PROPOSED RULE MAKING

CR-102 (December 2017)
(Implements RCW 34.05.320)
Do **NOT** use for expedited rule making

CODE REVISER USE ONLY

OFFICE OF THE CODE REVISER
STATE OF WASHINGTON
FILED

DATE: January 05, 2022
TIME: 11:55 AM

WSR 22-02-076

Agency: Washington State Building Code Council

☒ **Original Notice**
☐ **Supplemental Notice to WSR _____**
☐ **Continuance of WSR _____**

☒ **Preproposal Statement of Inquiry was filed as WSR 21-07-129 ; or**
☐ **Expedited Rule Making--Proposed notice was filed as WSR _____; or**
☐ **Proposal is exempt under RCW 34.05.310(4) or 34.05.330(1); or**
☐ **Proposal is exempt under RCW _____.**

Title of rule and other identifying information: (describe subject) WAC 51-11C, Adoption and amendment of the 2021 Washington State Energy Code, Commercial

Hearing location(s):

Date:	**Time:**	**Location:** (be specific)	**Comment:**
February 25, 2022	10 am	**Virtual meeting via Zoom**	In response to the Governor's Emergency Proclamation there will not be a physical location. Please access the meeting via Zoom or Conference Phone provided in the agenda posted for that date on **sbcc.wa.gov**
March 11, 2022	10 am	**Virtual meeting via Zoom**	

Date of intended adoption: April 15, 2022 (Note: This is **NOT** the **effective** date)

Submit written comments to:
Name: Washington State Building Code Council
Address: PO Box 41449, Olympia WA 98504-1449
Email: sbcc@des.wa.gov
Fax:
Other:
By (date) March 11, 2021

Assistance for persons with disabilities:
Contact Annette Haworth
Phone: 360-407-9255
Fax:
TTY:
Email: sbcc@des.wa.gov
Other:
By (date) February 18, 2022

Purpose of the proposal and its anticipated effects, including any changes in existing rules: Update from the 2018 edition of the Washington State Energy Code to the 2021 edition, incorporating changes from the 2021 International Energy Conservation Code and those code changes submitted to increase energy savings and provide better clarity. There are a few instances where two or more submitted proposals that were approved conflict, and options are provided. Testimony on the preferred option is requested.

Below are highlights of the significant changes in the 2021 Washington State Energy Code. A complete description of all changes can be found at https://www.sbcc.wa.gov/state-codes-regulations-guidelines/rulemaking

Section	Subject	Description of change	Log Number/ Action
C401.2.2:	Process Form	This section was added to pull together all of the sections that reference requirements for process equipment elsewhere in the code.	21-GP1-129 AS 6/25/21
C402.1.1.1	Low energy buildings	This change clarifies that areas must meet the definition of an enclosed space to be considered a low energy building, making it clear that parking garages are not considered low energy buildings	21-GP1-225 AS 7/09/21
C402.1.1.2	Semiheated buildings	The semi-heated building provisions contains several proposed changes. The specification for other than electric resistance heating was removed to clarify that the previously allowed electric infrared heating equipment must also meet the limitations defined for semi-heated spaces. This also provides some clarity for the use of heat pumps with cooling disabled. Clarification is also proposed to specify that fenestration is still required to meet the code and is not considered part of the opaque wall. The term "standard reference" was updated to "baseline building design." The exceptions were modified to correlate with the other changes.	21-GP1-130 AM 7/16/21 21-GP1-158 AM 7/09/21
C402.1.3 footnote c & C402.1.4 footnote d (Option 1)	CMU Walls footnote modification	There are two options offered for both opaque thermal envelope tables. Option 1 modifies the mass wall footnote c, limiting the application of the exception single wythe concrete block walls exposed on both sides. Option 2 removes the exception.	21-GP1-207 AS 7/16/21
C402.1.3 footnote c & C402.1.4 footnote d (Option 2)	Elimination of footnote for CMU walls		21-GP1-208 AS 7/16/21
C402.1.3(i) Table	Continuous insulation, Stainless steel penetrations	Footnote j was modified to include values for stainless steel penetrations used with continuous insulation. The definition of continuous insulation was also modified to include reference to stainless steel fasteners.	21-GP1-157 AS 7/16/21
C402.1.3/C402 .1.4 Table	Mass Transfer Decks	Clarification to the existing definition from the Seattle code and corresponding change to Tables C402.1.3 and C402.1.4 clarifying how this detail is accounted for in the thermal performance calculations	21-GP1-150 AM 7/16/21
C402.1.4.3	PTAC U-factors	New section requires heat loss for PTAC, PTHP and other through-wall mechanical equipment to be calculated as part of the envelope using the U-factor compliance method, with corresponding changes to Tables C402.1.3 and C402.1.4	21-GP1-160 AS 7/16/21
C402.2.8, C402.2.9	Thermal bridging concrete balconies and fenestration framing	New sections to provide guidance on control of thermal bridging at concrete balconies (C402.2.8) and fenestration frames (C402.2.9).	21-GP1-159 AM 8/20/21
C402.4 Table	Reduce fenestration U-values	Window U-factors are reduced, a U-factor is added for operable windows under "…all others." Window orientation has been changed to fixed and operable to align with the IECC and the associated footnote struck. Values in Section C402.4.1.1.2 were also modified with a corresponding reduction in high performance fenestration requirements.	21-GP1-161 AM 7/30/21
C402.4.2	Minimum Skylight fenestration	The minimum skylight area was amended to better match the ASHRAE 90.1 language and requires skylights in any space under a roof that meets the criteria, not just single story spaces	21-GP1-131 AS 7/16/21
C402.5.2 and C402.5.3	Dwelling Unit Enclosure	The IECC changed the model code to require air barrier testing, as has been required by the WSEC for the last few	21-GP1-91 AM 7/16/21

		code cycles. The new language was modified to conform to existing WSEC requirements.	
C402.5.3	Building thermal envelope testing	The existing WSEC exception allowing up to 0.30 cfm per square foot leakage with corrective action is deleted and testing must not exceed the 0.25 cfm per square foot rate.	21-GP1-108 AS 7/16/21
C402.5.9	No vestibules required for doors to outdoor dining	New exception added to exempt doors accessing only outdoor seating areas.	21-GP1-162 AS 6/25/21
C403.1.1 and App D	HVAC Total System Performance Ratio	Adds multifamily residential to the list of occupancy types required to comply with TSPR, as well as providing system updates and clarifications to the procedure.	21-GP1-69 AM 7/23/21
C403.1.4, C503.4.6	Space Heating Proposal	Requires heat pump space hearing rather than fossil fuel or electric space heating for all buildings to provide a reduction in carbon emissions. Exceptions are provided to allow electric resistance heating for small loads and as supplemental heating, and for fossil fuel auxiliary heat in climate zone 5 under certain conditions.	21-GP1-103 AM 8/27/21
C403.10.3	Refrigerant piping clarifications	Clarifies that field installed HVAC refrigerant piping, strainer do not need to meet the requirements in Table C403.10.3. Three new exceptions were also added to exempt radiant heating systems, low temperature buried piping, and strainers and valves associated with small diameter piping.	21-GP1-226 AM 8/20/21
C403.10.3.1	Protection of piping insulation	Clarification on the requirements for protection of piping insulation exposed to weather.	21-GP1-155 AM 6/25/21
C403.15	Indoor Horticulture Dehumidification	Adds requirements for dehumidification efficiency for indoor growing facilities	21-GP1-95 AM 8/13/21
C403.2.2.1,	Over 150% Ventilation - DOAS with energy recovery	Allows greater than 150% ventilation if the DOAS has a very efficient ERV and doesn't use supplemental heat.	21-GP1-188 AM 7/23/21
C403.2.4	5 HP threshold for variable flow	Decreases the size threshold for variable speed drive requirements from 7.5 to 5.0 horsepower. Correlating change in Section C404.13, Item 4 as well.	21-GP1-163 AM 8/27/21
C403.3.7, C403.3.7.1	New sub-section to C403.3 Equipment Selection	C403.3.7 Hydronic Coil Selection C403.3.7.1 Chilled-Water Coil Selection Two new subsections based on ASHRAE 90.1 to require minimum temperature difference for hydronic coils for increased pump efficiency and primary equipment efficiency.	21-GP1-52 AM 7/30/21
C403.3.2.4	Extend HP requirement from packaged to include split systems	Requires packaged and split systems providing heating and cooling, or cooling only to be heat pumps. The requirement previously applied to packaged systems with both heating and cooling.	21-GP1-164 AS 6/25/21
C403.3.2.4, C403.4.1.1	Packaged electric heating and cooling equipment.	Requires that the specified heat pump be a heat pump with defrost and the ability to operate in heat pump mode whenever the air temperature is over 25 degrees and the unit is not in defrost.	21-GP1-194 AM 8/13/21
C403.3.4	Boiler Controls	New section with criteria for combustion air controls and minimum stake gas oxygen concentration levels for boiler systems, applicable to building and process boilers. Also adds associated definitions.	21-GP1-139 AS 6/25/21
C403.3.4.2 (new)	High capacity space heating boiler	Adds requirements from ASHRAE 90.1 for high capacity gas-fired hot water boiler systems to have condensing boilers	21-GP1-133 AS 6/25/21
C403.3.5	DOAS fan power	Updates language and reformats the heat/energy recovery requirements with DOAS to improve clarity. It also provides a calculation procedure for watts per cfm and clarifies which fans are required to be included in this calculation. Also adds a definition of DOAS.	21-GP1-110 AM 7/23/21

C403.3.5.1	60% enthalpy ERV required for DOAS, except R1/R2	Increase the ERV effectiveness to 60 percent enthalpy recovery effectiveness or 68 percent minimum sensible recovery effectiveness, from the previous values of 50/60 percent. The exception is also limited to 650 square feet, with a smaller allowance for occupant load.	21-GP1-165 AM 7/23/21
C403.3.5.1	DOAS DCV Exception	Clarifies the application of the demand control ventilation exception to the requirement for energy recovery with DOAS.	21-GP1-111 AM 7/23/21
C403.3.5.1, C403.3.6, C406.7	DOAS Sensible Recovery Readiness	Makes various language updates and content location changes to improve code clarity and incorporates the ASHR 1060 calculation for sensible recovery effectiveness.	21-GP1-113 AM 7/23/21
C403.3.5.5, C403.7.3	DOAS Tempering	Adds supplemental heating and cooling capacity sizing and control requirements to DOAS and makes changes for consistency with Section C403.7.3.	21-GP1-239 AM 8/13/21
C403.3.7 new section	Hydronic system max flow in piping system	Add a new section and table based on ASHRAE 90.1 language to limit the flow rate in critical circuits of hydronic systems to minimize flow resistance.	21-GP1-166 AM 8/13/21
C403.4.1	DR Thermostats	Adds a requirement for demand responsive controls for thermostats in all buildings except health care and assisted living. It does not require participation in any demand response programs.	21-GP1-97 AM 8/13/21
C403.4.11	DDC Controls	Clarify that for example standalone mini-split heat pump and PTHP's installed in a residential apartment building that have no need for an interface between each other require a central DDC system. This change would require water source heat pumps or water source VRF systems (for example) that are part of a central system to have central DDC Controls. Add definition from 90.1-2019	21-GP1-227 AM 8/20/21
C403.4.12 new section	Pressure independent control valves	New section to require modulating PICVs where the flow rate over coils is over 5 gpm.	21-GP1-167 AM 6/25/21
C403.4.4	Part load controls	Modification to allow the operation of thermal energy storage systems without reduced capacity at part-load conditions.	21-GP1-54 AS 7/30/21
C403.5	Group R2 Exclusion for Econo Exp 1	Modify exception 1 to exclude Group R-2, to prohibit the installation of PTHP and PTVP without economizer when combined with a DOAS.	21-GP1-185 AS 8/13/21
C403.5 Exceptions 1 and 5	Airside Economizer	Clarifies the language of exception 1 and exception 5 to specify the condensing unit portion of a split system can be installed outdoors as long as the supply fan coil portion of the unit is installed indoors and not in a mechanical room. Also adds a definition for mechanical room.	21-GP1-228 AM 8/20/21
C402.5.11 & C403.4.1.6	Operable Openings	The IECC added a section requiring operable openings to be interlocked with the HVAC system. The language was modified to correlate with the existing WSEC requirement in Section C403.4.1.6	21-GP1-240 AM 8/27/21
C403.7.1	DCV	Replaces the current DCV language with a new section and removes the energy recover exception and reduces various thresholds. Requires gas sensors in spaces and systems required to have VSD control. Correlating changes to C403.3.5.1 and C503.4.4.	21-GP1-190 AM 8/13/21 21-GP1-168 AS 6/25/21
C403.7.5	Garage Ventilation	Clarify that the requirements include repair garages and require VFD control in garages with systems 5 hp and greater..	21-GP1-191 AS 8/13/21 21-GP1-169 AM 6/25/21
C403.7.5.2	Parking garage vent controls	Clarifications to correlate with requirements in the mechanical code.	21-GP1-229 AS 8/13/21

C403.7.6	Increase ERV effectiveness, except R1/R2	The IECC separated out residential occupancies under the ERV requirements. This proposal increases the enthalpy recovery ratio from 50 to 60 percent for other than R-2 occupancies.	21-GP1-170 AS 6/25/21
C403.7.7.1.3	Kitchen DCV	Adds a definition for demand control kitchen ventilation and cleans up language and incorporates a requirement for DCKV on hoods over 2,000 cfm.	21-GP1-236 AM 8/13/21
C403.8, C503.4	Fan Power Alowance tables	Updates the approach to fan power limitations and aligns with the Title 24 method. It also moves the threshold down to cover smaller nameplate HP fans.	21-GP1-138 AM 7/23/21
C404.11.1	Pool water heaters over 2000 gallons	Requires heat pump water heaters on heated pools over 2000 gallons.	21-GP1-177 AS 7/23/21
C404.14	DR Water Heaters	Bring in demand response requirements for water heaters between 40 and 120 gallons to provide grid flexibility as a step towards decarbonization	21-GP1-99 AM 8/27/21
C404.2.1, C404.7, C503.59	Heat pump water heating	Provide heat pump water heating rather than fossil fuel or electric resistance water heating in commercial buildings to provide a reduction in carbon emissions. Exceptions are provided to allow electric resistance heating for hand washing facilities.	21-GP1-136 AM 8/13/21
C404.3.1 Table	Allow 8 feet of pipe length between circ pipe and lavatory, instead of just 1 or 2	Allows 8 feet of pipe length between circulating pipe and lavatory, instead of just 1 or 2 to permit circulating piping to run in ceiling cavity.	21-GP1-173 AS 6/25/21
C404.6.1	Storage tank insulation for higher-temperature storage	Requires thicker insulation for service water heating storage tanks designed for storage temperatures over 130 degrees.	21-GP1-174 AS 7/16/21
C404.7.1	Require thermostatic balancing valves and thermostatic mixing valves	Require service water circulation systems with multiple risers or zones and variable flow circulation pumps to use self-actuating thermostatic balancing valves. Also, where electronic thermostatic mixing valves are used, configure valves to remain closed or maintain current valve position upon power loss.	21-GP1-175 AS 7/16/21
C404.7.1, 404.7.1.1, C404.7.1.2	Circulation pump	Requires ECM motors for all service water heating circulation pumps.	21-GP1-182 AM 7/16/21
C404.7.3.1	Pipe insulation 1” thicker on circulation system piping	New section to require thicker insulation for service water system piping in the circulation loop.	21-GP1-176 AS 7/16/21
C405.13	UPS efficiency for computer rooms	Adds new section with requirements for UPS efficiency for computer rooms based on energy star requirements.	21-GP1-137 AS 8/20/21
C405.2	Require LLLC lighting or digital lighting control system for large open office areas.	Require LLLC (luminaire-level lighting controls) or enhanced digital lighting control system for open office areas larger than 5,000 sf. Permit several adjacent fixtures within one daylight zone to be controlled together. Reduce allowance for 24/7 lighting from 0.02 down to 0.01 watts per sf.	21-GP1-178 AM 7/09/21
C405.4.2.1/C405.4.2.2	Interior Lighting Allowance	Clarifies the methodology for choosing the correct allowance for buildings or spaces that are occupied at different times for different purposes.	21-GP1-76 AM 7/09/21
C405.2.1	Occupant Sensor Controls	Clarification and alignment of WSEC requirements with IECC 2021 formatting.	21-GP1-93 AM 7/09/21
C405.2.1 Ex 4	Timer Switches	Eliminates the exception for timer switches. Correlating change to Section C4052.2.	21-GP1-92 AS 7/09/21

C405.2.1.4, C405.2.8	Parking Garage Lighting	Correlation of the parking garage occupant sensor controls with the ASHRAE 90.1 requirements.	21-GP1-127 AS 7/09/21
C405.2.4	Daylight Harvesting	Changing the fixture number threshold to a wattage based threshold.	21-GP1-026 AM 7/09/21
C405.2.7.3	Lighting setback	Decreases the lamp wattage for luminaires requiring activity sensor control.	21-GP1-125 AM 7/09/21
C405.3	Plant light efficacy	Sets a new metric for lighting for plant growth, along with a definition of photosynthetic photon efficacy, and reduces the exception threshold.	21-GP1-98 AM 7/09/21
C405.4.2(2) footnotes / C405.2.2.1	Additional interior lighting power	Revises the footnotes on display and ornamental lighting and what use types can take advantage of which types of increased lighting.	21-GP1-94 AM 8/27/21
C405.5.1	Exterior building grounds lighting	Lowers the threshold for lighting efficacy requirements from 50 watts to 25 watts and simplifies the language.	21-GP1-204 AM 7/09/21
C405.5.3	Exterior Lighting	Updates the exterior lighting tables in response to changes in technology, with an approximate 40 percent reduction across the board.	21-GP1-198 AM 7/09/21
C405.7.1	Electrical receptacles at gas appliances	Requires electric receptacles at dwelling unit gas appliances, to enable future installation of electric appliances.	21-GP1-179 AM 8/13/21
C406	HVAC applications	Adds load management requirements for new buildings to prepare buildings to interact efficiency with the evolving electrical grid in the future. Corresponding change also made to Section C403.4.11.1. Reformats Section C406 and sets credit requirements by occupancy type. The metric was changed to carbon emission and a standard of 0.1% reduction per point was set as the basis.	21-GP1-206 AM 8/27/21
C406	Additional efficiency	Increases the required number of energy efficiency credits to be achieved. The requirements were increased approximately 16 percent, if the heat pump water heating proposal is adopted, and by approximately 33 percent if it is not.	21-GP1-146 AM 8/27/21
C406.1	Additional energy efficiency credit requirements	Clarifies which space conditioning categories are subject to C406 compliance and clarifies application language.	21-GP1-230 AM 7/30/21
C406	A number of new options were added to C406 by proposals: Low-Carbon district energy Heat pump dryers Enhanced Commercial Kitchen equipment High performance temperature maintenance system High efficiency circulation systems Low flow showerheads for R-1 and R-2 occupancies Clarification of service water heat pump efficiencies Offsite Renewables		21-GP1-121 21-GP1-231 21-GP1-106 21-GP1-213 21-GP1-215 21-GP1-218 21-GP1-212 21-GP1-120 All AM 8/27/21
C407	Total Building Performance	Increases the stringency of the building performance factors used to set emissions targets which are based on regulated loads only by 10% over the previous code. Note that if the carbon emissions factors in Table C407.3(1) are updated during development of the 2022 code, the Building Performance Factors in Table C407.3(2) should be updated by PNNL to match the intent of this proposal. Added a second metric for compliance based on site energy performance that includes all loads (regulated and unregulated). The target for this new site energy metric is based on a tiered improvement from the 2018 WSEC to a 0.3 site energy use performance index by 2030 compared to the Appendix G Standard 90.1-2004 baseline (see table and graph	21-GP1-70 AM 8/27/21

		below). This is meant to meet the intent of the Washington State policy goal of having a code in 2030 that will result in new buildings that use 30% of the site energy of a building built to the 2006 WSEC. Adds allowances for reductions in site energy to be satisfied by use of on-site or off-site renewable energy sources and improvements to unregulated loads, as approved by the jurisdiction. The remaining existing carbon metric will not allow credit for improvements in unregulated loads or renewable energy systems, thus preserving the energy efficiency of the building itself. Sets criteria for how off-site renewable energy systems will be credited patterned after those in ASHRAE Standards 189.1 and 228. This includes discounting of credit, requirements for tracking renewable energy certificates, and other documentation.	
C407.3	Low-Carbon district energy x 2	Add section on how to utilize low carbon district energy systems in Total Building Performance. Adds associated definitions.	21-GP1-122 AM 8/27/21
Table C407.3(1)	updated carbon emissions factor	Updates the carbon emissions factor metric for electricity to 0.44 based on the Clean Energy Transformation Act effects.	21-GP1-156 AS 6/25/21
C408	Lower Commissioning exception thresholds	Reduces commissioning exception thresholds.	21-GP1-101 AM 8/20/21
C409	Metering	Editorial changes for clarification throughout the section.	21-GP1-222 21-GP1-238 21-GP1-223 AM 8/27/21
C410	Refrigeration	The IECC completely restructured the refrigeration sections for the 2021 code. The result here is a hybrid of the changes to the 2021 code, including the new tables and modifications to retain some of the existing WSEC language to retain requirements for some federally unregulated applications.	21-GP1-128 AM 8/27/21
C411	Renewable Energy	Requires on-site renewable energy generation for commercial buildings over 10,000 square feet.	21-GP1-78 AM 8/27/21
C411.1, C502.1, C503.1, C505.1	Solar Readiness Provision	Provides guidance on how solar readiness requirements are applied to existing buildings.	21-GP1-115 AS 8/20/21
C412	COMPRESSED AIR	New section proposed to regulate compressed air systems based on language from the Seattle code and California's Title 24 (2022 edition). This would apply to process loads.	21-GP1-193 AM 8/20/21
C501.2, C503.2, C503.3, C505.1	Change in space conditioning	The IECC relocated change in space conditioning to C503 Additions for the 2021 code. This proposal moves those requirements into the change of occupancy or use Section C505.	21-GP1-114 AM 8/27/21
C502, C503, new C506	Historic Buildings	Reverts the WSEC language back to the base IECC model code language.	21-GP1-102 AS 8/27/21
C503.3.1	Roof retrofit	Clarification of roof replacement when existing roof is uninsulated.	21-GP1-151 AS 6/25/21
Table C503.4	PTHP PTAC	Adds two rows to Table C503.4 to cover replacement of PTAC, PTHP, PVAC and PVHP for economizer compliance options.	21-GP1-183 AS 8/27/21
C503.6	Reduce threshold for LPA compliance from 50% to 20%	Requires alterations replacing 20 precent or more of existing lighting fixtures to comply with the lighting power allowance in Section C405. The previous threshold was 50 percent.	21-GP1-180 AM 7/09/21

App F	F101.3.2 Table	Updates to the EUI table of the Outcome based energy budget based on the 2018 Status report to the legislature towards the 70 percent reduction goal.	21-GP1-90 AM 6/25/21

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Reasons supporting proposal: The proposal helps increase energy efficiency towards the goals in RCW 19.27A.020, 19.27A.160, and Executive Order 16-07 and provides additional clarity in regulations to assist both builders and enforcers.

Statutory authority for adoption: RCW 19.27A.020, 19.27A.025, 19.27A.160

Statute being implemented: RCW 19.27A, 19.27

Is rule necessary because of a:

Federal Law?	☐ Yes	☒ No
Federal Court Decision?	☐ Yes	☒ No
State Court Decision?	☐ Yes	☒ No

If yes, CITATION:

Agency comments or recommendations, if any, as to statutory language, implementation, enforcement, and fiscal matters:

Name of proponent: (person or organization) Washington State Building Code Council and various stakeholders

☐ Private
☐ Public
☒ Governmental

Name of agency personnel responsible for:

	Name	Office Location	Phone
Drafting:	Krista Braaksma	1500 Jefferson SE, PO Box 41449, Olympia WA	(360) 407-9278
Implementation:	Krista Braaksma	1500 Jefferson SE, PO Box 41449, Olympia WA	(360) 407-9278
Enforcement:	Local Jurisdictions		

Is a school district fiscal impact statement required under RCW 28A.305.135? ☐ Yes ☒ No

If yes, insert statement here:

The public may obtain a copy of the school district fiscal impact statement by contacting:

Name:
Address:
Phone:
Fax:
TTY:
Email:
Other:

Is a cost-benefit analysis required under RCW 34.05.328?

☒ Yes: A preliminary cost-benefit analysis may be obtained by contacting:

Name: Stoyan Bumbalov
Address: 1500 Jefferson SE, PO Box 41449, Olympia WA 98504-1449
Phone: (360) 407-9277
Fax:

TTY:
Email: Stoyan.bumbalov@des.wa.gov
Other:

☐ No: Please explain:

Regulatory Fairness Act Cost Considerations for a Small Business Economic Impact Statement:

This rule proposal, or portions of the proposal, **may be exempt** from requirements of the Regulatory Fairness Act (see chapter 19.85 RCW). Please check the box for any applicable exemption(s):

☐ This rule proposal, or portions of the proposal, is exempt under RCW 19.85.061 because this rule making is being adopted solely to conform and/or comply with federal statute or regulations. Please cite the specific federal statute or regulation this rule is being adopted to conform or comply with, and describe the consequences to the state if the rule is not adopted.
Citation and description:

☐ This rule proposal, or portions of the proposal, is exempt because the agency has completed the pilot rule process defined by RCW 34.05.313 before filing the notice of this proposed rule.

☐ This rule proposal, or portions of the proposal, is exempt under the provisions of RCW 15.65.570(2) because it was adopted by a referendum.

☐ This rule proposal, or portions of the proposal, is exempt under RCW 19.85.025(3). Check all that apply:

☐ RCW 34.05.310 (4)(b) (Internal government operations)

☐ RCW 34.05.310 (4)(c) (Incorporation by reference)

☐ RCW 34.05.310 (4)(d) (Correct or clarify language)

☐ RCW 34.05.310 (4)(e) (Dictated by statute)

☐ RCW 34.05.310 (4)(f) (Set or adjust fees)

☐ RCW 34.05.310 (4)(g) ((i) Relating to agency hearings; or (ii) process requirements for applying to an agency for a license or permit)

☐ This rule proposal, or portions of the proposal, is exempt under RCW _____.
Explanation of exemptions, if necessary:

COMPLETE THIS SECTION ONLY IF NO EXEMPTION APPLIES

If the proposed rule is **not exempt**, does it impose more-than-minor costs (as defined by RCW 19.85.020(2)) on businesses?

☐ No Briefly summarize the agency's analysis showing how costs were calculated. _____

☒ Yes Calculations show the rule proposal likely imposes more-than-minor cost to businesses, and a small business economic impact statement is required. Insert statement here:
There are costs imposed by the proposed rules but the costs do not fall disproportionately on small businesses. These rules will not affect the distribution of impacted work, whether by small businesses or not, doing the work. The rules do not impact employment, reporting or record keeping

Description

The Washington State Building Code Council (Council) is filing a proposed rule to adopt the updated 2021 edition of the International Energy Conservation Code with state amendments, known as the 2021 Washington State Energy Code (WSEC): WAC 51-11C. Since 1985 the state building code council has been responsible to update to new editions of the building code per RCW19.27.074.

The administrative compliance requirements are under the authority of the local government. RCW19.27.050. Enforcement activities including permit issuance, plan review and approval, and inspections occur at the local level. Requirements for construction document submittal and other reporting requirements are determined by the local jurisdiction and are consistent with previously established policies. The proposed amendments to WAC 51-11C include specific technical requirements for building construction to be consistent with national standards.

The WSEC is updated every three years by the Council. The code development process conducted by the model code organization is open to all interest groups within the design and construction industry and from governmental organizations. See www.iccsafe.org for more information about the model code development process.

Professional Services

Washington has had a statewide building code in effect since 1974. The local enforcement authority having jurisdiction administers the codes through the building and/or fire departments. Administrative procedures for state building code compliance are

established and will not be changed by the adoption of the update to the current building codes. Small businesses will employ the same types of professional services for the design and construction of buildings and systems to comply with the state building code.

The proposed rule updates the state building code and does not require additional equipment, supplies, labor or other services. Services needed to comply with the building code are existing within the construction industry as required by the local authority having jurisdiction.

Costs of Compliance for Businesses

The Council accepts proposals to amend the WSEC to meet the legislative goals. The statewide code amendment proposal process is defined in WAC 51-04 and the Council by-laws. Proposals must increase the energy efficiency in buildings. Each proponent must identify where a proposed amendment has an economic impact and must quantify costs. The Council developed a specific set of forms for the Washington state energy code, so proponents could identify where a proposed amendment was editorial, technical or a policy change.

The Council received 161 proposals to improve the Washington state energy code. The energy code technical advisory group (TAG) recommended approval of 118 amendments as submitted or as modified. 23 proposed amendments were identified by the TAG as having a significant cost.

The Energy Code technical advisory group (TAG) and the Council Economic workgroup determined there is a cost for compliance on businesses for the following proposed state amendments. The Council recommended filing the proposed rule to allow input through the public hearing process.

1. WSEC C403.1.4, C503.4.6 Heat pump space heating (Proposal 21-GP1-103): Requires heat pump space hearing rather than fossil fuel or electric space heating for all buildings to provide a reduction in carbon emissions. Exceptions are provided to allow electric resistance heating for small loads and as supplemental heating, and for fossil fuel auxiliary heat in climate zone 5 under certain conditions. Cost: $0.24 per square foot. Energy Savings: Cost savings of $0.70 per square foot or $2.70 per square foot including the social cost of carbon.
2. WSEC C404.2.1, C404.7, C503.5 Heat pump water heating (Proposal 21-GP1-136): Provide heat pump water heating rather than fossil fuel or electric resistance water heating in commercial buildings to provide a reduction in carbon emissions. Exceptions are provided to allow electric resistance heating for hand washing facilities. Cost: $2.47 per square foot, with a $2.43 per square foot lifecycle cost increase without taking into account the social cost of carbon. When accounting for the adjusted social cost of carbon, there is an estimated $0.38 per square foot savings, with an average energy savings of 5.5 kBtu per square foot.
3. WSEC C405.7.1 Electrical receptacles at gas appliances (Proposal 21-GP1-179): Requires electric receptacles at dwelling unit gas appliances, to enable future installation of electric appliances. Cost: $250 per receptacle; square foot cost will vary depending on how many gas appliances are installed.
4. WSEC C411 Renewable energy (Proposal 21-GP1-078): Requires on-site renewable energy generation for commercial buildings over 10,000 square feet. Cost: $0.05 per square foot to install 0.50 W/sqft PV system. Energy Savings: 3-17% in annual energy savings. The payback for this measure is disputed, with the proponent stating a 17 year payback and the PUD association stating an average 25 year payback, with a worst case of 98 years.
5. WSEC Tables C402.1.3, C402.1.4 CMU Walls footnotes Option 1 (Proposal 21-GP1-207): This change (Option 1) would modify the mass wall footnote in both tables, limiting the application of the exception to single wythe concrete block walls exposed on both sides. Cost: The estimated cost of installing interior insulation would be equivalent to the cost of insulating the cores, with a net result of no cost increase. Energy Savings: The estimated annual energy savings is 0.2 kBtu per square foot for those buildings no longer able to apply the exception.
6. WSEC Tables C402.1.3, C402.1.4 CMU Walls footnotes Option 2 (Proposal 21-GP1-208): This change (Option 2) would eliminate the mass wall footnote on both tables, requiring CMU walls to be insulated to the R-value or U-factor in the table. Cost: The estimated cost is between $2.52 and $2.99 per square foot. Energy Savings: 0.2 kBtu per square foot.
7. WSEC C403.1.1, Appendix D HVAC Total system performance ratio (Proposal 21-GP1-069): Adds multifamily residential to the list of occupancy types required to comply, as well as providing system updates and clarifications to the procedure. Cost: For multifamily, it will add to the design costs at an estimated $0.02 per square foot. It will also require additional plan review time.
8. WSEC C403.15 Indoor horticulture dehumidification (Proposal 21-GP1-095): Adds requirements for dehumidification efficiency for indoor growing facilities. Cost: $8.11 per square foot. Energy Savings: 80 to 81 kBtu per square foot.
9. WSEC C404.14 Demand response water heaters (Proposal 21-GP1-099): Bring in demand response requirements for water heaters between 40 and 120 gallons to provide grid flexibility as a step towards decarbonization. Cost: If the heat pump water heater proposal is adopted, there will be no incremental cost for demand responsive controls. If not, there will be an estimated $1000 incremental cost. Energy Savings: Although a HP water heater would deliver a 60% savings on average, the intent is to serve peak energy.
10. WSEC C412 Compressed air (Proposal 21-GP1-193): New section proposed to regulate compressed air systems based on language from the Seattle code and California's Title 24 (2022 edition). This would apply to process loads. There is a significant first cost that varies on the size of the installed system. The modeled system was based on worst case scenarios in the California

cost benefit modeling and show a first cost of just over $300,000 (not broken down by square footage), with ongoing maintenance costs. Energy Savings: Based on the same model, annual energy savings totaled over 274,000 kWh with a 7% reduction of carbon emissions.

11. WSEC Table C406.1 Additional energy efficiency (Proposal 21-GP1-146): Increases the required number of energy efficiency credits to be achieved. The requirements were increased approximately 16 percent, if the heat pump water heating proposal is adopted, and by approximately 33 percent if it is not. The cost will vary greatly depending on the type of building and the measures selected. Not all measures are appropriate for all building types. Energy Efficiency: There will be some variation here as well, since not all building types have the same credit requirements. However, the average credit increase is 8, with each point corresponding to a 0.1 percent carbon reduction for an average 0.8 percent reduction.

12. WSEC C406.3 Load management credits (Proposal 21-GP1-206): Adds load management requirements for new buildings to prepare buildings to interact efficiency with the evolving electrical grid in the future. Costs: Range from $19,900 for a 240,000 sf hospital to $453 for a 5,000 sf office or restaurant, with simple payback ranging from 1.1 year (restaurant) to 25.0 years (warehouse), with a 3.66 year statistical average. Demand responsive lighting controls cost approximately $0.0825 per square foot. Energy Savings: Annual energy savings ranged from $5,700 for the hospital to $117 for the 5,000 sf office, with the statistical average of a 3.66 year payback.

13. WSEC C503.6, Reduced threshold for existing lighting replacement compliance (Proposal 21-GP1-180): Requires alterations replacing 20 precent or more of existing lighting fixtures to comply with the lighting power allowance in Section C405. The previous threshold was 50 percent. Cost: Estimate of $0.75 per square foot. Energy Savings: Estimate of 0.13 kWh per square foot.

14. WSEC C403.3.4 Boiler controls (Proposal 21-GP1-139): New section with criteria for combustion air controls and minimum stake gas oxygen concentration levels for boiler systems, applicable to building and process boilers. Cost: Estimated cost of $0.098 per square foot with ongoing maintenance costs. Energy Savings 2.116 kBtu per square foot.

15. WSEC C403.8.1, C503.4 (Proposal 21-GP1-138): Updates the approach to fan power limitations and aligns with the Title 24 method. It also moves the threshold down to cover smaller nameplate HP fans. Cost: $0.29 per square foot. Savings: 0.372 kWh per square foot (B/C ratio average of 3.8 across all building types) or about 2 percent energy savings per building.

16. WSEC C402.1.4.3 PTAC U-factors (Proposal 21-GP1-160): Requires heat loss for PTAC, PTHP and other through-wall mechanical equipment to be calculated as part of the envelope U-factor compliance method. Cost: $0.24 per square foot. Energy Savings: 36 kWh per year per dwelling/sleeping unit or about 0.013 kWh per square foot per year.

17. WSEC C403.3.2.4 Require heat pump for split systems (Proposal 21-GP1-164): Requires packaged and split systems providing heating and cooling, or cooling only to be heat pumps. The requirement previously applied to packaged systems with both heating and cooling. Cost: Estimated at $0.10 per square foot. Energy Savings: Estimated at 5.4 kBtu per square foot per year, or approximately a 60% reduction of heating energy.

18. WSEC C403.3.4.2 High capacity space heating boiler (Proposal 21-GP1-133): Adds requirements from ASHRAE 90.1 for high capacity gas-fired hot water boiler systems to have condensing boilers. Cost: Average estimate of $0.10 per kWh across various building types and climate zones. Energy Savings: Using the Standard 90.1 scalar ratio, the economic analysis shows an average scalar ratio of 4.2. The maximum scalar ratio of 17.2 for boilers with a life expectancy of 25 years. Models and estimates show that all prototypes fall within the maximum scalar ratio and are cost-effective.

19. WSEC C403.3.5.1 Require 60 percent enthalpy energy recover ventilation with DOAS (Proposal 21-GP1-165): Increase the ERV effectiveness to 60 percent enthalpy recovery effectiveness or 68 percent minimum sensible recovery effectiveness, from the previous values of 50/60 percent. The exception is also limited to 650 square feet, with a smaller allowance for occupant load. Cost: Estimate of $0.10 per square foot. Energy Savings: 0.1 kWh per square foot per year, assuming HVAC is one-third of total energy use, or a 2 percent reduction in annual HVAC energy.

20. WSEC C403.4.1 Demand responsive thermostat controls (Proposal 21-GP1-097): Adds a requirement for demand responsive controls for thermostats in all buildings except health care and assisted living. It does not require participation in any demand response programs. Cost: $0.03 per square foot, based on an assumption of $30 per unit controlling a 1000 square foot zone. Energy Savings: A California study reported an annual energy savings of 83 to 274 kWh.

21. WSEC C403.7.1 Demand control ventilation (Proposal 21-GP1-190): Replace the existing DCV section with updated language and expanded scope to require DCV in more spaces and systems, and removes the exemption for energy recovery. Cost and savings are based on ASHRAE 90.1 Addendum b, scaled down to show as cost effective in the OFM lifecycle cost tool. Cost: $300 per zone. Energy Savings: The ASHRAE model showed savings of 108 kWh and 75 therms for a two-zone model. For the cost savings of 47 kWh and 33 therms (for two zones) were found to be cost effective in the OFM calculator.

22. WSEC C405.5.1 Exterior building lighting (Proposal 21-GP1-204): Lowers the threshold for lighting efficacy requirements from 50 watts to 25 watts and simplifies the language. Cost: With LED fixtures as the dominant light source, there is no cost associated to achieve the higher efficacy requirement. Energy Savings: Estimated at 0.109 kWh per square foot, assuming 4,380 hours of operation.

23. WSEC C405.5.3 Exterior lighting (Proposal 21-GP1-198): Updates the exterior lighting tables in response to changes in technology, with an approximate 40 percent reduction across the board. Cost: Limited economic impact on building owners, tenants, and business. The values in the table have not been updated since 2016. As of 2016, LED technology was relatively new,

and the efficacy was around 82 lm/W. As of 2021, exterior LEDs are easily 105 lm/W and many exceed 120 lm/W. In 2016, light loss factors for LEDs were somewhat an unknown. As of 2021, the lighting industry's knowledge is deeper and different light loss factors are used now. These values are change in available lighting technology as well as informed design practices. Energy Savings: 0.08 kWh per square foot, assumed at 30,000 square foot parking lot, with the LPD reduced by 40 percent.

Loss of Sales or Revenue

The proposed rules make the state code for building construction consistent with national standards. Businesses with new products or updated test or design standards are recognized in the updated building code. For these businesses there will be a gain in sales and revenue.

The results of reduced energy use in buildings include avoiding the need for new power generation, reducing environmental impact, and providing local employment. The legislative findings state that energy efficiency is the cheapest, quickest, and cleanest way to meet rising energy needs, confront climate change, and boost our economy.

Cost of Compliance for Small Businesses

The majority of businesses affected by the updates to the building codes are small businesses; over 95 percent of those listed in the construction and related industries have under 50 employees. The costs per employee are comparable between the largest businesses and the majority of small businesses. The cost to comply with the updated codes is not a disproportionate impact on small business. Where the Council found the cost of compliance for small businesses to be disproportionate, the proposed rule mitigates the cost. The proposed rules include a definition of small business and provide exceptions for compliance with the updated rule.

Small Businesses Involved in the Development of the Rule

The SBCC conducted open public meetings of the energy code technical advisory group (TAG), available via zoom and telephone conference bridge, and allowed comment on every item on every agenda. The SBCC appointed over 100 representatives of all segments of the business and construction community to serve on the technical advisory groups.

List of Industries

Below is a list of industries required to comply with the commercial energy code:

2017 Industry NAICS Code	NAICS Code Title	Minor Cost Estimate	1% of Avg Annual Payroll	0.3% of Avg Annual Gross Business Income
236116	New Multifamily Housing Construction (except For-Sale Builders)	$ 32,067.43	$17,160.94 2020 Dataset pulled from USBLS	$32,067.43 2020 Dataset pulled from DOR
236118	Residential Remodelers	$ 1,457.74	$1,457.74 2020 Dataset pulled from USBLS	$901.20 2020 Dataset pulled from DOR
236210	Industrial Building Construction	$59,169.45	$59,169.45 2020 Dataset pulled from ESD	$53,925.71 2020 Dataset pulled from DOR
236220	Commercial and Institutional Building Construction	$41,552.81	$18,126.81 2020 Dataset pulled from ESD	$41,552.81 2020 Dataset pulled from DOR
238110	Poured Concrete Foundation and Structure Contractors	$ 3,442.28	$5,027.07 2019 Dataset pulled from CBP	$3,442.28 2020 Dataset pulled from DOR
238120	Structural Steel and Precast Concrete Contractors	$ 15,401.97	$20,212.19 2019 Dataset pulled from CBP	$15,401.97 2020 Dataset pulled from DOR
238130	Framing Contractors	$2,234.30	$3,139.71 2019 Dataset pulled from CBP	$2,234.30 2020 Dataset pulled from DOR
238140	Masonry Contractors	$ 1,900.60	$3,582.13 2019 Dataset pulled from CBP	$1,900.60 2020 Dataset pulled from DOR
238150	Glass and Glazing Contractors	$5,255.36	$9,574.95 2019 Dataset pulled from CBP	$5,255.36 2020 Dataset pulled from DOR
238160	Roofing Contractors	$ 3,589.99	$5,007.86 2019 Dataset pulled from CBP	$3,589.99 2020 Dataset pulled from DOR

238170	Siding Contractors	$ 1,905.61	$2,485.86 2019 Dataset pulled from CBP	$1,905.61 2020 Dataset pulled from DOR
238190	Other Foundation; Structure; and Building Exterior Contractors	$ 4,622.07	$4,141.38 2019 Dataset pulled from CBP	$4,622.07 2020 Dataset pulled from DOR
238210	Electrical Contractors and Other Wiring Installation Contractors	$ 5,941.60	$9,599.33 2019 Dataset pulled from CBP	$5,941.60 2020 Dataset pulled from DOR
238220	Plumbing; Heating; and Air-Conditioning Contractors	$ 5,353.76	$11,047.00 2019 Dataset pulled from CBP	$5,353.76 2020 Dataset pulled from DOR
238290	Other Building Equipment Contractors	$ 4,335.21	$16,142.07 2019 Dataset pulled from CBP	$4,335.21 2020 Dataset pulled from DOR
238310	Drywall and Insulation Contractors	$3,725.66	$9,461.67 2019 Dataset pulled from CBP	$3,725.66 2020 Dataset pulled from DOR
238990	All Other Specialty Trade Contractors	$ 3,585.74	$3,677.28 2019 Dataset pulled from CBP	$3,585.74 2020 Dataset pulled from DOR
321214	Truss Manufacturing	$28,620.35	$23,341.04 2020 Dataset pulled from ESD	$28,620.35 2020 Dataset pulled from DOR
321911	Wood Window and Door Manufacturing	$ 45,151.12	$18,811.08 2020 Dataset pulled from ESD	$45,151.12 2020 Dataset pulled from DOR
321992	Prefabricated Wood Building Manufacturing	$ 5,391.09	$5,391.09 2020 Dataset pulled from ESD	$4,888.53 2020 Dataset pulled from DOR
327310	Cement Manufacturing	$ 50,878.29	$44,741.20 2020 Dataset pulled from ESD	$50,878.29 2020 Dataset pulled from DOR
327320	Ready-Mix Concrete Manufacturing	$64,317.30	$46,126.21 2020 Dataset pulled from ESD	$64,317.30 2020 Dataset pulled from DOR
327331	Concrete Block and Brick Manufacturing	$ 15,030.60	$15,030.60 2020 Dataset pulled from ESD	$10,431.02 2020 Dataset pulled from DOR
332311	Prefabricated Metal Building and Component Manufacturing	$ 21,638.20	$10,043.73 2020 Dataset pulled from USBLS	$21,638.20 2020 Dataset pulled from DOR
332312	Fabricated Structural Metal Manufacturing	$22,220.31	$16,337.10 2020 Dataset pulled from USBLS	$22,220.31 2020 Dataset pulled from DOR
332321	Metal Window and Door Manufacturing	$ 26,369.28	$14,505.40 2020 Dataset pulled from ESD	$26,369.28 2020 Dataset pulled from DOR
332322	Sheet Metal Work Manufacturing	$ 23,337.23	$23,337.23 2020 Dataset pulled from ESD	$16,556.52 2020 Dataset pulled from DOR
335121	Residential Electric Lighting Fixture Manufacturing	$ 2,011.37	$2,011.37 2020 Dataset pulled from USBLS	$1,502.01 2020 Dataset pulled from DOR
335122	Commercial; Industrial; and Institutional Electric Lighting Fixture Manufacturing	$ 6,357.34	--	$6,357.34 2020 Dataset pulled from DOR
335129	Other Lighting Equipment Manufacturing	$ 6,281.32	$6,281.32 2020 Dataset pulled from ESD	$2,494.40 2020 Dataset pulled from DOR
423720	Plumbing and Heating Equipment and Supplies (Hydronics) Merchant Wholesalers	$24,486.53	$16,589.10 2020 Dataset pulled from ESD	$24,486.53 2020 Dataset pulled from DOR

541310	Architectural Services	$ 9,221.65	$9,221.65 2020 Dataset pulled from ESD	$3,738.99 2020 Dataset pulled from DOR
541330	Engineering Services	$14,801.92	$14,801.92 2020 Dataset pulled from USBLS	$7,177.43 2020 Dataset pulled from DOR
111419	Other Food Crops Grown Under Cover	$3,263.61	$3,263.61 2020 Dataset pulled from USBLS	$3,047.66 2020 Dataset pulled from DOR
111998	All Other Miscellaneous Crop Farming	$11,782.08	$11,782.08 2020 Dataset pulled from USBLS	$3,518.45 2020 Dataset pulled from DOR

The public may obtain a copy of the small business economic impact statement or the detailed cost calculations by contacting:

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Other:

Date: January 5, 2021	**Signature:** Andrew S Klein
Name: Andrew S. Klein	
Title: Acting Council Chair	

Summary of Changes for the
2021 Washington State Energy Code, Commercial Provisions

Please Note: Sections that had no changes are not shown in this filing and remain in effect as shown in the 2018 Washington State Energy Code.

Chapter 1

Section C101.1: A new paragraph was added to clarify the effective date of the new edition of the code.

Section C102.1: **IECC CHANGE** - Changes made to the model code for consistency throughout the International Code family.

Section C130.1: **IECC CHANGE** - Change to the model code allowing digital submittal of construction documents.

Section C103.2: **IECC CHANGE** - Change to the model code requiring the compliance path to be shown on the construction documents.

Sections C104-112: The Fees section was moved to Section C104 from C107 for consistency with the model code. The Inspections section was moved to C105, and former sections C104.7 and C104.7.1 became Section C106, Notice of Approval. Subsequent sections were renumbered to accommodate the additional section, but no additional changes were made, except for minor editorial changes to C109.

Section C109: **IECC CHANGE** - Minor editorial changes for consistency throughout the International Code family.

Chapter 2

The following definitions were changed or added at the model code level: Above-grade wall, Biogas, Biomass, Computer room, Corridor, Data center, Data center systems, Demand recirculation water system, Direct digital control, Enthalpy recovery ratio, Fan, embedded, Fan array, Fan efficiency grade (deleted), Fan energy index, Fan system electrical input power, Fault detection and diagnostics system, Skylights, General lighting, Greenhouse, Information technology equipment, Internal curtain system, Large diameter ceiling fan, Networked guest room control system, On-site renewable energy, Renewable energy resource, Testing unit enclosure area, Thermal distribution efficiency, Visible transmittance, annual, and Wall.

The following definitions were changed or added via a proposed state amendment:

Alternating current—output uninterruptible power supply 137

Attic and other roofs – Editorial changes for clarity

Automatic control device – New definition added to provide some clarification.

Building entrance – Editorial changes for clarity

Building thermal envelope – Definition modified to include reference to other pertinent terms to provide clarification

Ceiling fan – Added the ASHRAE definition for ceiling fan to differentiate from *large diameter ceiling fan*

Commercial boiler – Added definition to coordinate with the changes in Section C403.3.4 and differentiate from *process boiler*

Community renewable energy system – One of three terms added to coordinate with the changes in Section C407 on use of renewable energy

Compressed air system – One of three terms added to coordinate with new Section C412 regulating compressed air systems

Conditioned space – Incorporates language from Seattle clarifying that some spaces used to transfer air are considered conditioned spaces for the purpose of *building thermal envelope* requirements

Continuous insulation – Added sentence to coordinate with the allowance of stainless steel fasteners in Table C402.1.3

Controlled plant growth environment – Added clarification this only applies if the space is used exclusively for plant production

Controlled receptacle – Added definition to clarify intent

Dedicated outdoor air system – a general definition of DOAS was added

Demand control kitchen ventilation – New term added as part of the changes in Section C403.7.7.1.3.

Demand response signal, Demand responsive control – Two new definitions added to support proposed changes to C403.4.1.7 and C404.14 requiring demand responsive controls on water heaters

Desiccant dehumidification system – One of three added definitions to support the proposed requirement in Section C403.15 for dehumidification for indoor plant growth

Directly owned off-site renewable energy system – One of three terms added to coordinate with the changes in Section C407 on use of renewable energy

Door, garage – Clarification added to differentiate garage doors and to coordinate with the change to Table C402.1.4 added line and footnote for garage doors with up to 50% glazing

Electrical load coefficient – This term was eliminated as it is no longer referenced in the data center requirements in ASHRAE 90.4

Fan electrical input power, **Fan system**, Fan system, complex, Fan system, exhaust/relief, Fan system, multi-zone variable air volume, Fan system, return, Fan system, single cabinet, Fan system, supply only, Fan system, single-cabinet, and Fan system airflow – all modifications and additions support the revisions to Section C403.8.1 and the new fan power allowance tables

Historic buildings – This definition was modified to match the language in the International Energy Conservation Code, which was the work of a collective involving, among others, the AIA and the National Trust of Historic Preservation; the language in Section C501.6 also defaulted back to the base IECC language

Integrated HVAC system – One of three added definitions to support the proposed requirement in Section C403.15 for dehumidification for indoor plant growth.5

Largest net capacity increment – One of three terms added to coordinate with new Section C412 regulating compressed air systems

Low carbon district energy exchange system, Low carbon district heating and cooling or heating only system – These two terms were added to support the changes in Sections C404 and C407 regulating the utilization of district energy

Luminaire-level lighting control – Clarification that either local or central wireless control is acceptable for LLLC systems.

Mass transfer deck slab – Clarification to the existing definition from the Seattle code and corresponds with the change proposed in Table C402.1.3 clarifying how this detail is accounted for in the thermal performance calculations

Mechanical room – A definition was added to help clarify the intent of Section C403.5, exception 1

Multi-pass – One of the three added definitions to support the proposal for heat pump water heating

Photosynthetic photon efficacy – A new definition added to support the plant growth lighting efficiencies in Section C405.3

Primary storage – One of three terms added to coordinate with new Section C412 regulating compressed air systems

Process boiler – Added definition to coordinate with the changes in Section C403.3.4 and differentiate from *commercial boiler*

Renewable power purchase agreement – One of three terms added to coordinate with the changes in Section C407 on use of renewable energy

Semi-heated space – Editorial changes to clarify the definition

Single-pass – One of the three added definitions to support the proposal for heat pump water heating

Solar zone – A new definition added to help clarify the requirements in Section C411

Stand-alone dehumidifier – One of three added definitions to support the proposed requirement in Section C403.15 for dehumidification for indoor plant growth.

System – A new definition from ASHRAE 90.1 to support and help clarify the requirements in C403.4.11 on when DDC controls are required

Temperature maintenance – One of the three added definitions to support the proposal for heat pump water heating

Unconditioned space – Definition based on ASHRAE 90.1 to help clarify building thermal envelope requirements

Chapter 3

Section C303.1.2: **IECC CHANGE** – Added guidance on how to identify products that have no R-value markings

Section C303.1.3: **IECC CHANGE** – Clarification on rating and measuring tubular daylighting devices

Chapter 4

Section C401.2: **IECC CHANGE** – Editorial change to label the compliance paths

Section C401.2.1: The IECC modified this section and made it an exception to C401.2. The WSEC used the modified language but kept it as a subsection for better consistency with the state code

Section C401.2.2: This section was added to pull together all of the sections that reference requirements for process equipment elsewhere in the code.

Section C401.3: **IECC CHANGE** – This section was added to require a permanent certificate with all pertinent information on the building thermal envelope to be posted, similar to that required by the residential provisions

Section C402 Envelope

Section C402.1.1.1: This change clarifies that areas must meet the definition of an enclosed space to be considered a low energy building, making it clear that parking garages are not considered low energy buildings

Section C402.1.1.2: The semi-heated building provisions contains several proposed changes. The specification for other than electric resistance heating was removed to clarify that the previously allowed electric infrared heating equipment must also meet the limitations defined for semi-heated spaces. This also provides some clarity for the use of heat pumps with cooling disabled. Clarification is also proposed to specify that fenestration is still required to meet the code and is not considered part of the opaque wall. The term “standard reference” was updated to “baseline building design.” The exceptions were modified to correlate with the other changes.

Section C402.1.1.3: Terms within the greenhouse requirements were updated to conform with the new section adopted in the IECC. The table was also updated to the current IECC standards, but retaining the 2018 WSEC value for vertical fenestration.

Section C402.1.2: Editorial correction to item 2 and the citation of the efficiency table was updated to the 2021 IECC revisions; the former Table C403.3.2(2) was split into two separate tables consistent with ASHRAE 90.1

Table C402.1.3: There are two options offered for both opaque thermal envelope tables. Option 1 modifies the mass wall footnote c, limiting the application of the exception single wythe concrete block walls exposed on both sides. Option 2 removes the exception.

Other changes in this section (in both options) include increases in various R-values (**IECC CHANGE**), moving the opaque door requirement to Table C402.1.4, and adding a footnote to the mass transfer deck slab edge row stating that buildings with this feature must use the component performance method and deleting the table R-value. Footnote j was modified to include values for stainless steel penetrations. New footnote I adds a maximum area allowed for through-the-wall mechanical equipment using the R-value table.

Section C402.1.3: **IECC CHANGE** – language added to provide guidance on the correct procedure to calculate layered insulation thermal values.

Sections C402.1.4.1-C402.1.4.1.2: **IECC CHANGE** – New sections to clarify the use of area weighted average U-factor option.

Section C402.1.4.3: New section requires heat loss for PTAC, PTHP and other through-wall mechanical equipment to be calculated as part of the envelope using the U-factor compliance method.

Table C402.1.4: There are two options offered for both opaque thermal envelope tables. Option 1 modifies the mass wall footnote d, limiting the application of the exception single wythe concrete block walls exposed on both sides. Option 2 removes the exception.

Other changes in this section (in both options) include increases in various U-factors (**IECC CHANGE**), moving the opaque door requirement from Table C402.1.3, adding a new line for garage doors with glazing between 14 and 50%, and adding a footnote to the mass transfer deck slab edge row on how to address the detail using the component performance method. A footnote is also added referencing Section C402.1.4.3 for through the wall PTACs and similar mechanical equipment.

Section C402.1.5.1: Editorial change, adding a reference to F-factors into the paragraph.

Section C402.2: Editorial changes.

Sections C402.2.1-C402.2.1.4: **IECC CHANGE** – The continuous insulation sentence was moved from this section to new section C402.1.4.1.2. Exception 1 was deleted and addressed in new section C402.2.1.1 with less confusing language. Other new subsections provide guidance on various roof insulation details with content reorganized and renumbered.

Section C402.2.2: Above grade walls section was just renumbered, no change.

Section C402.2.3: Floors section (and above grade walls) was just renumbered, no change.

Section C402.2.6: Slab on grade section (and below grade walls) was renumbered, with some editorial changes for clarity coming from IECC changes.

Section C402.2.5: Below grade walls section (and floors) was renumbered with no changes.

Section C402.2.6: Insulation of radiant heating systems (and slab on grade perimeter insulation) was renumbered with no changes.

Section C402.2.7: Airspaces has some editorial changes for clarity.

Sections C402.2.8, C402.2.9: New sections to provide guidance on control of thermal bridging at concrete balconies (C402.2.8) and fenestration frames (C402.2.9).

Section C402.4: Corrected reference.

Table C402.4: Window U-factors are reduced, a U-factor is added for operable windows under "…all others." Window orientation has been changed to fixed and operable to align with the IECC, and the footnote struck.

Section C402.4.1.1.2: The high performance fenestration U-factors were decreased and the SHGC adjusted to correlate with the new values in Table C402.4.

Section C402.4.2: The minimum skylight area was amended to better match the ASHRAE 90.1 language and requires skylights in any space under a roof that meets the criteria, not just single story spaces.

Section C402.4.2.1: Editorial change.

Section C402.4.2.2: Adds tubular daylighting devices to the skylight exception.

Section C402.4.2.3: Editorial change.

Section C402.4.4: For the 2021 edition, the IECC turned this into three subsections and divided the door types between the two envelope tables. To match the changes in the WSEC moving all of the door types into Table C402.1.4, this was edited back into one section and simplified.

Section C402.5.1: Editorial changes for clarity.

Section C402.5.1.2-C402.5.3: The IECC changed the model code to require air barrier testing, as has been required by the WSEC for the last few code cycles. The new language was further modified to conform to existing WSEC requirements. The existing WSEC exception allowing up to 0.30 cfm per square foot leakage with corrective action is deleted and testing must not exceed the 0.25 cfm per square foot rate.

Section C402.5.4: Editorial section corrections.

Section C402.5.5: Renumbered; and the duct insulation value in 2.5 was increased to match the requirement in Section C403.10.1.1.

Sections C402.5.6-C402.5.8: Renumbered only, no changes.

Section C402.5.9: Renumbered; new exception to exempt doors accessing only outdoor seating areas.

Section C402.5.10: Renumbered, no changes.

Section C402.5.11: The IECC added a section requiring operable openings to be interlocked with the HVAC system. The language was modified to correlate with the existing WSEC requirement in Section C403.4.1.6.

Section C403 Mechanical

Section C403.1: The exception was revised to correlate with the change made to **Section C401.2.2** to more clearly show which code provisions applied to process equipment.

Section C403.1.1: The HVAC TSPR section was modified to include residential occupancies and provides clarifications based on interpretation questions. An exception was also added for HVAC systems connected to a low-carbon district energy exchange system.

Section C403.1.3: The requirements for data centers were revised for consistency with the most recent requirements of ASHRAE 90.4. There is no longer a need to modify the inputs.

Section C403.1.4: A new section is added to disallow the use of electric resistance and fossil fuel-fired heating equipment, except for small loads and as supplemental heating, and for fossil fuel auxiliary heat in climate zone 5 under certain conditions.

Section C403.2.1: Clarifications were made to the zone isolation requirements for ease of use and understanding.

Section C403.2.2.1: Clarification was added in Exceptions 1 and 2, and a fifth exception was added to allow overventilation for indoor air quality with efficiency energy recovery ventilation.

Section C403.2.3: **IECC CHANGE** – New section/requirement for fault detection and diagnostics in new buildings over 100,000 square feet, except residential occupancies, to reduce efficiency degradation of the HVAC system.

Section C403.2.4: Renumbered, and the threshold for variable speed drive requirements was decreased from 7.5 hp to 5.0 hp.

Tables C403.3.2(1)A through (12) (2018 Code) were reordered and reorganized into Tables C403.3.2(1) through (15) (2021 Code). They were moved to fall into correct numerical order within the WAC (WAC 51-11C-40332X rather than 51-11C-40323X).

ICC reorganized the tables to be more in line with the ASHRAE 90.1 order and content, and the footnotes now point to the corresponding ASHRAE table number. Where appropriate, the tables were updated to the latest federal standards.

Section C403.3.2: **ICC CHANGE** – This section was updated in conjunction with the change in efficiency table numbering.

Section C403.3.2.1/C403.3.2.2– These sections were broken out of Section C403.3.2, with gas-fired and oil-fired furnaces and high-capacity cooling equipment becoming new subsections. C403.3.2.2 also includes text previously codified as C403.6.7, moving it into the equipment selection section where it more logically belongs.

Section C403.3.2.3: This section was renumbered to accommodate the two new subsections above.

Section C403.3.2.4/C403.3.2.5: **IECC CHANGE –** This section was updated by ICC to coordinate with the efficiency table extract from ASHRAE 90.1. Renumbered to coordinate with the reformat of Section C403.3.2.

Section C403.3.2.6: Requires packaged and split systems providing heating and cooling, or cooling only, to be heat pumps. The requirement previously applied to packaged systems with both heating and cooling.

Section C403.3.4 through C403.3.4.4: New sections with criteria for combustion air controls and minimum stake gas oxygen concentration levels for boiler systems, applicable to building and process boilers. Also adds associated definitions.

Section C403.3.4.5 through C403.3.4.5.2: Adds requirements from ASHRAE 90.1 for high capacity gas-fired hot water boiler systems to have condensing boilers.

Section C403.3.5: Updates the language and reformats the heat/energy recovery requirements with DOAS to improve clarity. It also provides a calculation procedure for watts per cfm and clarifies which fans are required to be included in this calculation. Also adds a definition of DOAS.

Section C403.3.5.1/C403.3.5.2: Increase the ERV effectiveness to 60 percent enthalpy recovery effectiveness or 68 percent minimum sensible recovery effectiveness, from the previous values of 50/60 percent. The exception is also limited to 650 square feet, with a smaller allowance for occupant load. Clarifies the application of the demand control ventilation exception to the requirement for energy recovery with DOAS. Incorporates the AHRI 1060 calculation for sensible recovery effectiveness.

Section C403.3.5.5: New section adding requirements for supplemental heating and cooling capacity sizing and control requirements in DOAS.

Section C403.3.5.6: Editorial changes for clarity.

Section C403.3.6: Clarification of requirements, with a reference back to the new AHRI calculation for sensible recovery effectiveness and an exception added to allow HVI 920 as an alternate for residential and light commercial H/ERVs.

Section C403.3.7: A new section and table are added to incorporate requirements from ASHRAE 90.1 limiting the flow rate in critical circuits of hydronic systems to minimize flow resistance.

Section C403.3.8/C403.3.8.1/C403.3.8.3: A new section is added based on ASHRAE 90.1 to require minimum temperature difference for hydronic coils for increased pump efficiency and primary equipment efficiency.

Section C403.4.1: Exception 2 was rewritten for clarity.

Section C403.4.1.1: The exception for supplemental heat in PTHPs was revised to correlate with the new requirement in Section C403.3.2.4 to require a heat pump with defrost and the ability to operate in heat pump mode whenever the air temperature is over 25 degrees and the unit is not in defrost.

Section C403.4.1.4: Editorial change to the title to correlate with section content.

Section C403.4.1.6: Correlation language with the new IECC scoping for operable opening interlocks in Section C402.5.11.

Section C403.4.1.7: Adds a requirement for demand responsive controls for thermostats in all buildings except health care and assisted living. It does not require participation in any demand response programs.

Section C403.4.2.3: **IECC CHANGE** – ICC added language regulating automatic stop controls using language nearly identical to the existing WSEC language. A few correlating changes were made to mirror the ICC language.

Section C403.4.4: An exception was added to the part load controls for hydronic systems with thermal energy storage.

Section C403.4.11.1: Correlation with the new requirement in Section C406 for load management.

Section C403.4.11.2/C403.4.11.3: Editorial changes.

Section C403.4.11.4: Clarify that, for example, standalone mini-split heat pump and PTHPs installed in a residential apartment building that have no need for an interface between each other require a central DDC system. This change would require water source heat pumps or water source VRF systems (for example) that are part of a central system to have central DDC Controls. Correlating definitions from 90.1-2019 were also added to Chapter 2.

Section C403.4.12: Requires pressure independent control valves where the flow rate over coils is over 5 gallons per minute.

Section C403.5: Exception 1 for Economizers clarifies that it is for other than Group R-2 occupancies. Exception 5 was modified to clarify that the supply fan is not required to be installed outside the building thermal envelope. The equipment efficiency table references throughout have been updated.

Section C403.5.5: **IECC CHANGE** – Updated references to the equipment efficiency tables.

Section C403.6.1: Editorial change.

Section C403.6.4: **IECC CHANGE** – Specific requirements related to dehumidification control interaction are added to clarify requirements for supply air temperature reset.

Section C403.6.7 was moved to C403.3.2.2.

Section C403.6.10: Editorial changes to correlate with the fan system updates in Section C403.8.

Section C403.7.1 through C403.7.1.2: The demand control ventilation section is reformatted. The energy recovery exception is removed, and the various thresholds are reduced. Gas sensors are required in spaces and systems required to have VSD control.

Section C403.7.3: Coordinating modifications to the sizing and control requirements for DOAS heating and cooling in Section C403.3.5.5.

Section C403.7.4.1: **IECC CHANGE** – Clarifications of requirements for guest room temperature control.

Section C403.7.4.2: Changes the threshold of when HVAC controls shut off in an occupied guest room from 30 minutes to 20 minutes.

Section C403.7.5: Clarifies that the requirements include repair garaged and require variable frequency drives on all fan motors 5 hp and greater.

Section C403.7.5.1: Clarify that the function of the ventilation system shall be activated by the sensors.

Section C403.7.5.2: Exception is removed to correlate with the mechanical code requirements for parking garage ventilation.

Section C403.7.6 through C403.7.6.2: The IECC language was modified to align with the ASHRAE 90.1 requirements for energy recovery ventilation, including breaking it out into dwelling unit and other than dwelling unit requirements. This language was integrated into the WSEC language, retaining the Group R-2 designation. This proposal increases the enthalpy recovery ratio from 50 to 60 percent for other than R-2 occupancies.

Section C403.7.7.1.3: Requires demand control kitchen ventilation on hoods over 2,000 cfm and clarifies the existing language. An associated definition for demand control kitchen ventilation was added in Chapter 2.

Section C403.7.8.1: **IECC CHANGE –** Under exception 2, the allowance for gravity dampers was reduced from a design capacity of 400 cfm to 300 cfm.

Section C403.8: The requirement for Group R exhaust fans to comply with efficacy requirements was changed to all low capacity ventilation fans.

Section C403.8.1 through C403.8.4 (and associated tables): Updates the approach to fan power limitations and aligns with the Title 24 method. It also moves the threshold down to cover smaller nameplate HP fans. Group R exhaust fans were switched to low capacity ventilation fans—fans with motors less than 1/12 hp. Associated definitions related to fan systems were also added to Chapter 2, and a correlating change was made to Section C503.4.

Section C403.8.6: **IECC CHANGE –** Added testing standards for large-diameter ceiling fans.

Section C403.9.1: **IECC CHANGE** – Editorial; updating efficiency table references.

Section C403.9.2.1/C403.9.2.4: Editorial; clarification of title to match section content.

Section C403.9.2.2: Editorial; language clarification for steam condensate systems.

Section C403.10.1.1: Editorial changes to the duct requirements. Updating the section title to match the section content. Content broken into paragraphs for clarity. Exception 2 was deleted as it conflicted with other duct insulation requirements.

Section C403.10.1.2: **IECC CHANGE** – New requirement for underground ducts using thermal distribution efficiency to be listed and labeled with such. A definition for TDE was also added to Chapter 2.

Section C403.10.2: Clarifications added to define terms used in the duct construction sections.

Section C403.10.3: Clarifications on when piping is exempt from the pipe insulation requirements.

Section C403.10.3.1: Clarifications on required protection of pipe insulation exposed to weather.

Section C403.10.4: New section with requirements specific to HVAC system refrigerant piping insulation and protection to differentiate from the general requirements.

Section C403.12: Changing the term “fan system bhp” to “fan power budget” to correlate with the changes in Section C403.8. Efficiency table references are also updated.

Section C403.13: New section with requirements for dehumidification efficiency for indoor growing facilities. (Note: there is a typo in the section number. The CR102 has this as Section C403.15, but coming before C403.14)

Section C403.14: Relocation of the previous Section C403.13, no change.

Section C404 Service Water Heating

Section C404.1: An exception is added to correlate with the change in Section C401.2.2. This language was previously located in C401 but is more usefully located within the service water heating section.

Section C402.2: There are two options offered under this section. Two different sets of code change proposal were put forward for public hearing. The Council is seeking testimony on the preferred option:

Option 1: The existing WSEC requirements for water heaters are updated to reference UEF rather than EF, with updates drawn from ASHRAE 90.1 reflecting the 2017 DOE requirements. An exception to the requirements for high input-rated service water heating systems for systems utilizing district energy was also added.

Option 2: The existing WSEC language is struck and new language requires heat pump water heating rather than fossil fuel or electric resistance water heating in commercial buildings to provide a reduction in carbon emissions. Exceptions are provided to allow electric resistance heating for hand washing facilities.

Table C404.2: The water heater efficiency table is updated to the most recent federal requirements.

Table C404.3.1: Allows 8 feet of pipe length between circulating pipe and lavatory, instead of just 1 or 2 to permit circulating piping to run in ceiling cavity.

Section/Table C404.3.2.1: **IECC CHANGE** – This adds an allowance to use the internal volume of water distribution tubing as an alternative to using the water volume from Table C404.3.1.

Section C404.4: Editorial clarification.

Section C404.6.1: Requires thicker insulation for service water heating storage tanks designed for storage temperatures over 130 degrees.

Section C404.7: Correlation change associated with Section C404.2, Option 2.

Section C404.7.1 through C404.7.1.3: Requires ECM motors for all SWH circulation pumps. Require service water circulation systems with multiple risers or zones and variable flow circulation pumps to use self-actuating thermostatic balancing valves. Also, where electronic thermostatic mixing valves are used, configure valves to remain closed or maintain current valve position upon power loss.

Section C404.7.3.1: New section to require thicker insulation for service water system piping in the circulation loop.

Section C404.11.1: Requires heat pump water heaters on heated pools over 2000 gallons.

Section C404.14: New section to add demand response requirements for water heaters between 40 and 120 gallons to provide grid flexibility as a step towards decarbonization.

Section C404.15: Move and renumbering only, no change.

Section C405 Lighting & Power

Section C405.1/C405.1.1: The paragraph on dwelling units was deleted to remove conflicts. The IECC added the language on general lighting to set a standard for the lighting control requirements and includes language formerly found in the definition. An exception was added to correlate with the changes in Section 401.2.2 to clarify application to process equipment. The IECC made some simplifying and clarifying changes to C405.1.1.

Section C405.2: The requirements for LLLC were moved to a standalone section as referenced. The exception for uncontrolled egress lighting was reduced from 0.02 to 0.02 watts per square foot.

Section C405.2.1: The CR102 shows text from an early version of the code change proposal, not the one that was ultimately moved forward to public hearing. The intent was to clarify the control requirements for various space types, and library stacks was added to the list. The section should read:

C405.2.1 Occupant sensor controls. Occupant sensors shall be installed to control luminaires in the space types listed in Table C405.2.1, and shall comply with the requirements listed in the table.

Exceptions: 1. Corridors in manufacturing facilities.
2. General lighting and task lighting in shop and laboratory classrooms.
3. Luminaires that are required to have specific application controls in accordance with Section C405.2.6 unless specifically required to comply with this section by Section C405.2.6.

TABLE C405.2.1
OCCUPANT SENSOR COMPLIANCE REQUIREMENTS FOR SPACE TYPES

Space Type	Comply with Section
Classrooms/lecture/training rooms	C405.2.1.1
Conference/meeting/multipurpose rooms	C405.2.1.1
Copy/print rooms	C405.2.1.1
Lounge/breakrooms	C405.2.1.1
Enclosed offices	C405.2.1.1

Open plan office areas	C405.2.1.3
Restrooms	C405.2.1.1
Storage rooms	C405.2.1.1
Locker rooms	C405.2.1.1
Other spaces 300 square feet (28 m^2) or less that are enclosed by floor-to-ceiling height partitions	C405.2.1.1
Warehouse storage areas	C405.2.1.2
Library stacks	C405.2.1.2
Enclosed fire rated stairways	C405.2.1.5
Corridors	C405.2.1.6

Section C405.2.1.1: Language is simplified and correlated with the change to C405.2.1.

Section C405.2.1.2: Library stacks are added to this section, and the language is clarified.

Section C405.2.1.3: Clarification of lighting function in open office areas. Added requirement for LLLC or digital lighting controls for open office areas larger than 5,000 square feet. (Note: there is a typo in this requirement—it should reference Section C405.2.8, not C405.2.7)

Section C405.2.1.4: This section was deleted to correlate with the changes to Section C405.2.8 to provide control requirements for parking garages equivalent to ASHRAE 90.1.

Section C405.2.1.6: **IECC CHANGE** – Provides uniform occupant sensor control requirements for corridor lighting. An exception is provided for corridors with less than 2 footcandles of lighting.

Section C405.2.2: Clean up of the time switch control requirements correlating to the change in C405.2.1 Exception 3.

Section C405.2.3.1: Rather than being a subsection of manual controls, light reduction controls was moved to C405.2.4.

Sections C405.2.4/C405.2.4.1: **IECC CHANGE** – The light reduction controls section was moved and reformatted, separating out the scoping and technical requirement section.

Section C405.2.5: Daylight responsive controls was renumbered with a few editorial changes. Additionally, the threshold of two lighting fixtures was changed to more than 75 watts of general lighting.

Section C405.2.5.1: **IECC CHANGE** – Specifications were added to ensure controls work together to achieve maximum energy savings.

Section C405.2.5.2: The IECC adopted the primary and secondary daylighting approach for the 2021 code. The WSEC language was modified to align better with the model code language. Rooftop monitors were moved from the toplit zone into the sidelit zone.

Section C405.2.5.4: **IECC CHANGE** – This section adopts the IECC language for establishing daylighting zones in multistory atriums.

Section C405.2.6: Additional lighting controls is renumbered, with some editorial changes. Lighting for plant growth was changed to life support of non-human life forms to cover both plant and animal uses. The language on dwelling unit controls was deleted to eliminate confusion.

Section C405.2.7: Renumbered only, no changes.

Section C405.2.8: The LLLC requirements were moved into this section from Section C405.2, and an option for networked lighting was incorporated. Requirements were also added for high end trim.

Section C405.2.9: Exterior lighting controls was renumbered

Section C405.2.9.3 The lamp wattages for luminaires required to have activity sensor control was decreased. (Note: there are some errors in the filed text. “all of” in the first sentence should be struck; items 1 and 2 should be reversed with “All other lighting shall” added to the beginning of former item 1. The height in the former item 2 should be 24 feet.)

Section C405.2.9.4: Renumbered only.

Section C405.2.10: Correlation of the parking garage occupant sensor controls with the ASHRAE 90.1 requirements. This section takes the place of former Section C405.2.1.4 requirements for parking garages.

Section C405.3: A new section is added to provide a new metric for lighting for plant growth. The base language is from the 2021 IECC, but the metric is changed to photosynthetic photon efficacy from photon efficiency and the exemption is lowered from 40 kW of lighting load to 10 kW.

Section C405.4.1: Editorial changes to correlate with the new language on general lighting—redundant requirements are removed. A new exception is added for antimicrobial lighting for disinfection.

Section C405.4.2: Clarification is added that when lighting power allowance is being determined for only a portion of a building, the space by space method shall be used.

Section C405.4.2.1/C405.4.2.2: Clarifications on using the building area method and space by space method. Space by space now includes provisions on multi-use spaces.

Section C405.4.2.2.1: Along with changes to the footnotes in Table C405.4.2(2), clarifications and guidance on using the ornamental and display lighting allowance increases.

Table C405.4.2(1): The footnotes are all removed from the table as part of the clarification on lighting in dwelling units.

Table C405.4.2(2): The footnotes are cleaned up, removing all “reserved” footnotes. The footnotes for additional lighting power allowance for display and ornamental lighting are updated. An additional footnote is added for unfinished spaces.

Section C405.5.1: Lowers the threshold for lighting efficacy requirements from 50 watts to 25 watts and simplifies the language.

Section C405.5.3: Updates the exterior lighting tables in response to changes in technology, with an approximate 40 percent reduction across the board.

Section C405.5.3.1: **IECC CHANGE** – Simplification of the additional exterior lighting power language.

Tables C405.3(2).C405.5.3(3): Updates the exterior lighting tables in response to changes in technology, with an approximate 40 percent reduction across the board.

Section C405.7.1: New section requires electrical receptacles at dwelling unit gas appliances, to enable future installation of electric appliances.

Section C405.9.2.1: **IECC CHANGE** – The escalator energy recovery requirements were simplified. (Note: the second sentence of this section was removed by IECC errata and will be removed from the WSEC.)

Section C405.10: **IECC CHANGE** – The 2021 IECC added a section on automatic receptacle control that was essentially the same as the WSEC controlled receptacles section. The IECC language was adopted in place of the WSEC language to better align with the model code.

Section C405.11: **IECC CHANGE –** Clarification of the requirement for voltage drop, and extending the requirements to customer-owned service conductors.

Section C405.12: New section that adds uninterruptible power supply efficiency requirements for computer rooms based on ENERGY STAR requirements.

Section C405.13: Renumbered only, no changes.

Section C406 Additional Efficiency & Load Management

Section C406 is reformatted, and the credit requirements differ by occupancy type. The metric was changed to carbon emission and a standard of 0.1% reduction per point was set as the basis. The table has two options included that depend on the final action of the council. The required number of energy efficiency credits to be achieved has been increased by 16 percent, if the heat pump water heating proposal is adopted, and by approximately 33 percent if it is not.

A number of new options were added to C406 by proposals: Low-Carbon district energy, Heat pump dryers, Enhanced Commercial Kitchen equipment, High performance temperature maintenance system, High efficiency circulation systems, Low flow showerheads for R-1 and R-2 occupancies, Clarification of service water heat pump efficiencies, Offsite Renewables

Adds load management requirements for new buildings to prepare buildings to interact efficiency with the evolving electrical grid in the future. Corresponding change also made to Section C403.4.11.1.

Section C407 Total Building Performance

Section C407.2/Table C407.2: Editorial clarifications on the modeling process, with the mandatory compliance table updated with the new measures in the 2021 code, both from the IECC and state amendments.

Section C407.3: Increases the stringency of the building performance factors used to set emissions targets which are based on regulated loads only by 10% over the previous code. Note that if the carbon emissions factors in Table C407.3(1) are updated during development of the 2022 code, the Building Performance Factors in Table C407.3(2) should be updated by PNNL to match the intent of this proposal—this will be done via public testimony.

A second metric for compliance has been added based on site energy performance that includes all loads (regulated and unregulated). The target for this new site energy metric is based on a tiered improvement from the 2018 WSEC to a 0.3 site energy use

performance index by 2030 compared to the Appendix G Standard 90.1-2004 baseline (see table and graph below). This is meant to meet the intent of the Washington State policy goal of having a code in 2030 that will result in new buildings that use 30% of the site energy of a building built to the 2006 WSEC.

A subsection was added on how to utilize low carbon district energy systems in the total building performance path.

Section C408 Building Commissioning

The thresholds for required commissioning in Section C408.1 were lowered.

Section C409 Metering

There were editorial changes for clarity throughout this section.

Section C410 Refrigeration Systems

The IECC completely restructured the refrigeration sections for the 2021 code. The result here is a hybrid of the changes to the 2021 code, including the new tables and modifications to retain some of the existing WSEC language to retain requirements for some federally unregulated applications.

Section C411 Renewable Energy

Section C411 was renamed from Solar Readiness to Renewable Energy.

Section C411.1: Requires on-site renewable energy generation for commercial buildings over 10,000 square feet at 0.5W per square foot.

Section C411.1.1: Details on how on-site renewables interacts with Section C406, Additional efficiency requirements.

Section C411.2: Details on how renewable energy works with Section C407, Total building performance method.

Section/Table C411.2.1: Off-site renewable energy requirements and weighting factors. (Note: table is mis-numbered as C411.3.1)

Section C411.2.2: Requirements for off-site renewables documentation.

Section C411.2.3: Requirements for RECs.

Section C411.3: Renumbering of existing solar readiness provisions. The first exception has been clarified, and a second exception added to provide guidance on application to existing buildings.

Section C411.3.1: Clarification that area covered by mechanical equipment is not included in the percentage calculation.

Section C412 Compressed Air Systems NEW

This is a new section proposed to regulate compressed air systems comprised of language from the Seattle code and California's Title 24 (2022 edition). This would apply to process loads

Chapter 5

Section C501: This section was rearranged slightly by ICC, with a few editorial changes.

Section C501.6: The state amendment to this section was removed and it reverted back to the IECC language for historic buildings.

Section C502: Various clarifying amendments were made throughout this section. Specific guidance was added in Section C502.1.1 and C502.1.2 on how to apply requirements for additional energy efficiency credits and renewable energy requirements to additions.

Section C503: Various clarifying amendments were made throughout this section.

Section C503.2: This section was moved to C505 and should have been struck.

Section C503.4: There are two options proposed for Section C503.4 and subsections. Some of the proposals approved for inclusion in the proposed rule Option 1 does not include the heat pump space heating provisions from 21-GP1-103. Option 2 includes provisions from 21-GP1-103.

An allowance of 0.6 in. wg for supply systems and 0.3 in. wg for exhaust/return/relief systems (where the combined total equals 0.9 in. wg) is allowed for additions/alterations. In addition, an extra allowance is provided where an adapter curb is needed.

Section C503.5: There are two options proposed for Section C503.5, depending on the final action on provisions included in 21-GP1-136. Option 1 includes revisions that would be made if the heat pump water heater proposal is not adopted, and are editorial in nature. Option 2 would require replacement water heaters to be heat pump water heaters unless they qualify for one of the exceptions.

Section C503.6: A new scoping section is added for replacement of components in pools and spas.

Section C507: The lighting section was reformatted and renumbered. A subsection on new lighting was added to clarify that it needs to comply with all applicable lighting and commissioning provisions in the code. Section C503.7.2 requires alterations replacing 20 percent or more of existing lighting fixtures to comply with the lighting power allowance in Section C405. The previous threshold was 50 percent. The rest of the changes provide clarification only.

Section C505: The IECC moved the change of space conditioning requirements to the C502 Additions section. It was felt that rather than being contained in that section or the current C503 Alterations section, it would make sense to move it to Section 505 and change the name to change of space conditioning, occupancy or use. So provisions from C503 were moved to C505 but makes no technical changes.

Chapter 6 Referenced Standards

Various referenced standards were updated, and new standards added based on added provisions in the 2021 energy code.

Appendix D – HVAC TSPR Calculation

The calculation procedure has been updated and clarified based on interpretation requests received, and additional system parameters were added to Table D601.11.2

Appendix E – Renewable Energy

This appendix was removed as this requirement is part of the code text in Section C411 as of the 2018 Washington State Energy Code.

Appendix F – Outcome Based

The energy budget tables were updated based on the prototypes and findings in the 2018 Baseline Energy Consumption Report

Chapter 51-11C WAC
STATE BUILDING CODE ADOPTION AND AMENDMENT OF THE ((~~2018~~)) 2021 EDITION OF THE INTERNATIONAL ENERGY CONSERVATION CODE, COMMERCIAL

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-10100 Section C101—Scope and general requirements.

C101.1 Title. This code shall be known as the *Washington State Energy Code*, and shall be cited as such. It is referred to herein as "this code."

The 2021 edition of the Washington State Energy Code is hereby adopted. The Washington State Energy Code adopted under chapter 51-11C WAC shall become effective in all counties and cities of this state on July 1, 2023.

C101.2 Scope. This code applies to *commercial buildings* and the buildings sites and associated systems and equipment. References in this code to Group R shall include Group I-1, Condition 2 assisted living facilities licensed by Washington state under chapter 388-78A WAC and Group I-1, Condition 2 residential treatment facilities licensed by Washington state under chapter 246-337 WAC. Building areas that contain Group R sleeping units, regardless of the number of stories in height, are required to comply with the commercial sections of the energy code.

EXCEPTION: The provisions of this code do not apply to *temporary growing structures* used solely for the commercial production of horticultural plants including ornamental plants, flowers, vegetables, and fruits. A temporary growing structure is not considered a building for the purposes of this code. However, the installation of other than listed, portable mechanical equipment or listed, portable lighting fixtures is not allowed.

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

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-10200 Section C102—Alternative materials, design and methods of construction and equipment.

C102.1 General. The provisions of this code are not intended to prevent the installation of any material, or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been *approved*. ((~~An alternative material, design or method of construction shall be *approved* where~~)) The code official shall have the authority to approve an alternate material, design or method of construction upon the written application of the owner or the owner's authorized agent. The *code official* shall first find((~~s~~)) that the proposed design is satisfactory and complies

with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability, energy conservation, and safety. ((~~Where the alternative material, design or method of construction is not approved,~~)) The code official shall respond to the applicant, in writing, stating the reasons why the alternative was approved or was not approved.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-10300 Section C103—Construction documents.

C103.1 General. Construction documents and other supporting data shall be submitted in one or more sets, or in a digital format where allowed by the building official, 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 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. Energy compliance path per Section C401.
2. Insulation materials and their *R*-values.
((~~2.~~)) 3. Fenestration *U*-factors and SHGCs.
((~~3.~~)) 4. Area-weighted *U*-factor and SHGC calculations.
((~~4.~~)) 5. Mechanical system design criteria.
((~~5.~~)) 6. Mechanical and service water heating system and equipment types, sizes and efficiencies.
((~~6.~~)) 7. Economizer description.
((~~7.~~)) 8. Equipment and systems controls.
((~~8.~~)) 9. Fan motor horsepower (hp) and controls.
((~~9.~~)) 10. Duct sealing, duct and pipe insulation and location.
((~~10.~~)) 11. Lighting fixture schedule with wattage and control narrative.
((~~11.~~)) 12. Location of daylight zones on floor plan.
((~~12.~~)) 13. 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 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.

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 a maximum of 90 days of the date of receipt of the certificate of occupancy.

C103.6.1 Record documents. Construction documents shall be updated by the installing contractor and architect or engineer of record to convey a record of the completed work. Such updates shall include building envelope, mechanical, plumbing, electrical and control drawings red-lined, or redrawn if specified, that show all changes to size, type and locations of components, equipment and assemblies. Record documents shall include the location and model number of each piece of equipment as installed. The architect, engineer of record or installing contractor is required to provide consolidated record drawings in compliance with this section to the building owner or owner's authorized agent with the timeline specified in Section C103.6.

C103.6.2 Building operations and maintenance information. Required regular maintenance actions for equipment and systems shall be clearly stated on a readily visible label on the equipment. The label shall include the title or publication number for the operation and maintenance manual for that particular model and type of product and the manufacture date or installation date.

C103.6.2.1 Manuals. An operating and maintenance manual shall be provided for each component, device, piece of equipment, and system governed by this code. The manual shall include all of the following:

1. Submittal data indicating all selected options for each piece of equipment and control devices.
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. A schedule for inspecting and recalibrating all lighting controls. 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. Sequence of operation alone is not acceptable for this requirement.

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 or 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, the interior lighting power compliance path (building area, space-by-space) used to calculate the lighting power allowance.

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

1. The envelope insulation compliance path (prescriptive or component performance).
2. All completed code compliance forms, and all compliance calculations including, but not limited to, those required by sections C402.1.5, C403.2.12.1, C405.4, and C405.5.

For projects complying with Section C401.2 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.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-10400 Section C104—((~~Inspections~~)) Fees.

((~~**C104.1 General.** Construction or work for which a permit is required shall be subject to inspection by the *code official*, his or her designated agent, or an *approved agency*, and such construction or work shall remain visible and able to be accessed for inspection purposes until *approved*. Approval as a result of an inspection shall not be construed to be an approval of a violation of the provisions of this code or of other ordinances of the jurisdiction. Inspections presuming to give authority to violate or cancel the provisions of this code or of other ordinances of the jurisdiction shall not be valid. It shall be the duty of the permit applicant to cause the work to remain visible and able to be accessed for inspection purposes. Neither the *code official* 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*, his or her designated agent, or an *approved agency*, upon notification, shall make the inspections set forth in Sections C104.2.1 through C104.2.6.~~

~~**C104.2.1 Footing and foundation insulation.** Inspections shall verify footing and/or foundation insulation *R*-value, location, thickness, depth of burial and protection of insulation as required by the code, *approved* plans and specifications.~~

~~**C104.2.2 Thermal envelope.** Inspections shall be made before application of interior finish and shall verify that envelope components with the correct type of insulation, the *R*-values, the correct location of insulation, the correct fenestration, the *U*-factor, SHGC, VT, and air leakage controls are properly installed as required by the code, *approved* plans and specifications, including envelope components in future tenant spaces of multitenant buildings.~~

~~**C104.2.3 Plumbing system.** Inspections shall verify the type of insulation, the *R*-values, the protection required, controls, and heat traps as required by the code, *approved* plans and specifications.~~

~~**C104.2.4 Mechanical system.** Inspections shall verify the installed HVAC equipment for the correct type and size, controls, duct and piping insulation *R*-values, duct system and damper air leakage, minimum fan efficiency, energy recovery and economizer as required by the code, *approved* plans and specifications.~~

~~**C104.2.5 Electrical system.** Inspections shall verify lighting system controls, components, meters, motors and installation of an electric meter for each dwelling unit as required by the code, *approved* plans and specifications.~~

~~**C104.2.6 Final inspection.** The final inspection shall include verification of the installation and proper operation of all required building controls, and documentation verifying activities associated with required building commissioning have been conducted in accordance with Section C408.~~

~~**C104.3 Reinspection.** A building shall be reinspected when determined necessary by the *code official*.~~

~~**C104.4 Approved inspection agencies.** The *code official* is authorized to accept reports of *approved* inspection agencies, provided such agencies satisfy the requirements as to qualifications and reliability relevant to the building components and systems they are inspecting.~~

~~**C104.5 Inspection requests.** It shall be the duty of the holder of the permit or their duly authorized agent to notify the *code official* when work is ready for inspection. It shall be the duty of the permit holder to provide access to and means for inspections of such work that are required by this code.~~

~~**C104.6 Reinspection and testing.** Where any work or installation does not pass an initial test or inspection, the necessary corrections shall be made so as to achieve compliance with this code. The work or installation shall then be resubmitted to the *code official* for inspection and testing.~~

~~**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.~~))

C104.1 Fees. A permit shall not be issued until the fees prescribed in Section C104.2 have been paid, nor shall an amendment to a permit be released until the additional fee, if any, has been paid.

C104.2 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.

C104.3 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.

C104.4 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.

C104.5 Refunds. The *code official* is authorized to establish a refund policy.

AMENDATORY SECTION (Amending WSR 13-04-056, filed 2/1/13, effective 7/1/13)

WAC 51-11C-10500 Section C105—((~~Validity~~)) Inspections.

C105.1 General. ((~~If a portion of this code is held to be illegal or void, such a decision shall not affect the validity of the remainder of this code.~~)) Construction or work for which a permit is required shall be subject to inspection by the *code official*, his or her designated agent, or an *approved agency*, and such construction or work shall remain visible and able to be accessed for inspection purposes until *approved*. Approval as a result of an inspection shall not be construed to be an approval of a violation of the provisions of this code or of other ordinances of the jurisdiction. Inspections presuming to give authority to violate or cancel the provisions of this code or of other ordinances of the jurisdiction shall not be valid. It shall be the duty of the permit applicant to cause the work to remain visible and able to be accessed for inspection purposes. Neither the *code official* 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.

C105.2 Required inspections. The *code official*, his or her designated agent, or an *approved agency*, upon notification, shall make the inspections set forth in Sections C105.2.1 through C105.2.6.

C105.2.1 Footing and foundation insulation. Inspections shall verify footing and/or foundation insulation *R*-value, location, thickness, depth of burial and protection of insulation as required by the code, *approved* plans and specifications.

C105.2.2 Thermal envelope. Inspections shall be made before application of interior finish and shall verify that envelope components with the correct type of insulation, the *R*-values, the correct location of insulation, the correct fenestration, the *U*-factor, SHGC, VT, and air leakage controls are properly installed as required by the code, *approved* plans and specifications, including envelope components in future tenant spaces of multitenant buildings.

C105.2.3 Plumbing system. Inspections shall verify the type of insulation, the *R*-values, the protection required, controls, and heat traps as required by the code, *approved* plans and specifications.

C105.2.4 Mechanical system. Inspections shall verify the installed HVAC equipment for the correct type and size, controls, duct and piping insulation *R*-values, duct system and damper air leakage, minimum fan efficiency, energy recovery and economizer as required by the code, *approved* plans and specifications.

C105.2.5 Electrical system. Inspections shall verify lighting system controls, components, meters, motors and installation of an electric

meter for each dwelling unit as required by the code, *approved* plans and specifications.

C105.2.6 Final inspection. The final inspection shall include verification of the installation and proper operation of all required building controls, and documentation verifying activities associated with required building commissioning have been conducted in accordance with Section C408.

C105.3 Reinspection. A building shall be reinspected when determined necessary by the *code official*.

C105.4 Approved inspection agencies. The *code official* is authorized to accept reports of *approved* inspection agencies, provided such agencies satisfy the requirements as to qualifications and reliability relevant to the building components and systems they are inspecting.

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

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

AMENDATORY SECTION (Amending WSR 16-03-072, filed 1/19/16, effective 7/1/16)

WAC 51-11C-10600 Section C106—((~~Referenced standards~~)) Notice of approval.

((~~**C106.1 Referenced codes and standards.** The codes and standards referenced in this code shall be those listed in Chapter 5, 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 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.~~))

C106.1 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*.

