but if not approved and returned by the Mayor within ten days after presentation, it shall take effect as provided by Seattle Municipal Code Section 1.04.020.

Passed by the City Council the 3rd day of October, 2016, and signed by me in open session in authentication of its passage this 3rd day of October, 2016.

President _____ of the City Council

Approved by me this 7th day of October, 2016.

Edward B. Murray, Mayor

Filed by me this 7th day of OCTOBER, 2016.

Monica Martinez Simmons, City Clerk

(Seal)