C106.2 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.

AMENDATORY SECTION (Amending WSR 13-04-056, filed 2/1/13, effective 7/1/13)

WAC 51-11C-10700 Section C107—((~~Fees~~)) Validity.

((~~**C107.1 Fees.** 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.~~))

C107.1 General. If a portion of this code is held to be illegal or void, such a decision shall not affect the validity of the remainder of this code.

AMENDATORY SECTION (Amending WSR 16-03-072, filed 1/19/16, effective 7/1/16)

WAC 51-11C-10800 Section C108—((~~Stop work order~~)) Referenced standards.

((~~**C108.1 Authority.** 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.~~))

C108.1 Referenced codes and standards. The codes and standards referenced in this code shall be those listed in Chapter 5, 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 C108.1.1 and C108.1.2.

C108.1.1 Conflicts. Where differences occur between provisions of this code and referenced codes and standards, the provisions of this code shall apply.

C108.1.2 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.

C108.2 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.

C108.3 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.

AMENDATORY SECTION (Amending WSR 13-04-056, filed 2/1/13, effective 7/1/13)

WAC 51-11C-10900 Section C109—((~~Board of appeals~~)) Stop work order.

((~~**C109.1 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.~~))

C109.1 Authority. 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.

C109.2 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.

C109.3 Emergencies. Where an emergency exists, the *code official* shall not be required to give a written notice prior to stopping the work.

C109.4 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.

AMENDATORY SECTION (Amending WSR 13-04-056, filed 2/1/13, effective 7/1/13)

WAC 51-11C-11000 Section C110—((~~Violations~~)) Board of appeals.

((~~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.~~))

C110.1 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*.

C110.2 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.

C110.3 Qualifications. The board of appeals shall consist of members who are qualified by experience and training and are not employees of the jurisdiction.

AMENDATORY SECTION (Amending WSR 13-04-056, filed 2/1/13, effective 7/1/13)

WAC 51-11C-11100 Section C111—((~~Liability~~)) Violations. ((~~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.~~)) 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.

NEW SECTION

WAC 51-11C-11200 Section C112—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.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-20201 Section C202.1—A.

ABOVE-GRADE WALL. ((~~A wall enclosing *conditioned space*~~)) That portion of a wall in the building envelope that is not a below-grade wall. This includes between-floor spandrels, peripheral edges of floors, roof ((~~and basement~~)) knee walls, dormer walls, gable end walls, walls enclosing a mansard roof and skylight shafts.

ACCESS (TO). That which enables a device, appliance or equipment to be reached by *ready access* or by a means that first requires the removal or movement of a panel or similar obstruction.

ADDITION. An extension or increase in the *conditioned space* floor area, number of stories, or height of a building or structure.

AIR BARRIER. One or more materials joined together in a continuous manner to restrict or prevent the passage of air through the *building thermal envelope* and its assemblies.

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

ALTERNATING CURRENT-OUTPUT UNINTERRUPTIBLE POWER SUPPLY (AC-OUTPUT UPS). A combination of convertors, switches and energy storage devices, such as batteries, constituting a power system for maintaining continuity of load power in case of input power failure. Input power failure occurs when voltage and frequency are outside rated steady state and transient tolerance bands or when distortion or interruptions are outside the limits specified for the uninterruptible power supply. An *AC-output UPC* is an uninterruptible power supply that supplies power with a continuous flow of electric charge that periodically reverses direction.

ALTERATION. Any construction, retrofit or renovation to an existing structure other than repair or addition. Also, a change in a building, electrical, gas, mechanical or plumbing system that involves an extension, addition or change to the arrangement, type or purpose of the original installation.

APPROVED. Acceptable to the *code official*.

APPROVED AGENCY. An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, or furnishing product certification research reports, when such agency has been *approved* by the *code official*.

ATTIC AND OTHER ROOFS. ((~~All other~~)) 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. Self-acting, operating by its own mechanism when actuated by some impersonal influence, as, for example, a change in current strength, pressure, temperature or mechanical configuration (see "Manual").

AUTOMATIC CONTROL DEVICE. A device capable of automatically controlling equipment and devices without manual intervention.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-20202 Section C202.2—B.

BELOW-GRADE WALL. That portion of a wall in the building envelope that is entirely below the finish grade and in contact with the ground.

BIOGAS. A mixture of hydrocarbons that is a gas at 60°F (15.5°C) and one atmosphere of pressure that is produced through the anaerobic digestion of organic matter.

BIOMASS. Nonfossilized and biodegradable organic material originating from plants, animals and/or micro-organisms, including products, by-products, residues and waste from agriculture, forestry and related industries as well as the nonfossilized and biodegradable organic fractions of industrial and municipal wastes, including gases and liquids recovered from the decomposition of nonfossilized and biodegradable organic material.

BLOCK. A generic concept used in energy simulation. It can include one or more thermal zones. It represents a whole building or portion of a building with the same use type served by the same HVAC system type.

BOILER, MODULATING. A boiler that is capable of more than a single firing rate in response to a varying temperature or heating load.

BOILER SYSTEM. One or more boilers, their piping and controls that work together to supply steam or hot water to heat output devices remote from the boiler.

BUBBLE POINT. The refrigerant liquid saturation temperature at a specified pressure.

BUILDING. Any structure used or intended for supporting or sheltering any use or occupancy, including any mechanical systems, service water heating systems and electric power and lighting systems located on the building site and supporting the building.

BUILDING COMMISSIONING. A process that verifies and documents that the building systems have been installed and function according to the approved construction documents.

BUILDING ENTRANCE. Any doorway, set of doors, revolving door, vestibule or other form of portal (including elevator doors such as in parking garages) that is ordinarily used to gain access to the building or to exit from the building by its users and occupants. This does not include doors solely used to directly enter mechanical, electrical and other building utility service equipment rooms, or doors for emergency egress only. Where buildings have separate one-way doors to enter or leave, any doors ordinarily used to leave the building are also deemed a building entrance.

BUILDING SITE. A contiguous area of land that is under the ownership or control of one entity.

BUILDING THERMAL ENVELOPE. The *below-grade walls*, *above-grade walls*, floors, ceilings, roofs, and any other building element assemblies that ((~~enclose *conditioned space* or provides a boundary between *conditioned space*, *semiheated space* and exempt or unconditioned space~~)) meet one or more of the following criteria:

1. Separate a *conditioned space* from a *semiheated space*, a refrigerated space in accordance with Section C410.2, a low energy space in accordance with Section C402.1.1, or an area that is not an *enclosed space*.

2. Separate a *semiheated space* from a *conditioned space*, a refrigerated space, a low energy space or an area that is not an *enclosed space*.

3. Separate a refrigerated space from a low energy space or an area that is not an *enclosed space*.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-20203 Section C202.3—C.

C-FACTOR (THERMAL CONDUCTANCE). The coefficient of heat transmission (surface to surface) through a building component or assembly, equal to the time rate of heat flow per unit area and the unit temperature difference between the warm side and cold side surfaces (Btu/h ft^2 × °F) [W/(m^2 × K)].

CAPTIVE KEY DEVICE. A lighting control that will not release the key that activates the override when the lighting is on.

CAVITY INSULATION. Insulating material located between framing members.

CEILING FAN. A nonportable device suspended from a ceiling or overhead structure for circulating air via the rotation of the blades. See also **LARGE-DIAMETER CEILING FAN.**

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 the commissioning process.

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

1. A change of occupancy classification.

2. A change from one group to another group within an occupancy classification.

3. Any change in use within a group for which there is a change in the application of the requirements of this code.

CIRCULATING HOT WATER SYSTEM. A specifically designed water distribution system where one or more pumps are operated in the service hot water piping to circulate heated water from the water-heating equipment to the fixture supply and back to the water-heating equipment.

CLERESTORY FENESTRATION. See "**FENESTRATION.**"

CLIMATE ZONE. A geographical region based on climatic criteria as specified in this code.

CODE OFFICIAL. The officer or other designated authority charged with the administration and enforcement of this code, or a duly authorized representative.

COEFFICIENT OF PERFORMANCE (COP) - COOLING. The ratio of the rate of heat removal to the rate of energy input, in consistent units, for a complete refrigerating system or some specific portion of that system under designated operating conditions.

COEFFICIENT OF PERFORMANCE (COP) - HEATING. The ratio of the rate of heat removal to the rate of heat delivered to the rate of energy input, in consistent units, for a complete heat pump system, including the compressor and, if applicable, auxiliary heat, under designated operating conditions.

COMMERCIAL BOILER. A type of boiler with a capacity (rated maximum input) of 300,000 Btu/h or more and serving a space heating or water heating load in a commercial building.

COMMERCIAL BUILDING. For this code, all buildings that are not included in the definition of "Residential buildings."

COMMUNITY RENEWABLE ENERGY SYSTEM. An off-site renewable energy system for which the owner has purchased or leased renewable energy capacity along with other subscribers.

COMPRESSED AIR SYSTEM. A system of at least one compressor providing compressed air at 40 psig or higher.

COMPUTER ROOM. A room whose primary function is to house equipment for the processing and storage of electronic data and that has a design total *information technology equipment (ITE)* equipment power density less than or equal to 20 watts per square foot (215 watts per m^2) of conditioned floor area or a design *ITE* equipment load less than or equal to 10 kW. See also **DATA CENTER.**

CONDENSING UNIT. A factory-made assembly of refrigeration components designed to compress and liquefy a specific refrigerant. The unit consists of one or more refrigerant compressors, refrigerant condensers (air-cooled, evaporatively cooled, or water-cooled), condenser fans and motors (where used) and factory-supplied accessories.

CONDITIONED FLOOR AREA. The horizontal projection of the floors associated with the *conditioned space*.

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 intentionally 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 metal thermal bridges other than fasteners that have a total cross-sectional area not greater than 0.04 percent (0.12 percent where all metal thermal bridges are stainless steel) 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.*

CURTAIN WALL. Fenestration products used to create an external nonload-bearing wall that is designed to separate the exterior and interior environments.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-20204 Section C202.4—D.

DATA ACQUISITION SYSTEM. An electronic system managed by the building owner to collect, tabulate and display metering information.

DATA CENTER. A room or series of rooms that share *data center systems* whose primary function is to house equipment for the processing and storage of electronic data, which has a design total *information technology equipment (ITE)* power density exceeding 20 watts per square foot (215 watts per m^2) of conditioned area and a total design *ITE* equipment load greater than 10 kW.

DATA CENTER SYSTEMS. HVAC systems, electrical systems, equipment, or portions thereof used to condition *ITE* or electrical systems in a *data center*.

DAYLIGHT RESPONSIVE CONTROL. A device or system that provides automatic control of electric light levels based on the amount of daylight in a space.

DAYLIGHT ZONE. The portion of the building interior floor area that is illuminated by natural daylight through sidelit and toplit fenestration.

DECORATIVE APPLIANCE, VENTED. A vented appliance wherein the primary function lies in the aesthetic effect of the flames.

DEDICATED OUTDOOR AIR SYSTEM (DOAS). A ventilation system that supplies 100 percent outdoor air primarily for the purpose of ventilation and that is a separate system from the zone space-conditioning system.

DEMAND CONTROL KITCHEN VENTILATION (DCKV). A system that provides automatic, continuous control over exhaust hood and make-up air fan speed in response to temperature, optical or infrared (IR) sensors that monitor cooking activity or through direct communication with cooking appliances.

DEMAND CONTROL VENTILATION (DCV). A ventilation system capability that provides for the automatic reduction of outdoor air intake below design rates when the actual occupancy of spaces served by the system is less than design occupancy.

DEMAND RECIRCULATION WATER SYSTEM. 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.

DEMAND RESPONSE SIGNAL. A signal that indicates a price or a request to modify electricity consumption for a limited time period.

DEMAND RESPONSIVE CONTROL. A control capable of receiving and automatically responding to a *demand response signal*.

DESICCANT DEHUMIDIFICATION SYSTEM. A mechanical dehumidification technology that uses a solid or liquid material to remove moisture from the air.

DIRECT DIGITAL CONTROL (DDC). A type of control where controlled and monitored analog or binary data such as temperature and contact closures are converted to digital format for manipulation and calculations by a digital computer or microprocessor, then converted back to analog or binary form to control physical devices.

DIRECTLY OWNED OFF-SITE RENEWABLE ENERGY SYSTEM. An off-site renewable energy system owned by the building project owner.

DOOR, GARAGE. Nonswinging doors rated by ((~~ASMA~~)) DASMA 105 with a single panel or horizontally hinged sectional panels.

DOOR, NONSWINGING. Roll-up, tilt-up, metal coiling and sliding doors, access hatches, and all other doors that are not swinging doors or garage doors with less than or equal to 14 percent glazing.

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

DUCT. A tube or conduit utilized for conveying air. The air passages of self-contained systems are not to be construed as air ducts.

DUCT SYSTEM. A continuous passageway for the transmission of air that, in addition to ducts, includes duct fittings, dampers, plenums, fans and accessory air-handling equipment and appliances.

DWELLING UNIT. A single unit providing complete independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking and sanitation.

DX-DEDICATED OUTDOOR AIR SYSTEM UNITS (DX-DOAS UNITS). A type of air-cooled, water-cooled or water source factory assembled product that dehumidifies 100 percent outdoor air to a low dew point and includes reheat that is capable of controlling the supply dry-bulb temperature of the dehumidified air to the designated supply air temperature. This conditioned outdoor air is then delivered directly or indirectly to the conditioned spaces. It may precondition outdoor air by containing an enthalpy wheel, sensible wheel, desiccant wheel, plate heat exchanger, heat pipes, or other heat or mass transfer apparatus.

DYNAMIC GLAZING. Any fenestration product that has the fully reversible ability to change its performance properties, including *U*-factor, SHGC, or VT.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-20205 Section C202.5—E.

ECONOMIZER, AIR. A duct and damper arrangement and automatic control system that allows a cooling system to supply outside air to reduce or eliminate the need for mechanical cooling during mild or cold weather.

ECONOMIZER, WATER. A system where the supply air of a cooling system is cooled indirectly with water that is itself cooled by heat or mass transfer to the environment without the use of mechanical cooling.

((~~**ELECTRICAL LOAD COEFFICIENT (ELC).** In a *data center*, the ratio of the sum of three specific electrical losses (or losses calculated from efficiencies) to the *ITE* load itself. Specifically, *ELC* equals the sum of the incoming (to *ITE*) electrical service losses, UPS losses, and *ITE* distribution losses all divided by the peak *ITE* load. The design *ELC* is calculated at the full load design condition with active redundant equipment engaged, and the annual *ELC* is calculated the same way because it is assumed that *ITE* runs constantly at full power all year.~~))

ENCLOSED SPACE. A volume surrounded by solid surfaces such as walls, floors, roofs, and openable devices such as doors and operable windows. Unconditioned crawlspaces, attics, and parking garages with natural or mechanical ventilation are not considered *enclosed spaces.*

END USE CATEGORY. A load or group of loads that consume energy in a common or similar manner.

ENERGY ANALYSIS. A method for estimating the annual energy use of the *proposed design* and *standard reference design* based on estimates of energy use.

ENERGY COST. The total estimated annual cost for purchased energy for the building functions regulated by this code, including applicable demand charges.

ENERGY RECOVERY VENTILATION SYSTEM. Systems that employ air-to-air heat exchangers to recover energy from exhaust air for the purpose of preheating,

precooling, humidifying or dehumidifying outdoor ventilation air prior to supplying the air to a space, either directly or as part of an HVAC system.

ENERGY SIMULATION TOOL. An *approved* software program or calculation-based methodology that projects the annual energy use of a building.

ENERGY SOURCE METER. A meter placed at the source of the incoming energy that measures the energy delivered to the whole building or metered space.

ENTHALPY RECOVERY RATIO (ERR). Change in the enthalpy of the *outdoor air* supply divided by the difference between the *outdoor air* and entering exhaust air enthalpy, expressed as a percentage.

ENTRANCE DOOR. A vertical fenestration product used for occupant ingress, egress and access in nonresidential buildings including, but not limited to, exterior entrances utilizing latching hardware and automatic closers and containing over 50 percent glazing specifically designed to withstand heavy duty usage.

EQUIPMENT ROOM. A space that contains either electrical equipment, mechanical equipment, machinery, water pumps or hydraulic pumps that are a function of the building's services.

EXTERIOR WALL. Walls including both above-grade walls and below-grade walls.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-20206 Section C202.6—F.

FAN, EMBEDDED. A fan that is part of a manufactured assembly where the assembly includes functions other than air movement.

FAN ARRAY. Multiple fans in parallel between two plenum sections in an air distribution system.

FAN BRAKE HORSEPOWER (BHP). The horsepower delivered to the fan's shaft. Brake horsepower does not include the mechanical drive losses (belts, gears, etc.).

((~~**FAN EFFICIENCY GRADE (FEG).** A numerical rating identifying the fan's aerodynamic ability to convert shaft power, or impeller power in the case of a direct-driven fan, to air power.~~))

FAN ELECTRICAL INPUT POWER (Fan kW_{design}). The electrical input power in kilowatts required to operate an individual fan or fan array at design conditions. It includes the power consumption of motor controllers, if present.

FAN ENERGY INDEX (FEI). The ratio of the electric input power of a reference fan to the electric input power of the actual fan as calculated in accordance with AMCA 208.

FAN SYSTEM. Includes all the fans that contribute to the movement of air through a point of a common duct, plenum, or cabinet.

FAN SYSTEM, COMPLEX. A *fan system* that combines supply, exhaust and/or other fans, or is not captured by other *fan system* types.

FAN SYSTEM, EXHAUST/RELIEF. A *fan system* dedicated to the removal of air from interior spaces to the outdoors.

FAN SYSTEM, MULTI-ZONE VARIABLE AIR VOLUME (VAV). A *fan system* that serves three or more space-conditioning zones where airflow to each zone is individually controlled based on heating, cooling and/or ventilation requirements, indoor fan airflow varies as a function of load, and the sum of

the minimum zone airflows is 40 percent or less of the fan system design conditions.

FAN SYSTEM, RETURN. A *fan system* dedicated to removing air from interior where some or all the air is to be recirculated except during economizer operation.

FAN SYSTEM, SINGLE-CABINET. A *fan system* where a single fan, single fan array, a single set of fans operating in parallel, or fans or fan arrays in series and embedded in the same cabinet, that both supplies air to a space and recirculates the air.

FAN SYSTEM, SUPPLY-ONLY. A *fan system* that provides supply air to interior spaces and does not recirculate the air.

FAN SYSTEM, TRANSFER. A fan system that exclusively moves air from one occupied space to another.

FAN SYSTEM AIRFLOW (cfm). The sum of the airflow of all fans with *fan electrical input power* greater than 1 kW at *fan system design conditions*, excluding the airflow that passes through downstream fans with fan input power less than 1 kW.

FAN SYSTEM BHP. The sum of the fan brake horsepower of all fans that are required to operate at fan system design conditions to supply air from the heating or cooling source to the *conditioned space(s)* and return it to the source or exhaust it to the outdoors.

FAN SYSTEM DESIGN CONDITIONS. Operating conditions that can be expected to occur during normal system operation that result in the highest supply fan airflow rate to conditioned spaces served by the system, other than during air economizer operation.

FAN SYSTEM ELECTRICAL INPUT POWER (Fan $kW_{design, system}$). The sum of the fan electrical input power (Fan kW_{design}) of all fans that are required to operate at fan system design conditions to supply air from the heating or cooling source to the conditioned spaces, return it to the source, exhaust it to the outdoors, or transfer it to another space.

FAN SYSTEM MOTOR NAMEPLATE HP. The sum of the motor nameplate horsepower of all fans that are required to operate at design conditions to supply air from the heating or cooling source to the *conditioned space(s)* and return it to the source or exhaust it to the outdoors.

FAULT DETECTION AND DIAGNOSTICS (FDD) SYSTEM. A software platform that utilizes building analytic algorithms to convert data provided by sensors and devices to automatically identify faults in building systems and provide a prioritized list of actionable resolutions to those faults based on cost or energy avoidance, comfort and maintenance impact.

FENESTRATION. Products classified as either skylights or vertical fenestration.

- **SKYLIGHTS.** Glass or other transparent or translucent glazing material installed at a slope of less than 60 degrees (91.05 rad) from horizontal, including unit skylights, tubular daylighting devices and glazing materials in solariums, sunrooms, roofs*, greenhouses*, and sloped walls.
- **VERTICAL FENESTRATION.** Windows that are fixed or operable, doors with more than 50 percent glazed area and glazed block composed of glass or other transparent or translucent glazing materials and installed at a slope not less than 60 degrees (91.05 rad) from horizontal. Opaque areas such as spandrel panels are not considered vertical fenestration.
- **CLERESTORY FENESTRATION.** An upper region of vertical fenestration provided for the purpose of admitting daylight beyond the perimeter of a space. The entire clerestory fenestration assembly is installed at a height greater than 8 feet above the finished floor.

FENESTRATION AREA. Total area of the fenestration measured using the rough opening, and including the glazing, sash and frame.

FENESTRATION PRODUCT, FIELD-FABRICATED. A fenestration product whose frame is made at the construction site of standard dimensional lumber or other materials that were not previously cut, or otherwise formed with the specific intention of being used to fabricate a fenestration product or exterior door. Field fabricated does not include site-built fenestration.

FENESTRATION PRODUCT, SITE-BUILT. A fenestration designed to be made up of field-glazed or field-assembled units using specific factory cut or otherwise factory-formed framing and glazing units. Examples of site-built fenestration include storefront systems, curtain walls, and atrium roof systems.

***F*-FACTOR.** The perimeter heat loss factor for slab-on-grade floors (Btu/h × ft × $^{\circ}_{F}$) [W/(m × K)].

FLOOR AREA, NET. The actual occupied area not including unoccupied accessory areas such as corridors, stairways, toilet rooms, mechanical rooms and closets.

FURNACE ELECTRICITY RATIO. The ratio of furnace electricity use to total furnace energy computed as ratio = $(3.412 \times E_{AE})/1000 \times E_F + 3.412 \times E_{AE})$ where E_{AE} (average annual auxiliary electrical consumption) and E_F (average annual fuel energy consumption) are defined in Appendix N to Subpart B of Part 430 of Title 10 of the Code of Federal Regulations and E_F is expressed in millions of Btus per year.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-20207 Section C202.7—G.

GENERAL LIGHTING. Interior lighting that provides a substantially uniform level of illumination throughout ((~~an area~~)) a space. *General lighting* shall not include lighting that provides a dissimilar level of illumination to serve a specific application or decorative feature within such area.

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

GROUP R. Buildings or portions of buildings that contain any of the following occupancies as established in the *International Building Code*:

1. Group R-1.
2. Group R-2 where located more than three stories in height above grade plane.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-20208 Section C202.8—H.

HEAT TRAP. An arrangement of piping and fittings, such as elbows, or a commercially available heat trap that prevents thermosyphoning of hot water during standby periods.

HEAT TRAP, PIPE CONFIGURED. A pipe configured heat trap is either, as applicable:

1. A device specifically designed for the purpose or an arrangement of tubing that forms a loop of 360 degrees; or

2. Piping that from the point of connection to the water heater (inlet or outlet) includes a length of piping directed downward before connection to the vertical piping of the supply water or hot-water distribution system.

HEATED SLAB-ON-GRADE FLOOR. Slab-on-grade floor construction in which the heating elements, hydronic tubing, or hot air distribution system is in contact with, or placed within or under, the slab.

HEATED WATER CIRCULATION SYSTEM. A water distribution system having one or more recirculation pumps that pump water from a heated water source through a dedicated hot water circulation pipe or piping system.

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

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.~~)) Any building or structure that is one or more of the following:

1. Listed, or certified as eligible for listing, by the State Historic Preservation Officer or the Keeper of the National Register of Historic Places, in the National Register of Historic Places.

2. Designated as historic under an applicable state or local law.

3. Certified as a contributing resource within a National Register-listed, state-designated or locally designated historic district.

HUMIDISTAT. A regulatory device, actuated by changes in humidity, used for automatic control of relative humidity.

HVAC TOTAL SYSTEM PERFORMANCE RATIO (HVAC TSPR). The ratio of the sum of a building's annual heating and cooling load in thousands of Btus to the sum of annual carbon emissions in pounds from energy consumption of the building HVAC systems. Carbon emissions shall be calculated by multiplying site energy consumption by the carbon emission factors from Table C407.1.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-20209 Section C202.9—I.

IEC DESIGN H MOTOR. An electric motor that meets all of the following:

1. It is an induction motor designed for use with three-phase power.

2. It contains a cage rotor.

3. It is capable of direct-on-line starting.

4. It has 4, 6 or 8 poles.

5. It is rated from 0.4 kW to 1600 kW at a frequency of 60 Hz.

IEC DESIGN N MOTOR. An electric motor that meets all of the following:

1. It is an inductor motor designed for use with three-phase power.

2. It contains a cage rotor.

3. It is capable of direct-on-line starting.

4. It has 2, 4, 6 or 8 poles.

5. It is rated from 0.4 kW to 1600 kW at a frequency of 60 Hz.

INFILTRATION. The uncontrolled inward air leakage into a building caused by the pressure effects of wind or the effect of differences in the indoor and outdoor air density or both.

INFORMATION TECHNOLOGY EQUIPMENT (ITE). ((~~ITE includes~~)) Items including computers, data storage, servers ((~~and network/communications~~)), network, and communication equipment.

INSULATION ENTIRELY ABOVE DECK. A roof with all insulation:

1. Installed above (outside of) the roof structure; and

2. Continuous (i.e., uninterrupted by framing members).

INTEGRATED ENERGY EFFICIENCY RATIO (IEER). A single-number figure of merit expressing cooling part-load EER efficiency for unitary air-conditioning and heat pump equipment on the basis of weighted operation at various load capacities for the equipment.

INTEGRATED HVAC SYSTEM. An HVAC system designed to handle both sensible and latent heat removal. Integrated HVAC systems may include, but are not limited to, HVAC systems with a sensible heat ratio of 0.65 or less and the capability of providing cooling, dedicated outdoor air systems, single package air conditioners with at least one refrigerant circuit providing hot gas reheat, and stand-alone dehumidifiers modified to allow external heat rejection.

INTEGRATED PART LOAD VALUE (IPLV). A single number figure of merit based on part-load EER, COP, or kW/ton expressing part-load efficiency for air conditioning and heat pump equipment on the basis of weighted operation at various load capacities for equipment.

INTEGRATED SEASONAL COEFFICIENT OF PERFORMANCE (ISCOP). A seasonal efficiency number that is a combined value based on the formula listed in AHRI Standard 920 of the two COP values for the heating season of a DX-DOAS unit water or air source heat pump, expressed in W/W.

INTEGRATED SEASONAL MOISTURE REMOVAL EFFICIENCY (ISMRE). A seasonal efficiency number that is a combined value based on the formula listed in AHRI Standard 920 of the four dehumidification moisture removal efficiency (MRE) ratings required for DX-DOAS units, expressed in lb. of moisture/kWh.

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

ISOLATION DEVICES. Devices that isolate HVAC zones so they can be operated independently of one another. Isolation devices include separate systems, isolation dampers and controls providing shutoff at terminal boxes.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-20212 Section C202.12—L.

LABELED. Equipment, materials or products to which have been affixed a label, seal, symbol or other identifying mark of a nationally recognized testing laboratory, *approved agency* or other organization con-

cerned with product evaluation that maintains periodic inspection of the production of the above-labeled items and whose labeling indicates either that the equipment, material or product meets identified standards or has been tested and found suitable for a specified purpose.

LARGE-DIAMETER CEILING FAN. A ceiling fan that is greater than seven feet (2134 mm) in diameter. These fans are sometimes referred to as High-Volume, Low-Speed (HVLS) fans.

LARGEST NET CAPACITY INCREMENT. The largest increase in capacity when switching between combinations of base compressors that is expected to occur under the *compressed air system* control scheme.

LINER SYSTEM (LS). A system that includes the following:

1. A continuous vapor barrier liner membrane that is installed below the purlins and that is uninterrupted by framing members.

2. An uncompressed, unfaced insulation resting on top of the liner membrane and located between the purlins.

For multilayer installations, the last rated *R*-value of insulation is for unfaced insulation draped over purlins and then compressed when the metal roof panels are attached.

LISTED. Equipment, materials, products or services included in a list published by an organization acceptable to the *code official* and concerned with evaluation of products or services that maintains periodic inspection of production of *listed* equipment or materials or periodic evaluation of services and whose listing states either that the equipment, material, product or service meets identified standards or has been tested and found suitable for a specified purpose.

LOW-CARBON DISTRICT ENERGY EXCHANGE SYSTEM. Any system serving multiple buildings providing energy in the form of a circulated fluid that can accept or reject heat from individual buildings. Energy can be indirectly converted to meet building heating or cooling loads by serving as the heat source or sink for heat-pump systems. Examples include, but are not limited to, low temperature condenser water, ground source condenser water, or sewer heat recovery.

Low-carbon district energy exchange systems must demonstrate that 25 percent of the annual district-system-net-load-met (sum of heating and cooling energy provided to attached buildings) comes from heat recovery between connected buildings, waste heat, or *renewable energy resources* and no more than 25 percent of the annual heat input to the system comes from fossil fuel or electric-resistance sources.

LOW-CARBON DISTRICT HEATING AND COOLING OR HEATING ONLY SYSTEM. Any system serving multiple buildings providing energy in the form of direct heating and cooling, or heating only to a building. Energy can be directly converted to meet building heating or cooling loads through a heat exchanger. Examples include, but are not limited to, steam, hot water, and chilled water.

Low-carbon district systems must demonstrate the following:

1. Distribution losses must be accounted for and may not exceed 10 percent of the annual load delivered to buildings served by the system.

2. Twenty-five percent of the annual district-system-net-load-met (sum of heating and cooling energy provided to attached buildings) comes from heat recovery between connected buildings, waste heat or *renewable energy resources* and no more than 25 percent of the annual heat input to the system comes from fossil fuel or electric resistance sources; or

3. No more than 10 percent of the system annual heat input to the system comes from fossil fuel or electric resistance sources.

LOW-SLOPED ROOF. A roof having a slope less than 2 units vertical in 12 units horizontal.

LOW-VOLTAGE DRY-TYPE DISTRIBUTION TRANSFORMER. A transformer that is air-cooled, does not use oil as a coolant, has an input voltage less than or equal to 600 volts and is rated for operation at a frequency of 60 hertz.

LOW-VOLTAGE LIGHTING. A lighting system consisting of an isolating power supply, the low voltage luminaires, and associated equipment that are all identified for the use.

LUMINAIRE. A complete lighting unit consisting of a lamp or lamps together with the housing designed to distribute the light, position and protect the lamps, and connect the lamps to the power supply.

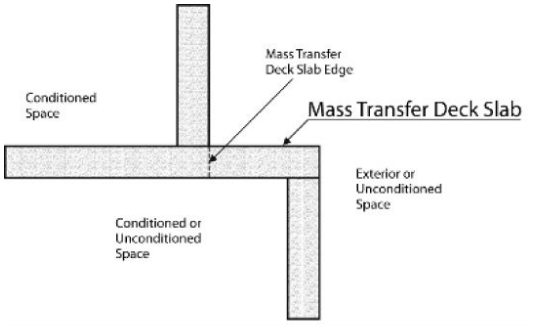
LUMINAIRE-LEVEL LIGHTING CONTROL. A lighting system consisting of one or more *luminaires* where each *luminaire* has embedded lighting control logic, occupancy and ambient light sensors, and local override switching capability, where required. Each *luminaire* shall also have local or central wireless networking capabilities to detect and share information with other *luminaires* to adjust to occupancy and/or daylight in the space.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-20213 Section C202.13—M.

MANUAL. Capable of being operated by personal intervention (see "Automatic").

MASS TRANSFER DECK SLAB ((~~EDGE~~)). ((~~That portion of the above-grade wall made up of the concrete slab where it extends past the footprint of the floor above, and there is space (conditioned or unconditioned) below the slab.~~)) A concrete slab designed to transfer structural load from the building perimeter wall or column line above, laterally to an offset wall or column line below, and which has conditioned or semiheated space on the inside of the upper wall and exterior or unconditioned space on the outside of the upper wall. The area of the slab edge shall be defined as the thickness of the slab multiplied by the ((~~perimeter~~)) length of the edge condition. Examples of this condition include, but are not limited to, the transition from an above-grade structure to a below-grade structure or the transition from a tower to a podium. A cantilevered ((~~balconies do not meet this definition~~)) concrete balcony does not constitute a mass transfer deck slab.



MECHANICAL COOLING. Reducing the temperature of a gas or liquid by using vapor compression, absorption, desiccant dehumidification combined with evaporative cooling, or another energy-driven thermodynamic cycle. Indirect or direct evaporative cooling alone is not considered mechanical cooling.

MECHANICAL HEATING. Raising the temperature of a gas or liquid by use of fossil fuel burners, electric resistance heaters, heat pumps, or other systems that require energy to operate.

MECHANICAL LOAD COEFFICIENT (MLC). In a *data center*, the ratio of the cooling system's net use of energy to that of the *ITE*. ((~~The design MLC is calculated for a local peak weather condition (stipulated in ASHRAE Standard 90.4) and equals the sum of all active cooling equipment input power, divided by total power into the *ITE*.~~)) The annual MLC is calculated using hourly ((~~TMY3~~)) weather data for the data center's location and equals the sum of all energy flowing into the cooling system to respond to that weather, minus any energy successfully recovered to avoid any new energy use, all divided by the energy flowing into the *ITE* during the same period.

MECHANICAL ROOM. A room or space in which mechanical equipment and appliances are located that has sufficient room for access and maintenance of the equipment or appliances with room energy doors closed.

METAL BUILDING ROOF. A roof that:

1. Is constructed with a metal, structural, weathering surface;
2. Has no ventilated cavity; and
3. Has the insulation entirely below deck (i.e., does not include composite concrete and metal deck construction nor a roof framing system that is separated from the superstructure by a wood substrate) and whose structure consists of one or more of the following configurations:

a. Metal roofing in direct contact with the steel framing members;

b. Metal roofing separated from the steel framing members by insulation;

c. Insulated metal roofing panels installed as described in a or b.

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

METER. A device that measures the flow of energy.

MICROCELL. A wireless communication facility consisting of an antenna that is either: (a) Four (4) feet in height and with an area of not more than 580 square inches; or (b) if a tubular antenna, no more than four (4) inches in diameter and no more than six (6) feet in length; and the associated equipment cabinet that is six (6) feet or less in height and no more than 48 square feet in floor area.

MULTI-PASS. A heat pump water heater control strategy requiring multiple passes of water through the heat pump to reach the final target storage water temperature.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-20214 Section C202.14—N.

NAMEPLATE HORSEPOWER. The nominal motor output power rating stamped on the motor nameplate.

NEMA DESIGN A MOTOR. A squirrel-cage motor that meets all of the following:

1. It is designed to withstand full-voltage starting and developing locked-rotor torque as shown in paragraph 12.38.1 of NEMA MG 1.

2. It has pull-up torque not less than the values shown in paragraph 12.40.1 of NEMA MG 1.

3. It has breakdown torque not less than the values shown in paragraph 12.39.1 of NEMA MG 1.

4. It has a locked-rotor current higher than the values shown in paragraph 12.35.1 of NEMA MG 1 for 60 Hz and paragraph 12.35.2 of NEMA MG 1 for 50 Hz.

5. It has a slip at rated load of less than 5 percent for motors with fewer than 10 poles.

NEMA DESIGN B MOTOR. A squirrel-cage motor that meets all of the following:

1. It is designed to withstand full-voltage starting.

2. It develops locked-rotor, breakdown and pull-up torques adequate for general application as specified in Sections 12.38, 12.39 and 12.40 of NEMA MG 1.

3. It draws locked-rotor current not to exceed the values shown in paragraph 12.35.1 of NEMA MG 1 for 60 Hz and paragraph 12.35.2 of NEMA MG 1 for 50 Hz.

4. It has a slip at rated load of less than 5 percent for motors with fewer than 10 poles.

NEMA DESIGN C MOTOR. A squirrel-cage motor that meets all of the following:

1. It is designed to withstand full-voltage starting and developing locked-rotor torque for high-torque applications up to the values shown in paragraph 12.38.2 of NEMA MG 1 (incorporated by reference; see Sec. 431.15).

2. It has pull-up torque not less than the values shown in paragraph 12.40.2 of NEMA MG 1.

3. It has breakdown torque not less than the values shown in paragraph 12.39.2 of NEMA MG 1.

4. It has a locked-rotor current not to exceed the values shown in paragraph 12.35.1 of NEMA MG 1 for 60 Hz and paragraph 12.35.2 of NEMA MG 1 for 50 Hz.

5. It has a slip at rated load of less than 5 percent.

NETWORKED GUEST ROOM CONTROL SYSTEM. A control system, ((~~accessible~~)) with access from the front desk or other central location associated with a Group R-1 building, that is capable of identifying the ((~~occupancy~~)) rented and unrented status of each guest room according to a timed schedule, and is capable of controlling HVAC in each hotel and motel guest room separately.

NONSTANDARD PART LOAD VALUE (NPLV). A single-number part-load efficiency figure of merit calculated and referenced to conditions other than IPLV conditions, for units that are not designed to operate at ARI standard rating conditions.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-20215 Section C202.15—O.

OCCUPANT SENSOR CONTROL. An automatic control device or system that detects the presence or absence of people within an area and causes lighting, equipment or appliances to be regulated accordingly.

ON-SITE RENEWABLE ENERGY. Energy ((~~derived from solar radiation, wind, waves, tides, landfill gas, biogas, biomass, or the internal heat of the earth. The energy system providing on-site renewable energy shall be located on the project site~~)) from *renewable energy resources* harvested at the building site.

OPAQUE DOOR. A door that is not less than 50 percent opaque in surface area.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-20216 Section C202.16—P.

PERSONAL WIRELESS SERVICE FACILITY. A wireless communication facility (WCF), including a microcell, which is a facility for the transmission and/or reception of radio frequency signals and which may include antennas, equipment shelter or cabinet, transmission cables, a support structure to achieve the necessary elevation, and reception and/or transmission devices or antennas.

PHOTOSYNTHETIC PHOTON EFFICACY (PPE). Photosynthetic photon flux divided by input electric power in units of micromoles per second per watt, or micromoles per joule as defined by ANSI/ASABE S640.

POWERED ROOF/WALL VENTILATORS. A fan consisting of a centrifugal or axial impeller with an integral driver in a weather-resistant housing and with a base designed to fit, usually by means of a curb, over a wall or roof opening.

POWER-OVER-ETHERNET LIGHTING (POE). Lighting sources powered by DC current utilizing Ethernet cables.

PRIMARY STORAGE. Compressed air storage located upstream of the distribution system and any pressure flow regulators.

PROCESS BOILER. A type of boiler with a capacity (rated maximum input) of 300,000 Btu/h or more that serves a process.

PROPOSED DESIGN. A description of the proposed building used to estimate annual energy use and carbon emissions from energy consumption for determining compliance based on total building performance and *HVAC total performance ratio*.

PUBLIC LAVATORY FAUCET. A lavatory faucet that is not intended for private use as defined by the *Uniform Plumbing Code* and that is supplied with both potable cold and hot water.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-20218 Section C202.18—R.

RADIANT HEATING SYSTEM. A heating system that transfers heat to objects and surfaces within a conditioned space, primarily by infrared radiation.

READY ACCESS (TO). That which enables a device, appliance or equipment to be directly reached, without requiring the removal or movement of any panel or similar obstruction.

REFRIGERANT DEW POINT. The refrigerant vapor saturation temperature at a specified pressure.

REFRIGERATED WAREHOUSE COOLER. An enclosed storage space that has a total chilled storage area of 3,000 ft^2 or greater and is designed to maintain a temperature of greater than 32°F but less than 55°F.

REFRIGERATED WAREHOUSE FREEZER. An enclosed storage space that has a total chilled storage area of 3,000 ft^2 or greater and is designed to maintain a temperature at or below 32°F.

REFRIGERATION SYSTEM, LOW TEMPERATURE. Systems for maintaining food product in a frozen state in refrigeration applications.

REFRIGERATION SYSTEM, MEDIUM TEMPERATURE. Systems for maintaining food product above freezing in refrigeration applications.

REGISTERED DESIGN PROFESSIONAL. An individual who is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws of the state or jurisdiction in which the project is to be constructed.

RENEWABLE ENERGY RESOURCES. Energy derived from solar radiation, wind, waves, tides, *biogas*, *biomass* or extracted from hot fluid or steam heated within the earth.

RENEWABLE POWER PURCHASE AGREEMENT. A power purchase agreement for off-site renewable energy where the owner agrees to purchase renewable energy output and the associated renewable energy certificates at a fixed price schedule.

REPAIR. The reconstruction or renewal of any part of an existing building.

REPLACEMENT AIR. Outdoor air that is used to replace air removed from a building through an exhaust system. Replacement air may be derived from one or more of the following: Make-up air, supply air, transfer air and infiltration. However, the ultimate source of all replacement air is outdoor air. When replacement air exceeds exhaust, the result is exfiltration.

REROOFING. The process of recovering or replacing an existing roof covering. See "Roof Recover" and "Roof Replacement."

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 buildings three stories or less in height above grade plane.

ROOF ASSEMBLY. A system designed to provide weather protection and resistance to design loads. The system consists of a roof covering and roof deck or a single component serving as both the roof covering and the roof deck. A roof assembly includes the roof covering, underlayment, roof deck, insulation, vapor retarder and interior finish. See also *attic and other roofs*, *metal building roof*, roof with *insulation entirely above deck* and *single-rafter roof*.

ROOF RECOVER. The process of installing an additional *roof covering* over a prepared existing *roof covering* without removing the existing *roof covering*.

ROOF REPAIR. Reconstruction or renewal of any part of an existing roof for the purposes of its maintenance.

ROOF REPLACEMENT. The process of removing the existing roof covering, repairing any damaged substrate and installing a new *roof covering*.

ROOFTOP MONITOR. A raised section of a roof containing vertical fenestration along one or more sides.

R-VALUE (THERMAL RESISTANCE). The inverse of the time rate of heat flow through a body from one of its bounding surfaces to the other surface for a unit temperature difference between the two surfaces, under steady state conditions, per unit area ($h \cdot ft^2 \cdot °F/Btu$) [$(m^2 \cdot K)/W$].

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-20219 Section C202.19—S.

SATURATED-CONDENSING TEMPERATURE. The saturation temperature corresponding to the measured refrigerant pressure at the condenser inlet for single component and azeotropic refrigerants, and the arithmetic average of the dew point and *bubble point* temperatures corresponding to the refrigerant pressure at the condenser entrance for zeotropic refrigerants.

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 an installed heating system output capacity greater than or equal to 3.4 Btu/(h-ft^2) but not greater than 8 Btu/(h-ft^2);

2. Is not a *walk-in* ((~~or~~)) *cooler, walk-in freezer, refrigerated warehouse cooler* or *refrigerated warehouse freezer* space.

SENSIBLE RECOVERY EFFECTIVENESS. Change in the dry-bulb temperature of the outdoor air supply divided by the difference between the outdoor air and return air dry-bulb temperatures, expressed as a percentage, governed by AHRI Standard 1060.

SERVICE WATER HEATING. Heating water for domestic or commercial purposes other than space heating and process requirements.

SIDELIT. See Section ((~~C405.2.4.2~~)) C405.2.5.2.

SINGLE-PASS. A heat pump water heater control strategy using variable flow or variable capacity to deliver water from the heat pump at the final target storage water temperature in a single-pass through the heat exchanger with variable incoming water temperatures.

SINGLE-RAFTER ROOF. A roof where the roof above and the ceiling below are both attached to the same wood rafter and where insulation is located in the space between these wood rafters.

SKYLIGHT. See "Fenestration."

SLAB BELOW GRADE. Any portion of a slab floor in contact with the ground which is more than 24 inches below the final elevation of the nearest exterior grade.

SLAB-ON-GRADE FLOOR. That portion of a slab floor of the building envelope that is in contact with the ground and that is either above grade or is less than or equal to 24 inches below the final elevation of the nearest exterior grade.

SLEEPING UNIT. A room or space in which people sleep, which can also include permanent provisions for living, eating, and either sanitation or kitchen facilities but not both. Such rooms and spaces that are also part of a dwelling unit are not *sleeping units*.

SMALL ELECTRIC MOTOR. A general purpose, alternating current, single speed induction motor.

SMALL BUSINESS. Any business entity (including a sole proprietorship, corporation, partnership or other legal entity) which is owned and oper-

ated independently from all other businesses, which has the purpose of making a profit, and which has fifty or fewer employees.

SOLAR HEAT GAIN COEFFICIENT (SHGC). The ratio of the solar heat gain entering the space through the fenestration assembly to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation which is then reradiated, conducted or convected into the space.

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

SPACE CONDITIONING CATEGORY. Categories are based on the allowed peak space conditioning output capacity per square foot of conditioned floor area, or the design set point temperature, for a building or space. Space conditioning categories include: Low energy, semi-heated, conditioned, refrigerated walk-in and warehouse coolers, and refrigerated walk-in and warehouse freezers.

STAND-ALONE DEHUMIDIFIER. A product with the sole purpose of dehumidifying the space that does not include a portable air conditioner, room air conditioner, or packaged terminal air conditioner. Stand-alone dehumidifier is a self-contained, electrically operated, and mechanically encased assembly consisting of:

1. A refrigerated surface (evaporator) that condenses moisture from the atmosphere;
2. A refrigerating system, including an electric motor;
3. An air-circulating fan; and
4. A means for collecting or disposing of the condensate.

STANDARD REFERENCE DESIGN. A version of the *proposed design* that meets the minimum requirements of this code and is used to determine the maximum annual energy use requirement and carbon emissions from energy consumption for compliance based on total building performance and *HVAC total system performance ratio*.

STEEL-FRAMED WALL. A *wall* with a cavity (insulated or otherwise) whose exterior surfaces are separated by steel framing members (i.e., typical steel stud *walls* and curtain *wall systems*).

STOREFRONT. A system of doors and windows mulled as a composite fenestration structure that has been designed to resist heavy use. *Storefront* systems include, but are not limited to, exterior fenestration systems that span from the floor level or above to the ceiling of the same story on commercial buildings, with or without mulled windows and doors.

SUBSYSTEM METER. A meter placed downstream of the energy supply meter that measures the energy delivered to a load or a group of loads.

SYSTEM. A combination of equipment and auxiliary devices (e.g., controls, accessories, interconnecting means and terminal elements) by which energy is transformed so it performs a specific function, such as HVAC, *service water heating* or lighting.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-20220 Section C202.20—T.

TEMPERATURE MAINTENANCE. The system used to maintain the temperature of the building service hot water delivery system, typically by circulation and reheating or by a heat trace system.

TEMPORARY GROWING STRUCTURE. A temporary growing structure has sides and roof covered with polyethylene, polyvinyl or similar flexible synthetic material and is used to provide plants with either frost protection or increased heat retention. Temporary structures are those that are erected for a period of less than 180 days.

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

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

THERMOSTAT. An automatic control device used to maintain temperature at a fixed or adjustable set point.

TIME SWITCH CONTROL. An automatic control device or system that controls lighting or other loads, including switching off, based on time schedules.

TOPLIT. See Section ((~~C405.2.4.3~~)) C405.2.5.3.

TUBULAR DAYLIGHTING DEVICE (TDD). A nonoperable skylight device primarily designed to transmit daylight from a roof surface to an interior ceiling surface via a tubular conduit. The device consists of an exterior glazed weathering surface, a light transmitting tube with a reflective inside surface and an interior sealing device, such as a translucent ceiling panel.

AMENDATORY SECTION (Amending WSR 16-03-072, filed 1/19/16, effective 7/1/16)

WAC 51-11C-20221 Section C202.21—U.

***U*-FACTOR (THERMAL TRANSMITTANCE).** The coefficient of heat transmission (air to air) through a building component or assembly, equal to the time rate of heat flow per unit area and unit temperature difference between the warm side and cold side air films (Btu/h • ft^2 • °F) [W/(m^2 • K)].

UNCONDITIONED SPACE. An *enclosed space* within a building that is not a *conditioned space*, a *semi-heated space* or a low energy space in accordance with Section C402.1.1. Crawlspaces, attics and parking garages with natural or mechanical *ventilation* are not considered *enclosed spaces.*

UNHEATED SLAB-ON-GRADE FLOOR. A slab-on-grade floor that is not a heated slab-on-grade floor.

UNIFORM ILLUMINATION. A quality of illumination delivered by a lighting system typically comprised of similar fixtures mounted at a regular spacing interval. This lighting system provides a uniform contrast ratio of no greater than 5:1 maximum-to-minimum ratio throughout the entire area served, including task areas.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-20222 Section C202.22—V.

VARIABLE REFRIGERANT FLOW SYSTEM. An engineered direct-expansion (DX) refrigerant system that incorporates a common condensing unit, at least one variable capacity compressor, a distributed refrigerant piping network to multiple indoor fan heating and cooling units each capable of individual zone temperature control, through integral zone temperature control devices and a common communications network. Variable refrigerant flow utilizes three or more steps of control on common interconnecting piping.

VENTILATION. The natural or mechanical process of supplying conditioned or unconditioned air to, or removing such air from, any space.

VENTILATION AIR. That portion of supply air that comes from outside (outdoors) plus any recirculated air that has been treated to maintain the desired quality of air within a designated space.

VERTICAL FENESTRATION. See "**FENESTRATION.**"

VISIBLE TRANSMITTANCE [VT]. The ratio of visible light entering the space through the fenestration product assembly to the incident visible light, visible transmittance, includes the effects of glazing material and frame and is expressed as a number between 0 and 1. For skylights, VT shall be measured and rated in accordance with NFRC 202.

VISIBLE TRANSMITTANCE - ANNUAL [VT-ANNUAL]. The ratio of visible light entering the space through the fenestration product assembly to the incident visible light during the course of a year, ((~~visible transmittance,~~)) which includes the effects of glazing material, frame, and light well or tubular conduit, and is expressed as a number between 0 and 1. For tubular daylighting devices, VT-annual shall be measured and rated in accordance with NFRC 203.

VOLTAGE DROP. A decrease in voltage caused by losses in the wiring system that connect the power source to the load.

AMENDATORY SECTION (Amending WSR 16-03-072, filed 1/19/16, effective 7/1/16)

WAC 51-11C-20223 Section C202.23—W.

WALK-IN COOLER. An enclosed storage space capable of being refrigerated to temperatures above 32°F (0°C) and less than 55°F (12.8°C) that can be walked into, has a ceiling height of not less than 7 feet (2134 mm) and has a total chilled storage area of less than 3,000 square feet (279 m^2).

WALK-IN FREEZER. An enclosed storage space capable of being refrigerated to temperatures at or below 32°F (0°C) that can be walked into, has a ceiling height of not less than 7 feet (2134 mm) and has a total chilled storage area of less than 3,000 square feet (279 m^2).

WALL. That portion of the *building envelope*, including opaque area and *fenestration*, that is vertical or tilted at an angle of 60 degrees from horizontal or greater. This includes *above-grade walls* and *below-grade walls*, between-floor spandrels, peripheral edges of floors,

((~~and~~)) foundation *walls*, roof and basement knee walls, dormer walls, gable end walls, walls enclosing a mansard roof, and skylight shafts.

WATER HEATER. Any heating appliance or equipment that heats potable water and supplies such water to the potable hot water distribution system.

WOOD-FRAMED AND OTHER WALLS. All other *wall* types, including wood stud *walls*.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-30310 Section 303.1—Identification.

C303.1 Identification. Materials, systems and equipment shall be identified in a manner that will allow a determination of compliance with the applicable provisions of this code.

C303.1.1 Building thermal envelope insulation. An *R*-value identification mark shall be applied by the manufacturer to each piece of *building thermal envelope* insulation 12 inches (305 mm) or greater in width. Alternately, the insulation installers shall provide a certification listing the type, manufacturer and *R*-value of insulation installed in each element of the *building thermal envelope*. For blown or sprayed insulation (fiberglass and cellulose), the initial installed thickness, settled thickness, settled *R*-value, installed density, coverage area and number of bags installed shall be *listed* on the certification. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the areas covered and *R*-value of installed thickness shall be *listed* on the certification. For insulated siding, the *R*-value shall be labeled on the product's package and shall be listed on the certification. The insulation installer shall sign, date and post the certification in a conspicuous location on the job site.

EXCEPTION: For roof insulation installed above the deck, the *R*-value shall be labeled as required by the material standards specified in Table 1508.2 of the *International Building Code*.

C303.1.1.1 Blown or sprayed roof/ceiling insulation. The thickness of blown-in or sprayed fiberglass and cellulose roof/ceiling insulation shall be written in inches (mm) on markers for every 300 square feet (28 m^2) of attic area throughout the attic space. The markers shall be affixed to the trusses or joists and marked with the minimum initial installed thickness with numbers of not less than 1 inch (25 mm) in height. Each marker shall face the attic access opening. Spray polyurethane foam thickness and installed *R*-value shall be *listed* on certification provided by the insulation installer.

C303.1.2 Insulation mark installation. Insulating materials shall be installed such that the manufacturer's *R*-value mark is readily observable upon inspection. For insulation materials that are installed without an observable manufacturer's *R*-value mark, such as blown or draped products, an insulation certificate complying with Section C303.1.1 shall be left immediately after installation by the installer, in a conspicuous location within the building, to certify the installed *R*-value of the insulation material.

C303.1.3 Fenestration product rating. *U*-factors of fenestration shall be determined as follows:

1. For windows, doors and skylights, *U*-factor ratings shall be determined in accordance with NFRC 100.

2. Where required for garage doors and rolling doors, *U*-factor ratings shall be determined in accordance with either NFRC 100 or ANSI/DASMA 105.

U-factors shall be determined by an accredited, independent laboratory, and labeled and certified by the manufacturer.

Products lacking such a labeled *U*-factor shall be assigned a default *U*-factor from Table C303.1.3(1), C303.1.3(2) or C303.1.3(4). The solar heat gain coefficient (SHGC) and *visible transmittance* (VT) of glazed fenestration products (windows, glazed doors and skylights) shall be determined in accordance with NFRC 200 by an accredited, independent laboratory, and labeled and certified by the manufacturer. Products lacking such a labeled SHGC or VT shall be assigned a default SHGC or VT from Table C303.1.3(3). For tubular daylighting devices, VT_{annual} shall be measured and rated in accordance with NFRC 203.

EXCEPTION: Units without NFRC ratings produced by a small business may be assigned default *U*-factors from Table C303.1.3(5) for vertical fenestration.

C303.1.4 Insulation product rating. The thermal resistance (*R*-value) of insulation shall be determined in accordance with the U.S. Federal Trade Commission *R*-value rule (C.F.R. Title 16, Part 460) in units of h × ft^2 × °F/Btu at a mean temperature of 75°F (24°C).

C303.1.4.1 Insulated siding. The thermal resistance (*R*-Value) shall be determined in accordance with ASTM C1363. Installation for testing shall be in accordance with the manufacturer's installation instructions.

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 nonmetallic 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 (with an *R*-value of 1.39) and one layer of 5/8-inch gypsum board (with an *R*-value of 0.56) 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 3-1, 3-2 or 3-3 where appropriate. Spandrel panel *U*-

factors for assemblies other than those covered by Table C303.1.5 or Equations 3-1 through 3-3 may be determined using an alternate approved methodology. Equations 3-1 through 3-3 do not calculate the value of any insulation inboard of the curtain wall assembly.

Aluminum without Thermal Break

(Equation 3-1)

$$U_{overall} = \left[\frac{1}{(R_{gypsum} + R_{airgap}) + \left[\frac{1}{0.2798 + \left(\frac{0.8929}{R_{addedinsulation} + \left(\frac{1}{U_{centerofglass}}\right)}\right)}\right]}\right]$$

Aluminum with Thermal Break
(Equation 3-2)

$$U_{overall} = \left[\frac{1}{(R_{gypsum} + R_{airgap}) + \left[\frac{1}{0.1808 + \left(\frac{0.8874}{R_{addedinsulation} + \left(\frac{1}{U_{centerofglass}}\right)}\right)}\right]}\right]$$

Structural Glazing
(Equation 3-3)

$$U_{overall} = \left[\frac{1}{(R_{gypsum} + R_{airgap}) + \left[\frac{1}{0.1151 + \left(\frac{0.9487}{R_{addedinsulation} + \left(\frac{1}{U_{centerofglass}}\right)}\right)}\right]}\right]$$

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40100 Section C401—General.

C401.1 Scope. The provisions in this chapter are applicable to commercial buildings and their building sites.

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

1. ((~~The requirements of Sections C402, C403, C404, C405, C406, C408, C409, C410, and C411.~~)) Prescriptive compliance. The prescriptive compliance option requires compliance with Sections C402 through C406, and Sections C408, C409, C410, and C411.

2. Total building performance. The ((~~requirements of~~)) total building performance option requires compliance with Section C407.

3. When adopted by the local jurisdiction, the requirements of Appendix F, Outcome-Based Energy Budget, Sections C408, C409, C410, C411 and any specific sections in Table C407.2 as determined by the local jurisdiction. The Proposed Total UA of the proposed building shall be no more than 20 percent higher than the Allowed Total UA as defined in Section C402.1.5.

C401.2.1 Application to existing buildings. ((~~Work on existing buildings shall comply with Chapter 5 in addition to the applicable provi-~~

~~sions of Chapter 4.~~)) Additions, alterations, repairs and changes of occupancy to existing buildings shall comply with Chapter 5.

C401.2.2 Application to process equipment. Energy using equipment used by a manufacturing, industrial, or commercial process other than for conditioning spaces or maintaining comfort and amenities for the occupants shall comply with Section C403.3.2, Tables C403.3.2(1) through (16) inclusive, Sections C403.7.7, C403.9.2.1, C403.10.3, C403.11.2, C403.11.3, C404.2, Table C404.2, and Sections C405.8, C410, and C412.

C401.3 Thermal envelope certificate. A permanent thermal envelope certificate shall be completed by an *approved* party. Such certificate shall be posted on a wall in the space where the space conditioning equipment is located, a utility room or other *approved* location. If located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label, or other required labels. A copy of the certificate shall also be included in the construction files for the project. The certificate shall include:

1. *R*-values of insulation installed in or on ceilings, roofs, walls, foundations and slabs, crawlspace walls and floors, and ducts outside *conditioned spaces*.

2. *U*-factors and *solar heat gain coefficients* (SHGC) of fenestration.

3. Results from any building envelope air leakage testing performed on the building.

Where there is more than one value for any component of the building envelope, the certificate shall indicate the area-weighted average value where available. If the area-weighted average is not available, the certificate shall list each value that applies to 10 percent or more of the total component area.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-40211 Section C402.1.1—Low energy buildings.

C402.1.1 Low energy buildings, semi-heated buildings and greenhouses. Low energy buildings shall comply with Section C402.1.1.1. Semi-heated buildings and spaces shall comply with Section C402.1.1.2. Greenhouses shall comply with Section C402.1.1.3.

C402.1.1.1 Low energy buildings. The following buildings, or enclosed 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 provision 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. Unstaffed equipment shelters or cabinets used solely for personal wireless service facilities.

C402.1.1.2 Semi-heated buildings and 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. The total installed output capacity of mechanical space conditioning systems serving a *semi-heated* building or space shall comply with Section C202. Building envelope assemblies separating conditioned space from *semi-heated space* shall comply with 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 that forms part of the *building thermal envelope* enclosing semi-heated spaces shall comply with Section C402.4. *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 Component Performance compliance per Section C402.1.5, and for the ((~~Standard Reference~~)) Baseline Building Design for Total Building Performance compliance per Section C407. The capacity of heat trace temperature maintenance systems complying with Section C404.7.2 that are provided for freeze protection of piping and equipment only shall not be included in the total installed output capacity of mechanical space conditioning systems.

EXCEPTION: ((~~Building or space may comply as semi-heated when served by one or more of the following system alternatives:~~
~~1. Electric infrared heating equipment for localized heating applications.~~
~~2. Heat pumps with cooling capacity permanently disabled, as preapproved by the jurisdiction.~~))
Provided the total installed heating output capacity of mechanical space conditioning does not exceed the criteria for semi-heated space as defined in Section C202, a semi-heated building or space may comply with this section when served by heat pumps without electric resistance back up and connected to a heating only thermostat.

C402.1.1.3 Greenhouses. *Greenhouse* structures or areas that comply with all of the following shall be exempt from the building envelope requirements of this code:

1. Exterior opaque envelope assemblies complying with Sections C402.2 and C402.4.4.

EXCEPTION: Low energy greenhouses that comply with Section C402.1.1.1.

2. Interior partition building thermal envelope assemblies that separate the *greenhouse* from conditioned space complying with Sections C402.2, C402.4.3 and C402.4.4.

3. ((~~Nonopaque envelope~~)) Fenestration assemblies complying with the thermal envelope requirements in Table C402.1.1.3. The *U*-factor for the ((~~nonopaque roof~~)) skylight shall be for the roof assembly or a roof that includes the assembly and an internal curtain system.

EXCEPTION: Unheated *greenhouses.*

4. No mechanical cooling is provided.

5. For heated greenhouses, heating is provided by a radiant heating system, a condensing natural gas-fired or condensing propane-fired heating system, or a heat pump with cooling capacity permanently disabled as preapproved by the jurisdiction.

Table C402.1.1.3
((~~Non-Opaque~~)) Fenestration Thermal Envelope Maximum Requirements

((~~Component *U*-Factor BTU/h-ft^2-°F~~	~~Climate Zone 5 and Marine 4~~
~~Non-opaque roof~~	~~0.5~~
~~Non-opaque SEW wall~~	~~0.7~~
~~Non-opaque N wall~~	~~0.6~~))

Component	*U*-Factor BTU/h-ft^2-°F
Skylights	0.5
Vertical fenestration	0.6

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40212 Section C402.1.2—Equipment buildings.

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

1. Are separate buildings with floor area no more than 500 square feet (50 m^2).

2. Are intended to house ((~~electronic~~)) electric equipment with installed equipment power totaling at least 7 watts per square foot (75 W/m^2) and not intended for human occupancy.

3. Are served by mechanical cooling and heating systems sized in accordance with Sections C403.1.2 and C403.3.1.

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

5. Have an average wall and roof *U*-factor less than 0.200.

EXCEPTION: Where the cooling and heating system is a heat pump, the heating capacity is allowed to exceed 17,000 Btu/h provided the heat pump cooling efficiency is at least 15 percent better than the requirements in Tables C403.3.2(2) and C403.3.2(14).

C402.1.2.1 Standalone elevator hoistways. Elevator hoistways that comply with all of the following shall be exempt from the building thermal envelope and envelope air barrier provisions of this code:

1. Are separate from any other conditioned spaces in the building (do not serve or open into any conditioned, semi-heated or indirectly conditioned space).

2. Have heating and/or cooling equipment sized only to serve the expected elevator loads with thermostat setpoints restricted to heating to no higher than 40°F and cooling to no lower than 95°F.

3. Have an area weighted average wall, roof and floor (where applicable) *U*-factor of less than or equal to 0.20. Calculations must include any floor-slab-edges that penetrate the hoistway and thus are considered part of the above-grade walls.

OPTION 1

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-402121 Table C402.1.3—Opaque thermal envelope assembly *R-value* requirements.

Table C402.1.3
Opaque Thermal Envelope Insulation Component Minimum Requirements, *R-value* Method[a], ((i)) j

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~~)) R-22 LS	R-25 + ((~~R-11~~)) R-22 LS
Attic and other	R-49	R-49
Walls, Above Grade[i]		
Mass[h]	R-9.5ci[c]	R-13.3ci
Mass transfer deck slab edge[g]	((~~R-5~~	~~R-5~~))
Metal buildings	((~~R-19ci or R-13 + 13ci~~)) R-13 + R-14ci	((~~R-19ci or R-13 + 13ci~~)) R-13 + R-14ci
Steel framed	R-13 + R-10ci	R-19 + R-8.5ci
Wood framed and other	((~~R-21 int or R-15 + 5ci std~~)) R-13 + R-7.5ci std or R-20 + R-3.8ci std	R-13 + R-7.5ci std or R-20 + R-3.8ci std or R-25 std
Walls, Below Grade		
Below-grade wall[d,h]	Same as above grade	Same as above grade
Floors		
Mass[f]	R-30ci	R-30ci
Joist/framing	R-30[e]	R-30[e]
Slab-on-Grade Floors		
Unheated slabs	R-10 for 24" below	R-10 for 24" below
Heated slabs	R-10 perimeter & under entire slab	R-10 perimeter & under entire slab
((~~**Opaque Doors**[g]~~		
~~Nonswinging~~	~~R-4.75~~	~~R-4.75~~))

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.

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

b Where using *R*-value compliance method, a thermal spacer block with minimum thickness of 1/2-inch and minimum *R*-value of R-3.5 shall be provided, otherwise use the *U*-factor compliance method in Table C402.1.4.

c Exception: ((~~Integral insulated concrete block walls complying with ASTM C90 with all cores filled and meeting both of~~)) Single wythe concrete block walls complying with ASTM C90 meeting all of the following:
1. The single wythe concrete block wall must be exposed on both sides. There are no interior or exterior wall coverings.
2. All cores must be filled and at least 50 percent of cores must be filled with vermiculite or equivalent fill insulation((~~; and~~)).
((~~2.~~)) 3. The concrete block must have a nominal thickness of 8 inches or greater.
4. 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~~)) C402.1.3.

d Where heated slabs are below grade, they shall comply with the insulation requirements for heated slabs.

e 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 ((~~Not applicable to garage doors. See Table C402.1.4.~~)) Component performance in accordance with Section C402.1.5 shall be required for buildings with a mass transfer deck slab.

h Peripheral edges of intermediate concrete floors are included in the above-grade mass wall category and therefore must be insulated as above-grade mass walls unless they meet the definition of Mass Transfer Deck Slab Edge. The area of the peripheral edges of concrete floors shall be defined as the thickness of the slab multiplied by the perimeter length of the edge condition. See Table A103.3.7.2 for typical default *U*-factors for above-grade slab edges and footnote [c] for typical conditions of above-grade slab edges.

i ((~~For roof, wall or floor assemblies where the proposed assembly would not be continuous insulation, an alternate nominal *R*-value compliance option for assemblies with isolated metal penetrations of otherwise continuous insulation is:~~)) Where the total area of through-wall mechanical equipment is greater than 1 percent of the opaque *above-grade wall area*, use of the *R*-value method is not permitted. See Section C402.1.4.3.

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

Table C402.1.3(i)
Continuous Insulation Equivalents

Column A	Column B	Column C
Assemblies with continuous insulation (see definition)	**Alternate option for assemblies with metal penetrations, greater than 0.04% but less than 0.08%**	**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-19ci	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

Notes for Table C402.1.3(j)

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

1a. 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 0.008 (0.08%), but less than 0.0012 (0.12%), for use of Column C equivalents.

1b. Where all metal penetrations are stainless steel, Column B is permitted to be used for penetrations greater than 0.12%, but less than 0.24% of opaque surface area, and Column C is permitted to be used for penetrations greater than or equal to 0.24%, but less than 0.48% of opaque surface area.

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.

OPTION 2

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-402121 Table C402.1.3—Opaque thermal envelope assembly *R-value* requirements.

Table C402.1.3
Opaque Thermal Envelope Insulation Component Minimum Requirements, *R-value* Method[a], ((i)) j

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~~)) R-22 LS	R-25 + ((~~R-11~~)) R-22 LS
Attic and other	R-49	R-49
Walls, Above Grade[i]		
Mass[h]	R-9.5ci((~~c~~))	R-13.3ci
Mass transfer deck slab edge[g]	((~~R-5~~	~~R-5~~))
Metal buildings	((~~R-19ci or R-13 + 13ci~~)) R-13 + R-14ci	((~~R-19ci or R-13 + 13ci~~)) R-13 + R-14ci
Steel framed	R-13 + R-10ci	R-19 + R-8.5ci
Wood framed and other	((~~R-21 int or R-15 + 5ci std~~)) R-13 + R-7.5ci std or R-20 + R-3.8ci std	R-13 + R-7.5ci std or R-20 + R-3.8ci std or R-25 std
Walls, Below Grade		
Below-grade wall[d,h]	Same as above grade	Same as above grade
Floors		
Mass[f]	R-30ci	R-30ci
Joist/framing	R-30[e]	R-30[e]
Slab-on-Grade Floors		
Unheated slabs	R-10 for 24" below	R-10 for 24" below
Heated slabs	R-10 perimeter & under entire slab	R-10 perimeter & under entire slab
((~~**Opaque Doors**[g]~~		
~~Nonswinging~~	~~R-4.75~~	~~R-4.75~~))

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.

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

b Where using *R*-value compliance method, a thermal spacer block with minimum thickness of 1/2-inch and minimum *R*-value of R-3.5 shall be provided, otherwise use the *U*-factor compliance method in Table C402.1.4.

c ((~~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.~~)) Reserved.

d Where heated slabs are below grade, they shall comply with the insulation requirements for heated slabs.

e 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 ((~~Not applicable to garage doors. See Table C402.1.4.~~)) Component performance in accordance with Section C402.1.5 shall be required for buildings with a mass transfer deck slab.

h Peripheral edges of intermediate concrete floors are included in the above-grade mass wall category and therefore must be insulated as above-grade mass walls unless they meet the definition of Mass Transfer Deck Slab Edge. The area of the peripheral edges of concrete floors shall be defined as the thickness of the slab multiplied by the perimeter length of the edge condition. See Table A103.3.7.2 for typical default *U*-factors for above-grade slab edges and footnote c for typical conditions of above-grade slab edges.

i ((~~For roof, wall or floor assemblies where the proposed assembly would not be continuous insulation, an alternate nominal *R*-value compliance option for assemblies with isolated metal penetrations of otherwise continuous insulation is:~~)) Where the total area of through-wall mechanical equipment is greater than 1 percent of the opaque *above-grade wall area*, use of the *R*-value method is not permitted. See Section C402.1.4.3.

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

Table C402.1.3(i)
Continuous Insulation Equivalents

Column A	Column B	Column C
Assemblies with continuous insulation (see definition)	**Alternate option for assemblies with metal penetrations, greater than 0.04% but less than 0.08%**	**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-19ci	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

Notes for Table C402.1.3(j)

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

1a. 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 0.008 (0.08%), but less than 0.0012 (0.12%), for use of Column C equivalents.

1b. Where all metal penetrations are stainless steel, Column B is permitted to be used for penetrations greater than 0.12%, but less than 0.24% of opaque surface area, and Column C is permitted to be used for penetrations greater than or equal to 0.24%, but less than 0.48% of opaque surface area.

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.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40213 Section C402.1.3—Insulation component *R*-value method.

C402.1.3 Insulation component *R-value*-based method. *Building thermal envelope* opaque assemblies shall comply with 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 cavity insulation and continuous insulation shall not be less than that specified in Table C402.1.3. Where cavity insulation is installed in multiple layers, the cavity insulation *R*-values shall be summed to determine compliance with the cavity insulation *R*-value requirements. Where continuous insulation is installed in multiple layers, the continuous insulation *R*-values shall be summed to determine compliance with the continuous insulation *R*-value requirements. Cavity insulation *R*-values shall not be used to determine compliance with the continuous insulation *R*-value requirements 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.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40214 Section C402.1.4—Assembly *U*-factor, *C*-factor, or *F*-factor-based method.

C402.1.4 Assembly *U*-factor, *C*-factor, or *F*-factor-based method. Building thermal envelope opaque assemblies shall meet the requirements of Section C402.2 based on the climate zone specified in Chapter 3. Building thermal envelope opaque assemblies intended to comply on an assembly *U*-, *C*-, or *F*-factor basis shall have a *U*-, *C*-, or *F*-factor not greater than that specified in 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 *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 Roof/ceiling assembly. The maximum roof/ceiling assembly *U*-factor shall not exceed that specified in Table C402.1.4 based on construction materials used in the roof/ceiling assembly.

C402.1.4.1.1 Suspended ceilings. Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the assembly *U*-factor of the roof/ceiling construction.

C402.1.4.1.2 Joints staggered. Continuous insulation board shall be installed not less than two layers, and the edge joints between each

layer of insulation shall be staggered, except where insulation tapers to the roof deck at a gutter edge, roof drain, or scupper.

C402.1.4.2 Thermal resistance of cold-formed steel stud walls. *U*-factors of walls with cold-formed steel studs shall be permitted to be determined in accordance with Equation 4-1:

Equation 4-1:

$$U = 1/[Rs + (ER)]$$

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 as specified in Table C402.1.4.2.

C402.1.4.3 Thermal resistance of mechanical equipment penetrations. When the total area of penetrations from through-wall mechanical equipment or equipment listed in Table C403.3.2(4) exceeds 1 percent of the opaque *above-grade wall* area, the mechanical equipment penetration area shall be calculated as a separate wall assembly with a default *U*-factor of 0.5. Mechanical system ducts and louvers, including those for supply, exhaust and relief, and for condenser air intake and outlet, are not considered to be mechanical equipment for the purposes of this section.

EXCEPTION: Where mechanical equipment has been tested in accordance with *approved* testing standards, the mechanical equipment penetration area is permitted to be calculated as a separate wall assembly using the *U*-factor determined by such test.

OPTION 1

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-402141 Table C402.1.4—Opaque thermal envelope requirements, *U*-factor method.

Table C402.1.4
Opaque Thermal Envelope Requirements[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-0.031
Attic and other	U-0.021	U-0.021

CLIMATE ZONE	5 AND MARINE 4	
	All Other	**Group R**
Joist or single rafter	U-0.027	U-0.027
Walls, Above Grade[k]		
Mass[g]	U-0.104[d]	U-0.078
Mass transfer deck slab[i] ((~~edge~~))	U-0.20	U-0.20
Metal building	((~~U-0.052~~)) U-0.050	((~~U-0.052~~)) U-0.050
Steel framed	U-0.055	U-0.055
Wood framed and other	((~~U-0.054~~)) U-0.051	U-0.051
Walls, Below Grade		
Below-grade wall[b, g]	Same as above grade	Same as above grade
Floors		
Mass[e]	U-0.031	U-0.031
Joist/framing	U-0.029	U-0.029
Slab-on-Grade Floors		
Unheated slabs	F-0.54	F-0.54
Heated slabs[c]	F-0.55	F-0.55
Opaque Doors		
Nonswinging door	U-0.31	U-0.31
Swinging door[h]	U-0.37	U-0.37
((~~Nonswinging door~~	~~U-0.34~~	~~U-0.34~~))
Garage door <14% glazing	U-0.31	U-0.31
Garage door ≥14% and <50% glazing[i]	U-0.34	U-0.34

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 Where heated slabs are below grade, they 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 Exception: ((~~Integral insulated concrete block walls complying with ASTM C90 with all cores filled and meeting both~~)) Single wythe concrete block walls complying with ASTM C90 meeting all of the following:

1. The single wythe concrete block wall must be exposed on both sides. There are no interior or exterior wall coverings.

2. All cores must be filled and at least 50 percent of cores must be filled with vermiculite or equivalent fill insulation((~~; and~~)).

((~~2.~~)) 3. The concrete block must have a nominal thickness of 8 inches or greater.

4. 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.

5. This exception may be used for prescriptive *U*-factor compliance.

6. When demonstrating compliance based on Section C402.1.5, component performance alternative, the Proposed UA for this wall assembly type shall equal the Target UA.

7. This exception cannot be applied when demonstrating compliance based on Section C407, total building performance.

[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 ((~~substracted~~)) subtracted from the original test design.

[g] Peripheral edges of intermediate concrete floors are included in the above-grade mass wall category and therefore must be insulated as above-grade mass walls unless they meet the definition of *Mass Transfer Deck Slab* ((~~Edge~~)). The area of the peripheral edges of concrete floors shall be defined as the thickness of the slab multiplied by the perimeter length of the edge condition. See Table A103.3.7.2 for typical default *U*-factors for above-grade slab edges and footnote [c] for typical conditions of above-grade slab edges.

[h] Swinging door *U*-factors shall be determined in accordance with NFRC-100.

[i] Garage doors having a single row of *fenestration* shall have an assembly *U*-factor less than or equal to 0.44, provided that the *fenestration* area is not less than 14 percent and not more than 25 percent of the total door area.

[j] Component performance in accordance with Section C402.1.5 shall be required for buildings with a mass transfer deck slab. A mass transfer deck, due to its configuration, is not insulated. The table value (U-0.20) shall be used as the baseline value for component performance or total building performance path calculations. For the proposed value, the appropriate value from Table A104.3.7.2 shall be used.

[k] Through-wall mechanical equipment subject to Section C402.1.4.3 shall be calculated at the *U*-factor defined in Section C402.1.4.3. The area-weighted *U*-factor of the wall, including through-wall mechanical equipment, shall not exceed the value in the table.

OPTION 2

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-402141 Table C402.1.4—Opaque thermal envelope requirements, *U*-factor method.

Table C402.1.4
Opaque Thermal Envelope Requirements[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-0.031
Attic and other	U-0.021	U-0.021
Joist or single rafter	U-0.027	U-0.027
Walls, Above Grade[k]		
Mass[g]	U-0.104((d))	U-0.078
Mass transfer deck slab[i] ((~~edge~~))	U-0.20	U-0.20

CLIMATE ZONE	5 AND MARINE 4	
	All Other	**Group R**
Metal building	((~~U-0.052~~)) U-0.050	((~~U-0.052~~)) U-0.050
Steel framed	U-0.055	U-0.055
Wood framed and other	((~~U-0.054~~)) U-0.051	U-0.051
Walls, Below Grade		
Below-grade wall[b, g]	Same as above grade	Same as above grade
Floors		
Mass[e]	U-0.031	U-0.031
Joist/framing	U-0.029	U-0.029
Slab-on-Grade Floors		
Unheated slabs	F-0.54	F-0.54
Heated slabs[c]	F-0.55	F-0.55
Opaque Doors		
Nonswinging door	U-0.31	U-0.31
Swinging door[h]	U-0.37	U-0.37
((~~Nonswinging door~~	~~U-0.34~~	~~U-0.34~~))
Garage door <14% glazing	U-0.31	U-0.31
Garage door ≥14% and <50% glazing[i]	U-0.34	U-0.34

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 Where heated slabs are below grade, they 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 ((~~Exception: Integral insulated concrete block walls complying with ASTM C90 with all cores filled and meeting both of the following:~~)) Reserved.
((~~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 ((~~substracted~~)) subtracted from the original test design.

g Peripheral edges of intermediate concrete floors are included in the above-grade mass wall category and therefore must be insulated as above-grade mass walls unless they meet the definition of *Mass Transfer Deck Slab* ((~~Edge~~)). The area of the peripheral edges of concrete floors shall be defined as the thickness of the slab multiplied by the perimeter length of the edge condition. See Table A103.3.7.2 for typical default *U*-factors for above-grade slab edges and footnote [c] for typical conditions of above-grade slab edges.

h Swinging door *U*-factors shall be determined in accordance with NFRC-100.

i Garage doors having a single row of *fenestration* shall have an assembly *U*-factor less than or equal to 0.44, provided that the *fenestration* area is not less than 14 percent and not more than 25 percent of the total door area.

j Component performance in accordance with Section C402.1.5 shall be required for buildings with a mass transfer deck slab. A mass transfer deck, due to its configuration, is not insulated. The table value (U-0.20) shall be used as the baseline value for component performance or total building performance path calculations. For the proposed value, the appropriate value from Table A104.3.7.2 shall be used.

k Through-wall mechanical equipment subject to Section C402.1.4.3 shall be calculated at the *U*-factor defined in Section C402.1.4.3. The area-weighted *U*-factor of the wall, including through-wall mechanical equipment, shall not exceed the value in the table.

AMENDATORY SECTION (Amending WSR 16-03-072, filed 1/19/16, effective 7/1/16)

WAC 51-11C-402142 Table ((~~C402.1.4.1~~)) C402.1.4.2—Effective *R-values* for steel stud wall assemblies.

Table ((~~C402.1.4.1~~)) C402.1.4.2
Effective *R*-values For Steel Stud Wall Assemblies

NOMINAL STUD DEPTH (inches)	SPACING OF FRAMING (inches)	CAVITY *R*-VALUE (insulation)	CORRECTION FACTOR (*Fc*)	EFFECTIVE *R*-VALUE (ER) (Cavity *R*-Value × *Fc*)
3 1/2	16	13	0.46	5.98
		15	0.43	6.45
3 1/2	24	13	0.55	7.15
		15	0.52	7.80
6	16	19	0.37	7.03
		21	0.35	7.35
6	24	19	0.45	8.55
		21	0.43	9.03
8	16	25	0.31	7.75
	24	25	0.38	9.50

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-40215 Section C402.1.5—Component performance alternative.

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 Table C402.1.4 and C402.4 and the maximum allowable fenestration areas in Section C402.4.1.

For buildings with more than one *space conditioning category*, component performance compliance shall be demonstrated separately for each space conditioning category. Interior partition ceilings, walls, fenestration and floors that separate space conditioning areas shall be applied to the component performance calculations for the space conditioning category with the highest level of space conditioning.

Equation 4-2

Proposed Total UA ≤ Allowable Total UA

Where:

Proposed Total UA	=	UA-glaz-prop + UA sky-prop + UA-opaque-prop + FL-slab-prop
Allowable Total UA	=	UA-glaz-allow + UA-glaz-excess + UA sky-allow + UA-sky-excess + UA-opaque-allow + FL-slab-allow
UA-glaz-prop	=	Sum of (proposed *U*-value x proposed area) for each distinct vertical fenestration type, up to code maximum area
UA-sky-prop	=	Sum of (proposed *U*-value x proposed area) for each distinct skylight type, up to the code maximum area
UA-opaque-prop	=	Sum of (proposed *U*-value x proposed area) for each distinct opaque thermal envelope type
FL-slab-prop	=	Sum of (proposed *F*-value x proposed length) for each distinct slab on grade perimeter assembly
UA-glaz-allow	=	Sum of (code maximum vertical fenestration *U*-value from Table C402.4, or Section C402.4.1.1.2 if applicable, x proposed area) for each distinct vertical fenestration type, not to exceed the code maximum area[1]
UA-glaz-excess	=	*U*-value for the proposed wall type from Table C402.4[2] x vertical fenestration area in excess of the code maximum area
UA-sky-allow	=	Sum of (code maximum skylight *U*-value from Table C402.4 x proposed area) for each distinct skylight type proposed, not to exceed the code maximum area
UA-sky-excess	=	*U*-value for the proposed roof type from Table C402.4[3] x skylight area in excess of the code maximum area
UA-opaque-allow	=	Code maximum opaque envelope *U*-value from Table C402.1.4 for each opaque door, wall, roof, and floor assembly x proposed area
FL-slab-allow	=	Code maximum *F*-value for each slab-on-grade perimeter assembly x proposed length

Notes:

[1] Where multiple vertical fenestration types are proposed and the code maximum area is exceeded, the *U*-value shall be the average Table C402.1.4 *U*-value weighted by the proposed vertical fenestration area of each type.

[2] Where multiple wall types are proposed the *U*-value shall be the average Table C402.1.4 *U*-value weighted by the proposed above grade wall area of each type.

[3] Where multiple roof types are proposed the *U*-value shall be the average Table C402.1.4 *U*-value weighted by the proposed roof area of each type.

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:

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

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

5. Tables in ASHRAE 90.1 Normative Appendix A.
6. Calculation method for steel-framed walls in accordance with Section C402.1.4.1 and Table C402.1.4.1.

C402.1.5.2 SHGC rate calculations. Fenestration SHGC values for individual components and/or fenestration are permitted to exceed the SHGC values in Table C402.4 and/or the maximum allowable fenestration areas in Section C402.4.1 where the proposed total SHGCxA less than the allowable total SHGCxA as determined by Equation 4-3.

Equation 4-3—SHGC Rate Calculations

Proposed Total SHGCxA ≤ Allowable Total SHGCxA

Where:

Proposed Total SHGCxA	=	SHGCxA-glaz-prop + SHGCxA-sky-prop
Allowable Total SHGCxA	=	SHGCxA-glaz-allow + SHGCxA-sky-allow
SHGCxA-glaz-prop	=	Sum of (proposed SHGCx proposed area) for each distinct vertical fenestration type
SHGCxA-sky-prop	=	Sum of (proposed SHGCx proposed area) for each distinct skylight type

SHGCxA-glaz-allow	=	Sum of (code maximum vertical fenestration SHGC from Table C402.4, or Section C402.4.1.3 if applicable, x proposed area) for each distinct vertical fenestration type, not to exceed the code maximum area
SHGCxA-sky-allow	=	Sum of (code maximum skylight SHGC from Table C402.4x proposed area) for each distinct skylight type, not to exceed the code maximum area

If the proposed vertical fenestration area does not exceed the Vertical Fenestration Area allowed, the target area for each vertical fenestration type shall equal the proposed area. If the proposed vertical fenestration area exceeds the Vertical Fenestration Area allowed, the target area of each vertical fenestration element shall be reduced in the base envelope design by the same percentage and the net area of each above-grade wall type increased proportionately by the same percentage so that the total vertical fenestration area is exactly equal to the Vertical Fenestration Area allowed.

If the proposed skylight area does not exceed the Allowable Skylight Area from Section C402.4.1, the target area shall equal the proposed area. If the proposed skylight area exceeds the Allowable Skylight Area from Section C402.4.1, the area of each skylight element shall be reduced in the base envelope design by the same percentage and the net area of each roof type increased proportionately by the same percentage so that the total skylight area is exactly equal to the allowed percentage per Section C402.3.1 of the gross roof area.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40220 Section C402.2—Specific insulation requirements.

C402.2 Specific building thermal envelope insulation requirements. 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 Section C402.1.3, assemblies complying prescriptively with Section C402.1.4 and buildings complying with Section C402.1.5 are allowed to install alternate levels of insulation so long as the *U*-factor of the insulated assembly is less than or equal to the *U*-factor required by the respective path.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40221 Section C402.2.1—Roof assembly.

C402.2.1 Roof assembly. The minimum thermal resistance (*R*-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table C402.1.3, based on construction materials used in the roof assembly. ((~~Continuous insulation board shall be installed in not less than 2 layers and the edge joints between each layer of insulation shall be staggered. Insulation installed on a suspended ceiling with removable ceiling tiles shall not be considered part of the minimum thermal resistance of the roof insulation.~~))

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.~~)) 1. Where tapered insulation is used with insulation entirely above deck, those roof assemblies shall show compliance on a *U*-factor basis per Section C402.1.4. The effective *U*-factor shall be determined through the use of Tables A102.2.6(1), A102.2.6(2) and A102.2.6(3).
((~~3.~~)) 2. Two layers of insulation are not required where insulation tapers to the roof deck, such as at roof drains. At roof drains, the immediate 24 inch by 24 inch plan area around each roof drain has a minimum insulation requirement of R-13, but otherwise is permitted to be excluded from the roof insulation area-weighted calculations.

C402.2.1.1 Minimum thickness, lowest point. The minimum thickness of above-deck roof insulation at its lowest point, gutter edge, roof drain or scupper, shall be not less than 1 inch (25 mm).

C402.2.1.2 Suspended ceilings. Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the minimum thermal resistance (*R*-value) of roof insulation in roof/ceiling construction.

C402.2.1.3 Skylight curbs. Skylight curbs shall be insulated to the level of roofs with insulation entirely above deck or R-5, whichever is less.

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

C402.2.1.4 Rooftop HVAC equipment curbs. Structural curbs installed to support rooftop HVAC equipment are allowed to interrupt the above roof insulation. The area under the HVAC equipment inside of the equipment curb shall be insulated to a minimum of R-13 in all locations where there are not roof openings for ductwork. The annular space between the roof opening and the ductwork shall be sealed to maintain the building air barrier. The plan-view area of the HVAC equipment curb shall be excluded from the prescriptive roof insulation requirements or the area-weighted component performance calculations.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-402211 ((~~Skylight curbs.~~)) Reserved.

((~~**C402.2.1.1 Skylight curbs.** Skylight curbs shall be insulated to the level of roofs with insulation entirely above deck or R-5, whichever is less.~~

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

~~**C402.2.1.2 Rooftop HVAC equipment curbs.** Structural curbs installed to support rooftop HVAC equipment are allowed to interrupt the above roof insulation. The area under the HVAC equipment inside of the equipment curb shall be insulated to a minimum of R-13 in all locations where there are not roof openings for ductwork. The annular space between the roof opening and the ductwork shall be sealed to maintain the building air barrier. The plan-view area of the HVAC equipment curb shall be excluded from the prescriptive roof insulation requirements or the area-weighted component performance calculations.~~))

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40222 ((~~Reserved.~~)) Section C402.2.2—Above-grade walls.

C402.2.2 Above-grade walls. The minimum thermal resistance (*R*-value) of materials installed in the wall cavity between the framing members and continuously on the walls shall be as specified in Table C402.1.3, based on framing type and construction materials used in the wall assembly. The *R*-value of integral insulation installed in concrete masonry units (CMU) shall not be used in determining compliance with Table C402.1.3 except as otherwise noted in the table. In determining compliance with Table C402.1.4, the use of the *U*-factor of concrete masonry units with integral insulation shall be permitted.

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

1. Weigh not less than 35 psf (170 kg/m^2) of wall surface area.

2. Weigh not less than 25 psf (120 kg/m^2) of wall surface area where the material weight is not more than 120 pounds per cubic foot (pcf) (1,900 kg/m^3).

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

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

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40223 Section C402.2.3—((~~Above-grade walls~~)) Floors.

((~~**C402.2.3 Above-grade walls.** The minimum thermal resistance (*R*-value) of materials installed in the wall cavity between the framing members and continuously on the walls shall be as specified in Table C402.1.3, based on framing type and construction materials used in the wall assembly. The *R*-value of integral insulation installed in concrete masonry units (CMU) shall not be used in determining compliance with Table C402.1.3 except as otherwise noted in the table. In determining compliance with Table C402.1.4, the use of the *U*-factor of concrete masonry units with integral insulation shall be permitted.~~

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

~~1. Weigh not less than 35 psf (170 kg/m^2) of wall surface area.~~

~~2. Weigh not less than 25 psf (120 kg/m^2) of wall surface area where the material weight is not more than 120 pounds per cubic foot (pcf) (1,900 kg/m^3).~~

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

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

C402.2.3 Floors. The thermal properties (component *R*-values or assembly *U*- or *F*-factors) of floor assemblies over outdoor air or unconditioned space shall be as specified in Table C402.1.3 or C402.1.4 based on the construction materials used in the floor assembly. Floor framing cavity insulation or structural slab insulation shall be installed to maintain permanent contact with the underside of the subfloor decking or structural slabs.

"Mass floors" where used as a component of the thermal envelope of a building shall provide one of the following weights:

1. Thirty-five pounds per square foot of floor surface area;

2. Twenty-five pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

EXCEPTIONS:

1. The floor framing cavity insulation or structural slab insulation shall be permitted to be in contact with the top side of sheathing or continuous insulation installed on the bottom side of floor assemblies where combined with insulation that meets or exceeds the minimum *R*-value in Table C402.1.3 for "Metal framed" or "Wood framed and other" values for "Walls, Above Grade" and extends from the bottom to the top of all perimeter floor framing or floor assembly members.

2. Insulation applied to the underside of concrete floor slabs shall be permitted an air space of not more than 1 inch where it turns up and is in contact with the underside of the floor under walls associated with the *building thermal envelope*.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40224 Section C402.2.4—((~~Below-grade walls~~)) Slab-on-grade.

((**C402.2.4 Below-grade walls.** ~~The *R*-value of the insulating material installed in, or continuously on, the below-grade walls shall be in accordance with Table C402.1.3. The *U*-factor or *R*-value required shall extend to the level of the lowest floor of the conditioned space enclosed by the below-grade wall.~~)) **C402.2.6 Slabs-on-grade.** The minimum thermal resistance (R-value) of the insulation for unheated or heated slab-on-grade floors designed in accordance with the R-value method of Section C402.1.3 shall be as specified in Table C402.1.3.

C402.2.4.1 Insulation installation. Where installed, the perimeter insulation shall be placed on the outside of the foundation or on the inside of the foundation wall. The perimeter insulation shall extend downward from the top of the slab for a minimum distance as shown in the table or to the top of the footing, whichever is less, or downward to not less than the bottom of the slab and then horizontally to the interior or exterior for the total distance shown in the table. Insulation extending away from the building shall be protected by pavement or by a minimum of 10 inches (254 mm) of soil. Where installed, full slab insulation shall be continuous under the entire area of the slab-on-grade floor, except at structural column locations and service pen-

etrations. Insulation required at the heated slab perimeter shall not be required to extend below the bottom of the heated slab and shall be continuous with the full slab insulation.

EXCEPTION: Where the slab-on-grade floor is greater than 24 inches (61 mm) below the finished exterior grade, perimeter insulation is not required.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40225 Section C402.2.5—((~~Floors~~)) Below-grade walls.

((**~~C402.2.5 Floors.~~** ~~The thermal properties (component *R*-values or assembly *U*- or *F*-factors) of floor assemblies over outdoor air or unconditioned space shall be as specified in Table C402.1.3 or C402.1.4 based on the construction materials used in the floor assembly. Floor framing cavity insulation or structural slab insulation shall be installed to maintain permanent contact with the underside of the subfloor decking or structural slabs.~~

~~"Mass floors" where used as a component of the thermal envelope of a building shall provide one of the following weights:~~

~~1. 35 pounds per square foot of floor surface area;~~

~~2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.~~

~~EXCEPTIONS: 1. The floor framing cavity insulation or structural slab insulation shall be permitted to be in contact with the top side of sheathing or continuous insulation installed on the bottom side of floor assemblies where combined with insulation that meets or exceeds the minimum *R*-value in Table C402.1.3 for "Metal framed" or "Wood framed and other" values for "Walls, Above Grade" and extends from the bottom to the top of all perimeter floor framing or floor assembly members.~~

~~2. Insulation applied to the underside of concrete floor slabs shall be permitted an air space of not more than 1 inch where it turns up and is in contact with the underside of the floor under walls associated with the *building thermal envelope*.~~))

C402.2.5 Below-grade walls. The *R*-value of the insulating material installed in, or continuously on, the below-grade walls shall be in accordance with Table C402.1.3. The *U*-factor or *R*-value required shall extend to the level of the lowest floor of the conditioned space enclosed by the below-grade wall.

AMENDATORY SECTION (Amending WSR 16-03-072, filed 1/19/16, effective 7/1/16)

WAC 51-11C-40226 Section C402.2.6—((~~Slab-on-grade perimeter insulation~~)) Insulation of radiant heating systems.

((**~~C402.2.6 Slabs-on-grade perimeter insulation.~~** ~~Where the slab-on-grade is in contact with the ground, the minimum thermal resistance (*R*-value) of the insulation around the perimeter of unheated or heated slab-on-grade floors designed in accordance with the *R*-value method of Section C402.1.3 shall be as specified in Table C402.1.3. The insulation shall be placed on the outside of the foundation or on the inside of the foundation wall. The insulation shall extend downward from the top of the slab for a minimum distance as shown in the table or to the top of the footing, whichever is less, or downward to at least the bottom of the slab and then horizontally to the interior or exterior for the total distance shown in the table. Insulation extending away from the building shall be protected by pavement or by a minimum of 10~~

~~inches (254 mm) of soil. Insulation complying with Table C402.1.3 shall be provided under the entire area of heated slabs on grade.~~

~~EXCEPTION: Where the slab-on-grade floor is greater than 24 inches (61 mm) below the finished exterior grade, perimeter insulation is not required.~~))

C402.2.86 Insulation of radiant heating systems. *Radiant heating system* panels, and their associated components that are installed in interior or exterior assemblies shall be insulated to an *R*-value of not less than R-3.5 on all surfaces not facing the space being heated. *Radiant heating system* panels that are installed in the *building thermal envelope* shall be separated from the exterior of the building or unconditioned or exempt spaces by not less than the *R*-value of insulation installed in the opaque assembly in which they are installed or the assembly shall comply with Section C402.1.4.

EXCEPTION: Heated slabs on grade insulated in accordance with Section C402.2.4.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40227 Airspaces. Where the ((~~thermal properties~~)) R-value of an airspace((~~s are~~)) is used ((~~to comply with this code~~)) for compliance in accordance with Section C401.2, ((~~such~~)) the airspace((~~s~~)) shall be enclosed in an unventilated cavity constructed to minimize airflow into and out of the enclosed airspace. Airflow shall be deemed minimized where the enclosed airspace is located on the interior side of the continuous air barrier and is bounded on all sides by building components.

EXCEPTION: The thermal resistance of airspaces located on the exterior side of the continuous air barrier and adjacent to and behind the exterior wall covering material shall be determined in accordance with ASTM C1363 modified with an airflow entering the bottom and exiting the top of the airspace at a minimum air movement rate of not less than 70 mm/sec.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40228 Section C402.2.8—((~~Insulation of radiant heating systems~~)) Above-grade exterior concrete slabs.

((~~**C402.2.8 Insulation of radiant heating systems.** *Radiant heating system* panels, and their associated components that are installed in interior or exterior assemblies shall be insulated to an *R*-value of not less than R-3.5 on all surfaces not facing the space being heated. *Radiant heating system* panels that are installed in the *building thermal envelope* shall be separated from the exterior of the building or unconditioned or exempt spaces by not less than the *R*-value of insulation installed in the opaque assembly in which they are installed or the assembly shall comply with Section C402.1.4.~~

~~EXCEPTION: Heated slabs on grade insulated in accordance with Section C402.2.6.~~))

C402.2.8 Above-grade exterior concrete slabs. Above-grade concrete slabs that penetrate the *building thermal envelope* including, but not limited to, decks and balconies, shall each include a minimum R-10 thermal break, aligned with the primary insulating layer in the adjoining wall assemblies. Stainless steel (but not carbon steel) rein-

forcing bars are permitted to penetrate the thermal break. If the total building performance path or the component performance alternative in Section C402.1.5 is utilized and the thermal break required by this section is not provided where concrete slabs penetrate the *building thermal envelope*, the sectional area of the penetration shall be assigned the default *U*-factors from the "exposed concrete" row of Table A103.3.7.2.

EXCEPTION: *Mass transfer deck slabs.*

NEW SECTION

WAC 51-11C-40229 Section C402.2.9—Vertical fenestration intersection with opaque walls.

C402.2.9 Vertical fenestration intersection with opaque walls. *Vertical fenestration* shall comply with Items 1, 2, and 3, as applicable.

1. Where wall assemblies include *continuous insulation*, the exterior glazing layer of *vertical fenestration* and any required thermal break in the frame shall each be aligned within 2 inches laterally of either face of the *continuous insulation* layer.

2. Where wall assemblies do not include *continuous insulation*, the exterior glazing layer of *vertical fenestration* and any required thermal break in the frame shall each be aligned within the thickness of the *wall* insulation layer and not more than 2 inches laterally from the exterior face of the outermost insulation layer.

3. Where the exterior face of the *vertical fenestration* frame does not extend to the exterior face of the opaque wall rough opening, the exposed exterior portion of the rough opening shall be covered with either a material having an *R*-value not less than R-3, or with minimum 1.5-inch thickness wood.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40230 Section C402.4—Fenestration.

((~~**C402.3 Reserved.**~~))

C402.4 Fenestration. 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~~)) C405.2.5.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-402300 Table C402.4—Building envelope requirements—Fenestration.

Table C402.4

Building Envelope Fenestration Maximum *U*-factor and SHGC Requirements

CLIMATE ZONE	5 AND MARINE 4	
***U*-factor for Class AW windows rated in accordance with AAMA/CSA101/I.S.2/A440, vertical curtain walls and site-built fenestration products[a]**		
Fixed[b] *U*-factor	((~~U-0.38~~)) U-0.34	
Operable[c] *U*-factor	((~~U-0.40~~)) U-0.36	
***Entrance doors*[d]**		
U-factor	U-0.60	
***U*-factor for all other vertical fenestration**		
Fixed *U*-factor	((~~U-0.30~~)) U-0.26	
Operable or mulled windows with fixed and operable sections *U*-factor	U-0.28	
SHGC for all vertical fenestration		
Orientation[e,f]	((~~SEW~~)) Fixed	((~~N~~)) Operable
PF < 0.2	0.38	((~~0.51~~)) 0.33
0.2 ≤ PF < 0.5	0.46	((~~0.56~~)) 0.40
PF ≥ 0.5	0.61	((~~0.61~~)) 0.53
Skylights		
***U*-factor**	U-0.50	
SHGC	0.35	

[a] *U*-factor and SHGC shall be rated in accordance with NFRC 100.
[b] "Fixed" includes curtain wall, storefront, picture windows, and other fixed windows.
[c] "Operable" includes openable fenestration products other than "entrance doors."
[d] "Entrance door" includes glazed swinging entrance doors. Other doors which are not entrance doors, including sliding glass doors, are considered "operable."
[e] ((~~"N" indicates vertical fenestration oriented within 30 degrees of true north. "SEW" indicates orientations other than "N."~~)) Reserved.
[f] Fenestration that is entirely within the conditioned space or is between conditioned and other enclosed space is exempt from solar heat gain coefficient requirements and not included in the SHGC calculation.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40231 Section C402.4.1—Maximum area.

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

For buildings with more than one *space conditioning category*, compliance with the maximum allowed window-to-wall ratio and skylight-to-roof ratio shall be demonstrated separately for each *space conditioning category*. Interior partition ceiling, wall, fenestration and floor areas that separate space conditioning areas shall not be applied to the window-to-wall ratio and skylight-to-roof ratio calculations.

C402.4.1.1 Vertical fenestration maximum area with high performance alternates. For buildings that comply with Section C402.4.1.1.1 or C402.4.1.1.2, the total building vertical fenestration area 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.

When determining compliance using the component performance alternative in accordance with Section C402.1.5, the total building vertical fenestration area allowed in Equation 4-2 is 40 percent of the above grade wall area for buildings that comply with the vertical fenestration alternates described in this section.

C402.4.1.1.1 Optimized daylighting. All of the following requirements shall be met:

1. Not less than 50 percent of the total conditioned floor area in the building is within a *daylight zone* that includes *daylight responsive controls* complying with Section ((~~C405.2.4.1~~)) C405.2.5.1.

2. Visible transmittance (VT) of all *vertical fenestration* in the building is greater than or equal to 1.1 times the required solar heat gain coefficient (SHGC) in accordance with Section C402.4, or 0.50, whichever is greater. It shall be permitted to demonstrate compliance based on the area weighted average *VT* being greater than or equal to the area weighted average of the minimum *VT* requirements.

EXCEPTION: Fenestration that is outside the scope of NFRC 200 is not required to comply with Item 2.

C402.4.1.1.2 High-performance fenestration. All of the following requirements shall be met:

1. All *vertical fenestration* in the building shall comply with the following *U*-factors:

a. *U*-factor for Class AW windows rated in accordance with AAMA/CSA101/I.S.2/A440, vertical curtain walls and site-built fenestration products (fixed) = ((~~0.34~~)) 0.31

b. *U*-factor for Class AW windows rated in accordance with AAMA/CSA101/I.S.2/A440, vertical curtain walls and site-built fenestration products (operable) = 0.36

c. Entrance doors = 0.60

d. *U*-factor for all other vertical fenestration, fixed = ((~~0.28~~)) 0.23

e. *U*-factor for all other vertical fenestration, operable, or mulled windows with fixed and operable sections = 0.24

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~~)) no more than 0.90 times the maximum SHGC values listed in Table C402.4.

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, except that fenestration from lines a. and b. are permitted to be combined.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40232 Section C402.4.2—Minimum skylight fenestration area.

C402.4.2 Minimum skylight fenestration area. ((~~For buildings with single story~~)) Skylights shall be provided in enclosed spaces that meet all the following criteria:

1. Floor area of enclosed spaces is greater than 2,500 square feet (232 m^2) ((~~in floor area that are~~)).

2. Space is located directly under a roof and have a ceiling height greater than 15 feet (4572 mm) for no less than 75 percent of the ceiling area((~~, these single-story spaces shall be provided with skylights and daylight responsive controls in accordance with Section C405.2.4~~)).

3. Space type((~~s required to comply with this provision include~~)) is one of the following: Office, lobby, atrium, concourse, corridor, gymnasium/exercise center, convention center, automotive service, manufacturing, nonrefrigerated warehouse, retail store, distribution/sorting area, transportation, and workshop. Skylights in these spaces are required to provide a total toplit daylight zone area not less than 50 percent of the floor area and shall provide one of the following:

1. A minimum ratio of skylight area to toplit daylight zone area under skylights of not less than 3 percent where all skylights have a VT of at least 0.40, or VT_{annual} of not less than 0.26, 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, of:

2.1. Not less than 1 percent using a skylight's VT rating; or

2.2. Not less than 0.66 percent using a *tubular daylight device's* VT_{annual} rating.

Skylight Effective Aperture = (0.85 x Skylight Area x Skylight VT x WF)/ Toplit daylight zone

(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, or 1.0 for *tubular daylighting devices (TDD)* with ((~~*VT-annual*~~)) VT_{annual} ratings measured in accordance with NFRC 203.
Light well depth	=	Measure vertically from the underside of the lowest point of the skylight glazing to the ceiling plane under the skylight.

EXCEPTIONS: 1. Skylights above daylight zones of enclosed spaces are not required in:
1.1. ((~~Reserved.~~)) Spaces designed as storm shelters complying with ICC 500.
1.2. Spaces where the designed *general lighting* power densities are less than 0.5 W/ft^2 (5.4 W/m^2) and at least 10 percent lower than the lighting power allowance in Section C405.4.2.
1.3. 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.
1.4. Spaces where the daylight zone under rooftop monitors is greater than 50 percent of the enclosed space floor area.
1.5. Spaces where the total floor area minus the sidelit 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.
2. The skylight effective aperture, calculated in accordance with Equation 4-5, is permitted to be 0.66 percent in lieu of 1 percent if the ((~~*VT annual*~~)) VT_{annual} of the skylight or *TDD*, as measured by NFRC 203, is greater than 38 percent.

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

C402.4.2.3 Daylight zones. Daylight zones referenced in Sections C402.4.1.1 through C402.4.2.2 shall comply with Sections ((~~C405.2.4.2 and C405.2.4.3~~)) C405.2.5.2 and C405.2.5.3, as applicable. Daylight zones shall include toplit daylight zones and sidelit daylight zones.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40234 Section C402.4.4—Doors.

C402.4.4 Doors. Opaque ((~~swinging~~)) doors shall ((~~comply with Table C402.1.4. Opaque nonswinging doors shall comply with Table C402.1.3. Opaque doors shall~~)) be considered part of the gross area of above-grade walls that are part of the building thermal envelope, including the frame. Opaque doors shall comply with Table C402.1.4. Other doors shall comply with the provisions of Section C402.4.3 for vertical ((~~fenestration and the entire door area, including the frame, shall be considered part of the fenestration area of the building thermal envelope~~)).

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40241 Section C402.5.1—Air barriers.

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

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. Sealing shall allow for expansion, contraction and mechanical vibration. Joints and seams associated with penetrations shall be sealed in the same manner or taped. Sealing materials shall be securely installed around the penetration so as not to dislodge, loosen or otherwise impair the penetrations' ability to resist positive and negative pressure from wind, stack effect, and mechanical ventilation. Sealing of concealed fire sprinklers, where required, shall be in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.

4. Recessed lighting fixtures shall comply with Section C402.5.8. 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 0.25 cfm/ft^2 at a pressure differential of 0.3 inches water gauge (2.0 L/s • 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 by up to 0.15 cfm/ft^2, 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. If the tested rate exceeds 0.40 cfm/ft^2, corrective actions must be made and the test completed again. A test above 0.40 cfm/ft^2 will not be accepted.~~

~~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 corrected P in accordance with Section 9.4 of ASTM E 779.~~

~~2. The test pressure range shall be from 25 Pa to 80 Pa per Section 8.10 of ASTM E 779, 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 E 779, the test shall be rerun with additional readings over a longer time interval.~~

~~**C402.5.1.2.1**~~**)) Air barrier compliance.** A continuous air barrier for the opaque building envelope shall comply with the following:

1. Group R dwelling units that are accessed directly from the outdoors shall meet the provisions of Section C402.5.2.

2. All other buildings or portions of buildings shall meet the provisions of Section C402.5.3.

C402.5.2 Enclosure testing for dwelling and sleeping unit accessed directly from the outdoors. For dwelling units accessed directly from outdoors, the *building thermal envelope* shall be tested in accordance with ASTM E779, ANSI/RESNET/ICC 380, ASTM E1827 or an equivalent method approved by the *code official*. The measured air leakage shall not exceed 0.25 cfm/ft^2 (1.27 L/s m^2) of the *testing unit enclosure area* at a pressure differential of 0.2 inch water gauge (50 Pa). Where multiple dwelling units or sleeping units or other occupiable conditioned spaces are contained within one *building thermal envelope* and are accessed directly from the outdoors, each unit shall be considered an individual testing unit, and the building air leakage shall be the weighted average of all testing unit results, weighted by each testing unit's enclosure area. Units shall be tested separately with an unguarded blower door test as follows:

1. Where buildings have fewer than eight testing units, each testing unit shall be tested.

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

3. Test shall be accomplished using either a) both pressurization and depressurization or b) 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.

Where the measured air leakage rate exceeds 0.25 cfm/ft^2 (2.0 L/s x m^2) corrective action shall be taken to seal leaks in the air barrier. Post-corrective action testing and repeated corrective action measures will be taken until the required air leakage rating is achieved. Final passing air leakage test results shall be submitted to the *code official*.

C402.5.3 Building thermal envelope testing. The *building thermal envelope* shall be tested in accordance with ASTM E779, ANSI/RESNET/ICC 380, ASTM E3158 or ASTM E1827 or an equivalent method approved by the code official. The measured air leakage shall not exceed 0.25 cfm/ft^2 (1.27 L/s × m^2) of the *building thermal envelope* area at a pressure differential of 0.3 inch water gauge (75 Pa). Alternatively, portions of the building shall be tested and the measured air leakages shall be area weighted by the surface areas of the building envelope in each portion. The weighted average test results shall not exceed the whole building leakage limit. In the alternative approach, the following portions of the building shall be tested:

1. The entire envelope area of all stories that have any spaces directly under a roof.

2. The entire envelope area of all stories that have a building entrance, exposed floor, or loading dock, or are below grade.

3. Representative above-grade sections of the building totaling at least 25 percent of the wall area enclosing the remaining conditioned space.

4. Test shall be accomplished using either a) both pressurization and depressurization or b) 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.

Where the measured air leakage rate exceeds 0.25 cfm/ft^2 (2.0 L/s x m^2) corrective action shall be taken to seal leaks in the air barrier. Post-corrective action testing and repeated corrective action measures will be taken until the required air leakage rating is achieved. Final passing of the air leakage test results shall be submitted to the *code official.*

C402.5.4 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~~)) C402.5.3, provided that the tested air leakage rate does not exceed the rate specified in Section ((~~C402.5.1.2~~)) C402.5.3.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40243 Section ((~~C402.5.3~~)) C402.5.5—Rooms containing fuel-burning appliances.

((~~C402.5.3~~)) C402.5.5 Rooms containing fuel-burning appliances. Where combustion air is supplied through openings in an exterior wall to a room or space containing a space conditioning fuel-burning appliance, one of the following shall apply:

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

2. The room or space containing the appliance shall be enclosed and isolated from conditioned spaces inside the building thermal envelope. Such rooms shall comply with all of the following:

2.1. The walls, floor and ceiling that separate the enclosed room or space from the conditioned spaces shall be insulated to be at least equivalent to the insulation requirement of below grade walls as specified in Table C402.1.3 or C402.1.4.

2.2. The walls, floors and ceilings that separate the enclosed room or space from conditioned spaces be sealed in accordance with Section C402.5.1.1.

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

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

2.5. Where the air duct supplying combustion air to the enclosed room or space passes through conditioned space, the duct shall be insulated to an *R*-value of not less than ((~~R-8~~)) R-16.

EXCEPTION: Fireplaces and stoves complying with Sections 901 through 905 of the *International Mechanical Code*, and Section 2111.13 of the *International Building Code*.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40244 Section ((~~C402.5.4~~)) C402.5.6—Doors and access openings.

((~~C402.5.4~~)) C402.5.6 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 716 of the *International Building Code*.
2. Doors and door openings required to comply with UL 1784 by the *International Building Code*.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40245 Section ((~~C402.5.5~~)) C402.5.7—Air intakes, exhaust openings, stairways and shafts.

((~~C402.5.5~~)) C402.5.7 Air intakes, exhaust openings, stairways and shafts. Stairway enclosures, elevator shaft vents and other outdoor air intakes and exhaust openings integral to the building envelope shall be provided with dampers in accordance with Section ((~~C403.7.9~~)) C403.7.8.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40246 Section ((~~C402.5.6~~)) C402.5.8—Loading dock weatherseals.

((~~C402.5.6~~)) C402.5.8 Loading dock weatherseals. Cargo door openings and loading dock door openings shall be equipped with weatherseals that restrict infiltration and provide direct contact along the top and sides of vehicles that are parked in the doorway.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40247 Section ((~~C402.5.7~~)) C402.5.9—Vestibules.

((~~C402.5.7~~)) C402.5.9 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.

EXCEPTION: Vestibules are not required for the following:
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 an enclosed space smaller than 3,000 square feet (298 m^2) in area and the exterior of the building or the building entrance lobby, where those doors do not comprise one of the primary building entrance paths to the remainder of the building. The space must be enclosed and separated without transfer air paths from the primary building entrance paths. If there are doors between the space and the primary entrance path, then the doors shall be equipped with self-closing devices so the space acts as a vestibule for the primary building entrance.
5. Revolving doors.
6. Doors used primarily to facilitate vehicular movement or material handling and adjacent personnel doors.
7. In buildings less than 3 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 ft^2 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 by a fence or other barrier.

AMENDATORY SECTION (Amending WSR 16-03-072, filed 1/19/16, effective 7/1/16)

WAC 51-11C-40248 Section ((~~C402.5.8~~)) C402.5.10—Recessed lighting.

((~~C402.5.8~~)) C402.5.10 Recessed lighting. Recessed luminaires installed in the *building thermal envelope* shall be all of the following:

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

C402.5.11 Operable openings interlocking. Where any operable openings to the outdoors are larger than 48 square feet (4.47 m^2) in area, such openings shall be interlocked with the heating and cooling system as required by Section C403.4.1.6.

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

4. Alterations to existing buildings.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-40310 Section C403.1—General.

C403.1 General. Mechanical systems and equipment serving heating, cooling, ventilating, and other needs shall comply with this section.

EXCEPTIONS: 1. Energy using equipment used by a manufacturing, industrial or commercial process other than for conditioning spaces or maintaining comfort and amenities for the occupants ((~~and not otherwise regulated by~~)) are exempt from all Section C403 subsections except for Section C403.3.2, Tables C403.3.2 (1) through (((~~12~~))) (16) inclusive, Sections C403.7.7, C403.9.2.1, C403.10.3, C403.11.2, and C403.11.3, ((~~C404.2, Table C404.2, C405.8 and C410~~)) as applicable. Data center and *computer room* HVAC equipment is not covered by this exception.
2. *Data center systems* are exempt from Sections C403.4 and C403.5.

C403.1.1 HVAC total system performance ratio (HVAC TSPR). For systems serving office (including medical office), retail, library, and education occupancies and buildings, which are subject to the requirements of Section C403.3.5 without exceptions, and the dwelling units and residential common areas within Group R-2 multi-family buildings, the *HVAC total system performance ratio* (*HVAC TSPR*) of the *proposed design* HVAC system shall be ((~~more~~)) greater than or equal to the *HVAC TSPR* of the *standard reference design* as calculated according to Appendix D, Calculation of HVAC Total System Performance Ratio.

EXCEPTIONS: 1. Buildings ((~~with conditioned floor area less than 5,000 square feet~~)) where the sum of the *conditioned floor area* of office, retail, education, library and multifamily spaces is less than 5,000 square feet. Areas that are eligible for any of the exceptions below do not count towards the 5,000 square feet.
2. HVAC systems using district heating water, chilled water or steam.
3. HVAC systems connected to a *low-carbon district energy exchange system*.
4. HVAC systems not included in Table ((~~D601.11.1~~)) D601.10.1.
((~~4.~~)) 5. HVAC systems with chilled water supplied by absorption chillers, heat recovery chillers, water to water heat pumps, air to water heat pumps, or a combination of air and water cooled chillers on the same chilled water loop.
6. HVAC systems included in Table D601.10.1 with parameters in Table D601.10.2 not identified as applicable to that HVAC system type.
((~~5.~~)) 7. HVAC systems served by heating water plants that include air to water or water to water heat pumps.
((~~6.~~)) 8. Underfloor air distribution and displacement ventilation HVAC systems.
((~~7.~~)) 9. Space conditioning systems that do not include *mechanical cooling*.
((~~8.~~)) 10. Alterations to existing buildings that do not substantially replace the entire HVAC system and are not serving initial build-out construction.
((~~9.~~)) 11. HVAC systems meeting all the requirements of the *standard reference design* HVAC system in Table D602.11, Standard Reference Design HVAC Systems.
12. Buildings or areas of medical office buildings that comply fully with ASHRAE Standard 170 including, but not limited to, surgical centers, or that are required by other applicable codes or standards to provide 24/7 air handling unit operation.
13. HVAC systems serving the following areas and spaces:
13.1. Laundry rooms.
13.2. Elevator machine rooms.
13.3. Mechanical and electrical rooms.
13.4. Data centers and computer rooms.
13.5. Laboratories with fume hoods.
13.6. Locker rooms with more than two showers.
13.7. Natatoriums and rooms with saunas.
13.8. Restaurants and commercial kitchens with total cooking capacity greater than 100,000 Btu/h.
13.9. Areas of buildings with commercial refrigeration equipment exceeding 100 kW of power input.
13.10. Cafeterias and dining rooms.

C403.1.2 Calculation of heating and cooling loads. Design loads associated with heating, ventilating and air conditioning of the building shall be determined in accordance with the procedures described in ANSI/ASHRAE/ACCA Standard 183 or by an *approved* equivalent computational procedure, using the design parameters specified in Chapter 3. Heating and cooling loads shall be adjusted to account for load reductions that are achieved where energy recovery systems are utilized in the HVAC system in accordance with the ASHRAE *HVAC Systems and Equipment Handbook* by an *approved* equivalent computational procedure.

C403.1.3 Data centers. *Data center systems* shall comply with Sections 6 and 8 of ASHRAE Standard 90.4 ((~~with the following changes:~~

~~1. Replace design MLC in ASHRAE Standard 90.4 Table 6.2.1.1 "Maximum Design Mechanical Load Component (Design MLC)" with the following per the applicable climate zone:~~

~~Zone 4C Design MLC = 0.22 Zone 5B Design MLC = 0.24~~

~~2. Replace annualized MLC values of Table 6.2.1.2 "Maximum Annualized Mechanical Load Component (Annualized MLC)" in ASHRAE Standard 90.4 with the following per applicable climate zone:~~

~~Zone 4C Annual MLC = 0.18 Zone 5B Annual MLC = 0.17~~)).

NEW SECTION

WAC 51-11C-40314 Section C403.1.4—HVAC heating equipment.

C403.1.4 Use of electric resistance and fossil fuel-fired HVAC heating equipment. HVAC heating energy shall not be provided by electric resistance or fossil fuel combustion appliances. For the purposes of this section, electric resistance HVAC heating appliances include, but are not limited to, electric baseboard, electric resistance fan coil and VAV electric resistance terminal reheat units and electric resistance boilers. For the purposes of this section, fossil fuel combustion HVAC heating appliances include, but are not limited to, appliances burning natural gas, heating oil, propane, or other fossil fuels.

EXCEPTIONS:

1. **Low heating capacity.** Buildings or areas of buildings, other than *dwelling units* or sleeping units, that meet the interior temperature requirements of Chapter 12 of the *International Building Code* with a total installed HVAC heating capacity no greater than 8.5 Btu/h (2.5 watts) per square foot of *conditioned space* are permitted to be heated using electric resistance appliances. For the purposes of this exception, overhead or wall-mounted radiant heating panels installed in an unheated or semi-heated space, insulated in compliance with Section C402.2.8 and controlled by occupant sensing devices in compliance with Section C403.11.1 need not be included as part of the HVAC heating energy calculation.

2. **Dwelling and sleeping units.** Dwelling or sleeping units having an installed HVAC heating capacity no greater than 750 watts in Climate Zone 4, and 1000 watts in Climate Zone 5, in any separate habitable room with exterior fenestration are permitted to be heated using electric resistance appliances. For buildings in locations with exterior design conditions below 4°F (-16°C), an additional 250 watts above that allowed for Climate Zone 5 is permitted.

2.1. **Corner rooms.** A room within a dwelling or sleeping unit that has two primary walls facing different cardinal directions, each with exterior fenestration, is permitted to have an installed HVAC heating capacity no greater than 1000 watts in Climate Zone 4, and 1300 watts in Climate Zone 5. Bay windows and other minor offsets are not considered primary walls. For buildings in locations with exterior design conditions below 4°F (-16°C), an additional 250 watts above that allowed for Climate Zone 5 is permitted.

3. **Small buildings.** Buildings with less than 2,500 square feet (232 m^2) of *conditioned floor area* are permitted to be heated using electric resistance appliances.

4. **Defrost.** Heat pumps are permitted to utilize electric resistance as the first stage of heating when a heat pump defrost cycle is required and is in operation.

5. **Air-to-air heat pumps.** Buildings are permitted to utilize internal electric resistance heaters to supplement heat pump heating for air-to-air heat pumps that meet all of the following conditions:

5.1. Internal electric resistance heaters have controls that prevent supplemental heater operation when the heating load can be met by the heat pump alone during both steady-state operation and setback recovery.

5.2. The heat pump controls are configured to use the compressor as the first stage of heating down to an outdoor air temperature of 17°F (-8°C) or lower.

5.3. The heat pump complies with one of the following:

5.3.1. Controlled by a digital or electronic thermostat designed for heat pump use that energizes the supplemental heat only when the heat pump has insufficient capacity to maintain set point or to warm up the space at a sufficient rate.

5.3.2. Controlled by a multistage space thermostat and an outdoor air thermostat wired to energize supplemental heat only on the last stage of the space thermostat and when outdoor air temperature is less than 32°F (0°C).

5.3.3. The minimum efficiency of the heat pump is regulated by NAECA, its rating meets the requirements shown in Table C403.3.2(2), and its rating includes all usage of internal electric resistance heating.

5.4. The heat pump rated heating capacity is sized to meet the heating load at an outdoor air temperature of 32°F (0°C) or lower and has a rated heating capacity at 47°F (8°C) no less than 2 times greater than supplemental internal electric resistance heating capacity in Climate Zone 4 and no less than the supplemental internal electric resistance heating capacity in Climate Zone 5, or utilizes the smallest available factory-available internal electric resistance heater.

6. **Air-to-water heat pumps.** Buildings are permitted to utilize electric resistance (for Climate Zone 4 or 5) or fossil fuel-fired (for Climate Zone 5) auxiliary heating to supplement heat pump heating for hydronic heating systems that meet all of the following conditions:

6.1. Controls for the auxiliary electric resistance or fossil fuel-fired heating are configured to lock out the supplemental heat when the outside air temperature is above 36°F (2°C), unless the hot water supply temperature setpoint to the building heat coils cannot be maintained for 20 minutes.

6.2. The heat pump controls are configured to use the compressor as the first stage of heating down to the lowest exterior design temperature for which the equipment is rated except during startup or defrost operation.
6.3. The heat pump rated heating capacity at 47°F (8°C) is no less than 75 percent of the design heating load at 29°F (-2°C).
7. **Ground source heat pumps.** Buildings are permitted to utilize electric resistance auxiliary heating to supplement heat pump heating for hydronic heating systems with ground source heat pump equipment that meets all of the following conditions:
7.1. Controls for the auxiliary resistance heating are configured to lock out the supplemental heat when the equipment source-side entering water temperature is above 42°F (6°C), unless the hot water supply temperature setpoint to the building heat coils cannot be maintained for 20 minutes.
7.2. The heat pump controls are configured to use the compressor as the first stage of heating.
7.3. The ground source heat exchanger shall be sized so that the heat pump annual heating output is no less than 70 percent of the total annual heating output in the final year of a 30-year simulation using IGSHPA listed simulation software.
8. **Small systems.** 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*.
9. **Specific conditions.** Portions of buildings that require fossil fuel or electric resistance space heating for specific conditions *approved* by the *code official* for research, health care, process or other specific needs that cannot practicably be served by heat pump or other space heating systems. This does not constitute a blanket exception for any occupancy type.
10. **Kitchen make-up air.** Make-up air for commercial kitchen exhaust systems required to be tempered by Section 508.1.1 of the *International Mechanical Code* is permitted to be heated by using fossil fuel in Climate Zone 5 or electric resistance in Climate Zone 4 or 5.
11. **District energy.** Steam or hot water district energy 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.
12. **Heat tape.** Heat tape is permitted where it protects water-filled equipment and piping located outside of the *building thermal envelope*, provided that it is configured and controlled to be automatically turned off when the outside air temperature is above 40°F (4°C).
13. **Temporary systems.** Temporary electric resistance heating systems are permitted where serving future tenant spaces that are unfinished and unoccupied, provided that the heating equipment is sized and controlled to achieve interior space temperatures no higher than 40°F (4°C).
14. **Pasteurization.** Electric resistance heat controls are permitted to reset the supply water temperature of hydronic heating systems that serve service water heating heat exchangers during pasteurization cycles of the service hot water storage volume. The hydronic heating system supply water temperature shall be configured to be 145°F (63°C) or lower during the pasteurization cycle.
15. **Freeze protection.** Heating systems sized for spaces with indoor design conditions of 45°F (7°C) and intended for freeze protection are permitted to use electric resistance. The building envelope of any such space shall be insulated in compliance with Section C402.1.
16. **DOAS ERV auxiliary heat.** Dedicated outdoor air systems with energy recovery ventilation are permitted to utilize fossil fuel for Climate Zone 5 or electric resistance in Climate Zone 4 or 5 for auxiliary heating to preheat outdoor air for defrost or as auxiliary supplemental heat to temper supply air to 55°F (13°C) or lower for buildings or portions of buildings that do not have hydronic heating systems.
17. **Low-carbon district energy systems** that meet the definitions of *low-carbon district energy exchange system* or *low-carbon district heating and cooling or heating only systems*.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40320 Section C403.2—System design.

C403.2 System design. Mechanical systems shall be designed to comply with Sections C403.2.1 and ((~~C403.2.2~~)) C403.2.4. Where elements of a building's mechanical systems are addressed in Sections C403.3 through C403.13, such elements shall comply with the applicable provisions of those sections.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40321 Section C403.2.1—Zone isolation.

C403.2.1 Zone isolation required. HVAC systems, DOAS and exhaust systems serving ((~~zones~~)) areas that are intended to operate or be occupied nonsimultaneously shall be divided into separate isolation areas. Zones intended to be occupied simultaneously may be grouped into a single isolation area provided ((~~it~~)) the combined total area does not exceed 25,000 square feet (2323 m^2) of conditioned floor area ((~~nor~~)) and does not include more than one floor. Each isolation area shall be equipped with isolation devices and controls configured to automati-

cally 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 C403.4.2.2. 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.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40322 Section C403.2.2—Ventilation and exhaust.

C403.2.2 Ventilation and exhaust.

C403.2.2.1 Ventilation. Ventilation, either natural or mechanical, shall be provided in accordance with Chapter 4 of the *International Mechanical Code*. Where mechanical ventilation is provided, the system shall be configured to provide no greater than 150 percent of the minimum outdoor air required by Chapter 4 of the *International Mechanical Code* or other applicable code or standard, whichever is greater.

EXCEPTIONS:
1. The mechanical system may supply outdoor air at rates higher than the limit above when it is used for particulate or VOC dilution, ((~~economizer,~~)) economizing or night flushing, dehumidification, pressurization, exhaust make-up, or other process air delivery. Outdoor air shall be reduced to the minimum ventilation rates when not required for the preceding uses.
2. Air systems supplying dwelling or sleeping units within Group R-1, R-2 or I-2 occupancies.
3. Alterations that replace less than half of the total heating and cooling capacity of the system.
4. Systems with energy recovery complying with the requirements of Section C403.7.6.1 that utilize sensible only active chilled beams for space cooling without any additional zonal fan power. Active chilled beams shall be permitted to utilize the increased outdoor airflow to increase space sensible capacity and to maintain space latent cooling loads without additional controls to reduce the outdoor airflow to each zone.
5. Systems that include energy recovery ventilation with an 80 percent minimum sensible recovery effectiveness in accordance with Section C403.3.5.1 and with controls capable and configured to lock-out the use of supplemental heat may provide ventilation up to a maximum of 200 percent of the minimum outdoor air required.

C403.2.2.2 Exhaust. Exhaust shall be provided in accordance with Chapters 4 and 5 of the *International Mechanical Code*. Where exhaust is provided, the system shall be configured to provide no greater than 150 percent of the minimum exhaust air required by Chapters 4 and 5 of the *International Mechanical Code* or other applicable code or standard, whichever is greater.

EXCEPTIONS:
1. The mechanical system may exhaust air at rates higher than the limit above when it is used for particulate or VOC dilution, economizer, night flushing, dehumidification, pressure equalization, relief, or other process exhaust air requirements. Outdoor air and exhaust air shall be reduced to the minimum ventilation rates when not required for the preceding uses.
2. Domestic range hood exhaust in Group R occupancies.
3. Exhaust from Group I occupancies.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40323 Section C403.2.3—((~~Variable flow capacity~~)) Fault detection and diagnostics.

((~~**C403.2.3 Variable flow capacity.** For fan and pump motors 7.5 hp and greater including motors in or serving custom and packaged air han-~~

~~dlers serving variable air volume fan systems, constant volume fans, heating and cooling hydronic pumping systems, pool and service water pumping systems, domestic water pressure-booster 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.).))~~

C403.2.3 Fault detection and diagnostics. New buildings with an HVAC system serving a gross conditioned floor area of 100,000 square feet (9290 m^2) or larger shall include a fault detection and diagnostics (FDD) system to monitor the HVAC system's performance and automatically identify faults. The FDD system shall:

1. Include permanently installed sensors and devices to monitor the HVAC system's performance.

2. Sample the HVAC system's performance at least once every 15 minutes.

3. Automatically identify and report HVAC system faults.

4. Automatically notify authorized personnel of identified HVAC system faults.

5. Automatically provide prioritized recommendations for repair of identified faults based on analysis of data collected from the sampling of HVAC system performance.

6. Be capable of transmitting the prioritized fault repair recommendations to remotely located authorized personnel.

EXCEPTION: Group R-1 and R-2 occupancies.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40324 ((~~Reserved.~~)) Section C403.2.4—Variable flow capacity.

C403.2.4 Variable flow capacity. For fan and pump motors 5.0 hp and greater including motors in or serving custom and packaged air handlers serving variable air volume fan systems, constant volume fans, heating and cooling hydronic pumping systems, pool and service water pumping systems, domestic water pressure-booster 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.).

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40332 Section C403.3.2—HVAC equipment performance requirements.

C403.3.2 HVAC equipment performance requirements. Equipment shall meet the minimum efficiency requirements of Tables C403.3.2(1) through C403.3.2((~~(12)~~)) (16) when tested and rated in accordance with the applicable test procedure. Plate-type liquid-to-liquid heat exchangers shall meet the minimum requirements of ((~~Table C403.3.2(10)~~)) AHRI 400. The efficiency shall be verified through certification and listed under an *approved* certification program or, if no certification program exists, the equipment efficiency ratings shall be supported by data furnished by the manufacturer. Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all stated requirements. Where components, such as indoor or outdoor coils, from different manufacturers are used, calculations and supporting data shall be furnished by the designer that demonstrates that the combined efficiency of the specified components meets the requirements herein.

C403.3.2.1 Gas-fired and oil-fired forced air furnaces. Forced air furnaces with input ratings ≥ 225,000 Btu/h (65 kW) and all unit heaters shall also have an intermittent ignition or interrupted device (IID), and have either mechanical draft (including power venting) or a flue damper. A vent damper is an acceptable alternative to a flue damper for furnaces where combustion air is drawn from the conditioned space. All furnaces with input ratings ≥ 225,000 Btu/h (65 kW), including electric furnaces, that are not located within the conditioned space shall have jacket losses not exceeding 0.75 percent of the input rating.

((~~C403.3.2.1~~)) C403.3.2.2 Hydronic and multiple-zone HVAC system controls and equipment. Hydronic and multiple-zone HVAC system controls and equipment shall comply with this section.

For buildings with a total equipment cooling capacity of 300 tons and above, the equipment shall comply with one of the following:

1. No one unit shall have a cooling capacity of more than 2/3 of the total installed cooling equipment capacity;
2. The equipment shall have a variable speed drive; or
3. The equipment shall have multiple compressors.

C403.3.2.3 Chillers. Chilled water plants and buildings with more than 500 tons total capacity shall not have more than 100 tons provided by air-cooled chillers.

EXCEPTIONS: 1. Where the designer demonstrates that the water quality at the building site fails to meet manufacturer's specifications for the use of water-cooled equipment.
2. Air-cooled chillers with minimum efficiencies at least 10 percent higher than those listed in Table ((~~C403.3.2(7)~~)) C403.3.2(3).
3. Replacement of existing air-cooled chiller equipment.
4. Air-to-water heat pump units that are configured to provide both heating and cooling and that are rated in accordance with AHRI 550/590. Where the air-to-water heat pumps are designed for a maximum supply leaving water temperature of less than 140°F, the efficiency rating will be calculated and reported at the maximum unit leaving water temperature for this test condition.

((~~C403.3.2.2~~)) C403.3.2.4 Water-cooled centrifugal chilling packages. Equipment not designed for operation at AHRI Standard 550/590 test conditions of ((~~44°F (7°C)~~)) 44.00°F (6.67°C) leaving and 54.00°F (12.22°C) entering chilled-water temperatures and ((~~2.4 gpm/ton evaporator fluid flow and 85°F (29°C) entering condenser water temperature with 3 gpm/ton (0.054 L/s • kW) condenser water flow~~)) with 85.00°F (29.44°C) entering and 94.30°F (34.61°C) leaving condenser-fluid temperatures, shall have maximum full-load kW/ton (FL) and *part-load* ratings adjusted using ((~~Equations 4-7 and 4-8~~)) the following equations.

$$FL_{adj} = FL/K_{adj}$$

(Equation 4-7)

$$PLV_{adj} = IPLV.IP/K_{adj}$$

(Equation 4-8)

Where:

K_{adj}	=	A × B
FL	=	Full-load kW/ton values as specified in Table C403.3.2(7)
FL_{adj}	=	Maximum full-load kW/ton rating, adjusted for nonstandard conditions
IPLV.IP	=	Value as specified in Table C403.3.2(7)
PLV_{adj}	=	Maximum NPLV rating, adjusted for nonstandard conditions
A	=	$0.00000014592 \times (LIFT)^4 - 0.0000346496 \times (LIFT)^3 + 0.00314196 \times (LIFT)^2 - 0.147199 \times LIFT +$ ((~~3.9302~~)) 3.93073
B	=	$0.0015 \times L_{vg}^{Evap}$ (° F) + 0.934
LIFT	=	$L_{vg}^{Cond} - L_{vg}^{Evap}$
L_{vg}^{Cond}	=	Full-load condenser leaving fluid temperature (°F)
L_{vg}^{Evap}	=	Full-load evaporator leaving temperature (°F)

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

((~~1. Minimum evaporator leaving temperature: 36°F.~~
~~2. Maximum condenser leaving temperature: 115°F.~~
~~3. LIFT is not less than 20°F (11.1°C) and not greater than 80°F (44.4°C)~~)) • 36.00°F ≤ $L_{vg}E_{vap}$ ≤ 60.00°F
• $L_{vg}Cond$ ≤ 115.00°F
• 20.00°F ≤ $LIFT$ ≤ 80.00°F

Manufacturers shall calculate the FL_{adj} and PLV_{adj}before determining whether to label the chiller. Centrifugal chillers designed to operate outside of these ranges are not covered by this code.

((~~C403.3.2.3~~)) C403.3.2.5 Positive displacement (air- and water-cooled) chilling packages. Equipment with a leaving fluid temperature higher than 32°F (0°C) and water-cooled positive displacement chilling packages with a condenser leaving fluid temperature below 115°F (46°C) shall meet the requirements ((~~of Table C403.3.2(7)~~)) the tables in Section C403.3.2 when tested or certified with water at standard rating conditions, in accordance with the referenced test procedure.

((~~C403.3.2.4~~)) C403.3.2.6 Packaged and split system electric heating and cooling equipment. Packaged ((~~electric~~)) and split system equipment providing both electric 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 configured to operate in heat pump mode whenever the outdoor air temperature is above 25°F (-3.9°C) and the unit is not in defrost. The unit shall have reverse-cycle demand defrost.

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

((~~C403.3.2.5~~)) C403.3.2.7 Humidification. If an air economizer is required on a cooling system for which humidification equipment is to be provided to maintain minimum indoor humidity levels, then the humidifier shall be of the adiabatic type (direct evaporative media or fog atomization type).

EXCEPTIONS:
1. Health care facilities licensed by the state where chapter 246-320 or 246-330 WAC requires steam injection humidifiers in duct work downstream of final filters.
2. Systems with water economizer.
3. 100 percent outside air systems with no provisions for air recirculation to the central supply fan.
4. Nonadiabatic humidifiers cumulatively serving no more than 10 percent of a building's air economizer capacity as measured in cfm. This refers to the system cfm serving rooms with stand alone or duct mounted humidifiers.

NEW SECTION

WAC 51-11C-403321 Table C403.3.2(1)—Electrically operated unitary air conditioners and condensing units.

Table C403.3.2(1)
Minimum Efficiency Requirements—Electrically Operated Unitary Air Conditioners and Condensing Units[c,d]

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
Air conditioners, air cooled	< 65,000 Btu/h[b]	All	Split System, three phase and applications outside U.S. single phase[b]	13.0 SEER before 1/1/2023 13.4 SEER2 after 1/1/2023	AHRI 210/240-2017 before 1/1/2023 AHRI 201/240-2023 after 1/1/2023
			Single package, three phase and applications outside U.S. single phase[b]	14.0 SEER before 1/1/2023 13.4 SEER2 after 1/1/2023	
Space constrained, air cooled	≤ 30,000 Btu/h[b]	All	Split System, three phase and applications outside U.S. single phase[b]	12.0 SEER before 1/1/2023 11.7 SEER2 after 1/1/2023	
			Single package, three phase and applications outside U.S. single phase[b]	12.0 SEER before 1/1/2023 11.7 SEER2 after 1/1/2023	
Small duct high velocity, air cooled	≤ 65,000 Btu/h[b]	All	Split System, three phase and applications outside U.S. single phase[b]	12.0 SEER before 1/1/2023 12.1 SEER2 after 1/1/2023	

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
Air conditioners, air cooled	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.2 EER 12.9 IEER before 1/1/2023 14.8 IEER after 1/1/2023	AHRI 340/360
		All other	Split System and Single Package	11.0 EER 12.7 IEER before 1/1/2023 14.6 IEER after 1/1/2023	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.0 EER 12.4 IEER before 1/1/2023 14.2 IEER after 1/1/2023	
		All other	Split System and Single Package	10.8 EER 12.2 IEER before 1/1/2023 14.0 IEER after 1/1/2023	
	≥ 240,000 Btu/h and < 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	10.0 EER 11.6 IEER before 1/1/2023 13.2 IEER after 1/1/2023	
		All other	Split System and Single Package	9.8 EER 11.4 IEER before 1/1/2023 13.0 IEER after 1/1/2023	
	≥ 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	9.7 EER 11.2 IEER before 1/1/2023 12.5 IEER after 1/1/2023	
		All other	Split System and Single Package	9.5 EER 11.0 IEER before 1/1/2023 12.3 IEER after 1/1/2023	

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
Air conditioners, water cooled	< 65,000 Btu/h[b]	All	Split System and Single Package	12.1 EER 12.3 IEER	AHRI 210/240
	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	12.1 EER 13.9 IEER	AHRI 340/360
		All other	Split System and Single Package	11.9 EER 13.7 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	12.5 EER 13.9 IEER	
		All other	Split System and Single Package	12.3 EER 13.7 IEER	
	≥ 240,000 Btu/h and < 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	12.4 EER 13.6 IEER	
		All other	Split System and Single Package	12.2 EER 13.4 IEER	
	≥ 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	12.2 EER 13.5 IEER	
		All other	Split System and Single Package	12.0 EER 13.3 IEER	
Air conditioners, evaporatively cooled	< 65,000 Btu/h[b]	All	Split System and Single Package	12.1 EER 12.3 IEER	AHRI 210/240
	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	12.1 EER 12.3 IEER	AHRI 340/360
		All other	Split System and Single Package	11.9 EER 12.1 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	12.0 EER 12.2 IEER	
		All other	Split System and Single Package	11.8 EER 12.0 IEER	
	≥ 240,000 Btu/h and < 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.9 EER 12.1 IEER	
		All other	Split System and Single Package	11.7 EER 11.9 IEER	
	≥ 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.7 EER 11.9 EER	
		All other	Split System and Single Package	11.5 EER 11.7 EER	
Condensing units, air cooled	≥ 135,000 Btu/h			10.5 EER 11.8 IEER	AHRI 365
Condensing units, water cooled	≥ 135,000 Btu/h			13.5 EER 14.0 IEER	
Condensing units, evaporatively cooled	≥ 135,000 Btu/h			13.5 EER 14.0 IEER	

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

[a] Chapter 6 contains a complete specification of the referenced standards, which include test procedures, including the reference year version of the test procedure.

[b] Single-phase, U.S. air-cooled air conditioners less than 65,000 Btu/h are regulated as consumer products by the U.S. Department of Energy Code of Federal Regulations DOE 10 C.F.R. 430. SEER and SEER2 values for single-phase products are set by the U.S. Department of Energy.

[c] DOE 10 C.F.R. 430 Subpart B Appendix MI includes the test procedure updates effective 1/1/2023 that will be incorporated in AHRI 210/240-2023.
[d] This table is a replica of ASHRAE 90.1 Table 6.8.1-1 Electrically Operated Unitary Air Conditioners and Condensing Units—Minimum Efficiency Requirements.

NEW SECTION

WAC 51-11C-403322 Table C403.3.2(2)—Electrically operated air-cooled unitary heat pumps—Minimum efficiency requirements.

Table C403.3.2(2)
Electrically Operated Air-Cooled Unitary Heat Pumps—Minimum Efficiency Requirements

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
Air cooled (cooling mode)	< 65,000 Btu/h	All	Split System, three phase and applications outside U.S. single phase[b]	14.0 SEER before 1/1/2023 14.3 SEER2 after 1/1/2023	AHRI 210/240-2017 before 1/1/2023 AHRI 201/240-2023 after 1/1/2023
			Single Package, three phase and applications outside U.S. single phase[b]	14.0 SEER before 1/1/2023 13.4 SEER2 after 1/1/2023	
Space constrained, air cooled	≤ 30,000 Btu/h	All	Split System, three phase and applications outside U.S. single phase[b]	12.0 SEER before 1/1/2023 11.7 SEER2 after 1/1/2023	
			Single Package, three phase and applications outside U.S. single phase[b]	12.0 SEER before 1/1/2023 11.7 SEER2 after 1/1/2023	
Single duct high velocity, air cooled (cooling mode)	≤ 65,000 Btu/h	All	Split System, three phase and applications outside U.S. single phase[b]	12.0 SEER before 1/1/2023 12.0 SEER2 after 1/1/2023	

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
Air cooled (cooling mode)	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.0 EER 12.2 IEER before 1/1/2023 14.1 IEER after 1/1/2023	AHRI 340/360
		All other	Split System and Single Package	10.8 EER 12.0 IEER before 1/1/2023 13.9 IEER after 1/1/2023	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	10.6 EER 11.6 IEER before 1/1/2023 13.5 IEER after 1/1/2023	
		All other	Split System and Single Package	10.4 EER 11.4 IEER before 1/1/2023 13.3 IEER after 1/1/2023	
	≥ 240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	9.5 EER 10.6 IEER before 1/1/2023 12.5 IEER after 1/1/2023	
		All other	Split System and Single Package	9.3 EER 10.4 IEER before 1/1/2023 12.3 IEER after 1/1/2023	
Air cooled (heating mode)	< 65,000 Btu/h[b]	-	Split System, three phase and applications outside U.S. single phase[b]	8.2 HSPF before 1/1/2023 7.5 HSPF after 1/1/2023	AHRI 210/240-2017 before 1/1/2023 AHRI 201/240-2023 after 1/1/2023
		-	Single Package, three phase and applications outside U.S. single phase[b]	8.0 HSPF before 1/1/2023 6.7 HSPF after 1/1/2023	
Space constrained, air cooled (heating mode)	≤ 30,000 Btu/h	-	Split System, three phase and applications outside U.S. single phase[b]	7.4 HSPF before 1/1/2023 6.3 HSPF after 1/1/2023	
		-	Single Package, three phase and applications outside U.S. single phase[b]	7.4 HSPF before 1/1/2023 6.3 HSPF after 1/1/2023	
Small-duct high velocity air cooled (heating mode)	< 65,000 Btu/h	-	Split System, three phase and applications outside U.S. single phase[b]	7.2 HSPF before 1/1/2023 6.1 HSPF after 1/1/2023	

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
Air cooled (heating mode)	≥ 65,000 Btu/h and < 135,000 Btu/h (cooling capacity)	-	47ºF db/43ºF wb Outdoor Air	3.30 COP_H before 1/1/2023 3.40 COP_H after 1/1/2023	AHRI 340/360
			17ºF db/15ºF wb Outdoor Air	2.25 COP_H	
	≥ 135,000 Btu/h and < 240,000 Btu/h (cooling capacity)	-	47ºF db/43ºF wb Outdoor Air	3.20 COP_H before 1/1/2023 3.30 COP_H after 1/1/2023	
			17ºF db/15ºF wb Outdoor Air	2.05 COP_H	
	≥ 240,000 Btu/h (cooling capacity)		47ºF db/43ºF wb Outdoor Air	3.20 COP_H	
			17ºF db/15ºF wb Outdoor Air	2.05 COP_H	

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

[a] Chapter 6 contains a complete specification of the referenced standards, which include test procedures, including the reference year version of the test procedure.

[b] Single-phase, U.S. air-cooled heat pumps less than 65,000 Btu/h are regulated as consumer products by the U.S. Department of Energy Code of Federal Regulations DOE 10 C.F.R. 430. SEER, SEER2, and HSPF values for single-phase products are set by the U.S. Department of Energy.

[c] DOE 10 C.F.R. 430 Subpart B Appendix MI includes the test procedure updates effective 1/1/2023 that will be incorporated into AHRI 210/240-2023.

[d] This table is a replica of ASHRAE 90.1 Table 6.8.1-2 Electrically Operated Air-Cooled Unitary Heat Pumps—Minimum Efficiency Requirements.

NEW SECTION

WAC 51-11C-403323 Table C403.3.2(3)—Water chilling packages—Minimum efficiency requirements.

Table C403.3.2(3)

Water Chilling Packages—Minimum Efficiency Requirements[a,b,e,f]

Equipment Type	Size Category	Units	Path A		Path B		Test Procedure[c]
			FL	IPLV,IP	FL	IPLV,IP	
Air-cooled chillers	< 150 tons	EER(Btu/Wh)	≥ 10.100	≥ 13.700	≥ 9.700	≥ 15.800	AHRI 550/590
	≥ 150 tons	EER(Btu/Wh)	≥ 10.100	≥ 14.000	≥ 9.700	≥ 16.100	
Air cooled without condenser, electrically operated	All capacities	EER(Btu/Wh)	Air-cooled chillers without condensers shall be rated with matching condensers and comply with the air-cooled chiller efficiency requirements				
Water cooled, electrically operated, positive displacement	< 75 tons	kW/ton	≤ 0.750	≤ 0.600	≤ 0.780	≤ 0.500	
	≥ 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	

Equipment Type	Size Category	Units	Path A		Path B		Test Procedure[c]
			FL	IPLV,IP	FL	IPLV,IP	
Water cooled, electrically operated, centrifugal	< 150 tons	kW/ton	≤ 0.610	≤ 0.550	≤ 0.695	≤ 0.440	
	≥ 150 tons and < 300 tons	kW/ton	≤ 0.610	≤ 0.550	≤ 0.695	≤ 0.400	
	≥ 300 tons and < 400 tons	kW/ton	≤ 0.560	≤ 0.520	≤ 0.595	≤ 0.390	
	≥ 400 tons and < 600 tons	kW/ton	≤ 0.560	≤ 0.500	≤ 0.585	≤ 0.380	
	≥ 600 tons	kW/ton	≤ 0.560	≤ 0.500	≤ 0.585	≤ 0.380	
Air cooled absorption, single effect	All capacities	COP(W/W)	≥ 0.600	NR	NA[d]	NA[d]	AHRI 560
Water cooled absorption, single effect	All capacities	COP(W/W)	≥ 0.700	NR	NA[d]	NA[d]	
Absorption double effect, indirect fired	All capacities	COP(W/W)	≥ 1.000	≥ 1.050	NA[d]	NA[d]	
Absorption double effect, direct fired	All capacities	COP(W/W)	≥ 1.000	≥ 1.000	NA[d]	NA[d]	

For SI: 1 ton = 3517 W, 1 British thermal unit per hour = 0.2931 W, °C = [(°F) - 32]/1.8.
NR = No requirement.

[a] Chapter 6 contains a complete specification of the referenced standards, which includes test procedures, including the referenced year version of the test procedure.
[b] The requirements for centrifugal chiller shall be adjusted for nonstandard rating conditions per Section C403.3.2.4 and are applicable only for the range of conditions listed there. The requirements for air-cooled, water-cooled positive displacement and absorption chillers are at standard rating conditions defined in the referenced test procedure.
[c] Both the full load and IPLV.IP requirements must be met or exceeded to comply with this standard. When there is a Path B, compliance can be with either Path A or Path B for any application.
[d] NA means the requirements are not applicable for Path B and only Path A can be used for compliance.
[e] FL is the full-load performance requirements, and IPLV.IP is for the part-load performance requirements.
[f] This table is a replica of ASHRAE 90.1 Table 6.8.1-3 Water-Chilling Packages—Minimum Efficiency Requirements.

NEW SECTION

WAC 51-11C-403324 Table C403.3.2(4)—Minimum efficiency requirements—Electrically operated PTAC, PTHP, SPVAC, SPVHP, room air conditioners.

Table C403.3.2(4)
Electrically Operated Packaged Terminal Air Conditioners, Packaged Terminal Heat Pumps, Single-Package Vertical Air Conditioners, Single-Package Vertical Heat Pumps, Room Air Conditioners and Room Air-Conditioner Heat Pumps—Minimum Efficiency Requirements[e]

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
PTAC (cooling mode) Standard size	< 7,000 Btu/h	95°F db/75°F wb outdoor air[c]	11.9 EER	AHRI 310/380
	≥ 7,000 Btu/h and ≤ 15,000 Btu/h		14.0 - (0.300 × Cap/1000) EER[d]	
	> 15,000 Btu/h		9.5 EER	
PTAC (cooling mode) Nonstandard size[a]	< 7,000 Btu/h	95°F db/75°F wb outdoor air[c]	9.4 EER	AHRI 310/380
	≥ 7,000 Btu/h and ≤ 15,000 Btu/h		10.9 - (0.213 × Cap/1000) EER[d]	
	> 15,000 Btu/h		7.7 EER	

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
PTHP (cooling mode) Standard size	< 7,000 Btu/h	95°F db/75°F wb outdoor air[c]	11.9 EER	AHRI 310/380
	≥ 7,000 Btu/h and ≤ 15,000 Btu/h		14.0 - (0.300 × Cap/1000) EER[d]	
	> 15,000 Btu/h		9.5 EER	
PTHP (cooling mode) Nonstandard size[b]	< 7,000 Btu/h	95°F db/75°F wb outdoor air[c]	9.3 EER	AHRI 310/380
	≥ 7,000 Btu/h and ≤ 15,000 Btu/h		10.8 - (0.213 × Cap/1000) EER[d]	
	> 15,000 Btu/h		7.6 EER	
PTHP (heating mode) Standard size	< 7,000 Btu/h	47°F db/43°F wb outdoor air	3.3 COP_H	AHRI 310/380
	≥ 7,000 Btu/h and ≤ 15,000 Btu/h		3.7 - (0.052 × Cap/1000) COP_H[d]	
	> 15,000 Btu/h		2.90 COP_H	
PTHP (heating mode) Nonstandard size[b]	< 7,000 Btu/h	47°F db/43°F wb outdoor air	2.7 COP_H	AHRI 310/380
	≥ 7,000 Btu/h and ≤ 15,000 Btu/h		2.9 - (0.026 × Cap/1000) COP_H[d]	
	> 15,000 Btu/h		2.5 COP_H	
SPVAC (cooling mode)	< 65,000 Btu/h	95°F db/75°F wb outdoor air[c]	11.0 EER	AHRI 390
	≥ 65,000 Btu/h and < 135,000 Btu/h		10.0 EER	
	≥ 135,000 Btu/h and < 240,000 Btu/h		10.0 EER	
SPVHP (cooling mode)	< 65,000 Btu/h	95°F db/75°F wb outdoor air[c]	11.0 EER	AHRI 390
	≥ 65,000 Btu/h and < 135,000 Btu/h		10.0 EER	
	≥ 135,000 Btu/h and < 240,000 Btu/h		10.0 EER	
SPVHP (heating mode)	<65,000 Btu/h	47°F db/43°F wb outdoor air	3.3 COP	AHRI 390
	≥ 65,000 Btu/h and < 135,000 Btu/h		3.0 COP	
	≥ 135,000 Btu/h and < 240,000 Btu/h		3.0 COP	
Room air conditioners without reverse cycle with louvered sides for applications outside U.S.	< 6,000 Btu/h	-	11.0 CEER	ANSI/ AHAMRAC-1
	≥ 6,000 Btu/h and < 8,000 Btu/h	-	11.0 CEER	
	≥ 8,000 Btu/h and < 14,000 Btu/h	-	10.9 CEER	
	≥ 14,000 Btu/h and < 20,000 Btu/h	-	10.7 CEER	
	≥ 20,000 Btu/h and < 28,000 Btu/h	-	9.4 CEER	
	≥ 28,000 Btu/h	-	9.0 CEER	

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
Room air conditioners without louvered sides	< 6,000 Btu/h	-	10.0 CEER	ANSI/ AHAMRAC-1
	≥ 6,000 Btu/h and < 8,000 Btu/h	-	10.0 CEER	
	≥ 8,000 Btu/h and < 11,000 Btu/h	-	9.6 CEER	
	≥ 11,000 Btu/h and < 14,000 Btu/h	-	9.5 CEER	
	≥ 14,000 Btu/h and < 20,000 Btu/h	-	9.3 CEER	
	≥ 20,000 Btu/h	-	9.4 CEER	
Room air conditioners with reverse cycle, with louvered sides for applications outside U.S.	< 20,000 Btu/h	-	9.8 CEER	ANSI/ AHAMRAC-1
	≥ 20,000 Btu/h	-	9.3 CEER	
Room air conditioners with reverse cycle without louvered sides for applications outside U.S.	< 14,000 Btu/h	-	9.3 CEER	ANSI/ AHAMRAC-1
	≥ 14,000 Btu/h	-	8.7 CEER	
Room air conditioners, casement only for applications outside U.S.	All capacities	-	9.5 CEER	ANSI/ AHAMRAC-1
Room air conditioners, casement-slider for application outside U.S.	All capacities	-	10.4 CEER	ANSI/ AHAMRAC-1

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

"Cap" = The rated cooling capacity of the product in Btu/h. If the unit's capacity is less than 7,000 Btu/h, use 7,000 Btu/h in the calculation. If the unit's capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculations.

a Chapter 6 contains a complete specification of the referenced standards, which include test procedures, including the referenced year version of the test procedure.

b Nonstandard size units must be factory labeled as follows: "MANUFACTURED FOR NONSTANDARD SIZE APPLICATIONS ONLY: NOT TO BE INSTALLED IN NEW STANDARD PROJECTS." Nonstandard size efficiencies apply only to units being installed in existing sleeves having an external wall opening of less than 16 inches (406 mm) high or less than 42 inches (1067 mm) wide and having a cross-sectional area less than 670 square inches (0.43 m^2).

c The cooling-mode wet bulb temperature requirement only applies for units that reject condensate to the condenser coil.

d "Cap" in EER and COPH equations for PTACs and PTHPs means cooling capacity in Btu/h at 95°F outdoor dry-bulb temperature.

e This table is a replica of ASHRAE 90.1 Table 6.8.1-4 Electrically Operated Packaged Terminal Air Conditioners, Packaged Terminal Heat Pumps, Single-Package Vertical Air Conditioners, Single-Package Vertical Heat Pumps, Room Air Conditioners, and Room Air-Conditioner Heat Pumps—Minimum Efficiency Requirements.

NEW SECTION

WAC 51-11C-403325 Table C403.3.2(5)—Minimum efficiency requirements—Warm air furnaces and unit heaters.

Table C403.3.2(5)
Warm Air Furnaces and Combination Warm Air Furnaces/Air-Conditioning Units, Warm Air Duct Furnaces and Unit Heaters—Minimum Efficiency Requirements

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Minimum Efficiency[d,c]	Test Procedure[a]
Warm-air furnace, gas fired for application outside the U.S.	< 225,000 Btu/h	Maximum capacity[c]	80% AFUE (nonweatherized) or 1% AFUE (weatherized) or 80% E_t[b,d]	DOE 10 C.F.R. 430 Appendix N or Section 2.39, Thermal Efficiency, ANSI Z21.47
Warm-air furnace, gas fired	< 225,000 Btu/h	Maximum capacity[c]	80% E_t[b,d] before 1/1/2023 81% E_t[d] after 1/1/2023	Section 2.39, Thermal Efficiency, ANSI Z21.47
Warm-air furnace, oil fired	< 225,000 Btu/h	Maximum capacity[c]	83% AFUE (nonweatherized) or 78% AFUE (weatherized) or 80% E_t[b,d]	DOE 10 C.F.R. 430 Appendix N or Section 42, Combustion UL 727
Warm-air furnace, oil fired	< 225,000 Btu/h	Maximum capacity[c]	80% E_t before 1/1/2023 82% E_t[d] after 1/1/2023	Section 42, Combustion UL 727
Electric furnaces for applications outside the U.S.	< 225,000 Btu/h	All	96% AFUE	DOE 10 C.F.R. 430 Appendix N
Warm air duct furnaces, gas fired	All capacities	Maximum capacity[c]	80% E_c[e]	Section 2.10, Efficiency, ANSI Z83.8
Warm air unit heaters, gas fired	All capacities	Maximum capacity[c]	80% E_c[e,f]	Section 2.10, Efficiency, ANSI Z83.8
Warm air unit heaters, oil fired	All capacities	Maximum capacity[c]	80% E_c[e,f]	Section 40, Combustion, UL 731

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

[a] Chapter 6 contains a complete specification of the referenced standards, which include test procedures, including the referenced year version of the test procedure.

[b] Combination units (i.e., furnaces contained within the same cabinet as an air conditioner) not covered by DOE 10 C.F.R. 430 (i.e., 3-phase power or with cooling capacity greater than or equal to 65,000 Btu/h) may comply with either rating. All other units greater than 225,000 Btu/h sold in the U.S. must meet the AFUE standards for consumer products and testing using U.S. DOE's AFUE test procedure at DOE 10 C.F.R. 430 Subpart B, Appendix N.

[c] Compliance of multiple firing rate units shall be at the maximum firing rate.

[d] E_t = Thermal efficiency. Units must also include an interrupted or intermittent ignition device (IID), have jacket losses not exceeding 0.75 percent of the input rating, and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for those furnaces where combustion air is drawn from the conditioned space.

[e] E_c = Combustion efficiency (100% less flue losses). See test procedure for detailed discussion.

[f] Units must also include an interrupted or intermittent ignition device (IID) and have either power venting or an automatic flue damper.

[g] This table is a replica of ASHRAE 90.1 Table 6.8.1-5 Warm-Air Furnaces and Combination Warm-Air Furnaces/Air-Conditioning Units, Warm-Air Duct Furnaces, and Unit Heaters—Minimum Efficiency Requirements.

NEW SECTION

WAC 51-11C-403326 Table C403.3.2(6)—Minimum efficiency requirements—Gas-fired and oil-fired boilers.

Table C403.3.2(6)
Gas- and Oil-Fired Boilers—Minimum Efficiency Requirements

Equipment Type[a]	Subcategory or Rating Condition	Size Category (Input)	Minimum Efficiency	Test Procedure[a]
Boilers, hot water	Gas-fired	< 300,000 Btu/h[g,h] for applications outside the U.S.	82% AFUE	DOE 10 C.F.R. 430 Appendix N
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[e]	84% E_t[d]	DOE 10 C.F.R. 431.86
		> 2,500,000 Btu/h and ≤ 10,000,000 Btu/h[b]	85% E_t[d]	
		> 10,000,000 Btu/h[b]	82% E_c[c]	
	Oil-fired[f]	< 300,000 Btu/h[g,h]	84% AFUE	DOE 10 C.F.R. 430 Appendix N
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[e]	87% E_t[d]	DOE 10 C.F.R. 431.86
		> 2,500,000 Btu/h[b]	88% E_c[c]	
		> 10,000,000 Btu/h[b]	84% E_c[d]	
Boilers, steam	Gas-fired	< 300,000 Btu/h[g]	81% AFUE	DOE 10 C.F.R. 430 Appendix N
	Gas-fired - all, except natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[b]	82% E_t[d]	DOE 10 C.F.R. 431.86
		> 2,500,000 Btu/h[a]	79% E_t[d]	
		> 10,000,000 Btu/h[b]	79% E_t[d]	
	Gas-fired - natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[b]	81% E_t[d]	
		> 2,500,000 Btu/h[b]	82% E_t[d]	
		> 10,000,000 Btu/h[b]	79% E_t[d]	
	Oil-fired[f]	< 300,000 Btu/h	82% AFUE	DOE 10 C.F.R. 430 Appendix N
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[b]	84% E_t[d]	DOE 10 C.F.R. 431.86
		> 2,500,000 Btu/h[b]	85% E_t[d]	
		> 10,000,000 Btu/h[b]	81% E_t[d]	

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

[a] Chapter 6 contains a complete specification of the referenced standards, which include test procedures, including the reference year version of the test procedure.

[b] These requirements apply to boilers with rated input of 8,000,000 Btu/h or less that are not packaged boilers and to all packaged boilers. Minimum efficiency requirements for boilers cover all capacities of packaged boilers.

[c] E_c = Combustion efficiency (100 percent less flue losses).

[d] E_t = Thermal efficiency.

[e] Maximum capacity – Minimum and maximum ratings as provided for and allowed by the unit's controls.

[f] Includes oil-fired (residual).

[g] Boilers shall not be equipped with a constant burning pilot light.

[h] A boiler not equipped with a tankless domestic water heating coil shall be equipped with an automatic means for adjusting the temperature of the water such that an incremental change in inferred heat load produces a corresponding incremental change in the temperature of the water supplied.

[i] This table is a replica of ASHRAE 90.1 Table 6.8.1-6 Gas- and Oil-Fired Boilers—Minimum Efficiency Requirements.

NEW SECTION

WAC 51-11C-403327 Table C403.3.2(7)—Heat rejection equipment—Minimum efficiency requirements.

Table C403.3.2(7)
Heat Rejection Equipment—Minimum Efficiency Requirements[i]

Equipment Type[a]	Total System Heat Rejection Capacity at Rated Conditions	Subcategory or Rating Condition[h]	Performance Required[b,c,d,f,g]	Test Procedure[a,e]
Propeller or axial fan open-circuit cooling towers	All	95°F Entering Water 85°F Leaving Water 75°F Entering wb	≥ 40.2 gpm/hp	CTI ATC-105 and CTI STD-201 RS
Centrifugal fan open circuit cooling towers	All	95°F Entering Water 85°F Leaving Water 75°F Entering wb	≥ 20.0 gpm/hp	CTI ATC-105 and CTI STD-201 RS
Propeller or axial fan closed-circuit cooling towers	All	102°F Entering Water 90°F Leaving Water 75°F Entering wb	≥ 16.1 gpm/hp	CTI ATC-105S and CTI STD-201 RS
Centrifugal closed-circuit cooling towers	All	102°F Entering Water 90°F Leaving Water 75°F Entering wb	≥ 7.0 gpm/hp	CTI ATC-105S and CTI STD-201 RS
Propeller or axial fan dry coolers (air-cooled fluid coolers)	All	115°F Entering Water 105°F Leaving Water 95°F Entering wb	≥ 4.5 gpm/hp	CTI ATC-106
Propeller or axial fan evaporative condensers	All	R-448A Test Fluid 165°F Entering Gas Temperature 105°F Condensing Temperature 75°F Entering wb	≥ 160,000 Btu/h • hp	CTI ATC-106
Propeller or axial fan evaporative condensers	All	Ammonia Test Fluid 140°F Entering Gas Temperature 96.3°F Condensing Temperature 75°F Entering wb	≥ 134,000 Btu/h • hp	CTI ATC-106
Centrifugal fan evaporative condensers	All	R-448A Test Fluid 165°F Entering Gas Temperature 105°F Condensing Temperature 75°F Entering wb	≥ 137,000 Btu/h • hp	CTI ATC-106
Centrifugal fan evaporative condensers	All	Ammonia Test Fluid 140°F Entering Gas Temperature 96.3°F Condensing Temperature 75°F Entering wb	≥ 110,000 Btu/h • hp	CTI ATC-106
Air cooled condensers	All	125°F Condensing Temperature R-22 Test Fluid 190°F Entering Gas Temperature 15°F Subcooling 95°F Entering db	≥ 176,000 Btu/h • hp	AHRI 460

For SI: °C = [(°F) - 32]/1.8, L/s • kW = (gpm/hp)/(11.83), COP = (Btu/h • hp)/(2550.7).
db = dry-bulb temperature, °F.
wb = wet-bulb temperature, °F.

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

b For purposes of this table, open-circuit cooling tower performance is defined as the water-flow rating of the tower at the thermal rating condition listed in the table divided by the fan motor nameplate power.

c For purposes of this table, closed-circuit cooling tower performance is defined as the water-flow rating of the tower at the thermal rating condition divided by the sum of the fan motor nameplate power and the integral spray pump motor nameplate power.

d For purposes of this table, dry-cooler performance is defined as the process water-flow rating of the unit at the thermal rating condition listed in the table divided by the total fan motor nameplate power of the unit, and air-cooled condenser performance is defined as the heat rejected from the refrigerant divided by the total fan motor nameplate power of the unit.

e The efficiencies and test procedures for both open- and closed-circuit cooling towers are not applicable to hybrid cooling towers that contain a combination of separate wet and dry heat exchange sections. The certification requirements do not apply to field-erected cooling towers.
f All cooling towers shall comply with the minimum efficiency listed in the table for that specific type of tower with the capacity effect of any project-specific accessories and/or options included in the capacity of the cooling tower.
g For purposes of this table, evaporative condenser performance is defined as the heat rejected at the specified rating condition in the table, divided by the sum of the fan motor nameplate power and the integral spray pump nameplate power.
h Requirements for evaporative condensers are listed with ammonia (R-717) and R-448A as test fluids in the table. Evaporative condensers intended for use with halocarbon refrigerants other than R-448A must meet the minimum efficiency requirements listed above with R-448A as the test fluid. For ammonia, the condensing temperature is defined as the saturation temperature corresponding to the refrigerant pressure at the condenser entrance. For R-448A, which is a zeotropic refrigerant, the condensing temperature is defined as the arithmetic average of the dew point and the bubble point temperatures corresponding to the refrigerant pressure at the condenser entrance.
i This table is a replica of ASHRAE 90.1 Table 6.8.1-7 Performance Requirements for Heat Rejection Equipment—Minimum Efficiency Requirements.

NEW SECTION

WAC 51-11C-403328 Table C403.3.2(8)—Electrically operated variable refrigerant flow air conditioners—Minimum efficiency requirements.

Table C403.3.2(8)
Electrically Operated Variable Refrigerant Flow Air Conditioners—Minimum Efficiency Requirements[b]

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
VRF Air Conditioners, Air Cooled	< 65,000 Btu/h	All	VRF Multi-Split System	13.0 SEER	AHRI 1230
	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric Resistance (or none)	VRF Multi-Split System	11.2 EER 15.5 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric Resistance (or none)	VRF Multi-Split System	11.0 EER 14.9 IEER	
	≥ 240,000 Btu/h	Electric Resistance (or none)	VRF Multi-Split System	10.0 EER 13.9 IEER	

For SI: 1 British thermal unit per hour = 0.2931 W.
a Chapter 6 contains a complete specification of the referenced standards, which include test procedures, including the reference year version of the test procedure.
b This table is a replica of ASHRAE 90.1 Table 6.8.1-8 Electrically Operated Variable-Refrigerant-Flow Air Conditioners—Minimum Efficiency Requirements.

NEW SECTION

WAC 51-11C-403329 Tables C403.3.2(9) through C403.3.2(16)—HVAC equipment minimum efficiency requirements.

Table C403.3.2(9)
Electrically Operated Variable Refrigerant Flow Air-to-Air and Applied Heat Pumps—Minimum Efficiency Requirements[b]

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
	< 65,000 Btu/h	All	VRF Multi-Split System	13.0 SEER	
	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric Resistance (or none)	VRF Multi-Split System	11.0 EER 14.6 IEER	

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
VRF Air Cooled (cooling mode)	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric Resistance (or none)	VRF Multi-Split System with Heat Recovery	10.8 EER 14.4 IEER	AHRI 1230
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric Resistance (or none)	VRF Multi-Split System	10.6 EER 13.9 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric Resistance (or none)	VRF Multi-Split System with Heat Recovery	10.4 EER 13.7 IEER	
	≥ 240,000 Btu/h	Electric Resistance (or none)	VRF Multi-Split System	9.5 EER 12.7 IEER	
	≥ 240,000 Btu/h	Electric Resistance (or none)	VRF Multi-Split System with Heat Recovery	9.3 EER 12.5 IEER	
VRF Water Source (cooling mode)	< 65,000 Btu/h	All	VRF Multi-Split System 86ºF entering water	12.0 EER 16.0 IEER	AHRI 1230
	< 65,000 Btu/h	All	VRF Multi-Split System with Heat Recovery 86ºF entering water	11.8 EER 15.8 IEER	
	≥ 65,000 Btu/h and < 135,000 Btu/h	All	VRF Multi-Split System 86ºF entering water	12.0 EER 16.0 IEER	
	≥ 65,000 Btu/h and < 135,000 Btu/h	All	VRF Multi-Split System with Heat Recovery 86ºF entering water	11.8 EER 15.8 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	All	VRF Multi-Split System 86ºF entering water	10.0 EER 14.0 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	All	VRF Multi-Split System with Heat Recovery 86ºF entering water	9.8 EER 13.8 IEER	
	≥ 240,000 Btu/h	All	VRF Multi-Split System 86ºF entering water	10.0 EER 12.0 IEER	
	≥ 240,000 Btu/h	All	VRF Multi-Split System with Heat Recovery 86ºF entering water	9.8 EER 11.8 IEER	
VRF Groundwater Source (cooling mode)	< 135,000 Btu/h	All	VRF Multi-Split System 59ºF entering water	16.2 EER	AHRI 1230
	< 135,000 Btu/h	All	VRF Multi-Split System with Heat Recovery 59ºF entering water	16.0 EER	
	≥ 135,000 Btu/h	All	VRF Multi-Split System 59ºF entering water	13.8 EER	
	≥ 135,000 Btu/h	All	VRF Multi-Split System with Heat Recovery 59ºF entering water	13.6 EER	
VRF Ground Source (cooling mode)	< 135,000 Btu/h	All	VRF Multi-Split System 77ºF entering water	13.4 EER	AHRI 1230
	< 135,000 Btu/h	All	VRF Multi-Split System with Heat Recovery 77ºF entering water	13.2 EER	
	≥ 135,000 Btu/h	All	VRF Multi-Split System 77ºF entering water	11.0 EER	

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
	≥ 135,000 Btu/h	All	VRF Multi-Split System with Heat Recovery 77ºF entering water	10.8 EER	
VRF Air Cooled (heating mode)	< 65,000 Btu/h (cooling capacity)		VRF Multi-Split System	7.7 HSPF	AHRI 1230
	≥ 65,000 Btu/h and < 135,000 Btu/h (cooling capacity)		VRF Multi-Split System 47ºF db/43ºF wb outdoor air 17ºF db/15ºF wb outdoor air	3.3 COP 2.25 COP	
	≥ 135,000 Btu/h (cooling capacity)		VRF Multi-Split System 47ºF db/43ºF wb outdoor air 17ºF db/15ºF wb outdoor air	3.2 COP 2.05 COP	
VRF Water Source (heating mode)	< 65,000 Btu/h (cooling capacity)		VRF Multi-Split System 68ºF entering water	4.3 COP	AHRI 1230
	≥ 65,000 Btu/h and < 135,000 Btu/h (cooling capacity)		VRF Multi-Split System 68ºF entering water	4.3 COP	
	≥ 135,000 Btu/h and < 240,000 Btu/h (cooling capacity)		VRF Multi-Split System 68ºF entering water	4.0 COP	
	≥ 240,000 Btu/h (cooling capacity)		VRF Multi-Split System 68ºF entering water	3.9 COP	
VRF Groundwater Source (heating mode)	< 135,000 Btu/h (cooling capacity)		VRF Multi-Split System 50ºF entering water	3.6 COP	AHRI 1230
	≥ 135,000 Btu/h (cooling capacity)		VRF Multi-Split System 50ºF entering water	3.3 COP	
VRF Ground Source (heating mode)	< 135,000 Btu/h (cooling capacity)		VRF Multi-Split System 32ºF entering water	3.1 COP	AHRI 1230
	≥ 135,000 Btu/h (cooling capacity)		VRF Multi-Split System 32ºF entering water	2.8 COP	

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

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

b This table is a replica of ASHRAE 90.1 Table 6.8.1-9 Electrically Operated Variable-Refrigerant-Flow and Applied Heat Pumps—Minimum Efficiency Requirements.

Table C403.3.2(10)
Floor-Mounted Air Conditioners and Condensing Units Serving Computer Rooms—Minimum Efficiency Requirements[b]

Equipment Type	Standard Model	Net Sensible Cooling Capacity	Minimum Net Sensible COP	Rating Conditions Return Air (dry bulb/dew point)	Test Procedure[a]
Air cooled	Downflow	< 80,000 Btu/h	2.70	85°F/52°F (Class 2)	AHRI 1360
		≥ 80,000 Btu/h and < 295,000 Btu/h	2.58		
		≥ 295,000 Btu/h	2.36		
	Upflow - Ducted	< 80,000 Btu/h	2.67		
		≥ 80,000 Btu/h and < 295,000 Btu/h	2.55		
		≥ 295,000 Btu/h	2.33		

Equipment Type	Standard Model	Net Sensible Cooling Capacity	Minimum Net Sensible COP	Rating Conditions Return Air (dry bulb/dew point)	Test Procedure[a]
	Upflow - Nonducted	> 65,000 Btu/h	2.16	75°F/52°F (Class 1)	
		≥ 65,000 Btu/h and < 240,000 Btu/h	2.04		
		≥ 240,000 Btu/h	1.89		
	Horizontal	> 65,000 Btu/h	2.65	95°F/52°F (Class 3)	
		≥ 65,000 Btu/h and < 240,000 Btu/h	2.55		
		≥ 240,000 Btu/h	2.47		
Air cooled with fluid economizer	Downflow	< 80,000 Btu/h	2.70	85°F/52°F (Class 1)	AHRI 1360
		≥ 80,000 Btu/h and < 295,000 Btu/h	2.58		
		≥ 295,000 Btu/h	2.36		
	Upflow - Ducted	< 80,000 Btu/h	2.67		
		≥ 80,000 Btu/h and < 295,000 Btu/h	2.55		
		≥ 295,000 Btu/h	2.33		
	Upflow - Nonducted	> 65,000 Btu/h	2.09	75°F/52°F (Class 1)	
		≥ 65,000 Btu/h and < 240,000 Btu/h	1.99		
		≥ 240,000 Btu/h	1.81		
	Horizontal	> 65,000 Btu/h	2.65	95°F/52°F (Class 3)	
		≥ 65,000 Btu/h and < 240,000 Btu/h	2.55		
		≥ 240,000 Btu/h	2.47		
Water cooled	Downflow	< 80,000 Btu/h	2.82	85°F/52°F (Class 1)	AHRI 1360
		≥ 80,000 Btu/h and < 295,000 Btu/h	2.73		
		≥ 295,000 Btu/h	2.67		
	Upflow - Ducted	< 80,000 Btu/h	2.79		
		≥ 80,000 Btu/h and < 295,000 Btu/h	2.70		
		≥ 295,000 Btu/h	2.64		
	Upflow - Nonducted	> 65,000 Btu/h	2.43	75°F/52°F (Class 1)	
		≥ 65,000 Btu/h and < 240,000 Btu/h	2.32		
		≥ 240,000 Btu/h	2.20		
	Horizontal	> 65,000 Btu/h	2.79	95°F/52°F (Class 3)	
		≥ 65,000 Btu/h and < 240,000 Btu/h	2.68		
		≥ 240,000 Btu/h	2.60		
Water cooled with fluid economizer	Downflow	< 80,000 Btu/h	2.77	85°F/52°F (Class 1)	AHRI 1360
		≥ 80,000 Btu/h and < 295,000 Btu/h	2.68		
		≥ 295,000 Btu/h	2.61		
	Upflow - Ducted	< 80,000 Btu/h	2.74		
		≥ 80,000 Btu/h and < 295,000 Btu/h	2.65		
		≥ 295,000 Btu/h	2.58		

Equipment Type	Standard Model	Net Sensible Cooling Capacity	Minimum Net Sensible COP	Rating Conditions Return Air (dry bulb/dew point)	Test Procedure[a]
	Upflow - Nonducted	> 65,000 Btu/h	2.35	75°F/52°F (Class 1)	
		≥ 65,000 Btu/h and < 240,000 Btu/h	2.24		
		≥ 240,000 Btu/h	2.12		
	Horizontal	> 65,000 Btu/h	2.71	95°F/52°F (Class 3)	
		≥ 65,000 Btu/h and < 240,000 Btu/h	2.60		
		≥ 240,000 Btu/h	2.54		
Glycol cooled	Downflow	< 80,000 Btu/h	2.56	85°F/52°F (Class 1)	AHRI 1360
		≥ 80,000 Btu/h and < 295,000 Btu/h	2.24		
		≥ 295,000 Btu/h	2.21		
	Upflow - Ducted	< 80,000 Btu/h	2.53		
		≥ 80,000 Btu/h and < 295,000 Btu/h	2.21		
		≥ 295,000 Btu/h	2.18		
	Upflow - Nonducted	> 65,000 Btu/h	2.08	75°F/52°F (Class 1)	
		≥ 65,000 Btu/h and < 240,000 Btu/h	1.90		
		≥ 240,000 Btu/h	1.81		
	Horizontal	> 65,000 Btu/h	2.48	95°F/52°F (Class 3)	
		≥ 65,000 Btu/h and < 240,000 Btu/h	2.18		
		≥ 240,000 Btu/h	2.18		
Glycol cooled with fluid economizer	Downflow	< 80,000 Btu/h	2.51	85°F/52°F (Class 1)	AHRI 1360
		≥ 80,000 Btu/h and < 295,000 Btu/h	2.19		
		≥ 295,000 Btu/h	2.15		
	Upflow - Ducted	< 80,000 Btu/h	2.48		
		≥ 80,000 Btu/h and < 295,000 Btu/h	2.16		
		≥ 295,000 Btu/h	2.12		
	Upflow - Nonducted	> 65,000 Btu/h	2.00	75°F/52°F (Class 1)	
		≥ 65,000 Btu/h and < 240,000 Btu/h	1.82		
		≥ 240,000 Btu/h	1.73		
	Horizontal	> 65,000 Btu/h	2.44	95°F/52°F (Class 3)	
		≥ 65,000 Btu/h and < 240,000 Btu/h	2.10		
		≥ 240,000 Btu/h	2.10		

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

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

b This table is a replica of ASHRAE 90.1 Table 6.8.1-10 Floor-Mounted Air Conditioners and Condensing Units Serving Computer Rooms—Minimum Efficiency Requirements.

Table C403.3.2(11)
Vapor-Compression-Based Indoor Pool Dehumidifiers—Minimum Efficiency Requirements[b]

Equipment Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
Single package indoor (with or without economizer)	Rating Conditions: A or C	3.5 MRE	AHRI 910
Single package indoor water cooled (with or without economizer)	Rating Conditions: A, B or C	3.5 MRE	
Single package indoor air cooled (with or without economizer)	Rating Conditions: A, B or C	3.5 MRE	
Split system indoor air cooled (with or without economizer)	Rating Conditions: A, B or C	3.5 MRE	

[a] Chapter 6 contains a complete specification of the referenced standards, which include test procedures, including the reference year version of the test procedure.
[b] This table is a replica of ASHRAE 90.1 Table 6.8.1-11 Vapor-Compressor-Based Indoor Pool Dehumidifiers—Minimum Efficiency Requirements.

Table C403.3.2(12)
Electrically Operated DX-DOAS Units, Single-Package and Remote Condenser, Without Energy Recovery—Minimum Efficiency Requirements[b]

Equipment Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
Air cooled (dehumidification mode)		4.0 ISMRE	AHRI 920
Air source heat pumps (dehumidification mode)		4.0 ISMRE	AHRI 920
Water cooled (dehumidification mode)	Cooling tower condenser water	4.9 ISMRE	AHRI 920
	Chilled water	6.0 ISMRE	
Air source heat pump (heating mode)		2.7 ISCOP	AHRI 920
Water source heat pump (dehumidification mode)	Ground source, closed loop	4.8 ISMRE	AHRI 920
	Ground-water source	5.0 ISMRE	
	Water source	4.0 ISMRE	
Water source heat pump (heating mode)	Ground source, closed loop	2.0 ISCOP	AHRI 920
	Ground-water source	3.2 ISCOP	
	Water source	3.5 ISCOP	

[a] Chapter 6 contains a complete specification of the referenced standards, which include test procedures, including the reference year version of the test procedure.
[b] This table is a replica of ASHRAE 90.1 Table 6.8.1-13 Electrically Operated DX-DOAS Units, Single-Package and Remote Condenser, without Energy Recovery—Minimum Efficiency Requirements.

Table C403.3.2(13)
Electrically Operated DX-DOAS Units, Single-Package and Remote Condenser, with Energy Recovery—Minimum Efficiency Requirements[b]

Equipment Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
Air cooled (dehumidification mode)		5.2 ISMRE	AHRI 920
Air source heat pumps (dehumidification mode)		5.2 ISMRE	AHRI 920
Water cooled (dehumidification mode)	Cooling tower condenser water	5.3 ISMRE	AHRI 920
	Chilled water	6.6 ISMRE	
Air source heat pump (heating mode)		3.3 ISCOP	AHRI 920

Equipment Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
Water source heat pump (dehumidification mode)	Ground source, closed loop	5.2 ISMRE	AHRI 920
	Ground-water source	5.8 ISMRE	
	Water source	4.8 ISMRE	
Water source heat pump (heating mode)	Ground source, closed loop	3.8 ISCOP	AHRI 920
	Ground-water source	4.0 ISCOP	
	Water source	4.8 ISCOP	

a Chapter 6 contains a complete specification of the referenced standards, which include test procedures, including the reference year version of the test procedure.
b This table is a replica of ASHRAE 90.1 Table 6.8.1-14 Electrically Operated DX-DOAS Units, Single-Package and Remote Condenser, with Energy Recovery—Minimum Efficiency Requirements.

Table C403.3.2(14)
Electrically Water Source Heat Pumps—Minimum Efficiency Requirements[c]

Equipment Type	Size Category[b]	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
Water to air, water loop (cooling mode)	< 17,000 Btu/h	All	86°F entering water	12.2 EER	ISO 13256-1
	≥ 17,000 Btu/h and < 65,000 Btu/h	All	86°F entering water	13.0 EER	
	≥ 65,000 Btu/h and < 135,000 Btu/h	All	86°F entering water	13.0 EER	
Water to air, ground water (cooling mode)	< 135,000 Btu/h	All	59°F entering water	18.0 EER	
Brine to air, ground loop (cooling mode)	< 135,000 Btu/h	All	77°F entering water	14.1 EER	
Water to water, water loop (cooling mode)	< 135,000 Btu/h	All	86°F entering water	10.6 EER	ISO 13256-2
Water to water, ground water (cooling mode)	< 135,000 Btu/h	All	59°F entering water	16.3 EER	
Brine to water, ground loop (cooling mode)	< 135,000 Btu/h	All	77°F entering fluid	12.1 EER	
Water to air, water loop (heating mode)	< 135,000 Btu/h (cooling capacity)		68°F entering water	4.3 COP_H	ISO 13256-1
Water to air, ground water (heating mode)	< 135,000 Btu/h (cooling capacity)		50°F entering water	3.7 COP_H	
Brine to air, ground loop (heating mode)	< 135,000 Btu/h (cooling capacity)		32°F entering fluid	3.2 COP_H	
Water to water, water loop (heating mode)	< 135,000 Btu/h (cooling capacity)		68°F entering water	3.7 COP_H	ISO 13256-1
Water to water, ground water (heating mode)	< 135,000 Btu/h (cooling capacity)		50°F entering water	3.1 COP_H	ISO 13256-2
Brine to water, ground loop (heating mode)	< 135,000 Btu/h (cooling capacity)		32°F entering fluid	2.5 COP_H	ISO 13256-2

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

[a] Chapter 6 contains a complete specification of the referenced standards, which include test procedures, including the reference year version of the test procedure.

[b] Single-phase, U.S. air-cooled heat pumps less than 19 kW are regulated as consumer produces by DOE 10 C.F.R. 430. SCOPC, SCOP2C, SCOPH and SCOP2H values for single-phase products are set by the U.S. DOE.

[c] This table is a replica of ASHRAE 90.1 Table 6.8.1-15 Electrically Operated Water-Source Heat Pumps—Minimum Efficiency Requirements.

Table C403.3.2(15)
Heat-Pump and Heat Recovery Chiller Packages—Minimum Efficiency Requirements[g]

HEATING OPERATION													
Equipment Type	Size Category, ton$_R$	Cooling-Only Operation Cooling Efficiency[c] Air-Source EER (FL/IPLV), Btu/W×h Water-Source Power Input per Capacity (FL/IPLV), kW/ton$_R$		Heating Source Conditions (entering/leaving water) or OAT (db/wb), °F	Heat-Pump Heating Full-Load Efficiency (COP$_H$)[b], W/W				Heat Recovery Chiller Full-Load Efficiency (COP$_{HR}$)[c,d], W/W Simultaneous Cooling and Heating Full-Load Efficiency (COP$_{SHC}$)[c], W/W				Test Procedure[a]
					Leaving Heating Water Temperature				Leaving Heating Water Temperature				
					Low	Medium	High	Boost	Low	Medium	High	Boost	
		Path A	Path B		105°F	120°F	140°F	140°F	105°F	120°F	140°F	140°F	
Air source	All sizes	≥9.595 FL ≥13.02 IPLV.IP	≥9.215 FL ≥15.01 IPLV.IP	47 db 43 wb[e]	≥3.290	≥2.770	≥2.310	NA	NA	NA	NA	NA	AHRI 550/590
		≥9.595 FL ≥13.30 IPLV.IP	≥9.215 FL ≥15.30 IPLV.IP	17 db 15 wb[e]	≥2.230	≥1.950	≥1.630	NA	NA	NA	NA	NA	
Water-source electrically operated positive displacement	< 75	≥0.7885 FL ≥0.6316 IPLV.IP	≥0.7875 FL ≥0.5145 IPLV.IP	54/44[f]	≥4.640	≥3.680	≥2.680	NA	≥8.330	≥6.410	≥4.420	NA	
				75/65[f]	NA	NA	NA	≥3.550	NA	NA	NA	≥6.150	
	≥ 75 and < 150	≥0.7579 FL ≥0.5895 IPLV.IP	≥0.7140 FL ≥0.4620 IPLV.IP	54/44[f]	≥4.640	≥3.680	≥2.680	NA	≥8.330	≥6.410	≥4.420	NA	
				75/65[f]	NA	NA	NA	≥3.550	NA	NA	NA	≥6.150	
	≥ 150 and < 300	≥0.6947 FL ≥0.5684 IPLV.IP	≥0.7140 FL ≥0.4620 IPLV.IP	54/44[f]	≥4.640	≥3.680	≥2.680	NA	≥8.330	≥6.410	≥4.420	NA	
				75/65[f]	NA	NA	NA	≥3.550	NA	NA	NA	≥6.150	
	≥ 300 and < 600	≥0.6421 FL ≥0.5474 IPLV.IP	≥0.6563 FL ≥0.4305 IPLV.IP	54/44[f]	≥4.930	≥3.960	≥2.970	NA	≥8.900	≥6.980	≥5.000	NA	
				75/65[f]	NA	NA	NA	≥3.990	NA	NA	NA	≥6.850	
	≥ 600	≥0.5895 FL ≥0.5263 IPLV.IP	≥0.6143 FL ≥0.3990 IPLV.IP	54/44[f]	≥4.930	≥3.960	≥2.970	NA	≥8.900	≥6.980	≥5.000	NA	
				75/65[f]	NA	NA	NA	≥3.990	NA	NA	NA	≥6.850	
Water-source electrically operated centrifugal	< 75	≥0.6421 FL ≥0.5789 IPLV.IP	≥0.7316 FL ≥0.4632 IPLV.IP	54/44[f]	≥4.640	≥3.680	≥2.680	NA	≥8.330	≥6.410	≥4.420	NA	
				75/65[f]	NA	NA	NA	≥3.550	NA	NA	NA	≥6.150	
	≥ 75 and < 150	≥0.5895 FL ≥0.5474 IPLV.IP	≥0.6684 FL ≥0.4211 IPLV.IP	54/44[f]	≥4.640	≥3.680	≥2.680	NA	≥8.330	≥6.410	≥4.420	NA	
				75/65[f]	NA	NA	NA	≥3.550	NA	NA	NA	≥6.150	
	≥ 150 and < 300	≥0.5895 FL ≥0.5263 IPLV.IP	≥0.6263 FL ≥0.4105 IPLV.IP	54/44[f]	≥4.640	≥3.680	≥2.680	NA	≥8.330	≥6.410	≥4.420	NA	
				75/65[f]	NA	NA	NA	≥3.550	NA	NA	NA	≥6.150	
	≥ 300 and < 600	≥0.5895 FL ≥0.5263 IPLV.IP	≥0.6158 FL ≥0.4000 IPLV.IP	54/44[f]	≥4.640	≥3.680	≥2.680	NA	≥8.900	≥6.980	≥5.000	NA	
				75/65[f]	NA	NA	NA	≥3.990	NA	NA	NA	≥6.850	
	≥ 600	≥0.5895 FL ≥0.5263 IPLV.IP	≥0.6158 FL ≥0.4000 IPLV.IP	54/44[f]	≥4.640	≥3.680	≥2.680	NA	≥8.900	≥6.980	≥5.000	NA	
				75/65[f]	NA	NA	NA	≥3.990	NA	NA	NA	≥6.850	

For SI: °C = [(°F) - 32]/1.8.

[a] Chapter 6 contains a complete specification of the referenced standards, which include test procedures, including the reference year version of the test procedure.

[b] Cooling-only rating conditions are standard rating conditions defined in AHRI 550/590, Table 1.

[c] Heating full-load rating conditions are at rating conditions defined in AHRI 550/590, Table 1.

[d] For water-cooled heat recovery chillers that have capabilities for heat rejection to a heat recovery condenser and a tower condenser, the COPHR applies to operation at full load with 100 percent heat recovery (no tower rejection). Units that only have capabilities for partial heat recovery shall meet the requirements of Table C403.3.2(3).

[e] Outdoor air entering dry-bulb (db) temperature and wet-bulb (wb) temperature.

[f] Source-water entering and leaving water temperature.

[g] This table is a replica of ASHRAE 90.1 Table 6.8.1-16 Heat-Pump and Heat Recovery Chiller Packages—Minimum Efficiency Requirements.

Table C403.3.2(16)
Ceiling-Mounted Computer-Room Air Conditioners—Minimum Efficiency Requirements[b]

Equipment Type	Standard Model	Net Sensible Cooling Capacity	Minimum Net Sensible COP	Rating Conditions Return Air (dry-bulb/dew point)	Test Procedure[a]
Air cooled with free air discharge condenser	Ducted	< 29,000 Btu/h	2.05	75°F/52°F (Class 1)	AHRI 1360
		≥ 29,000 Btu/h and < 65,000 Btu/h	2.02		
		≥ 65,000 Btu/h	1.92		
	Nonducted	< 29,000 Btu/h	2.08		
		≥ 29,000 Btu/h and < 65,000 Btu/h	2.05		
		≥ 65,000 Btu/h	1.94		
Air cooled with free air discharge condenser with fluid economizer	Ducted	< 29,000 Btu/h	2.01	75°F/52°F (Class 1)	AHRI 1360
		≥ 29,000 Btu/h and < 65,000 Btu/h	1.97		
		≥ 65,000 Btu/h	1.87		
	Nonducted	< 29,000 Btu/h	2.04		
		≥ 29,000 Btu/h and < 65,000 Btu/h	2.00		
		≥ 65,000 Btu/h	1.89		
Air cooled with ducted condenser	Ducted	< 29,000 Btu/h	1.86	75°F/52°F (Class 1)	AHRI 1360
		≥ 29,000 Btu/h and < 65,000 Btu/h	1.83		
		≥ 65,000 Btu/h	1.73		
	Nonducted	< 29,000 Btu/h	1.89		
		≥ 29,000 Btu/h and < 65,000 Btu/h	1.86		
		≥ 65,000 Btu/h	1.75		
Air cooled with fluid economizer and ducted condenser	Ducted	< 29,000 Btu/h	1.82	75°F/52°F (Class 1)	AHRI 1360
		≥ 29,000 Btu/h and < 65,000 Btu/h	1.78		
		≥ 65,000 Btu/h	1.68		
	Nonducted	< 29,000 Btu/h	1.85		
		≥ 29,000 Btu/h and < 65,000 Btu/h	1.81		
		≥ 65,000 Btu/h	1.70		

Equipment Type	Standard Model	Net Sensible Cooling Capacity	Minimum Net Sensible COP	Rating Conditions Return Air (dry-bulb/dew point)	Test Procedure[a]
Water cooled	Ducted	< 29,000 Btu/h	2.38	75°F/52°F (Class 1)	AHRI 1360
		≥ 29,000 Btu/h and < 65,000 Btu/h	2.28		
		≥ 65,000 Btu/h	2.18		
	Nonducted	< 29,000 Btu/h	2.41		
		≥ 29,000 Btu/h and < 65,000 Btu/h	2.31		
		≥ 65,000 Btu/h	2.20		
Water cooled with fluid economizer	Ducted	< 29,000 Btu/h	2.33	75°F/52°F (Class 1)	AHRI 1360
		≥ 29,000 Btu/h and < 65,000 Btu/h	2.23		
		≥ 65,000 Btu/h	2.13		
	Nonducted	< 29,000 Btu/h	2.36		
		≥ 29,000 Btu/h and < 65,000 Btu/h	2.26		
		≥ 65,000 Btu/h	2.16		
Glycol cooled	Ducted	< 29,000 Btu/h	1.97	75°F/52°F (Class 1)	AHRI 1360
		≥ 29,000 Btu/h and < 65,000 Btu/h	1.93		
		≥ 65,000 Btu/h	1.78		
	Nonducted	< 29,000 Btu/h	2.00		
		≥ 29,000 Btu/h and < 65,000 Btu/h	1.98		
		≥ 65,000 Btu/h	1.81		
Glycol cooled with fluid economizer	Ducted	< 29,000 Btu/h	1.92	75°F/52°F (Class 1)	AHRI 1360
		≥ 29,000 Btu/h and < 65,000 Btu/h	1.88		
		≥ 65,000 Btu/h	1.73		
	Nonducted	< 29,000 Btu/h	1.95		
		≥ 29,000 Btu/h and < 65,000 Btu/h	1.93		
		≥ 65,000 Btu/h	1.76		

For SI: 1 British thermal unit per hour = 0.2931 W, °C = [(°F) – 32]/1.8, COP = (Btu/h × hp)(2,550.7).

[a] Chapter 6 contains a complete specification of the referenced standards, which include test procedures, including the reference year version of the test procedure.

[b] This table is a replica of ASHRAE 90.1 Table 6.8.1-17 Ceiling-Mounted Computer-Room Air Conditioners—Minimum Efficiency Requirements.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40334 Section C403.3.4—Boilers ((~~turndown~~)).

C403.3.4 Boiler requirements. Boiler equipment and systems shall comply with this section.

C403.3.4.1 Combustion air positive shut-off. Combustion air positive shut-off shall be provided on all newly installed *boiler systems* as follows:

1. All *boiler systems* with an input capacity of 2,500,000 Btu/h and above, in which the boiler is designed to operate with a nonpositive vent static pressure.

2. All *boiler systems* where one stack serves two or more boilers with a total combined input capacity per stack of 2,500,000 Btu/h.

C403.3.4.2 Boiler system oxygen concentration controls. Boiler system combustion air fans with motors 10 horsepower or larger shall meet one of the following for newly installed boilers:

1. The fan motor shall be driven by a variable speed drive; or

2. The fan motor shall include controls that limit the fan motor demand to no more than 30 percent of the total design wattage at 50 percent of design air volume.

C403.3.4.3 Boiler systems oxygen concentration controls. Newly installed *boiler systems* with a steady state full-load combustion efficiency less than 90 percent and an input capacity of 5,000,000 Btu/h and greater shall maintain stack-gas oxygen concentrations at less than or equal to the values specified in Table C403.3.4.3. Combustion air volume shall be controlled with respect to firing rate or flue gas oxygen concentration. Use of a common gas and combustion air control linkage or jack shaft is prohibited.

Table C403.3.4.3
Boiler Stack-Gas Oxygen Concentrations

Boiler System Type	Minimum Stack-Gas Oxygen Concentration[a]
Commercial Boilers	5%
Process Boilers	3%

[a] Concentration levels measured by volume on a dry basis over firing rates of 20 to 100 percent.

C403.3.4.4 Boiler turndown. *Boiler systems* with design input of greater than 1,000,000 Btu/h (293 kW) shall comply with the turndown ratio specified in Table ((~~C403.3.4~~)) C403.3.4.4.

The system turndown requirement shall be met through the use of multiple single input boilers, one or more *modulating boilers* or a combination of single input and modulating boilers.

Table ((~~C403.3.4~~)) C403.3.4.4
Boiler Turndown

Boiler System Design Input (Btu/h)	Minimum Turndown Ratio
≥ 1,000,000 and less than or equal to 5,000,000	3 to 1
≥ 5,000,000 and less than or equal to 10,000,000	4 to 1
≥ 10,000,000	5 to 1

C403.3.4.5 Buildings with high-capacity space-heating gas boiler systems. New buildings with gas hot water boiler systems for space heating with a total system input of at least 1,000,000 Btu/h but not more than 10,000,000 Btu/h shall comply with this section.

EXCEPTIONS:
1. Where 25 percent of the annual space heating requirement is provided by site-recovered energy, or heat recovery chillers.
2. Space heating boilers installed in individual dwelling units.
3. Where 50 percent or more of the design heat load is served using perimeter convective heating, radiant ceiling panels, or both.

4. Individual gas boilers with input capacity less than 300,000 Btu/h shall not be included in the calculations of the total system input or total system efficiency.

C403.3.4.5.1 Boiler efficiency. Gas hot water boilers shall have a minimum thermal efficiency (Et) of 90 percent when rated in accordance with the test procedures in Table C403.3.2(6). Systems with multiple boilers are allowed to meet this requirement if the space-heating input provided by equipment with thermal efficiency (Et) above and below 90 percent provides an input capacity-weighted average thermal efficiency of at least 90 percent. For boilers rated only for combustion efficiency, the calculation for the input capacity-weighted average thermal efficiency shall use the combustion efficiency value.

C403.3.4.5.2 Hot water distribution system design. The hot water distribution system shall be designed to meet all of the following:

1. Coils and other heat exchangers shall be selected so that at design conditions the hot water return temperature entering the boilers is 120°F (48.9°C) or less.

2. Under all operating conditions, the water temperature entering the boiler is 120°F (48.9°C) or less, or the flow rate of supply hot water that recirculates directly into the return system, such as three-way valves or minimum flow bypass controls, shall be no greater than 20 percent of the design flow of the operating boilers.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-40335 Section C403.3.5—Dedicated outdoor air systems.

C403.3.5 Dedicated outdoor air systems (DOAS). For buildings with occupancies as shown in Table C403.3.5, 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 in accordance with Section 402 of the *International Mechanical Code*.
2. High efficiency variable air volume (VAV) systems complying with Section C403.6.10 for occupancy classifications other than Groups A-1, A-2 and A-3 as specified in Table C403.3.5, and high efficiency VAV systems complying with Section C403.12 for occupancy classification Groups A-1, A-2 and A-3 as specified in Table C403.3.5. This exception shall not be used as a substitution for a DOAS per Section C406.6.

Table C403.3.5
Occupancy Classifications Requiring DOAS

Occupancy Classification[a]	Inclusions	Exempted
A-1	All occupancies not specifically exempted	Television and radio studios
A-2	Casinos (gaming area)	All other A-2 occupancies
A-3	Lecture halls, community halls, exhibition halls, gymnasiums, courtrooms, libraries, places of religious worship	All other A-3 occupancies
A-4, A-5		All occupancies excluded

Occupancy Classification[a]	Inclusions	Exempted
B	All occupancies not specifically exempted	Food processing establishments including commercial kitchens, restaurants, cafeterias; laboratories for testing and research; data processing facilities and telephone exchanges; air traffic control towers; animal hospitals, kennels, pounds; ambulatory care facilities
F, H, I, R, S, U		All occupancies excluded
E, M	All occupancies included	

a. Occupancy classification from the *International Building Code* Chapter 3.

C403.3.5.1 DOAS with energy recovery ventilation ((~~with DOAS~~)). The DOAS shall include energy recovery ((~~*ventilation*~~)). The *energy recovery ventilation* system shall have a ((~~60~~)) 68 percent minimum sensible recovery effectiveness of the energy recovery device as calculated in accordance with Equation 4-9 or have ((~~50~~)) 60 percent enthalpy recovery effectiveness in accordance with Section C403.7.6. ((~~For DOAS having a total fan system motor nameplate hp less than 5 hp, total combined fan power shall not exceed 1 W/cfm of outdoor air. For DOAS having a total fan system motor hp greater than or equal to 5 hp, refer to fan power limitations of Section C403.8.1. This fan power restriction applies to each dedicated outdoor air unit in the permitted project, but does not include the fan power associated with the zonal heating/cooling equipment. The airflow rate thresholds for energy recovery requirements in Tables C403.7.6(1) and C403.7.6(2) do not apply.~~)) The airflow rate thresholds in Section C403.7.6 that define when the energy recovery requirements in that section do not apply, are not applicable to this section. 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.

(Equation 4-9)

$$\text{Sensible Recovery Effectiveness} = \frac{T_{OA} - T_{SA}}{T_{OA} - T_{RA}}$$

Where:

T_{OA} = Design outdoor air dry bulb temperature entering the energy recovery device.

T_{SA} = Supply air dry bulb temperature leaving the energy recovery device at design temperatures and airflow conditions, as selected for the proposed DOAS unit(s).

T_{RA} = Design return air dry bulb temperature.

EXCEPTIONS:

1. ((~~Occupied spaces with all of the following characteristics: Complying with Section C403.7.6, served by equipment less than 5000 cfm, with an average occupant load greater than 25 people per 1000 square feet (93 m²) 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 percent 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.
2. Heat recovery and energy recovery ventilators (H/ERV) that are rated and *listed* in accordance with HVI 920 can demonstrate compliance with the sensible recovery effectiveness requirement using the adjusted sensible recovery effectiveness (ASRE) rating of the equipment at 32°F test conditions. Applied flow rate for ASRE rating shall be no less than the design flow rate or the closest value interpolated between two listed flow rates.
3. The energy recovery systems for Group R-2 occupancies are permitted to provide 60 percent minimum sensible heat recovery effectiveness in lieu of 68 percent sensible recovery effectiveness. The return/exhaust air stream temperature for heat recovery device selection shall be 70°F (21°C) or as determined by an *approved* calculation procedure.

C403.3.5.2 DOAS fan power. For a DOAS that does not have at least one fan or fan array with fan electrical input power ≥ 1 kW, the total combined fan power shall not exceed 1 watt per cfm of outdoor air as calculated in accordance with Equation 4-10 using design maximum airflows and external static pressures. For a DOAS with at least one fan or fan array with fan electrical input power ≥ 1 kW, the DOAS shall comply with the fan power limitations of Section C403.8.1. DOAS total combined fan power shall include all supply, exhaust and other fans utilized for the purpose of ventilation. This fan power restriction applies to each DOAS in the permitted project, but does not include the fan power associated with the zonal heating and cooling equipment.

(Equation 4-10)

DOAS Total Combined Fan Power

$$\left(\frac{Watts}{CFM}\right) = \sum\left(\frac{Fan\ bhp}{\eta_m}\right) \times \frac{746}{CFM_{supply}}$$

Where:

Fan bhp	=	Brake horsepower for each supply, exhaust and other fan in the system at design maximum airflow rate.
η_m	=	Fan motor efficiency including all motor, drive and other losses for each fan in the system.
CFM_{supply}	=	Design maximum airflow rate of outdoor (supply) air.

C403.3.5.3 Heating((/)) and 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 C403.4.1.2) to provide destratification and air mixing in the space.

((~~C403.3.5.3~~)) C403.3.5.4 Decoupled DOAS supply air. The DOAS supply air shall be delivered directly to the occupied space or downstream of the terminal heating and/or cooling coils.

EXCEPTIONS:
1. Active chilled beam systems.
2. Sensible only cooling terminal units with pressure independent variable airflow regulating devices limiting the DOAS supply air to the greater of latent load or minimum ventilation requirements.
3. Terminal heating and/or cooling units that comply with the low fan power allowance requirements in the exception of Section ((~~C403.3.5.2~~)) C403.3.5.3.

C403.3.5.5 Supplemental heating and cooling. Supply air stream heating in the DOAS system shall comply with Section C403.7.3. Cooling is permitted for dehumidification only. Cooling coil shall be sized to meet peak dehumidification requirement at design outdoor temperatures, and no larger. Cooling coil shall be controlled to maintain supply air RH or *zone* RH.

EXCEPTION: Heating permitted for defrost control shall be locked out when outside air temperatures are above 35°F (2°C). Supplemental heating for defrost shall modulate to 10 percent of the peak capacity, and shall be sized to prevent frost/damage dame to the unit at design temperatures and provide supply air less than or equal to 55°F (13°C).

((~~C403.3.5.4~~)) C403.3.5.6 Impracticality. Where the *code official* determines that full compliance with ((~~all~~)) one or more of the requirements ((~~of~~)) in Sections C403.3.5.1 ((~~and C403.3.5.2 would be~~)) through C403.3.5.5 is impractical, it is permissible to provide an approved alternate means of compliance that achieves a comparable level of energy efficiency as the requirement(s) deemed impractical. For the purposes of this section, impractical means that an HVAC system com-

plying with all requirements in Section C403.3.5 cannot effectively be utilized due to an unusual use or configuration of the building.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40336 Section C403.3.6—Ventilation for Group R-2 occupancy.

C403.3.6 Ventilation for Group R-2 occupancy. For all Group R-2 dwelling and sleeping units, a balanced ventilation system with a heat recovery system ((~~with minimum 60 percent sensible recovery effectiveness~~)) shall provide outdoor air directly to all habitable spaces. The heat recovery system shall have a 60 percent minimum *sensible recovery effectiveness* as calculated in accordance with Section C403.3.5.1. The ventilation system shall allow for the design flow rates to be tested and verified at each habitable space as part of the commissioning process in accordance with Section C408.2.2.

EXCEPTION: Heat recovery and energy recovery ventilators (H/ERV) that are rated and *listed* in accordance with HVI 920 can demonstrate compliance with the sensible recovery effectiveness requirement using the adjusted sensible recovery effectiveness (ASRE) rating of the equipment at 32°F test conditions. Applied flow rate for ASRE rating shall be no less than the design flow rate or the closest value interpolated between two listed flow rates.

NEW SECTION

WAC 51-11C-40337 Section C403.3.7—Hydronic system flow rate.

C403.3.7 Hydronic system flow rate. 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 C403.3.7 for the appropriate total annual hours of operation. Pipe sizes 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 permitted to be selected from the "Variable Flow/Variable Speed" columns. All others shall be selected from the "Other" columns.

EXCEPTION: Design flow rates exceeding the values in Table C403.3.7 are permitted 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 C403.3.7
Piping System Design Maximum Flow Rate in GPM[a]

Pipe Size	≤ 2000 hours/year		> 2000 and ≤ 4400 hours/year		> 4400 hours/year	
(in)	Other	Variable Flow/ Variable Speed	Other	Variable Flow/ Variable Speed	Other	Variable Flow/ Variable Speed
2 1/2	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

Pipe Size	≤ 2000 hours/year		> 2000 and ≤ 4400 hours/year		> 4400 hours/year	
(in)	Other	Variable Flow/ Variable Speed	Other	Variable Flow/ Variable Speed	Other	Variable Flow/ Variable Speed
12	2500	3800	1900	2900	1500	2300
Maximum velocity for pipes over 14 to 24 in. in size	8.5 ft/s	13.0 ft/s	6.5 ft/s	9.5 ft/s	5.0 ft/s	7.5 ft/s

[a] There are no requirements for pipe sizes smaller than the minimum size or larger than the maximum size shown in the table.

NEW SECTION

WAC 51-11C-40338 Section C403.3.8—Hydronic coils.

C403.3.8 Hydronic coil selection. Hydronic coils shall comply with Sections C403.3.8.1 and C403.3.8.2.

EXCEPTION: Replacement coils within existing equipment.

C403.3.8.1 Chilled-water coil selection. Chilled-water cooling coils shall be selected to provide a 15°F or higher temperature difference between leaving and entering water temperatures and a minimum of 57°F leaving water temperature at design conditions.

EXCEPTIONS:
1. Chilled-water cooling coils that have an airside pressure drop exceeding 0.70 in. of water when rated at 500 fpm face velocity and dry conditions (no condensation).
2. Individual fan-cooling units with a design supply airflow rate ≤ 5000 cfm.
3. Constant-air-volume systems.
4. Coils selected at the maximum temperature difference allowed by the chiller.
5. Passive coils (no mechanically supplied airflow).
6. Coils with design entering chilled-water temperature ≥ 50°F (10°C).
7. Coils with design entering air dry-bulb temperature ≤ 65°F (18°C).

C403.3.8.2 Hot-water coil selection. Hot-water heating coils shall be selected to provide a maximum 20°F temperature difference between leaving and entering water temperatures and a maximum of 118°F (48°C) entering water temperature at design conditions.

EXCEPTIONS:
1. Hot-water heating systems which utilize heat pumps as the primary source.
2. Individual fan units with a design supply airflow rate ≤ 1000 cfm.
3. Passive coils (no mechanically supplied airflow).
4. Coils with design leaving air temperature ≥ 95°F (35°C).

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40340 Section C403.4—HVAC system controls.

C403.4 HVAC system controls. HVAC systems shall be provided with controls in accordance with Sections C403.4.1 through ((~~C403.4.11~~)) C403.4.12 and shall be capable of and configured to implement all required control functions in this code.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40341 Section C403.4.1—Thermostatic controls.

C403.4.1 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 C403.5 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 interior zone open to a perimeter zone shall have setpoints and deadbands coordinated so that cooling in the interior zone shall not operate while the perimeter zone is in heating until the interior zone temperature is 5°F (2.8°C) higher than the perimeter zone temperature, unless the interior and perimeter zones are separated by a partition whose permanent openings are smaller than 10 percent of the perimeter zone floor area.~~)) Where an interior zone and a perimeter zone are open to each other with permanent openings 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. For the purposes of this exception, a permanent opening is an opening without doors or other operable closures.
3. Dedicated outdoor air units that provide ventilation air, make-up air or replacement air for exhaust systems are permitted to be controlled based on supply air temperature. The supply air temperature shall be controlled to a maximum of 65°F (18.3°C) in heating and a minimum of 72°F (22°C) in cooling unless the supply air temperature is being reset based on the status of cooling or heating in the zones served or it being reset based on outdoor air temperature.

C403.4.1.1 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 (4.4°C).

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 (4.4°C)~~)) that have reverse-cycle demand defrost and are configured to operate in heat pump mode whenever the outdoor air temperatures are above 25°F (-3.9°C) and the unit is not in defrost.

C403.4.1.2 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*.

C403.4.1.3 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 setpoint from exceeding the cooling setpoint and to maintain a deadband in accordance with Section C403.4.1.2.

C403.4.1.4 Heated or cooled vestibules and air curtains. The heating system for heated vestibules and air curtains with integral heating shall be provided with controls configured to shut off the source of heating when the outdoor air temperature is greater than 45°F (7°C). Vestibule heating and cooling systems shall be controlled by a thermostat located in the vestibule configured to limit heating to a temperature not greater than 60°F (16°C) and cooling to a temperature not less than 85°F (29°C).

EXCEPTIONS: 1. Control of heating or cooling provided by transfer air that would otherwise be exhausted.
2((;)). Vestibule heating only systems are permitted to be controlled without an outdoor air temperature lockout when controlled by a thermostat located in the vestibule configured to limit heating to a temperature not greater than 45°F (7°C) where required for freeze protection of piping and sprinkler heads located in the vestibule.

C403.4.1.5 Hot water boiler outdoor temperature setback control. Hot water boilers that supply heat to the building through one- or two-pipe heating systems shall have an outdoor setback control that lowers the boiler water temperature based on the outdoor temperature.

C403.4.1.6 ((~~Door~~)) Operable opening switches for HVAC system thermostatic control. ((~~Doors~~)) Operable openings meeting the minimum size criteria of Section C402.5.11 and that open to the outdoors from a conditioned space must have controls configured to do the following once doors have been open for 5 minutes:

1. Disable the mechanical heating to the zone or reset the space heating temperature setpoint to 55°F or less within 5 minutes of the door open enable signal.

2. Disable the mechanical cooling to the zone or reset the space cooling temperature setpoint to 85°F or more within 5 minutes of the door open enable signal.

EXCEPTION((~~S~~)): ((~~1. Building entrances with vestibules.~~)) Hydronic radiant heating and cooling systems.
((~~2. Alterations to existing buildings.~~
~~3. Loading docks.~~))

C403.4.1.7 Demand responsive controls. All thermostatic controls shall be provided with *demand responsive controls* capable of increasing the cooling setpoint and decreasing the heating setpoint by no less than 4°F (2.2°C). The thermostatic controls shall be capable of performing all other functions provided by the control when the *demand responsive controls* are not available. Systems with *direct digital control* of individual *zones* report to a central control panel shall be capable of remotely increasing the cooling setpoint and decreasing the heating setpoint for each *zone* by no less than 4°F (2.2°C).

EXCEPTION: Health care and assisted living facilities.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40342 Section C403.4.2—Off-hour controls.

C403.4.2 Off-hour controls. For all occupancies other than Group R, each *zone* shall be provided with thermostatic setback controls that are controlled by either an automatic time clock or programmable control system.

EXCEPTIONS: 1. *Zones* that will be operated continuously.
2. *Zones* with a full HVAC load demand not exceeding 6,800 Btu/h (2 kW) and having a manual shutoff switch located with *ready access*.

C403.4.2.1 Thermostatic setback. Thermostatic setback controls shall be configured to set back or temporarily operate the system to maintain *zone* temperatures down to 55°F (13°C) or up to 85°F (29°C).

C403.4.2.2 Automatic setback and shutdown. Automatic time clock or programmable controls shall be capable of starting and stopping the system for seven different daily schedules per week and retaining their programming and time setting during a loss of power for at least 10 hours. Additionally, the controls shall have a manual override that allows temporary operation of the system for up to 2 hours; a manually operated timer configured to operate the system for up to 2 hours; or an occupancy sensor.

C403.4.2.3 Automatic start and stop. Automatic start and stop controls shall be provided for each HVAC system. The automatic start controls shall be configured to automatically adjust the daily start time of the HVAC system in order to bring each space to the desired occupied temperature immediately prior to scheduled occupancy. Automatic stop controls shall be provided for each HVAC system with direct digital control of individual zones. The automatic stop controls shall be configured to reduce the HVAC system's heating temperature setpoint and increase the cooling temperature setpoint by at least 2°F (1.1°C) before scheduled unoccupied periods based upon the thermal lag and acceptable drift in space temperature that is within comfort limits. ((~~At a minimum, the controls shall be a function of the space temperature, occupied and unoccupied temperatures, and the amount of time prior to scheduled occupancy.~~))

C403.4.2.4 Exhaust system off-hour controls. For all occupancies other than Group R, exhaust systems serving spaces within the conditioned envelope shall be controlled by either an automatic time clock, thermostatic controls or programmable control system to operate on the same schedule as the HVAC systems providing their make-up air.

EXCEPTIONS: 1. Exhaust systems requiring continuous operation.
2. Exhaust systems that are controlled by occupancy sensor control configured with automatic on and automatic shutoff within 15 minutes after occupants have left the space.

C403.4.2.5 Transfer and destratification fan system off-hour controls. For all occupancies other than Group R, transfer fan or mixing fan systems serving spaces within the conditioned envelope shall be controlled by either an automatic time clock, thermostatic controls or programmable control system to operate on the same schedule as the associated HVAC systems.

EXCEPTION: Transfer fan and destratification fan systems that are controlled by occupancy sensor control configured with manual on and automatic shutoff within 15 minutes after occupants have left the space.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40344 Section C403.4.4—Part load controls.

C403.4.4 Part load controls. Hydronic systems greater than or equal to 300,000 Btu/h (88 kW) in design output capacity supplying heated or chilled water to comfort conditioning systems shall include controls that are configured to:

1. Automatically reset the supply-water temperatures in response to varying building heating and cooling demand using coil valve posi-

tion, zone-return water temperature or outdoor air temperature. The temperature shall be reset by not less than 25 percent of the design supply-to-return water temperature difference.

EXCEPTIONS: 1. Hydronic systems serving hydronic heat pumps.
2. Hydronic systems with thermal energy storage where resetting the supply-water temperature would reduce the capacity of the storage.

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

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

3.1. Where pumps operate continuously or operate based on a time schedule, pumps with nominal output motor power of 2 hp or more shall have a variable speed drive.

3.2. Where pumps have automatic direct digital control configured to operate pumps only when zone heating or cooling is required, a variable speed drive shall be provided for pumps with motors having the same or greater nominal output power indicated in Table C403.4.4 based on the climate zone and system served.

4. Where variable speed drive is required by Item 3 of this section, pump motor power input shall be not more than 30 percent of design wattage at 50 percent of the design water flow. Pump flow shall be controlled to maintain one control valve nearly wide open or to satisfy the minimum differential pressure.

EXCEPTIONS: 1. Supply-water temperature reset is not required for chilled-water systems supplied by off-site district chilled water or chilled water from ice storage systems.
2. Variable pump flow is not required on dedicated coil circulation pumps where needed for freeze protection.
3. Variable pump flow is not required on dedicated equipment circulation pumps where configured in primary/secondary design to provide the minimum flow requirements of the equipment manufacturer for proper operation of equipment.
4. Variable speed drives are not required on heating water pumps where more than 50 percent of annual heat is generated by an electric boiler.

Table C403.4.4
Variable Speed Drive (VSD) Requirements for Demand-Controlled Pumps

Climate Zones 4c, 5b	VSD Required for Motors with Rated Output of at Least
Heating water pumps	≥7.5 hp
Chilled water and heat rejection loop pumps	≥7.5 hp

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40349 Sections C403.4.11((~~—DDC systems~~)) and C403.4.12.

C403.4.11 Direct digital control systems. Direct digital control (DDC) shall be required as specified in Sections C403.4.11.1 through ((~~C403.4.11.3~~)) C403.4.11.4.

C403.4.11.1 DDC applications. DDC shall be provided in the applications and qualifications listed in Table C403.4.11.1 and for load management measures where installed to meet the requirements of Section C406.3.

C403.4.11.2 DDC controls. Where DDC is required by Section C403.4.11.1, the DDC system shall be ((~~capable of~~)) configured to perform all of the following functions, as required to provide the system and zone control logic required in Sections C403.2, C403.5, C403.6.8 and C403.4.3:

1. ((~~Monitoring~~)) Monitor zone and system demand for fan pressure, pump pressure, heating and cooling.

2. ((~~Transferring~~)) Transfer zone and system demand information from zones to air distribution system controllers and from air distribution systems to heating and cooling plant controllers.

C403.4.11.3 DDC display. Where DDC is required by Section C403.4.11.1 for new buildings, the DDC system shall be ((~~capable of~~)) configured to gather and provide trending data and graphically displaying input and output points.

C403.4.11.4 DDC demand response setpoint adjustment. Where DDC is required by Section C403.4.11.1 for new buildings and serve mechanical systems with a cooling capacity exceeding 780,000 Btu/h (2,662 kW), the *DDC system* shall be capable of demand response setpoint adjustment. The *DDC system* shall be configured with control logic to increase the cooling zone setpoints by at least 2°F (1°C) and reduce the heating zone setpoints by at least 2°F (1°C) when activated by a *demand response signal*. The *demand response signal* shall be a binary input to the control system or other interface approved by the serving electric utility.

Table C403.4.11.1
DDC Applications and Qualifications

Building Status	Application	Qualifications
New building	((~~Air-handling system and all zones served by the system~~	~~All air-handling systems in buildings with building cooling capacity greater than 780,000 Btu/h~~))
	Air-handling system and all zones served by the system	Individual systems supplying more than three zones and with fan system bhp of 10 hp and larger
	Chilled-water plant and all coils and terminal units served by the system	Individual plants supplying more than three zones and with design cooling capacity of 300,000 Btu/h and larger
	Hot-water plant and all coils and terminal units served by the system	Individual plants supplying more than three zones and with design heating capacity of 300,000 Btu/h and larger
Alteration or addition	Zone terminal unit such as VAV box	Where existing zones served by the same air-handling, chilled-water, or hot-water system have DDC
	Air-handling system or fan coil	Where existing air-handling system(s) and fan coil(s) served by the same chilled- or hot-water plant have DDC
	New air-handling system and all new zones served by the system	Individual systems with fan system bhp of 10 hp and larger and supplying more than three zones and more than 75 percent of zones are new
	New or upgraded chilled-water plant	Where all chillers are new and plant design cooling capacity is 300,000 Btu/h and larger
	New or upgraded hot-water plant	Where all boilers are new and plant design heating capacity is 300,000 Btu/h and larger

C403.4.12 Pressure independent control valves. Where design flow rate of heating water and chiller water coils is 5 gpm or higher, modulating pressure independent control valves shall be provided.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40350 Section C403.5—Economizers.

C403.5 Economizers. Air economizers shall be provided on all new cooling systems including those serving computer server rooms, electronic equipment, radio equipment, and telephone switchgear. Economizers shall comply with Sections C403.5.1 through C403.5.5.

EXCEPTIONS:

1. For other than Group R-2 occupancies, cooling system((s)) where the supply fan is not installed ((~~outdoors~~)) outside the *building thermal envelope* nor in a *mechanical room* adjacent to outdoors, and is installed in conjunction with DOAS complying with Section C403.3.5 and serving only spaces 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 increase the overall building energy consumption. New humidification equipment shall comply with Section ((~~C403.3.2.5~~)) C403.3.2.7.
3. Unitary or packaged systems serving one zone where the cooling efficiency meets or exceeds the efficiency requirements in Table C403.5.
4. Equipment serving chilled beams and chilled ceiling space cooling systems only which are provided with a water economizer meeting the requirements of Section C403.5.4.
5. For Group R occupancies, cooling unit((s)) where the supply fan is not installed ((~~outdoors~~)) outside the *building thermal envelope* 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, CEER, SEER, and EER values more than 15 percent higher than minimum efficiencies listed in ((~~Tables C403.3.2 (1) through (3)~~)) the tables in Section C403.3.2, 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.
6. 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 C403.3.2 (1), (3), (4), and ((~~(7)~~)) (15).
7. Equipment serving a space with year-round cooling loads from lights and equipment of 5 watts per square foot or greater complying with the following criteria:
7.1. Equipment serving the space utilizes chilled water as the cooling source; and
7.2. The chilled water plant includes a condenser heat recovery system that meets the requirements of Section C403.9.5 or the building and water-cooled system meets the following requirements:
7.2.1. A minimum of 90 percent (capacity-weighted) of the building space heat is provided by hydronic heating water.
7.2.2. Chilled water plant includes a heat recovery chiller or water-to-water heat pump capable of rejecting heat from the chilled water system to the hydronic heating equipment capacity.
7.2.3. Heat recovery chillers shall have a minimum COP of 7.0 when providing heating and cooling water simultaneously.
8. Water-cooled equipment served by systems meeting the requirements of Section C403.9.2.4 Condenser heat recovery.
9. Equipment used to cool any dedicated server room, electronic equipment room or telecom switch room provided the system complies with option a, b, or c in the table below. The total cooling capacity of all fan systems 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.
10. Dedicated outdoor air systems that include energy recovery as required by Section C403.7.6 but do not include mechanical cooling.
11. Dedicated outdoor air systems not required by Section C403.7.6 to include energy recovery that modulate the supply airflow to provide only the minimum outdoor air required by Section C403.2.2.1 for ventilation, exhaust air make-up, or other process air delivery.

	Equipment Type	Higher Equipment Efficiency	Part-Load Control	Economizer
Option a	Tables C403.3.2(1), C403.3.2(2) and C403.3.2((~~(2)~~)) (14)[a]	+15%[b]	Required over 85,000 Btu/h[c]	None Required
Option b	Tables C403.3.2(1), C403.3.2(2) and C403.3.2((~~(2)~~)) (14)[a]	+5%[d]	Required over 85,000 Btu/h[c]	Waterside Economizer[e]
Option c	ASHRAE Standard 127[f]	+0%[g]	Required over 85,000 Btu/h[c]	Waterside Economizer[e]

Notes for Exception 9:

[a]For a system where all of the cooling equipment is subject to the AHRI standards listed in Tables C403.3.2(1), C403.3.2(2), and C403.3.2((~~(2)~~)) (14), the system shall comply with all of the following (note that if the system contains any cooling equipment that exceeds the capacity limits in Table C403.3.2(1), C403.3.2(2), or C403.3.2((~~(2)~~)) (14), or if the system contains any cooling equipment that is not included in Table C403.3.2(1), C403.3.2(2), or C403.3.2((~~(2)~~)) (14), then the system is not allowed to use this option).

[b]The cooling equipment shall have an EER value and an IPLV value that is a minimum of 15 percent greater than the value listed in Tables C403.3.2(1), C403.3.2(2), and C403.3.2((~~(2)~~)) (14).

[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 EER value and an IPLV value that is a minimum of 5 percent greater than the value listed in Tables C403.3.2(1), C403.3.2(2), and C403.3.2(((~~2~~))) (14).

[e]The system shall include a water economizer in lieu of air economizer. Water economizers shall meet the requirements of C403.5.1 and C403.5.2 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.

[g]The cooling equipment subject to the ASHRAE Standard 127 shall have an EER value and an IPLV value that is equal to or greater than the value listed in Tables C403.3.2(1), C403.3.2(2), and C403.3.2(((~~2~~))) (14) 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.

Table C403.5
Equipment Efficiency Performance Exception for Economizers

Climate Zones	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.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40355 Section C403.5.5—Economizer fault detection and diagnostics.

C403.5.5 Economizer fault detection and diagnostics (FDD). Air-cooled unitary direct-expansion units with a cooling capacity of 54,000 Btu/h or greater listed in ((~~Tables C403.3.2(1) through C403.3.2(3)~~)) the tables in Section C403.3.2 that are equipped with an economizer in accordance with Section C403.5 shall include a fault detection and diagnostics (FDD) system complying with the following:

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

1.1. Outside air.

1.2. Supply air.

1.3. Return air.

2. Temperature sensors shall have an accuracy of ±2°F (1.1°C) over the range of 40°F to 80°F (4°C to 26.7°C).

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

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

4.1. Free cooling available.

4.2. Economizer enabled.

4.3. Compressor enabled.

4.4. Heating enabled.

4.5. Mixed air low limit cycle active.

4.6. The current value of each sensor.

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

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

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

7.1. Air temperature sensor failure/fault.

7.2. Not economizing when the unit should be economizing.

7.3. Economizing when the unit should not be economizing.

7.4. Damper not modulating.

7.5. Excess outdoor air.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-40360 Section C403.6—Requirements for mechanical systems serving multiple zones.

C403.6 Requirements for mechanical systems serving multiple zones. Sections C403.6.1 through C403.6.10 shall apply to mechanical systems serving multiple zones.

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

1. Twenty percent of the zone design peak supply for systems with *direct digital control* (DDC) and 30 percent of the maximum supply air for other systems.

2. Systems with DDC where items 2.1 through 2.3 apply.

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

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

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

3. The outdoor airflow rate required to meet the minimum ventilation requirements of Chapter 4 of the *International Mechanical Code*.

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

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

EXCEPTION: The following individual *zones* or entire air distribution systems are exempted from the requirement for VAV control:
1. *Zones* or supply air systems where not less than 75 percent of the energy for reheating or for providing warm air in mixing systems is provided from a site-recovered source, including condenser heat.
2. Systems that prevent reheating, recooling, mixing or simultaneous supply of air that has been previously cooled, either mechanically or through the use of economizer systems, and air that has been previously mechanically heated.
3. Ventilation systems complying with Section C403.3.5, DOAS, with ventilation rates comply with Section C403.2.2.

C403.6.2 Single duct variable air volume (VAV) systems, terminal devices. Single duct VAV systems shall use terminal devices capable of and configured to reduce the supply of primary supply air before reheating or recooling takes place.

C403.6.3 Dual duct and mixing VAV systems, terminal devices. Systems that have one warm air duct and one cool air duct shall use terminal devices which are capable of and configured to reduce the flow from one duct to a minimum before mixing of air from the other duct takes place.

C403.6.4 Supply-air temperature reset controls. Multiple *zone* HVAC systems shall include controls that are capable of and configured to automatically reset the supply-air temperature in response to representative building loads, or to outdoor air temperature. The controls shall be configured to reset the supply air temperature at least 25 percent of the difference between the design supply-air temperature and the design room air temperature. Controls that adjust the reset based on zone humidity are allowed. HVAC zones that are expected to experience relatively constant loads shall have maximum airflow designed to accommodate the fully reset supply air temperature.

EXCEPTIONS: 1. Systems that prevent reheating, recooling or mixing of heated and cooled supply air.
2. Seventy-five percent of the energy for reheating is from a site-recovered source.
((~~3. Zones with peak supply air quantities of 300 cfm (142 L/s) or less.~~))

C403.6.5 Multiple-zone VAV system ventilation optimization control. Multiple-zone VAV systems with direct digital control of individual zone boxes reporting to a central control panel shall have automatic controls configured to reduce outdoor air intake flow below design rates in response to changes in system ventilation efficiency (E_v) as defined by the *International Mechanical Code*.

EXCEPTIONS: 1. VAV systems with zonal transfer fans that recirculate air from other zones without directly mixing it with outdoor air, dual-duct dual-fan VAV systems, and VAV systems with fan-powered terminal units.
2. Systems where total design exhaust airflow is more than 70 percent of total design outdoor air intake flow requirements.

C403.6.6 Parallel-flow fan-powered VAV air terminal control. Parallel-flow fan-powered VAV air terminals shall have automatic controls configured to:

1. Turn off the terminal fan except when space heating is required or where required for ventilation.

2. Turn on the terminal fan as the first stage of heating before the heating coil is activated.

3. During heating for warmup or setback temperature control, either:

3.1. Operate the terminal fan and heating coil without primary air.

3.2. Reverse the terminal damper logic and provide heating from the central air handler by primary air.

((~~**C403.6.7 Hydronic and multiple-zone HVAC system controls and equipment.** Hydronic and multiple-zone HVAC system controls and equipment shall comply with this section.~~

~~For buildings with a total equipment cooling capacity of 300 tons and above, the equipment shall comply with one of the following:~~

~~1. No one unit shall have a cooling capacity of more than 2/3 of the total installed cooling equipment capacity;~~

~~2. The equipment shall have a variable speed drive; or~~

~~3. The equipment shall have multiple compressors.~~))

C403.6.7 Reserved.

C403.6.8 Set points for direct digital control. For systems with direct digital control of individual *zones* reporting to the central control panel, the static pressure setpoint shall be reset based on the *zone* requiring the most pressure. In such cases, the set point is reset lower until one zone damper is nearly wide open. The direct digital controls shall be capable of monitoring zone damper positions or shall have an alternative method of indicating the need for static pressure that is configured to provide all of the following:

1. Automatically detecting any zone that excessively drives the reset logic.
2. Generating an alarm to the system operational location.
3. Allowing an operator to readily remove one or more zones from the reset algorithm.

C403.6.9 Static pressure sensor location. Static pressure sensors used to control VAV fans shall be located such that the controller setpoint is no greater than 1.2 inches w.c. (299 Pa). Where this results in one or more sensors being located downstream of major duct splits, not less than one sensor shall be located on each major branch to ensure that static pressure can be maintained in each branch.

EXCEPTION: Systems complying with Section C403.6.8.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-403610 Section C403.6.10—High efficiency VAV systems.

C403.6.10 High efficiency variable air volume (VAV) systems. For HVAC systems subject to the requirements of Section C403.3.5 but utilizing Exception 2 of that section, a high efficiency multiple-zone 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 (this exception shall not be used as a substitution for a DOAS per Section C406.6):

1. Each VAV system must serve a minimum of 3,000 square feet (278.7 m^2) and have a minimum of five VAV zones.
2. The VAV systems are provided with airside economizer per Section C403.5 without exceptions.
3. A direct-digital control (DDC) system is provided to control the VAV air handling units and associated terminal units per Section C403.4.11 regardless of sizing thresholds of Table C403.4.11.1.
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 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 C403.6.5, without exceptions, and Section C403.7.1 demand controlled ventilation.
5. 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.

6. In addition to meeting the zone isolation requirements of C403.2.1 a single VAV air handling unit shall not serve more than 50,000 square feet (4645 m^2) unless a single floor is greater than 50,000 square feet (4645 m^2) in which case the air handler is permitted to serve the entire floor.

7. 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.

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

9. Allowable fan ((~~motor horsepower~~)) power shall not exceed 90 percent of the allowable ((~~HVAC *fan system bhp* (Option 2)~~)) fan power budget as defined by Section C403.8.1.1.

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.

EXCEPTION: Fan powered VAV terminal units are allowed at interior spaces with an occupant load greater than or equal to 25 people per 1000 square feet of floor area (as established in Table 403.3.1.1 of the *International Mechanical Code*) with demand control ventilation in accordance with Section C403.7.1.

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*.

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 data centers, computer rooms, electronic equipment rooms, telecom rooms, or other similar spaces with cooling loads greater than 5 watts/sf shall be provided with separate cooling sys-

tems 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, computer rooms, electronic equipment rooms, telecom rooms, or other similar spaces shall be provided with airside economizer in accordance with Section 403.5 without using the exceptions to Section C403.5.

EXCEPTION: Heat recovery per Exception 9 of Section C403.5 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 92 percent, air-to-water heat pumps or heat recovery chillers. Hydronic heating coils shall be sized for a maximum entering hot water temperature of 120°F (48.9°C) for peak anticipated heating load conditions.

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 ((~~C403.3.2(7)~~)) C403.3.2(3), 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 percent of the total central plant cooling capacity or the chilled water system shall include thermal storage sized for a minimum of 20 percent 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 able to be accessed 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.

16.6.2. Command VAV terminal unit primary air inlet valve to design airflow and verify that unit is controlling to within 10 percent 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.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40371 Section C403.7.1—Demand control ventilation.

C403.7.1 Demand control ventilation.

C403.7.1.1 Spaces requiring demand control ventilation. Demand control ventilation (DCV) shall be provided for ((~~spaces larger than 500 square feet (50 m^2) and~~)) either of the following:

1. Spaces with ventilation provided by single-zone systems where an air economizer is provided to comply with Section C403.5.

2. Spaces with an occupant load greater than or equal to ((~~25~~)) 15 people per 1000 square feet (93 m^2) of floor area (as established in Table 403.3.1.1 of the *International Mechanical Code*) ((~~and served by systems with one or more of the following:~~

~~1. An air-side economizer;~~

~~2. Automatic modulating control of the outdoor air damper; or~~

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

~~EXCEPTION: Demand control ventilation is not required for systems and spaces as follows:~~

~~1. Systems with energy recovery complying with Section C403.7.6.1 or C403.3.5.1. This exception is not available for space types located within the "inclusions" column of Groups A-1 and A-3 occupancy classifications of Table C403.3.5.~~

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

~~3. System with a design outdoor airflow less than 750 cfm (354 L/s).~~

~~4. Spaces where the supply airflow rate minus any makeup or outgoing transfer air requirement is less than 1,200 cfm (566 L/s).~~

~~5. Ventilation provided for process loads only.~~

~~6. Spaces with one of the following occupancy categories (as defined by the *International Mechanical Code*): Correctional cells, daycare sickrooms, science labs, barbers, beauty and nail salons, and bowling alley seating.~~))

or with an occupant outdoor airflow rate greater than or equal to 15 cfm/person, as established in Table 403.3.1.1 of the *International Mechanical Code*.

EXCEPTIONS:
1. Spaces including, but not limited to, dining areas, where more than 75 percent of the space design outdoor airflow is transfer air required for makeup air supplying an adjacent commercial kitchen.
2. Spaces with one of the following occupancy classifications as defined in Table 403.3.1.1 of the *International Mechanical Code*: Correctional cells, educational laboratories, barbers, beauty and nail salons, and bowling alley seating.
3. Dormitory sleeping areas with fewer than five occupants per space.
4. Spaces with ventilation not provided by a single-zone system where the design occupant component outdoor airflow is less than 50 cfm (23.6 L/s), or 100 cfm (47.2 L/s) with system having energy recovery with minimum 60 percent sensible effectiveness. Design occupant component outdoor airflow shall be calculated as the product of the design number of occupants in the space and the people outdoor airflow rate per occupant (R_p) as established in Table 403.3.1.1 of the *International Mechanical Code*.
5. Spaces with ventilation not provided by a single-zone system where the total system design outdoor airflow is less than 750 cfm (354 L/s), or 1500 cfm (708 L/s) with system having energy recovery with minimum 60 percent sensible effectiveness.

C403.7.1.2 Demand control ventilation design. Each space required to have demand control ventilation shall have equipment and controls capable of and configured to automatically change the quantity of outdoor air supplied to the space based upon the output of a CO_2 sensor. System outdoor air intake shall be adjusted from peak design levels in response to changes in outdoor air required in the spaces served by the system. This adjustment shall be accomplished by variable speed fan control.

EXCEPTION: Systems designed to recirculate return air and systems with total supply air less than 1500 cfm (708 L/s) may use other means of modulating outdoor air.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40373 Section C403.7.3—Ventilation air heating control.

C403.7.3 Ventilation air heating control. ((~~Units that provide ventilation air to multiple zones and~~)) For ventilation air units with supplemental heating capacity that operate in conjunction with zone heating and cooling systems ((~~shall not use heating or heat recovery to warm supply air to a temperature greater than 60°F (16°C) when representative building loads or outdoor air temperature indicate that the majority of zones require cooling~~)), supplemental heating shall not warm ventilation supply air to a temperature greater than 55°F (13°C).

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-40374 Section C403.7.4—HVAC serving guestrooms.

C403.7.4 Automatic control of HVAC systems serving guestrooms. In Group R-1 buildings containing more than 50 guestrooms, each guestroom shall be provided with controls complying with the provisions of Sections C403.7.4.1 and C403.7.4.2. Card key controls comply with these requirements.

C403.7.4.1 Temperature setpoint controls. Controls shall be provided on each HVAC system that are capable of and configured ((~~to~~)) with three modes of temperature control.

1. When the guestroom is rented but unoccupied, the controls shall automatically raise the cooling setpoint and lower the heating setpoint by not less than 4°F (2°C) from the occupant setpoint within 30 minutes after the occupants have left the guestroom.

2. When the guestroom is unrented and unoccupied, the controls shall ((~~be capable of and configured to~~)) automatically raise the cooling setpoint to not lower than 80°F (27°C) and lower the heating setpoint to not higher than 60°F (16°C) ((~~when the guestroom is unrented or has been continuously unoccupied for over 16 hours or~~)). Unrented and unoccupied guestroom mode shall be initiated within 16 hours of the guestroom being continuously occupied or where a *networked guestroom control system* indicates that the guestroom is unrented and the guestroom is unoccupied for more than ((~~30~~)) 20 minutes. A *networked guestroom control system* that is capable of returning the thermostat setpoints to default occupied setpoints 60 minutes prior to the time a guestroom is scheduled to be occupied is not precluded by this section. Cooling that is capable of limiting relative humidity with a setpoint not lower than 65 percent relative humidity during unoccupied periods is not precluded by this section.

3. When the guestroom is occupied, HVAC set points shall return to their occupied set point once occupancy is sensed.

C403.7.4.2 Ventilation controls. Controls shall be provided on each HVAC system that are capable of and configured to automatically turn off the ventilation and exhaust fans within ((~~30~~)) 20 minutes of the occupants leaving the guestroom or isolation devices shall be provided to each guestroom that are capable of automatically shutting off the supply of outdoor air to and exhaust air from the guestroom.

EXCEPTION: Guestroom ventilation systems are not precluded from having an automatic daily preoccupancy purge cycle that provides daily outdoor air ventilation during unrented periods at the design ventilation rate for 60 minutes, or at a rate and duration equivalent to one air change.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40375 Section C403.7.5—Loading dock and ((~~parking~~)) garage ventilation system controls.

C403.7.5 ((~~Enclosed~~)) Loading dock, motor vehicle repair garage, and parking garage ((~~exhaust~~)) ventilation system controls. 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~~)) 20 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.

Ventilation systems with total ventilation system motor nameplate horsepower exceeding 5 hp (3.7 kW) at fan system design conditions and those with heating and/or cooling shall have controls and devices that

modulate fan speed and result in fan motor demand of no more than 30 percent of design wattage at 50 percent of the design airflow.

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. Parking 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.

C403.7.5.1 System activation devices for ((~~enclosed~~)) loading docks. Ventilation systems for enclosed loading docks shall operate continuously during unoccupied hours at 50 percent or less of design capacity 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.

C403.7.5.2 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.~~))

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40376 Section C403.7.6—Energy recovery ventilation systems.

C403.7.6 Energy recovery ventilation systems. Energy recovery ventilation systems shall be provided as specified in either Section C403.7.6.1 or C403.7.6.2.

C403.7.6.1 Ventilation for Group R-2 occupancy. For all Group R-2 dwelling and sleeping units, a balanced ventilation system with heat recovery system with minimum 60 percent sensible recovery effectiveness shall provide outdoor air directly to all habitable space. The ventilation system shall allow for the design flow rates to be tested and verified at each habitable space as part of the commissioning process in accordance with Section C408.2.2.

C403.7.6.2 Spaces other than Group R-2 dwelling units. Any system serving a space other than a Group R-2 dwelling or sleeping unit 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 C403.7.6(1) and C403.7.6(2), based on the climate zone and percentage of outdoor airflow rate at design conditions, shall include an energy recovery system. Table C403.7.6(1) shall be used for all ventilation systems that operate less than 8,000 hours per year, and Table C403.7.6(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,~~)) provide an *enthalpy recovery ratio* of not less than 60 percent at design conditions. Where an air economizer is required, the energy recovery system shall include a bypass of the energy recovery media for both the outdoor air and exhaust air or return air dampers and controls which permit operation of the air economizer as required by Section C403.5. 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 C403.7.7.1.
1.2. Laboratory fume hood systems where they comply with Exception 2 of Section C403.7.6.
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 C403.7.7.2:
2.1. Variable-air-volume hood exhaust and room supply systems configured to reduce exhaust and makeup air volume to 50 percent or less of design values.
2.2. Direct makeup (auxiliary) air supply equal to 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 air heating energy is provided from site-recovered energy.
5. Systems exhausting toxic, flammable, paint or corrosive fumes or dust.
6. Cooling energy recovery.
7. Systems requiring dehumidification that employ energy recovery in series with the cooling coil.
8. Multiple-zone systems where the supply airflow rate is less than the values specified in Tables C403.7.6 (1) and (2), for the corresponding percent of outdoor air. Where a value of NR is listed, energy recovery shall not be required.
9. Equipment which meets the requirements of Section C403.9.2.4.
10. Systems serving Group R-1 ((~~and R-3~~)) 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.

Table C403.7.6(1)
Energy Recovery Requirement
(Ventilation systems operating less than 8,000 hours per year)

Percent (%) Outdoor Air at Full Design Airflow Rate								
Climate zone	≥ 10% and < 20%	≥ 20% and < 30%	≥ 30% and < 40%	≥ 40% and < 50%	≥ 50% and < 60%	≥ 60% and < 70%	≥ 70% and < 80%	≥ 80%
Design Supply Fan Airflow Rate (cfm)								
4C, 5B	NR	NR	NR	NR	NR	NR	≥ 5000	≥ 5000

NR = Not required.

Table C403.7.6(2)
Energy Recovery Requirement
(Ventilation systems operating not less than 8,000 hours per year)

Percent (%) Outdoor Air at Full Design Airflow Rate								
Climate zone	≥ 10% and < 20%	≥ 20% and < 30%	≥ 30% and < 40%	≥ 40% and < 50%	≥ 50% and < 60%	≥ 60% and < 70%	≥ 70% and < 80%	≥ 80%
Design Supply Fan Airflow Rate (cfm)								
4C	NR	≥ 19500	≥ 9000	≥ 5000	≥ 4000	≥ 3000	≥ 1500	≥ 120
5B	≥ 2500	≥ 2000	≥ 1000	≥ 500	≥ 140	≥ 120	≥ 100	≥ 80

NR = Not required.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40377 Section C403.7.7—Exhaust systems.

C403.7.7 Exhaust systems.

C403.7.7.1 Kitchen exhaust systems.

C403.7.7.1.1 Replacement air. Replacement air introduced directly into the exhaust hood cavity shall not be greater than 10 percent of the hood exhaust airflow rate.

C403.7.7.1.2 Kitchen exhaust hood certification and maximum airflow. Where a kitchen or kitchen/dining facility has a total kitchen hood exhaust airflow rate that is greater than 2,000 cfm, each hood shall be a factory built commercial exhaust hood listed by a nationally recognized testing laboratory in compliance with UL 710 and each hood shall have a maximum exhaust rate as specified in Table C403.7.7.1.2. Where a single hood, or hood section, is installed over appliances with different duty ratings, the maximum allowable flow rate for the hood or hood section shall be based on the requirements for the highest appliance duty rating under the hood or hood section.

EXCEPTION: Type II dishwasher exhaust hoods that have an exhaust airflow of 1000 cfm or less.

Table C403.7.7.1.2
Maximum Net Exhaust Flow Rate,
CFM Per Linear Foot of Hood Length

Type of Hood	Light-duty Equipment	Medium-duty Equipment	Heavy-duty Equipment	Extra-heavy-duty Equipment
Wall-mounted canopy	140	210	280	385
Single island	280	350	420	490
Double island (per side)	175	210	280	385
Eyebrow	175	175	NA	NA
Backshelf/pass-over	210	210	280	NA

For SI: 1 cfm = 0.4719 L/s; 1 foot = 305 mm
NA = Not allowed

C403.7.7.1.3 Kitchen exhaust hood system. Kitchen exhaust hood systems serving Type I exhaust hoods shall be provided with *demand control kitchen ventilation* (DCKV) controls where a kitchen or kitchen/dining facility has a total kitchen hood exhaust airflow rate greater than 2000 cfm((~~, it shall comply with one of the following:~~

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

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

~~3. Listed energy recovery devices with a sensible heat recovery effectiveness of not less than 40 percent on not less than 50 percent of the total exhaust hood airflow~~)). DCKV systems shall be configured to provide a minimum of 50 percent reduction in exhaust and replacement air system airflows in response to appliance operation and to maintain full capture and containment of smoke, effluent and combustion products during cooking and idle operation.

EXCEPTIONS: 1. ((~~Where not less than 75 percent of all the replacement air is transfer air that would otherwise be exhausted.~~ ~~2.~~)) UL 710 listed exhaust hoods that have a design maximum exhaust airflow rate no greater than 250 cfm per linear foot of hood that serve kitchen or kitchen/dining facilities with a total kitchen hood exhaust airflow rate less than 5000 cfm.
((~~3. Type II dishwasher exhaust hoods that have an exhaust airflow of 1000 cfm or less.~~)) 2. An energy recovery device is installed on the kitchen exhaust with a sensible heat recovery effectiveness of not less than 40 percent or not less than 50 percent of the total exhaust hood airflow.

C403.7.7.2 Laboratory exhaust systems. Buildings with laboratory exhaust systems having a total exhaust rate greater than 5,000 cfm (2360 L/s) shall include heat recovery systems to precondition replacement air from laboratory exhaust. The heat recovery system shall be capable of increasing the outside air supply temperature at design heating conditions by 25°F (13.9°C). A provision shall be made to bypass or control the heat recovery system to permit air economizer operation as required by Section C403.5.

EXCEPTIONS: 1. Variable air volume laboratory exhaust and room supply systems configured to reduce exhaust and makeup air volume to 50 percent or less of design values; or
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) below room setpoint, cooled to no cooler than 3°F (1.7°C) above room setpoint, no humidification added, and no simultaneous heating and cooling used for dehumidification control; or
3. Combined energy reduction method: VAV exhaust and room supply system configured to reduce exhaust and makeup air volumes and a heat recovery system to precondition makeup air from laboratory exhaust that when combined will produce the same energy reduction as achieved by a heat recovery system with a 50 percent sensible recovery effectiveness as required above. For calculation purposes, the heat recovery component can be assumed to include the maximum design supply airflow rate at design conditions. The combined energy reduction (Q_{ER}) shall meet the following:

$$Q_{ER} \geq Q_{MIN}$$

$$Q_{MIN} = CFM_S \cdot (T_R - T_O) \cdot 1.1 \cdot 0.6$$

$$Q_{ER} = CFM_S \cdot (T_R - T_O) \cdot 1.1(A + B)/100$$

Where:

Q_{MIN} = Energy recovery at 60 percent sensible effectiveness (Btu/h)

Q_{ER} = Combined energy reduction (Btu/h)

CFM_S = The maximum design supply airflow rate to conditioned spaces served by the system in cubic feet per minute

T_R = Space return air dry-bulb at winter design conditions

T_O = Outdoor air dry-bulb at winter design conditions

A = Percentage that the exhaust and makeup air volumes can be reduced from design conditions

B = Percentage sensible heat recovery effectiveness

C403.7.7.3 Transfer air. Conditioned supply air delivered to any space with mechanical exhaust shall not exceed the greater of:

1. The supply flow required to meet the space heating or cooling load;

2. The ventilation rate required by the authority having jurisdiction, the facility environmental health and safety department, or Section C403.2.2; or

3. The mechanical exhaust flow minus the available transfer air from conditioned spaces or return air plenums that at their closest point are within 15 feet of each other on the same floor that are not in different smoke or fire compartments. Available transfer air is that portion of outdoor ventilation air that:

3.1. Is not required to satisfy other exhaust needs;

3.2. Is not required to maintain pressurization of other spaces; and

3.3. Is transferable according to applicable codes and standards and per the *International Mechanical Code*.

EXCEPTIONS:
1. Laboratories classified as biosafety level 3 or higher.
2. Vivarium spaces.
3. Spaces that are required by applicable codes and standards to be maintained at positive pressure relative to adjacent spaces. For spaces taking this exception, any transferable air that is not directly transferred shall be made available to the associated air-handling unit and shall be used whenever economizer or other options do not save more energy.
4. Spaces where the demand for transfer air may exceed the available transfer airflow rate and where the spaces have a required negative pressure relationship. For spaces taking this exception, any transferable air that is not directly transferred shall be made available to the associated air-handling unit and shall be used whenever economizer or other options do not save more energy.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40378 Section C403.7.8—Shutoff dampers.

C403.7.8 Shutoff dampers. Mechanical openings shall be provided with shutoff dampers in accordance with Sections C403.7.8.1 through C403.7.8.4.

C403.7.8.1 Shutoff dampers for building isolation. Outdoor air supply, exhaust openings and relief outlets and stairway and elevator hoistway shaft vents shall be provided with Class I motorized dampers. See Sections C403.10.1 and C403.10.2 for ductwork insulation requirements upstream and downstream of the shutoff damper.

EXCEPTIONS:
1. Gravity (nonmotorized) dampers shall be permitted in lieu of motorized dampers as follows:
1.1. Relief dampers serving systems less than 5,000 cfm total supply shall be permitted in buildings less than three stories in height.
1.2. Gravity (nonmotorized) dampers where the design outdoor air intake or exhaust capacity does not exceed ((~~400~~)) 300 cfm (142 L/s).
1.3. Systems serving areas which require continuous operation for 24/7 occupancy schedules.
2. Shutoff dampers are not required in:
2.1. Combustion air intakes.
2.2. Systems serving areas which require continuous operation in animal hospitals, kennels and pounds, laboratories, and Group H, I and R occupancies.
2.3. Subduct exhaust systems or other systems that are required to operate continuously by the *International Mechanical Code*.
2.4. Type I grease exhaust systems or other systems where dampers are prohibited by the *International Mechanical Code* to be in the airstream.
2.5. Unconditioned stairwells or unconditioned elevator hoistway shafts that are only connected to unconditioned spaces.

C403.7.8.2 Shutoff dampers for return air. Return air openings used for airside economizer operation shall be equipped with Class I motorized dampers.

C403.7.8.3 Damper leakage rating. Class 1 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. Gravity (nonmotorized) dampers shall have an air leakage rate not greater than 20 cfm/ft^2 where not less than 24 inches (610 mm) in either dimension and 40 cfm/ft^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.

EXCEPTIONS: 1. Gravity (nonmotorized) dampers are not required to be tested to verify the air leakage rating when installed in exhaust systems where the exhaust capacity does not exceed 400 cfm and the gravity damper is provided with a gasketed seal.
2. Motorized dampers on return air openings in unitary packaged equipment that have the minimum leakage rate available from the manufacturer.

C403.7.8.4 Damper actuation. Outdoor air intake, relief and exhaust shutoff 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 elevator hoistway 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.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-4038 Section C403.8—Fan and fan controls.

C403.8 Fan and fan controls. Fans in HVAC systems shall comply with Sections C403.8.1 through C403.8.5.1.

The airflow requirements of Section C403.8.5.1 shall apply to all fan motors. ((~~Group R occupancy exhaust~~)) Low capacity ventilation fans shall also comply with Section C403.8.4.

C403.8.1 ((~~Allowable fan motor horsepower.~~ ~~Each HVAC system having a total fan system motor nameplate horsepower exceeding 5 hp (3.7 kW) at fan system design conditions shall not exceed the allowable *fan system motor nameplate hp* (Option 1) or *fan system bhp* (Option 2) as shown in Table C403.8.1(1). This includes supply fans, exhaust fans, return/relief fans, and fan-powered VAV air terminal units associated with systems providing heating or cooling capability. Single *zone* variable-air-volume systems shall comply with the constant volume fan power limitation. Zone heating and/or cooling terminal units installed in conjunction with a dedicated outdoor air system (DOAS) shall be evaluated as separate HVAC systems for allowable fan motor horsepower.~~

~~EXCEPTIONS: 1. Hospital, vivarium and laboratory systems that utilize flow control devices on exhaust or return to maintain space pressure relationships necessary for occupant health and safety or environmental control shall be permitted to use variable volume fan power limitation.~~
~~2. Individual exhaust fans with motor nameplate horsepower of 1 hp or less are exempt from allowable fan motor horsepower requirements.~~

~~**Table C403.8.1(1)**~~
~~**Fan Power Limitation**~~

	~~Limit~~	~~Constant Volume~~	~~Variable Volume~~
~~Option 1: Fan system motor nameplate hp~~	~~Allowable nameplate motor hp~~	~~$hp \le CFM_S \times 0.0011$~~	~~$hp \le CFM_S \times 0.0015$~~
~~Option 2: Fan system bhp~~	~~Allowable fan system bhp~~	~~$bhp \le CFM_S \times 0.00094 + A$~~	~~$bhp \le CFM_S \times 0.0013 + A$~~

~~For SI: 1 cfm = 0.471 L/s. 1 bhp = 735.5 W, 1 hp = 745.5 W.~~

~~Where:~~

~~CFM_S = The maximum design supply airflow rate to conditioned spaces served by the system in cubic feet per minute.~~

~~hp~~	=	~~The maximum combined motor nameplate horsepower.~~
~~bhp~~	=	~~The maximum combined fan brake horsepower.~~
~~*A*~~	=	~~Sum of [*PD* × CFM_D/4131]~~

~~Where:~~

~~*PD*~~	=	~~Each applicable pressure drop adjustment from Table C403.8.1(2) in. w.c.~~
~~CFM_D~~	=	~~The design airflow through each applicable device from Table C403.8.1(2) in cubic feet per minute.~~

~~Table C403.8.1(2)~~
~~Fan Power Limitation Pressure Drop Adjustment~~

~~Device~~	~~Adjustment~~
~~Credits~~	
~~Return air or exhaust system required by code or accreditation standards to be fully ducted, or systems required to maintain air pressure differentials between adjacent rooms~~	~~0.5 inch w.c. (2.15 inches w.c. for laboratory and vivarium systems)~~
~~Return and/or exhaust air flow control devices~~	~~0.5 inch w.c.~~
~~Exhaust filters, scrubbers, or other exhaust treatment~~	~~The pressure drop of device calculated at fan system design condition~~
~~Particulate filtration credit: MERV 9 - 12~~	~~0.5 inch w.c.~~
~~Particulate filtration credit: MERV 13 - 15~~	~~0.9 inch w.c.~~
~~Particulate filtration credit: MERV 16 and greater and electronically enhanced filters~~	~~Pressure drop calculated at 2x clean filter pressure drop at fan system design condition~~
~~Carbon and other gas-phase air cleaners~~	~~Clean filter pressure drop at fan system design condition~~
~~Biosafety cabinet~~	~~Pressure drop of device at fan system design condition~~
~~Energy recovery device, other than coil runaround loop~~	~~For each airstream (2.2 × energy recovery effectiveness − 0.5) inch w.c.~~
~~Coil runaround loop~~	~~0.6 inch w.c. for each airstream~~
~~Evaporative humidifier/ cooler in series with another cooling coil~~	~~Pressure drop of device at fan system design conditions~~
~~Sound attenuation section (fans serving spaces with design background noise goals below NC35)~~	~~0.15 inch w.c.~~
~~Exhaust system serving fume hoods~~	~~0.35 inch w.c.~~

~~Device~~	~~Adjustment~~
~~Laboratory and vivarium exhaust systems in high-rise buildings~~	~~0.25 inch w.c./100 feet of vertical duct exceeding 75 feet~~
~~Deductions~~	
~~Systems without central cooling device~~	~~-0.6 inch w.c~~
~~Systems without central heating device~~	~~-0.3 inch w.c.~~
~~Systems with central electric resistance heat~~	~~-0.2 inch w.c.~~

~~For SI: 1 inch w.c. = 249 Pa, 1 inch = 25.4 mm. w.c. = water column.~~))

Fan System. Each *fan system* that includes at least one fan or fan array with *fan electrical input power* ≥ 1 kW, moving air into, out of, or between conditioned spaces or circulating air for the purpose of conditioning air within a space shall comply with Sections C403.8.1.1 through C403.8.1.2.

C403.8.1.1 Determining fan power budget. For each *fan system*, the *fan system electrical input power* (Fan $kW_{design,system}$) determined in accordance with Section C403.8.1.2 at the *fan system airflow* shall not exceed Fan kW_{budget}. Calculate fan power budget (Fan kW_{budget}) for each *fan system* as follows:

1. Determine the *fan system airflow* and choose the appropriate table(s) for fan power allowance.

1.1. For *single-cabinet fan systems*, use the *fan system airflow* and the power allowances in both Table C403.8.1.1(1) and Table C403.8.1.1(2).

1.2. For *supply-only fan systems*, use the *fan system airflow* and power allowances in Table C403.8.1.1(1).

1.3. For *relief fan systems*, use the design relief airflow and the power allowances in Table C403.8.1.1(2).

1.4. For exhaust, return and transfer *fan systems*, use the *fan system airflow* and the power allowances in Table C403.8.1.1(2).

1.5. For complex and DOAS with energy recovery *fan systems*, separately calculate the *fan power* allowance for the supply and return/exhaust systems and sum them. For the supply airflow, use supply airflow at the *fan system* design conditions, and the power allowances in Table C403.8.1.1(1). For the return/exhaust airflow, use return/exhaust airflow at the *fan system* design conditions, and the power allowances in Table C403.8.1.1(2).

2. For each *fan system*, determine the components included in the fan system and sum the fan power allowances of those components. All fan systems shall include the system base allowance. If, for a given component, only a portion of the fan system airflow passes through the component, calculate the fan power allowance for that component in accordance with Equation 4-11:

(Equation 4-11)

$$FPA_{adj} = (Q_{comp}/Q_{sys}) \times FPA_{comp}$$

Where:

FPA_{adj} = The corrected fan power allowance for the component in W/cfm.

Q_{comp}	=	The airflow through component in cfm.
Q_{sys}	=	The *fan system airflow* in cfm.
FPA_{comp}	=	The fan power allowance of the component from Table C403.8.1.1(1) or Table C403.8.1.1(2).

3. Multiply the *fan system airflow* by the sum of the fan power allowances for the *fan system*.

4. Divide by 1,000 to convert to Fan kW_{budget}.

5. For building sites at elevations greater than 3,000 feet, multiply Fan kW_{budget} by 0.896.

Table C403.8.1.1(1)
Supply Fan Power Allowances (W/CFM)

Airflow	Multi-Zone VAV Systems[a] ≤ 5,000 cfm	Multi-Zone VAV Systems[a] > 5,000 and ≤ 10,000 cfm	Multi-Zone VAV Systems[a] > 10,000 cfm	All Other *Fan Systems* ≤ 5,000 cfm	All Other *Fan Systems* > 5,000 and ≤ 10,000 cfm	All Other *Fan Systems* > 10,000 cfm
Supply system base allowance for AHU serving spaces ≤ 6 floors away	0.395	0.453	0.413	0.232	0.256	0.236
Supply system base allowance for AHU serving spaces > 6 floors away	0.508	0.548	0.501	0.349	0.356	0.325
MERV 13 to MERV 16 Filter upstream of thermal conditioning equipment (two-times the clean filter pressure drop)[b]	0.136	0.114	0.105	0.139	0.120	0.107
MERV 13 to MERV 16 Final filter downstream of thermal conditioning equipment (two-times the clean filter pressure drop)[b]	0.225	0.188	0.176	0.231	0.197	0.177
Filtration allowance for > MERV 16 or HEPA Filter (two-times the clean filter pressure drop)[b]	0.335	0.280	0.265	0.342	0.292	0.264
Central hydronic heating coil allowance	0.046	0.048	0.052	0.046	0.050	0.054
Electric heat allowance	0.046	0.038	0.035	0.046	0.040	0.036

Airflow	Multi-Zone VAV Systems[a] ≤ 5,000 cfm	Multi-Zone VAV Systems[a] > 5,000 and ≤ 10,000 cfm	Multi-Zone VAV Systems[a] > 10,000 cfm	All Other *Fan Systems* ≤ 5,000 cfm	All Other *Fan Systems* > 5,000 and ≤ 10,000 cfm	All Other *Fan Systems* > 10,000 cfm
Gas heat allowance	0.069	0.057	0.070	0.058	0.060	0.072
Hydronic/DX cooling coil or heat pump coil (wet) allowance[c]	0.135	0.114	0.105	0.139	0.120	0.107
Solid or liquid desiccant system allowance	0.157	0.132	0.123	0.163	0.139	0.124
Reheat coil for dehumidification allowance	0.045	0.038	0.035	0.046	0.040	0.036
Allowance for evaporative humidifier/ cooler in series with a cooling coil. Value shown is allowed W/cfm per 1.0 inches of water gauge (in.w.g.). Determine pressure loss (in.w.g.) at 400 fpm or maximum velocity allowed by the manufacturer, whichever is less[d]	0.224	0.188	0.176	0.231	0.197	0.177
Allowance for 100% Outdoor air system[e]	0.000	0.000	0.000	0.070	0.100	0.107
Energy recovery allowance for 0.50 ≤ ERR <0.55[f]	0.135	0.114	0.105	0.139	0.120	0.107
Energy recovery allowance for 0.55 ≤ ERR <0.60[f]	0.160	0.134	0.124	0.165	0.141	0.126
Energy recovery allowance for 0.60 ≤ ERR <0.65[f]	0.184	0.155	0.144	0.190	0.163	0.146
Energy recovery allowance for 0.65 ≤ ERR <0.70[f]	0.208	0.175	0.163	0.215	0.184	0.165
Energy recovery allowance for 0.70 ≤ ERR <0.75[f]	0.232	0.196	0.183	0.240	0.205	0.184

Airflow	Multi-Zone VAV Systems[a] ≤ 5,000 cfm	Multi-Zone VAV Systems[a] > 5,000 and ≤ 10,000 cfm	Multi-Zone VAV Systems[a] > 10,000 cfm	All Other *Fan Systems* ≤ 5,000 cfm	All Other *Fan Systems* > 5,000 and ≤ 10,000 cfm	All Other *Fan Systems* > 10,000 cfm
Energy recovery allowance for 0.75 ≤ ERR <0.80[f]	0.257	0.216	0.202	0.264	0.226	0.203
Energy recovery allowance for ERR ≥ 0.80[f]	0.281	0.236	0.222	0.289	0.247	0.222
Coil runaround loop	0.135	0.114	0.105	0.139	0.120	0.107
Allowance for Gas phase filtration required by code or accredited standard. Value shown is allowed W/cfm per 1.0 in. wg air pressure drop[d]	0.224	0.188	0.176	0.231	0.197	0.177
Economizer damper return	0.045	0.038	0.035	0.046	0.040	0.036
Air blender allowance	0.045	0.038	0.035	0.046	0.040	0.036
Sound attenuation section [fans serving spaces with design background noise goals below NC35]	0.034	0.029	0.026	0.035	0.030	0.027
Deduction for systems that feed a terminal unit with a fan with electrical input power < 1kW	-0.100	-0.100	-0.100	-0.100	-0.100	-0.100
Low-turndown single-zone VAV fan systems[g]	0.000	0.000	0.000	0.070	0.100	0.089

a See definition of FAN SYSTEM, MULTI-ZONE VARIABLE AIR VOLUME (VAV).
b Filter fan power allowance can only be counted once per fan system, except fan systems in health care facilities, which can claim one of the MERV 13 to 16 filter allowances and the HEPA filter allowance if both are included in the *fan system*.
c Health care facilities can claim this fan power allowance twice per *fan system* where coil design leaving air temperature is less than 44ºF.
d Power allowance requires further calculation by multiplying the actual inches of water gauge (in.w.g.) of the device/component by the w/cfm in Table C403.8.1(1).
e The 100% outdoor air system must serve 3 or more HVAC zones and airflow during noneconomizer operating periods must comply with Section C403.2.2.1.
f Enthalpy Recovery Ratio (ERR) calculated per ANSI/ASHRAE 84-2020.
g A low-turndown single-zone VAV fan system must be capable of and configured to reduce airflow to 50 percent of design airflow and use no more than 30 percent of the design wattage at that airflow. No more than 10 percent of the design load served by the equipment shall have fixed loads.

Table C403.8.1.1(2)
Exhaust, Return, Relief, Transfer Fan Power Allowances (W/CFM)

Airflow	Multi-Zone VAV Systems[a] ≤ 5,000 cfm	Multi-Zone VAV Systems[a] > 5,000 and ≤ 10,000 cfm	Multi-Zone VAV Systems[a] > 10,000 cfm	All Other *Fan Systems* ≤ 5,000 cfm	All Other *Fan Systems* > 5,000 and ≤ 10,000 cfm	All Other *Fan Systems* > 10,000 cfm
Exhaust system base allowance	0.221	0.246	0.236	0.186	0.184	0.190
Filter (any MERV value)[b]	0.046	0.041	0.036	0.046	0.041	0.035
Energy recovery allowance for 0.50 ≤ ERR <0.55[c]	0.139	0.120	0.107	0.139	0.123	0.109
Energy recovery allowance for 0.55 ≤ ERR <0.60[c]	0.165	0.142	0.126	0.165	0.144	0.128
Energy recovery allowance for 0.60 ≤ ERR <0.65[c]	0.190	0.163	0.146	0.191	0.166	0.148
Energy recovery allowance for 0.65 ≤ ERR <0.70[c]	0.215	0.184	0.165	0.216	0.188	0.167
Energy recovery allowance for 0.70 ≤ ERR <0.75[c]	0.240	0.206	0.184	0.241	0.209	0.186
Energy recovery allowance for 0.75 ≤ ERR <0.80[c]	0.265	0.227	0.203	0.266	0.231	0.205
Energy recovery allowance for ERR ≥ 0.80[c]	0.289	0.248	0.222	0.291	0.252	0.225
Coil runaround loop	0.139	0.120	0.107	0.139	0.123	0.109
Return or exhaust systems required by code or accreditation standards to be fully ducted, or systems required to maintain air pressure differentials between adjacent rooms	0.116	0.100	0.089	0.116	0.102	0.091
Return and/or exhaust airflow control devices	0.116	0.100	0.089	0.116	0.102	0.091

Airflow	Multi-Zone VAV Systems[a] ≤ 5,000 cfm	Multi-Zone VAV Systems[a] > 5,000 and ≤ 10,000 cfm	Multi-Zone VAV Systems[a] > 10,000 cfm	All Other *Fan Systems* ≤ 5,000 cfm	All Other *Fan Systems* > 5,000 and ≤ 10,000 cfm	All Other *Fan Systems* > 10,000 cfm
Laboratory and vivarium exhaust systems in high-rise buildings for vertical duct exceeding 75 ft. Value shown is allowed W/cfm per 0.25 in. wg for each 100 feet exceeding 75 feet[d]	0.058	0.051	0.045	0.058	0.052	0.046
Biosafety cabinet. Value shown is allowed W/cfm per 1.0 in. wg air pressure drop[d]	0.231	0.198	0.177	0.232	0.202	0.179
Exhaust filters, scrubbers, or other exhaust treatment required by code or standard. Value shown is allowed W/cfm per 1.0 in. wg air pressure drop[d]	0.231	0.198	0.177	0.232	0.202	0.179
Health care facility allowance[e]	0.231	0.198	0.177	0.232	0.202	0.179
Sound attenuation section [Fans serving spaces with design background noise goals below NC35.]	0.035	0.030	0.027	0.035	0.031	0.028

[a] See definition of FAN SYSTEM, MULTI-ZONE VARIABLE AIR VOLUME (VAV) to be classified as a Multi-Zone VAV System.
[b] Filter pressure loss can only be counted once per fan system.
[c] Enthalpy Recovery Ratio (ERR) calculated per ANSI/ASHRAE 84-2020.
[d] Power allowance requires further calculation, multiplying the actual pressure drop (in. wg) of the device/component by the W/cfm in the Table C403.8.1(2).
[e] This allowance can only be taken for health care facilities.

C403.8.1.2 Determining *Fan System Electrical Input Power* (Fan $kW_{design,system}$). *Fan* $kW_{design,system}$ is the sum of *Fan* kW_{design} for each fan or fan array included in the *fan system*. If variable speed drives are used, their efficiency losses shall be included. Fan input power shall be calculated with two-times the clean filter pressure drop. The *Fan* kW_{design} for each fan or fan array shall be determined using one of the following methods. There is no requirement to use the same method for all fans in a *fan system*:

1. Use the default *Fan* kW_{design} in Table C403.8.1.2 for one or more of the fans. This method cannot be used for *complex fan systems*.

2. Use the *Fan kW$_{design}$* at *fan system design conditions* provided by the manufacturer of the fan, fan array, or equipment that includes the fan or fan array calculated per a test procedure included in 10 C.F.R. Part 430, 10 C.F.R. Part 431, ANSI/AMCA 208, ANSI/AMCA S210, AHRI 430, AHRI 440, or ISO 5801.

3. Use the *Fan kW$_{design}$* provided by the manufacturer, calculated at *fan system design conditions* per one of the methods listed in Section 5.3 of ANSI/AMCA 208.

4. Determine the *Fan kW$_{design}$* by using the maximum electrical input power provided on the motor nameplate.

Table C403.8.1.2

Default Values for Fan kW$_{design}$ Based on Motor Nameplate HP[a,b]

Motor Nameplate HP	Default *Fan kW$_{design}$* with variable speed drive (Fan kW$_{design}$)	Default *Fan kW$_{design}$* without variable speed drive (Fan kW$_{design}$)
<1	0.96	0.89
≥1 and <1.5	1.38	1.29
≥1.5 and <2	1.84	1.72
≥2 and <3	2.73	2.57
≥3 and <5	4.38	4.17
≥5 and <7.5	6.43	6.15
≥7.5 and <10	8.46	8.13
≥10 and <15	12.4	12.0
≥15 and <20	16.5	16.0
≥20 and <25	20.5	19.9
≥25 and <30	24.5	23.7
≥30 and <40	32.7	31.7
≥40 and <50	40.7	39.4
≥50 and <60	48.5	47.1
≥60 and <75	60.4	58.8
≥75 and ≤100	80.4	78.1

[a] This table cannot be used for motor nameplate horsepower values greater than 100.

[b] This table is to be used only with motors with a service factor ≤1.15. If the service factor is not provided, this table may not be used.

C403.8.2 Motor nameplate horsepower. For each fan, the selected fan motor shall be no larger than the first available motor size greater than the brake horsepower (bhp). The fan brake horsepower (bhp) shall be indicated on the design documents to allow for compliance verification by the *code official*.

EXCEPTIONS:
1. For fans less than 6 bhp (((~~4413~~)) 4476 W), where the first available motor larger than the brake horsepower has a nameplate rating within 50 percent of the bhp, selection of the next larger nameplate motor size is allowed.
2. For fans 6 bhp (((~~4413~~)) 4476 W) and larger, where the first available motor larger than the bhp has a nameplate rating within 30 percent of the bhp, selection of the next larger nameplate motor size is allowed.
3. For fans used only in *approved* life safety applications such as smoke evacuation.
4. Fans with motor nameplate horsepower less than 1 hp ((~~are exempt from this section~~)) or fans with a fan motor nameplate electrical input power of less than 0.89 kW.
5. Fans equipped with electronic speed control devices to vary the fan airflow as a function of load.

C403.8.3 Fan efficiency. ((~~Fans shall have a fan efficiency grade (FEG) of 67 or higher based on manufacturers' certified data, as defined by AMCA 205. The total efficiency of the fan at the design point of operation shall be within 15 percentage points of the maximum total efficiency of the fan.~~)) Each fan and *fan array* shall have a *fan energy index (FEI)* of not less than 1.00 at the design point of operation, as determined in accordance with AMCA 208 by an *approved*, independent

testing laboratory and labeled by the manufacturer. Each fan and *fan array* used for a variable-air volume system shall have an *FEI* of not less than 0.95 at the design point of operation as determined in accordance with AMCA 208 by an *approved*, independent testing laboratory and labeled by the manufacturer. The *FEI* for *fan arrays* shall be calculated in accordance with AMCA 208 Annex C.

EXCEPTION: The following fans are not required to have a fan ((~~efficiency grade~~)) energy index:
1. ((~~Individual fans with a motor nameplate horsepower of 5 hp (3.7 kW) or less that are not part of a group operated as the functional equivalent of a single fan.~~)) Fans that are not *embedded pans* with motor nameplate horsepower of less than 1.0 hp (0.75 kW) or with a nameplate electrical input power of less than 0.89 kW.
2. *Embedded fans* that have a motor nameplate horsepower of 5 hp (3.7 kW) or less or with a fan system electrical input power of 4.1 kW or less.
3. Multiple fans operated in series or parallel as the functional equivalent of a single fan that have a combined motor nameplate horsepower of 5 hp (3.7 kW) or less ((~~and are operated as the functional equivalent of a single fan~~)) or with a fan system electrical input power of 4.1 kW or less.
((~~3.~~)) 4. Fans that are part of equipment covered under Section C403.3.2.
((~~4.~~)) 5. Fans included in an equipment package certified by an *approved agency* for air or energy performance.
((~~5. Powered wall/roof ventilators.~~)) 6. *Ceiling fans*.
((~~6. Fans outside the scope of AMCA 205.~~)) 7. Fans used for moving gases at temperatures above 425°F (250°C).
((~~7. Fans that are intended to operate only during emergency conditions.~~)) 8. Fans used for operation in explosive atmospheres.
9. Reversible fans used for tunnel ventilation.
10. Fans that are intended to operate only during emergency conditions.
11. Fans outside the scope of AMCA 208.

C403.8.4 ((~~Group R occupancy exhaust fan efficacy.~~ ~~The Group R occupancies of the building shall be provided with ventilation that meets the requirements of the *International Mechanical Code*, as applicable, or with other approved means of ventilation. Mechanical ventilation system fans with 400 cfm or less~~)) **Low-capacity ventilation fans.** Mechanical ventilation system fans with motors less than 1/12 hp (0.062 kW) in capacity shall meet the efficacy requirements of Table C403.8.4 at one or more rating points.

EXCEPTIONS: 1. ((~~Group R heat recovery ventilator and energy recovery ventilator fans that are less than 400 cfm.~~)) Where ventilation fans are a component of a listed heating or cooling appliance.
2. ((~~Where whole house ventilation fans are integrated with forced-air systems that are tested and listed HVAC equipment, provided they are powered by an electronically commutated motor where required by Section C405.8.~~)) Dryer exhaust duct power ventilators and domestic range booster fans that operate intermittently.
((~~3. Domestic clothes dryer booster fans, domestic range hood exhaust fans, and domestic range booster fans that operate intermittently.~~))

Table C403.8.4
((~~Group R Exhaust Fan Efficacy~~))
Low-Capacity Ventilation Fan Efficacy[a]

((~~Fan Location~~	~~Air Flow Rate Minimum (cfm)~~	~~Minimum Efficacy (cfm/watt)~~	~~Air Flow Rate Maximum (cfm)~~
~~Exhaust fan: Bathroom, utility room, whole house~~	~~10~~	~~2.8~~	~~< 90~~
~~Exhaust fan: Bathroom, utility room, whole house~~	~~90~~	~~3.5~~	~~Any~~
~~In-line (single-port and multi-port) fans~~	~~Any~~	~~3.8~~	~~Any~~))

Fan Location	Airflow Rate Minimum (cfm)	Minimum Efficacy (cfm/watt)	Airflow Rate Maximum (cfm)
HRV or ERV	Any	1.2 cfm/watt	Any
Range hood	Any	2.8 cfm/watt	Any
In-line fan	Any	3.8 cfm/watt	Any
Bathroom, utility room	10	2.8 cfm/watt	< 90
Bathroom, utility room	90	3.5 cfm/watt	Any

For SI: 1 cfm/ft = 47.82 W.
[a] Airflow shall be tested in accordance with HVI 916 and listed. Efficacy shall be listed or shall be derived from listed power and airflow. Fan efficacy for fully ducted HRV, ERV, balanced and in-line fans shall be determined at a static pressure not less than 0.2 inch w.c. Fan efficacy for ducted range hoods, bathroom, and utility room fans shall be determined at a static pressure not less than 0.1 inch w.c.

C403.8.5 Fan controls. Controls shall be provided for fans in accordance with Section C403.8.5.1 and as required for specific systems provided in Section C403.

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

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

2. Other units including DX cooling units and chilled water units that control the space temperature by modulating the airflow to the space shall have modulating fan control. Minimum speed shall be not greater than 50 percent of full speed. At minimum speed, the fan system shall draw no more than 30 percent of the power at full fan speed. Low or minimum speed shall be used during periods of low cooling load and ventilation-only operation.

3. Units that include an airside economizer in accordance with Section C403.5 shall have not fewer than two speeds of fan control during economizer operation.

EXCEPTIONS:
1. Modulating fan control is not required for chilled water and evaporative cooling units with fan motors of less than 1 hp (0.746 kW) where the units are not used to provide ventilation air and the indoor fan cycles with the load.
2. Where the volume of outdoor air required to comply with the ventilation requirements of the *International Mechanical Code* at low speed exceeds the air that would be delivered at the minimum speed defined in Section C403.8.5, the minimum speed shall be selected to provide the required ventilation air.

Table C403.8.5.1
Fan Control

Cooling System Type	Fan Motor Size	Mechanical Cooling Capacity
DX cooling	Any	≥ 42,000 Btu/h
Chilled water and evaporative cooling	≥ 1/4 hp	Any

C403.8.6 Large-diameter ceiling fans. Where provided, *large-diameter ceiling fans* shall be tested and labeled in accordance with AMCA 230.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-4039 Section C403.9—Heat rejection and heat recovery equipment.

C403.9 Heat rejection and heat recovery equipment.

C403.9.1 Heat rejection equipment. Heat rejection equipment, including air-cooled condensers, dry coolers, open-circuit cooling towers, closed-circuit cooling towers and evaporative condensers, shall comply with this section.

EXCEPTION: Heat rejection devices where energy usage is included in the equipment efficiency ratings listed in Tables ((~~C403.3.2(1)A, C403.3.2(1)B, C403.3.2(1)C, C403.3.2(2), C403.3.2(3), C403.3.2(7) and C403.3.2(9)~~)) C403.3.2(1), C403.3.2(2), C403.3.2(3), C403.3.2(4), C403.3.2(8), C403.3.2(9), C403.3.2(10) and C403.3.2(16).

Heat rejection equipment shall have a minimum efficiency performance not less than values specified in Table C403.3.2((~~(8)~~)) (7).

C403.9.1.1 Fan speed control. Each fan powered by an individual motor or array of motors with a connected power, including the motor service factor, totaling 5 hp (3.7 kW) or more shall have controls and devices configured to automatically modulate the fan speed to control the leaving fluid temperature or condensing temperature and pressure of the heat rejection device. Fan motor power input shall be not more than 30 percent of design wattage at 50 percent of the design airflow.

EXCEPTIONS: 1. Fans serving multiple refrigerant or fluid cooling circuits.
2. Condenser fans serving flooded condensers.

C403.9.1.2 Multiple-cell heat rejection equipment. Multiple-cell heat rejection equipment with variable speed fan drives shall be controlled to operate the maximum number of fans allowed that comply with the manufacturer's requirements for all system components and so that all fans can operate at the same fan speed required for the instantaneous cooling duty, as opposed to staged (on/off) operation. The minimum fan speed shall be the minimum allowable speed of the fan drive system in accordance with the manufacturer's recommendations.

C403.9.1.3 Limitation on centrifugal fan open-circuit cooling towers. Centrifugal fan open-circuit cooling towers with a combined rated capacity of 1,100 gpm (4164 L/m) or greater at 95°F (35°C) condenser water return, 85°F (29°C) condenser water supply, and 75°F (24°C) outdoor air wet-bulb temperature shall meet the energy efficiency requirement for axial fan open-circuit cooling towers listed in Table C403.3.2((~~(8)~~)) (7).

C403.9.1.4 Tower flow turndown. Open-circuit cooling towers used on water-cooled chiller systems that are configured with multiple- or variable-speed condenser water pumps shall be designed so that all open circuit cooling tower cells can be run in parallel with the larger of the flow that is produced by the smallest pump at its minimum expected flow rate or at 50 percent of the design flow for the cell.

C403.9.2 Heat recovery.

C403.9.2.1 Condenser heat recovery for service water heating. Condenser heat recovery shall be installed for heating or reheating of service hot water provided the facility operates 24 hours a day, the total installed heat capacity of water cooled systems exceeds 1,500,000 Btu/hr of heat rejection, and the design service water heating load exceeds 250,000 Btu/hr.

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

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

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

EXCEPTIONS: 1. Facilities that employ condenser heat recovery for space heating or reheat purposes with a heat recovery design exceeding 30 percent of the peak water-cooled condenser load at design conditions.
2. Facilities that provide 60 percent of their service water heating from site recovered energy.

C403.9.2.2 Steam 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~~)) generated steam where the condensate is not returned to the source, shall have an on-site condensate water heat recovery system.

C403.9.2.3 Refrigeration 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.

C403.9.2.4 Condenser heat recovery for space heating. A water-source condenser heat recovery system meeting the requirements of Sections C403.9.2.4.1 through C403.9.2.4.4 shall be installed to serve space and ventilation heating systems in new buildings and additions meeting the following criteria:

1. The facility operates greater than 70 hours per week.
2. The sum of all heat rejection equipment capacity serving the new building or addition exceeds 1,500,000 Btu/hr.
3. The sum of zone minimum airflows in all zones with zone reheat coils divided by the conditioned floor area served by those systems is at least 0.45 cfm per square foot.

EXCEPTION: Systems complying with Section C403.3.5, Dedicated outdoor air systems.

C403.9.2.4.1 Water-to-water heat recovery. Ninety percent (90%) of the total building space and ventilation heating system design load shall be served by systems that include heat recovery chiller or water-to-water heat pump equipment capable of rejecting heat from the cooling loop to the space and ventilation heating loop as the first stage of heating.

C403.9.2.4.2 Exhaust heat recovery. Heat shall be recovered by the heat recovery system from 90 percent of the total building exhaust airflow. The maximum leaving air temperature of exhaust air after heat recovery shall be 55°F dry-bulb when operating at full capacity in heat recovery mode.

EXCEPTIONS:
1. Where energy recovery systems are restricted by Section 514 of the International Mechanical Code to sensible energy, those systems shall not be included in the calculation of total building exhaust airflow.
2. Exhaust air systems handling contaminated airstreams that are regulated by applicable codes or accreditation standards and pose a health risk to maintenance personnel to maintain heat recovery devices, those systems shall not be included in the calculation of total building exhaust airflow.

C403.9.2.4.3 Process heat recovery. Spaces with year-round cooling loads from lights and equipment of 5 watts and greater per square foot shall be served by water-cooled equipment. Cooling loops serving the water-cooled equipment shall be served by water source heat recovery systems meeting the requirements of Section C403.9.2.4.1. If such spaces are provided with an air or water economizer, the economizer controls shall be configured with an override signal from the building automation system to disable economizer operation during heat recovery mode.

C403.9.2.4.4 Water-to-water heat recovery sizing. The minimum total combined capacity of heat recovery chillers or water-to-water heat pumps shall match the total combined capacity of installed equipment sized to meet the requirements of Sections C403.9.2.4.2 and C403.9.2.4.3.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-40391 Section C403.10—Construction of HVAC system elements.

C403.10 Construction of HVAC system elements. Ducts, plenums, piping and other elements that are part of an HVAC system shall be constructed and insulated in accordance with Sections C403.10.1 through C403.10.3.1.

C403.10.1 Duct and plenum insulation and sealing.

C403.10.1.1 Ducts, shafts, and plenums conveying outdoor air. ((~~Ducts,~~)) Shafts and plenums conveying outdoor air from the exterior of the building to the mechanical system shall meet all air leakage and building envelope insulation requirements of Section C402, plus building envelope vapor control requirements from the *International Building Code*((~~, extending~~)).

Ducts conveying outdoor air shall be insulated continuously from the building exterior to an automatic shutoff damper or heating or cooling equipment. ((~~For the purposes of building envelope insulation requirements,~~)) Duct surfaces shall be insulated with the minimum insulation values in Table C403.10.1.1. Duct surfaces included as part of the building envelope shall not be used in the calculation of maximum glazing area as described in Section C402.4.1.

EXCEPTION((~~S~~)): ((~~1.~~)) Outdoor air ducts serving individual supply air units with less than 2,800 cfm of total supply air capacity, provided these are insulated to the minimum insulation values in Table C403.10.1.1.
((~~2. Unheated equipment rooms with combustion air louvers, provided they are isolated from conditioned space at sides, top and bottom of the room with R-11 nominal insulation.~~))

Table C403.10.1.1
Outdoor Air Ductwork Insulation

Duct system	Duct Location and Use	Climate Zone	Airflow	Minimum Installed Duct Insulation *R*-value[a,b]	Notes
Outdoor Air	Inside conditioned space and upstream of automatic shutoff damper	4C and 5B	≥ 2800 CFM	R-16	See Section C403.10.1.1 for additional requirements
Outdoor Air	Inside conditioned space and downstream of automatic shutoff damper to HVAC unit or room	4C	≥ 2800 CFM	R-8	

Duct system	Duct Location and Use	Climate Zone	Airflow	Minimum Installed Duct Insulation *R*-value[a,b]	Notes
Outdoor Air	Inside conditioned space and downstream of automatic shutoff damper to HVAC unit or room	5B	≥ 2800 CFM	R-12	
Outdoor Air	Inside conditioned space	4C and 5B	≤ 2800 CFM	R-7	See Exception 1 to Section C403.10.1.1 for additional details

[a] Insulation *R*-values, measured in h·ft^2·°F/Btu, are for the insulation as installed and do not include film resistance. The required minimum thicknesses do not consider water vapor transmission and possible surface condensation. Insulation resistance measured on a horizontal plane in accordance with ASTM C518 at a mean temperature of 75°F at the installed thickness.
[b] See *International Mechanical Code* Sections 603.12 and 604 for further details on duct insulation requirements.

C403.10.1.2 Other supply and return ducts. All other supply and return air ducts and plenums shall be insulated with a minimum of R-6 insulation where located in unconditioned spaces, and where located outside the building with a minimum of R-8 insulation in Climate Zone 4 and R-12 insulation in Climate Zone 5. Ducts located underground beneath buildings shall be insulated as required in this section or have an equivalent *thermal distribution efficiency*. Underground ducts utilizing the *thermal distribution efficiency* method shall be listed and labeled to indicate the *R*-value equivalency. Where located within a building envelope assembly, the duct or plenum shall be separated from the building exterior or unconditioned or exempt spaces by minimum insulation value as required for exterior walls by Section C402.1.3.

EXCEPTIONS: 1. Where located within equipment.
2. Supply and return ductwork located in unconditioned spaces where the design temperature difference between the interior and exterior of the duct or plenum does not exceed 15°F (8°C) and are insulated in accordance with Table C403.10.1.2.

Where located within conditioned space, supply ducts which convey supply air at temperatures less than 55°F or greater than 105°F shall be insulated with a minimum insulation *R*-value in accordance with Table C403.10.1.2.

EXCEPTION: Ductwork exposed to view within a zone that serves that zone is not required to be insulated.

Where located within conditioned space, return or exhaust air ducts that convey return or exhaust air downstream of an energy recovery media shall be insulated with a minimum insulation *R*-value in accordance with Table C403.10.1.2.

All ducts, air handlers, and filter boxes shall be sealed. Joints and seams shall comply with Section 603.9 of the *International Mechanical Code*.

Table C403.10.1.2
Supply, Return, Exhaust and Relief Air Ductwork Insulation

Duct System	Duct Location and Use	Climate Zone	Minimum Installed Duct Insulation *R*-value[a,b]	Notes
Supply air or return air	Outside the building (outdoors and exposed to weather)[c]	4C	R-8	See Section C403.10.1.2 for details
Supply air or return air	Outside the building (outdoors and exposed to weather)[c]	5B	R-12	See Section C403.10.1.2 for details

Duct System	Duct Location and Use	Climate Zone	Minimum Installed Duct Insulation *R*-value[a,b]	Notes
Supply air or return air	Unconditioned space (enclosed but not in the building conditioned envelope)	4C and 5B	R-6	See Section C403.10.1.2 for details
Supply air or return air	Unconditioned space where the duct conveys air that is within 15°F of the air temperature of the surrounding unconditioned space	4C and 5B	R-3.3	See IMC Section 603.12 for additional requirements for condensation control at ductwork
Supply air or return air	Where located in a building envelope assembly	4C and 5B	R-16	Duct or plenum is separated from building envelope assembly with the minimum insulation value
Supply air	Within conditioned space where the supply duct conveys air that is less than 55°F or greater than 105°F	4C and 5B	R-3.3	See Section C403.10.1.2 for details
Supply air	Within conditioned space that the duct directly serves where the supply duct conveys air that is less than 55°F or greater than 105°F	4C and 5B	None	See Section C403.10.1.2 for details
Supply air	Within conditioned space where the supply duct conveys air that is 55°F or greater and 105°F or less	4C and 5B	None	
Return or exhaust air	Within conditioned space, downstream of an energy recovery media, upstream of an automatic shutoff damper	4C	R-8	
Return or exhaust air	Within conditioned space, downstream of an energy recovery media, upstream of an automatic shutoff damper	5B	R-12	
Relief or exhaust air	Conditioned space and downstream of an automatic shutoff damper	4C and 5B	R-16	

[a] Insulation *R*-values, measured in h·ft^2·°F/Btu, are for the insulation as installed and do not include film resistance. The required minimum thicknesses do not consider water vapor transmission and possible surface condensation. Insulation resistance measured on a horizontal plane in accordance with ASTM C518 at a mean temperature of 75°F at the installed thickness.

[b] See *International Mechanical Code* Sections 603.12 and 604 for further details on duct insulation requirements.

[c] Includes attics above insulated ceilings, parking garages and crawl spaces.

C403.10.2 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.

C403.10.2.1 Low-pressure duct systems. 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.

C403.10.2.2 Medium-pressure duct systems. 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 C403.10.1. Pressure classifications specific to the duct system shall be clearly indicated on the construction documents in accordance with the *International Mechanical Code*.

C403.10.2.3 High-pressure duct systems. Ducts designed to operate at static pressures equal to or greater than 3 inches water gauge (w.g.) (750 Pa) shall be insulated and sealed in accordance with Section C403.10.1. In addition, ducts and plenums shall be leak-tested in accordance with the SMACNA *HVAC Air Duct Leakage Test Manual* and shown to have a rate of air leakage (*CL*) less than or equal to 4.0 as determined in accordance with Equation ((~~4–9~~)) 4-12.

(Equation ((~~4–9~~)) 4-12)

$$CL \quad F/P^{0.65}$$

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.

C403.10.3 Piping insulation. All piping, other than field installed HVAC system refrigerant piping, serving as part of a heating or cooling system shall be thermally insulated in accordance with Table C403.10.3.

EXCEPTIONS:
1. Factory-installed piping within HVAC equipment tested and rated in accordance with a test procedure referenced by this code.
2. Factory-installed piping within room fan-coils and unit ventilators tested and rated according to AHRI 440 (except that the sampling and variation provisions of Section 6.5 shall not apply) and 840, respectively.
3. Piping that conveys fluids that have a design operating temperature range between 60°F (15°C) and 105°F (41°C).
4. Piping that conveys fluids that have not been heated or cooled through the use of fossil fuels or electric power.
5. Strainers, control valves, and balancing valves associated with piping 1 inch (25 mm) or less in diameter.
6. Direct buried piping that conveys fluids at or below 60°F (15°C).
7. In radiant heating systems, sections of piping intended by design to radiate heat.

Table C403.10.3

Minimum Pipe Insulation Thickness (thickness in inches)[a]

Fluid Operating Temperature Range and Usage (°F)	Insulation Conductivity		Nominal Pipe or Tube Size (inches)				
	Conductivity Btu • in. /(h • ft^2 • °F)[b]	Mean Rating Temperature, °F	< 1	1 to < 1-1/2	1-1/2 to < 4	4 to < 8	≥ 8
> 350	0.32 - 0.34	250	4.5	5.0	5.0	5.0	5.0

Fluid Operating Temperature Range and Usage (°F)	Insulation Conductivity		Nominal Pipe or Tube Size (inches)				
	Conductivity Btu • in. /(h • ft^2 • °F)[b]	Mean Rating Temperature, °F	< 1	1 to < 1-1/2	1-1/2 to < 4	4 to < 8	≥ 8
251 - 350	0.29 - 0.32	200	3.0	4.0	4.5	4.5	4.5
201 - 250	0.27 - 0.30	150	2.5	2.5	2.5	3.0	3.0
141 - 200	0.25 - 0.29	125	1.5	1.5	2.0	2.0	2.0
105 - 140	0.21 - 0.28	100	1.0	1.0	1.5	1.5	1.5
40 - 60	0.21 - 0.27	75	0.5	0.5	1.0	1.0	1.0
< 40	0.20 - 0.26	75	0.5	1.0	1.0	1.0	1.5

[a] For piping smaller than 1-1/2 inch (38 mm) and located in partitions within *conditioned spaces*, reduction of these thicknesses by 1 inch (25 mm) shall be permitted (before thickness adjustment required in footnote b) but not to a thickness less than 1 inch (25 mm).

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

$$T \quad r\{(1 + t/r)^{K/k} - 1\}$$

Where:

T = Minimum insulation thickness.

r = Actual outside radius of pipe.

t = Insulation thickness listed in the table for applicable fluid temperature and pipe size.

K = Conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu × in/h × ft^2 × °F).

k = The upper value of the conductivity range listed in the table for the applicable fluid temperature.

[c] For direct-buried heating and hot water system piping, reduction of these thicknesses by 1-1/2 inches (38 mm) shall be permitted (before thickness adjustment required in footnote b but not to thicknesses less than 1 inch (25 mm).

C403.10.3.1 Protection of piping insulation. Piping insulation exposed to weather shall be protected from damage, including that due to sunlight, moisture, ((~~equipment maintenance~~)) physical damage and wind, and shall provide shielding from solar radiation that can cause degradation of the material. Protection shall be removable for no less than six feet from the equipment for maintenance. Adhesive((~~s~~)) tape shall not be permitted.

C403.10.4 Insulation of HVAC system refrigerant piping. Field installed HVAC refrigerant piping, other than piping factory installed in HVAC equipment, shall have insulation as listed below, at a conductivity rating of 0.21 to 0.26 Btu × in/(h × ft^2 × °F) with a mean temperature rating of 75°F. Piping insulation exposed to weather shall be protected from damage, including that due to sunlight, moisture, physical damage and wind, and shall provide shielding from solar radiation that can cause degradation of the material. Adhesive tape shall not be permitted. Manufacturer's required minimum pipe insulation shall be maintained.

1. For lines that convey hot gas for space heating:

1.1. Minimum 1-inch insulation on the portions outside the building thermal envelope.

1.2. Minimum 1/2-inch insulation on the portions within the building thermal envelope.

2. Minimum 1/2-inch insulation on the liquid line for mini-split systems and other systems for which insulation is required by the manufacturer, or where the metering device is located in the outdoor unit.

3. No insulation is required on the liquid line for other heat pump types or for cooling-only units where insulation is not required by the manufacturer.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-40393 Section C403.12—High efficiency single zone VAV systems.

C403.12 High efficiency single-zone variable air volume (VAV) systems. For HVAC systems subject to the requirements of Section C403.3.5 but utilizing Exception 2 of that section, a high efficiency single-zone 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 (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* in accordance with Section C407):

1. The single-zone VAV system is provided with airside economizer in accordance with Section C403.3 without exceptions.

2. A direct-digital control (DDC) system is provided to control the system as a single zone in accordance with Section C403.4.11 regardless of sizing thresholds of Table C403.4.11.1.

3. Single-zone VAV systems with a minimum outdoor air requirement of 1,000 cfm (472 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 Section C403.7.1, Demand controlled ventilation.

4. Allowable fan ((~~motor horsepower~~)) power shall not exceed 90 percent of the allowable ((~~HVAC fan system bhp (Option 2)~~)) fan power budget as defined by Section C403.8.1.1.

5. Each single-zone VAV system shall be designed to vary the supply fan airflow as a function of heating and cooling load and minimum fan speed shall not be more than the greater of:

5.1. 30 percent of peak design airflow; or

5.2. The required ventilation flow assuming no occupants.

6. 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:

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

6.2. 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.

7. Single-zone VAV systems shall comply with one of the following options:

7.1. Single-zone VAV air handling units with a hydronic heating coil 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 92 percent, air-to-water heat pumps or heat recovery chillers. Hydronic heating coils shall be sized

for a maximum entering hot water temperature of 120°F for peak anticipated heating load conditions.

7.2. Single-zone VAV air handing units with a chilled water coil 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 C403.3.2((~~(7)~~)) (3), 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 percent of the total central plant cooling capacity or the chilled water system shall include thermal storage sized for a minimum of 20 percent of the total central cooling plant capacity.

7.3. Single-zone VAV air handling units with DX cooling, heat pump heating or gas-fired furnace shall comply with the following requirements as applicable:

7.3.1. Have a DX cooling coil with cooling part load efficiency that is a minimum of 15 percent higher than the minimum SEER or IEER listed in Tables C403.3.2(1), C403.3.2(2), and C403.3.2((~~(2)~~)) (14).

7.3.2. Have a gas-fired furnace with a thermal efficiency, E_t, of not less than 90 percent or heat pump with a minimum heating HSPF or COP efficiency that are a minimum of 10 percent higher than the minimum heating efficiency in Tables C403.3.2(1), C403.3.2(2), and C403.3.2((~~(2)~~)) (14).

7.3.3. Heating coils or burner output shall be modulating or have a minimum of 2 stages with the first stage being less than 50 percent of total heating capacity. Cooling coils shall be modulating or have a minimum of 2 stages with the first stage being less than 50 percent of the total cooling capacity.

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

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

8.1.1. Outside air.

8.1.2. Supply air.

8.1.3. Return air.

8.2. 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).

8.3. The single-zone VAV air handling unit controller shall be configured to provide system status by indicating the following:

8.3.1. Free cooling available.

8.3.2. Economizer enabled.

8.3.3. Compressor enabled.

8.3.4. Heating enabled.

8.3.5. Mixed air low limit cycle active.

8.3.6. The current value of each sensor.

8.4. The single-zone 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.

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

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

8.6.1. Air temperature sensor failure/fault.

8.6.2. Not economizing when the unit should be economizing.
8.6.3. Economizing when the unit should not be economizing.
8.6.4. Outdoor air or return air damper not modulating.
8.6.5. Excess outdoor air.

((~~**C403.13 Commissioning.** Mechanical systems shall be commissioned in accordance with Section C408.~~))

NEW SECTION

WAC 51-11C-40394 Section C403.13—Dehumidification for plant growth.

C403.15 Dehumidification in spaces for plant growth and maintenance. Equipment that dehumidifies building spaces used for plant growth and maintenance shall be one of the following:

1. *Stand-alone dehumidifiers* that meet the following minimum integrated energy factors as measured by the test conditions in Appendix X1 to Subpart B of 10 C.F.R. Part 430:

1.1. Minimum integrated energy factor of 1.77 L/kWh for product case volumes of 8.0 cubic feet or less;

1.2. Minimum integrated energy factor of 2.41 L/kWh for product case volumes greater than 8.0 cubic feet;

2. *Integrated HVAC system* including, but not limited to, heat pump technology, with on-site heat recovery designed to fulfill at least 75 percent of the annual energy for dehumidification reheat;

3. Chilled water system including, but not limited to, heat pump technology, with on-site heat recovery designed to fulfill at least 75 percent of the annual energy for dehumidification reheat; or

4. Solid or liquid *desiccant dehumidification system* for system designs that require dewpoint of 50°F (10°C) or less.

C403.14 Commissioning. Mechanical systems shall be commissioned in accordance with Section C408.

AMENDATORY SECTION (Amending WSR 13-04-056, filed 2/1/13, effective 7/1/13)

WAC 51-11C-40401 Section C404.1—General.

C404.1 General. This section covers the minimum efficiency of, and controls for, service water-heating equipment and insulation of service hot water piping.

EXCEPTION: Energy using equipment used by a manufacturing, industrial or commercial process other than maintaining comfort and amenities for the occupants are exempt from all Section C404 subsections except Sections C404.2 and C404.13.

OPTION 1

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-40402 Section C404.2—Service water-heating equipment performance efficiency.

C404.2 Service water-heating equipment performance efficiency. Water-heating equipment and hot water storage tanks shall meet the requirements of Table C404.2. The efficiency shall be verified through certification and *listed* under an *approved* certification program, or if no certification program exists, the equipment efficiency ratings shall be supported by data furnished by the manufacturer. Water-heating equipment intended to be used to provide space heating shall meet the applicable provisions of Table C404.2.

C404.2.1 High input-rated service water heating systems for other than Group R-1 and R-2 occupancies. In new buildings where the combined input rating of the water-heating equipment installed in a building is equal to or greater than 1,000,000 Btu/h (293 kW), the ((~~combined input-capacity-weighted-average efficiency of water-heating equipment shall be no less than the following for each water heating fuel source~~)) water-heating equipment serving occupancies other than Group R-1 and R-2 shall be one or both of the following:

1. ((~~Electric: A rated COP of not less than 2.0. For air-source heat pump equipment, the COP rating will be reported at the design leaving heat pump water temperature with an entering air temperature of 60°F (15.6°C) or less~~)) Heat pump water heater.

2. Fossil fuel((~~: A~~)) fired with a combined input-capacity-weighted-average rated E_t of not less than ((~~90~~)) 92 percent as determined by the applicable test procedure in Table C404.2.

EXCEPTIONS:

1. Where not less than 25 percent of the annual service water-heating requirement is provided from any of the following sources:
1.1. Renewable energy generated on-site that is not being used to satisfy another requirement of this code; or
1.2. Site-recovered energy that is not being used to satisfy other requirements of this code.
2. Redundant equipment intended to only operate during equipment failure or periods of extended maintenance.
3. Electric resistance heated systems installed as part of an alteration where the water heating equipment is installed at the grade level in a building with a height of four stories or greater.
4. Hot water heat exchangers used to provide service water heating from a district utility (steam, heating hot water).
5. Water heaters provided as an integral part of equipment intended to only heat or boost the heat of water used by that equipment.
6. ((~~For electric heat systems, supplemental water heaters not meeting this criteria that function as auxiliary heating only when the outdoor temperature is below 32°F (0°C) or when a defrost cycle is required are not required to have a rated COP of 2.0. 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.~~)) For heat pump water heater systems, supplemental electric resistance and fossil fuel water heaters that function as auxiliary heating 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).
7. Systems connected to a *low-carbon district energy exchange system*.

C404.2.2 High input-rated service water heating system for Group R-1 and R-2 occupancies. In new buildings with over 1,000,000 Btu/h installed service water heating capacity serving Group R-1 and R-2 occupancies, at least 25 percent of annual water heating energy shall be provided from any combination of the following water heating sources:

1. Renewable energy generated on-site that is not being used to satisfy other requirements of this code; or

2. Site-recovered energy that is not being used to satisfy other requirements of this code.

EXCEPTION: Compliance with this section is not required if ((~~the combined input-capacity-weighted average equipment rating for each service water heating fuel source type is not less than~~)) all service water heating is accomplished by equipment complying with one or more of the following:

1. Electric Resistance: ((~~An electric resistance water heater with a rating of 105 percent of the rated efficiency of Table C404.2.~~)) Electric resistance water heaters with an input capacity weighted average rating exceeding the average minimum efficiency of Table C404.2 by 5 percent.

2. Electric Heat Pump (((~~10 C.F.R. Part 430): A heat pump water heater rated in accordance with 10 C.F.R. Part 430 with a rating of 105 percent of the rated efficiency of Table C404.2.~~)):

2.1. Heat pump water heaters with rated input of 12 kW or less and rated in accordance with 10 C.F.R. Part 430.

2.2. Commercial heat pump water heaters tested in accordance with Appendix E, Subpart G of 10 C.F.R. 431. 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.

3. ((~~Electric Heat Pump (not listed in accordance with 10 C.F.R. Part 430): A heat pump water heater not rated in accordance with 10 C.F.R. Part 430 shall have a COP of not less than 2.0. For air-source heat pump equipment the COP rating will be reported at the design leaving heat pump water temperature with an entering air temperature of 60°F (15.6°C) or less. Supplemental water heaters not meeting the above criteria that function as auxiliary heating only when the outdoor temperature is below 32°F (0°C) or when a defrost cycle is required are not required to have a rated COP of 2.0. 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.~~

~~4.~~)) Fossil Fuels: ((~~A~~)) Fossil fuel water heaters with an input capacity weighted rated E_t of not less than ((~~90~~)) 92 percent as determined by the applicable test procedures in Table C404.2.

((~~5.~~)) 4. Hot water heat exchangers used to provide service water heating from a district utility (steam, heating hot water).

5. Systems connected to a *low-carbon district energy exchange system*.

OPTION 2

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-40402 Section C404.2—Service water-heating equipment performance efficiency.

C404.2 Service water-heating equipment performance efficiency. Water-heating equipment and hot water storage tanks shall meet the requirements of Table C404.2. The efficiency shall be verified through certification and *listed* under an *approved* certification program, or if no certification program exists, the equipment efficiency ratings shall be supported by data furnished by the manufacturer. Water-heating equipment intended to be used to provide space heating shall meet the applicable provisions of Table C404.2.

((~~**C404.2.1 High input-rated service water heating systems for other than Group R-1 and R-2 occupancies.** In new buildings where the combined input rating of the water-heating equipment installed in a building is equal to or greater than 1,000,000 Btu/h (293 kW), the combined input-capacity-weighted-average efficiency of water-heating equipment shall be no less than the following for each water heating fuel source:~~

~~1. Electric: A rated COP of not less than 2.0. For air-source heat pump equipment, the COP rating will be reported at the design leaving heat pump water temperature with an entering air temperature of 60°F (15.6°C) or less.~~

~~2. Fossil Fuel: A rated E_t of not less than 90 percent as determined by the applicable test procedure in Table C404.2.~~

~~EXCEPTIONS:~~ ~~1. Where not less than 25 percent of the annual service water-heating requirement is provided from any of the following sources:~~
~~1.1. Renewable energy generated on-site that is not being used to satisfy another requirement of this code; or~~
~~1.2. Site-recovered energy that is not being used to satisfy other requirements of this code.~~
~~2. Redundant equipment intended to only operate during equipment failure or periods of extended maintenance.~~
~~3. Electric resistance heated systems installed as part of an alteration where the water heating equipment is installed at the grade level in a building with a height of four stories or greater.~~
~~4. Hot water heat exchangers used to provide service water heating from a district utility (steam, heating hot water).~~
~~5. Water heaters provided as an integral part of equipment intended to only heat or boost the heat of water used by that equipment.~~
~~6. For electric heat systems, supplemental water heaters not meeting this criteria that function as auxiliary heating only when the outdoor temperature is below 32°F (0°C) or when a defrost cycle is required are not required to have a rated COP of 2.0. 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.~~

~~**C404.2.2 High input-rated service water heating system for Group R-1 and R-2 occupancies.** In new buildings with over 1,000,000 Btu/h installed service water heating capacity serving Group R-1 and R-2 occupancies, at least 25 percent of annual water heating energy shall be provided from any combination of the following water heating sources:~~

~~1. Renewable energy generated on-site that is not being used to satisfy other requirements of this code; or~~

~~2. Site-recovered energy that is not being used to satisfy other requirements of this code.~~

~~EXCEPTION:~~ ~~Compliance with this section is not required if the combined input-capacity-weighted average equipment rating for each service water heating fuel source type is not less than the following:~~
~~1. Electric Resistance: An electric resistance water heater with a rating of 105 percent of the rated efficiency of Table C404.2.~~
~~2. Electric Heat Pump (10 C.F.R. Part 430): A heat pump water heater rated in accordance with 10 C.F.R. Part 430 with a rating of 105 percent of the rated efficiency of Table C404.2.~~
~~3. Electric Heat Pump (not listed in accordance with 10 C.F.R. Part 430): A heat pump water heater not rated in accordance with 10 C.F.R. Part 430 shall have a COP of not less than 2.0. For air-source heat pump equipment the COP rating will be reported at the design leaving heat pump water temperature with an entering air temperature of 60°F (15.6°C) or less. Supplemental water heaters not meeting the above criteria that function as auxiliary heating only when the outdoor temperature is below 32°F (0°C) or when a defrost cycle is required are not required to have a rated COP of 2.0. 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.~~
~~4. Fossil Fuels: A rated E_t of not less than 90 percent as determined by the applicable test procedures in Table C404.2.~~
~~5. Hot water heat exchangers used to provide service water heating from a district utility (steam, heating hot water).~~))

C404.2.1 Service water heating system type. Service water-heating equipment shall not use fossil fuel combustion or electric resistance. Service hot water shall be provided by an electric air-source heat pump water heating (HPWH) system meeting the requirements of this section. Supplemental service water heating equipment is permitted to use electric resistance in compliance with Section C404.2.1.4.

EXCEPTIONS: 1. 24 kW plus 0.1 watts per square foot of building area of electric resistance service water heating capacity is allowed per building.
2. Solar thermal, wastewater heat recovery, other *approved* waste heat recovery, ground source heat pumps, water-source heat pump systems utilizing waste heat, and combinations thereof, are permitted to offset all or any portion of the required HPWH capacity where such systems comply with this code and the *Uniform Plumbing Code*.
3. Systems that comply with the Northwest Energy Efficiency Alliance (NEEA) Commercial Electric Advanced Water Heating Specification.
4. Service hot water systems served by a district energy system that serves multiple buildings and that was in service before the effective date of this code.
5. Commercial dishwashers, commercial food service equipment, and other *approved* process equipment are permitted to utilize electric booster heaters for supply water temperatures 120°F (49°C) or higher.

C404.2.1.1 Primary heat pump system sizing. The system shall include a primary service output of 100 percent load at 40°F (4°C) dry bulb or wet bulb outdoor air temperature for air-source heat pumps, or 44°F (7°C) ground temperature for ground-source heat pumps that provides sufficient hot water as calculated using the equipment manufacturer's selection criteria or another *approved* methodology. Electric air source heat pumps shall be sized to deliver no less than 50 percent of the calculated demand for hot water production during the peak demand period when entering dry bulb or wet bulb outdoor air temperature of 24°F (-4°C).

EXCEPTION: Fifty percent sizing at entering dry bulb or wet bulb air temperature of 24°F (-4°C) is not required for air-source heat pumps located in a below-grade enclosed parking structure or other ventilated and unconditioned space that is not anticipated to fall below 40°F (4°C) at any time.

C404.2.1.2 Primary hot water storage sizing. The system shall provide sufficient hot water to satisfy peak demand period requirements.

C404.2.1.3 System design. The service water heating system shall be configured to conform to one of the following provisions:

1. For *single-pass* HPWHs, *temperature maintenance* heating provided for reheating return water from the building's heated water circulation system shall be physically decoupled from the primary service water heating system storage tank(s) in a manner that prevents destratification of the primary system storage tanks. *Temperature maintenance* heating is permitted to be provided by electric resistance or a separate dedicated heat pump system.

2. For *multi-pass* HPWHs, *recirculated temperature* maintenance water is permitted to be returned to the primary water storage tanks for reheating.

3. For unitary HPWHs, located in conditioned space, are permitted, where they are sized to meet all calculated service water heating demand using the heat pump compressor, and not supplementary heat.

C404.2.1.3.1 Mixing valve. A thermostatic mixing valve capable of supplying hot water to the building at the user temperature setpoint shall be provided, in compliance with requirements of the *Uniform Plumbing Code* and the HPWH manufacturer's installation guidelines. The mixing valve shall be sized and rated to deliver tempered water in a range from the minimum flow of the *temperature maintenance* recirculation system up to the maximum demand for the fixtures served.

C404.2.1.4 Supplemental water heating. Total supplemental electric resistance water heating equipment shall not have an output capacity greater than the primary water heating equipment at 40°F (4°C) entering dry bulb or wet bulb outdoor air temperature for air-source heat pumps or 44°F (7°C) ground temperature for ground-source heat pumps. Supplemental electric resistance heating is permitted for the following uses:

1. *Temperature maintenance* of heated-water circulation systems, physically separate from the primary service water heating system. *Temperature maintenance* heating capacity shall be no greater than the primary water heating capacity at 40°F (4°C) dry bulb or wet bulb outdoor air temperature for air-source heat pumps or 44°F (7°C) ground temperature for ground-source heat pumps.

2. Defrost of compressor coils.

3. Heat tracing of piping for freeze protection or for *temperature maintenance* in lieu of recirculation of hot water.

4. Backup or low ambient temperature conditions, where all of the following are true:

4.1. The supplemental heating capacity is no greater than the primary service water heating capacity at 40°F (4°C) dry bulb or wet bulb outdoor air temperature for air-source heat pumps or 44°F (7°C) ground temperature for ground-source heat pumps.

4.2. During normal operations, the supplemental heating is controlled to operate only when the entering air temperature at the air-source HPWH is below 40°F (4°C), and the primary HPWH compressor continues to operate together with the supplemental heating when the entering air temperature is between 17°F (-8°C) and 40°F (4°C).

4.3. The primary water heating equipment cannot satisfy the system load due to equipment failure or entering air temperature below 40°F (4°C).

C404.2.1.5 Alarms. The control system shall be capable of and configured to send automatic error alarms to building or maintenance personnel upon detection of equipment faults, low leaving water temperature from primary storage tanks, or low hot water supply delivery temperature to building distribution system.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-404021 Table C404.2—Minimum performance of water-heating equipment.

Table C404.2
Minimum Performance of Water-Heating Equipment

((~~Equipment Type~~	~~Size Category (input)~~	~~Subcategory or Rating Condition~~	~~Performance Required[a, b]~~	~~Test Procedure~~
~~Storage water heaters, electric~~	~~≤ 12 kW[d]~~	~~Tabletop[c] ≥ 20 gal and ≥ 120 gal~~	~~0.93 - 0.00132V, EF~~	~~DOE 10 C.F.R. Part 430~~
		~~Resistance ≥ 20 gal and ≤ 55 gal~~	~~0.960 - 0.0003V, EF~~	
		~~Grid-enabled[f] > 75 gal and ≤ 120 gal~~	~~1.06 - 0.00168V, EF~~	
	~~> 12 kW[d]~~	~~Resistance~~	~~(0.3 + 27)/V_m,%/h[g]~~	~~Section G.2 of ANSI Z21.10.3~~
	~~≤ 24 amps and ≤ 250 volts~~	~~Heat pump~~	~~2.057 - 0.00113V, EF~~	~~DOE 10 C.F.R. Part 430~~
~~Instantaneous water heaters, electric~~	~~All~~	~~Resistance~~	~~0.93 - 0.00132V, EF~~	~~DOE 10 C.F.R. Part 430~~
~~Storage water heaters, gas~~	~~≤ 75,000 Btu/h~~	~~≥ 20 gal and ≤ 55 gal~~	~~0.675 - 0.0015V, EF~~	~~DOE 10 C.F.R. Part 430~~
		~~> 55 gal and ≤ 100 gal~~	~~0.8012 - 0.00078V, EF~~	
	~~> 75,000 Btu/h~~	~~< 4,000 Btu/h/gal~~	~~80% E_t (Q/800 + 110$\sqrt{V}$) SL, Btu/h~~	~~Section G.1 and G.2 of ANSI Z21.10.3~~
~~Instantaneous water heaters, gas~~	~~> 50,000 Btu/h and < 200,000 Btu/h~~	~~≥ 4,000 (Btu/h)/gal and < 2 gal~~	~~0.82 - 0.0019V, EF~~	~~DOE 10 C.F.R. Part 430~~
	~~≥ 200,000 Btu/h[c]~~	~~≥ 4,000 Btu/h/gal and < 10 gal~~	~~80% E_t~~	~~Section G.1 and G.2 of ANSI Z21.10.3~~
	~~≥ 200,000 Btu/h~~	~~≥ 4,000 Btu/h/gal and ≥ 10 gal~~	~~80% E_t (Q/800 + 110$\sqrt{V}$) SL, Btu/h~~	
~~Storage water heaters, oil~~	~~≤ 105,000 Btu/h~~	~~≥ 20 gal~~	~~0.68 - 0.0019V, EF~~	~~DOE 10 C.F.R. Part 430~~
	~~> 105,000 Btu/h~~	~~< 4,000 Btu/h/gal~~	~~80% E_t (Q/800 + 110$\sqrt{V}$) SL, Btu/h~~	~~Section G.1 and G.2 of ANSI Z21.10.3~~
~~Instantaneous water heaters, oil~~	~~≤ 210,000 Btu/h~~	~~≥ 4,000 Btu/h/gal and < 2 gal~~	~~0.59 - 0.0019V, EF~~	~~DOE 10 C.F.R. Part 430~~
	~~> 210,000 Btu/h~~	~~≥ 4,000 Btu/h/gal and < 10 gal~~	~~80% E_t~~	~~Section G.1 and G.2 of ANSI Z21.10.3~~
	~~> 210,000 Btu/h~~	~~≥ 4,000 Btu/h/gal and ≥ 10 gal~~	~~78% E_t (Q/800 + 110$\sqrt{V}$) SL, Btu/h~~	
~~Hot water supply boilers, gas and oil~~	~~≥ 300,000 Btu/h and < 12,500,000 Btu/h~~	~~≥ 4,000 Btu/h/gal and < 10 gal~~	~~80% E_t~~	~~Section G.1 and G.2 of ANSI Z21.10.3~~
~~Hot water supply boilers, gas~~	~~≥ 300,000 Btu/h and < 12,500,000 Btu/h~~	~~≥ 4,000 Btu/h/gal and ≥ 10 gal~~	~~80% E_t (Q/800 + 110$\sqrt{V}$) SL, Btu/h~~	
~~Hot water supply boilers, oil~~	~~≥ 300,000 Btu/h and < 12,500,000 Btu/h~~	~~≥ 4,000 Btu/h/gal and > 10 gal~~	~~78% E_t (Q/800 + 110$\sqrt{V}$) SL, Btu/h~~	
~~Pool heaters, gas and oil~~	~~All~~	—	~~82% E_t~~	~~ASHRAE 146~~
~~Heat pump pool heaters~~	~~All~~	—	~~4.0 COP~~	~~AHRI 146~~
~~Unfired storage tanks~~	~~All~~	—	~~Minimum insulation requirement R-12.5 (h • ft^2 • °F)/Btu~~	~~(none)~~

~~For SI: °C = [(°F) - 32]/1.8, 1 British thermal unit per hour = 0.2931 W, 1 gallon = 3.785 L, 1 British thermal unit per hour per gallon = 0.078 W/L.~~

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

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

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

~~[d]Electric water heaters with an input rating of 12 kW (40,950 Btu/h) or less that are designed to heat water to temperatures of 180°F or greater shall comply with the requirements for electric water heaters that have an input rating greater than 12 kW (40,950 Btu/h).~~

~~[e]A tabletop water heater is a water heater that is enclosed in a rectangular cabinet with a flat top surface not more than three feet (0.91 m) in height.~~

~~[f]A grid-enabled water heater is an electric resistance water heater that meets all of the following:~~

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

~~[g]%/h is the energy consumed to replace the heat loss from the tank while on standby, expressed as a percentage of the total energy in the stored water per hour.~~))

Equipment Type	**Size Category (input)**	**Subcategory or Rating Condition**	**Draw Pattern**	**Performance Required[a]**	**Test Procedure[b]**
Electric table-top water heaters[g]	≤ 12 kW	≥ 20 gal ≤ 120 gal[f]	Very small Low Medium High	UEF ≥ 0.6323 - (0.0058 × Vr) UEF ≥ 0.9188 - (0.0031 × Vr) UEF ≥ 0.9577 - (0.0023 × Vr) UEF ≥ 0.9884 - (0.0016 × Vr)	DOE 10 C.F.R. Part 430 App. E
Electric storage water heaters[g,i] resistance and heat pump	≤ 12 kW	≥ 20 gal ≤ 55 gal[f]	Very small Low Medium High	UEF ≥ 0.8808 - (0.0008 × Vr) UEF ≥ 0.9254 - (0.0003 × Vr) UEF ≥ 0.9307 - (0.0002 × Vr) UEF ≥ 0.9349 - (0.0001 × Vr)	DOE 10 C.F.R. Part 430 App. E
	≤ 12 kW	> 55 gal ≤ 120 gal[f]	Very small Low Medium High	UEF ≥ 1.9236 - (0.0011 × Vr) UEF ≥ 2.0440 - (0.0011 × Vr) UEF ≥ 2.1171 - (0.0011 × Vr) UEF ≥ 2.2418 - (0.0011 × Vr)	DOE 10 C.F.R. Part 430 App. E
Electric storage water heaters[g,i]	> 12 kW			(0.3 + 27/Vm), %h	DOE 10 C.F.R. 431.106 App B.
Grid-enabled water heaters[g]		> 75 gal[f]	Very small Low Medium High	UEF ≥ 1.0136 - (0.0028 × Vr) UEF ≥ 0.9984 - (0.0014 × Vr) UEF ≥ 0.9853 - (0.0010 × Vr) UEF ≥ 0.9720 - (0.0007 × Vr)	10 C.F.R. 430 Appendix E
Electric instantaneous water heater[h]	≤ 12 kW	< 2 gal[f]	Very small Low Medium High	UEF ≥ 0.91 UEF ≥ 0.91 UEF ≥ 0.91 UEF ≥ 0.92	DOE 10 C.F.R. Part 430
	> 12 kW & ≤ 58.6 kW[c]	≤ 2 gal ≤ 180F	All	UEF ≥ 0.80	DOE 10 C.F.R. Part 430

Equipment Type	Size Category (input)	Subcategory or Rating Condition	Draw Pattern	Performance Required[a]	Test Procedure[b]
Gas storage water heaters[g]	≤ 75,000 Btu/h	≥ 20 gal & ≤ 55 gal[f]	Very small Low Medium High	UEF ≥ 0.3456 - (0.0020 × Vr) UEF ≥ 0.5982 - (0.0019 × Vr) UEF ≥ 0.6483 - (0.0017 × Vr) UEF ≥ 0.6920 - (0.0013 × Vr)	DOE 10 C.F.R. Part 430 App. E
	≤ 75,000 Btu/h	> 55 gal & ≤ 100 gal[f]	Very small Low Medium High	UEF ≥ 0.6470 - (0.0006 × Vr) UEF ≥ 0.7689 - (0.0005 × Vr) UEF ≥ 0.7897 - (0.0004 × Vr) UEF ≥ 0.8072 - (0.0003 × Vr)	DOE 10 C.F.R. Part 430 App. E
	> 75,000 Btu/h and ≤ 105,000 Btu/h[d]	≤ 120 gal ≤ 180 F	Very small Low Medium High	UEF ≥ 0.2674-0.0009 x Vr UEF ≥ 0.5362-0.0012 x Vr UEF ≥ 0.6002-0.0011 x Vr UEF ≥ 0.6597-0.0009 x Vr	DOE 10 C.F.R. Part 430 App. E
	> 105,000 Btu/h[d,f]			80% E_t SL ≤ (Q/800 +110√V), Btu/h	DOE 10 C.F.R. 431.106
Gas instantaneous water heater[h]	> 50,000 Btu/h and < 200,000 Btu/h	< 2 gal	Very small Low Medium High	UEF ≥ 0.80 UEF ≥ 0.81 UEF ≥ 0.81 UEF ≥ 0.81	DOE 10 C.F.R. Part 430 App. E
	≥ 200,000 Btu/h[d,f]	< 10 gal[f]		80% E_t	DOE 10 C.F.R. 431.106
	≥ 200,000 Btu/h[f]	≥ 10 gal		80% E_t SL ≤ (Q/800 +110√V), Btu/h	
Oil storage water heaters[g]	≤ 105,000 Btu/h	≤ 50 gal[f]	Very small Low Medium High	UEF = 0.2509 – (0.0012 × Vr) UEF = 0.5330 – (0.0016 × Vr) UEF = 0.6078 – (0.0016 × Vr) UEF = 0.6815 – (0.0014 × Vr)	DOE 10 C.F.R. Part 430
	> 105,000 Btu/h and ≤ 140,000 Btu/h[e]	≤ 120 gal ≤ 180 F	Very small Low Medium High	UEF ≥ 0.2932-0.0015 x Vr UEF ≥ 0.5596-0.0018 x Vr UEF ≥ 0.6194-0.0016 x Vr UEF ≥ 0.6740-0.0013 x Vr	DOE 10 C.F.R. Part 430 App. E
	> 140,000 Btu/h			80% E_t SL ≤ (Q/800 +110√V), Btu/h	DOE 10 C.F.R. 431.106
Oil instantaneous water heater[h]	≤ 210,000 Btu/h	< 2 gal		80% E_t EF ≥ 0.59 - 0.0005 x V	DOE 10 C.F.R. Part 430 App. E
	> 210,000 Btu/h	< 10 gal		80% E_t	DOE 10 C.F.R. 431.106
	> 210,000 Btu/h	≥ 10 gal		78% E_t SL ≤ (Q/800 +110√V), Btu/h	DOE 10 C.F.R. 431.106
Hot water supply boilers, gas and oil[h]	≥ 300,000 Btu/h and < 12,500,000 Btu/h	< 10 gal		80% E_t	DOE 10 C.F.R. 431.106
Hot water supply boilers, gas[h]	≥ 300,000 Btu/h and < 12,500,000 Btu/h	≥ 10 gal		80% E_t SL ≤ (Q/800 +110√V), Btu/h	DOE 10 C.F.R. 431.106
Hot water supply boilers, oil[h]	≥ 300,000 Btu/h and < 12,500,000 Btu/h	≥ 10 gal		78% E_t SL ≤ (Q/800 +110√V), Btu/h	DOE 10 C.F.R. 431.106

Equipment Type	Size Category (input)	Subcategory or Rating Condition	Draw Pattern	Performance Required[a]	Test Procedure[b]
Pool heaters, gas	All			82% E_t	DOE 10 C.F.R. Part 430 App. P
Heat pump pool heaters	All	50°F db 44.2°F wb outdoor air 80.0°F entering water		4.0 COP	DOE 10 C.F.R. Part 430 App. P
Unfired storage tanks	All			Minimum insulation requirement R-12.5 (h-ft^2-°F)/Btu	(none)

[a] Thermal efficiency (E_t) is a minimum requirement, while standby loss is a maximum requirement. In the standby loss equation, V is the rated volume in gallons and Q is the nameplate input rate in Btu/h. V_m is the measured volume in the tank in gallons. Standby loss for electric water heaters is in terms of %/h and denoted by the term "S," and standby loss for gas and oil water heaters is in terms of Btu/h and denoted by the term "SL" Draw pattern (DP) refers to the water draw profile in the Uniform Energy Factor (UEF) test. UEF and Energy Factor (EF) are minimum requirements. In the UEF standard equations, V_r refers to the rated volume in gallons.

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

[c] Electric instantaneous water heaters with input capacity > 12 kW and ≤ 58.6 kW that have either (1) a storage volume > 2 gal; or (2) is designed to provide outlet hot water at temperatures greater than 180°F; or (3) uses three-phase power has no efficiency standard.

[d] Gas storage water heaters with input capacity > 75,000 Btu/h and ≤ 105,000 Btu/h must comply with the requirements for the > 105,000 Btu/h if the water heater either (1) has a storage volume > 120 gal; (2) is designed to provide outlet hot water at temperatures greater than 180°F; or (3) uses three-phase power.

[e] Oil storage water heaters with input capacity > 105,000 Btu/h and ≤ 140,000 Btu/h must comply with the requirements for the > 140,000 Btu/h if the water heater either (1) has a storage volume > 120 gal; (2) is designed to provide outlet hot water at temperatures greater than 180°F; or (3) uses three-phase power.

[f] Water heaters or gas pool heaters in this category are regulated as consumer products by the USDOE as defined in 10 C.F.R. Part 430 and do not need to be checked for code compliance. Numbers in table are for reference or to use for over code performance determinations.

[g] Table top and storage water heaters have a ratio of input capacity (Btu/h) to tank volume (gal) < 4000.

[h] Instantaneous water heaters and hot water supply boilers have an input capacity (Btu/h) divided by storage volume (gal) ≥ 4000 Btu/h-gal.

[i] There are no minimum efficiency requirements for electric heat pump water heaters greater than 12 kW or for gas heat pump water heaters.

AMENDATORY SECTION (Amending WSR 16-03-072, filed 1/19/16, effective 7/1/16)

WAC 51-11C-40403 Section C404.3—Efficient heated water supply piping.

C404.3 Efficient heated water supply piping. Heated water supply piping shall be in accordance with Section C404.3.1 or C404.3.2. The flow rate through 1/4-inch (6.4 mm) piping shall be not greater than 0.5 gpm (1.9 L/m). The flow rate through 5/16-inch (7.9 mm) piping shall be not greater than 1 gpm (3.8 L/m). The flow rate through 3/8-inch (9.5 mm) piping shall be not greater than 1.5 gpm (5.7 L/m). Water heaters, circulating water systems and heat trace temperature maintenance systems shall be considered sources of heated water.

C404.3.1 Maximum allowable pipe length method. The maximum allowable piping length from the nearest source of heater water to the termination of the fixture supply pipe shall be in accordance with the following. Where the piping contains more than one size of pipe, the largest size of pipe within the piping shall be used for determining the maximum allowable length of the piping in Table C404.3.1.

1. For a public lavatory faucet, use the "Public lavatory faucets" column in Table C404.3.1.

2. For all other plumbing fixtures and plumbing appliances, use the "Other fixtures and appliances" column in Table C404.3.1.

Table C404.3.1

Piping Volume and Maximum Piping Lengths

Nominal Pipe Size (inches)	Volume (liquid ounces per foot length)	Maximum Piping Length (feet)	
		Public lavatory faucets	Other fixtures and appliances
1/4	0.33	6	50
5/16	0.5	4	50
3/8	0.75	3	50
1/2	1.5	((~~2~~)) 8	43
5/8	2	((~~1~~)) 8	32
3/4	3	0.5	21
7/8	4	0.5	16
1	5	0.5	13
1 1/4	8	0.5	8
1 1/2	11	0.5	6
2 or larger	18	0.5	4

C404.3.2 Maximum allowable pipe volume method. The water volume in the piping shall be calculated in accordance with Section C404.3.2.1.

The volume from the nearest source of heated water to the termination of the fixture supply pipe shall be as follows:

1. For a public lavatory faucet: Not more than 2 ounces (0.06 L).
2. For other plumbing fixtures or plumbing appliances; not more than 0.5 gallon (1.89 L).

C404.3.2.1 Water volume determination. The volume shall be the sum of the internal volumes of pipe, fittings, valves, meters and manifolds between the nearest source of heated water and the termination of the fixture supply pipe. The volume in the piping shall be determined from the "Volume" column in Table C404.3.1 or from Table C404.3.2.1. The volume contained within fixture shutoff valves, within flexible water supply connectors to a fixture fitting and within a fixture fitting shall not be included in the water volume determination. Where heated water is supplied by a recirculating system or heat-traced piping, the volume shall include the portion of the fitting on the branch pipe that supplies water to the fixture.

Table C404.3.2.1
Internal Volume of Various Water Distribution Tubing

Ounces of Water per Foot of Tube									
Nominal Size (inches)	Copper Type M	Copper Type L	Copper Type K	CPVC CTS SDR 11	CPVC SCH 40	CPVC SCH 80	PE-RT SDR	Composite ASTM F1281	PEX CTS SDR 9
3/8	1.06	0.97	0.84	N/A	1.17	—	0.64	0.63	0.64
1/2	1.69	1.55	1.45	1.25	1.89	1.46	1.18	1.31	1.18
3/4	3.43	3.22	2.90	2.67	3.38	2.74	2.35	3.39	2.35
1	5.81	5.49	5.17	4.43	5.53	4.57	3.91	5.56	3.91
11/4	8.70	8.36	8.09	6.61	9.66	8.24	5.81	8.49	5.81
11/2	12.18	11.83	11.45	9.22	13.20	11.38	8.09	13.88	8.09
2	21.08	20.58	20.04	15.79	21.88	19.11	13.86	21.48	13.86

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40404 Section C404.4—Heat traps.

C404.4 Heat traps for hot water storage tanks. Storage tank-type water heaters and hot water storage tanks that have vertical water pipes connecting to the inlet and outlet of the tank shall be provided with integral heat traps at ((~~those~~)) the vertical inlets and outlets or shall have pipe-configured heat traps in the piping connected to those inlets and outlets. Tank inlets and outlets associated with solar water heating system circulation loops shall not be required to have heat traps.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-40406 Section C404.6—Pipe insulation.

C404.6 Insulation of piping. Piping from a water heater to the termination of the heated water fixture supply pipe shall be insulated in accordance with Table C403.10.3. On both the inlet and outlet piping of a storage water heater or heated water storage tank, the piping to a heat trap or the first 8 feet (2438 mm) of piping, whichever is less, shall be insulated. Piping that is heat traced shall be insulated in accordance with Table C403.10.3 or the heat trace manufacturer's instructions. Tubular pipe insulation shall be installed in accordance with the insulation manufacturer's instructions. Pipe insulation shall be continuous, including through hangers and supports, such that thermal bridging is prevented, except where the piping passes through a framing member. The minimum insulation thickness requirements of this section shall not supersede any greater insulation thickness requirements necessary for the protection of piping from freezing temperatures or the protection of personnel against external surface temperatures on the insulation.

EXCEPTION: Tubular pipe insulation shall not be required on the following:
1. The tubing from the connection at the termination of the fixture supply piping to a plumbing fixture or plumbing appliance.
2. Valves, pumps, strainers and threaded unions in piping that is 1 inch (25 mm) or less in nominal diameter.
3. Piping from user-controlled shower and bath mixing valves to the water outlets.
4. Cold-water piping of a demand recirculation water system.
5. Tubing from a hot drinking-water heating unit to the water outlet.
6. Piping at locations where a vertical support of the piping is installed.
7. Piping surrounded by building insulation with a thermal resistance (*R*-value) of not less than R-3.
8. Hot water piping that is part of the final pipe run to the plumbing fixture and is not part of the heated-water circulation system circulation path is not required to meet the minimum insulation requirements of Section C404.6.

C404.6.1 Storage tank insulation. Unfired storage tanks used to store service hot water at temperatures above 130°F (54°C) shall be wrapped with an insulating product, installed in accordance with the insulation manufacturer's instructions and providing a minimum of R-2 additional insulation for every 10°F (5°C) increase in stored water temperature above 130°F (54°C). Such additional insulation is also permitted to be integral to the tank. The insulation is permitted to be discontinuous at structural supports.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40407 Section C404.7—Heated-water circulating and temperature maintenance systems.

C404.7 Heated-water circulating and heat trace temperature maintenance systems. Heated-water circulation systems for *temperature maintenance* shall be in accordance with Section C404.7.1. Electric resistance heat trace ((~~temperature maintenance~~)) systems for *temperature maintenance* shall be in accordance with Section C404.7.2. Controls for hot water storage shall be in accordance with Section C404.7.3. Automatic controls, temperature sensors and pumps shall be in a location with *access*. Manual controls shall be in a location with *ready access*.

C404.7.1 Circulation systems. Heated-water circulation systems shall be provided with a circulation pump. The pump shall have an electronically commutated motor with a means of adjusting motor speed for system balancing. The system return pipe shall be a dedicated return pipe. Gravity and thermo-syphon circulation systems ((~~shall be~~)) are prohibited. Controls shall start the circulation pump based on the identification of a demand for hot water within the occupancy.

C404.7.1.1 Single riser systems. Where the circulation system serves only a single domestic hot water riser or zone, the following controls shall be provided:

1. Controls shall be configured to automatically turn off the pump when the water in the circulation loop is at the design supply temperature and shall not turn the pump back on until the temperature is a minimum of 10°F (5°C) lower than the design supply temperature ((~~or have controls equipped with automatic time switches or other controls that can be set to switch off the pump during unoccupied hours when hot water is not required~~)).

2. Controls shall be equipped with a manual switch or other control((~~s~~)) method that can be used to turn off the circulating pump during extended periods when hot water is not required.

C404.7.1.2 Multiple riser systems. Where the circulation system serves multiple domestic hot water risers or piping zones, the following controls shall be provided ((~~such that they can be set to switch off the~~)):

1. Controls shall be configured to automatically turn off the circulation pump during extended periods when hot water is not required.

2. System shall include means for balancing the flow rate through each individual hot water supply riser or piping zone.

3. For circulation systems that use a variable flow circulation pump, each riser and piping zone shall have a self-actuating thermostatic balancing valve.

C404.7.1.3 Electronic thermostatic mixing valve (TMV). Where a heated water circulation system utilizes an electronic TMV to control the temperature of hot water supplied to the building, the TMV shall be configured so that it either reverts closed (fully COLD) or maintains its current valve position upon power failure or cessation of circulation flow.

C404.7.2 Heat trace systems. Electric heat trace systems shall comply with IEEE 515.1. Controls for such systems shall be able to automatically adjust the energy input to the heat tracing to maintain the desired water temperature in the piping in accordance with the times when heated water is used in the occupancy. Heat trace shall be arranged to be turned off automatically when there is no hot water demand.

C404.7.3 Controls for hot water storage. The controls on pumps that circulate water between a water heater and a heated-water storage tank shall limit operation of the pump from heating cycle startup to not greater than 5 minutes after the end of the cycle.

C404.7.3.1 Pipe insulation. For heated water circulation systems, both supply and return pipe insulation shall be at minimum 1.0 inch thicker than that required by Table C403.10.3.

EXCEPTION: Where piping is centered within a wall, ceiling or floor framing cavity with a depth at least 4 inches greater than the diameter of the pipe and that is completely filled with batt or blown-in insulation, additional pipe insulation is not required.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40410 Section C404.11—Pools and spas.

C404.11 Energy consumption of pools and permanent spas. 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 (10°C) db, 44.2°F (6.8°C) wb outdoor air and 80°F (27°C) entering water, determined in accordance with ((~~ASHRAE Standard 146~~)) AHRI 1160. Other pool heating equipment shall comply with the applicable efficiencies in Section C404.2.

The electric power to all heaters shall be controlled by an 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 in a location with *ready access*. Operation of such switch shall not change the setting of the heater thermostat. Such switches shall be in addition to a circuit breaker for the power to the heater. Gas-fired heaters shall not be equipped with constant burning pilot lights.

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

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

C404.11.3 Covers. Heated pools and permanent spas shall be provided with a vapor-retardant cover on or at the water surface. Pools heated to more than 90°F shall have a pool cover with a minimum insulation value of R-12, and the sides and bottom of the pool shall also have a minimum insulation value of R-12.

C404.11.4 Heat recovery. Heated indoor swimming pools, spas or hot tubs with water surface area greater than 200 square feet shall provide for energy conservation by an exhaust air heat recovery system that heats ventilation air, pool water or domestic hot water. The heat recovery system shall be configured to decrease the exhaust air temperature at design heating conditions (80°F indoor) by 36°F (10°C).

EXCEPTION: Pools, spas or hot tubs that include system(s) that provide equivalent recovered energy on an annual basis through one of the following methods:
1. Solar water heating systems not claimed in Section C406.5 or C407;
2. Dehumidification heat recovery;
3. Waste heat recovery; or
4. A combination of these system sources capable of and configured to provide at least 70 percent of the heating energy required over an operating season.

C404.12 ((~~Energy consumption of~~)) Portable spas. The energy consumption of electric-powered portable spas shall be controlled by the requirements of APSP 14.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40413 Section C404.13—Service water pressure-booster systems.

C404.13 Service water pressure-booster systems. Service water pressure-booster systems shall be designed and configured such that the following apply:

1. One or more pressure sensors shall be used to vary pump speed and/or start and stop pumps. The sensors shall either be located near the critical fixtures that determine the pressure required, or logic shall be employed that adjusts the setpoint to simulate operations of remote sensors.

2. No devices 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. Booster system pumps shall not operate when there is no service water flow except to refill hydro-pneumatic tanks.

4. System pump motors ((~~7.5~~)) 5.0 hp and greater shall be provided with variable flow capacity in accordance with Section ((~~C403.2.3~~)) C403.2.4.

((**~~C404.14 Commissioning.~~** ~~Service water heating systems shall be commissioned in accordance with Section C408.~~))

NEW SECTION

WAC 51-11C-40414 Section C404.14—Demand responsive water heating.

C404.14 Demand responsive water heating. Electric storage water heaters with rated water storage volume between 40 and 120 gallons and a nameplate input rating equal to or less than 12kW shall be provided with *demand responsive controls* that comply with ANSI/CTA-2045-B Level 2 or another equivalent *approved demand responsive control*.

EXCEPTIONS:
1. Water heaters that provide a hot water delivery temperature of 180°F (82°C) or greater.
2. Water heaters that comply with Section IV, Part HLW or Section X of the ASME Boiler and Pressure Vessel Code.
3. Water heaters that use three-phase electric power.
4. Storage water heaters with *demand responsive controls* that comply with ANSI/CTA 2045-A or ANSI/CTA 2045-B Level 1, that are also capable of initiating water heating to meet the temperature setpoint in response to a *demand response signal*.

NEW SECTION

WAC 51-11C-40415 Section C404.15—Service water heating commissioning.

C404.15 Commissioning. Service water heating systems shall be commissioned in accordance with Section C408.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40501 Section C405.1—General.

C405.1 General. ((~~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 shall comply with this section.

((~~*Dwelling units* within multifamily buildings shall comply with Sections C405.1.1 and C405.7. All other *dwelling units* in dormitory, hotel and other residential occupancies that are not classified as multifamily residential occupancies shall comply with Section C405.2.5 and Section C405.1.1 or Section C405.4.~~)) *Sleeping units* shall comply with Section ((~~C405.2.5~~)) C405.2.6, item 2 and Section C405.1.1 or Section C405.4.

General lighting shall consist of all lighting included when calculating the total connected interior lighting power in accordance with Section C405.4.1 and which does not require specific application controls in accordance with Section C405.2.5.

Lighting installed in *walk-in coolers*, *walk-in freezers*, *refrigerated warehouse coolers* and *refrigerated warehouse freezers* shall comply with the lighting requirements of Section C410.2.

Transformers, uninterruptable power supplies, motors and electrical power processing equipment in *data center systems* shall comply with Section 8 of ASHRAE Standard 90.4 in addition to this code.

EXCEPTION: Energy using equipment used by a manufacturing, industrial or commercial process other than maintaining comfort and amenities for the occupants are exempt from all Section C405 subsections except Section C405.8. Data center and computer room HVAC equipment is not covered by this exemption.

C405.1.1 ((~~Dwelling and sleeping unit lighting efficacy~~)) Lighting for dwelling and sleeping units. No less than 90 percent of the ((~~lamps~~)) permanently installed lighting serving *dwelling units* or *sleeping units*, excluding kitchen appliance lighting, shall be provided by ((~~light emitting diodes (LED), T-8 or smaller diameter linear fluorescent lamps, or other~~)) lamps with a minimum efficacy of 65 lumens per watt or luminaires with an efficacy of not less than 45 lumens per watt.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-40502 Section C405.2—Electrical power and lighting systems.

C405.2 Lighting controls. Lighting systems shall be provided with controls that comply with one of the following:

1. Lighting controls as specified in Sections C405.2.1 through ((~~C405.2.7~~)) C405.2.10.

2. ((~~Luminaire level~~)) *Luminaire-level* lighting controls (LLLC) ((~~and lighting controls as specified in Sections C405.2.1, C405.2.3 and C405.2.5. The LLLC luminaire shall be independently configured to:~~

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

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

~~2.3. For each control strategy, configuration and reconfiguration of performance parameters including: Bright and dim setpoints, time-outs, dimming fade rates, sensor sensitivity adjustments, and wireless zoning configuration~~)) as specified in Section C405.2.8.1.

EXCEPTION: Except for specific application controls required by Section ((~~C405.2.5~~)) C405.2.6, lighting controls are not required for the following:
1. Areas designated as security or emergency areas that are required to be continuously lighted.
2. Means of egress illumination serving the exit access that does not exceed ((~~0.02~~)) 0.01 watts per square foot of building area.
3. Emergency egress lighting that is normally off.
4. Industrial or manufacturing process areas, as may be required for production and safety.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-405021 Section C405.2.1—Occupant sensor controls.

C405.2.1 Occupant sensor controls. Occupant sensor controls shall be installed to control ((~~lights~~)) luminaires in the following space types((~~:~~)) and in compliance with Sections C405.2.1.1 through C405.2.1.6.

1. Classrooms/lecture/training rooms.
2. Conference/meeting/multipurpose rooms.
3. Copy/print rooms.
4. Lounges/breakrooms.
5. Enclosed offices.
6. Open plan office areas.
7. Restrooms.
8. Storage rooms.
9. Locker rooms.
10. Other spaces 300 square feet (28 m^2) or less that are enclosed by floor-to-ceiling height partitions.
11. Warehouse storage areas.
12. Enclosed ((~~fire rated~~)) stairways.
13. ((~~Service~~)) Corridors.
14. Covered parking areas.

((~~Occupant sensor controls in warehouse storage areas, corridors, and library stacks, shall comply with Section C405.2.1.2. Occupant sensor controls in fire rated stairways shall comply with Section~~

~~C405.2.1.5. Occupant sensor controls in open plan office areas shall comply with Section C405.2.1.3. Occupant sensor controls in covered parking areas shall comply with Section C405.2.1.4.~~)) 15. Library stacks.

Occupant sensor controls for all other spaces shall comply with Section C405.2.1.1.

EXCEPTIONS: 1. Corridors in manufacturing facilities.
2. *General lighting* and task lighting in shop and laboratory classrooms.
3. ((~~Digital timer switch controls may be provided in lieu of occupant sensor controls in the following space types if under 300 square feet: Copy/print rooms, storage rooms, and janitorial closets. Digital timer switches shall comply with the following:~~)) Luminaires that are required to have specific application controls in accordance with Section C405.2.6 unless specifically required to comply with this section by Section C405.2.6.
((~~3.1. Turn lights on or off with operation of a button, switch or other manual means.~~
~~3.2. Automatically turn lights off within 15 minutes of the lights being turned on. The means for setting the time delay shall not be visible on the front of the switch.~~
~~3.3. The switch shall provide both audible and visual indication of impending time-out of the switch. Audible and visual indication shall be given at least once within 5 minutes of time-out of the switch. Visual indication shall consist of turning the lights momentarily off, and then back on.~~))

C405.2.1.1 Occupant sensor control function. Occupant sensor controls for the space types listed in Section C405.2.1 shall comply with all of the following:

1. They shall be configured to automatically turn off lights within 20 minutes of all occupants leaving the space.

2. They shall be manual on or configured 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 entrances areas and lobbies, and areas where manual-on operation would endanger the safety or security of the room or building occupants.~~))

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

EXCEPTION: Full automatic-on controls with no manual control shall be permitted in corridors, interior parking areas, stairways, restrooms, locker rooms, library stacks, lobbies, and areas where manual operation would endanger occupant safety or security.

4. They shall incorporate a manual control to allow occupants to turn lights off.

C405.2.1.2 Occupant sensor control function in warehouse((~~s,~~)) storage areas and ((~~service corridors.~~ ~~Occupant sensor controls shall be configured to comply with all of the following:~~)) library stacks. Lighting in library stacks and warehouse storage areas shall be controlled as follows.

1. ((~~Automatically reduce lighting power by not less than 50 percent within 20 minutes of all occupants leaving the area.~~

~~2. Control lighting in each aisleway and corridor independently, and shall not control lighting beyond the aisleway or corridor being controlled by the sensor.~~)) Lighting in each aisleway shall be controlled independently of lighting in all other aisleways and open areas.

2. Occupant sensors shall automatically reduce lighting power within each controlled area to an unoccupied setpoint of not more than 50 percent within 20 minutes after all occupants have left the controlled area.

3. ((~~Automatically~~)) Lights which are not turned off by occupant sensors shall be turned off by time schedule sweep to turn lighting off within 20 minutes of all occupants leaving the space, or comply with Section C405.2.2 to turn lighting off when the building is vacant.

4. Restore lighting to full power or target light level when occupants enter the space.

5. A *manual* control shall be provided to allow occupants to turn off lights in the space.

C405.2.1.3 Occupant sensor control function in open plan office areas. Occupant sensor controls in open plan office spaces less than 300 square feet (28 m^2) in area shall comply with Section C405.2.1.1. Occupant sensor controls in all other open plan office spaces shall be configured to comply with all of the following:

1. *General lighting* is controlled separately in control zones with floor areas not greater than 600 square feet (55 m^2) within the open plan office space.

2. *General lighting* in each control zone shall be permitted to automatically turn on upon occupancy within the control zone. *General lighting* in other unoccupied zones within the open plan office space shall be permitted to turn on to not more than 20 percent of full power or remain unaffected.

3. Automatically turn off *general lighting* in all control zones within 20 minutes after all occupants have left the open plan office space.

((~~3.~~)) 4. *General lighting* ((~~power~~)) in each control zone ((~~is reduced by not less than 80 percent of the full zone general lighting power within 20 minutes of all occupants leaving that control zone. Control functions that switch control zone lights completely off when the zone is unoccupied meet this requirement.~~

~~4. Daylight responsive controls activate open plan office space general lighting or control zone general lighting only when occupancy for the same area is detected.~~

~~**C405.2.1.4 Occupant sensor control function in parking garages.** Occupant sensor controls shall be configured to comply with all of the following:~~

~~1. Lighting power of each *luminaire* shall be automatically reduced by a minimum of 30 percent when there is no vehicle or pedestrian activity detected within a lighting zone for 20 minutes. Lighting zones for this requirement shall be no larger than 3,600 square feet.~~

~~**Exceptions:**~~

~~1.1. Lighting in daylight transition zones and ramps without parking.~~

~~1.2. Covered parking garages with a total lighting power less than 0.07 watts per square foot.~~

~~2. Where time switch controls in accordance with Section C405.2.2 are not installed, the occupant sensor shall automatically turn all the lighting off within 20 minutes of all occupants leaving the space and restore lighting to full power when occupants enter the space.~~)) shall turn off or uniformly reduce lighting power to an unoccupied setpoint of not more than 20 percent of full power within 20 minutes after all occupants have left the control zone.

5. Lighting controls in open plan office areas larger than 5,000 square feet must also comply with Section C405.2.7.

C405.2.1.5 Occupant sensor control function in enclosed fire rated stairways. Occupant sensor controls shall be configured 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 20 minutes and restore lighting to full power when occupants enter the stairway. All portions of stairways shall remain illuminated to meet the requirements of Section 1009 of the *International Building Code* when the lighting power is reduced.

C405.2.1.6 Occupant sensor control function in corridors. Occupant sensor controls in *corridors* shall uniformly reduce lighting power to an unoccupied setpoint of not more than 50 percent of full power within 20 minutes after all occupants have left the space.

EXCEPTION: *Corridors* provided with less than two foot-candles of illumination on the floor at the darkest point with all lights on.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-405022 Section C405.2.2—Time switch controls.

C405.2.2 Time switch controls. Each area of the building that is not provided with *occupant sensor controls* ((~~or digital timer switch controls~~)) complying with Section ((~~C405.2.1~~)) C405.2.1.1 shall be provided with time switch controls complying with Section C405.2.2.1.

EXCEPTIONS: ((~~Where a manual control provides light reduction in accordance with Section C405.2.3.1, time switch controls shall not be required for the following:~~)) 1. Luminaires which are required to have specific application controls in accordance with Section C405.2.6 unless specifically required to comply with this section by Section C405.2.6.
((~~1.~~)) 2. Spaces where patient care is directly provided.
((~~2.~~)) 3. Spaces where an automatic shutoff would endanger occupant safety or security.
((~~3.~~)) 4. Lighting intended for continuous operation.
((~~4.~~)) 5. Shop and laboratory classrooms.

C405.2.2.1 Time switch control function. 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 controlled lighting 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 square feet (465 m^2).

6. Time switch controls are allowed to automatically turn on lighting to full power in corridors, lobbies, restrooms, storage rooms less than 50 square feet, and medical areas of health care facilities. In all other spaces, time switch controls are allowed to automatically turn on the lighting to not more than 50 percent power.

EXCEPTION((~~S~~)): ((~~1.~~)) Within mall concourses, auditoriums, sales areas, manufacturing facilities, pools, gymnasiums, skating rinks, and sports arenas:
((~~1.1.~~)) 1. The time limit shall be permitted to be greater than 2 hours provided the switch is a captive key device.
((~~1.2.~~)) 2. The area controlled by the override switch shall not be limited to 5,000 square feet (465 m^2), provided that such area is less than 20,000 square feet (1860 m^2).

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-405023 Section C405.2.3—Manual controls.

C405.2.3 Manual controls. All lighting shall have *manual* controls complying with the following:

1. They shall be in a location with *ready access* to occupants.

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

3. Each control device shall control an area no larger than a single room, or 2,500 square feet, whichever is less, if the room area is less than or equal to 10,000 square feet, or one-quarter of the room area or 10,000 square feet, whichever is less, if the room area is greater than 10,000 square feet.

EXCEPTIONS: 1. A *manual* control may be installed in a remote location for the purpose of safety or security provided each remote control device has an indicator pilot light as part of or next to the control device and the light is clearly labeled to identify the controlled lighting.
2. Restrooms.

((~~**C405.2.3.1 Light reduction controls.** Manual controls shall be configured to provide light reduction control that allows the occupant to reduce the connected lighting load between 30 and 70 percent. Lighting reductions 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 luminaires independently of the outer lamps.~~

~~4. Switching each luminaire or each lamp.~~

~~EXCEPTIONS: 1. Light reduction controls are not required in daylight zones with *daylight responsive controls* complying with Section C405.2.4.~~
~~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. Lighting in corridors, lobbies, electrical rooms, restrooms, storage rooms, airport concourse baggage areas, dwelling and sleeping rooms, and mechanical rooms.~~))

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-405024 Section C405.2.4—((~~Daylight responsive~~)) Light-reduction controls.

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

~~1. *Sidelit* zones as defined in Section C405.2.4.2 with more than two *general lighting* fixtures within the combined primary and secondary *sidelit* zones.~~

~~2. *Toplit* 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. Lighting that is required to have specific application control in accordance with Section C405.2.4.~~
~~3. *Sidelit* zones on the first floor above grade in Group A-2 and Group M occupancies.~~
~~4. 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 *sidelit* zones shall be controlled independently of lights in secondary *sidelit* zones in accordance with Section C405.2.4.2.~~

~~EXCEPTION: Spaces enclosed by walls or ceiling height partitions with 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 *toplit zones* in accordance with Section C405.2.4.3 shall be controlled independently of lights in *sidelit* 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 in a location with *ready access*.~~

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

~~6. Lights in *sidelit 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).~~

~~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.~~

~~**C405.2.4.1.1 Dimming.** *Daylight responsive controls* shall be configured to automatically reduce the power of *general lighting* in the daylight zone in response to available daylight, while maintaining *uniform illumination* in the space through one of the following methods:~~

~~1. Continuous dimming using dimming ballasts/dimming drivers and daylight-sensing controls. The system shall reduce lighting power continuously to less than 15 percent of rated power at maximum light output.~~

~~2. Stepped dimming using multi-level switching and daylight-sensing controls. The system shall provide a minimum of two steps of uniform illumination between 0 percent and 100 percent of rated power at maximum light output. Each step shall be in equal increments of power, plus or minus 10 percent.~~

~~General lighting within daylight zones in offices, classrooms, laboratories and library reading rooms shall use the continuous dimming method. Stepped dimming is not allowed as a method of daylight zone control in these spaces.~~

~~**C405.2.4.2 Sidelit zone.** The *sidelit zone* is the floor area adjacent to vertical fenestration which complies with the following:~~

~~1. Where the *fenestration* is located in a wall, the *sidelit zone* includes the primary and secondary daylight zones. The primary daylight zone shall extend laterally to the nearest full height wall, or up to 1.0 times the height from the floor to the top of the *fenestra-*~~

~~*tion*, and longitudinally from the edge of the fenestration to the nearest full height wall, or up to 2 feet (610 mm), whichever is less, as indicated in Figure C405.2.4.2(1). The secondary daylight zone begins at the edge of the primary daylight zone and extends laterally to the nearest full height wall, or up to 2.0 times the height from the floor to the top of the fenestration, whichever is less, as indicated in Figure C405.2.4.2(1).~~

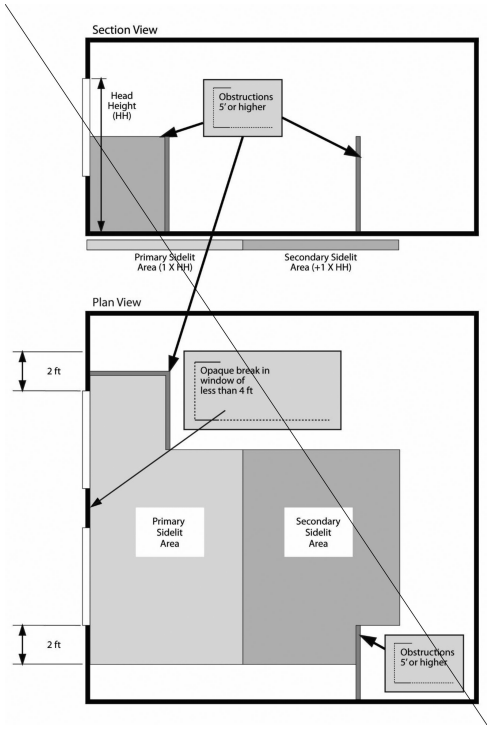
~~2. Where *clerestory fenestration* is located in a wall, the *sidelit zone* includes a lateral area twice the depth of the clerestory fenestration height, projected upon the floor at a 45 degree angle from the center of the clerestory fenestration. The longitudinal width of the sidelit zone is calculated the same as for fenestration located in a wall. Where the 45 degree angle is interrupted by an obstruction greater than 0.7 times the ceiling height, the sidelit zone shall remain the same lateral area but be located between the clerestory and the obstruction, as indicated in Figure C405.2.4.2(2).~~

~~3. If the rough opening area of a vertical fenestration assembly is less than 10 percent of the calculated primary sidelit zone area for this fenestration, it does not qualify as a sidelit zone.~~

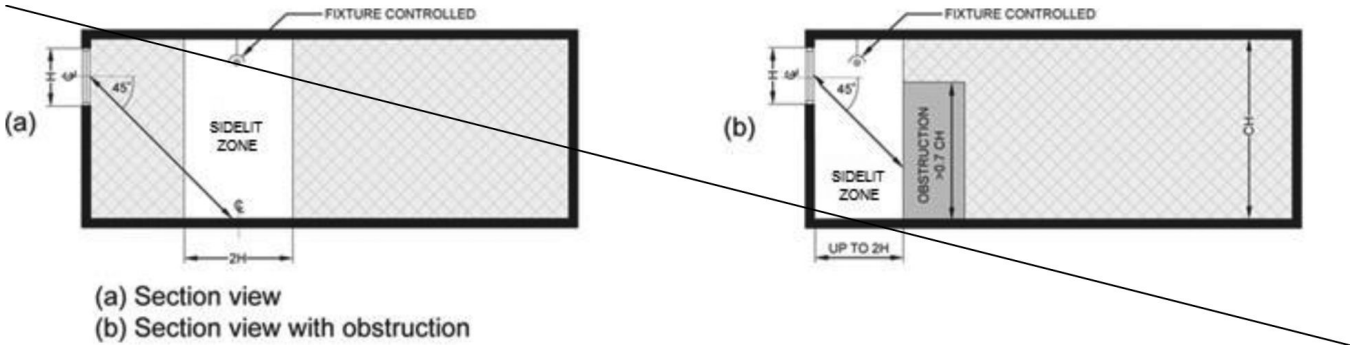
~~4. The visible transmittance of the fenestration is no less than 0.20.~~

~~5. In parking garages with floor area adjacent to perimeter wall openings, the sidelit zone shall include the area within 20 feet of any portion of a perimeter wall that has a net opening to wall ratio of at least 40 percent.~~

~~**Figure C405.2.4.2(1)**~~
~~**Sidelit Zone Adjacent to Fenestration in a Wall**~~



~~**Figure C405.2.4.2(2)**~~
~~**Sidelit Zone Adjacent to Clerestory Fenestration in a Wall**~~



(a) Section view
(b) Section view with obstruction

~~**C405.2.4.3 *Toplit* zone.** The *toplit zone* is the floor area underneath a roof fenestration assembly which complies with the following:~~

~~1. The *toplit zone* shall extend laterally and longitudinally beyond the edge of the roof *fenestration* assembly to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 0.7 times the ceiling height, whichever is less, as indicated in Figure C405.2.4.3(1).~~

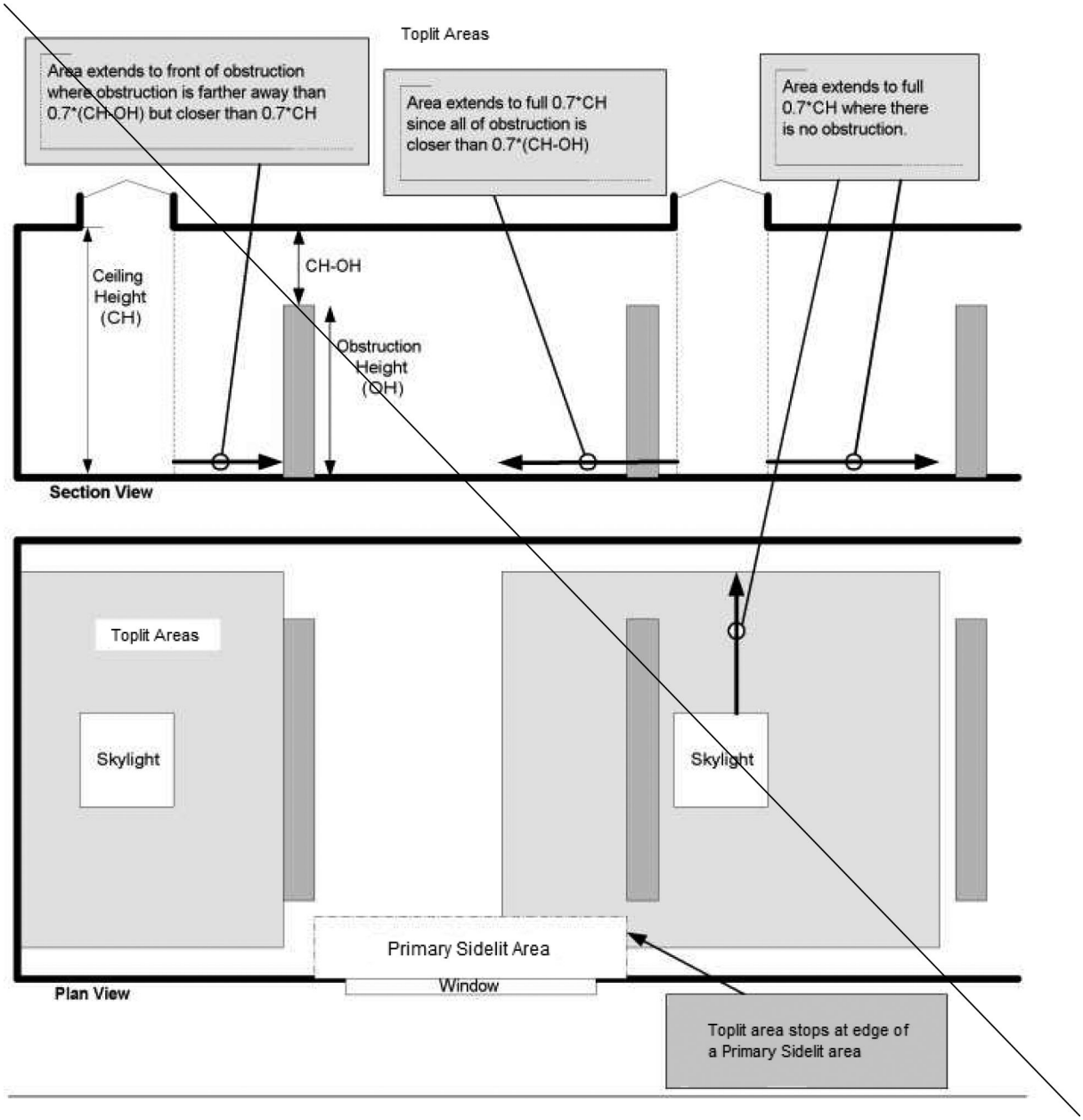
~~2. Where the fenestration is located in a rooftop monitor, the *toplit* zone shall extend laterally to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 1.0 times the height from the floor to the bottom of the fenestration, whichever is less, and longitudinally from the edge of the fenestration to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 0.25 times the height from the floor to the bottom of the fenestration, whichever is less, as indicated in Figures C405.2.4.3(2) and C405.2.4.3(3).~~

~~3. Where *toplit* zones overlap with *sidelit* zones, lights within the overlapping area shall be assigned to the *toplit* zone.~~

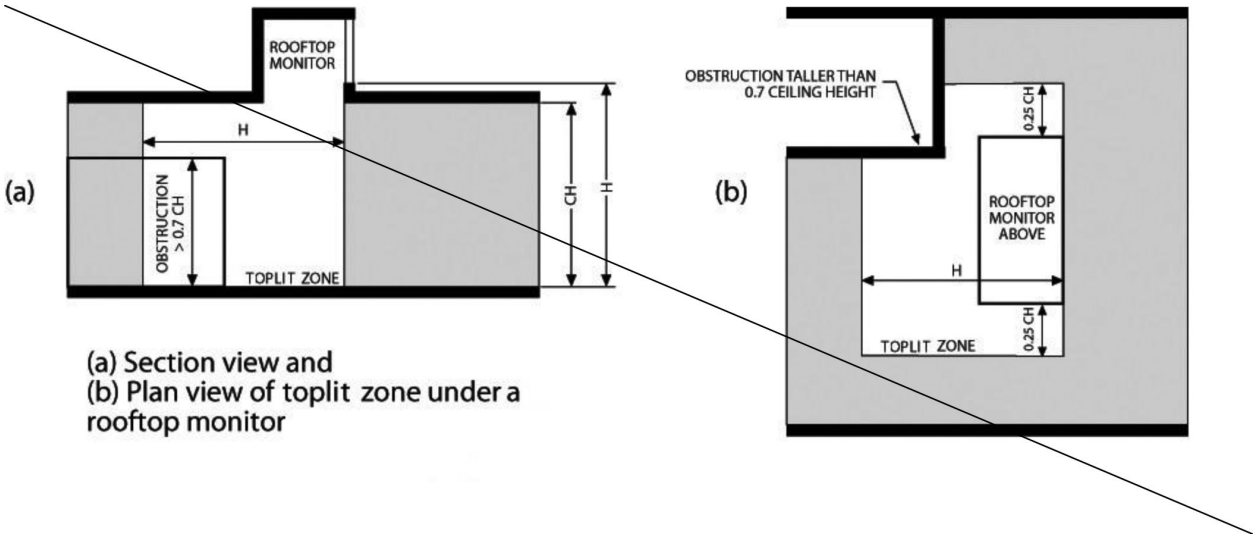
~~4. The product of the *visible transmittance* of the roof *fenestration* assembly and the area of the rough opening of the roof fenestration assembly, divided by the area of the *toplit* zone is no less than 0.008.~~

~~5. Where located under atrium fenestration, the *toplit zone* shall include the bottom floor area directly beneath the atrium fenestration, and the top floor directly under the atrium fenestration, as indicated in Figure C405.2.4.3(4). The toplit zone area at the top floor is calculated the same as for a *toplit* zone. Intermediate levels below the top floor that are not directly beneath the atrium are not included.~~

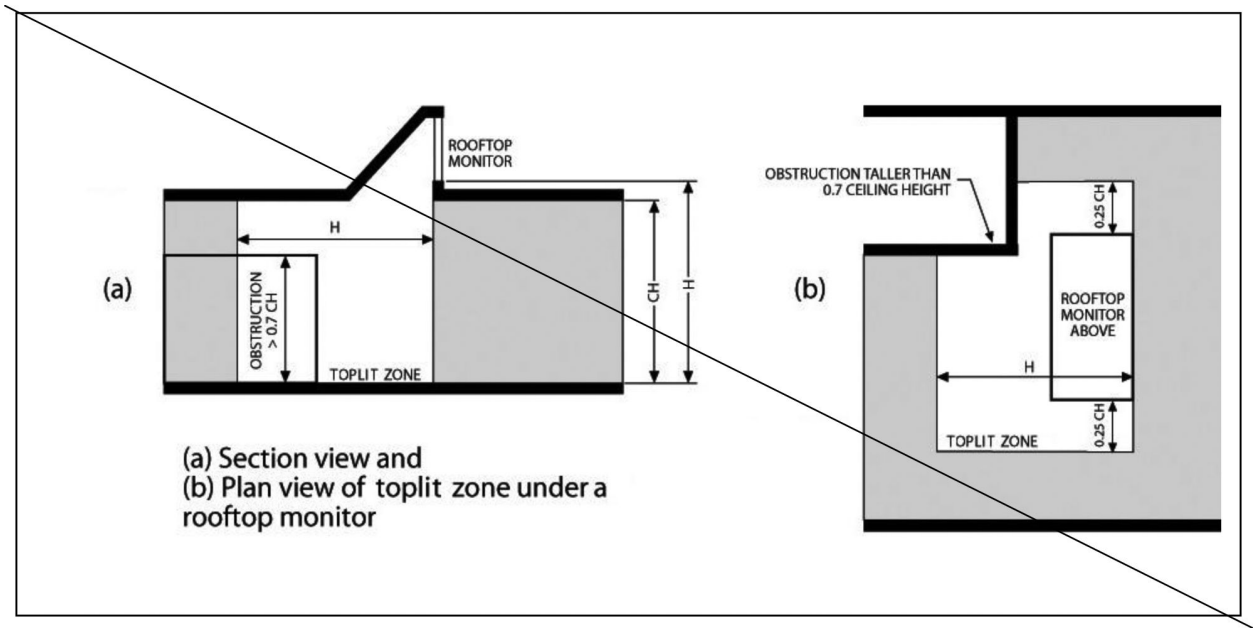
~~**Figure C405.2.4.3(1)**~~
~~**Toplit Zone Under a Rooftop Fenestration Assembly**~~



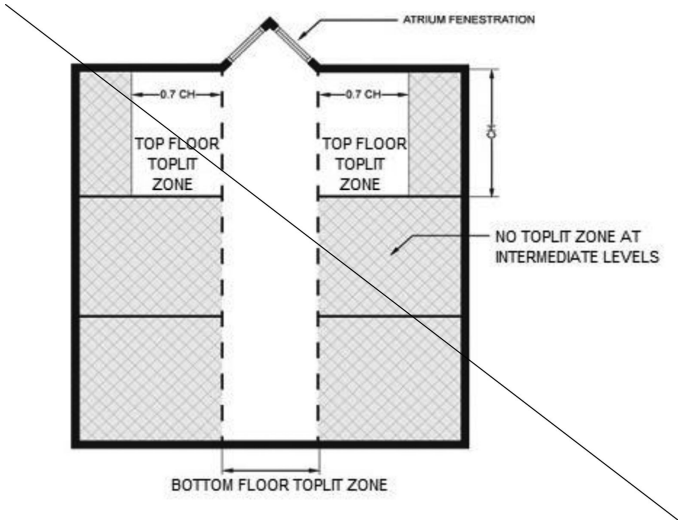
~~**Figure C405.2.4.3(2)**~~
~~**Toplit Zone Under a Rooftop Monitor**~~



~~**Figure C405.2.4.3(3)**~~
~~**Toplit Zone Under a Sloped Rooftop Monitor**~~



~~**Figure C405.2.4.3(4)**~~
~~**Toplit Zone Under Atrium Fenestration**~~



))

C405.2.4 Light-reduction controls. Where not provided with occupant sensor controls complying with Section C405.2.1.1, *general lighting* shall be provided with light-reduction controls complying with Section C405.2.4.1.

EXCEPTIONS:
1. Luminaires controlled by daylight responsive controls complying with Section C405.2.5.
2. Luminaires controlled by special application controls complying with Section C405.2.6.
3. Where provided with manual control, the following areas are not required to have light reduction control:
3.1. Spaces that have only one luminaire with a rated power of less than 60 watts.
3.2. Spaces that use less than 0.45 watts per square foot (4.9 W/m^2).
3.3. Corridors, lobbies, electrical rooms and/or mechanical rooms.

C405.2.4.1 Light reduction control function. *Manual* controls shall be configured to provide light reduction control that allows the occupant to reduce the connected lighting load by not less than 50 percent in a reasonable uniform illumination pattern with an intermediate step in addition to full on or off, or with continuous dimming control, by using one of the following or another *approved* method:

1. Continuous dimming of all luminaires from full output to less than 20 percent of full power.
2. Switching all luminaires to a reduced output of not less than 30 percent and not more than 70 percent of full power.
3. Switching alternate rows of luminaires or alternate luminaires to achieve a reduced output of not less than 30 percent and not more than 70 percent of full power.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-405025 Section C405.2.5—((~~Additional lighting~~)) Daylight responsive controls.

((**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. The following lighting shall be controlled by an occupant sensor complying with Section C405.2.1.1 or a time switch control complying with Section C405.2.2.1. In addition, a manual control shall be provided to control such lighting separately from the general lighting in the space:

1.1. Display and accent.

1.2. Lighting in display cases.

1.3. Supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting.

1.4. Lighting equipment that is for sale or demonstration in lighting education.

2. *Sleeping units* shall have control device(s) or systems configured to automatically switch off all permanently installed luminaires and switched receptacles within 20 minutes after all occupants have left the unit.

EXCEPTIONS: 1. Lighting and switched receptacles controlled by card key controls.
2. Spaces where patient care is directly provided.

3. Permanently installed luminaires within dwelling units shall be provided with controls complying with either Section C405.2.1.1 or C405.2.3.1.

4. Lighting for nonvisual applications, such as plant growth and food warming, shall be controlled by a dedicated control that 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.

5. Luminaires serving the exit access and providing means of egress illumination required by Section 1008.2 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.))

C405.2.5 Daylight responsive controls. *Daylight responsive controls* complying with Section C405.2.5.1 shall be provided to control the *general lighting* within *daylight zones* in the following spaces:

1. Spaces with a total of more than 75 watts of *general lighting* within *primary sidelit daylight zones* complying with Section C405.2.5.2.

2. Spaces with a total of more than 150 watts of *general lighting* within the combined *primary* and *secondary daylight zones* complying with Section C405.2.5.2.

3. Spaces with a total of more than 75 watts of *general lighting* within *toplit daylight zones* complying with Section C405.2.5.3.

EXCEPTION: *Daylight responsive controls* are not required for the following:
1. Spaces in health care facilities where patient care is directly provided.
2. Sidelit 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.

C405.2.5.1 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 sidelit daylight zones shall be controlled independently of lights in secondary sidelit daylight zones in accordance with Section C405.2.5.2.

2. Lights in toplit daylight zones in accordance with Section C405.2.5.3 shall be controlled independently of lights in sidelit daylight zones in accordance with Section C405.2.5.2.

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 in a location with *ready access.*

5. *Daylight responsive controls* shall dim lights continuously from full light output to 15 percent of full light output or lower.

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

7. When occupant sensor controls have reduced the lighting power to an unoccupied setpoint in accordance with Sections C405.2.1.2 through C405.2.1.4, *daylight responsive controls* shall continue to adjust electric light levels in response to available daylight but shall be configured to not increase the lighting power above the specified unoccupied setpoint.

8. Lights in sidelit daylight zones in accordance with Section C405.2.5.2 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 75 watts of *general lighting* are permitted to be controlled together with lighting in a daylight zone facing a different cardinal orientation.

9. Incorporate time-delay circuits to prevent cycling of light level changes of less than three minutes.

10. The maximum area a single *daylight responsive control* device serves shall not exceed 2,500 square feet (232 m^2).

11. 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.

C405.2.5.2 Sidelit daylight zone. The sidelit daylight zone is the floor area adjacent to vertical *fenestration* which complies with the following:

1. Where the *fenestration* is located in a wall, the primary sidelit daylight zone shall extend laterally to the nearest full height wall, or up to 1.0 times the height from the floor to the top of the *fenestration*, and longitudinally from the edge of the *fenestration* to the nearest full height wall, or up to 0.5 times the height from the floor to the top of the fenestration, whichever is less, as indicated in Figure C405.2.5.2(1).

2. The secondary sidelit daylight zone is directly adjacent to the primary daylight zone and shall extend laterally to 2.0 times the height from the floor to the top of the *fenestration* or to the nearest full height wall, whichever is less, and longitudinally from the edge of the *fenestration* to the nearest full height wall or up to 2 feet, whichever is less, as indicated in Figure C405.2.5.2(1).

3. Where *clerestory fenestration* is located in a wall, the sidelit daylight zone includes a lateral area twice the depth of the *clerestory fenestration* height, projected upon the floor at a 45 degree angle from the center of the *clerestory fenestration*. The longitudinal width of the sidelit daylight zone is calculated the same as for *fenestration* located in a wall. Where the 45 degree angle is interrupted

by an obstruction greater than 0.7 times the ceiling height, the sidelit daylight zone shall remain the same lateral area but be located between the clerestory and the obstruction, as indicated in Figure C405.2.5.2(2).

4. Where the *fenestration* is located in a rooftop monitor, the sidelit daylight zone shall extend laterally to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 1.0 times the height from the floor to the bottom of the *fenestration*, whichever is less, and longitudinally from the edge of the *fenestration* to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 0.25 times the height from the floor to the bottom of the *fenestration*, whichever is less, as indicated in Figures C405.2.5.2(3) and C405.2.5.2(4).

5. If the rough opening area of a vertical fenestration assembly is less than 10 percent of the calculated primary sidelit daylight zone area for this fenestration, it does not qualify as a sidelit daylight zone.

6. The visible transmittance of the fenestration is no less than 0.20.

7. The projection factor (determined in accordance with Equation 4-5) for any overhanging projection which is shading the *fenestration* is not greater than 1.0 for fenestration oriented 45 degrees or less from true north, and not greater than 1.5 for all other orientations.

Figure C405.2.5.2(1)
Sidelit Daylight Zone Adjacent to Fenestration in a Wall

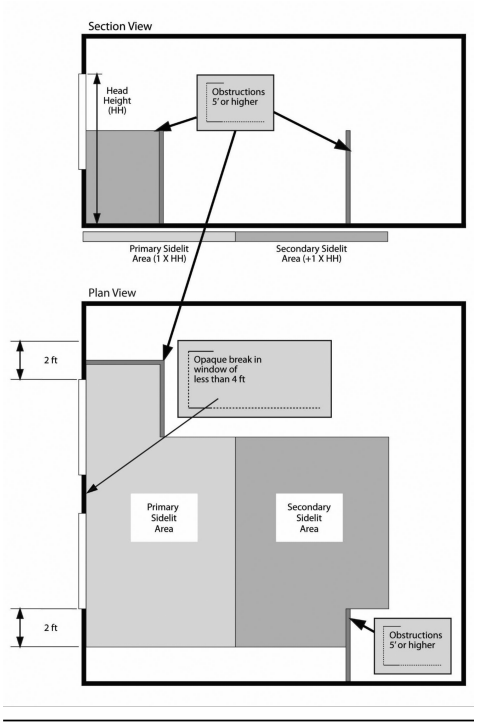


Figure C405.2.5.2(2)
Sidelit Daylight Zone Adjacent to Clerestory Fenestration in a Wall

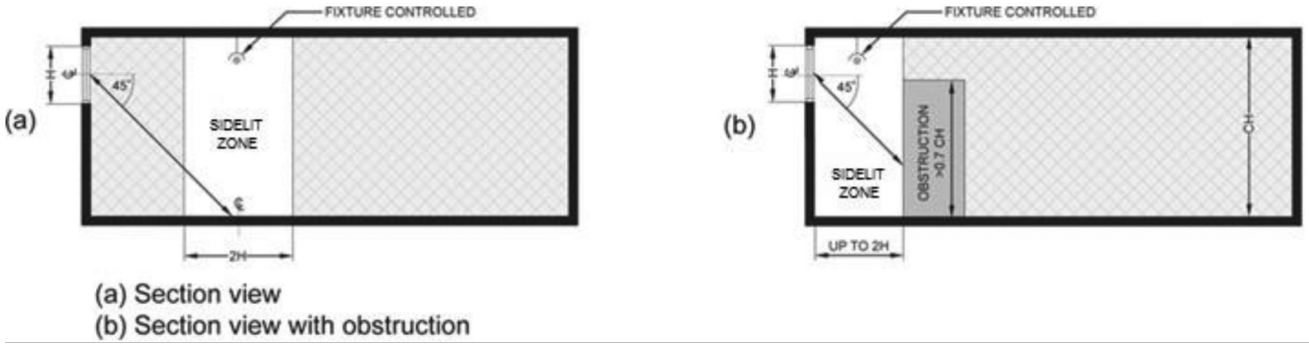
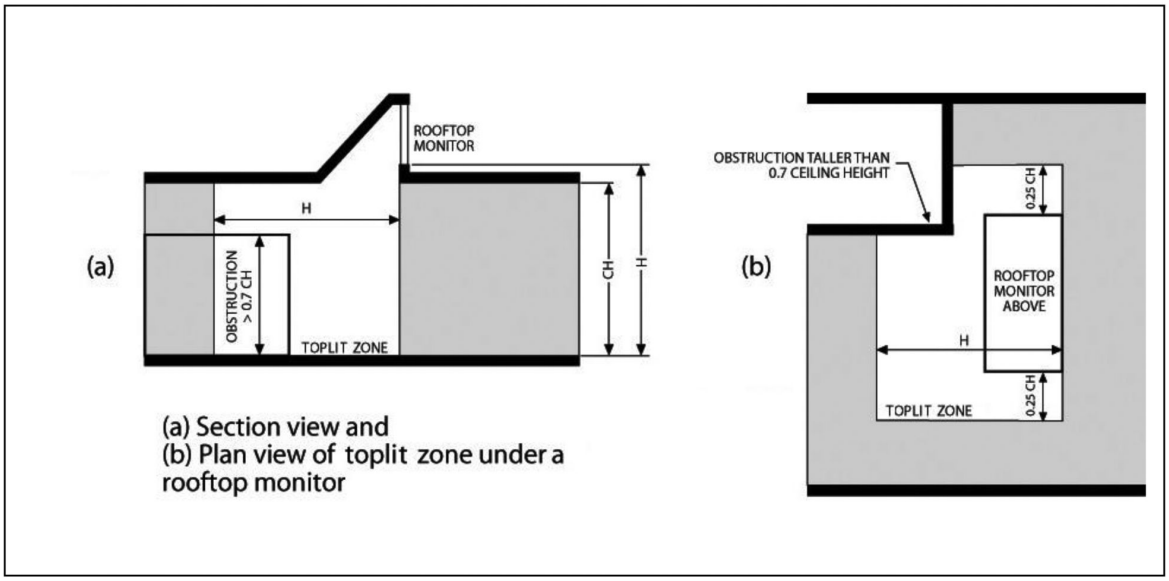


Figure C405.2.5.2(3)
Sidelit Daylight Zone Under a Sloped Rooftop Monitor



C405.2.5.3 Toplit daylight zone. The toplit daylight zone is the floor area underneath a roof fenestration assembly which complies with the following:

1. The toplit daylight zone shall extend laterally and longitudinally beyond the edge of the roof *fenestration* assembly to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 0.7 times the ceiling height, whichever is less, as indicated in Figure C405.2.5.3(1).

2. Where toplit daylight zones overlap with sidelit daylight zones, lights within the overlapping area shall be assigned to the toplit daylight zone.

3. The product of the *visible transmittance* of the roof *fenestration* assembly and the area of the rough opening of the roof fenestration assembly, divided by the area of the toplit daylight zone is no less than 0.008.

4. Where located under atrium fenestration, the toplit daylight zone shall include the bottom floor area directly beneath the atrium

fenestration, and the top floor directly under the atrium fenestration, as indicated in Figure C405.2.5.3(4). The toplit daylight zone area at the top floor is calculated the same as for a toplit daylight zone. Intermediate levels below the top floor that are not directly beneath the atrium are not included.

Figure C405.2.5.3(1)
Toplit Daylight Zone Under a Rooftop Fenestration Assembly

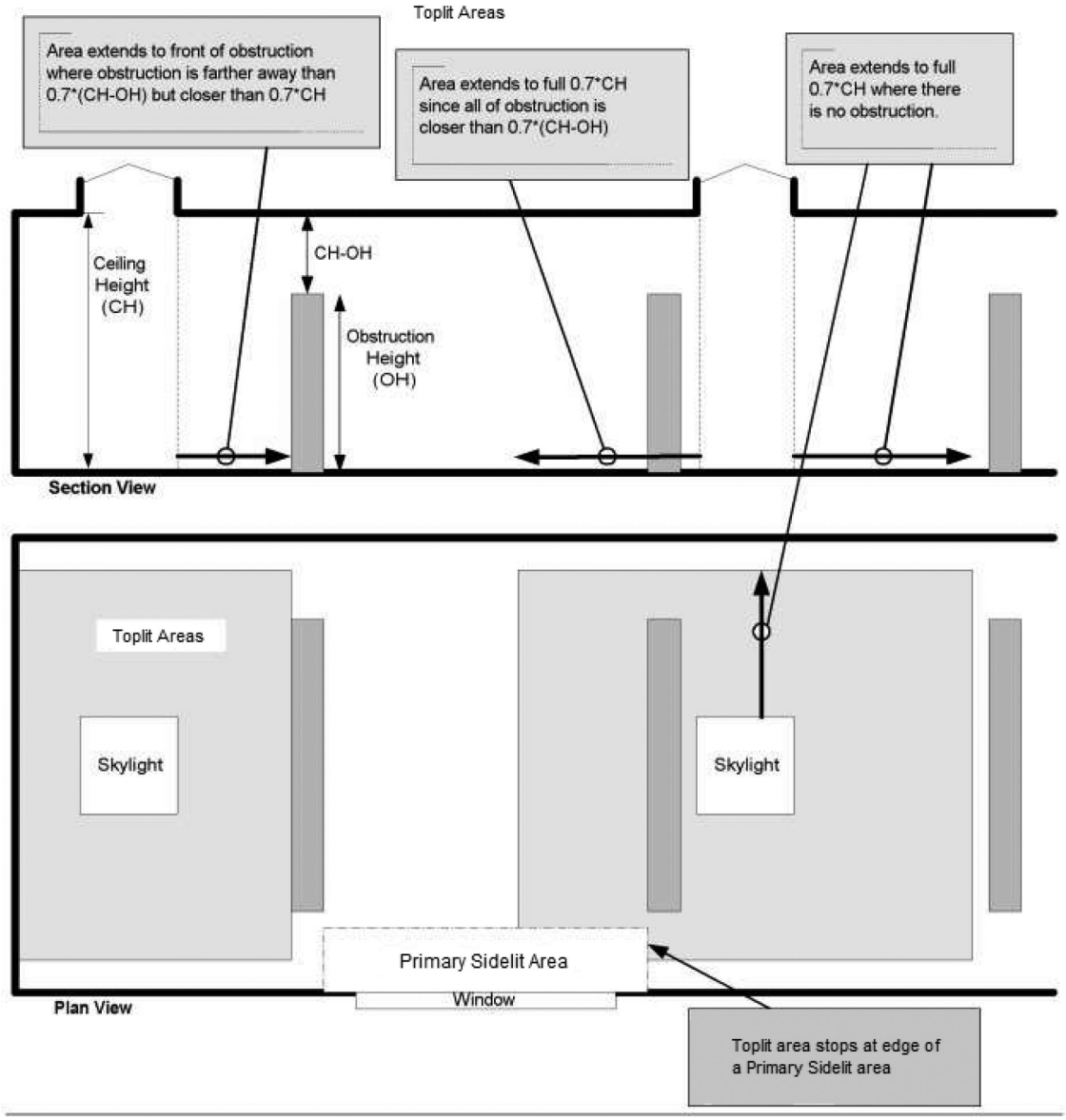
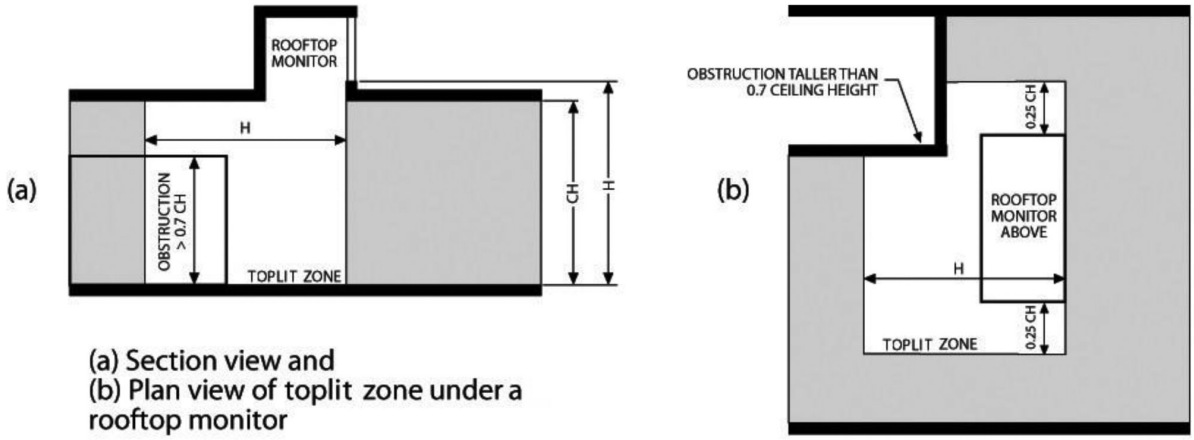
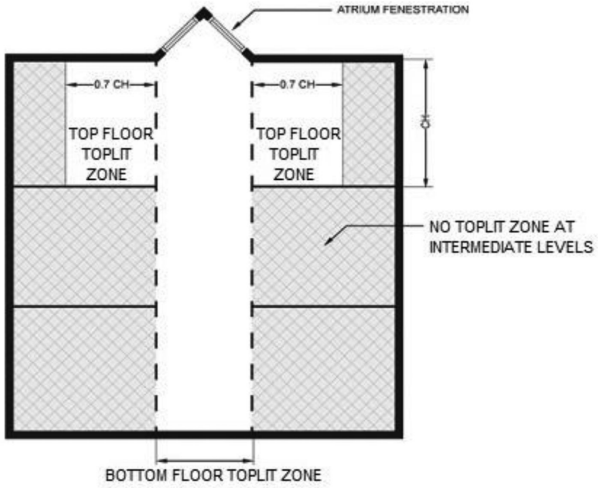


Figure C405.2.5.3(2)
Toplit Daylight Zone Under a Rooftop Monitor



(a) Section view and
(b) Plan view of toplit zone under a rooftop monitor

Figure C405.2.5.4
Toplit Daylight Zone Under Atrium Fenestration



C405.2.5.4 Atriums. Daylight zones at atrium spaces shall be established at the top floor surrounding the atrium and at the floor of the atrium space, and not on intermediate floors, as indicated in Figure C405.2.5.4.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-405026 Section C405.2.6—((~~Exterior~~)) Additional lighting controls. ((~~**C405.2.6 Exterior lighting controls.** Exterior~~

~~lighting systems shall be provided with controls that comply with Sections C405.2.6.1 through C405.2.6.4. Decorative lighting systems shall comply with Sections C405.2.6.1, C405.2.6.2, and C405.2.6.4.~~

~~EXCEPTIONS: 1. Lighting for covered vehicle entrances or exits from buildings or parking structures where required for safety, security or eye adaption.~~
~~2. Lighting controlled from within dwelling units.~~

~~**C405.2.6.1 Daylight shutoff.** Lights shall be configured to automatically turn off when daylight is present and satisfies the lighting needs.~~

~~**C405.2.6.2 Façade and landscape lighting shutoff.** Building façade and landscaping lighting shall be configured to automatically shutoff for a minimum of 6 hours per night or from not later than 1 hour after business closing to not earlier than 1 hour before business opening, whichever is less.~~

~~EXCEPTION: Areas where an automatic shutoff would endanger safety or security.~~

~~**C405.2.6.3 Lighting setback.** Lighting that is not controlled in accordance with Section C405.2.6.2 shall be controlled so that the total wattage of such lighting is automatically reduced by not less than 30 percent by selectively switching off or dimming luminaires at one of the following times:~~

~~1. From not later than 12 midnight to 6 a.m.~~

~~2. From not later than 1 hour after business closing to not earlier than 1 hour before business opening.~~

~~3. During any period when no activity has been detected for 15 minutes or more.~~

~~**C405.2.6.4 Exterior time-switch control functions.** Time-switch controls for exterior lighting shall comply with the following:~~

~~1. They shall have a clock capable of being programmed for not fewer than 7 days.~~

~~2. They shall be capable of being set for 7 different day types per week.~~

~~3. They shall incorporate an automatic holiday setback feature.~~

~~4. They shall have program backup capabilities that prevent the loss of program and time settings for a period of at least 10 hours in the event that power is interrupted.~~))

C405.2.6 Additional lighting controls. Specific application lighting shall be provided with controls, in addition to controls required by other sections, for the following:

1. The following lighting shall be controlled by an occupant sensor complying with Section C405.2.1.1 or a time switch control complying with Section C405.2.2.1. In addition, a *manual* control shall be provided to control such lighting separately from the *general lighting* in the space:

1.1. Luminaires for which additional lighting power is claimed in accordance with Section C405.4.2.2.1.

1.2. Display and accent.

1.3. Lighting in display cases.

1.4. Supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting.

1.5. Lighting equipment that is for sale or demonstration in lighting education.

1.6. Display lighting for exhibits in galleries, museums and monuments that is in addition to *general lighting*.

2. *Sleeping units* shall have control device(s) or systems configured to automatically switch off all permanently installed luminaires and switched receptacles within 20 minutes after all occupants have left the unit.

EXCEPTIONS: 1. Lighting and switched receptacles controlled by card key controls.
2. Spaces where patient care is directly provided.

3. Lighting for life support of nonhuman life forms and food warming, shall be controlled by a dedicated control that 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 (372 m^2), whichever is larger.

4. Task lighting for medical and dental purposes that is in addition to *general lighting* shall be provided with a manual control.

5. Luminaires serving the exit access and providing means of egress illumination required by Section 1008.2 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 0.01 watts per square foot (0.108 W/m^2) of building area is exempt from this requirement.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-405027 ((~~Reserved.~~)) Section C405.2.7—Area controls.

C405.2.7 Area controls. The maximum lighting power that may be controlled from a single switch or automatic control device 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.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-405028 Section ((~~C405.2.7 Area~~)) C405.2.8—Advanced lighting controls.

((~~**C405.2.7 Area controls.** The maximum lighting power that may be controlled from a single switch or automatic control device 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.~~))

C405.2.8 Advanced lighting controls. Any contiguous open office area larger than 5,000 square feet shall have its *general lighting* controlled by either:

1. *Luminaire-level lighting controls* (LLLC) conforming to the requirements of Section C405.2.8.1.

2. Networked lighting control (NLC) conforming to the requirements of Section C405.2.8.2.

C405.2.8.1 Luminaire-level lighting controls. Where *luminaire-level lighting controls* are required, they shall be configured to provide the controls or equivalent control function specified in Sections C405.2.1, C405.2.3, and C405.2.5. In addition, each LLLC luminaire shall be independently configured to:

1. Provide for continuous full range dimming.

2. Monitor occupant activity to brighten or dim lights when occupied or unoccupied, respectively.

3. Monitor ambient lighting, both electric and daylight, and brighten or dim artificial light to maintain desired light level. A maximum of 8 fixtures are permitted to be controlled together to maintain uniform light levels within a single daylight zone.

4. Allow configuration and reconfiguration of performance parameters for each control strategy including: High trim and low trim setpoints, timeouts, dimming fade rates, and sensor sensitivity adjustment.

5. Construction documents shall include a submittal of a sequence of operations including a specification outlining each of the functions required by this section.

6. Luminaires shall be configured with high end trim in accordance with Section C405.2.8.3.

C405.2.8.2 Networked lighting control (NLC). Where NLC are required, they shall be configured to provide controls and minimum function as specified in Section C405.2. In addition, each NLC luminaire shall be independently configured to:

1. Provide for continuous full range dimming.

2. Each luminaire shall be individually addressed.

EXCEPTIONS TO ITEM 2:

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

4. Monitor ambient lighting, both electric and daylight, and brighten or dim artificial light to maintain desired light level. A maximum of 8 fixtures are permitted to be controlled together to maintain uniform light levels within a single daylight zone.

5. Allow configuration and reconfiguration of performance parameters for each control strategy including: High trim and low trim setpoints, timeouts, dimming fade rates, and sensor sensitivity adjustment.

6. Allow for demand response load shed.

7. Construction documents shall include a submittal of a sequence of operations including a specification outlining each of the functions required by this section.

8. Luminaires shall be configured with high end trim in accordance with Section C405.2.8.3.

C405.2.8.3 High end trim. Luminaires subject to high end trim shall be initially configured with the following:

1. Programmed to limit the initial maximum lumen output or maximum lighting power to 85 percent or less of full light output or full power from full output or to meet the target light level documented in project sequence of operations using the least amount of power.

2. High end trim power levels are allowed to automatically reset to accommodate lumen maintenance.

3. High end trim controls shall be accessible only to authorized personnel.

NEW SECTION

WAC 51-11C-405029 Section C405.2.9—Exterior lighting controls.

C405.2.9 Exterior lighting controls. Exterior lighting systems shall be provided with controls that comply with Sections C405.2.9.1 through C405.2.9.4.

EXCEPTIONS: 1. Lighting for covered vehicle entrances or exits from buildings or parking structures where required for safety, security or eye adaption.
2. Lighting controlled from within dwelling units.

C405.2.9.1 Daylight shutoff. Lights shall be configured to automatically turn off when daylight is present and satisfies the lighting needs.

C405.2.9.2 Building façade and landscape lighting. Building façade and landscaping lighting shall be configured to automatically shutoff for a minimum of 6 hours per night or from not later than 1 hour after business closing to not earlier than 1 hour before business opening, whichever is less.

EXCEPTION: Areas where an automatic shutoff would endanger safety or security.

C405.2.9.3 Lighting setback. Lighting that is not controlled in accordance with Section C405.2.9.2 shall comply with all of the following:

1. Be controlled so that the total wattage of such lighting is automatically reduced by not less than 50 percent by selectively switching off or dimming luminaires at one of the following times:

1.1. From not later than 12 midnight to 6 a.m.

1.2. From not later than 1 hour after business closing to not earlier than 1 hour before business opening.

1.3. During any period when no activity has been detected for 15 minutes or more.

2. Luminaires serving outdoor parking areas and having a rated input wattage of greater than 40 watts and a mounting height of 30 feet (9144 mm) or less above the ground shall also be controlled so that the total wattage of such lighting is automatically reduced by not less than 50 percent during any time where activity has not been detected for 15 minutes or more. Not more than 1,500 watts of lighting power shall be controlled together.

C405.2.9.4 Exterior time-switch control functions. Time-switch controls for exterior lighting shall comply with the following:

1. They shall have a clock capable of being programmed for not fewer than 7 days.

2. They shall be capable of being set for 7 different day types per week.

3. They shall incorporate an automatic holiday setback feature.

4. They shall have program backup capabilities that prevent the loss of program and time settings for a period of at least 10 hours in the event that power is interrupted.

AMENDATORY SECTION (Amending WSR 16-03-072, filed 1/19/16, effective 7/1/16)

WAC 51-11C-40503 ((~~Reserved.~~)) Section C405.2.10—Parking garage lighting control.

C405.2.10 Parking garage lighting control. Parking garage lighting shall be controlled by an *occupant sensor* complying with Section C405.2.1.1 or a *time-switch control* complying with Section C405.2.2.1. Additional lighting controls shall be provided as follows:

1. Lighting power of each luminaire shall be automatically reduced by not less than 30 percent when there is no activity detected within a lighting zone for 20 minutes. Lighting zones for this requirement shall be not larger than 3,600 square feet (334.5 m^2).

2. Where lighting for eye adaptation is provided at covered vehicle entrances and exits from buildings and parking structures, such lighting shall be separately controlled by a device that automatically reduces lighting power by at least 50 percent from sunset to sunrise.

3. The power to luminaires within 20 feet (6096 mm) of perimeter wall openings shall automatically reduce in response to daylight by at least 50 percent.

EXCEPTIONS TO ITEM 3:

1. Daylight transition lighting for covered vehicle entrances and exits from buildings and parking structures; each transition zone shall not exceed a depth of 66 feet inside the structure and a width of 50 feet.
2. Where permanent screens or architectural elements obstruct more than 50 percent of the opening.
3. Where the top of any existing adjacent structure or natural object is at least twice as high above the openings as its horizontal distance from the opening.

NEW SECTION

WAC 51-11C-405030 Section C405.3—Lighting for plant growth and maintenance.

C405.3 Lighting for plant growth and maintenance. All permanently installed luminaires used for plant growth and maintenance shall have a *photosynthetic photon efficacy* of not less than 1.7 µmol/J for greenhouses and not less than 1.9 µmol/J for all other indoor growing spaces as defined in accordance with ANSI/ASABE S640.

EXCEPTION: Buildings with no more than 10 kW of aggregate horticultural lighting load.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-405051 Section C405.4.1—Total connected interior lighting power.

C405.4.1 Total connected interior lighting power. The total connected interior lighting power shall be determined in accordance with Equation ((~~4-10~~)) 4-13.

TCLP = [LVL + BLL + TRK + POE + Other]

(Equation ((~~4-10~~)) 4-13)

Where:

TCLP = Total connected lighting power (watts).

LVL = For luminaires with lamps connected directly to building power, such as line voltage lamps, the rated wattage of the lamp, which must be minimum 60 lumens/watt.

BLL = For luminaires incorporating a ballast or transformer, the rated input wattage of the ballast or transformer when operating the lamp.

TRK = For lighting track, cable conductor, rail conductor and plug-in busway systems that allow the addition and relocation of luminaires without rewiring, the wattage shall be one of the following:

1. The specified wattage of the luminaires, but not less than 16 W/lin. ft. (52 W/lin. m).

2. The wattage limit of the permanent current limiting devices protecting the system.

3. The wattage limit of the transformer supplying the system.

POE = For other modular lighting systems served with power supplied by a driver, power supply for transformer including, but not limited to, low-voltage lighting systems, the wattage of the system shall be the maximum rated input wattage of the driver, power supply or transformed published in the manufacturer's catalogs, as specified by UL 2108 or 8750. For power-over-Ethernet lighting systems, power provided to installed nonlighting devices may be subtracted from the total power rating of the power-over-Ethernet systems.

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.

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

1. Television broadcast lighting for playing areas in sports arenas.

2. Emergency lighting automatically off during normal building operation.

3. Lighting in spaces specifically designed for use by occupants with special lighting needs including those with visual impairment and other medical and age-related issues.

4. Casino gaming areas.

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

6. Mirror lighting in dressing rooms.

7. Task lighting for medical and dental purposes that is in addition to *general lighting* ((~~and controlled by an independent control device~~)).

8. Display lighting for exhibits in galleries, museums and monuments that is in addition to *general lighting* ((~~and controlled by an independent control device~~)).

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

10. Lighting for photographic processes.

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

12. Task lighting for plant growth or maintenance where the lamp efficacy is not less than 90 lumens per watt.

13. Advertising signage or directional signage.

14. Lighting for food warming.

15. Lighting equipment that is for sale.

16. Lighting demonstration equipment in lighting education facilities.

17. Lighting *approved* because of safety considerations.

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

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

20. Exit signs.

21. Lighting used for aircraft painting.

22. Antimicrobial lighting used for the sole purpose of disinfecting a space.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-405052 Section C405.4.2—Interior lighting power requirements.

C405.4.2 Interior lighting power allowance. The total interior lighting power allowance (watts) ((~~is~~)) for an entire building shall be 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~~)). The interior lighting power allowance for projects that involve only portions of a building shall be determined according to Table C405.4.2(2) using the Space-by-Space Method. Buildings with unfinished spaces shall use the Space-by-Space Method.

C405.4.2.1 Building area method. For the Building Area Method, the interior lighting power allowance is ((~~the floor area~~)) calculated as follows:

1. For each building area type ((~~listed in Table C405.4.2(1) times the value from Table C405.4.2(1) for~~)) inside the building, determine the applicable building area type and the allowed lighting power density for that type from Table C405.4.2(1). For building area types not listed, select the building area type that most closely represents the use of 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~~)).

2. Determine the floor area for each building area type listed in Table C405.4.2(1) and multiply this area by the applicable value from Table C405.4.2(1) to determine the lighting power (watts) for each building area type. ((~~Where this method is used to calculate~~))

3. The total interior lighting power allowance (watts) for ((~~an~~)) the entire building((~~,~~)) is the sum of the lighting power from 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 are permitted.~~)) Where a building has a space designated as unfinished, neither the area nor the lighting power in the space shall be calculated as part of the LPA. For the Space-by-Space Method, the interior lighting power allowance is calculated as follows:

1. For each area enclosed by partitions that are not less than 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~~)) determine the applicable space type from Table C405.4.2(2). For space types not listed, select the space type that most closely represents the proposed use of the space. Where a space has multiple functions, that space shall be broken up into smaller subspaces, each using their own space type. If an entire space has multiple functions that necessitate a higher lighting power allowance in order to serve one of the primary functions, the higher allowance is permitted to be used.

2. Determine the total floor area of all of the spaces of each space type and multiply by the value for the space type in Table C405.4.2(2) to determine the lighting power (watts) for each space type.

3. The total interior lighting power allowance (watts) shall be the sum of the lighting power allowances for all space types.

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 in addition to and automatically controlled separately from ((~~the~~)) *general lighting*, ((~~to be turned off during nonbusiness hours~~)) in accordance with Section C405.2.6. 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 be determined in accordance with Equation ((~~4-11~~)) 4-14.

(Equation ((~~4-11~~)) 4-14)

Additional Interior Lighting Power Allowance = 500 watts + (Retail Area 1 × 0.45 W/ft^2) + (Retail Area 2 × 0.45 W/ft^2) + (Retail Area 3 × 1.05 W/ft^2) + (Retail Area 4 × 1.87 W/ft^2).

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.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-405053 Table C405.4.2(1)—Interior lighting power allowances—Building area method.

Table C405.4.2(1)
Interior Lighting Power Allowances—Building Area Method

Building Area Type	LPD (w/ ft^2)
Automotive facility	0.64
Convention center	0.64
Court house	0.79
Dining: Bar lounge/leisure	0.79
Dining: Cafeteria/fast food	0.72
Dining: Family	0.71
Dormitory((~~[a,b]~~))	0.46
Exercise center	0.67
Fire station((~~[a]~~))	0.54
Gymnasium	0.75
Health care clinic	0.70
Hospital((~~[a]~~))	0.84
Hotel/motel((~~[a,b]~~))	0.56
Library	0.83
Manufacturing facility	0.82
Motion picture theater	0.44
((~~Multifamily[c]~~)) Multiple family	0.41
Museum	0.55
Office	0.64
Parking garage	0.14
Penitentiary	0.65
Performing arts theater	0.84
Police station	0.66
Post office	0.65
Religious building	0.67
Retail	0.84
School/university	0.70
Sports arena	0.62
Town hall	0.69
Transportation	0.50
Warehouse	0.40
Workshop	0.91

((~~[a] Where sleeping units are excluded from lighting power calculations by application of Section R404.1, neither the area of the sleeping units nor the wattage of lighting in the sleeping units is counted.~~

~~[b] Where dwelling units are excluded from lighting power calculations by application of Section R404.1, neither the area of the dwelling units nor the wattage of lighting in the dwelling units is counted.~~

~~c Dwelling units are excluded. Neither the area of the dwelling units nor the wattage of lighting in the dwelling units is counted.~~))

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-405054 Table C405.4.2(2)—Interior lighting power allowances—Space-by-space method.

Table C405.4.2(2)
Interior Lighting Power Allowances—Space-by-Space Method

Common Space-by-Space Types[a,i]	LPD (w/ft^2)
Atrium - Less than 20 feet in height	0.39
Atrium - 20 to 40 feet in height	0.48
Atrium - Above 40 feet in height	0.60
Audience/seating area - Permanent[i]	
In an auditorium	0.61
In a gymnasium	0.23
In a motion picture theater	0.27
In a penitentiary	0.67
In a performing arts theater	1.16
In a religious building	0.72
In a sports arena	0.33
Otherwise	0.23
Banking activity area((n)) [i]	0.61
Breakroom (see lounge/breakroom)	
Classroom/lecture hall/training room	
In a penitentiary	0.89
Otherwise[h]	0.71((m))
Computer room, data center	0.94
Conference/meeting/multipurpose	0.97
Confinement cell	0.70
Copy/print room	0.31
Corridor	
In a facility for the visually impaired (and not used primarily by the staff)[b]	0.71
In a hospital	0.71
In a manufacturing facility	0.41
Otherwise[c,i]	0.41
Courtroom[c]	1.20
Dining area	
In a penitentiary	0.42
In a facility for the visually impaired (and not used primarily by the staff)[b]	1.27

Common Space-by-Space Types[a,i]	LPD (w/ft^2)
In a bar/lounge or leisure dining((n)) [i]	0.86
In cafeteria or fast food dining	0.40
In a family dining area((n)) [i]	0.60
Otherwise	0.43
Electrical/mechanical	0.43
Emergency vehicle garage	0.52
Food preparation	1.09
Guest room[a,b]	0.41
Laboratory	
In or as a classroom	1.11
Otherwise	1.33
Laundry/washing area	0.53
Loading dock, interior	0.88
Lobby[c]	
In a facility for the visually impaired (and not used primarily by the staff)[b]	1.69
For an elevator	0.65
In a hotel	0.51
In a motion picture theater	0.23
In a performing arts theater	1.25
Otherwise	0.84
Locker room	0.52
Lounge/breakroom((n)) [i]	
In a health care facility((n)) [c,i]	0.42
Otherwise((n)) [i]	0.59
Office	
Enclosed ≤ 250	0.74
Enclosed > 250	0.66
Open plan	0.61
Parking area, interior	0.15
Pharmacy area	1.66
Restroom	
In a facility for the visually impaired (and not used primarily by the staff)[b]	1.26
Otherwise((n)) [i]	0.63
Sales area	1.05
Seating area, general	0.23
Stairway (see space containing stairway)	
Stairwell((n)) [c,i]	0.49
Storage room	
< 50 ft^2	0.51
50-100 ft^2	0.38

Common Space-by-Space Types[a,i]	LPD (w/ft^2)
All other storage	0.38
Vehicular maintenance	0.60
Workshop	1.26

Building Specific Space-by-Space Types[a]	LPD (w/ft^2)
Automotive (see vehicular maintenance)	
Convention center - Exhibit space[i]	0.61
Dormitory living quarters[a,b]	0.50
Facility for the visually impaired[b]	
In a chapel (and not used primarily by the staff)[b]	0.70
In a recreation room (and not used primarily by the staff)[b]	1.77
Fire stations((~~g~~))	
Sleeping quarters	0.23
Gymnasium/fitness center	
In an exercise area	0.90
In a playing area	0.85
Health care facility[c,i]	
In an exam/treatment room	1.40
In an imaging room	0.94
In a medical supply room	0.62
In a nursery	0.92
In a nurse's station	1.17
In an operating room	2.26
In a patient room((~~g~~))	0.68
In a physical therapy room	0.91
In a recovery room	1.25
Library	
In a reading area((~~n~~)) [i]	((~~0.31~~)) 0.96
In the stacks	1.10
Manufacturing facility	
In a detailed manufacturing area	0.80
In an equipment room	0.76
In an extra high bay area (greater than 50-foot floor-to-ceiling height)	1.42
In a high bay area (25 - 50-foot floor-to-ceiling height)	1.24
In a low bay (< 25-foot floor-to-ceiling height)	0.86
Museum	
In a general exhibition area[i]	0.31
In a restoration room	1.10
Performing arts theater dressing/ fitting room	0.41

Building Specific Space-by-Space Types[a]	LPD (w/ft^2)
Post office - Sorting area	0.76
Religious buildings	
In a fellowship hall((n)) i	0.54
In a worship/pulpit/choir area((n)) i	0.85
Retail facilities	
In a dressing/fitting room	0.51
In a mall concourse	0.82
Sports arena - Playing area	
For a Class 1 facility((i)) d	2.94
For a Class 2 facility((j)) e	2.01
For a Class 3 facility((k)) f	1.30
For a Class 4 facility((l)) g	0.86
Transportation	
In a baggage/carousel area	0.39
In an airport concourse	0.25
At a terminal ticket counter((n)) i	0.51
Warehouse - Storage area	
For medium to bulky palletized items	0.33
For smaller, hand-carried items	0.69

For SI: 1 foot = 304.8 mm, 1 watt per square foot = ((~~11~~)) 10.76 W/m^2.

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 purpose of highlighting art or exhibits, provided that the additional lighting power shall not exceed 0.5 W/ft^2 of such spaces.~~)) Additional lighting power allowance of 0.2 watts per square foot for the purpose of highlighting art or exhibits. This additional power shall be permitted only where the specified lighting is installed in addition to and controlled separately from *general lighting* in accordance with Section C405.2.6. This additional power shall be used only for the specified luminaires and shall not be used for any other purpose and it shall not be added to any other space or the interior power allowance.

((~~d~~ ~~Reserved.~~

~~e~~ ~~Reserved.~~

~~f~~ ~~Reserved.~~

~~g~~ ~~Where sleeping units are excluded from lighting power calculations by application of Section R404.1, neither the area of the sleeping units nor the wattage of lighting in the sleeping units is counted.~~

~~h~~ ~~Where dwelling units are excluded from lighting power calculations by application of Section R404.1, neither the area of the dwelling units nor the wattage of lighting in the dwelling units is counted.~~

~~i~~)) d Class I facilities consist of professional facilities; and semiprofessional, collegiate or club facilities with seating for 5,000 or more spectators.

((~~j~~)) e Class II facilities consist of collegiate and semiprofessional facilities with seating for fewer than 5,000 spectators; club facilities with seating between 2,000 and 5,000 spectators; and amateur league and high school facilities with seating for more than 2,000 spectators.

((k)) f Class III facilities consist of club, amateur league and high school facilities with seating for 2,000 or fewer spectators.

((l)) g Class IV facilities consist of elementary school and recreational facilities; and amateur league and high school facilities without provisions for spectators.

((m)) h For classrooms, additional lighting power allowance of 4.50 W/lineal foot of white or chalk boards for directional lighting dedicated to white or chalk boards.

((n)) i Additional lighting power allowance of ((~~0.30~~)) 0.15 W/ft^2 for ornamental lighting. Qualifying ornamental lighting includes luminaires ((~~such as chandeliers, sconces, lanterns, neon and cold cathode, light emitting diodes, theatrical projectors, moving lights and light color panels when any of those lights are~~)) that are specifically used in a decorative manner ((~~that does not serve as~~)). This additional power shall be permitted only where the specified lighting is installed in addition to and controlled separately from display ((~~lighting~~)) or *general lighting* in accordance with Section C405.2.6. This additional power shall be used only for the specified luminaires and it shall not be added to any other space or the interior power allowance.

j Where a space is designated as unfinished, neither the area nor the lighting power in the space shall be calculated as part of the LPA.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-405061 Section C405.5.1—Exterior building grounds lighting.

C405.5.1 Exterior building grounds lighting. All exterior building grounds luminaires that operate at greater than ((~~50~~)) 25 watts shall have a minimum efficacy of 100 lumens per watt ((~~unless the luminaire is controlled by a motion sensor or qualifies for one of the exceptions under Section C405.5.2~~)).

EXCEPTIONS:
1. ((~~Solar-powered lamps not connected to any electrical source.~~
~~2.~~)) Luminaires controlled by a motion sensor.
((~~3.~~)) 2. Luminaires that qualify for one of the exceptions under Section C405.5.2.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-405062 Section C405.5.2—Exterior building lighting power.

C405.5.2 Total connected exterior building lighting power. The total exterior connected lighting power shall be the total maximum rated wattage of all exterior lighting that is powered through the energy service for the building.

EXCEPTION: Lighting used for the following applications shall not be included:
1. Lighting approved because of safety considerations;
2. Emergency lighting automatically off during normal business operation;
3. Exit signs;
4. Specialized signal, directional and marker lighting associated with transportation;
5. Advertising signage or directional signage;
6. Integral to equipment or instrumentation and is installed by its manufacturer;
7. Theatrical purposes, including performance, stage, film production and video production;
8. Athletic playing areas;
9. Temporary lighting;
10. Industrial production, material handling, transportation sites and associated storage areas;
11. Theme elements in theme/amusement parks;
12. Lighting integrated within or used to highlight features of art, public monuments and the national flag;
13. Lighting for water features and swimming pools; and
14. Lighting that is controlled from within dwelling units, where the lighting complies with Section R404.1.

C405.5.3 Exterior lighting power allowance. ((~~The total exterior lighting power allowance is the sum of the base site allowance plus the individual allowances for areas that are to be illuminated by lighting that is powered through the energy service for the building. Lighting power allowances are as specified in Table C405.5.3(2). The lighting zone for the building exterior is determined in accordance with Table C405.5.3(1) unless otherwise specified by the code official.~~)) The exterior lighting power allowance (watts) is calculated as follows:

1. Determine the Lighting Zone (LZ) for the building according to Table C405.5.3(1), unless otherwise specified by the code official.

2. For each exterior area that is to be illuminated by lighting that is powered through the energy service for the building, determine the applicable area type from Table C405.5.3(2). For area types not listed, select the area type that most closely represents the proposed use of the area. Covered parking garage lighting is not considered exterior lighting for the purposes of this calculation.

3. Determine the total area or length of each area type and multiply by the value for the area type in Table C405.5.3(2) to determine the lighting power (watts) allowed for each area type.

4. The total exterior lighting power allowance (watts) is the sum of the base site allowance determined according to Table C405.5.3(2), plus the watts from each area type.

C405.5.3.1 Additional exterior lighting power. ((~~Any increase in the~~)) Additional exterior lighting power allowances ((~~is limited to~~)) are available for the specific lighting applications ((~~indicated~~)) listed in Table C405.5.3(3). ((~~The~~)) These additional power allowances shall be used only for the luminaires ((~~that are~~)) serving these applications and shall not be used ((~~for any other purpose~~)) to increase any other lighting power allowance.

C405.5.4 Gas lighting. Gas-fired lighting appliances shall not be equipped with continuously burning pilot ignition systems.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-405064 Table C405.5.3(2)—Individual lighting power allowances for building exteriors.

Table C405.5.3(2)
Lighting Power Allowances for Building Exteriors

	Lighting Zones			
	Zone 1	**Zone 2**	**Zone 3**	**Zone 4**
Base Site Allowance	((~~350~~)) 160 W	((~~400~~)) 280 W	((~~500~~)) 400 W	((~~900~~)) 560 W
Uncovered Parking Areas				
Parking areas and drives	((~~0.03~~)) 0.015 W/ft^2	((~~0.04~~)) 0.026 W/ft^2	((~~0.06~~)) 0.037 W/ft^2	((~~0.08~~)) 0.052 W/ft^2
Building Grounds				

	Lighting Zones			
	Zone 1	**Zone 2**	**Zone 3**	**Zone 4**
Walkways and ramps less than 10 feet wide	((~~0.5 W/ linear foot~~)) 0.04 W/ft^2	((~~0.5 W/ linear foot~~)) 0.07 W/ft^2	((~~0.6 W/ linear foot~~)) 0.10 W/ft^2	((~~0.7 W/ linear foot~~)) 0.14 W/ft^2
Walkways and ramps 10 feet wide or greater, plaza areas, special feature areas	((~~0.10~~)) 0.04 W/ft^2	((~~0.10~~)) 0.07 W/ft^2	((~~0.11~~)) 0.10 W/ft^2	0.14 W/ft^2
Dining areas	((~~0.65~~)) 0.156 W/ft^2	((~~0.65~~)) 0.273 W/ft^2	((~~0.75~~)) 0.390 W/ft^2	((~~0.95~~)) 0.546 W/ft^2
Stairways	((~~0.6 W/ ft^2~~)) Exempt	((~~0.7 W/ ft^2~~)) Exempt	((~~0.7 W/ ft^2~~)) Exempt	((~~0.7 W/ ft^2~~)) Exempt
Pedestrian tunnels	((~~0.12~~)) 0.063 W/ft^2	((~~0.12~~)) 0.110 W/ft^2	((~~0.14~~)) 0.157 W/ft^2	((~~0.21~~)) 0.220 W/ft^2
Landscaping	((~~0.03~~)) 0.014 W/ft^2	((~~0.04~~)) 0.025 W/ft^2	((~~0.04~~)) 0.036 W/ft^2	((~~0.04~~)) 0.050 W/ft^2
Building Entrances and Exits				
Pedestrian and vehicular entrances and exits	((~~14~~)) 5.6 W/linear foot of opening	((~~14~~)) 9.8 W/linear foot of opening	((~~21~~)) 14.0 W/ linear foot of opening	((~~21~~)) 19.6 W/ linear foot of opening
Entry canopies	((~~0.2~~)) 0.072 W/ft^2	((~~0.25~~)) 0.126 W/ft^2	((~~0.4~~)) 0.180 W/ft^2	((~~0.4~~)) 0.252 W/ft^2
Loading docks	((~~0.35~~)) 0.104 W/ft^2	((~~0.35~~)) 0.182 W/ft^2	((~~0.35~~)) 0.260 W/ft^2	((~~0.35~~)) 0.364 W/ft^2
Sales Canopies				
Free standing and attached	((~~0.4~~)) 0.20 W/ft^2	((~~0.4~~)) 0.35 W/ft^2	((~~0.6~~)) 0.50 W/ft^2	((~~0.7~~)) 0.70 W/ft^2
Outdoor Sales				
Open areas (including vehicle sales lots)	((~~0.2~~)) 0.072 W/ft^2	((~~0.2~~)) 0.126 W/ft^2	((~~0.35~~)) 0.180 W/ft^2	((~~0.5~~)) 0.252 W/ft^2
Street frontage for vehicle sales lots in addition to "open area" allowance	No Allowance	7 W/ linear foot	((~~7~~)) 10.3 W/linear foot	((~~21~~)) 14.4 W/ linear foot

For SI: 1 foot = 304.8 mm, 1 watt per square foot = ((~~W/0.0929~~)) 10.76 W per m^2

Table C405.5.3(3)
Individual Lighting Power Allowances for Building Exteriors

	((~~Lighting Zones~~			
	~~Zone 1~~	~~Zone 2~~	~~Zone 3~~	~~Zone 4~~
~~Building facades~~	~~No allowance~~	~~0.075 W/ft^2 of gross above-grade wall area~~	~~0.113 W/ft^2 of gross above-grade wall area~~	~~0.150 W/ft^2 of gross above-grade wall area~~
~~Automated teller machines and night depositories~~	~~135W per location plus 45W per additional ATM per location~~			

	((~~Lighting Zones~~			
	~~Zone 1~~	~~Zone 2~~	~~Zone 3~~	~~Zone 4~~
~~Uncovered entrances and gatehouse inspection stations at guarded facilities~~	~~0.5 W/ft^2~~			
~~Uncovered loading areas for law enforcement, fire, ambulance and other emergency service vehicles~~	~~0.35 W/ft^2~~			
~~Drive-up windows/doors~~	~~200 W per drive-through~~			
~~Parking near 24-hour retail entrances~~	~~400 W per main entry~~))			

	Lighting Zones			
	Zone 1	**Zone 2**	**Zone 3**	**Zone 4**
Base site allowance	No allowance	0.075 W/ft^2 of gross above-grade wall area	0.113 W/ft^2 of gross above-grade wall area	0.150 W/ft^2 of gross above-grade wall area
Automated teller machines (ATM) and night depositories	80 W per location plus 25 per additional ATM	80 W per location plus 25 per additional ATM	80 W per location plus 25 per additional ATM	80 W per location plus 25 per additional ATM
Uncovered entrances and gatehouse inspection stations at guarded facilities	0.144 W/ft^2	0.252 W/ft^2	0.360 W/ft^2	0.504 W/ft^2
Uncovered loading areas for law enforcement, fire, ambulance and other emergency service vehicles	0.104 W/ft^2	0.182 W/ft^2	0.260 W/ft^2	0.364 W/ft^2
Drive-up windows/doors	53 W per drive through	92 W per drive through	132 W per drive through	185 W per drive through
Parking near 24-hour retail entrances	80 W per main entry	140 W per main entry	200 W per main entry	280 W per main entry

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40507 Sections C405.6 and C405.7—Electrical energy consumption.

C405.6 Electrical transformers. Low-voltage dry-type distribution electric transformers shall meet the minimum efficiency requirements of Table C405.6 as tested and rated in accordance with the test procedure listed in DOE 10 C.F.R. 431. The efficiency shall be verified through certification under an approved certification program or, where no certification program exists, the equipment efficiency ratings shall be supported by data furnished by the transformer manufacturer.

EXCEPTION: The following transformers are exempt:
1. Transformers that meet the Energy Policy Act of 2005 exclusions based on the DOE 10 C.F.R. 431 definition of special purpose applications.

2. Transformers that meet the Energy Policy Act of 2005 exclusions that are not to be used in general purpose applications based on information provided in DOE 10 C.F.R. 431.
3. Transformers that meet the Energy Policy Act of 2005 exclusions with multiple voltage taps where the highest tap is not less than 20 percent more than the lowest tap.
4. Drive transformers.
5. Rectifier transformers.
6. Auto-transformers.
7. Uninterruptible power system transformers.
8. Impedance transformers.
9. Regulating transformers.
10. Sealed and nonventilating transformers.
11. Machine tool transformer.
12. Welding transformer.
13. Grounding transformer.
14. Testing transformer.

Table C405.6
Minimum Nominal Efficiency Levels For 10 C.F.R. 431 Low Voltage Dry-Type Distribution Transformers

Single Phase Transformers		Three Phase Transformers	
kVA[a]	Efficiency (%)[b]	kVA[a]	Efficiency (%)[b]
15	97.70	15	97.89
25	98.00	30	98.23
37.5	98.20	45	98.40
50	98.30	75	98.60
75	98.50	112.5	98.74
100	98.60	150	98.83
167	98.70	225	98.94
250	98.80	300	99.02
333	98.90	500	99.14
		750	99.23
		1000	99.28

[a] kiloVolt-Amp rating.
[b] Nominal efficiencies shall be established in accordance with the DOE 10 C.F.R. 431 test procedure for low voltage dry-type transformers.

C405.7 Dwelling unit electrical energy consumption. Each dwelling unit located in a Group R-2 building shall have a separate electrical meter. A utility tenant meter meets this requirement. See Section C409 for additional requirements for energy metering and energy consumption management.

EXCEPTION: Dwelling units in other than Group R-2 multi-family and live/work units are not required to provide a separate electrical metering at each dwelling unit where electrical usage is metered separately for each of the following building end uses:
1. Dwelling units.
2. Sleeping units.
3. Commercial kitchens.
4. Central laundries.

C405.7.1 Electric receptacles at dwelling unit gas appliances. Where *dwelling unit* appliances are served by natural gas, an electrical receptacle or junction box and circuit shall be provided at each gas appliance with sufficient capacity to serve a future electric appliance in the same location. The receptacles and circuits shall be included in the electrical service load calculation and shall meet the requirements of items 1 through 3 below. The receptacle or junction box for each gas appliance shall be located within 12 inches of the appliance and without obstructions between the appliance and the outlet. An electric receptacle is not required for a decorative gas fireplace.

1. Each gas range, cooktop, or oven, or combination appliance, location shall be served by a dedicated 240/208-volt, 40-amp receptacle connected to the *dwelling unit* electric panel with a 3-conductor branch circuit complying with 210.19(A)(3) of the NEC as adopted by Washington state and a minimum included load of 9600 VA for 240-volt systems or 8000 VA for 208-volt systems.

2. Each gas clothes dryer location shall be served by a dedicated 240/208-volt, 30-amp receptacle connected to the *dwelling unit* electric panel with a 3-conductor branch circuit and a minimum included load of 5000 VA.

3. Each gas domestic water heater location shall be served by a dedicated 240/208-volt, 30-amp junction box connected to the *dwelling unit* electrical panel with a 3-conductor branch circuit and a minimum included load of 4500 VA.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-40508 Section C405.8—Electric motors.

C405.8 Electric motor efficiency. All electric motors, fractional or otherwise, shall meet the minimum efficiency requirements of Tables C405.8(1) through C405.8(4) when tested and rated in accordance with DOE 10 C.F.R. 431. The efficiency shall be verified through certification under an approved certification program or, where no certification program exists, the equipment efficiency ratings shall be supported by data furnished by the motor manufacturer.

EXCEPTION: The standards in this section shall not apply to the following exempt electric motors.
1. Air-over electric motors.
2. Components sets of an electric motor.
3. Liquid-cooled electric motors.
4. Submersible electric motors.
5. Inverter-only electric motors.

Fractional hp fan motors that are 1/12 hp or greater and less than 1 hp (based on output power) which are not covered by Tables C405.8(3) and C405.8(4) shall be electronically commutated motors or shall have a minimum motor efficiency of 70 percent when rated in accordance with DOE 10 C.F.R. 431. These motors shall also have the means to adjust motor speed for either balancing or remote control. Belt-driven fans may use sheave adjustments for airflow balancing in lieu of a varying motor speed.

EXCEPTIONS:
1. Motors that are an integral part of specialized process equipment.
2. Where the motor is integral to a listed piece of equipment for which no complying motor has been approved.
3. Motors used as a component of the equipment meeting the minimum efficiency requirements of Section C403.3.2 and Tables C403.3.2(1) through C403.3.2((~~(12)~~)) (16) provided that the motor input is included when determining the equipment efficiency.
4. Motors in the airstream within fan-coils and terminal units that operate only when providing heating to the space served.
5. Fan motors that are not covered by Tables C405.8(1) through C405.8(4) and are used to power heat recovery ventilators, energy recovery ventilators, or local exhaust fans in Group R subject to the efficacy requirements of Section C403.8.4.
6. Domestic clothes dryer booster fans, range hood exhaust fans, and domestic range booster fans that operate intermittently.
7. Radon and contaminated soil exhaust fans.
8. Group R heat recovery ventilator and energy recovery ventilator fans that are less than 400 cfm.

Table C405.8(1)
Minimum Nominal Full-load Efficiency for NEMA Design A, NEMA Design B and IEC Design N Motors (Excluding Fire Pump) Electric Motors at 60 Hz[a,b]

Motor horsepower (Standard kilowatt equivalent)	Nominal full-load efficiency (%) as of June 1, 2016							
	2 pole		4 pole		6 pole		8 pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open	Enclosed	Open
1 (0.75)	77.0	77.0	85.5	85.5	82.5	82.5	75.5	75.5
1.5 (1.1)	84.0	84.0	86.5	86.5	87.5	86.5	78.5	77.5
2 (1.5)	85.5	85.5	86.5	86.5	88.5	87.5	84.0	86.5
3 (2.2)	86.5	85.5	89.5	89.5	89.5	88.5	85.5	87.5
5 (3.7)	88.5	86.5	89.5	89.5	89.5	89.5	86.5	88.5
7.5 (5.5)	89.5	88.5	91.7	91.0	91.0	90.2	86.5	89.5
10 (7.5)	90.2	89.5	91.7	91.7	91.0	91.7	89.5	90.2
15 (11)	91.0	90.2	92.4	93.0	91.7	91.7	89.5	90.2
20 (15)	91.0	91.0	93.0	93.0	91.7	92.4	90.2	91.0
25 (18.5)	91.7	91.7	93.6	93.6	93.0	93.0	90.2	91.0
30 (22)	91.7	91.7	93.6	94.1	93.0	93.6	91.7	91.7
40 (30)	92.4	92.4	94.1	94.1	94.1	94.1	91.7	91.7
50 (37)	93.0	93.0	94.5	94.5	94.1	94.1	92.4	92.4
60 (45)	93.6	93.6	95.0	95.0	94.5	94.5	92.4	93.0
75 (55)	93.6	93.6	95.4	95.0	94.5	94.5	93.6	94.1
100 (75)	94.1	93.6	95.4	95.4	95.0	95.0	93.6	94.1
125 (90)	95.0	94.1	95.4	95.4	95.0	95.0	94.1	94.1
150 (110)	95.0	94.1	95.8	95.8	95.8	95.4	94.1	94.1
200 (150)	95.4	95.0	96.2	95.8	95.8	95.4	94.5	94.1
250 (186)	95.8	95.0	96.2	95.8	95.8	95.8	95.0	95.0
300 (224)	95.8	95.4	96.2	95.8	95.8	95.8		
350 (261)	95.8	95.4	96.2	95.8	95.8	95.8		
400 (298)	95.8	95.8	96.2	95.8				
450 (336)	95.8	96.2	96.2	96.2				
500 (373)	95.8	96.2	96.2	96.2				

[a] Nominal efficiencies shall be established in accordance with DOE 10 C.F.R. 431.

[b] For purposes of determining the required minimum nominal full-load efficiency of an electric motor that has a horsepower or kilowatt rating between two horsepower or two kilowatt ratings listed in this table, each such motor shall be deemed to have a listed horsepower or kilowatt rating, determined as follows:
1. A horsepower at or above the midpoint between the two consecutive horsepowers shall be rounded up to the higher of the two horsepowers.
2. A horsepower below the midpoint between the two consecutive horsepowers shall be rounded down to the lower of the two horsepowers.
3. A kilowatt rating shall be directly converted from kilowatts to horsepower using the formula 1 kW = (1/0.746) horsepower. The conversion should be calculated to three significant decimal places, and the resulting horsepower shall be rounded in accordance with 1 or 2, whichever applies.

Table C405.8(2)
Minimum Nominal Full-load Efficiency for NEMA Design C and IEC Design H Motors at 60 Hz[a,b]

Motor horsepower (Standard kilowatt equivalent)	Nominal full-load efficiency (%) as of June 1, 2016					
	4 pole		6 pole		8 pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open
1 (0.75)	85.5	85.5	82.5	82.5	75.5	75.5
1.5 (1.1)	86.5	86.5	87.5	86.5	78.5	77.5
2 (1.5)	86.5	86.5	88.5	87.5	84.0	86.5
3 (2.2)	89.5	89.5	89.5	88.5	85.5	87.5
5 (3.7)	89.5	89.5	89.5	89.5	86.5	88.5
7.5 (5.5)	91.7	91.0	91.0	90.2	86.5	89.5
10 (7.5)	91.7	91.7	91.0	91.7	89.5	90.2

Motor horsepower (Standard kilowatt equivalent)	Nominal full-load efficiency (%) as of June 1, 2016					
	4 pole		6 pole		8 pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open
15 (11)	92.4	93.0	91.7	91.7	89.5	90.2
20 (15)	93.0	93.0	91.7	92.4	90.2	91.0
25 (18.5)	93.6	93.6	93.0	93.0	90.2	91.0
30 (22)	93.6	94.1	93.0	93.6	91.7	91.7
40 (30)	94.1	94.1	94.1	94.1	91.7	91.7
50 (37)	94.5	94.5	94.1	94.1	92.4	92.4
60 (45)	95.0	95.0	94.5	94.5	92.4	93.0
75 (55)	95.4	95.0	94.5	94.5	93.6	94.1
100 (75)	95.4	95.4	95.0	95.0	93.6	94.1
125 (90)	95.4	95.4	95.0	95.0	94.1	94.1
150 (110)	95.8	95.8	95.8	95.4	94.1	94.1
200 (150)	96.2	95.8	95.8	95.4	94.5	94.1

NR - No requirement.

[a] Nominal efficiencies shall be established in accordance with DOE 10 C.F.R. 431.

[b] For purposes of determining the required minimum nominal full-load efficiency of an electric motor that has a horsepower or kilowatt rating between two horsepower or two kilowatt ratings listed in this table, each such motor shall be deemed to have a listed horsepower or kilowatt rating, determined as follows:

1. A horsepower at or above the midpoint between the two consecutive horsepowers shall be rounded up to the higher of the two horsepowers.
2. A horsepower below the midpoint between the two consecutive horsepowers shall be rounded down to the lower of the two horsepowers.
3. A kilowatt rating shall be directly converted from kilowatts to horsepower using the formula 1 kW = (1/0.746) horsepower. The conversion should be calculated to three significant decimal places, and the resulting horsepower shall be rounded in accordance with 1 or 2, whichever applies.

Table C405.8(3)
Minimum Average Full Load Efficiency for Polyphase Small Electric Motors[a]

OPEN MOTORS			
NUMBER OF POLES ==>	**2**	**4**	**6**
SYNCHRONOUS SPEED (RPM) ==>	**3600**	**1800**	**1200**
MOTOR HORSEPOWER ▼			
0.25	65.6	69.5	67.5
0.33	69.5	73.4	71.4
0.50	73.4	78.2	75.3
0.75	76.8	81.1	81.7
1	77.0	83.5	82.5
1.5	84.0	86.5	83.8
2	85.5	86.5	N/A
3	85.5	86.9	N/A

[a] Average full load efficiencies shall be established in accordance with 10 C.F.R. 431.

Table C405.8(4)
Minimum Average Full Load Efficiency For Capacitor-start Capacitor-run and Capacitor-start Induction-run Small Electric Motors[a]

OPEN MOTORS			
NUMBER OF POLES ==>	2	4	6
SYNCHRONOUS SPEED (RPM) ==>	3600	1800	1200
MOTOR HORSEPOWER ▼			
0.25	66.6	68.5	62.2
0.33	70.5	72.4	66.6
0.50	72.4	76.2	76.2
0.75	76.2	81.8	80.2
1	80.4	82.6	81.1
1.5	81.5	83.8	N/A
2	82.9	84.5	N/A
3	84.1	N/A	N/A

[a] Average full load efficiencies shall be established in accordance with 10 C.F.R. 431.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40509 Section C405.9—Vertical and horizontal transportation systems.

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

C405.9.1 Elevator cabs. For the luminaires in each elevator cab, not including signals and displays, the sum of the lumens divided by the sum of the watts shall be 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 deenergize 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~~)) that reduce speed ((~~to the minimum~~)) as permitted speed in accordance with ASME A17.1/CSA B44 ((~~or~~)) and applicable local code when not conveying passengers.

EXCEPTION: A variable voltage drive system that reduces operating voltage in response to light loading conditions ((~~may~~)) is allowed to be provided in ((~~place~~)) lieu of the variable speed function.

C405.9.2.1 ((~~Regenerative drive.~~ ~~An escalator designed either for one-way down operation only or for reversible operation shall have a variable frequency regenerative drive that supplies electrical energy to the building electrical system when the escalator is loaded with passengers whose combined weight exceeds 750 pounds.~~)) **Energy recovery.** Escalators shall be designed to recover electrical energy when resisting overspeed in the down direction. The escalator shall be designed to recover, on average, more power than is consumed by the power recovery feature of its motor controller system.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40510 Section C405.10—Controlled receptacles.

C405.10 ((~~Controlled~~)) Automatic receptacle((~~s~~)) control. ((~~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), a controlled receptacle shall be located within 72 inches (1.8 m) of each uncontrolled receptacle. Controlled receptacles shall be visibly differentiated from standard receptacles and shall be controlled by one of the following automatic control devices:~~

~~1. An occupant sensor that turns receptacle power off when no occupants have been detected for a maximum of 20 minutes.~~

~~2. A time-of-day operated control device that turns receptacle power off at specific programmed times and can be programmed separately for each day of the week. The control device shall be configured to provide an independent schedule for each portion of the building not to exceed 5,000 square feet (465 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 in a location with *access* to occupants. Any individual override switch shall control the controlled receptacles for a maximum area of 5,000 square feet (465 m^2). Override switches for controlled receptacles are permitted to control the lighting within the same area.~~

~~EXCEPTION: 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 inches (1.8 m) of a controlled receptacle.~~))

The following shall have automatic receptacle control complying with Section C405.10.1:

1. At least 50 percent of all 125V, 15- and 20-amp receptacles installed in enclosed offices, conference rooms, rooms used primarily for copy or print functions, breakrooms, classrooms and individual workstations, including those installed in modular partitions and module office workstation systems.

2. At least 50 percent of branch circuit feeders installed for modular furniture not shown on the construction documents.

C405.10.1 Automatic receptacle control function. Automatic receptacle controls shall comply with the following:

1. Either split controlled receptacles shall be provided with the top receptacle controlled, or a controlled receptacle shall be located within 12 inches (304.8 mm) of each uncontrolled receptacle.

2. One of the following methods shall be used to provide control:

2.1. A scheduled basis using 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 of not more than 5,000 square feet (464.5 m^2) and not more than one floor. The occupant shall be able to manually override an area for not more than 2 hours. Any individual override

switch shall control the receptacles of not more than 5,000 feet (1524 m).

2.2. An occupant sensor control that shall turn off receptacles within 20 minutes of all occupants leaving a space.

2.3. An automated signal from another control or alarm system that shall turn off receptacles within 20 minutes after determining that the local area is unoccupied.

3. All controlled receptacles shall be permanently marked in accordance with NFPA 70 and be uniformly distributed throughout the space.

4. Plug-in devices shall not comply.

EXCEPTION: Automatic receptacle controls are not required for the following:
1. Receptacles specifically designated for equipment requiring continuous operation (24 hours per day, 365 days per year).
2. Spaces where an automatic control would endanger the safety or security of the room or building occupants.
3. Within a single modular office workstation, noncontrolled receptacles are permitted to be located more than 12 inches (304.8 mm), but not more than 72 inches (1828 mm) from the controlled receptacles serving that workstation.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-40511 Section C405.11—Voltage drop ((~~in feeders and branch circuits~~)).

C405.11 Voltage drop ((~~in feeders and branch circuits~~)). The total voltage drop across the combination of ((~~feeders and branch circuits~~)) customer-owned service conductors, feeder conductors and branch circuit conductors shall not exceed five percent.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40512 Section C405.12—((~~Electrical commissioning.~~)) Alternating current-output uninterruptible power supplies (AC-output UPS).

((**~~C405.12 Commissioning.~~** ~~Controlled receptacles and lighting systems shall be commissioned in accordance with Section C408.~~)) *AC-output UPS* systems serving a *computer room* shall meet or exceed the calculation and testing requirements identified in ENERGY STAR Program Requirements for Uninterruptible Power Supplies (UPSs) – Eligibility Criteria Version 2.0.

EXCEPTION: AC-output UPC that utilizes standardized NEMA-1-15P or NEMA 5-15P input plug, as specified in ANSI/NEMA WD 6.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40513 ((~~Reserved.~~)) Section C405.13—Electrical commissioning.

C405.13 Commissioning. Controlled receptacles and lighting systems shall be commissioned in accordance with Section C408.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-40600 Section C406—Efficiency ((~~packages~~)) and load management measures.

C406.1 Additional energy efficiency and load management measures credit requirements. The project as defined in the building permit shall meet the following requirements as applicable:

1. New buildings ((~~and~~)), changes in *space conditioning category*, change of occupancy group, and building additions in accordance with Chapter 5 shall comply with sufficient ((~~packages~~)) measures from ((~~Table C406.1~~)) Section C406.2 so as to achieve ((~~a~~)) the minimum number of ((~~6~~)) required efficiency credits((~~. Each area shall be permitted to apply for different packages provided all areas in the building comply with the requirements for 6 credits. Areas included in the same permit within mixed use buildings shall be permitted to demonstrate compliance by an area weighted average number of credits by building occupancy achieving a minimum number of 6 credits~~)) shown in Table C406.1.

2. New buildings greater than 5000 gross square feet of floor area shall comply with sufficient measures from Section C406.3 so as to achieve the minimum number of required load management credits shown in Table C406.1.

3. Tenant spaces shall comply in accordance with Section C406.1.1.

4. Projects using discrete area credit weighting shall comply in accordance with Section C406.1.2.

EXCEPTIONS: 1. Low energy spaces in accordance with Section C402.1.1.1 ((~~and~~)), equipment buildings in accordance with Section C402.1.2 ((~~shall~~)), unconditioned spaces, open parking garages, and enclosed parking garages that comply with sufficient ((~~packages~~)) measures from Table ((~~C406.1~~)) C406.2 to achieve a minimum ((~~number of 3~~)) of 24 efficiency credits. Such projects shall be exempt from the load management requirements in Table C406.1.
2. Building additions that have less than 1,000 square feet of *conditioned floor area* ((~~shall~~)) that comply with sufficient ((~~packages~~)) measures from Table ((~~C406.1~~)) C406.2 to achieve a minimum ((~~number of 3~~)) of 24 efficiency credits.
3. Warehouses are exempt from the load management credit requirements in Table C406.1.

Table C406.1
((~~**Efficiency Package Credits**~~))
Energy Measure Credit Requirements

((~~Code Section~~	~~Commercial Building Occupancy~~					
	~~Group R-1~~	~~Group R-2~~	~~Group B~~	~~Group E~~	~~Group M~~	~~All Other~~
	~~Additional Efficiency Credits~~					
~~1. More efficient HVAC performance in accordance with Section C406.2~~	~~2.0~~	~~3.0~~	~~3.0~~	~~2.0~~	~~1.0~~	~~2.0~~
~~2. Reduced lighting power: Option 1 in accordance with Section C406.3.1~~	~~1.0~~	~~1.0~~	~~2.0~~	~~2.0~~	~~3.0~~	~~2.0~~
~~3. Reduced lighting power: Option 2 in accordance with Section C406.3.2~~[a]	~~2.0~~	~~3.0~~	~~4.0~~	~~4.0~~	~~6.0~~	~~4.0~~

((~~Code Section~~	~~Commercial Building Occupancy~~					
	~~Group R-1~~	~~Group R-2~~	~~Group B~~	~~Group E~~	~~Group M~~	~~All Other~~
	~~Additional Efficiency Credits~~					
~~4. Enhanced lighting controls in accordance with Section C406.4~~	~~NA~~	~~NA~~	~~1.0~~	~~1.0~~	~~1.0~~	~~1.0~~
~~5. On-site supply of renewable energy in accordance with C406.5~~	~~3.0~~	~~3.0~~	~~3.0~~	~~3.0~~	~~3.0~~	~~3.0~~
~~6. Dedicated outdoor air system in accordance with Section C406.6[b]~~	~~4.0~~	~~4.0~~	~~4.0~~	~~NA~~	~~NA~~	~~4.0~~
~~7. High performance dedicated outdoor air system in accordance with Section C406.7~~	~~4.0~~	~~4.0~~	~~4.0~~	~~4.0~~	~~4.0~~	~~4.0~~
~~8. High-efficiency service water heating in accordance with Sections C406.8.1 and C406.8.2~~	~~4.0~~	~~5.0~~	~~NA~~	~~NA~~	~~NA~~	~~8.0~~
~~9. High performance service water heating in multi-family buildings in accordance with Section C406.9~~	~~7.0~~	~~8.0~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~
~~10. Enhanced envelope performance in accordance with Section C406.10[c]~~	~~3.0~~	~~6.0~~	~~3.0~~	~~3.0~~	~~3.0~~	~~4.0~~
~~11. Reduced air infiltration in accordance with Section C406.11[c]~~	~~1.0~~	~~2.0~~	~~1.0~~	~~1.0~~	~~1.0~~	~~1.0~~
~~12. Enhanced commercial kitchen equipment in accordance with Section C406.12~~	~~5.0~~	~~NA~~	~~NA~~	~~NA~~	~~5.0~~	~~5.0 (Group A-2 only)~~

~~a Projects using this option may not use Item 2.~~
~~b This option is not available to buildings subject to the prescriptive requirements of Section C403.3.5.~~
~~c Buildings or building areas that are exempt from the thermal envelope requirements in accordance with Sections C402.1.1 and C402.1.2, do not qualify for this package.~~))

Required Credits for Projects	Section	Occupancy Group					
		Group R-1	Group R-2	Group B	Group E	Group M	All Other
New building energy efficiency credit requirement	C406.2	54	41	42	48	74	49
Building additions energy efficiency credit requirement	C406.2	27	20	21	23	36	21
If proposal 21-GP-136 is not included in the final adoption, then replace the two rows above with the following two rows:							
New building energy efficiency credit requirement	C406.2	68	80	48	55	84	49
Building additions energy efficiency credit requirement	C406.2	33	40	24	27	41	24
New building load management credit requirement	C406.3	12	15	27	15	13	26

C406.1.1 Tenant spaces. An initial tenant improvement shall comply with sufficient ((~~packages~~)) measures from Table ((~~C406.1~~)) C406.2 to achieve a minimum ((~~number of six~~)) of efficiency credits required in Table C406.1 and are not required to achieve any load management credits. In ((~~buildings~~)) projects with multiple tenant spaces, each tenant space is permitted to apply for different ((~~packages~~)) measures provided the weighted average of all areas in the ((~~building~~)) project

comply with the overall efficiency credit requirement ((~~for six credits~~)) in Table C406.1. Whole building or addition energy credits shall be allocated to tenant spaces in accordance with Sections C406.1.1.1 and C406.1.1.2.

EXCEPTIONS: 1. An initial tenant improvement where the core and shell building complied via Section C407 in 2018 or later edition of the Washington State Energy Code.
2. Previously occupied tenant spaces in existing buildings that comply with this code in accordance with Section C501.

C406.1.1.1 Applicable envelope ((~~and~~)), on-site renewable and elevator energy credits. Where an entire building or building addition complies with Section ((~~C406.5, C406.10 or C406.11~~)) C406.2.4, C406.2.9, C406.2.10, or C406.2.14, under an initial tenant improvement permit, tenant spaces within the building qualify for the number of credits assigned to the occupancy ((~~type~~)) group of the tenant space in accordance with Table ((~~C406.1~~)) C406.2. Where prior energy credits were achieved under the 2018 Washington State Energy Code, they shall be multiplied by 6 for applicability to this code.

C406.1.1.2 Applicable HVAC and service water heating credits. Where HVAC and service water heating systems and services are installed and comply with Section ((~~C406.2 or C406.8~~)) C406.2.4, C406.2.9, C406.2.10, or C406.2.14 under an initial tenant improvement permit, those systems and services shall be considered a part of the tenant space. Tenant spaces qualify for the credits assigned to the occupancy ((~~type~~)) group of the tenant space in accordance with Table ((~~C406.1~~)) C406.2 if the tenant space includes the distribution system and equipment that the central HVAC systems or service water heating systems were designed to support.

((~~EXCEPTION: Previously occupied tenant spaces in existing buildings that comply with this code in accordance with Section C501.~~))

C406.1.2 Discrete area-weighted projects. Discrete building areas shall be permitted to achieve credits using different measures provided that the whole project complies with both the energy and load management credit requirements. Compliance shall be determined as follows:

1. Project credit requirement shall be the individual occupancy group requirements from Table C406.1 for each discrete area weighted by discrete area *conditioned floor area*.
2. Determine the energy and load management credits achieved for each discrete area based on its occupancy group.
3. Determine project credits achieved by weighting individual discrete area credits by discrete area *conditioned floor area*.
4. A project complies when both energy and load management credits are equal to or greater than the weighted project requirement.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-40602 Section C406.2—((~~HVAC option.~~)) Additional energy efficiency credit measures.

C406.2 ((~~More efficient HVAC equipment and fan performance.~~ ~~No less than 90 percent of the total HVAC capacity serving the total conditioned floor area of the entire building, building addition or tenant space in accordance with Section C406.1.1 shall comply with Sections~~

~~C406.2.1 through C406.2.3. For systems required to comply with Section C403.1.1, HVAC total system performance ratio, exceed the minimum requirement by 10 percent.~~

~~EXCEPTION: In low energy spaces complying with Section C402.1.1 and semi-heated spaces complying with Section C402.1.1.2, no less than 90 percent of the installed heating capacity is provided by electric infrared or gas-fired radiant heating equipment for localized heating applications. Stand-alone supply, return and exhaust fans shall comply with Section C406.2.3.~~

~~**C406.2.1 HVAC system selection.** Equipment installed shall be types that are listed in Tables C403.3.2(1) through C403.3.2(12) or a combination thereof. Electric resistance heating does not meet this requirement.~~

~~EXCEPTION: Allowed equipment not listed in Tables C403.3.2(1) through C403.3.2(12):~~
~~1. Air-to-water heat pumps.~~
~~2. Heat recovery chillers.~~

~~**C406.2.2 Minimum equipment efficiency.** Equipment shall exceed the minimum efficiency requirements listed in Tables C403.3.2(1) through C403.3.2(12) by 15 percent, in addition to the requirements of Section C403. Where multiple performance requirements are provided, the equipment shall exceed all requirements by 15 percent.~~

~~EXCEPTIONS: 1. Equipment that is larger than the maximum capacity range indicated in Tables C403.3.2(1) through C403.3.2(12) shall utilize the values listed for the largest capacity equipment for the associated equipment type shown in the table.~~
~~2. Equipment that complies with the exception to Section C406.2.1 is not required to comply with the minimum equipment efficiency requirement.~~
~~3. Compliance may be demonstrated by calculating a total weighted average percentage for all heating and cooling equipment combined. All equipment shall have efficiency that is no less than 5 percent better than the minimum required efficiency in Table C403.3.2(1) through C403.3.2(12), and the resulting weighted average percentage for all equipment performance requirements shall exceed 15 percent. Calculation shall include heating and cooling capacities for all equipment, percentage better or worse than minimum required efficiency per Tables C403.3.2(1) through C403.3.2(12) for each performance requirement (SEER, EER/IEER, COP, HSPF, E_t, E_c, and AFUE), and the total weighted average efficiency percentage.~~
~~4. Hot water boilers with input capacity greater than 2,500,000 Btu/h shall be considered to comply with this section with a minimum thermal efficiency of 95 percent E_t in accordance with the test procedure in 10 C.F.R. Part 431.~~

~~**C406.2.3 Minimum fan efficiency.** Stand-alone supply, return and exhaust fans designed for operating with motors over 750 watts (1 hp) shall have a fan efficiency grade of not less than FEG 71 as defined in AMCA 205. The total efficiency of the fan at the design point of operation shall be within 10 percentage points of either the maximum total efficiency of the fan or the static efficiency of the fan.~~)) **Additional energy efficiency credit measures.** Each energy efficiency credit measure used to meet credit requirements for the project shall include efficiency that is greater than the energy efficiency required for the building type and configuration requirements in Sections C402 through C405. Measures installed in the project that meet the requirements in Sections C406.2.1 through C406.2.14 shall achieve the credits listed for the measure and occupancy group in Table C406.2 or where calculations required by Sections C406.2.1 through C406.2.14 create or modify the table credits, the credits achieved shall be based upon the section calculations.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-40603 ((~~Section C406.3 LPA option.~~)) Reserved.

((~~**C406.3 Reduced lighting power.** Interior lighting within the whole building, building addition or tenant space shall comply with Section C406.3.1 or Section C406.3.2. Dwelling units and sleeping units within the building shall comply with Section C406.3.3.~~

~~**C406.3.1 Reduced lighting power Option 1.** The total connected interior lighting power calculated in accordance with Section C405.4.1 shall be 90 percent or less of the lighting power values specified in Table C405.4.2(1) times the floor area for the building types, or 90 percent or less of the total interior lighting power allowance calculated in accordance with Section C405.4.2.~~

~~**C406.3.2 Reduced lighting power Option 2.** The total connected interior lighting power calculated in accordance with Section C405.4.1 shall be 80 percent or less of the lighting power values specified in Table C405.4.2(1) times the floor area of the building types, or 80 percent or less of the total interior lighting power allowance calculated in accordance with Section C405.4.2.~~

~~**C406.3.3 Lamp fraction.** No less than 95 percent of the permanently installed light fixtures in dwelling units and sleeping units shall be provided by lamps with a minimum efficacy of 65 lumens per watt.~~))

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40604 ((~~Section C406.4 Lighting controls option.~~)) Reserved.

((~~**C406.4 Enhanced digital lighting controls.** No less than 90 percent of the total installed interior lighting power within the whole building, building addition or tenant space shall comply with Section C406.4.1.~~

~~**C406.4.1 Lighting controls function.** Interior lighting shall be located, scheduled and operated in accordance with Section C405.2, and 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 TO ITEM 2:~~

~~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. No 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.~~))

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40605 ((~~Section C406.5 On-site renewable energy option.~~)) Reserved.

((~~**C406.5 On-site renewable energy.** A whole building, building addition or tenant space shall be provided with on-site renewable energy systems with an annual energy production per square foot of no less than the value specified in Table C406.5 based on the total conditioned floor area of the whole building. The on-site renewable used in this option shall be separate from on-site renewables used as part of Section C406.8 or used to qualify for any exception in this code.~~

~~**Table C406.5**~~
~~**On-Site Renewable Energy System Rating**~~
~~**(per square foot)**~~

~~Building Area Type~~	~~kBtu/year~~	~~kWh/year~~
~~Assembly~~	~~1.8~~	~~0.53~~
~~Dining~~	~~10.7~~	~~3.14~~
~~Hospital~~	~~3.6~~	~~1.06~~
~~Hotel/Motel~~	~~2.0~~	~~0.59~~
~~Multifamily 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~~))

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-40606 ((~~Section C406.6 DOAS option.~~)) Reserved.

((~~**C406.6 Dedicated outdoor air system (DOAS).** No less than 90 percent of the total conditioned floor area of the whole building, building addition or tenant space, excluding floor area of unoccupied spaces that do not require ventilation per the *International Mechanical Code*, shall be served by DOAS installed in accordance with Section C403.3.5. This option is not available to buildings subject to the prescriptive requirements of Section C403.3.5.~~))

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40607 ((~~Section C406.7 High performance dedicated outdoor air system option.~~)) Reserved.

((~~**C406.7 High performance dedicated outdoor air system (DOAS).** A whole building, building addition or tenant space which includes a DOAS complying with Section C406.6 shall also provide minimum sensible effectiveness of heat recovery of 80 percent and DOAS total combined fan power less than 0.5 W/cfm of outdoor air. For the purpose of this section, total combined fan power includes all supply, exhaust, recirculation and other fans utilized for the purpose of ventilation.~~))

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40608 ((~~Section C406.8 Service water heating option.~~)) Reserved.

((~~**C406.8 Reduced energy use in service water heating.** Buildings with service hot water heating equipment shall comply with Sections C406.8.1 and C406.8.2.~~

~~**C406.8.1 Building or area type.** Not less than 90 percent of the conditioned floor area of the whole building, building addition or tenant space shall be of the following types:~~

~~1. Group R-1: Boarding houses, hotels, or motels.~~

~~2. Group I-2: Hospitals, psychiatric hospitals, and nursing homes.~~

~~3. Group A-2: Restaurants and banquet halls or buildings containing food preparation areas.~~

~~4. Group F: Laundries.~~

~~5. Group R-2.~~

~~6. Group A-3: Health clubs and spas.~~

~~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 or as shown through alternate service hot water load calculations showing a minimum service water energy use of 15 k/Btu per square foot per year, as approved by the building official.~~

~~**C406.8.2 Load fraction.** Not less than 60 percent of the annual service hot water heating energy use, or not less than 100 percent of the annual service hot water heating energy use with water-cooled systems subject to the requirements of Section C403.9.5 or qualifying for one of its exceptions, 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. For air-source equipment, the COP rating will be reported at the design leaving heat pump water temperature with an entering air temperature of 60°F (15.6°C) or lower. For water-source equipment, the COP rating will be reported at the design leaving load water temperature with an entering water temperature of 74°F (23.3°C) or lower.~~

~~2. Waste heat recovery from service hot water, heat recovery chillers, building equipment, process equipment, or other *approved* system. Qualifying heat recovery must be above and beyond heat recovery required by other sections of this code.~~

~~3. On-site renewable energy water-heating systems.~~))

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40609 ((~~Section C406.9 High performance service water heating in multifamily option.~~)) Reserved.

((~~**C406.9 High performance service water heating in multifamily buildings.** For a whole building, building addition or tenant space with not less than 90 percent of the conditioned floor area being Group R-2 occupancy, not less than 90 percent of the annual building service hot water energy use shall be provided by a heat pump system with a minimum COP of 3.0. This efficiency package is allowed to be taken in addition to Section C406.8.2.~~))

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40610 ((~~Section C406.10 Envelope option.~~)) Reserved.

((~~**C406.10 Enhanced envelope performance.** The Proposed Total UA of the thermal envelope of the whole building or building addition shall be 15 percent lower than the Allowable Total UA for an area of identical configuration and fenestration area in accordance with Section C402.1.5 and Equation 4-2.~~))

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40611 ((~~Section C406.11 Air infiltration option.~~)) Reserved.

((~~**C406.11 Reduced air infiltration.** Measured air infiltration of the total conditioned floor area of the whole building, fully isolated building addition or tenant space shall comply with Section C406.11.1.~~

~~**C406.11.1 Air leakage testing and verification.** Air infiltration shall be verified by whole building pressurization testing conducted in accordance with ASTM E779 or ASTM E1827 by an independent third party. The measured air leakage rate of the *building envelope* shall not exceed 0.17 cfm/ft^2 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 sur-~~

~~face 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.~~))

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40612 ((~~Section C406.12—Commercial kitchen option.~~)) Reserved.

((~~**C406.12 Enhanced commercial kitchen equipment.** For buildings or areas designated as Group A-2, or facilities whose primary business type involves the use of a commercial kitchen with at least one gas or electric fryer, all fryers, dishwashers, steam cookers and ovens shall comply with all of the following:~~

~~1. Achieve the ENERGY STAR label in accordance with the specifications current as of January 1, 2018.~~

~~2. Be installed prior to the issuance of the certificate of occupancy.~~

~~3. Have the ENERGY STAR qualified model number listed on the construction documents submitted for permitting.~~))

NEW SECTION

WAC 51-11C-40620 Section C406.2—Additional energy efficiency credit measures.

C406.2 Additional energy efficiency credit measures. Each energy efficiency credit measure used to meet credit requirements for the project shall include efficiency that is greater than the energy efficiency required for the building type and configuration requirements in Sections C402 through C405. Measures installed in the project that meet the requirements in Sections C406.2.1 through C406.2.14 shall achieve the credits listed for the measure and occupancy group in Table C406.2 or where calculations required by Sections C406.2.1 through C406.2.14 create or modify the table credits, the credits achieved shall be based upon the section calculations.

Table C406.2
Efficiency Measure Credits

Measure Title	Applicable Section	Occupancy Group					
		Group R-1	Group R-2	Group B	Group E	Group M	All Other
1. Dwelling unit HVAC control	C406.2.1	NA	7	NA	NA	NA	NA
2. Improved HVAC TSPR[a]	C406.2.2.1	NA	8	11	17	22	NA
3. Improve cooling and fan efficiency	C406.2.2.2	2	1	2	2	3	2
4. Improve heating efficiency	C406.2.2.3	2	3	3	10	16	7

Measure Title	Applicable Section	Occupancy Group					
		Group R-1	Group R-2	Group B	Group E	Group M	All Other
5. Low-carbon district energy system (45% annual district-system-net-load-met)	C406.2.2.4	3	3	4	11	17	8
6. Improved low-carbon district energy system (50% annual district-system-net-load-met)[b]	C406.2.2.5	9	10	12	33	52	24
7. High performance DOAS	C406.2.2.6	31	31	21	39	40	21/ (A) 40[c]
8. Fault detection & diagnostics (FDD)	C406.2.2.7	2	2	2	6	9	4
9. 10% reduced lighting power	C406.2.3.1	7	4	18	16	20	15
10. 20% reduced lighting power[d]	C406.2.3.2	13	8	36	32	40	29
11. Lamp efficacy improvement	C406.2.3.3	5	6	NA	NA	NA	NA
12. Residential lighting control	C406.2.4.1	NA	8	NA	NA	NA	NA
13. Enhanced lighting control	C406.2.4.2	1	1	6	6	11	6
14. Renewable energy	C406.2.5	7	12	13	13	10	11
15. Shower drain heat recovery	C406.2.6.1	9	30	NA	3	NA	NA
16. Service water heat recovery	C406.2.6.2	35	111	13	14	(Grocery) 41[e]	NA
17. Heat pump water heating	C406.2.6.3	NA	NA	17	33	(Grocery) 95[e]	(A-2) 95[f]
Note: If proposal 21-GP1-136 is not included in the final WSEC, then replace the row above with the following:							
17. Heat pump water heating	C406.2.6.3	81	261	17	33	(Grocery) 95[e]	(A-2) 95[f]
18. Heat trace system	C406.2.7.1	6	13	4	1	NA	6
19. Point of use water heater	C406.2.7.2	NA	NA	19	5	NA	NA
20. Service hot water distribution right sizing	C406.2.8	13	42	NA	NA	NA	NA
21. High performance service hot water temperature maintenance system	C406.2.9	TBD	TBD	TBD	TBD	TBD	TBD
22. High efficiency service hot water circulation system	C406.2.10	3	6	2	1	NA	4
23. Low flow residential showerheads	C406.2.11	3	3	NA	NA	NA	NA
24. Enhanced envelope performance[g]	C406.2.12	24	20	13	5	19	14
25. Base reduced air infiltration[g]	C406.2.13.2	29	24	6	3	9	11
26. Enhanced reduced air infiltration[g]	C406.2.13.3	53	44	11	5	16	20
27. Enhanced commercial kitchen equipment	C406.2.14	30[h]	18[h]	18[h]	30[h]	30[h]	31[h]
28. Enhanced residential kitchen equipment	C406.2.15	12	19	NA	NA	NA	NA
29. Enhanced residential laundry equipment	C406.2.16	NA	6	NA	NA	NA	NA
30. Heat pump clothes dryers	C406.2.17	6	6	NA	NA	NA	NA
31. Efficient elevator equipment	C406.2.18	3	5	5	5	4	4

[a] Projects using Item 2 shall not use Items 3 through 5.
[b] Projects using C406.2.2.5 shall not use C406.2.2.4.
[c] For C406.2.2.6, occupancy Group A achieves 40 credits while other occupancy groups within the "all other" category achieve 21 credits.
[d] Projects using C406.2.3.2 shall not use C406.2.3.1.
[e] Service water heat recovery and heat pump water heating are available in Group M only for grocery stores larger than 10,000 ft^2. Large mixed retail with full grocery and butcher sections shall achieve half the credits.

[f] Heat pump water heating efficiency credits are available in the "all other" category only for Group A-2.
[g] Buildings or building areas that are exempt from the thermal envelope requirements in accordance with Sections C402.1.1 and C402.1.2, do not qualify for this package.
[h] Additional energy efficiency credits, up to the maximum shown in Table C406.2, shall be calculated according to Section C406.2.11.

NEW SECTION

WAC 51-11C-40621 Section C406.2.1—Dwelling unit HVAC measures.

C406.2.1 Dwelling unit HVAC controls. HVAC systems serving *dwelling units* or *sleeping units* shall be controlled with a programmable *thermostat* that is configured to automatically activate a setback condition of at least 5°F (3°C) for both heating and cooling. The programmable *thermostat* shall be configured to provide setback during occupied sleep periods. The unoccupied setback mode shall be configured to operate in conjunction with one of the following:

1. A manual main control device by each *dwelling unit* main entrance that initiates setback for all HVAC units in the *dwelling unit* and is clearly identified as "Heating/Cooling Master Setback."

2. Occupancy sensors in each room of the *dwelling unit* combined with a door switch to initiate setback for all HVAC units in the dwelling within 20 minutes of all spaces being vacant immediately following a door switch operation. Where separate room HVAC units are used, an individual occupancy sensor on each unit that is configured to provide setback shall meet this requirement.

3. An advanced learning thermostat that senses occupant presence and automatically creates a schedule for occupancy and provides a dynamic setback schedule based on when the spaces are generally unoccupied.

4. An automated control and sensing system that uses geographic sensing connected to the *dwelling unit* occupants' cell phones and initiates the setback condition when all occupants are away from the building.

NEW SECTION

WAC 51-11C-40622 Section C406.2.2—HVAC measures. C406.2.2 More efficient HVAC system performance. All heating and cooling systems shall meet the minimum requirements of Section C403 and efficiency improvements shall be referenced to the minimum efficiency requirements listed in the tables in Section C403.3.2. Where multiple efficiency requirements are listed, equipment shall meet the seasonal efficiencies including SEER, EER/IEER, IPLV or AFUE. Equipment that is larger than the maximum capacity range indicated in the tables in Section C403.3.2 shall utilize the values listed for the largest capacity equipment for the associated equipment type shown in the table. Where multiple individual heating or cooling systems serve the project, the improvement shall be the weighted average improvement based on individual system capacity.

For occupancies and systems required to comply with Section C403.1.1, credits are permitted to be achieved by meeting the require-

ments of Section C406.2.2.1. Other systems are permitted to achieve credits by meeting the requirements of either:

1. Section C406.2.2.2, More efficient HVAC equipment cooling and fan performance.
2. Section C406.2.2.3, More efficient HVAC equipment heating performance.
3. Section C406.2.2.4, High performance dedicated outdoor air system (DOAS).
4. Any combination of Sections C406.2.2.2, C406.2.2.3, and C406.2.2.4.

In addition, energy credits are permitted to be achieved for Section C406.2.2.5, Fault detection and diagnostics, where not otherwise required by Section C403.2.3 or C403.6.10(15).

C406.2.2.1 Improved HVAC TSPR. For systems required to comply with Section C403.1.1, the *HVAC TSPR* shall exceed the minimum requirement by five percent. If improvement is greater, the credits in Table C406.2 are permitted to be prorated up to a 20 percent improvement.

C406.2.2.2 More efficient HVAC equipment cooling and fan performance. No less than 90 percent of the total HVAC capacity serving the total *conditioned floor area* of the entire building, building addition or tenant space in accordance with Section C406.1.1 shall comply with Sections C406.2.2.2.1 through C406.2.2.2.3. Where individual equipment efficiencies vary, weigh them based on capacity.

C406.2.2.2.1 HVAC system selection. Equipment installed shall be types that are listed in the tables in Section C403.3.2.

C406.2.2.2.2 Cooling equipment efficiency. Equipment shall exceed the minimum cooling efficiency requirements listed in the tables in Section C403.3.2 by at least 5 percent. Where equipment exceeds the minimum annual cooling efficiency and heat rejection efficiency requirements by more than 5 percent, energy efficiency credits for cooling shall be determined using Equation 4-15, rounded to the nearest whole number.

(Equation 4-15)

$$\mathrm{EEC_{HEC}} = \mathrm{EEC_5} \times \left[1 + \frac{\mathrm{CEI} - 5\ \mathrm{percent}}{5\ \mathrm{percent}}\right]$$

Where:

$\mathrm{EEC_{HEC}}$	=	Energy efficiency credits for cooling efficiency improvement.
$\mathrm{EEC_5}$	=	Section C406.2.2.2 credits from Table C406.2.
CEI	=	The lesser of the improvement above minimum cooling efficiency requirements, minimum heat rejection efficiency requirements, or 20 percent. Where cooling efficiency varies by system, use the capacity weighted average efficiency improvement for all cooling equipment combined. Where cooling rating reduces as efficiency increases, base the efficiency improvement on the inverse of the rating.

C406.2.2.2.3 Minimum fan efficiency. Where fan energy is not included in packaged equipment rating or it is and the fan size has been increased from the as-rated equipment condition, fan power or horsepower shall be less than 95 percent of the allowed fan power in Section C403.8.1.

C406.2.2.3 More efficient HVAC equipment heating performance. No less than 90 percent of the total HVAC capacity serving the total *conditioned floor area* of the entire building, building addition or tenant space in accordance with Section C406.1.1 shall comply with Sections C406.2.2.3.1 through C406.2.2.3.2.

C406.2.2.3.1 HVAC system selection. Equipment installed shall be types that are listed in the tables in Section C403.3.2. Electric resistance heating shall be limited to 20 percent of system capacity, with the exception of heat pump supplemental heating.

C406.2.2.3.2 Heating equipment efficiency. Equipment shall exceed the minimum heating efficiency requirements of the tables in Section C403.3.2 by at least 5 percent. Where equipment exceeds the minimum annual heating efficiency requirements by more than 5 percent, energy efficiency credits for heating shall be determined using Equation 4-16, rounded to the nearest whole number.

(Equation 4-16)

$$\mathrm{EEC_{HEH}} = \mathrm{EEC_5} \times \left[1 + \frac{\mathrm{CEI} - 5\ \mathrm{percent}}{5\ \mathrm{percent}}\right]$$

Where:

$\mathrm{EEC_{HEH}}$	=	Energy efficiency credits for heating efficiency improvement.
$\mathrm{EEC_5}$	=	Section C406.2.2.2 credits from Table C406.2.
CEI	=	The lesser of the improvement above minimum heating efficiency requirements or 20 percent. Where heating efficiency varies by system, use the capacity weighted average percentage for all heating equipment combined.

EXCEPTION: In low energy spaces complying with Section C402.1.1 and *semi-heated spaces* complying with Section C402.1.1.2, no less than 90 percent of the installed heating capacity is provided by electric infrared or gas-fired radiant heating equipment for localized heating applications. Such spaces shall achieve credits for $\mathrm{EEC_5}$.

C406.2.2.4 Low-carbon district energy systems. Not less than 90 percent of the annual service hot water and space heating load, or not less than 90 percent of the annual service hot water, space heating, and space cooling load shall meet the criteria of Section C406.2.2.4.1 or C406.2.2.4.2.

Documentation for the low-carbon district system that is operational prior to the final inspection shall be provided to demonstrate that the definition of *low-carbon district energy exchange system* is satisfied.

C406.2.2.4.1 Low-carbon district energy exchange systems. Low-carbon district energy exchange systems must demonstrate the following:

1. Forty-five percent of the annual district-system-net-load-met (sum of heating and cooling energy provided to attached buildings)

comes from heat recovery between connected buildings, waste heat, or renewable energy resources and no more than 25 percent of the annual heat input to the system comes from fossil fuel or electric-resistance sources.

C406.2.2.4.2 Low-carbon district energy heating and cooling or heating only systems. Distribution losses must be accounted for and may not exceed 5 percent of the annual load delivered to buildings served by the system. *Low-carbon district energy heating and cooling or heating only systems* must demonstrate one of the following:

1. Forty-five percent of the annual district-system-net-load-met (sum of heating and cooling energy provided to attached buildings) comes from heat recovery between connected buildings, waste heat, or renewable energy resources and no more than 25 percent of the annual heat input to the system comes from fossil fuel or electric-resistance sources.
2. No more than 10 percent of the system annual heat input to the system comes from fossil fuels or electric-resistance sources. The remaining annual heat input must be provided using heat pump technology with a minimum annual operating COP of 3.0.

C406.2.2.5 Improved low-carbon district energy systems. Not less than 90 percent of the annual service hot water and space heating load, or not less than 90 percent of the annual service hot water, space heating, and space cooling load shall meet the criteria of Section C406.2.2.5.1 or C406.2.2.5.2.

Documentation for the low-carbon district system that is operational prior to the final inspection shall be provided to demonstrate that the definition of *low-carbon district energy exchange system* is satisfied.

C406.2.2.5.1 Low-carbon district energy exchange systems. Low-carbon district energy exchange systems must demonstrate the following:

1. Fifty percent of the annual district-system-net-load-met (sum of heating and cooling energy provided to attached buildings) comes from heat recovery between connected buildings, waste heat, or renewable energy resources and no more than 10 percent of the annual heat input to the system comes from fossil fuel or electric-resistance sources.

C406.2.2.5.2 Low-carbon district energy heating and cooling or heating only systems. Distribution losses must be accounted for and may not exceed 5 percent of the annual load delivered to buildings served by the system. *Low-carbon district energy heating and cooling or heating only systems* must demonstrate one of the following:

1. Fifty percent of the annual district-system-net-load-met (sum of heating and cooling energy provided to attached buildings) comes from heat recovery between connected buildings, waste heat, or renewable energy resources and no more than 10 percent of the annual heat input to the system comes from fossil fuel or electric-resistance sources.
2. No more than 10 percent of the system annual heat input to the system comes from fossil fuels or electric-resistance sources. The remaining annual heat input must be provided using heat pump technology with a minimum annual operating COP of 4.0.

C406.2.2.6 High performance dedicated outdoor air system (DOAS). No less than 90 percent of the total conditioned floor area of the whole project, excluding floor area of unoccupied spaces that do not require

ventilation as specified by the *International Mechanical Code*, shall be served by DOAS installed in accordance with Section C403.3.5 with the following adjustments:

1. Minimum heat recovery sensible effectiveness of 80 percent, calculated in accordance with Section C403.3.5.1.

2. Where design outdoor airflow is greater than 500 cfm (250 L/s), the DOAS shall be equipped with an economizer bypass, damper control, or wheel speed control that is active between 55°F (13°C) and 75°F (24°C) and minimizes energy recovery or maintains an appropriate DOAS leaving air temperature when the building is generally in cooling, based either on outdoor air temperature or a DDC zone-based cooling system reset.

3. DOAS total combined fan power shall be less than either:

3.1. 0.769 W/cfm (1.55 W/L/s) when calculated in accordance with Section C403.3.5.2.

3.2. Eighty percent of fan power allowance for a constant volume system when calculated in accordance with Section C406.8.1.

This option is not available to areas served by systems utilizing Section C403.2.2.1 exception 5.

C406.2.2.7 Fault detection and diagnostics system. A project not required to comply with Section C403.2.3 or C403.6.10(15) shall achieve energy credits for installing a fault detection and diagnostics system to monitor the HVAC system's performance and automatically identify faults. The installed system shall comply with items 1 through 6 in Section C403.2.3.

NEW SECTION

WAC 51-11C-40623 Section C406.2.3—Lighting measures.

C406.2.3 Reduced lighting power. Interior lighting within the whole project shall achieve credits by complying with Section C406.2.3.1 or C406.2.3.2. In Group R-1 and Group R-2 occupancies, lighting power reduction applies to the entire R-1 or R-2 occupancy group area. *Dwelling units* and *sleeping units* within the building shall achieve credits by complying with Section C406.2.3.3.

C406.2.3.1 Reduced lighting power option 1. The total connected interior lighting power calculated in accordance with Section C405.4.1 shall be 90 percent or less of the lighting power values specified in Table C405.4.2(1) times the floor area for the building types, or 90 percent or less of the total interior lighting power allowance calculated in accordance with Section C405.4.2.

C406.2.3.2 Reduced lighting power option 2. The total connected interior lighting power calculated in accordance with Section C405.4.1 shall be 80 percent or less of the lighting power values specified in Table C405.4.2(1) times the floor area of the building types, or 80 percent or less of the total interior lighting power allowance calculated in accordance with Section C405.4.2.

C406.3.3 Lamp efficacy. No less than 95 percent of the permanently installed light fixtures in dwelling units and sleeping units shall be provided by lamps with a minimum efficacy of 90 lumens per watt.

C406.2.4 Lighting controls. For buildings with nontransient *dwelling units* and *sleeping units*, energy credits shall be achieved by installation of systems that comply with the requirements of Section C406.2.4.1. All other buildings shall achieve energy credits by complying with Section C406.2.4.2. For buildings with mixed occupancies, credits shall be prorated based on floor area.

C406.2.4.1 Residential building lighting control. In buildings with nontransient dwelling units and sleeping units, lighting controls shall be configured to meet the following:

1. Each *dwelling unit* or *sleeping unit* shall have a main control by the main entrance that turns off all the lights and switched receptacles in the unit. The main control shall be permitted to have two controls, one for permanently wired lighting and one for switched receptacles. The main controls shall be clearly identified as "lights master off" and "outlet master off."
2. Switched receptacles shall be clearly identified and all switched receptacles shall be located within 12 inches of an unswitched receptacle.

C406.2.4.2 Enhanced digital lighting controls. Measure credits shall be achieved where no less than 50 percent of the gross floor area within the project has luminaires and lighting controls that include high end trim in compliance with Section C405.2.3 and either *luminaire-level lighting controls* in compliance with Section C405.2.8.1 or networked lighting controls in accordance with Section C405.2.8.2. Where *general lighting* in more than 50 percent of the gross floor area complies, the base credits from Table C406.2 shall be prorated as follows:

[Tuned lighted floor area, %] x [Base energy credits for C406.2.4.2] / 50%

NEW SECTION

WAC 51-11C-40624 Section C406.2.5—Renewable energy measures.

C406.2.4 On-site and off-site renewable energy. Projects installing on-site or off-site renewable energy systems with a capacity of at least 0.1 watts per gross square foot (1.08 W/m^2) of building area in addition to the renewable energy capacity required elsewhere in this code shall achieve energy credits for this measure. Renewable energy systems achieving energy credits shall not be used to satisfy other requirements of this code. Off-site renewable energy systems shall comply with Sections C411.2.2 and C411.2.3. Credits shall be prorated from the table value in accordance with Equation 4-17.

(Equation 4-17)

$$\mathrm{AEC_{RRa}} = \mathrm{AEC_{0.1}} \times \left[\frac{\mathrm{RR}_t - RR_r}{0.1 \times \mathrm{PGFA}}\right] \times \mathrm{REF}$$

Where:

AEC_{RRa}	=	Section C406.2.5 achieved energy credits for this project as calculated in accordance with Equation 4-17, limited to 50 percent of the required credits in Section C406.1.
RR_t	=	Actual total rating of on-site renewable energy systems (W).
RR_r	=	Rating of on-site renewable energy systems required by other sections in this code or used to qualify for exceptions in this code (W).
PGFA	=	The lesser of the improvement above minimum heating efficiency requirements or 20 percent. Where heating efficiency varies by system, use the capacity weighted average percentage for all heating equipment combined.
$AEC_{0.1}$	=	Section C406.2.5 base credits from Table C406.2.
REF	=	Renewable Energy Factor from Table C411.3.1.

Informative Note: On-site renewable energy may include thermal service water heating or pool water heating, in which case ratings in Btu/h can be converted to W where W = Btu/h / 3.413.

NEW SECTION

WAC 51-11C-40625 Section C406.2.6—Service water measures.

C406.2.6 Reduced energy use in service water heating. Buildings with service hot water heating equipment that serves the whole building, building addition or tenant space shall achieve credits through compliance with either:

1. Section C406.2.6.1, C406.2.6.2, or C406.2.6.3.
2. Section C406.2.6.1 and Section C406.2.6.2 or C406.2.6.3.

C406.2.6.1 Shower drain heat recovery. Shower drain heat recovery units shall comply with Section C404.10 and preheat cold water supply to the showers. Portable waterside pressure loss shall be less than 10 psi (69 kPa) at maximum design flow. The efficiency of drain water heat recovery units shall be 54 percent in accordance with CSA B55.1. Full credits are applicable to the following building use types: Multi-family, hotel, motel, dormitory, and schools with locker room showers. Where not all showers in the project have drain heat recovery, the credit is adjusted based on the following:

[Section C406.2.6.1 table credits] x [Showers with drain recovery] / [Total number of showers]

C406.2.6.2 Service water heating energy recovery. Not less than 30 percent of the annual service hot water heating energy use, or not less than 70 percent of the annual service hot water heating energy use in buildings with water-cooled chiller systems subject to the requirements of Section C403.9.2.1 or qualifying for one of its exceptions, shall be provided by one or more of the following:

1. Waste heat recovery from service hot water, heat recovery chillers, building equipment, process equipment, or other *approved* system. Qualifying heat recovery must be above and beyond heat recovery required by other sections of this code.

2. On-site renewable energy water-heating systems where not used to meet other requirements or to obtain other energy credits.

OPTION 1 for Section C406.2.6.3 (if 136/HP water heating is not adopted)

C406.2.6.3 Heat pump service water heating. Projects shall achieve credits through compliance with Section C406.2.6.3.1 or C406.2.6.3.2.

C406.2.6.3.1 Heat pump water heater. Credit shall be achieved where service hot water system capacity is 82,000 Btu/h (24kW) or less and is served using air-source heat pump technology with no more than 4.5 kW of resistance supplemental heating and meets one of the following:

1. The COP rating will be with a minimum COP of 3.0 and reported at the design leaving heat pump water temperature with an entering air temperature of 60°F (16°C) or lower. For water-source equipment, the COP rating will be reported at the design leaving loadwater temperature with an entering water temperature of 74°F (23°C) or lower.

2. The uniform energy factor (UEF) shall be a minimum of 3.40 rated based on U.S. Department of Energy requirements.

C406.2.6.3.2 Central heat pump service water heating. Energy credits shall be achieved where service hot water shall be provided by an electric air-source heat pump water heating (HPWH) system meeting the requirements of Sections C406.2.6.3.1 through C406.2.6.3.2.5. Supplemental service water heating equipment is permitted to use electric resistance in compliance with Section C404.2.1.4.

C406.2.6.3.2.1 Primary heat pump system sizing. The system shall include a primary service output of 100 percent load at 40°F (4°C) dry bulb or wet bulb outdoor air temperature for air-source heat pumps, or 44°F (7°C) ground temperature for ground-source heat pumps that provides sufficient hot water as calculated using the equipment manufacturer's selection criteria or another *approved* methodology. Electric air source heat pumps shall be sized to deliver no less than 50 percent of the calculated demand for hot water production during the peak demand period when entering dry bulb or wet bulb outdoor air temperature of 24°F (-4°C).

C406.2.6.3.2.2 Primary hot water storage sizing. The system shall provide sufficient hot water to satisfy peak demand period requirements.

C406.2.6.3.2.3 System design. The service water heating system shall be configured to conform to one of the following provisions:

1. For *single-pass* HPWHs, *temperature maintenance* heating provided for reheating return water from the building's heated water circulation system shall be physically decoupled from the primary service water heating system storage tank(s) in a manner that prevents destratification of the primary system storage tanks. *Temperature maintenance* heating is permitted to be provided by electric resistance or a separate dedicated heat pump system.

2. For *multi-pass* HPWHs, *recirculated temperature* maintenance water is permitted to be returned to the primary water storage tanks for reheating.

3. Unitary HPWHs located in conditioned space are permitted, where they are sized to meet all calculated service water heating demand using the heat pump compressor, and not supplementary heat.

C404.2.6.3.2.3.1 Mixing valve. A thermostatic mixing valve capable of supplying hot water to the building at the user temperature setpoint shall be provided, in compliance with requirements of the *Uniform Plumbing Code* and the HPWH manufacturer's installation guidelines. The mixing valve shall be sized and rated to deliver tempered water in a range from the minimum flow of the *temperature maintenance* recirculation system up to the maximum demand for the fixtures served.

C406.2.6.3.2.4 Supplemental water heating. Total supplemental electric resistance water heating equipment shall not have an output capacity greater than the primary water heating equipment at 40°F (4°C) entering dry bulb or wet bulb outdoor air temperature for air-source heat pumps or 44°F(7°C) ground temperature for ground-source heat pumps. Supplemental electric resistance heating is permitted for the following uses:

1. *Temperature maintenance* of heated-water circulation systems, physically separate from the primary service water heating system. *Temperature maintenance* heating capacity shall be no greater than the primary water heating capacity at 40°F (4°C) dry bulb or wet bulb outdoor air temperature for air-source heat pumps or 44°F (7°C) ground temperature for ground-source heat pumps.

2. Defrost of compressor coils.

3. Heat tracing of piping for freeze protection or for *temperature maintenance* in lieu of recirculation of hot water.

4. Backup or low ambient temperature conditions, where all of the following are true:

4.1. The supplemental heating capacity is no greater than the primary service water heating capacity at 40°F (4°C) dry bulb or wet bulb outdoor air temperature for air-source heat pumps or 44°F (7°C) ground temperature for ground-source heat pumps.

4.2. During normal operations the supplemental heating is controlled to operate only when the entering air temperature at the air-source HPWH is below 40°F (4°C), and the primary HPWH compressor continues to operate together with the supplemental heating when the entering air temperature is between 17°F (-8°C) and 40°F (4°C).

4.3. The primary water heating equipment cannot satisfy the system load due to equipment failure or entering air temperature below 40°F (4°C).

C406.2.6.3.2.5 Alarms. The control system shall be capable of and configured to send automatic error alarms to building or maintenance personnel upon detection of equipment faults, low leaving water temperature from primary storage tanks, or low hot water supply delivery temperature to building distribution system.

OPTION 2 for Section C406.2.6.3 (if 136/HP water heating is adopted)

C406.2.6.3 Heat pump service water heating. Projects shall achieve credits through compliance with Section C406.2.6.3.1.

C406.2.6.3.1 Heat pump water heater. Credit shall be achieved where service hot water system capacity is 82,000 Btu/h (24kW) or less and is served using air-source heat pump technology with no more than 4.5 kW of resistance supplemental heating and meets one of the following:

1. The COP rating will be with a minimum COP of 3.0 and reported at the design leaving heat pump water temperature with an entering air

temperature of 60°F (16°C) or lower. For water-source equipment, the COP rating will be reported at the design leaving load water temperature with an entering water temperature of 74°F (23°C) or lower.

2. The uniform energy factor (UEF) shall be a minimum of 3.40 rated based on U.S. Department of Energy requirements.

C406.2.6.7 Improved service hot water temperature maintenance. For buildings with gross floor area greater than 10,000 square feet, credit shall be achieved when hot water temperature maintenance is installed in accordance with Section C406.2.7.1 or C406.2.7.2.

C406.2.7.1 Self-regulated heat trace system. The credit achieved shall be from Table C406.2. This system shall include self-regulating electric heat cables, connection kits and electronic controls. The cable shall be installed directly on the hot water supply pipes underneath the insulation to replace standby losses.

C406.2.7.2. Point of use water heater. The credit achieved shall be from Table C406.2 where any fixtures requiring hot water shall be supplied from a localized electric source of hot water with no recirculation or heat trace and limited to 2 kW and 6 gallons of storage. The supply pipe length from the point of use water heater to the termination of the fixture supply pipe shall be no more than 20 feet.

C406.2.8 Service hot water distribution right sizing. To achieve this credit, where Group R-1 and R-2 occupancies are served by a central service hot water system, the distribution system serving *dwelling units*, *sleeping units* and guestrooms shall be sized using Appendix M of the *Uniform Plumbing Code*.

C406.2.9 High performance service hot water temperature maintenance system. Systems with multiple riser service hot water circulation systems shall use only heat pump technology for temperature maintenance. Service hot water system delivering heating requirements shall use heat pump technology with a minimum COP of 3.0 or UEF of 3.4. For air-source equipment, the COP rating will be reported at the design leaving heat pump water temperature with an entering dry bulb air temperature of 60°F (16°C) or lower and a relative humidity of 50 percent or lower. For water-source equipment, the COP rating will be reported at the design leaving load water temperature with an entering water temperature of 74°F (23°C) or lower. The system shall comply with the requirements of Section C404.7.1.

C406.2.10 High efficiency service hot water circulation system. Multiple riser service hot water circulation systems shall use a variable volume circulation pump controlled to vary the pump speed based on system demand and shall include self-actuated thermostatic balancing valves to control the system flow at each riser.

C406.2.11 Low flow showerheads for Group R-1 and R-2 occupancies. All showerheads installed in Group R-1 and R-2 *dwelling units* or *sleeping units* shall have a maximum listed flowrate of 1.25 gallons per minute or less at 80 psi operating pressure for fixed showerheads and a maximum listed flowrate of 1.50 gallons per minute or less at 80 psi operating pressure for handheld showerheads. When a shower is served by more than one showerhead, including handheld showerheads, the combined flow rate of all showerheads and/or other shower outlets controlled by a single valve shall not exceed 1.25 gallons per minute or less for fixed or 1.5 gallons per minute or less for handheld, or the shower

shall be designed to allow only one shower outlet to be in operation at a time.

NEW SECTION

WAC 51-11C-40626 Section C406.2—Envelope measures.

C406.2.12 Enhanced envelope performance. The Proposal Total UA of the thermal envelope of the project shall be 15 percent lower than the Allowable Total UA for an area of identical configuration and fenestration area in accordance with Section C402.1.5 and Equation 4-2.

C406.2.13 Reduced air infiltration. Energy credits shall be achieved where measured air infiltration of the total *conditioned floor area* of the whole building, fully isolated building addition or tenant space is determined in accordance with Section C406.13.1 and complies with the maximum leakage in either Section C406.2.13.2 or C406.2.13.3.

C406.2.13.1 Air leakage testing and verification. Air infiltration shall be verified by whole building pressurization testing conducted in accordance with ASTM E779 or ASTM E1827 by an independent third party. The measured air leakage rate of the building thermal envelope shall not exceed the specified maximum air leakage in cfm/ft^2 (L/s per m^2) under a pressure differential of 0.3 in. water gauge (75 Pa), with the calculated surface area being the sum of the above and below grade *building thermal 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.

C406.2.13.2 Base reduced air infiltration. Measured air infiltration determined in accordance with Section C406.13.1 shall not exceed 0.17 cfm/ft^2 (0.86 L/s per m^2).

C406.2.13.3 Enhanced reduced air infiltration. Measured air infiltration determined in accordance with Section C406.13.1 shall not exceed 0.8 cfm/ft^2 (0.41 L/s per m^2).

NEW SECTION

WAC 51-11C-40627 Section C406.2—Other measures.

C406.2.14 Enhanced commercial kitchen equipment. For buildings or areas designated as Group A-2, or facilities whose primary business type involves the use of a commercial kitchen with at least one gas or electric fryer, all fryers, dishwashers, steam cookers and ovens shall comply with all of the following:

1. Achieve the ENERGY STAR label in accordance with the specifications current as of January 1, 2022.
2. Be installed prior to the issuance of the certificate of occupancy.

3. Have the ENERGY STAR qualified model number listed on the construction documents submitted for permitting.

Energy efficiency credits for efficient commercial kitchen equipment shall be determined based on Equation 4-19, rounded to the nearest whole number.

(Equation 4-19)

$$\mathrm{AEEC}_K = 20 \times \frac{\mathrm{Area}_K}{\mathrm{Area}_B}$$

Where:

AEEC_K	=	Section C406.2.14 table credits, to a maximum of those allowed in Table C406.2 for this option.
Area_K	=	Floor area of full-service kitchen (ft^2 or m^2).
Area_B	=	Gross floor area of building (ft^2 or m^2).

C406.2.15 Residential kitchen equipment. For projects with Group R-1 and R-2 occupancies, energy credits shall be achieved where all dishwashers, refrigerators and freezers comply with all of the following:

1. Achieve the ENERGY Most Efficient 2021 label in accordance with the specifications current as of:

1.1. Refrigerators and freezers: 5.0, 9/15/2014.

1.2. Dishwashers: 6.0, 1/29/2016.

2. Be installed prior to the issuance of the certificate of occupancy.

For Group R-1 where only some guestrooms are equipped with both refrigerators and dishwashers, the table credits shall be prorated as follows:

[Section C406.2.15 table credits] x [Floor area of guestrooms with kitchens] / [Total guestroom floor area]

C406.2.16 Residential laundry appliances. For projects with Group R-2 occupancies, energy credits shall be achieved where all clothes washers and dryers in the project meet the following requirements:

1. Each dwelling unit contains in-unit washing washer and dryer equipment that meets the following requirements:

1.1. Achieve the ENERGY STAR Most Efficient label in accordance with the 2021 specifications.

1.2. Be installed prior to the issuance of the certificate of occupancy.

2. Where only some dwelling units are equipped with both washers and dryers, the table credits shall be prorated as follows:

[Section C406.2.16 table credits] x [Floor area of dwelling units with laundry] / [Total dwelling unit floor area]

C406.2.17 Heat pump clothes dryers. All domestic clothes dryers located in Group R-1 and R-2 of the whole project are ENERGY STAR rated heat pump dryers. Credit applies only to buildings where heat pump dryers are within each residential dwelling or sleeping units or grouped together in central multi-family use laundry rooms.

To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall show the appliance

type and provide documentation of ENERGY STAR compliance. At the time of inspection, all appliances shall be installed and connected to utilities.

C406.2.18 Efficient elevator equipment. Qualifying elevators in the building shall be Energy Efficient Class A in accordance with ISO 25745-2, Table 7. Only buildings three or more floors above grade shall be permitted to use this credit. Credits shall be prorated based on Equation 4-18, rounded to the nearest whole credit. Projects with a compliance ratio below 0.5 do not qualify for this credit.

(Equation 4-18)

$$\mathrm{EC_e} = \mathrm{EC_t} \times CR_e$$

Where:

$\mathrm{EC_e}$ = Elevator energy credit achieved for building.

$\mathrm{EC_t}$ = Section C406.2.18 table energy credit.

$\mathrm{CR_e} = \dfrac{F_A}{F_B}$

$\mathrm{F_A}$ = Sum of floors served by Class A elevators.

$\mathrm{F_B}$ = Sum of floors served by all building elevators and escalators.

NEW SECTION

WAC 51-11C-40630 Section C406.3—Load management credits.

C406.3 Load management credits. Load management measures installed in the building that meet the requirements in Sections C406.3.1 through C406.3.7 shall achieve the credits listed for the occupancy group in Table C406.3 or where calculations required by Sections C406.3.1 through C406.3.7 create or modify the table credits the credits achieved will be based upon the section calculations.

Each load management measure required automatic controls activated by either utility demand response, utility price response signal, peak price period time control, or local building demand monitoring to be capable of performing the described load management practices. Controls shall be capable of and configured to provide the required load management sequences. The following additional control systems apply to these measures:

1. Where credit is taken for C406.3.6, service water heating energy storage, the equipment shall be provided with controls that comply with ANSI/CTA 2045-B.

2. For other load management measures:

2.1. Where the serving utility has a real-time demand response or pricing program, an interface compliant with serving utility requirements shall be installed.

2.2. Where the serving utility does not have a real-time demand response or pricing program, a digital input to the system to support future utility programs shall be installed and building demand moni-

toring shall be installed and integrated into the load management sequence.

2.3. All equipment involved in the required load management sequence shall have controls connected to a central DDC system.

Table C406.3
Load Management Measure Credits

Measure Title	Applicable Section	Occupancy Group					
		Group R-1	Group R-2	Group B	Group E	Group M	All Other
1. Lighting load management	C406.3.1	12	15	27	15	NA	NA
2. HVAC load management	C406.3.2	29	24	42	23	13	26
3. Automated shading	C406.3.3	NA	7	12	16	NA	NA
4. Electric energy storage	C406.3.4	41	50	126	72	37	65
5. Cooling energy storage	C406.3.5	13	10	14	19	NA	14
6. Service hot water energy storage	C406.3.6	31	248	59	8	5	70
7. Building thermal mass	C406.3.7	NA	NA	50	95	96	80

C406.3.1 Lighting load management. Automatic controls shall be capable of gradually reducing general lighting power with continuous dimming in 75 percent of the building area by at least 20 percent during peak demand periods. Where less than 75 percent, but at least 50 percent, of the building area lighting is controlled, the credits from Table C406.3 shall be prorated as follows:

$$\frac{[\textit{Area of building with lighting load management}, \%] \times [\textit{Table credits for } \text{C406.3.1}]}{75\%}$$

EXCEPTION: Warehouse or retail storage building areas shall be permitted to achieve this credit by switching off at least 25 percent of lighting power in 75 percent of the building area without dimming.

C406.3.2 HVAC load management. Automatic controls shall:

1. Where electric cooling is used, be configured to gradually increase, over a minimum of three hours, the cooling setpoint by at least 3°F over the course of the coincident summer peak building load and peak price or demand periods.

2. Where electric heating is used, be configured to gradually reduce, over a minimum of three hours, the heating setpoint by at least 3°F during winter peak pricing or building peak demand periods.

C406.3.3 Automated shading load management. Where fenestration on south and west exposures exceeds 20 percent of the wall area, automatic controls shall be configured to operate movable exterior shading devices or dynamic glazing to reduce solar gain through sunlit fenestration on southern and western exposures by at least 50 percent during electrical summer peak periods.

Informative Note: This credit can be met by exterior roller, movable blind or movable shutter shading devices; however, fixed overhang, screen or shutter shading will not meet the requirement. Roller shades that reject solar gain but still allow a view are allowed as long as they provide an effective 50 percent reduction in net solar gain (e.g., have a shading coefficient of less than 0.5 for the shading material itself). Interior shading devices will not meet the requirement. Electrochromatic windows that achieve 50 percent of SHGC would qualify.

C406.3.4 Electric energy storage. Automatic controls shall store electricity in electric storage devices during nonpeak periods and use stored energy during peak periods to reduce building demand. Electric storage devices shall have a minimum capacity of 5 Wh/ft^2 (58 Wh/m^2) of gross building area. For greater storage capacity up to 15 Wh/ft^2 (160 Wh/m^2), credits shall be prorated as follows:

$$\frac{[\text{Installed electric storage capacity, Wh/ft}^2]}{5\ (58)\times[\text{C406.3.4 credits from Table C406.3}]}$$

C406.3.5 Cooling energy storage. Automatic controls shall be capable of activating ice or chilled water storage to reduce electric demand during the hours of summer peak electric prices. Credits shown in Table C406.3 are based on storage capacity of 2 ton-hours per design day ton of colling load with a 1.15 sizing factor. Credits shall be prorated for installed storage systems sized between 0.5 and 3.5 ton-hours per design day ton of cooling load rounded to the nearest whole credit. The storage tank shall have no more than 1.5 percent of storage capacity standby loss per day.

C406.3.6 Service hot water energy storage. To achieve this credit, where service hot water is heated by electricity, automatic controls activated by utility demand response signal, peak price period time control, or local building demand monitoring shall preheat stored service hot water before the peak price period and suspend electric water heating during the period of peak prices coincident with peak building load. Storage capacity shall be provided by either:

1. Preheating water above 140°F (60°C) delivery temperature with at least 1.34 kWh of energy storage per kW of water heating capacity. Tempering valves shall be provided at the water heater delivery location.
2. Providing additional heated water tank storage capacity above peak service hot water demand with equivalent peak storage capacity to item 1.

C406.3.7 Building thermal mass. To achieve this credit, the building shall have both additional passive interior mass and a night-flush control of the HVAC system.

1. Interior to the *building thermal envelope* insulation, provide 15 pounds of passive thermal mass per square foot of building floor area. Mass construction shall be in the building interior and the indoor facing portion of the exterior wall, and interior floor construction. Mass construction shall have mass surfaces in direct contact with the air in conditioned spaces with directly attached wall board or hard surface flooring allowed. Mass with carpet or furred wallboard shall not be counted toward the building mass required. For integral insulated concrete block walls complying with ASTM C90, only the mass of the interior face shall be counted toward the building mass required.
2. When summer mode is active and indoor average temperature is 5°F (3°C) or more above outdoor temperature and between 10:00 p.m. and 6:00 a.m., *automatic* night flush controls shall operate outdoor air economizers at low fan speed less than 66 percent during the unoccupied period until the average indoor air temperature falls to the occupied heating setpoint. Summer mode shall be activated when outdoor air exceeds 70°F (21°C) and continues until deactivated when outdoor air falls below 45°F (7°C). Another night flush strategy shall be permitted where demonstrated to be effective, avoids added morning heating and is *approved* by the *code official*.

Informative Note: The simplified night flush sequence described will operate in "summer mode" below the 70°F outdoor air trigger temperature down until outdoor air of 45°F is hit when the "summer mode" is deactivated until the outdoor air temperature rises above 70°F again. Other strategies may be implemented that cool the space below the heating setpoint and adjust the morning heating setpoint to avoid morning reheating.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-40702 Section C407.2—Mandatory requirements.

C407.2 Mandatory requirements. Compliance with ((~~this~~)) Section C407 also requires compliance with those sections shown in Table C407.2.

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~~)) in the baseline in accordance with ANSI/ASHRAE/IESNA 90.1 Appendix G and in the proposed model in accordance with the requirements of the Washington State Energy Code.

Table C407.2
Mandatory Compliance Measures for Total Building Performance Method

Section[a]	Title	Comments
Envelope		
C401	Thermal envelope certificate	
C402.2.7	Airspaces	
C402.5	Air leakage	
Mechanical		
C403.1.2	Calculation of heating and cooling loads	
C403.1.3	Data centers	
C403.2	System design	
C403.3.1	Equipment and system sizing	
C403.3.2	HVAC equipment performance requirements	
C403.3.3	Hot gas bypass limitation	
C403.3.4	Boiler turndown	
C403.3.6	Ventilation for Group R occupancy	
((~~C403.4~~	~~HVAC system controls~~))	
C403.4.1	Thermostatic controls	((~~Except for C403.4.1.4~~))

Section[a]	Title	Comments
C403.4.2	Off-hour controls	((~~Except for Group R~~))
C403.4.7	Combustion heating equipment controls	
C403.4.8	Group R-1 hotel/ motel guestrooms	See Section C403.7.4
C403.4.9	Group R-2 and R-3 dwelling units	
C403.4.10	Group R-2 sleeping units	
C403.4.11	Direct digital control systems	
C403.5.5	Economizer fault detection and diagnostics (FDD)	
C403.7	Ventilation and exhaust systems	Except for C403.7.6
C403.8	Fan and fan controls	
C403.9.1.1	Variable flow controls	For cooling tower fans ≥ 7.5 hp
C403.9.1.2	Limitation on centrifugal fan cooling towers	For open cooling towers
C403.10	Construction of HVAC elements	
C403.11	Mechanical systems located outside of the building thermal envelope	
C403.13	Commissioning	
Service Water Heating		
C404	Service water heating	
Lighting and Electrical		
((~~C405.1~~	~~General~~	
~~C405.2~~	~~Lighting controls~~	
~~C405.3~~	~~Exit signs~~	
~~C405.4~~	~~Interior lighting power~~	
~~C405.5~~	~~Exterior building lighting power~~	
~~C405.6~~	~~Electrical transformers~~	
~~C405.7~~	~~Dwelling unit energy consumption~~	
~~C405.8~~	~~Electric motor efficiency~~	
~~C405.9~~	~~Vertical and horizontal transportation~~	
~~C405.10~~	~~Controlled receptacles~~	
~~C405.11~~	~~Voltage drop in feeders~~))	

Section[a]	Title	Comments
C405	Electrical power and lighting systems	
Other Requirements		
C407	Total building performance	
C408	System commissioning	
C409	Energy metering	
C410	Refrigeration requirements	
C411	Solar readiness	

[a] Reference to a code section includes all the relative subsections except as indicated in the table.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40703 Section C407.3—Performance-based compliance.

C407.3 Performance-based compliance. Compliance with this section requires compliance with ASHRAE Standard 90.1 Appendix G, Performance Rating Method, in accordance with Standard 90.1 Section 4.2.1 with the following modifications:

1. The mandatory requirements of the Washington State Energy Code are required to be met, instead of those of Section G1.2.1a of ((~~Standard~~)) ANSI/ASHRAE/IESNA 90.1 ((~~are not required to be met~~)).

2. ((~~The reduction in annual carbon emissions of the proposed building design associated with on-site renewable energy shall not be more than 3 percent of the total carbon emissions of the baseline building design.~~

~~3. References to energy cost in Section 4.2.1.1 and Appendix G shall be replaced by carbon emissions calculated by multiplying site energy consumption by the carbon emission factor from Table C407.3(1).~~

~~4. The building performance factors in Table C4.2.1.1 shall be replaced with those in Table C407.3(2).~~)) Compliance with Section C407 requires meeting both an emissions and site energy reduction target in accordance with the following:

2.1. Carbon emissions target. The carbon emissions target is focused on regulated load energy efficiency, thus shall be met only via regulated load savings without consideration of the contribution of on-site or off-site renewable energy or unregulated load savings. Adjustments to the PCI, to account for the contribution of renewable energy found in ANSI/ASHRAE/IESNA 90.1 Section 4.2.1.1 shall not be used. References to energy cost in Section 4.2.1.1 and Appendix G shall be replaced by carbon emissions calculated by multiplying site energy consumption by the carbon emission factor from Table C407.3(1). The building performance factors in Table 4.2.1.1 of ANSI/ASHRAE/IESNA 90.1 shall be replaced with those in Table C407.3(2).

2.2. Site energy target. The site energy performance target shall be met including the contributions of on-site or off-site renewable energy as described in Section C411.3 as well as the contributions of improvements in unregulated loads as allowed by Section C407.3.2. Com-

pliance with the site energy performance target requires that the proposed building site energy use/baseline building site energy use is less than or equal to the site energy performance target from Table C407.3(2).

3. Documentation requirements in Section G1.3.2.d shall be replaced by a list showing compliance with the mandatory provisions of Table C407.2.

4. Forms demonstrating compliance with Appendix G developed by the U.S. Department of Energy shall be completed and submitted to the *code official*. The forms are available at energycodes.gov/ashrae-standard-901-performance-based-compliance-form.

5. References to yet-to-be-designed future building components in the Proposed Building Performance column of Table G3.1 shall be modified to reference the corresponding sections of the Washington State Energy Code in lieu of the requirements of ANSI/ASHRAE/IESNA 90.1 in the following sections of the table:

5.1. No. 1, Design Model, subclause c.

5.2. No. 6, Lighting, subclause c.

5.3. No. 11, Service Water Heating System, subclause c.

5.4. No. 12, Receptacle and Other Loads, subclause b.

6. HVAC systems, subclauses c and d of Table G3.1, shall meet the following requirements:

6.1. For yet-to-be-designed systems in office, retail, library, education, and multifamily buildings and occupancies subject to the TSPR requirements of Section C403.1.1, the system type and efficiency parameters shall meet but not exceed those shown in Table D602.11 Standard Reference Design HVAC Systems.

6.2. For all other buildings and occupancies, the system type shall be the same as the system modeled in the baseline design and shall comply with but not exceed the requirements of Section C403 in lieu of ANSI/ASHRAE/IESNA 90.1.

6.3. For HVAC systems serving future tenant spaces, where the current building permit applies to only a portion of an HVAC system, and future components will receive HVAC services from systems included in the current building permit, those future components shall be modeled as the type required to complete the HVAC system portions under the current permit and shall meet but not exceed the requirements found in Section C403.

7. The requirements for proposed and baseline building lighting system shall be modified in accordance with Addendum af to ANSI/ASHRAE/IESNA 90.1.

8. Energy modeler qualifications. The energy analyst in responsible charge of the Section C407 submittal shall meet at least one of the following:

8.1. ASHRAE Building Energy Modeling Professional (BEMP) certification.

8.2. Association of Energy Engineer's Building Energy Simulation Analyst (BESA) certification.

8.3. Successful completion of at least five projects modeled following any version of ANSI/ASHRAE/IESNA 90.1 Appendix G within the last three years that were reviewed and approved by a *code official* or rating authority.

C407.3.1 Limits on nonmandatory measures. The Proposed Total UA of the proposed building shall be no more than 20 percent higher than the Allowed Total UA as defined in Section C402.1.5.

C407.3.2 On-site and off-site renewable energy accounting for use with Appendix G. Qualifying on-site and off-site renewable energy delivered or credited to the building project to comply with Section C407.3 item 2.2 shall meet the requirements of Section C411.2.

C407.3.3 Low-carbon district energy use with Appendix G. Qualifying *low-carbon district heating and cooling or heating only systems* and *low-carbon district energy exchange systems* shall meet the requirements of Section C407.3.3.1 or C407.3.3.2, as applicable.

C407.3.3.1 Utilization of low-carbon district heating and cooling or heating only systems. Applicable if heating and cooling or heating only is provided to the *proposed building* from a *low-carbon district heating and cooling or heating only system* that is fully operational prior to the final inspection. Proposed model shall account for all on-site HVAC and service hot water related equipment, such as circulation pump energy and heat-exchanger efficiency.

1. The following modifications shall be applied to Appendix G of ANSI/ASHRAE/IESNA 90.1 in addition to what is described in Section C407.3:

1.1. For low-carbon district heating and cooling systems, strike the text of Sections G3.1.1.1, G3.1.1.2, G3.1.1.3.1, and G3.1.1.3.4. Baseline system shall be selected based on unmodified versions of Tables G3.1.1-3 and G3.1.1-4, with carbon emission factors from Table C407.3(1).

1.2. For low-carbon district heating only systems, strike the text of Sections G3.1.1.1, G3.1.1.3.1, and G3.1.1.3.4. Baseline system shall be selected based on unmodified versions of Tables G3.1.1-3 and G3.1.1-4, with carbon emission factors from Table C407.3(1).

2. Any heating or cooling energy provided by the *low-carbon district heating and cooling or heating only system* shall utilize footnote a of Table C407.3(1) for the district system carbon emission factor in the proposed model.

3. Waste energy exported from the building to the low-carbon district heating and cooling or heating only system shall not be considered purchased energy. Carbon emissions from the waste heat exported shall be accounted for in the proposed design carbon emissions at the seasonal factors below. The exported energy emissions credit shall be calculated based on footnote a of Table C407.3(1):

3.1. Fifty percent of the waste heat exported during the months of October through December and January through March shall be subtracted from the proposed design carbon emissions.

3.2. Twenty-five percent of the waste heat exported during the months of April through September shall be subtracted from the proposed design carbon emissions.

EXCEPTION: Waste heat exported from the building to the *low-carbon district heating and cooling or heating only system* shall not be subtracted from the proposed design carbon emissions if they are already accounted for in the calculation of emissions from the district heating or cooling plant.

Documentation for the low-carbon district system that is operational prior to the final inspection shall be provided to demonstrate the following:

1. Distribution losses must be accounted for and may not exceed 10 percent of the annual load delivered to buildings served by the system.

2. Twenty-five percent of the annual district-system-net-load-met (sum of heating and cooling energy provided to attached buildings) comes from heat recovery between connected buildings, waste heat or

renewable energy resources and no more than 25 percent of the annual heat input to the system comes from fossil fuel or electric-resistance sources, or not more than 10 percent of the system annual heat input to the system comes from fossil fuel or electric-resistance sources.

C407.3.3.2 Utilization of low-carbon district energy exchange systems. Applicable if heating or cooling is provided to the *proposed building* from a *low-carbon district energy exchange system* that is fully operational prior to the final inspection. Proposed model shall account for all on-site HVAC and service hot water related equipment, such as circulation pump energy and heat-exchanger efficiency.

1. The following modifications shall be applied to Appendix G of ANSI/ASHRAE/IESNA 90.1 in addition to what is described in Section C407.3:

1.1. Strike the text of Sections G3.1.1.1, G3.1.1.2, G3.1.1.3, G3.1.1.3.1, G3.1.1.3.2, G3.1.1.3.3, and G3.1.1.3.4. Baseline system shall be selected based on unmodified versions of Tables G3.1.1-3 and G3.1.1-4, with carbon emission factors from Table C407.3(1).

2. Any heating or cooling energy provided by a low-carbon district energy exchange system shall utilize footnote a of Table C407.3(1) for the district system carbon emission factor in the proposed model.

3. Waste energy exported from the building to the *low-carbon district energy exchange system* shall not be considered purchased energy and shall be accounted for in the proposed design carbon emissions based on footnote a of Table C407.3(1) at the factors below:

3.1. Fifty percent of the waste heat exported to the *low-carbon district energy exchange system* during the months of October through December and January through March shall be subtracted from the proposed design carbon emissions.

3.2. Twenty-five percent of the waste heat exported to the *low-carbon district energy exchange system* during the months of April through September shall be subtracted from the proposed design carbon emissions.

EXCEPTION: Waste heat exported from the building to the *low-carbon district heating and cooling or heating only system* shall not be subtracted from the proposed design carbon emissions if they are already accounted for in the calculation of emissions from the district heating or cooling plant.

Documentation for the low-carbon district system that is operational prior to the final inspection shall be provided to demonstrate that the definition of *low-carbon district energy exchange system* is satisfied.

C407.3.4 Credit for improvements in unregulated loads when using Appendix G. When calculating savings for site energy targets in accordance with Section C407.3 item 2.2, but not when calculating savings for emissions targets in accordance with Section C407.3 item 2.1, differences in the simulation of unregulated loads and equipment modeled in the baseline building design from those in the *proposed design* shall be approved by the *code official* based on documentation that the equipment installed in the *proposed design* represents a significant verifiable departure from documented current conventional practice. All unregulated equipment for which savings is claimed must be installed by the time of final inspection. The burden of this documentation is to demonstrate that accepted conventional practice would result in baseline building equipment different from that installed in the *proposed design*. Occupancy and occupancy schedules shall not be changed.

NEW SECTION

WAC 51-11C-407031 Tables for Section C407.3.

Table C407.3(1)
Carbon Emissions Factors

Type	CO2e (lb/unit)	Unit
Electricity	0.44	kWh
Natural gas	11.7	Therm
Oil	19.2	Gallon
Propane	10.5	Gallon
Other[a]	195.00	mmBtu
On-site renewable energy	0.00	

[a] District energy systems may use alternative emissions factors supported by calculations approved by the *code official*.

Table C407.3(2)
Building Performance Factors (BPF) to be used for Compliance with Section C407.3

Building Area Type	Building Performance Factor
Multifamily	0.52
Health care/hospital	0.49
Hotel/motel	0.57
Office	0.50
Restaurant	0.63
Retail	0.43
School	0.33
Warehouse	0.43
All others	0.49

Table C407.3(3)
Site Energy Performance Targets to be used for Compliance with Section C407.3

Building Area Type	Building Performance Factor
Multifamily	0.58
Health care/hospital	0.57
Hotel/motel	0.62
Office	0.56
Restaurant	0.70
Retail	0.45
School	0.44
Warehouse	0.49
All others	0.55

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-407051 ((~~Tables for Section C407.5—Carbon emissions factors and building performance factors.~~)) Reserved.

((~~**Table C407.3(1)**~~
~~**Carbon Emissions Factors**~~

~~Type~~	~~CO2e (lb/unit)~~	~~Unit~~
~~Electricity~~	~~0.70~~	~~kWh~~
~~Natural Gas~~	~~11.7~~	~~Therm~~
~~Oil~~	~~19.2~~	~~Gallon~~
~~Propane~~	~~10.5~~	~~Gallon~~
~~Other[a]~~	~~195.00~~	~~mmBtu~~
~~On-site renewable energy~~	~~0.00~~	

~~a District energy systems may use alternative emissions factors supported by calculations approved by the *code official*.~~

~~**Table C407.3(2)**~~
~~**Building Performance Factors (BPF) to be used for Compliance with Section C407.3**~~

~~Building Area Type~~	~~Building Performance Factor~~
~~Multifamily~~	~~0.58~~
~~Healthcare/hospital~~	~~0.54~~
~~Hotel/motel~~	~~0.64~~
~~Office~~	~~0.56~~
~~Restaurant~~	~~0.70~~
~~Retail~~	~~0.47~~
~~School~~	~~0.36~~
~~Warehouse~~	~~0.48~~
~~All others~~	~~0.54~~))

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-40801 Section C408.1—General.

C408.1 General. A building commissioning process led by a *certified commissioning professional* and functional testing requirements shall be completed for mechanical systems in Section C403; service water heating systems in Section C404; controlled receptacle and lighting control systems in Section C405; equipment, appliances and systems installed to comply with Sections C406 or C407; energy metering in Section C409; and refrigeration systems in Section C410.

EXCEPTION: Buildings, or portions thereof, which are exempt from Sections C408.2 through C408.7 may be excluded from the commissioning process.

1. Mechanical systems that are not required to comply with Section C403.3.5 are exempt from the commissioning process where the installed total mechanical equipment capacity is less than ((~~240,000~~)) 180,000 Btu/h (15 tons) cooling capacity and less than ((~~300,000~~)) 240,000 Btu/h (20 tons) heating capacity and energy recovery ventilation (ERV) equipment is less than 300 cfm capacity.
2. 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 and where there are ((~~no pools or permanent spas.~~)) any of the following:
2.1. No pools or permanent spas.
2.2. No solar thermal water heating.
2.3. No recirculation pumps.
2.4. No heat pump water heaters, except fully-packaged for individual residential dwelling unit use.
3. Lighting control systems are exempt from the commissioning process in buildings where both the total installed lighting load is less than ((~~20~~)) 10 kW and the lighting load controlled by occupancy sensors or automatic daylighting controls is less than ((~~10~~)) 5 kW.
4. Refrigeration systems are exempt from the commissioning process in buildings if they are limited to self-contained units.

C408.1.1 Commissioning in construction documents. Construction documents shall clearly indicate provisions for commissioning process. The construction documents shall minimally include the following:

1. A narrative description of the activities that will be accomplished during the commissioning process. At a minimum, the commissioning process is required to include:

1.1. Development and execution of the commissioning plan, including all subsections of Section C408.1.2;

1.2. The *certified commissioning professional's* review of the building documentation and close out submittals in accordance with Section C103.6; and

1.3. The commissioning report in accordance with Section C408.1.3.

2. Roles, responsibilities, and required qualifications of the *certified commissioning professional*.

3. A listing of the specific equipment, appliances, or systems to be tested.

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.

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, systems testing and balancing, functional performance testing, and verification of the building documentation requirements in Section C103.6.

2. Roles and responsibilities of the commissioning team, including the name and statement of qualifications of the *certified commissioning professional*.

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

C408.1.2.1 In-house commissioning disclosure and conflict management plan. Where the *certified commissioning professional's* contract or employment is other than directly with the building owner, an in-house commissioning disclosure and conflict management plan shall be a part of the commissioning process. A copy shall be included in 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.

C408.1.2.2 Functional performance testing. Functional performance testing shall be conducted for mechanical systems in Sections C403; service water heating systems in Section C404; controlled receptacles and lighting control systems in Section C405; equipment, appliances, systems installed to comply with Section C406 or C407; energy metering in Section C409; and refrigeration systems in Section C410. Written

procedures which clearly describe the individual systematic test procedures, the expected system response or acceptance criteria for each procedure, the actual response or findings, and any pertinent discussion shall be followed. This testing shall include control systems which will be tested to document that control devices, components, equipment, and systems are calibrated and adjusted to operate in accordance with approved construction documents. Testing shall affirm the conditions required within Sections C408.2 through C408.7 under system testing.

C408.1.2.3 Functional performance testing - Sampling. For projects with 7 or fewer similar systems, each system shall be tested. For projects with more than 7 systems, testing shall be done for each unique combination of control types. Where multiples of each unique combination of control types exist, no fewer than 20 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 system fail, all remaining identical combinations shall be tested.

C408.1.2.4 Deficiencies. Deficiencies found during testing shall be resolved including corrections and retesting.

C408.1.3 Commissioning report. A 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, service water heating, controlled receptacle and lighting control systems, energy metering, and refrigeration 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.
4. Commissioning plan.
5. Testing, adjusting and balancing report.

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* shall provide evidence of *building commissioning* in accordance with the provisions of this section.

C408.1.4.1 Commissioning compliance. Buildings, or portions thereof, shall not be considered acceptable for a final inspection pursuant to Section C104.2.6 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 Commissioning Report. Completion of Commissioning Compliance Checklist (Figure C408.1.4.1) is deemed to satisfy this requirement. Phased acceptance of Commissioning Compliance Checklist for portions of the work specific to the trade that is being inspected is permissible where accepted by the *code official* and where the *certified commissioning professional* remains responsible for completion of the commissioning process.

If there are unresolved deficiencies when the final inspection is scheduled, the Commissioning Report shall be submitted and shall describe the unresolved deficiencies.

C408.1.4.2 Copy of report. The *code official* shall be permitted to require that a copy of the Commissioning Report be made available for review by the *code official*.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-40901 Section C409.1—General.

C409.1 General. All new buildings and additions shall have the capability of metering all source energy usage in accordance with Section C409.2 in addition to the source energy for on-site renewable energy production in accordance with Section C409.2.4 and the end-use energy usage for electric vehicle charging in accordance with Section C409.3.4. New buildings and additions with a gross conditioned floor area over ((~~50,000~~)) 25,000 square feet shall comply with Sections((~~ C409. Buildings~~)) C409.2, C409.3, and C409.4. New buildings and additions 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. Existing buildings shall comply with the energy metering provisions of Section C506.1.

EXCEPTIONS:
1. Tenant spaces smaller than ((~~50,000~~)) 25,000 square feet within buildings if the tenant space has its own utility service and utility meters shall comply with Section C409.2 and are exempt from the end-use metering, measurement devices, data acquisition system and energy display requirements of Sections C409.3 and C409.4.
2. Buildings in which there is no gross conditioned floor area over 25,000 square feet, including building common area, that is served by its own utility services and meters shall comply with Section C409.2 and are exempt from the end-use metering, measurement devices, data acquisition system and energy display requirements of Sections C409.3 and C409.4.

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 shall include the equivalent BTU/h heating and cooling capacity of installed equipment at a conversion factor of 3,412 Btu per kW ((~~at 50 percent demand~~)) or 2,730 Btu per kVA.

C409.1.3 Dwelling units. See Sections C404.9 and C405.7 for additional metering requirements for Group R-2 dwelling units.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-40904 Section C409.4—Measurement devices, data acquisition system and energy display.

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 and energy display. 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. Electrical meters shall be configured to communicate data to the data acquisition system and energy display for both consumption (e.g., kWh) and consumption rate (e.g., kW). Other meters and measurement devices shall be configured to communicate data to the data acquisition system for consumption.

C409.4.2 Data acquisition system. The data acquisition system shall store the data from the required meters and other sensing devices in a single database 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~~)) energy consumption logged in one-hour or less intervals and energy consumption rate logged in 10-minute or less intervals. Data from the data acquisition system shall be viewable via the energy display in accordance with the requirements of Section C409.4.3.

C409.4.3 Energy display. For each building subject to Section C409.2 and C409.3, either a single visible display in a location with *ready access*, or a single web page or other electronic document available for access to building operation and management personnel or to a third-party energy data analysis service shall be provided in the building ((~~available for access by~~)); for metering data acquisition systems and energy displays monitored by a third-party energy data analysis service, building operation and management personnel shall retain access to the metering data acquisition system and energy display. The display shall ((~~graphically~~)) numerically provide the current energy consumption rate and energy consumption total for each whole building energy source((~~, plus~~)) and each end use category((~~, as well as the total and peak values for any day, week, month, and year~~)). The energy display shall also graphically and numerically display logged data from the data acquisition system for energy consumption and energy consumption rate for each whole building energy source and each end use category for any selected day, week, month, or year.

C409.4.4 Commissioning. Energy metering and energy consumption management systems shall be commissioned in accordance with Section ((~~C408~~)) C408.6.

AMENDATORY SECTION (Amending WSR 16-03-072, filed 1/19/16, effective 7/1/16)

WAC 51-11C-40905 ((~~Section C409.5 Metering for existing buildings.~~)) Reserved.

((~~**C409.5 Metering for existing buildings.**~~

~~**C409.5.1 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.~~

~~**C409.5.1.1 Small existing buildings.** Metering and data acquisition systems shall be provided for additions over 25,000 square feet to buildings that were constructed subject to the requirement of this section, in accordance with the requirements of sections C409.2 and C409.3.~~))

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-41000 Section C410—Refrigeration system requirements.

C410.1 General. Walk-in coolers, walk-in freezers, refrigerated warehouse coolers, refrigerated warehouse freezers, and refrigerated display cases shall comply with this Section.

((~~Refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C402. Section C402.1.5 Component performance alternative, may be used if granted prior approval by the jurisdiction.~~

~~**C410.1.1 Refrigeration equipment performance.** Refrigeration equipment shall have an energy use in kWh/day not greater than the values of Tables C410.1(1) and C410.1(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.~~

~~**Table C410.1.1(1)**~~
~~**Minimum Efficiency Requirements: Commercial Refrigeration**~~

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

~~[a] V = Volume of the chiller for frozen compartment as defined in AHAM-HRF-1.~~

~~Table C410.1.1(2)~~
~~Minimum Efficiency Requirements: Commercial Refrigerators and Freezers~~

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

~~EQUIPMENT TYPE~~				~~ENERGY USE LIMITS (kWh per day)[a,b]~~	~~TEST PROCEDURE~~
~~Equipment Class[c]~~	~~Family Code~~	~~Operating Mode~~	~~Rating Temperature~~		
~~HZO.RC.I~~	~~Horizontal open~~	~~Remote condensing~~	~~Ice cream~~	~~0.72 x TDA + 8.74~~	
~~VCT.RC.I~~	~~Vertical transparent door~~	~~Remote condensing~~	~~Ice cream~~	~~0.66 x TDA + 3.05~~	
~~HCT.RC.M~~	~~Horizontal transparent door~~	~~Remote condensing~~	~~Medium~~	~~0.16 x TDA + 0.13~~	
~~HCT.RC.L~~	~~Horizontal transparent door~~	~~Remote condensing~~	~~Low~~	~~0.34 x TDA + 0.26~~	
~~HCT.RC.I~~	~~Horizontal transparent door~~	~~Remote condensing~~	~~Ice cream~~	~~0.4 x TDA + 0.31~~	
~~VCS.RC.M~~	~~Vertical solid door~~	~~Remote condensing~~	~~Medium~~	~~0.11 x V + 0.26~~	
~~VCS.RC.L~~	~~Vertical solid door~~	~~Remote condensing~~	~~Low~~	~~0.23 x V + 0.54~~	
~~VCS.RC.I~~	~~Vertical solid door~~	~~Remote condensing~~	~~Ice cream~~	~~0.27 x V + 0.63~~	
~~HCS.RC.M~~	~~Horizontal solid door~~	~~Remote condensing~~	~~Medium~~	~~0.11 x V + 0.26~~	
~~HCS.RC.L~~	~~Horizontal solid door~~	~~Remote condensing~~	~~Low~~	~~0.23 x V + 0.54~~	
~~HCS.RC.I~~	~~Horizontal solid door~~	~~Remote condensing~~	~~Ice cream~~	~~0.27 x V + 0.63~~	
~~SOC.RC.L~~	~~Service over counter~~	~~Remote condensing~~	~~Low~~	~~1.08 x TDA + 0.22~~	
~~SOC.RC.I~~	~~Service over counter~~	~~Remote condensing~~	~~Ice cream~~	~~1.26 x TDA + 0.26~~	
~~VOP.SC.L~~	~~Vertical open~~	~~Self-contained~~	~~Low~~	~~4.37 x TDA + 11.82~~	
~~VOP.SC.I~~	~~Vertical open~~	~~Self-contained~~	~~Ice cream~~	~~5.55 x TDA + 15.02~~	
~~SVO.SC.L~~	~~Semivertical open~~	~~Self-contained~~	~~Low~~	~~4.34 x TDA + 11.51~~	
~~SVO.SC.I~~	~~Semivertical open~~	~~Self-contained~~	~~Ice cream~~	~~5.52 x TDA + 14.63~~	
~~HZO.SC.I~~	~~Horizontal open~~	~~Self-contained~~	~~Ice cream~~	~~2.44 x TDA + 9.0~~	
~~SOC.SC.I~~	~~Service over counter~~	~~Self-contained~~	~~Ice cream~~	~~1.76 x TDA + 0.36~~	
~~HCS.SC.I~~	~~Horizontal solid door~~	~~Self-contained~~	~~Ice cream~~	~~0.38 x V + 0.88~~	

~~a V = Volume of the case, as measured in accordance with Appendix C of AHRI 1200.~~

~~b TDA = Total display area of the case, as measured in accordance with Appendix D of AHRI 1200.~~

~~c Equipment class designations consist of a combination [(in sequential order separated by periods (AAA).(BB).(C))] of:~~

~~(AAA) An equipment family code where:~~

~~VOP = Vertical open~~
~~SVO = Semi-vertical open~~
~~HZO = Horizontal open~~
~~VCT = Vertical transparent doors~~
~~VCS = Vertical solid doors~~
~~HCT = Horizontal transparent doors~~
~~HCS = Horizontal solid doors~~
~~SOC = Service over counter~~

~~(BB) An operating mode code:~~

~~RC = Remote condensing~~
~~SC = Self-contained~~

~~(C) A rating temperature code:~~
~~M = Medium temperature (38°F)~~
~~L = Low temperature (0°F)~~
~~I = Ice cream temperature (15°F)~~
~~For example, "VOP.RC.M" refers to the "vertical-open, remote-condensing, medium-temperature" equipment class.~~))

Table C410.2
Minimum Efficiency Requirements: Commercial Refrigerators and Freezers and Refrigeration

Equipment Category	Condensing Unit Configuration	Equipment Family	Rating Temp. °F	Operating Temp. °F	Equipment Classification[c]	Maximum Daily Energy Consumption kWh/day[d,e]	Test Standard
Remote condensing commercial refrigerators and commercial freezers	Remote (RC)	Vertical open (VOP)	38 (M)	≥32	VOP.RC.M	0.64 × TDA + 4.07	AHRI 1200
			0 (L)	<32	VOP.RC.L	2.20 × TDA + 6.85	
		Semivertical open (SVO)	38 (M)	≥32	SVO.RC.M	0.66 × TDA + 3.18	
			0 (L)	<32	SVO.RC.L	2.20 × TDA + 6.85	
		Horizontal open (HZO)	38 (M)	≥32	HZO.RC.M	0.35 × TDA + 2.88	
			0 (L)	<32	HZO.RC.L	0.55 × TDA + 6.88	
		Vertical closed transparent (VCT)	38 (M)	≥32	VCT.RC.M	0.15 × TDA + 1.95	
			0 (L)	<32	VCT.RC.L	0.49 × TDA + 2.61	
		Horizontal closed transparent (HCT)	38 (M)	≥32	HCT.RC.M	0.16 × TDA + 0.13	
			0 (L)	<32	HCT.RC.L	0.34 × TDA + 0.26	
		Vertical closed solid (VCS)	38 (M)	≥32	VCS.RC.M	0.10 × V + 0.26	
			0 (L)	<32	VCS.RC.L	0.21 × V + 0.54	
		Horizontal closed solid (HCS)	38 (M)	≥32	HCS.RC.M	0.10 × V + 0.26	
			0 (L)	<32	HCS.RC.L	0.21 × V + 0.54	
		Service over counter (SOC)	38 (M)	≥32	SOC.RC.M	0.44 × TDA + 0.11	
			0 (L)	<32	SOC.RC.L	0.93 × TDA + 0.22	
Self-contained commercial refrigerators and commercial freezers with and without doors	Self-contained (SC)	Vertical open (VOP)	38 (M)	≥32	VOP.RC.M	1.69 × TDA + 4.71	AHRI 1200
			0 (L)	<32	VOP.RC.L	4.25 × TDA + 11.82	
		Semivertical open (SVO)	38 (M)	≥32	SVO.RC.M	1.70 × TDA + 4.59	
			0 (L)	<32	SVO.RC.L	4.26 × TDA + 11.51	
		Horizontal open (HZO)	38 (M)	≥32	HZO.RC.M	0.72 × TDA + 5.55	
			0 (L)	<32	HZO.RC.L	1.90 × TDA + 7.08	
		Vertical closed transparent (VCT)	38 (M)	≥32	VCT.RC.M	0.10 × V + 0.86	
			0 (L)	<32	VCT.RC.L	0.29 × V + 2.95	
		Vertical closed solid (VCS)	38 (M)	≥32	VCS.RC.M	0.05 × V + 1.36	
			0 (L)	<32	VCS.RC.L	0.22 × V + 1.38	
Self-contained commercial refrigerators and commercial freezers with and without doors	Self-contained (SC)	Horizontal closed transparent (HCT)	38 (M)	≥32	HCT.RC.M	0.06 × V + 0.37	AHRI 1200
			0 (L)	<32	HCT.RC.L	0.08 × V + 1.23	
		Horizontal closed solid (HCS)	38 (M)	≥32	HCS.RC.M	0.05 × V + 0.91	
			0 (L)	<32	HCS.RC.L	0.06 × V + 1.12	
		Service over counter (SOC)	38 (M)	≥32	SOC.RC.M	0.52 × TDA + 1.00	
			0 (L)	<32	SOC.RC.L	1.10 × TDA + 2.10	
Self-contained commercial refrigerators with transparent doors for pull-down temperature applications	Self-contained (SC)	Pull-down	38(M)	≥32	PD.SC.M	0.11 × V + 0.81	AHRI 1200

Equipment Category	Condensing Unit Configuration	Equipment Family	Rating Temp. °F	Operating Temp. °F	Equipment Classification[c]	Maximum Daily Energy Consumption kWh/day[d,e]	Test Standard
Commercial ice cream freezers	Remote (RC)	Vertical open (VOP)	-15 (I)	≤-5[b]	VOP.RC.I	2.79 × TDA + 8.70	AHRI 1200
		Semivertical open (SVO)			SVO.RC.I	2.79 × TDA + 8.70	
		Horizontal open (HZO)			HZO.RC.I	0.70 × TDA + 8.74	
		Vertical closed transparent (VCT)			VCT.RC.I	0.58 × TDA + 3.05	
		Horizontal closed transparent (HCT)			HCT.RC.I	0.40 × TDA + 0.31	
		Vertical closed solid (VCS)			VCS.RC.I	0.25 × V + 0.63	
		Horizontal closed solid (HCS)			HCS.RC.I	0.25 × V + 0.63	
		Service over counter (SOC)			SOC.RC.I	1.09 × TDA + 0.26	
	Self-contained (SC)	Vertical open (VOP)	-15 (I)	≤-5[b]	VOP.SC.I	× TDA +	AHRI 1200
		Semivertical open (SVO)			SVO.SC.I	× TDA +	
		Horizontal open (HZO)			HZO.SC.I	× TDA +	
		Vertical closed transparent (VCT)			VCT.SC.I	× TDA +	
		Horizontal closed transparent (HCT)			HCT.SC.I	× TDA +	
		Vertical closed solid (VCS)			VCS.SC.I	× V +	
		Horizontal closed solid (HCS)			HCS.SC.I	× V +	
		Service over counter (SOC)			SOC.SC.I	× TDA +	

For SI: 1 square foot = 0.0929 m^2, 1 cubic foot = 0.02832 m^3, °C = (°F – 32)/1.8.

[a] The meaning of the letters in this column is indicated in the columns to the left.

[b] Ice cream freezer is defined in DOE 10 C.F.R. Part 431.62 as a commercial freezer that is designed to operate at or below -5°F and that the manufacturer designs, markets or intends for the storing, displaying, or dispensing of ice cream.

[c] Equipment class designations consist of a combination [(in sequential order separated by periods (AAA).(BB).(C))] of:

(AAA) An equipment family code where:
- VOP = Vertical open
- SVO = Semi-vertical open
- HZO = Horizontal open
- VCT = Vertical transparent doors
- VCS = Vertical solid doors
- HCT = Horizontal transparent doors
- HCS = Horizontal solid doors
- SOC = Service over counter

(BB) An operating mode code:
- RC = Remote condensing
- SC = Self-contained

(C) A rating temperature code:
- M = Medium temperature (38°F)
- L = Low temperature (0°F)
- I = Ice cream temperature (15°F)

For example, "VOP.RC.M" refers to the "vertical-open, remote-condensing, medium-temperature" equipment class.

[d] V is the volume of the case (ft^3) as measured in AHRI 1200, Appendix C.

[e] TDA is the total display area of the case (ft^2) as measured in AHRI 1200, Appendix D.

C410.2 Commercial refrigerators, freezers and refrigerator-freezers. Refrigeration equipment, defined in DOE 10 C.F.R. Part 431.62, shall have an energy use in kWh/day not greater than the values of Table C410.2 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.

C410.2.1 Refrigerated display cases. Refrigerated display cases shall comply with the following:

1. Lighting 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 Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers. ((~~*Refrigerated warehouse coolers*, *refrigerated warehouse freezers*, *and all walk-in coolers and walk-in freezers* including site assembled, *site constructed and prefabricated units*~~)) Site-assembled and site-constructed *walk-in coolers* and *walk-in freezers* and *refrigerated warehouse coolers* and *refrigerated warehouse 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: 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 be provided with 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 be provided with 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 be provided with 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: 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 coolers* shall be provided with floor insulation of not less than R-25 or have a floor assembly *U*-factor no greater than *U*-0.40. The floor of *walk-in freezers* shall be provided with floor insulation of not less than R-28 or have a floor assembly *U*-factor no greater than *U*-0.035.

EXCEPTION: Insulation is not required in the floor of a *walk-in cooler* that is mounted directly on a slab on grade.

5. Transparent fixed window and reach-in doors for *walk-in freezers* and windows in *walk-in freezer* doors shall be provided with triple-pane glass, with the interstitial spaces filled with inert gas or be provided with heat-reflective treated glass.

6. Transparent fixed window and reach-in doors for *walk-in coolers* and windows for *walk-in coolers* doors shall be provided with double-pane or triple-pane glass, with interstitial space filled with inert gas, or be provided with heat-reflective treated glass.

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

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

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

10. Where antisweat heater controls are provided, they 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. Lights in *walk-in coolers*, *walk-in freezers*, *refrigerated warehouse coolers* and *refrigerated warehouse freezers* shall either be provided with light sources with an efficacy of not less than 40 lumens per watt, including 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* space is not occupied.

((~~C410.2.1~~)) C410.3.1 Performance standards. Site-assembled and site-constructed *walk-in coolers* and *walk-in freezers* shall meet the requirements of Tables ((~~C410.2.1.1(1), C410.2.1.1(2), and C410.2.1.1(3)~~)) C410.3.1(1), C410.3.1(2), and C410.2.1(3).

Table ((~~C410.2.1.1(1)~~)) C410.3.1(1)
Walk-in Cooler and Freezer Display Doors Efficiency Requirements

Class Description	Class	Maximum Energy Consumption (kWh/day)[a]
Display door, medium temperature	DD, M	$0.04 \times A_{dd} + 0.41$
Display door, low temperature	DD, L	$0.15 \times A_{dd} + 0.29$

[a] A_{dd} is the surface area of the display door.

Table ((~~C410.2.1.1(2)~~)) C410.3.1(2)
Walk-in Cooler and Freezer Nondisplay Doors Efficiency Requirements

Class Description	Class	Maximum Energy Consumption (kWh/day)[a]
Passage door, medium temperature	PD, M	$0.05 \times A_{nd} + 1.7$
Passage door, low temperature	PD, L	$0.14 \times A_{nd} + 4.8$
Freight door, medium temperature	FD, M	$0.04 \times A_{nd} + 1.9$
Freight door, low temperature	FD, L	$0.12 \times A_{nd} + 5.6$

[a] A_{nd} is the surface area of the display door.

Table ((~~C410.2.1.1(3)~~)) C410.3.1(3)

Walk-in Cooler and Freezer Refrigeration Systems Efficiency Requirements

((~~Class Description~~	~~Class~~	~~Minimum Annual Walk-in Energy Factor AWEF (Btu/hW-h)~~
~~Dedicated condensing, medium temperature, indoor system~~	~~DC.M.I~~	~~5.61~~
~~Dedicated condensing, medium temperature, indoor system, >9,000 Btu/h capacity~~	~~DC.M.I, >9,000~~	~~5.61~~
~~Dedicated condensing, medium temperature, outdoor system~~	~~DC.MI~~	~~7.60~~
~~Dedicated condensing, medium temperature, outdoor system, >9,000 Btu/h capacity~~	~~DC.M.I, >9,000~~	~~7.60~~))

Class Description	Class	Minimum Annual Walk-in Energy Factor AWEF (Btu/hW-h)	Test Procedure
Dedicated condensing, medium temperature, indoor system	DC.M.I	5.61	AHRI 1250
Dedicated condensing, medium temperature, outdoor system	DC.M.O	7.60	
Dedicated condensing, low temperature, indoor system, net capacity (q_{net}) < 6,500 Btu/h	DC.L.I, < 6,500	$9.091 \times 10^{-5} \times q_{net} + 1.81$	
Dedicated condensing, low temperature, indoor system, net capacity (q_{net}) ≥ 6,500 Btu/h	DC.L.I, ≥ 6,500	2.40	
Dedicated condensing, low temperature, outdoor system, net capacity (q_{net}) < 6,500 Btu/h	DC.L.O, < 6,500	$9.091 \times 10^{-5} \times q_{net} + 2.73$	
Dedicated condensing, low temperature, outdoor system, net capacity (q_{net}) ≥ 6,500 Btu/h	DC.L.O, ≥ 6,500	3.15	
Unit cooler, medium	UC.M	9.00	
Unit cooler, low temperature, net capacity (q_{net}) < 15,500 Btu/h	UC.L, < 15,500	$9.091 \times 10^{-5} \times q_{net} + 2.73$	
Unit cooler, low temperature, net capacity (q_{net}) ≥ 15,500 Btu/h	UC.L, ≥ 15,500	4.15	

((~~C410.2.2~~)) C410.4 Refrigerated ((~~display~~)) case((s)) and walk-on display doors. ((~~Site-assembled or site-constructed refrigerated display cases~~)) Lighting in glass doors in all *walk-in coolers* and *walk-in freezers* and all *refrigerated warehouse coolers* and *refrigerated warehouse freezers* 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.~~)) 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~~)) C410.5 Refrigeration systems. Refrigerated display cases, *walk-in coolers* or *walk-in freezers* that are served by remote compressor and remote condensers not located in a *condensing unit*, shall comply with Sections ((~~C410.4.1, C410.4.2~~)) C410.5.1, C410.5.2, and C403.9.2.3.

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~~)) C410.5.1 Condensers serving refrigeration systems. Fan-powered condensers shall comply with the following:

1. The design *saturated condensing temperatures* for air-cooled condensers shall not exceed the design dry-bulb temperature plus 10°F (5.6°C) for low-*temperature refrigeration systems*, and the design dry-bulb temperature plus 15°F (8°C) for *medium temperature refrigeration systems* where the *saturated condensing temperature* for blend refrigerants shall be determined using the average of liquid and vapor temperatures as converted from the condenser drain pressure.

2. Condenser fan motors that are less than 1 hp (0.75 kW) shall use electronically commutated motors, permanent split-capacitor-type motors or 3-phase motors.

3. Condenser fans for air-cooled condensers, evaporatively cooled condensers, air- or water-cooled fluid coolers or cooling towers shall reduce fan motor demand to not more than 30 percent of design wattage at 50 percent of design air volume, and incorporate one of the following continuous variable speed fan control approaches:

3.1. Refrigeration system condenser control for air-cooled condensers shall use variable setpoint control logic to reset the condensing temperature setpoint in response to ambient dry-bulb temperature.

3.2. Refrigeration system condenser control for evaporatively cooled condensers shall use variable setpoint control logic to reset the condensing temperature setpoint in response to ambient wet-bulb temperature.

4. Multiple fan condensers shall be controlled in unison.

5. The minimum condensing temperature setpoint shall be not greater than 70°F (21°C).

((~~C410.3.2~~)) C410.5.2 Compressor systems. Refrigeration compressor systems shall comply with the following:

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

EXCEPTION: Controls are not required for the following:
1. Single-compressor systems that do not have variable capacity capability.
2. Suction groups that have a design saturated suction temperature of 30°F (-1.1°C) or higher, suction groups that comprise the high stage of a two-stage or cascade system, or suction groups that primarily serve chillers for secondary cooling fluids.

2. Liquid subcooling shall be provided for all low-temperature compressor systems with a design cooling capacity equal to or greater than 100,000 Btu/hr (29.3 kW) with a design-saturated suction temperature of -10°F (-23°C) or lower. The 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.

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

((~~C410.4~~)) C410.6 Commissioning. Refrigeration systems shall be commissioned in accordance with Section C408.

EXCEPTION: Self-contained units.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-41100 Section C411—((~~Solar readiness.~~)) Renewable energy.

C411.1 ((~~General.~~)) On-site renewable energy. Each new building, or addition larger than 10,000 square feet of gross *conditioned floor area*, shall include a renewable energy generation system consisting of not less than 0.5 W/ft^2 or 1.7 Btu/ft^2 multiplied by the sum of the gross *conditioned floor area*.

EXCEPTIONS:
1. Any building where more than 50 percent of the roof area is shaded from direct beam sunlight by natural objects or by structures that are not part of the building for more than 2500 annual hours between 8:00 a.m. and 4:00 p.m.
2. Any building where more than 80 percent of the roof area is covered by any combination of equipment other than for on-site renewable energy systems, planters, vegetated space, skylights or occupied roof deck.
3. Alterations that do not include additions.

C411.1.1 Additional efficiency credits.

C411.1.1.1 On-site renewable energy reduced. Buildings which qualify for one of the exceptions in Section C411.1 to omit installation of on-site renewable energy must achieve an additional 18 efficiency package credits from Table C406.2.

C411.1.1.2 On-site renewable energy capacity increased. Buildings which install PV systems which exceed the capacity requirements of Section C411.1 may achieve additional efficiency package credits as described in Section C406.2.5.

C411.1.1.3 Partial capacity. On-site renewable energy installations of lower than required capacity can be counted proportionally toward achievement of required or additional efficiency credits in Section C411.1.1 based on the capacity of renewable energy installed compared to the requirements of Section C411.1.

C411.2 On-site and off-site renewable energy accounting for use with Appendix G. Qualifying on-site and off-site renewable energy delivered or credited to the building project to comply with Section C407.3 item 2.2 shall meet the requirements of this section. Renewable energy certificates for an on-site or off-site renewable energy system shall be

retired on behalf of the building owner for a period of not less than 15 years and tracked in accordance with Section C407.3.2.3 and submitted to the code official as part of the permit application.

C411.2.1 Qualifying types of off-site renewable energy systems. The following are considered qualifying off-site renewable energy systems:

1. Systems connected to the Western Interconnection.
2. Self-generation (an off-site renewable energy system owned by the building project owner) systems complying with Section C407.3.2.2.
3. Community renewable energy facility systems complying with Section C407.3.2.2.
4. Purchase contracts complying with Section C407.3.2.3.
5. Each source of renewable energy delivered to or credited to the building project shall be multiplied by the factors in Table C407.3.2.1 and subtracted from the proposed building site energy use.

Table C411.3.1
Multipliers for Renewable Energy Procurement Methods

Location	Renewable Energy Source	Renewable Energy Factor		
		In the state of Washington	Western Interconnected	In the states of Oregon or Idaho
On-site	On-site renewable energy system	1	NA	NA
Off-site	Directly owned off-site renewable energy system that begins operation after submission of the initial permit application	0.95	0.75	0.85
Off-site	Community renewable energy facility that begins operation after submission of the initial permit application	0.95	0.75	0.85
Off-site	Directly owned off-site renewable energy system that begins operation before submission of the initial permit application	0.75	0.55	0.65
Off-site	Community renewable energy facility that begins operation before submission of the initial permit application	0.75	0.55	0.65
Off-site	Renewable Power Purchase Agreement (PPA)	0.75	0.55	0.65

C411.2.2 Documentation requirements for off-site renewable energy systems. Off-site renewable energy delivered or credited to the building project to comply with Section C407.3 item 2.2 shall be subject to a legally binding contract to procure qualifying off-site renewable energy. Qualifying off-site renewable energy shall meet the following requirements:

1. Documentation of off-site renewable energy procurement shall be submitted to the *code official*.
2. The purchase contract shall have a duration of not less than 15 years. The contract shall be structured to survive a partial or full transfer of ownership of the building property.
3. Records on renewable power purchased by the building owner from the off-site renewable energy generator that specifically assign the RECs to the building owner shall be retained or retired by the building owner on behalf of the entity demonstrating financial or operational control over the building seeking compliance to this standard and made available for inspection by the *code official* upon request.

4. Where multiple buildings in a building project are allocated energy procured by a contract subject to this section, the owner shall allocate for not less than 15 years the energy procured by the contract to the buildings in the building project. A plan on operation shall be developed which shall indicate how renewable energy produced from on-site or off-site systems that is not allocated before issuance of the certificate of occupancy will be allocated to new or existing buildings included in the building project.

C411.2.3 Renewable energy certificate (REC) tracking. For multitenant buildings where RECs are transferred to tenants, the plan for operation shall include procedures for tracking the quantity and vintage of RECs that are required to be retained and retired. The plan shall include provisions to transfer the RECs to building tenants, or to retire RECs on their behalf, in proportion to the gross conditioned and semi-heated floor area leased or rented. The plan shall include provisions to use a REC tracking system that meets the requirements of Section V.B of the Green-e Framework for Renewable Energy Certification. The plan shall describe how the building owner will procure alternative qualifying renewable energy in the case that the renewable energy producer ceases.

C411.3 Solar readiness. A solar zone shall be provided on nonresidential buildings that are 20 stories or less in height above grade plan. 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 C411.2 through C411.8 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 C411.5, in the same location, as measured by one of~~)) under the following conditions:
1. 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 C411.5, in the same location, as measured by one of the following:
1.1. Incident solar radiation expressed in kWh/ft^2-yr using typical meteorological year (TMY) data.
((~~2.~~)) 1.2. Annual sunlight exposure expressed in cumulative hours per year using TMY data.
((~~3.~~)) 1.3. Shadow studies indicating that the roof area is more than 25 percent in shadow, on September 21st at 10 a.m., 11 a.m., 12 p.m., 1 p.m., and 2 p.m. solar time.
2. Buildings, building additions, changes in space conditioning or occupancy where the total floor area is equal to or less than 500 square feet.

((~~C411.2~~)) C411.3.1 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, mechanical equipment, 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 C411.2 to the maximum practicable area.

((~~C411.3~~)) C411.3.2 Contiguous area. The solar zone is permitted to be comprised of separated subzones. Each subzone shall be at least 5 feet wide in the narrowest dimension.

((~~C411.4~~)) C411.3.3 Obstructions. The solar zone shall be free of pipes, vents, ducts, HVAC equipment, skylights and other obstructions, except those serving photovoltaic systems 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 instal-

led 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*. Photovoltaic or solar water heating systems are permitted to be installed within the solar zone.

((~~C411.5~~)) C411.3.4 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 degrees of true north.

((~~C411.6~~)) C411.3.5 Access. Areas contiguous to the solar zone shall provide access pathways and provisions for emergency smoke ventilation as required by the *International Fire Code*.

((~~C411.7~~)) C411.3.6 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 system arrays at an assumed dead load of 4 pounds per square foot in addition to other required live and dead loads. 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 assume dead load of 175 pounds per square foot. Where photovoltaic systems are installed in the solar zone, structural analysis shall be based upon calculated loads, not upon these assumed loads.

((~~C411.8~~)) C411.3.7 Photovoltaic interconnection. 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:

1. 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.
2. 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 all of the following:

1. Solar zone boundaries and access pathways.
2. Location for future inverters and metering equipment.
3. Route for future wiring between the photovoltaic panels and the inverter, and between the inverter and the main service panel.

NEW SECTION

WAC 51-11C-41200 Section C412—Compressed air systems.

C412.1 General. All new *compressed air systems*, and all additions or alterations of *compressed air systems* where the total combined horsepower (hp) of the compressor(s) is 25 hp or more, shall meet the re-

quirements of this section. These requirements apply to the compressors, related piping systems, and related controls that provide compressed air and do not apply to any equipment or controls that use or process the compressed air.

EXCEPTION: Medical gas compressed air systems in health care facilities.

C412.2 Trim compressor and storage. The compressed air system shall be equipped with an appropriately sized trim compressor and primary storage to provide acceptable performance across the range of the system and to avoid control gaps. The compressed air system shall comply with 1 or 2 below:

1. The *compressed air system* shall include one or more variable speed drive (VSD) compressors. For systems with more than one compressor, the total combined capacity of the VSD compressor(s) acting as trim compressors must be at least 1.25 times the *largest net capacity increment* between combinations of compressors. The *compressed air systems* hall include *primary storage* of at least one gallon per actual cubic feet per minute (acfm) of the largest trim compressor; or

2. The *compressed air system* shall include a compressor or set of compressors with total effective trim capacity at least the size of the *largest net capacity increment* between combinations of compressors, or the size of the smallest compressor, whichever is larger. The total effective trim capacity of single compressor systems shall cover at least the range from 70 percent to 100 percent of rated capacity. The effective trim capacity of a compressor is the size of the continuous operational range where the specific power of the compressor (kW/100 acfm) is within 15 percent of the specific power at its most efficient operating point. The total effective trim capacity of the system is the sum of the effective trim capacity of the trim compressors. The system shall include *primary storage* of at least 2 gallons per acfm of the largest trim compressor.

EXCEPTIONS:
1. Alterations where the total combined added or replaced compressor horsepower is less than the average per-compressor horsepower of all compressors in the system.
2. Alterations where all added or replaced compressors are variable speed drive (VSD) compressors and *compressed air systems* includes *primary storage* of at least one gallon per acfm of the largest trim compressor.
3. *Compressed air systems* that have been pre*approved* as having demonstrated that the system serves loads for which typical air demand fluctuates less than 10 percent.
4. Alterations of existing *compressed air systems* that include one or more centrifugal compressors.

C412.3 Controls. *Compressed air systems* with three or more compressors and a combined horsepower rating of more than 100 hp, shall operate with controls that are able to choose the most energy efficient combination and loading of compressors within the system based on the current compressed air demand.

C412.4 Monitoring. *Compressed air systems* having a combined horsepower rating equal to or greater than 100 hp shall have an energy and air demand monitoring system with the following minimum requirements:

1. Measurement of system pressure.
2. Measurement of amps or power of each compressor.
3. Measurement or determination of total airflow from compressors in cfm.
4. Data logging of pressure, power in kW, airflow in cfm, and *compressed air system* specific efficiency in kW/100 cfm at intervals of five minutes or less.
5. Maintained data storage of at least the most recent 24 months.
6. Visual trending display of each recorded point, load and specific efficiency.

C412.5 Leak testing of compressed air piping. *Compressed air system* piping greater than 50 adjoining feet in length shall be pressure tested after being isolated from the compressed air supply and end-uses. The piping shall be pressurized to the design pressure and test pressures shall be held for a length of time at the discretion of the local jurisdiction, but in no case for less than 30 minutes, with no perceptible drop in pressure.

If dial gauges are used for conducting this test, for pressure tests less than or equal to 100 psi (689 kPa) gauges shall be incremented in units of 1 psi (7 kPa) less, for pressure tests greater than 100 psi (689 kPa) gauges shall be incremented in units less than 2 percent of the test pressure. Test gauges shall have a pressure range not exceeding twice the test pressure.

Piping less than or equal to 50 adjoining feet in length shall be pressurized and inspected. Connections shall be tested with a noncorrosive leak-detecting fluid or other leak-detecting methods as pre*approved* by the local jurisdiction.

C412.6 Pipe sizing. Compressed air piping greater than 50 adjoining feet in length shall be designed and installed to minimize frictional losses in the distribution network. These piping installations shall meet the requirements of Section C412.6.1 and either Section C412.6.2 or C412.6.3.

C412.6.1 Service line piping. Service line piping shall have inner diameters greater than or equal to 3/4 inch. Service line piping are pipes that deliver compressed air from distribution piping to end uses.

C412.6.2 Piping section average velocity. Compressor room interconnection and main header piping shall be sized so that at coincident peak flow conditions, the average velocity in the segment of pipe is no greater than 20 ft/sec. Compressor room interconnection and main header piping are the pipes that deliver compressed air from the compressor outlets to the inlet to the distribution piping. Each segment of distribution and service piping shall be sized so that at coincident peak flow conditions, the average velocity in the segment of pipe is no greater than 30 ft/sec. Distribution piping are pipes that deliver compressed air from the compressor room interconnection piping or main header piping to the service line piping.

C412.6.3 Piping total pressure drop. Piping shall be designed such that piping frictional pressure loss at coincident peak loads are less than 5 percent of operating pressure between the compressor and end use or end use regulator.

C412.6 Compressed air system acceptance. Before an occupancy permit is granted for a *compressed air system*, a certificate of acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the requirements of this code.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-50000 Chapter 5 [CE]——Existing buildings.

C501 General.

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

((~~C501.2~~)) **C501.1.1 Existing buildings.** Except as specified in this chapter, this code shall not be used to require the removal, *alteration* or abandonment of, nor prevent the continued use and maintenance of, an existing building or building system lawfully in existence at the time of adoption of this code.

C501.2 Compliance. *Additions*, *alterations*, *repairs*, changes in space conditioning and changes of occupancy to, or relocation of, existing buildings and structures shall comply with Section C502, C503, C504, or C505 of this code, and with all applicable provisions in the *International Building Code*, *International Existing Building Code*, *International Fire Code*, *International Fuel Gas Code*, *International Mechanical Code*, *Uniform Plumbing Code*, and NFPA 70.

C501.2.1 *U*-factor requirements for additions and alterations. For existing building projects where an *addition* or *building envelope alteration* area is combined with existing-to-remain building areas to demonstrate compliance with this code as a whole building, the *U*-factors applied to existing-to-remain envelope assemblies shall be in accordance with record documents.

EXCEPTION: If accurate record documents are not available, *U*-factors for the existing envelope assemblies may be in accordance with the edition of the Washington State Energy Code that was in effect at the time the building was permitted, or as approved by the *code official*.

C501.2.2 Calculations of mechanical heating and cooling loads for alterations. For the installation of new or replacement mechanical equipment that serves existing building areas, design loads associated with heating, cooling and ventilation of the existing building areas served shall be determined in accordance with Section C403.1.2.

R-values and *U*-factors used to determine existing thermal envelope performance for the purpose of calculating design loads shall be in accordance with record documents or existing conditions.

EXCEPTION: If accurate record documents are not available, *R*-values and *U*-factors used to determine existing building thermal envelope performance may be in accordance with the edition of the Washington State Energy Code that was in effect at the time the building was permitted, or as *approved* by the *code official*.

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

((~~**C501.4 Compliance.** *Alterations*, *repairs*, *additions* and changes of occupancy to, or relocation of, existing buildings and structures shall comply with the provisions for *alterations*, *repairs*, *additions* and changes of occupancy or relocation, respectively, in this code and in the *International Building Code*, *International Existing Building Code*, *International Fire Code*, *International Fuel Gas Code*, *International Mechanical Code*, *Uniform Plumbing Code*, and NFPA 70.~~

~~**C501.4.1 *U*-factor requirements for additions and alterations.** For existing building projects where an *addition* or *building envelope alter-*~~

~~*ation* area is combined with existing-to-remain building areas to demonstrate compliance with this code as a whole building, the *U*-factors applied to existing-to-remain envelope assemblies shall be in accordance with record documents.~~

~~EXCEPTION: If accurate record documents are not available, *U*-factors for the existing envelope assemblies may be in accordance with the edition of the Washington State Energy Code that was in effect at the time the building was permitted, or as approved by the *code official*.~~

~~**C501.4.2 Calculations of mechanical heating and cooling loads for alterations.** For the installation of new or replacement mechanical equipment that serves existing building areas, design loads associated with heating, cooling and ventilation of the existing building areas served shall be determined in accordance with Section C403.1.2.~~

~~*R*-values and *U*-factors used to determine existing thermal envelope performance for the purpose of calculating design loads shall be in accordance with record documents or existing conditions.~~

~~EXCEPTION: If accurate record documents are not available, *R*-values and *U*-factors used to determine existing building thermal envelope performance may be in accordance with the edition of the Washington State Energy Code that was in effect at the time the building was permitted, or as *approved* by the *code official*.~~

~~**C501.5**~~)) **C501.4 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**~~)) **C501.5 Historic buildings.** ((~~The building official may modify the specific requirements of this code for historic buildings and require alternate provisions which 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 historic preservation officer or the keeper of the national register of historic places.~~)) Provisions of this code relating to the construction, *repair*, *alteration*, restoration and movement of structures, and *change of occupancy* shall not be mandatory for historic buildings provided that a report has been submitted to the code official and signed by a registered design professional, or a representative of the state historic preservation office or the historic preservation authority having jurisdiction, demonstrating that compliance with that provision would threaten, degrade or destroy the historic form, fabric or function of the building.

((~~**C501.7**~~)) **C501.6 Commissioning.** Existing building systems shall be commissioned in accordance with Section C408. For the purposes of meeting the commissioning thresholds in Section C408.1, only the new and altered system capacities are considered when determining whether the project is exempt from some portion of the commissioning process.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-50200 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 comply with Sections C402, C403, C404, C405, C406, C409.5, C410 and C502.2.~~

~~**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. *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. Component performance alternative with target area adjustment per Section C402.1.5 for the addition area of the building only.~~

~~2. Existing building and addition area are combined to demonstrate compliance with the component performance alternative for the whole building.~~

~~3. Total building performance in accordance with Section C407 for the addition area of the building only.~~

~~4. Total building performance 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. Additions with skylights that result in a total building skylight 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 for the *addition* area of the building only.~~

~~2. Component performance alternative with target area adjustment per Section C402.1.5 for the addition area of the building only.~~

~~3. Existing building and addition area are combined to demonstrate compliance with the component performance alternative for the whole building.~~

~~4. Total building performance in accordance with Section C407 for the addition area of the building only.~~

~~5. Total building performance for the whole building.~~

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

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

~~**C502.2.5 Pools and permanent spas.** New pools and permanent spas shall comply with Section C404.11.~~

~~**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 for the addition alone, or the existing building and the addition shall comply as a single building.~~

~~**C502.2.7 Refrigeration systems.** New refrigerated spaces and refrigeration equipment shall comply with Section C410.~~)) This allowance applies to prescriptive compliance in accordance with Section C502.2 or total building performance in accordance with Section C407.

C502.1.1 Additional energy efficiency credits. Additions shall comply with Section C406.1. The addition shall be deemed to comply with this section if the addition alone complies or if the addition area is combined with existing building areas to demonstrate compliance with an additional efficiency credit.

C502.1.2 Renewable energy. Additions shall comply with Section C411. The addition shall be deemed to comply with this section if the addition alone complies or if the addition area is combined with existing building areas to demonstrate compliance with the requirements for onsite renewable energy or solar readiness, as applicable.

C502.2 Prescriptive compliance. *Additions* shall comply with Sections C502.3 through C502.8.

C502.2.2 Skylights. *Additions* with *skylights* shall comply with the following:

1. Where an *addition* with skylight area results in a total building skylight area less than or equal to the maximum allowed by Section C402.4.1, the *addition* shall comply with Section C402.4.

2. Where an *addition* with skylight area results in a total building skylight area greater than the maximum allowed by Section C402.4.1 (regardless of the ratio prior to the *addition*), the *addition* shall comply with one of the following:

2.1. Component performance alternative with target area adjustment per Section C402.1.5 for the addition area of the building only.

2.2. Existing building and addition area are combined to demonstrate compliance with the component performance alternative for the whole building. *U*-factors applied to existing envelope assemblies in the UA calculation shall comply with Section C501.2.1.

2.3. Total building performance in accordance with Section C407 for the addition area of the building only.

2.4. Total building performance for the whole building.

C502.2.4 Building mechanical systems. New mechanical systems and equipment serving the building heating, cooling or ventilation needs, that are installed as a part of the *addition* shall comply with Sections C403, C408.2, C409.5, and C501.6.

C502.2.5 Service water heating systems. New service water-heating systems and equipment that are installed as a part of the *addition* shall comply with Sections C404, C408.3, C409.5, and C501.6.

C502.2.6 Pools and permanent spas. Systems and equipment serving new pools and permanent spas that are installed as a part of the *addition* shall comply with Sections C404.11, C408.3, C409.5, and C501.6.

C502.2.7 Electrical power and lighting systems and motors. New electrical power and lighting systems and motors that are installed as a part of the *addition* shall comply with Sections C405, C408.4, C409.5, and C501.6.

C502.2.7.1 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.

C502.2.7.2 Exterior lighting power. The total exterior lighting power for the addition shall comply with Section C405.5.2 for the addition alone, or the existing building and the addition shall comply as a single building.

C502.2.8 Refrigeration systems. New refrigerated spaces and refrigeration systems and equipment that are installed as a part of the *addition* shall comply with Sections C408.7, C409.5, C410, and C501.6.

C502.3 Building envelope. Additions shall comply with Sections C402.1 through C402.5, C502.3.1, and C502.3.2.

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

1. Where an *addition* with *vertical fenestration* area results in a total building *vertical fenestration* area less than or equal to the maximum allowed by Section C402.4.1, the addition shall comply with Section C402.4.

2. Where an *addition* with *vertical fenestration* area results in a total building vertical fenestration area greater than the maximum allowed by Section C402.4.1 (regardless of the ratio prior to the *addition*), the *addition* shall comply with one of the following:

2.1. Component performance alternative with target area adjustment per Section C402.1.5 for the addition area of the building only.

2.2. Existing building and addition area are combined to demonstrate compliance with the component performance alternative for the whole building. *U*-factors applied to existing envelope assemblies in the UA calculation shall comply with Section C501.2.1.

2.3. Total building performance in accordance with Section C407 for the addition area of the building only.

2.4. Total building performance for the whole building.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-50300 Section C503—Alterations.

C503.1 General. Alterations to any building or structure shall comply with the requirements of Section C503 and the code for new construc-

tion. 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 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. The additional energy efficiency credit requirements in Section C406.1 and the renewable energy requirements in Section C411 do not apply to alterations.

EXCEPTION: The following alterations need not comply with the requirements for new construction provided the energy use of the building is not increased:
1. Storm windows installed over existing fenestration.
2. Surface applied window film installed on existing single pane fenestration assemblies 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.

C503.2 Change in space conditioning. Any low energy space in accordance with Section C402.1.1.1 that is altered to become *conditioned space* or *semi-heated* space shall be brought into full compliance with this code. Any semi-heated space in accordance with Section C402.1.1.2 that is altered to become conditioned space shall be brought into full compliance with this code.

For buildings with more than one space conditioning category, the interior partition walls, ceilings, floors and fenestration that separate space conditioning areas shall comply with the thermal envelope requirements per the area with the highest level of space conditioning.

A change in space conditioning project shall be deemed to comply with this code if the project area alone complies or if the existing building and the project area combined comply with this code as a whole building.

EXCEPTION: Buildings or spaces that were permitted prior to the 2009 Washington State Energy Code, or were originally permitted as unconditioned, may comply with this section as follows:
1. Where the component performance alternative in Section C402.1.5 is used to demonstrate compliance with this Section, the Proposed Total UA is allowed to be up to 110 percent of the Allowable Total UA. This exception may be applied to the project area alone, or to the existing building and project area combined as a whole building.
2. Where total building performance in accordance with Section C407 is used to demonstrate compliance with this Section, the total annual carbon emissions from energy consumption of the proposed design is allowed to be up to 110 percent of the annual carbon emissions from energy consumption allowed by Section C407.3. This exception may be applied to the project area alone, or to the existing building and project area combined as a whole building.

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~~)) and Sections C503.3.1 through C503.3.3.

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 no insulation or the insulation is located entirely above the roof deck. In no case shall the *R*-value of the roof insulation be reduced or the *U*-factor of the roof assembly be increased as part of the *roof replacement*.

C503.3.2 Vertical fenestration. Alterations that include the addition of new vertical fenestration area shall comply with the following:

1. Where the addition of new *vertical fenestration* ((~~that~~)) area results in a total building vertical fenestration area less than or

equal to ((~~that specified in~~)) the maximum allowed by Section C402.4.1, the alteration shall comply with Section C402.4.

2. Where the addition of new *vertical fenestration* ((~~that~~)) area result in a total building *vertical fenestration* area greater than ((~~specified in~~)) the maximum allowed by Section C402.4.1 (regardless of the ratio prior to the addition), the alteration shall comply with one of the following:

((~~1.~~)) 2.1. Vertical fenestration alternate in accordance with Section C402.1.3 for the new vertical fenestration added.

((~~2.~~)) 2.2. Vertical fenestration alternate in accordance with Section C402.4.1.1 for the area adjacent to the new vertical fenestration added.

((~~3.~~)) 2.3. Existing building and alteration areas are combined to demonstrate compliance with the component performance alternate in accordance with Section C402.1.5 for the whole building. *U*-factors applied to existing envelope assemblies in the UA calculation shall comply with Section C501.2.1. The Proposed Total UA is allowed to be up to 110 percent of the Allowed Total UA.

((~~4.~~)) 2.4. Total building performance in accordance with Section C407 for the whole building. The total annual carbon emissions from energy consumption of the proposed design is allowed to be up to 110 percent of the annual carbon emissions from energy consumption allowed in accordance with Section C407.3.

EXCEPTION: ((~~Additional envelope upgrades are included in the project so the addition of vertical fenestration does not cause a reduction in overall building energy efficiency, as approved by the *code official*.~~)) Where *approved* by the *code official*, additional *fenestration* is permitted where sufficient envelope upgrades beyond those required by other sections of this code are included in the project so that the addition of new *vertical fenestration* does not cause an increase in the overall energy use of the 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.

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 Skylights ((~~area~~)). Alterations that include the addition of new skylight area shall comply with the following:

1. Where the addition of new *skylight*((~~s that~~)) area results in a total building skylight area less than or equal to ((~~that specified in~~)) the maximum allowed by Section C402.4.1, the alteration shall comply with Section C402.4.

2. Where the addition of new *skylight*((~~s that~~)) area results in a total building skylight area greater than ((~~that specified in~~)) the maximum allowed by Section C402.4.1 (regardless of the ratio prior to the addition), the alteration shall comply with one of the following:

((~~1.~~)) 2.1. Existing building and alteration area are combined to demonstrate compliance with the component performance alternative with target area adjustment in accordance with Section C402.1.5 for the whole building. *U*-factors applied to existing envelope assemblies in the UA calculation shall comply with Section C501.2.1. The Proposed Total UA is allowed to be up to 110 percent of the Allowed Total UA.

((~~2.~~)) 2.2. Total building performance in accordance with Section C407 for the whole building. The annual carbon emissions from energy consumption of the proposed design is allowed to be up to 110 percent of the annual carbon emissions from energy consumption allowed in accordance with Section C407.3.

EXCEPTION: Additional envelope upgrades are included in the project so the addition of new skylights does not cause a reduction in overall building energy efficiency, as *approved* by the *code official*.

OPTION 1 for C503.4 through C503.4.6.1:

C503.4 Building mechanical systems. ((~~Those parts of~~)) Components of existing mechanical systems ((~~which~~)) that are altered or replaced shall comply with Sections C403, C408.2, C409.5, C501.2.2, C501.6 and C503.4.2 through C503.4.5. Additions or alterations shall not be made to an existing mechanical system that will cause the existing ((~~mechanical~~)) system to become out of compliance.

EXCEPTIONS: 1. Existing mechanical systems ((~~which~~)) that are altered or ((~~where~~)) parts of the systems that are replaced are not required to be modified to comply with Section C403.3.5 as long as mechanical cooling capacity is not added to a system that did not have cooling capacity prior to the alteration.
2. Alternate mechanical system 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 or exhausts makes full compliance impractical. Alternate designs shall include additional energy saving strategies not prescriptively required by this code for the scope of the project including, but not limited to, demand control ventilation, energy recovery, or increased mechanical cooling or heating equipment efficiency above that required by Tables C403.3.2(1) through C403.3.2(((~~12~~))) (16).
3. Only those components of existing HVAC systems that are altered or replaced shall be required to ((~~meet the requirements of~~)) comply with Section C403.8.1((~~, Allowable fan motor horsepower. Components replaced or altered shall not exceed the fan power limitation pressure drop adjustment values in Table C403.8.1(2) at design conditions~~)). Section C403.8.1 does not require the removal and replacement of existing system ductwork. Additional fan power allowances are available when determining the fan power budget (Fan kW_{budget}) as specified in Table C503.4. These values can be added to the fan power allowance values in Tables C403.8.1.1(1) and C403.8.1.1(2) when calculating a new Fan kW_{budget} for the fan system being altered. The additional fan power allowance is not applicable to alterations that add or change passive components which do not increase the fan system static pressure.

Table C503.4
Additional Fan Power Allowances (W/CFM)

Airflow	Multi-Zone VAV Systems[a] ≤5,000 cfm	Multi-Zone VAV Systems[a] >5,000 and ≤10,000 cfm	Multi-Zone VAV Systems[a] >10,000 cfm	All Other Fan Systems ≤5,000 cfm	All Other Fan Systems >5,000 and ≤10,000 cfm	All Other Fan Systems >10,000 cfm
Supply *Fan System* additional allowance	0.135	0.114	0.105	0.139	0.120	0.107
Supply *Fan System* additional allowance in unit with adapter curb	0.033	0.033	0.043	0.000	0.000	0.000
Exhaust/ Relief/ Return/ Transfer *Fan System* additional allowance	0.070	0.061	0.054	0.070	0.062	0.055
Exhaust/ Relief/ Return/ Transfer *Fan System* additional allowance with adapter curb	0.016	0.017	0.220	0.000	0.000	0.000

[a] See definition of *FAN SYSTEM, MULTI-ZONE VARIABLE AIR VOLUME (VAV).*

C503.4.1 New building mechanical systems. All new mechanical systems and equipment in existing buildings, including packaged unitary equipment and packaged split systems, shall comply with Sections C403, C408.2, C409.5, and C501.6.

C503.4.2 Addition of cooling capacity. Where mechanical cooling is added to a space that was not previously cooled, the mechanical system shall comply with either Section C403.3.5 or C403.5.

EXCEPTIONS: 1. Qualifying small equipment: Economizers are not required for cooling units and split systems serving one zone with a total cooling capacity rated in accordance with Section C403.3.2 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 C403.3.2 (1) ((~~through (3)~~)), (2), (4), (8), (9), and (14), 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 the building total air economizer capacity, whichever is greater.
Notes and exclusions for Exception 1:

1.1. The portion of the equipment serving Group R occupancies is not included in determining the total capacity of all units without economizers in a building.
1.2. Redundant units are not counted in the capacity limitations.
1.3. This exception shall not be used for the initial tenant improvement of a shell-and-core building or space, or for Total Building Performance in accordance with Section C407.
1.4. This exception shall not be used for unitary cooling equipment installed outdoors or in a mechanical room adjacent to the outdoors.
2. Chilled water terminal units connected to systems with chilled water generation equipment with IPLV values more than 25 percent higher than minimum part load equipment efficiencies listed in Table C403.3.2((~~(7)~~)) (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 systems without economizers shall not exceed 480,000 Btu/h per building, or 20 percent of the building total air economizer capacity, whichever is greater.
Notes and exclusions for Exception 2:
2.1. The portion of the equipment serving Group R occupancy is not included in determining the total capacity of all units without economizers in a building.
2.2. This exception shall not be used for the initial tenant improvement of a shell-and-core building or space, or for total building performance in accordance with Section C407.

C503.4.3 Alterations or replacement of existing cooling systems. Alterations to, or replacement of, existing mechanical cooling systems shall not decrease the building total economizer capacity unless the system complies with either Section C403.3.5 or C403.5. System alterations or replacement shall comply with Table ((~~C503.4~~)) C503.4.3 when either the individual cooling unit capacity ((~~and~~)) or the building total capacity of all cooling equipment without economizer ((~~do~~)) does not comply with Section C403.3.5 or C403.5.

C503.4.4 Controls for cooling equipment replacement. When space cooling equipment is replaced, controls shall comply with all requirements under Section C403.3.5 and related subsections, and Section C403.5.1 for integrated economizer control. Single-zone systems providing ventilation where the equipment containing the supply fan is replaced shall also comply with Section C403.7.1.

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.

Table ((~~C503.4~~)) C503.4.3
Economizer Compliance Options for Mechanical Alterations

	Option A	Option B (alternate to A)	Option C (alternate to A)	Option D (alternate to A)
Unit Type	**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. [a] Economizer: C403.5[b]	Efficiency: min. [a] Economizer: C403.5[b]	Efficiency: min. [a] Economizer: C403.5[b]	Efficiency: min. [a] Economizer: C403.5[b]
2. Split Systems	Efficiency: min. [a] Economizer: C403.5[b]	For units ≤ 60,000 Btuh, comply with two of two measures: 1. Efficiency: + 10%[e] 2. Economizer: shall not decrease existing economizer capability	For units ≤ 60,000 Btuh replacing unit installed prior to 1991 comply with at least one of two measures: 1. Efficiency: + 10%[e] 2. Economizer: 50% [f]	Efficiency: min. [a] Economizer: C403.5[b]
		For all other capacities: Efficiency: min.[a] Economizer: C403.5[b]	For all other capacities: Efficiency: min.[a] Economizer: C403.5[b]	
3. Water Source Heat Pump	Efficiency: min. [a] Economizer: C403.5[b]	For units ≤ 72,000 Btuh, comply with at least two of three measures: 1. Efficiency: +10%[e] 2. Flow control valve [g] 3. Economizer: 50% [f]	For units ≤ 72,000 Btuh, comply with at least three of three measures: 1. Efficiency: +10%[e] 2. Flow control valve [g] 3. Economizer: 50% [f] (except for certain pre-1991 systems [q])	Efficiency: min. [a] Economizer: C403.5[b] (except for certain pre-1991 systems [q])
		For all other capacities: Efficiency: min.[a] Economizer: C403.5[b]	For all other capacities: Efficiency: min.[a] Economizer: C403.5[b]	

	Option A	Option B (alternate to A)	Option C (alternate to A)	Option D (alternate to A)
Unit Type	**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**
4. Water Economizer using Air-Cooled Heat Rejection Equipment (Dry Cooler)	Efficiency: min. [a] Economizer: C403.5[b]	Efficiency: + 5%[d] Economizer: shall not decrease existing economizer capacity	Efficiency: min.[a] Economizer: C403.5[b]	Efficiency: min. [a] Economizer: C403.5[b]
5. Air-Handling Unit (including fan coil units) where the system has an air-cooled chiller	Efficiency: min. [a] Economizer: C403.5[b]	Economizer: shall not decrease existing economizer capacity	Efficiency: min.[a] Economizer: C403.5[b] (except for certain pre-1991 systems [q])	Efficiency: min.[a] Economizer: C403.5[b] (except for certain pre-1991 systems [q])
6. Air-Handling Unit (including fan coil units) and Water-cooled Process Equipment, where the system has a water-cooled chiller[10]	Efficiency: min. [a] Economizer: C403.5[b]	Economizer: shall not decrease existing economizer capacity	Efficiency: min.[a] Economizer: C403.5[b] (except for certain pre-1991 systems [q] and certain 1991-2016 systems [i])	Efficiency: min. [a] Economizer: C403.5[b] (except for certain pre-1991 systems [q] and certain 1991-2016 systems [i])
7. Cooling Tower	Efficiency: min. [a] Economizer: C403.5[b]	No requirements	Efficiency: min.[a] Economizer: C403.5[b]	Efficiency: min.[a] Economizer: C403.5[b]
8. Air-Cooled Chiller	Efficiency: min. [a] Economizer: C403.5[b]	Efficiency: + 10%[k] Economizer: shall not decrease existing economizer capacity	Efficiency: Comply with two of two measures: 1. + 10% [k,l] and 2. Multistage compressor(s) Economizer: shall not decrease existing economizer capacity	Efficiency: min. [a] Economizer: C403.5[b]
9. Water-Cooled Chiller	Efficiency: min. [a] Economizer: C403.5[b]	Efficiency: Comply with at least one of two measures: 1. Part load IPLV + 15%[n] or 2. Plate frame heat exchanger [o] Economizer: shall not decrease existing economizer capacity	Efficiency: Comply with two of two measures: 1. Part load IPLV + 15% [n] 2. Plate-frame heat exchanger [o] Economizer: shall not decrease existing economizer capacity	Efficiency: min. [a] Economizer: C403.5[b]
10. Package Terminal Air Conditioner	Efficiency: min. [a] Economizer: C403.5[b]	Efficiency: + 5%[a] Economizer: shall not decrease existing economizer capacity	Efficiency: + 5%[a] Economizer: shall not decrease existing economizer capacity	Efficiency: min. [a] Economizer: C403.5[b]
11. Package Terminal Heat Pump	Efficiency: min. [a] Economizer: C403.5[b]	Cooling efficiency: + 5%[d] Heating efficiency: + 10%[e] Shall not decrease existing economizer capacity	Cooling efficiency: + 5%[d] Heating efficiency: + 10%[e] Shall not decrease existing economizer capacity	Efficiency: min. [a] Economizer: C403.5[b]

a Minimum equipment efficiency shall comply with Section C403.3.2 and ((~~Tables C403.3.2(1) through C403.3.3.2(12)~~)) the tables in Section C403.3.2.

b All separate new equipment and replacement equipment shall have air economizer complying with Section C403.5 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 C403.5.

c Reserved.

d Equipment shall have a capacity-weighted average cooling system efficiency that is 5% better than the requirements in ((~~Tables C403.3.2(1) and C403.3.2(2)~~)) the tables in Section C403.3.2 (1.05 × values in ((~~Tables C403.3.2(1) and C403.3.2(2)~~)) the tables).

e Equipment shall have a capacity-weighted average cooling system efficiency that is 10% better than the requirements in ((~~Tables C403.3.2(1)A and C403.3.2(2)~~)) the tables in Section C403.3.2 (1.10 × values in ((~~Tables C403.3.2(1)A and C403.3.2(2)~~)) the tables).

f 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 configured to provide this additional outside air and be equipped with economizer control.

g Water-source heat pump systems shall have a flow control valve to eliminate flow through the heat pumps that are not in operation and variable speed pumping control complying with Section C403.4.3 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, the capacity-weighted average cooling system efficiency shall be 5% better than the requirements in footnote [e] for water-source heat pumps (i.e., a minimum of 15% greater than the requirements in Table C403.3.2((~~(2)~~)) (14)).

h Water economizer equipment shall have a capacity-weighted average cooling system efficiency that is 10% better than the requirements in Tables C403.3.2((~~(8)~~)) (7), C403.3.2(10), and C403.3.2((~~(9)~~)) (16) (1.10 × values in Tables C403.3.2((~~(8)~~)) (7), C403.3.2(10), and C403.3.2((~~(9)~~)) (16)).

i Air economizer is not required for systems installed with water economizer plate and frame heat exchanger complying with previous codes between 1991 and June 2016, provided that the total fan coil load does not exceed the existing or added capacity of the heat exchangers.

j 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.

k The air-cooled chiller shall have an IPLV efficiency that is a minimum of 10% greater than the IPLV requirements in EER in Table C403.3.2((~~(7)~~)) (3) (1.10 × IPLV values in EER in Table C403.3.2((~~(7)~~)) (3)).

l The air-cooled chiller shall be multistage with a minimum of two compressors.

m The water-cooled chiller shall have full load and part load IPLV efficiency that is a minimum of 5% greater than the IPLV requirements in Table ((~~C403.2.3(7)~~)) C403.3.2(3).

n The water-cooled chiller shall have an IPLV value that is a minimum of 15% lower than the IPLV requirements in Table ((~~C403.2.3(7)~~)) C403.3.2(3) (1.15 × IPLV values in Table C403.3.2((~~(7)~~)) (3)). Water-cooled centrifugal chillers designed for nonstandard conditions shall have an NPLV value that is at least 15% lower than the adjusted maximum NPLV rating in kW per ton defined in Section ((~~C403.3.2.1~~)) C403.3.2.3 (1.15 × NPLV).

o 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.

p Reserved.

q 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.

OPTION 2 for Section C503.4 thourgh C503.4.6.1

C503.4 Building mechanical systems. ((~~Those parts of~~)) Components of existing mechanical systems ((~~which~~)) that are altered or replaced shall comply with Section C403, unless specifically exempted in this section, and Sections C408.2, C409.5, C501.2.2, C501.6, and C503.4.2 through C503.4.5. Additions or alterations shall not be made to an existing mechanical system that will cause the existing ((~~mechanical~~)) system to become out of compliance.

EXCEPTIONS: 1. Existing mechanical systems ((~~which are altered or parts of the systems are replaced are not required to be modified to comply with Section C403.3.5 as long as~~)) are not required to be modified to comply with Section C403.3.5 where mechanical cooling capacity is not added to a system that did not have cooling capacity prior to the alteration.
2. Compliance with Section C403.1.4 is not required where the alteration does not include replacement of a heating appliance.
3. Alternate mechanical system 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 or exhausts makes full compliance impractical. Alternate designs shall include additional energy saving strategies not prescriptively required by this code for the scope of the project including, but not limited to, demand control ventilation, energy recovery, or increased mechanical cooling or heating equipment efficiency above that required by Tables C403.3.2(1) through C403.3.2((~~(12)~~)) (16).
((~~3.~~)) 4. Only those components of existing HVAC systems that are altered or replaced shall be required to ((~~meet the requirements of~~)) comply with Section C403.8.1((~~, Allowable fan motor horsepower. Components replaced or altered shall not exceed the fan power limitation pressure drop adjustment values in Table C403.8.1(2) at design conditions~~)). Section C403.8.1 does not require the removal and replacement of existing system ductwork. Additional fan power allowances are available when determining the fan power budget (Fan kW_{budget}) as specified in Table C503.4. These values can be added to the fan power allowance values in Tables C403.8.1.1(1) and C403.8.1.1(2) when calculating a new Fan kW_{budget} for the fan system being altered. The additional fan power allowance is not applicable to alterations that add or change passive components which do not increase the fan system static pressure.

Table C503.4
Additional Fan Power Allowances (W/CFM)

Airflow	Multi-Zone VAV Systems[a] ≤5,000 cfm	Multi-Zone VAV Systems[a] >5,000 and ≤10,000 cfm	Multi-Zone VAV Systems[a] >10,000 cfm	All Other Fan Systems ≤5,000 cfm	All Other Fan Systems >5,000 and ≤10,000 cfm	All Other Fan Systems >10,000 cfm
Supply *Fan System* additional allowance	0.135	0.114	0.105	0.139	0.120	0.107
Supply *Fan System* additional allowance in unit with adapter curb	0.033	0.033	0.043	0.000	0.000	0.000
Exhaust/ Relief/ Return/ Transfer *Fan System* additional allowance	0.070	0.061	0.054	0.070	0.062	0.055

Airflow	Multi-Zone VAV Systems[a] ≤5,000 cfm	Multi-Zone VAV Systems[a] >5,000 and ≤10,000 cfm	Multi-Zone VAV Systems[a] >10,000 cfm	All Other Fan Systems ≤5,000 cfm	All Other Fan Systems >5,000 and ≤10,000 cfm	All Other Fan Systems >10,000 cfm
Exhaust/ Relief/ Return/ Transfer *Fan System* additional allowance with adapter curb	0.016	0.017	0.220	0.000	0.000	0.000

[a] See definition of *FAN SYSTEM, MULTI-ZONE VARIABLE AIR VOLUME (VAV).*

C503.4.1 New building mechanical systems. All new mechanical systems and equipment in existing buildings((~~, including packaged unitary equipment and packaged split systems,~~)) shall comply with Sections C403, C408.2, C409.5, and C501.6.

C503.4.2 Addition of cooling capacity. Where mechanical cooling is added to a space that was not previously cooled, the mechanical system shall comply with either Section C403.3.5 or C403.5.

EXCEPTIONS:

1. Qualifying small equipment: Economizers are not required for cooling units and split systems serving one zone with a total cooling capacity rated in accordance with Section C403.3.2 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 C403.3.2 (1) ((~~through (3)~~)), (2), (4), (8), (9), and (14), 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 the building total air economizer capacity, whichever is greater.
Notes and exclusions for Exception 1:
1.1. The portion of the equipment serving Group R occupancies is not included in determining the total capacity of all units without economizers in a building.
1.2. Redundant units are not counted in the capacity limitations.
1.3. This exception shall not be used for the initial tenant improvement of a shell-and-core building or space, or for Total Building Performance in accordance with Section C407.
1.4. This exception shall not be used for unitary cooling equipment installed outdoors or in a mechanical room adjacent to the outdoors.
2. Chilled water terminal units connected to systems with chilled water generation equipment with IPLV values more than 25 percent higher than minimum part load equipment efficiencies listed in Table C403.3.2((~~(7)~~)) (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 systems without economizers shall not exceed 480,000 Btu/h per building, or 20 percent of the building total air economizer capacity, whichever is greater.
Notes and exclusions for Exception 2:
2.1. The portion of the equipment serving Group R occupancy is not included in determining the total capacity of all units without economizers in a building.
2.2. This exception shall not be used for the initial tenant improvement of a shell-and-core building or space, or for total building performance in accordance with Section C407.

C503.4.3 Alterations or replacement of existing cooling systems. Alterations to, or replacement of, existing mechanical cooling systems shall not decrease the building total economizer capacity unless the system complies with either Section C403.3.5 or C403.5. System alterations or replacement shall comply with Table ((~~C503.4~~)) C503.4.3 when either the individual cooling unit capacity ((~~and~~)) or the building total capacity of all cooling equipment without economizer ((~~do~~)) does not comply with Section C403.3.5 or C403.5. Equipment replacements that include space heating shall also comply with Section C503.4.3.

((~~**C503.4.4 Controls for cooling equipment replacement.** When space cooling equipment is replaced, controls shall comply with all requirements under Section C403.3.5 and related subsections, and Section C403.5.1 for integrated economizer control.~~

~~**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.~~))

Table ((~~C503.4~~)) C503.4.3
Economizer Compliance Options for Mechanical Alterations

	Option A	Option B (alternate to A)	Option C (alternate to A)	Option D (alternate to A)
Unit Type	**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. [a] Economizer: C403.5[b]	Efficiency: min. [a] Economizer: C403.5[b]	Efficiency: min. [a] Economizer: C403.5[b]	Efficiency: min. [a] Economizer: C403.5[b]
2. Split Systems	Efficiency: min. [a] Economizer: C403.5[b]	For units ≤ 60,000 Btuh, comply with two of two measures: 1. Efficiency: + 10%[e] 2. Economizer: shall not decrease existing economizer capability	For units ≤ 60,000 Btuh replacing unit installed prior to 1991 comply with at least one of two measures: 1. Efficiency: + 10%[e] 2. Economizer: 50% [f]	Efficiency: min. [a] Economizer: C403.5[b]
		For all other capacities: Efficiency: min.[a] Economizer: C403.5[b]	For all other capacities: Efficiency: min.[a] Economizer: C403.5[b]	
3. Water Source Heat Pump	Efficiency: min. [a] Economizer: C403.5[b]	For units ≤ 72,000 Btuh, comply with at least two of three measures: 1. Efficiency: +10%[e] 2. Flow control valve [g] 3. Economizer: 50% [f]	For units ≤ 72,000 Btuh, comply with at least three of three measures: 1. Efficiency: +10%[e] 2. Flow control valve [g] 3. Economizer: 50% [f] (except for certain pre-1991 systems [q])	Efficiency: min. [a] Economizer: C403.5[b] (except for certain pre-1991 systems [q])
		For all other capacities: Efficiency: min.[a] Economizer: C403.5[b]	For all other capacities: Efficiency: min.[a] Economizer: C403.5[b]	
4. Water Economizer using Air-Cooled Heat Rejection Equipment (Dry Cooler)	Efficiency: min. [a] Economizer: C403.5[b]	Efficiency: + 5%[d] Economizer: shall not decrease existing economizer capacity	Efficiency: min.[a] Economizer: C403.5[b]	Efficiency: min. [a] Economizer: C403.5[b]
5. Air-Handling Unit (including fan coil units) where the system has an air-cooled chiller	Efficiency: min. [a] Economizer: C403.5[b]	Economizer: shall not decrease existing economizer capacity	Efficiency: min.[a] Economizer: C403.5[b] (except for certain pre-1991 systems [q])	Efficiency: min.[a] Economizer: C403.5[b] (except for certain pre-1991 systems [q])
6. Air-Handling Unit (including fan coil units) and Water-cooled Process Equipment, where the system has a water-cooled chiller[10]	Efficiency: min. [a] Economizer: C403.5[b]	Economizer: shall not decrease existing economizer capacity	Efficiency: min.[a] Economizer: C403.5[b] (except for certain pre-1991 systems [q] and certain 1991-2016 systems [i])	Efficiency: min. [a] Economizer: C403.5[b] (except for certain pre-1991 systems [q] and certain 1991-2016 systems [i])
7. Cooling Tower	Efficiency: min. [a] Economizer: C403.5[b]	No requirements	Efficiency: min.[a] Economizer: C403.5[b]	Efficiency: min.[a] Economizer: C403.5[b]
8. Air-Cooled Chiller	Efficiency: min. [a] Economizer: C403.5[b]	Efficiency: + 10%[k] Economizer: shall not decrease existing economizer capacity	Efficiency: Comply with two of two measures: 1. + 10% [k,l] and 2. Multistage compressor(s) Economizer: shall not decrease existing economizer capacity	Efficiency: min. [a] Economizer: C403.5[b]
9. Water-Cooled Chiller	Efficiency: min. [a] Economizer: C403.5[b]	Efficiency: Comply with at least one of two measures: 1. Part load IPLV + 15%[n] or 2. Plate frame heat exchanger [o] Economizer: shall not decrease existing economizer capacity	Efficiency: Comply with two of two measures: 1. Part load IPLV + 15% [n] 2. Plate-frame heat exchanger [o] Economizer: shall not decrease existing economizer capacity	Efficiency: min. [a] Economizer: C403.5[b]
10. Package Terminal Air Conditioner	Efficiency: min. [a] Economizer: C403.5[b]	Efficiency: + 5%[a] Economizer: shall not decrease existing economizer capacity	Efficiency: + 5%[a] Economizer: shall not decrease existing economizer capacity	Efficiency: min. [a] Economizer: C403.5[b]
11. Package Terminal Heat Pump	Efficiency: min. [a] Economizer: C403.5[b]	Cooling efficiency: + 5%[d] Heating efficiency: + 10%[e] Shall not decrease existing economizer capacity	Cooling efficiency: + 5%[d] Heating efficiency: + 10%[e] Shall not decrease existing economizer capacity	Efficiency: min. [a] Economizer: C403.5[b]

a Minimum equipment efficiency shall comply with Section C403.3.2 and ((~~Tables C403.3.2(1) through C403.3.3.2(12)~~)) the tables in Section C403.3.2.

b All separate new equipment and replacement equipment shall have air economizer complying with Section C403.5 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 C403.5.

c Reserved.

d Equipment shall have a capacity-weighted average cooling system efficiency that is 5% better than the requirements in ((~~Tables C403.3.2(1) and C403.3.2(2)~~)) the tables in Section C403.3.2 (1.05 × values in ((~~Tables C403.3.2(1) and C403.3.2(2)~~)) the tables).

e Equipment shall have a capacity-weighted average cooling system efficiency that is 10% better than the requirements in ((~~Tables C403.3.2(1)A and C403.3.2(2)~~)) the tables in Section C403.3.2 (1.10 × values in ((~~Tables C403.3.2(1)A and C403.3.2(2)~~)) the tables).

f 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 configured to provide this additional outside air and be equipped with economizer control.

g Water-source heat pump systems shall have a flow control valve to eliminate flow through the heat pumps that are not in operation and variable speed pumping control complying with Section C403.4.3 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, the capacity-weighted average cooling system efficiency shall be 5% better than the requirements in footnote [e] for water-source heat pumps (i.e., a minimum of 15% greater than the requirements in Table C403.3.2((~~(2)~~)) (14)).

h Water economizer equipment shall have a capacity-weighted average cooling system efficiency that is 10% better than the requirements in Tables C403.3.2((~~(8)~~)) (7), C403.3.2(10), and C403.3.2((~~(9)~~)) (16) (1.10 × values in Tables C403.3.2((~~(8)~~)) (7), C403.3.2(10), and C403.3.2((~~(9)~~)) (16)).

i Air economizer is not required for systems installed with water economizer plate and frame heat exchanger complying with previous codes between 1991 and June 2016, provided that the total fan coil load does not exceed the existing or added capacity of the heat exchangers.

j 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.

k The air-cooled chiller shall have an IPLV efficiency that is a minimum of 10% greater than the IPLV requirements in EER in Table C403.3.2((~~(7)~~)) (3) (1.10 × IPLV values in EER in Table C403.3.2((~~(7)~~)) (3)).

l The air-cooled chiller shall be multistage with a minimum of two compressors.

m The water-cooled chiller shall have full load and part load IPLV efficiency that is a minimum of 5% greater than the IPLV requirements in Table ((~~C403.2.3(7)~~)) C403.3.2(3).

n The water-cooled chiller shall have an IPLV value that is a minimum of 15% lower than the IPLV requirements in Table ((~~C403.2.3(7)~~)) C403.3.2(3) (1.15 × IPLV values in Table C403.3.2((~~(7)~~)) (3)). Water-cooled centrifugal chillers designed for nonstandard conditions shall have an NPLV value that is at least 15% lower than the adjusted maximum NPLV rating in kW per ton defined in Section ((~~C403.3.2.1~~)) C403.3.2.3 (1.15 × NPLV).

o 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.

p Reserved.

q 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.

C503.4.4 Controls for cooling equipment replacement. When space cooling equipment is replaced, controls shall comply with all requirements under Section C403.3.5 and related subsections, and Section C403.5.1 for integrated economizer control.

C503.4.5 Mechanical 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 Addition or replacement of heating appliances. Where a mechanical heating appliance is added or replaced, the added or replaced appliance shall comply with Section C403.1.4 or with an alternate compliance option in Table C503.4.6.

EXCEPTIONS:
1. Terminal unit equipment including, but not limited to, hydronic VAV boxes, electric resistance VAV boxes, electric duct heaters, water source heat pumps, fan coils, or VRF indoor units that are served by an unaltered central system.
2. Air handling equipment with hydronic coils.
3. Air handling equipment designed for 100 percent outdoor air that is not subject to the requirements in Section C403.3.5 or that qualifies for an exception to Section C403.3.5.
4. Replacement of existing oil-fired boilers.
5. Replacement of existing steam boilers with steam distribution to terminal units and the associated boiler feed equipment.
6. Where compliance with Section C403.1.4 would trigger an unplanned utility electrical service upgrade based on the NEC 220.87 method for determining existing loads.
7. Like-for-like replacement of a single heating appliance is permitted where that appliance is failing, requires immediate replacement, and where no other HVAC work is planned.

Table C503.4.6
Compliance Options for Mechanical Heating Equipment Alterations

	Proposed Heating Equipment Type[a]	Heating Efficiency Table Reference	Alternate Compliance Options to Section C403.1.4
1	Air-Cooled Unitary Heat Pumps	Table C403.3.2(2)	1. Compliance with C403.1.4, except heat pump rated capacity in accordance with Section C403.1.4 exception 5d is permitted to be sized equal to the supplemental internal resistance heating capacity in Climate Zone 4 or 5[c] 2. Compliance with C403.1.4, except electric resistance mixed air preheat is permissible[c]
2	Packaged terminal, single-package vertical, and room air-conditioner heat pumps	Table C403.3.2(4)	1. Compliance with C403.1.4, except heat pump rated capacity in accordance with Section C403.1.4 Exception 5d is permitted to be sized equal to the supplemental internal resistance heating capacity in Climate Zone 4 or 5
3	Furnaces, duct furnaces, and unit heaters	Table C403.3.2(5)	1. Efficiency: +10%[b]
4	Gas-fired hot water boilers with fewer than 80% of coils replaced	Table C403.3.2(6)	1. Efficiency: +10%[b]
5	Variable refrigerant flow air-to-air and applied heat pumps	Table C403.3.2(9)	No alternate compliance option
6	DX-DOAS equipment	Table C403.3.2(12) and Table C403.3.2(13)	1. DX-DOAS is provided with heat recovery if not required by C403.3.5.1.
7	Water-source heat pumps	Table C403.3.2(14)	No alternate compliance option

[a] Includes replacement of equipment with a unit that is the same type or higher efficiency and the same or lower capacity, or a replacement of one equipment type with a different equipment type.
[b] Equipment shall have a capacity-weighted average heating system efficiency that is 10 percent better than that shown in the reference table (1.10 x values in reference table).
[c] Option 1 and Option 2 can be combined.

C503.4.6.1 Hydronic system alteration supply water temperature. Hydronic heating coils and appliances subject to Section C503.4.5 or Section C503.4.6 shall comply with Section C403.3.7.2.

OPTION 1 for Section C503.5:

C503.5 Service ((~~hot~~)) water heating systems. All new service ((~~hot~~)) water heating systems ((~~that are part of the alteration~~)), equipment and components of existing systems that are altered or replaced shall comply with Sections C404, C408.3, C409.5 and C501.6. Additions or alterations shall not be made to an existing service water heating system that will cause the existing system to become out of compliance.

OPTION 2 for Section C503.5:

C503.5 Service ((~~hot~~)) water ((~~systems~~)) heating equipment. New service ((~~hot~~)) water ((~~systems that are part of the alteration~~)) heating equipment shall comply with Section C404.

EXCEPTIONS:
1. Replacement of a single electric resistance or fuel-fired service water heating appliance with a unit that is the same type and has the same or higher efficiency and the same or lower capacity, provided there are no other alterations made to the existing service water heating system size or configuration.
2. Replacement of any of the following water heater appliances:
2.1. Electric water heaters with an input of 12 kW or less.
2.2. Gas storage water heaters with an input of 75,000 Btu/h or less.
2.3. Gas instantaneous water heaters with an input of 200,000 Btu/h or less and 2 gallons or less of storage.
3. Where it has been determined by the code official that existing building constraints including, but not limited to, available floor space or ceiling height, limitations of the existing structure, or electrical service capacity, make compliance technically infeasible.

C503.6 Pools and permanent spas. All new systems and equipment serving pools and permanent spas and components of existing systems that are altered or replaced, shall comply with Sections C404.11, C408.3, C409.5, and C501.6. Additions or alterations shall not be made to an

existing system serving a pool or spa that will cause the existing system to become out of compliance.

((~~C503.6 Lighting, controlled receptacles~~)) C503.7 Electrical power and lighting systems and motors. Alterations or the addition of lighting, ((~~electric~~)) receptacles and motors shall comply with Sections ((~~C503.6.1 through C503.6.6~~)) C503.7.1 through C503.7.7. Additions or alterations shall not be made to an existing lighting or electrical system that will cause the existing system to become out of compliance.

((~~C503.6.1~~)) C503.7.1 New lighting systems and controls. All new interior and exterior lighting systems within an existing building site shall be provided with lighting controls in accordance with Section C405.2 and shall comply with C408.4, C409.5, and C501.6.

C503.7.2 Luminaire additions and alterations. Alterations that add or replace ((~~50~~)) 20 percent or more of the luminaires in a space enclosed by walls or ceiling-height partitions, replace ((~~50~~)) 20 percent or more of parking garage luminaires, or replace ((~~50~~)) 20 percent or more of the total installed wattage of exterior luminaires shall comply with Sections C405.4 and C405.5. Exterior power allowance shall be determined using the specific area allowances for the areas altered and shall not include the base site allowance. Where less than ((~~50~~)) 20 percent of the fixtures in an interior space enclosed by walls or ceiling-height partitions or in a parking garage are added or replaced, or less than ((~~50~~)) 20 percent of the installed exterior wattage is replaced, the installed lighting wattage shall be maintained or reduced.

((~~C503.6.2~~)) C503.7.3 Rewiring and recircuiting. Where new wiring is being installed to serve added fixtures and/or fixtures are being relocated to a new circuit, lighting controls shall comply with all applicable requirements in accordance with Sections C405.2.1, C405.2.3, C405.2.4, C405.2.5, C405.2.6, ((~~and as applicable C408.3. New lighting control devices shall comply with the requirements of Section C405.2~~)) C405.2.7, C405.2.8, C408.4, and C501.6.

((~~C503.6.3~~)) C503.7.4 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, lighting controls shall also comply with, in addition to the requirements of Section ((~~C503.6.2~~)) C503.7.3, all remaining requirements in Sections C405.2 ((~~and C408.3~~)), C408.4, and C501.6.

((~~C503.6.4~~)) C503.7.5 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 lighting controls that comply with all applicable requirements in accordance with Sections C405.2.1, C405.2.2, C405.2.3, C405.2.4, C405.2.5 ((~~and C408.3~~)), C405.2.6, C408.4 and C501.6.

((~~C503.6.5~~)) C503.7.6 Motors. ((~~Those motors which~~)) Motors that are altered or replaced shall comply with Section C405.8.

((~~C503.6.6~~)) C503.7.7 Controlled receptacles. Where electric receptacles are added or replaced, controlled receptacles shall be provided in accordance with Section C405.10 and shall comply with Sections C408.4 and C501.6.

EXCEPTIONS: 1. Where an alteration project impacts an area smaller than 5,000 square feet, controlled receptacles are not required.

2. Where existing systems furniture or partial-height relocatable office cubical 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 the exception to Section C405.10, they are not required to be controlled receptacles or be located within 12 inches of noncontrolled receptacles.

((~~C503.7~~)) C503.8 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.~~)) Components of existing refrigeration systems that are altered or replaced shall comply with Sections C408.7, C410 and C501.6. Additions or alterations shall not be made to an existing refrigeration system that will cause the existing system to become out of compliance. All new refrigerated spaces and refrigeration systems and equipment in existing buildings, including new refrigerated display cases, shall comply with Sections C408.7, C409.5, C410 and C501.6.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-50500 Section C505—Change of space conditioning, occupancy or use.

C505.1 General. Buildings or spaces undergoing a change in space conditioning alteration shall comply with Sections C505.2 and C505.4. Buildings or spaces undergoing a change in occupancy alterations shall comply with Sections C505.3 and C505.4. Spaces changing from one use type to another shall comply with Section C505.5.

Buildings or spaces undergoing a change in space conditioning, change in occupancy or use shall conform to the provisions of this code without requiring the unaltered portion of the existing building to comply with this code. Alterations shall be such that the existing building or structure is no less conforming to the provisions of this code than the existing building or structure was prior to the alteration.

A change in space conditioning alteration shall be deemed to comply with this code if the alteration area alone complies or if the alteration area is combined with all other spaces within the existing building that are of the same space conditioning category according to Section C505.2 to demonstrate compliance. A change in occupancy alteration shall be deemed to comply with this code if the alteration area alone complies or if the existing building and the alteration area are combined to demonstrate complete for the whole building. This allowance applies to prescriptive compliance in accordance with Section C505.4 or total building performance in accordance with Section C407.

Buildings or spaces that were permitted prior to the 2009 Washington state energy code, or were originally permitted as unconditioned, may comply with this section as follows:

1. Where the component performance alternative in Section C402.1.5 is used to demonstrate compliance with this section, the Proposed Total UA is allowed to be up to 110 percent of the Allowable To-

tal UA. This exception may be applied to the project area alone, or to the existing building and project area combined as a whole building.

2. Where total building performance in accordance with Section C407 is used to demonstrate compliance with this section, the total annual carbon emissions from energy consumption of the proposed design is allowed to be up to 110 percent of the annual carbon emissions from energy consumption allowed by Section C407.3. This exception may be applied to the project area alone, or to the existing building and project area combined as a whole building.

C505.1.1 Additional energy efficiency credits. Buildings or spaces that are required to comply with Sections C505.2 or C505.3 shall also comply with Section C502.1.1 in the same manner as an addition.

C505.1.2 Renewable energy. Buildings or spaces that are required to comply with Section C505.2 or C505.3 shall also comply with Section C502.1.2 in the same manner as an addition.

C505.2 Change in space conditioning. Spaces undergoing a change in space conditioning alteration shall be brought up to full compliance with this code for all disciplines in the following cases:

1. Any low energy space in accordance with Section C402.1.1.1 that is altered to become *conditioned space* or *semi-heated* space shall be brought into full compliance with this code.

2. Any semi-heated space in accordance with Section C402.1.1.2 that is altered to become conditioned space shall be brought into full compliance with this code.

For buildings with more than one space conditioning category, the interior partition walls, ceilings, floors and fenestration that separate space conditioning areas shall comply with the thermal envelope requirements per the area with the highest level of space conditioning.

C505.3 Change in occupancy. Spaces undergoing a change in occupancy alteration shall be brought up to full compliance with this code for all disciplines in the following cases:

1. Any space that is converted from ((~~an~~)) a Group F, S or U occupancy to an occupancy other than Group 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.

((~~A change in occupancy project shall be deemed to comply with this code if the project area alone complies or if the existing building and the project area combined comply with this code as a whole building.~~

~~EXCEPTION: Buildings or spaces that were permitted prior to the 2009 WSEC may comply with this section as follows:~~
~~1. Where the component performance alternative in Section C402.1.5 is used to demonstrate compliance with this section, the Proposed Total UA is allowed to be up to 110 percent of the Allowable Total UA. This exception may be applied to the project area alone, or to the existing building and project area combined as a whole building.~~
~~2. Where total building performance in Section C407 is used to demonstrate compliance with this section, the total annual carbon emissions from energy consumption of the proposed design is allowed to be 110 percent of the annual carbon emissions from energy consumption allowed by Section C407.3. This exception may be applied to the project area alone, or to the existing building and project area combined as a whole building.~~))

C505.4 Prescriptive compliance. Change in space conditioning and change in occupancy alterations shall comply with Sections C505.4.1 through C505.4.6.

C505.4.1 Vertical fenestration. A change in space conditioning alteration with vertical fenestration shall comply with the following:

1. Where the vertical fenestration area of the alteration combined with the vertical fenestration area of all equivalent space conditioning areas in the existing building results in a total vertical fenestration area that is less than or equal to the maximum allowed by Section C402.4.1, the alteration shall comply with Section C402.4.

2. Where the vertical fenestration area of the alteration combined with the vertical fenestration area of all equivalent space conditioning areas in the existing building results in a total vertical fenestration area that is greater than the maximum allowed by Section C402.4.1, the alteration shall comply with one of the following:

2.1. Component performance alternative with target area adjustment in accordance with Section C402.1.5 for the alteration area of the building only.

2.2. Alteration area is combined with all equivalent space conditioning areas to demonstrate compliance with the component performance alternative.

2.3. Total building performance in accordance with Section C407 for the alteration area of the building only.

2.4. Alteration area is combined with all equivalent space conditioning areas to demonstrate total building performance compliance.

C505.4.1.2 Skylights. A change in space conditioning alteration with skylights shall comply with the following:

1. Where the skylight area of the alteration combined with the skylight area of all equivalent space conditioning areas in the existing building results in a total skylight area that is less than or equal to the maximum allowed by Section C402.4.1, the alteration shall comply with Section C402.4.

2. Where the skylight area of the alteration combined with the skylight area of all equivalent space conditioning areas in the existing building results in a total skylight area that is greater than the maximum allowed by Section C402.4.1, the alteration shall comply with one of the following:

2.1. Component performance alternative with target area adjustment in accordance with Section C402.1.5 for the alteration area of the building only.

2.2. Alteration area is combined with all equivalent space conditioning areas to demonstrate compliance with the component performance alternative.

2.3. Total building performance in accordance with Section C407 for the alteration area of the building only.

2.4. Alteration area is combined with all equivalent space conditioning areas to demonstrate total building performance compliance.

C505.4.2 Building mechanical systems. All new and existing mechanical systems and equipment that serve the new building heating, cooling and ventilation needs of the alteration area shall comply with Sections C403, C408.2, C409.5 and C501.6.

C505.4.3 Service water-heating systems. All new and existing service water-heating systems and equipment that serve the new service water-heating needs of the alteration area shall comply with Sections C404, C408.3, C409.5 and C501.6.

C505.4.4 Pools and permanent spas. All new and existing systems and equipment serving pools and permanent spas that are included in the alteration shall comply with Sections C404.11, C408.3, C409.5 and C501.6.

C505.4.5 Electrical power and lighting systems and motors. All new and existing electrical power and lighting systems and motors that are included in the alteration shall comply with Sections C405, C408.4, C409.5 and C501.6.

C505.4.6 Refrigeration systems. All new and existing refrigerated spaces and refrigeration systems and equipment that serve the new refrigeration needs of the alteration area shall comply with Sections C410, C408.7, C409.5 and C501.6.

C505.5 Change of 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 in the space shall comply with Section C405.4 and the ventilation air flow provided to the space shall be in accordance with Chapter 4 of the *International Mechanical Code*.

NEW SECTION

WAC 51-11C-50600 Section C506—Metering for existing buildings.

C506.1 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 subject to the requirements of this section, in accordance with the requirements of Sections C409.2 and C409.3.

AMENDATORY SECTION (Amending WSR 13-04-056, filed 2/1/13, effective 7/1/13)

WAC 51-11C-60000 ((~~Appendix A—Default heat loss coefficients.~~)) Reserved.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-600000 Chapter 6 [CE]—Referenced standards. This chapter lists the standards that are referenced in various sections of this document. The standards are listed herein by the promulgating agency of the standard, the standard identification, the effective date and title, and the section or sections of this document that ref-

erence the standard. The application of the referenced standards shall be as specified in Section C106.

AAMA	American Architectural Manufacturers Association 1827 Walden Office Square Suite 550 Schaumburg, IL 60173-4268		
Standard reference number	Title		Referenced in code section number
AAMA/WDMA/CSA 101/I.S.2/A C440—17	North American Fenestration Standard/ Specifications for Windows, Doors and Unit Skylights	. . . . .	Table C402.4.1.1.2
AHAM	Association of Home Appliance Manufacturers 1111 19th Street, N.W., Suite 402 Washington, D.C. 20036		
Standard reference number	Title		Referenced in code section number
ANSI/AHAM RAC-1—2008	Room Air Conditioners	. . . . .	Table C403.3.2((~~(3)~~)) (4)
AHAM HRF-1—2017	Energy, Performance and Capacity of Household Refrigerators, Refrigerator-Freezers and Freezers	. . . . .	Table C410.1(1)
AHRI	Air Conditioning, Heating, and Refrigeration Institute 4100 North Fairfax Drive, Suite 200 Arlington, VA 22203		
Standard reference number	Title		Referenced in code section number
ISO/AHRI/ASHRAE 5801—2017	Fans - Performance Testing Using Standardized Airways	. . . . .	C403.8.1.1
ISO/AHRI/ASHRAE 13256-1 (2017)	Water-source Heat Pumps - Testing and Rating for Performance - Part 1: Water-to-air and Brine-to-air Heat Pumps	. . . . .	Table C403.3.2((~~(2)~~)) (14)
ISO/AHRI/ASHRAE 13256-2 (2017)	Water-source Heat Pumps - Testing and Rating for Performance - Part 2: Water-to-water and Brine-to-water Heat Pumps	. . . . .	Table C403.3.2((~~(2)~~)) (14)
210/240—((~~2016~~)) 2017 and 2023	Performance Rating of Unitary Air Conditioning and Air-source Heat Pump Equipment	. . . . .	Table C403.3.2(1), Table C403.3.2(2)
310/380—((~~2014~~)) 2017	Standard for Packaged Terminal Air Conditioners and Heat Pumps	. . . . .	Table C403.3.2((~~(3)~~)) (4)
340/360—((~~2015~~)) 2018	Commercial and Industrial Unitary Air-conditioning and Heat Pump Equipment	. . . . .	Table C403.3.2(1), Table C403.3.2(2)
365—2009	Commercial and Industrial Unitary Air-conditioning Condensing Units	. . . . .	Table C403.3.2(1)((~~, Table C403.3.2(6)~~))
390—2015	Performance Rating of Single Package Vertical Air Conditioners and Heat Pumps	. . . . .	Table C403.3.2((~~(3)~~)) (4)
400—2015	Liquid to Liquid Heat Exchangers with Addendum 2	. . . . .	((~~Table~~)) C403.3.2((~~(9)~~))
430—2020	Performance Rating of Central Station Air-Handling Unit Supply Fans	. . . . .	C403.8.1.1
440—((~~08~~)) 19	Room Fan Coil	. . . . .	C403.8.1.1, C403.10.3

460—05	Performance Rating Remote Mechanical Draft Air-cooled Refrigerant Condensers	. . . . .	Table C403.3.2((~~(8)~~)) (7)
550/590—((~~2015~~)) 2018	Water Chilling Packages Using the Vapor Compression Cycle—with Addenda	. . . . .	((~~C403.3.2.1~~)) C403.3.2.3, Table C403.3.2((~~(7)~~)) (3), Table C403.3.2(15)
560—((~~00~~)) 2018	Absorption Water Chilling and Water-heating Packages	. . . . .	Table C403.3.2((~~(7)~~)) (3)
910—2014	Performance Rating of Indoor Pool Dehumidifiers	. . . . .	Table C403.3.2(11)
920—2015	Performance Rating of DX-Dedicated Outdoor Air System Units	. . . . .	C202, Table C403.3.2((~~(11)~~)) (12), Table C403.3.2((~~(12)~~)) (13)
1160—2014	Performance Rating of Heat Pump Pool Heaters	. . . . .	Table C404.2, C404.11.1
1200—2013	Performance Rating of Commercial Refrigerated Display Merchandisers and Storage Cabinets	. . . . .	C410.1,Table C410.1(1), Table C410.1(2)
1230—2014	Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment (with Addendum 1)	. . . . .	Table C403.3.2(9)
1250—2014	Standard for Performance Rating in Walk-in Coolers and Freezers	. . . . .	Table C410.2.1(3)
AMCA	Air Movement and Control Association International 30 West University Drive Arlington Heights, IL 60004-1806		
Standard reference number	Title		Referenced in code section number
205—12	Energy Efficiency Classification for Fans	. . . . .	C403.8.3
208—2018	Calculation of the Fan Energy Index	. . . . .	C403.8.1.1, C403.8.3
210—2016	Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating	. . . . .	C403.8.1.1
220—((~~8 (2012)~~)) 19	Laboratory Methods for Testing Air Curtain Units for Aerodynamic Performance Rating	. . . . .	C402.5.7
230—15	Laboratory Methods of Testing Air Circulating Fans for Rating and Certification	. . . . .	C403.9
500D—((~~12~~)) 18	Laboratory Methods for Testing Dampers for Rating	. . . . .	C402.4.5.1, C402.4.5.2
ANSI	American National Standards Institute 25 West 43rd Street Fourth Floor New York, NY 10036		
Standard reference number	Title		Referenced in code section number
ANSI/AMCA 208-2018	Calculation of the Fan Energy Index	. . . . .	C403.8.1.1
ANSI/AMCA 210-16/ ASHRAE 51-16	Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating	. . . . .	C403.8.1.1
ANSI/ASME A17.1—2010	Safety code for elevators and escalators	. . . . .	C405.12.1
ANSI/CTA 2045-A—2018	Modular Communications Interface for Energy Management	. . . . .	C404.14
ANSI/CTA 2045-B—2021	Modular Communications Interface for Energy Management	. . . . .	C404.14

Z21.10.3/CSA 4.3—((~~11~~)) 17	Gas Water Heaters, Volume III—Storage Water Heaters with Input Ratings Above 75,000 Btu per Hour, Circulating Tank and Instantaneous	.....	Table C404.2
Z21.47/CSA 2.3—((~~12~~)) 16	Gas-fired Central Furnaces	.....	Table C403.3.2((~~(4)~~)) (5)
Z83.8/CSA 2.6—((~~09~~)) 16	Gas Unit Heaters, Gas Packaged Heaters, Gas Utility Heaters and Gas-fired Duct Furnaces	.....	Table C403.3.2((~~(4)~~)) (5)
APSP	The Association of Pool and Spa Professionals 2111 Eisenhower Avenue Alexandria, VA 22314		
Standard reference number	Title		Referenced in code section number
14—((~~2014~~)) 2019	American National Standards for Portable Electric Spa Efficiency	.....	C404.12
ASABE	American Society of Agricultural and Biological Engineers 2950 Niles Road St. Joseph, MI 49085		
Standard reference number	Title		Referenced in code section number
S640—2017	Quantities and Units of Electromagnetic Radiation for Plants (Photosynthetic Organisms)	.....	C405.3
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. 1791 Tullie Circle, N.E. Atlanta, GA 30329-2305		
Standard reference number	Title		Referenced in code section number
ANSI/ASHRAE/ACCA Standard 127-2007	Method of Testing for Rating Computer and Data Processing Room Unitary Air Conditioners	.....	((~~Table C403.3.2(9)~~)) C403.5
Standard 183—((~~2007~~)) RA2017	Peak Cooling and Heating Load Calculations in Buildings, Except Low-rise Residential Buildings	.....	C403.1.2
ASHRAE—((~~2016~~)) 2020	ASHRAE HVAC Systems and Equipment Handbook—((~~2016~~)) 2020	.....	C403.1.2
ISO/AHRI/ASHRAE 13256-1 (((~~2011~~)) 2012)	Water-source Heat Pumps—Testing and Rating for Performance—Part 1: Water-to-air and Brine-to-air Heat Pumps	.....	Table C403.3.2((~~(2)~~)) (14)
ISO/AHRI/ASHRAE 13256-2 (((~~2011~~)) 2012)	Water-source Heat Pumps—Testing and Rating for Performance—Part 2: Water-to-water and Brine-to-water Heat Pumps	.....	Table C403.3.2((~~(2)~~)) (14)
90.1—((~~2016~~)) 2019	Energy Standard for Buildings Except Low-rise Residential Buildings (ANSI/ASHRAE/IESNA 90.1—((~~2010~~)) 2019)(with addendum af)	.....	Table C402.1.3, Table C402.1.4, C406.2
90.4—((~~2016~~)) 2019	Energy Standard for Data Centers (with Addenda a, b, d, e)	.....	C403.1.3
146—2011	Testing and Rating Pool Heaters	.....	Table C404.2
ASME	American Society of Mechanical Engineers		

	Two Park Avenue New York, NY 10016-5990		
Standard reference number	Title		Referenced in code section number
ASME A17.1/CSA B44—((~~2016~~)) 2019	Safety Code for Elevators and Escalators	. . . . .	C405.9.2
BPVC Section IV-2021	Boiler and Pressure Vessel Code, Section IV—Rules for Construction of Heating Boilers	. . . . .	C404.14
BPVC Section X-2021	Boiler and Pressure Vessel Code, Section X—Fiber-Reinforced Plastic Pressure Vessels	. . . . .	C404.14
ASTM	ASTM International 100 Barr Harbor Drive West Conshohocken, PA 19428-2859		
Standard reference number	Title		Referenced in code section number
C 90—((~~14~~)) 206A	Specification for Load-bearing Concrete Masonry Units	. . . . .	Table C402.1.3
C518—17	Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus	. . . . .	Table C403.10.1.1
C1363—11	Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus	. . . . .	C303.1.4.1, Table C402.1.4
C1363—11	Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus	. . . . .	C303.1.4.1, Table C402.1.4, C402.2.7
C 1371—15	Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers	. . . . .	Table C402.4
C 1549—09	Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using A Portable Solar Reflectometer	. . . . .	Table C402.4
D 1003—13	Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics	. . . . .	C402.4.2.2
E 283—04 (2012)	Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen	. . . . .	C402.5.8
E 408—13	Test Methods for Total Normal Emittance of Surfaces Using Inspection-meter Techniques	. . . . .	Table ((~~C402.4~~)) C402.3
E 779—((~~10~~)) 2018	Standard Test Method for Determining Air Leakage Rate by Fan Pressurization	. . . . .	C402.5.1.2.3
E 903—12	Standard Test Method Solar Absorptance, Reflectance and Transmittance of Materials Using Integrating Spheres (Withdrawn 2005)	. . . . .	Table C402.4
E 1677—11	Standard Specification for an Air-retarder (AR) Material or System for Low-rise Framed Building Walls	. . . . .	C402.5.1.2.2
E 1827—2011(2017)	Standard Test Methods for Determining Airtightness of Building Using an Orifice Blower Door	. . . . .	C402.5.2, C402.5.3

E 1918—06 (2015)	Standard Test Method for Measuring Solar Reflectance of Horizontal or Low-sloped Surfaces in the Field	. . . . .	Table C402.4
E 1980—11	Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-sloped Opaque Surfaces	. . . . .	Table C402.2.1.1
E 2178—13	Standard Test Method for Air Permanence of Building Materials	. . . . .	C402.4
E 2357—11	Standard Test Method for Determining Air Leakage of Air Barrier Assemblies	. . . . .	C402.5.1.2.2
F 1281—2017	Specification for Cross-linked Polyethylene/ Aluminum/Cross-linked Polyethylene (PEX-AL_PEX) Pressure Pipe	. . . . .	Table C404.5.2.1
CSA	Canadian Standards Association 5060 Spectrum Way Mississauga, Ontario, Canada L4W 5N6		
Standard reference number	Title		Referenced in code section number
AAMA/WDMA/CSA 101/I.S.2/A440—11	North American Fenestration Standard/ Specification for Windows, Doors and Unit Skylights	. . . . .	Table C402.4.2
CSA B55.1—2015	Test Method for Measuring Efficiency and Pressure Loss of DWHR Units	. . . . .	C404.10
CSA B55.2—2015	Drain Water Heat Recovery Units	. . . . .	C404.10
CTA	Consumer Technology Association 1919 S Eads Street Arlington, VA 22202		
Standard reference number	Title		Referenced in code section number
ANSI/CTA 2045-A—2018	Modular Communications Interface for Energy Management	. . . . .	C404.14
ANSI/CTA 2045-B—2021	Modular Communications Interface for Energy Management	. . . . .	C404.14
CTI	Cooling Technology Institute 2611 FM 1960 West, Suite A-101 Houston, TX 77068		
Standard reference number	Title		Referenced in code section number
ATC 105 (((~~00~~)))—2019	Acceptance Test Code for Water Cooling Tower	. . . . .	Table C403.3.2(((~~8~~))) (7)
ATC 105DS—2018	Acceptance Test Code for Dry Fluid Coolers	. . . . .	Table C403.3.2(7)
ATC 105S—11	Acceptance Test Code for Closed Circuit Cooling Towers	. . . . .	Table C403.3.2(((~~8~~))) (7)
ATC 106—11	Acceptance Test Code for Mechanical Draft Evaporative Vapor Condensers	. . . . .	Table C403.3.2(((~~8~~))) (7)
STD 201—((~~11~~)) 17	Standard for Certification of Water Cooling Towers Thermal Performances	. . . . .	Table C403.3.2(((~~8~~))) (7)
DASMA	Door and Access Systems Manufacturers Association 1300 Sumner Avenue Cleveland, OH 44115-2851		
Standard reference number	Title		Referenced in code section number

105—((~~92 (R2004)—13~~)) 17	Test Method for Thermal Transmittance and Air Infiltration of Garage Doors	. . . . .	Table C402.4.2
DOE	U.S. Department of Energy c/o Superintendent of Documents U.S. Government Printing Office Washington, D.C. 20402-9325		
Standard reference number	Title		Referenced in code section number
10 C.F.R., Part 430—2015	Energy Conservation Program for Consumer Products: Test Procedures and Certification and Enforcement Requirement for Plumbing Products; and Certification and Enforcement Requirements for Residential Appliances; Final Rule	. . . . .	Table C403.3.2((~~(4)~~)) (1), Table C403.3.2((~~(5)~~)) (2), Table C403.3.2(5), Table C403.3.2(6), Table C403.3.2(14), Table C404.2
((~~10 C.F.R., Part 430, Subpart B, Appendix N—2015~~	~~Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers~~	~~. . . . . .~~	~~C202~~))
10 C.F.R., Part 431—2015	Energy Efficiency Program for Certain Commercial and Industrial Equipment: Test Procedures and Efficiency Standards; Final Rules	. . . . .	Table C403.3.2((~~(5)~~)) (6), C403.8.4, C403.11, Table ((~~C406.2(5)~~)) C403.11, C403.11.2, C405.7, Table C405.7, C405.8, Table C405.8(1), Table C405.8(2), Table C405.8(3)
((~~NAECA 87—(88)~~	~~National Appliance Energy Conservation Act 1987 [(Public Law 100-12 (with Amendments of 1988-P.L. 100-357)]~~	~~. . . . . .~~	~~Tables C403.3.2 (1), (2), (4)~~))
HVI	Home Ventilating Institute 1740 Dell Range Blvd., Ste. H, PMB 450 Cheyenne, WY 82009		
Standard reference number	Title		Referenced in code section number
920—2020	Product Performance Certification Procedure Including Verification and Challenge	. . . . .	C403.3.5.1, C403.3.6
IAPMO	International Association of Plumbing and Mechanical Officials 4755 E. Philadelphia Street Ontario, CA 91761		
Standard reference number	Title		Referenced in code section number
UPC—((~~2015~~)) 2021	Uniform Plumbing Code	. . . . .	C201.3, ((~~C501.4~~)) C501.2
ICC	International Code Council, Inc. 500 New Jersey Avenue, N.W., 6th Floor Washington, D.C. 20001		
Standard reference number	Title		Referenced in code section number
IBC—((~~15~~)) 21	International Building Code	. . . . .	C201.3, C303.2, C402.4.3, C501.2
ICC 500—2020	Standard for the Design and Construction of Storm Shelters	. . . . .	C402.4.2
IFC—((~~15~~)) 21	International Fire Code	. . . . .	C201.3, ((~~C501.4~~)) C501.2

IFGC—((~~15~~)) 21	International Fuel Gas Code	. . . . .	C201.3, ((~~C501.4~~)) C501.2
IMC—((~~15~~)) 21	International Mechanical Code	. . . . .	C106.3, C201.3, C402.5.3, C403.2.2.1, C403.2.2.2, C403.3.5, C403.3.5.1, C403.6.1, C403.6.5, C403.6.10, C403.7.1, C403.7.2, C403.7.5, C403.7.5.1, C403.7.6, C403.7.7.3, C403.7.8.1, C403.7.8.4, C403.8.4, C403.8.5.1, Table C403.10.1, C403.10.1.2, Table C403.10.1.2, C403.10.2.2, C403.12, C406.6, C408.2.2.1, ((~~C501.4~~)) C501.2
IEEE	The Institute of Electrical and Electronic Engineers, Inc. 3 Park Avenue New York, NY 10016		
Standard reference number	Title		Referenced in code section number
IEEE 515.1—2012	IEEE Standard for the Testing, Design, Installation and Maintenance of Electrical Resistance Trace Heating for Commercial Applications	. . . . .	C404.6.2
((~~IESNA~~)) IES	Illuminating Engineering Society ((~~of North America~~)) 120 Wall Street, 17th Floor New York, NY 10005-4001		
Standard reference number	Title		Referenced in code section number
ANSI/ASHRAE/IESNA 90.1—((~~2016~~)) 2019	Energy Standard for Buildings Except Low-rise Residential Buildings	. . . . .	Table C402.1.3, Table C402.1.4, Table C407.5.1
ISO	International Organization for Standardization 1, rue de Varembe, Case postale 56, CH-1211 Geneva, Switzerland		
Standard reference number	Title		Referenced in code section number
ISO/AHRI/ASHRAE 13256-1 (2017)	Water-Source Heat Pumps—Testing and Rating for Performance—Part 1: Water-to-air and Brine-to-air Heat Pumps	. . . . .	C403.3.2(((~~2~~))) (14)
ISO/AHRI/ASHRAE 13256-2 (2017)	Water-Source Heat Pumps—Testing and Rating for Performance—Part 2: Water-to-water and Brine-to-water Heat Pumps	. . . . .	C403.3.2(((~~2~~))) (14)
25745-2:2015	Energy Performance of Lifts, Escalators and Moving Walks—Part 2: Energy Calculation and Classification for Lifts (Elevators)	. . . . .	C406.2.14
NEEA	Northwest Energy Efficiency Alliance 421 SW 6th Ave. Suite 600 Portland, OR 97204		
Standard reference number	Title		Referenced in code section number
AWHS Vers. 8.0—2022	Advanced Water Heating Specification	. . . . .	C404.2.1
NEMA	National Electric Manufacturers Association		

	1300 North 17th Street Suite 1752 Rosslyn, VA 22209		
Standard reference number	Title		Referenced in code section number
((~~TP-1-2002~~	~~Guide for Determining Energy Efficiency for Distribution Transformers~~	~~. . . . . .~~	~~C405.9~~))
ANSI/NEMA WD 6-2016	Wiring Devices—Dimensional Specifications	. . . . .	C405.12
MGI—((~~2014~~)) 2016	Motors and Generators	. . . . .	C202
TP-1-2002	Guide for Determining Energy Efficiency for Distribution Transformers	. . . . .	C405.9
NFRC	National Fenestration Rating Council, Inc. 6305 Ivy Lane, Suite 140 Greenbelt, MD 20770		
Standard reference number	Title		Referenced in code section number
100—((~~2017~~)) 2020	Procedure for Determining Fenestration Product U-factors	. . . . .	C303.1.2, C402.2.2
200—((~~2017~~)) 2020	Procedure for Determining Fenestration Product Solar Heat Gain Coefficients and Visible Transmittance at Normal Incidence	. . . . .	C303.1.3, C402.4.1.1
202—2017	Procedure for Determining Fenestration Product Visible Transmittance at Normal Incidence	. . . . .	C202
NFRC 203—2017	Procedure for Determining Visible Transmittance of Tubular Daylighting Devices	. . . . .	C202, C402.4.2
400—2017	Procedure for Determining Fenestration Product Air Leakage	. . . . .	Table C402.4.2
SMACNA	Sheet Metal and Air Conditioning Contractors National Association, Inc. 4021 Lafayette Center Drive Chantilly, VA 20151-1209		
Standard reference number	Title		Referenced in code section number
SMACNA—2012	HVAC Air Duct Leakage Test Manual	. . . . .	C403.10.2.3
UL	Underwriters Laboratories 333 Pfingsten Road Northbrook, IL 60062-2096		
Standard reference number	Title		Referenced in code section number
710—12	Exhaust Hoods for Commercial Cooking Equipment	. . . . .	C403.7.5
727—((~~06~~)) 18	Oil-fired Central Furnaces—with Revisions through April 2010	. . . . .	Table C403.3.2(4), Table C403.3.2(5)
731—((~~95~~)) 18	Oil-fired Unit Heaters—with Revisions through April 2010	. . . . .	Table C403.3.2((~~(4)~~)) (5)
US-FTC	United States-Federal Trade Commission 600 Pennsylvania Avenue N.W. Washington, D.C. 20580		
Standard reference number	Title		Referenced in code section number
C.F.R. Title 16 (2015)	R-value Rule	. . . . .	C303.1.4

WDMA	Window and Door Manufacturers Association 1400 East Touhy Avenue, Suite 470 Des Plaines, IL 60018		
Standard reference number	Title		Referenced in code section number
AAMA/WDMA/CSA 101/I.S.2/A440—17	North American Fenestration Standard/ Specification for Windows, Doors and Unit Skylights	.....	Table C402.4.2

NEW SECTION

WAC 51-11C-61000 Appendix A—Default heat loss coefficients.

AMENDATORY SECTION (Amending WSR 20-21-080, filed 10/19/20, effective 2/1/21)

WAC 51-11C-80500 Appendix D—Calculation of HVAC total system performance ratio.

D101 Scope. This appendix establishes criteria for demonstrating compliance using the *HVAC total system performance ratio (HVAC TSPR)* for systems serving office (including medical offices), retail, library and education occupancies and buildings, which are subject to the requirements of Section C403.3.5 without exceptions, and *dwelling units* and common areas within multifamily buildings. Those HVAC systems shall comply with Section C403 and this appendix as required by Section C403.1.1.

D101.1 Core and Shell/Initial Build-Out, and Future System Construction Analysis.

Where the *building* permit applies to only a portion of the *HVAC system* in a *building* and the remaining components will be designed under a future *building* permit or were previously installed, the future or previously installed components shall be modeled as follows:

1. Where the HVAC zones that do not include HVAC systems in the current permit will be or are served by independent systems, then the block including those zones shall not be included in the model.

2. Where the HVAC zones that do not include complete HVAC systems in the permit are intended to receive HVAC services from systems in the permit, their proposed zonal systems shall be modeled with equipment that meets, but does not exceed, the requirements of Section C403.

3. Where the zone equipment in the permit receives HVAC services from previously installed systems that are not in the permit, the previously installed systems shall be modeled with equipment matching the certified value of what is installed or equipment that meets the requirements of Section C403.

4. Where the central plant heating and cooling equipment is completely replaced and HVAC zones with existing systems receive HVAC

services from systems in the permit, their proposed zonal systems shall be modeled with equipment that meets, but does not exceed, the requirements of Section C403.

Informative Notes: 1. Examples of HVAC systems that are intended to receive HVAC services from systems in the permit include future zonal water source heat pumps that will receive loop water that is heated by a boiler or cooled by a cooling tower included in the permit, any system that will receive outdoor ventilation air from a dedicated outdoor air system included in the permit, and future zone terminal units that will be connected to a central VAV system included in the permit.
2. An initial build-out with heating coils served from a previously installed system with a high-efficiency condensing boiler would use the installed efficiency if it exceeded the current requirements. If the installed boiler had a lower efficiency than the current requirements, the current requirement would be used.
3. A partial central plant upgrade (e.g., chiller, but not boiler replacement) cannot use this method.

D201 Compliance. Compliance based on *HVAC total system performance ratio* requires that the provisions of Section C403.3 are met and the *HVAC total system performance ratio* of the *proposed design* is more than or equal to the *HVAC total system performance ratio* of the *standard reference design*. The *HVAC TSPR* is calculated according to the following formula:

HVAC TSPR = annual heating and cooling load/annual carbon emissions from energy consumption of the building HVAC systems

Where:

Annual carbon emissions from energy consumption of the building HVAC systems	=	sum of the annual carbon emissions in pounds for heating, cooling, fans, energy recovery, pumps, and heat rejection calculated by multiplying site energy consumption by the carbon emission factors from Table C407.1
Annual heating and cooling load	=	sum of the annual heating and cooling loads met by the building HVAC system in thousands of Btus.

Table ((~~C407.1~~)) C407.3(1) (Reprinted from Chapter 4)
Carbon Emissions Factors

Type	CO2e (lb/unit)	Unit
Electricity	((~~0.70~~)) 0.44	kWh
Natural gas	11.70	Therm
Oil	19.2	Gallon
Propane	10.5	Gallon
Other[a]	195.00	mmBtu
On-site renewable energy[b]	0.00	

[a] District energy systems may use alternative emissions factors supported by calculations approved by the *code official*.

[b] Not applicable to TSPR calculation in Appendix D.

D300 Simulation program.

D301 General.

D302 Calculation of the HVAC TSPR for the *Standard Reference Design*. The simulation program shall calculate the HVAC TSPR based only on the input for the *proposed design* and the requirements of this appendix.

The calculation procedure shall not allow the user to directly modify the building component characteristics of the *standard reference design*.

D303 Specific approval. Performance analysis tools meeting the applicable subsections of Appendix D and tested according to ASHRAE Standard 140 shall be permitted to be *approved*. Tools are permitted to be *approved* based on meeting a specified threshold for a jurisdiction. The *code official* shall be permitted to approve tools for a specified application or limited scope.

D400 Climatic data. The simulation program shall perform the simulation using hourly values of climatic data, such as temperature and humidity, using TMY3 data for the site as specified here: https://buildingenergyscore.energy.gov/resources

D500 Documentation. Documentation conforming to the provisions of this section shall be provided to the *code official*.

D501 Compliance report. Building permit submittals shall include:

1. A report produced by the simulation software that includes the following:

1.1 Address of the building.

1.2 Name of individual completing the compliance report.

1.3 Name and version of the compliance software tool.

1.4 The dimensions, floor heights and number of floors for each *block*.

1.5 By block, the *U*-factor, *C*-factor, or *F*-factor for each simulated opaque envelope component and the *U*-factor and SHGC for each fenestration component.

1.6 By *block* or by surface for each block, the fenestration area.

1.7 By *block*, a list of the HVAC equipment simulated in the proposed design including the equipment type, fuel type, equipment efficiencies and system controls.

1.8 Annual site HVAC energy use by end use for the proposed and baseline building.

1.9 Annual sum of heating and cooling loads for the baseline building.

1.10 The *HVAC total system performance ratio* for both the *standard reference design* and the *proposed design*.

2. A mapping of the actual building HVAC component characteristics and those simulated in the *proposed design* showing how individual pieces of HVAC equipment identified above have been combined into average inputs as required by Section ((~~D601.11~~)) D601.10 including:

2.1 Fans.

2.2 Hydronic pumps.

2.3 Air handlers.

2.4 Packaged cooling equipment.

2.5 Furnaces.

2.6 Heat pumps.

2.7 Boilers.

2.8 Chillers.

2.9 Cooling towers.

2.10 Electric resistance coils.

2.11 Condensing units.

2.12 Motors for fans and pumps.

2.13 Energy recovery devices.

For each piece of equipment identified above, include the following as applicable:

2.14 Equipment name or tag consistent with that found on the design documents.

2.15 Rated efficiency level.

2.16 Rated capacity.

2.17 ((~~Input power for fans and pumps.~~)) Electrical input power for fans and pumps (before any speed or frequency control device) at design conditions and calculation of input value (W/cfm or W/gpm).

3. Floor plan of the building identifying how portions of the building are assigned to the simulated *blocks* and areas of the building that are not covered under the requirements of Section C403.1.1.

D600 Calculation procedure. Except as specified by this appendix, the *standard reference design* and *proposed design* shall be configured and analyzed using identical methods and techniques.

D601 Simulation of the proposed building design. The *proposed design* shall be configured and analyzed as specified in this section.

D601.1 ((~~Utility rates.~~ ~~For the purpose of calculating the *HVAC TSPR* the following simple utility rate determined by the Washington state department of commerce shall be used:~~

~~$0.112/kWh of electricity.~~

~~$1.158/therm of fossil fuel.~~

~~**D601.2**~~**)) Block geometry.** The geometry of buildings shall be configured using one or more *blocks*. Each *block* shall define attributes including *block* dimensions, number of floors, floor to floor height and floor to ceiling height. Simulation software may allow the use of simplified shapes (such as rectangle, L shape, H shape, U shape or T shape) to represent *blocks*. Where actual building shape does not match these predefined shapes, simplifications are permitted providing the following requirements are met:

1. The conditioned floor area and volume of each block shall match the *proposed design* within 10 percent.

2. The area of each exterior envelope component from Table C402.1.4 is accounted for within 10 percent of the actual design.

3. The area of vertical fenestration and skylights is accounted for within 10 percent of the actual design.

4. The orientation of each component in 2 and 3 above is accounted for within 45 degrees of the actual design.

The creation of additional *blocks* may be necessary to meet these requirements.

EXCEPTION: Portions of the building that are unconditioned or served by systems not covered by the requirements of Section C403.1.1 shall be omitted.

((~~D601.2.1~~)) D601.1.1 Number of blocks. One or more *blocks* may be required per building based on the following restrictions:

1. Each *block* can have only one occupancy type (multifamily *dwelling unit*, multifamily common area, office, library, education or retail). Therefore, at least one single *block* shall be created for each unique use type.

2. Each *block* can be served by only one type of HVAC system. Therefore, a single *block* shall be created for each unique HVAC system and use type combination. Multiple HVAC units of the same type may be represented in one *block*. ((~~Table~~)) Section D601.10.2 provides directions for combining multiple HVAC units or components of the same type into a single *block*.

3. Each *block* can have a single definition of floor to floor or floor to ceiling heights. Where floor heights differ by more than 2

feet, unique *blocks* should be created for the floors with varying heights.

4. Each *block* can include either above grade or below grade floors. For buildings with both above grade and below grade floors, separate *blocks* should be created for each. For buildings with floors partially above grade and partially below grade, if the total wall area of the floor(s) in consideration is greater than or equal to 50 percent above grade, then it should be simulated as a completely above grade *block*, otherwise it should be simulated as a below grade *block*.

5. Each wall on a façade of a *block* shall have similar vertical fenestration. The product of the *proposed design U*-factor times the area of windows (UA) on each façade of a given floor cannot differ by more than 15 percent of the average UA for that façade in each *block*. The product of the *proposed design SHGC* times the area of windows ((~~(USHGC)~~)) (SHGCA) on each façade of a given floor cannot differ by more than 15 percent of the average ((~~USHGC~~)) SHGCA for that façade in each *block*. If either of these conditions are not met, additional *blocks* shall be created consisting of floors with similar fenestration.

6. For a building model with multiple *blocks*, the *blocks* should be configured together to have the same adjacencies as the actual building design.

((~~D601.3~~)) D601.2 Thermal zoning. Each floor in a *block* shall be modeled as a single thermal zone or as five thermal zones consisting of four perimeter zones and a core zone. Below grade floors shall be modeled as a single thermal *block*. If any façade in the *block* is less than 45 feet in length, there shall only be a single thermal zone per floor. Otherwise each floor shall be modeled with 5 thermal zones. A perimeter zone shall be created extending from each façade to a depth of 15 feet. Where facades intersect, the zone boundary shall be formed by a 45 degree angle with the 2 facades. The remaining area or each floor shall be modeled as a core zone with no exterior walls.

((~~D601.4~~)) D601.3 Occupancy.

((~~D601.4.1~~)) D601.3.1 Occupancy type. The occupancy type for each *block* shall be consistent with the building area type as determined in accordance with Section C405.4.2.1. Portions of the building that are building area types other than multifamily *dwelling unit*, multifamily common area, office, school (education), library, or retail shall not be included in the simulation. Surfaces adjacent to such building portions shall be modeled as adiabatic in the simulation program.

((~~D601.4.2~~)) D601.3.2 Occupancy schedule, density, and heat gain. The occupant density, heat gain, and schedule shall be for multifamily, office, retail, library, or school as specified by ASHRAE Standard 90.1 Normative Appendix C.

((~~D601.5~~)) D601.4 Envelope components.

((~~D601.5.1~~)) D601.4.1 Roofs. Roofs will be modeled with insulation above a steel roof deck. The roof *U*-factor and area shall be modeled as in the proposed design. If different roof thermal properties are present in a single block, an area weighted *U*-factor shall be used. Roof solar absorbtance shall be modeled at 0.70 and emittance at 0.90.

((~~D601.5.2~~)) D601.4.2 Above grade walls. Walls will be modeled as steel frame construction. The *U*-factor and area of above grade walls shall be modeled as in the *proposed design*. If different wall con-

structions exist on the façade of a *block* an area-weighted *U*-factor shall be used.

((~~D601.5.3~~)) D601.4.3 Below grade walls. The *C*-factor and area of below grade walls shall be modeled as in the *proposed design*. If different slab on grade floor constructions exist in a *block*, an area-weighted *C*-factor shall be used.

((~~D601.5.4~~)) D601.4.4 Above grade exterior floors. Exterior floors shall be modeled as steel frame. The *U*-factor and area of floors shall be modeled as in the *proposed design*. If different wall constructions exist in the block an area-weighted *U*-factor shall be used.

((~~D601.5.5~~)) D601.4.5 Slab on grade floors. The *F*-factor and area of slab on grade floors shall be modeled as in the *proposed design*. If different below grade wall constructions exist in a *block*, an area-weighted *F*-factor shall be used.

((~~D601.5.6~~)) D601.4.6 Vertical fenestration. The window area and area weighted *U*-factor and SHGC shall be modeled for each façade based on the *proposed design*. Each exterior surface in a *block* must comply with Section ((~~D601.2.1~~)) D601.1.1 item 5. Windows will be combined in to a single window centered on each façade based on the area and sill height input by the user. When different *U*-factors, SHGC or sill heights exist on a single façade, area weighted average for each shall be input by the user.

((~~D601.5.7~~)) D601.4.7 Skylights. The skylight area and area weighted *U*-factor and SHGC shall be modeled for each floor based the *proposed design*. Skylights will be combined in to a single skylight centered on the roof of each zone based on the area ((~~and sill height~~)) input by the user.

D601.4.8 Exterior shading. Permanent window overhangs shall be modeled. When windows with and without overhangs or windows with different overhang projection factors exist on a façade, window width weighted projection factors shall be input by the user as follows.

$$P_{avg} \equiv \frac{A_1 \times L_{o1} + A_2 \times L_{o2} \ldots A_n \times L_{on}}{L_{w1} + L_{w2} \ldots L_{wn}}$$

Where:

P_{avg} ≡ Average overhang projection modeled in the simulation tool.

A ≡ Distance measured horizontally from the furthest continuous extremity of any overhang, eave or permanently attached shading device to the vertical surface of the glazing.

L_o ≡ Length off the overhang.

L_w ≡ Length of the window.

((~~D601.6~~)) D601.5 Lighting. Interior lighting power density shall be equal to the allowance in Table C405.4.2(1) for multifamily, office, retail, library, or school. The lighting schedule shall be for multifamily, office, retail, library, or school as specified by ASHRAE Standard 90.1 Normative Appendix C. The impact of lighting controls is assumed to be captured by the lighting schedule and no explicit controls shall be modeled. Exterior lighting shall not be modeled.

((~~D601.7~~)) D601.6 Miscellaneous equipment. The miscellaneous equipment schedule and power shall be for multifamily, office, retail, library, or school as specified by ASHRAE Standard 90.1 Normative Appendix C. The impact of miscellaneous equipment controls is assumed to be captured by the equipment schedule and no explicit controls shall be modeled.

EXCEPTIONS:
1. Multifamily *dwelling units* shall have a miscellaneous load density of 0.42 W/ft^2.
2. Multifamily common areas shall have a miscellaneous load density of 0 W/ft^2.

((~~D601.8~~)) D601.7 Elevators. Elevators shall not be modeled.

((~~D601.9~~)) D601.8 Service water heating equipment. Service water heating shall not be modeled.

((~~D601.10~~)) D601.9 On-site renewable energy systems. On-site renewable energy systems shall not be modeled.

((~~D601.11~~)) D601.10 HVAC equipment. HVAC systems shall meet the requirements of Section C403.

((~~D601.11.1~~)) D601.10.1 Supported HVAC systems. At a minimum, the HVAC systems shown in Table ((~~D601.11.1~~)) D601.10.1 shall be supported by the simulation program.

Table ((~~D601.11.1~~)) D601.10.1
Proposed Building HVAC Systems Supported by HVAC TSPR Simulation Software

System No.	System Name	System Abbreviation
1	Packaged Terminal Air Conditioner	PTAC
2	Packaged Terminal Air Heat Pump	PTHP
3	Packaged Single Zone Gas Furnace	PSZGF
4	Packaged Single Zone Heat Pump (air to air only)	PSZHP
5	Variable Refrigerant Flow (air cooled only)	VRF
6	Four Pipe Fan Coil	FPFC
7	Water Source Heat Pump	WSHP
8	Ground Source Heat Pump	GSHP
9	Packaged Variable Air Volume (dx cooling)	PVAV
10	Variable Air Volume (hydronic cooling)	VAV
11	Variable Air Volume with Fan Powered Terminal Units	VAVFPTU
12	Dedicated Outdoor Air System (in conjunction with systems 1-8)	DOAS

((~~D601.11.2~~)) D601.10.2 Proposed building HVAC system simulation. The HVAC systems shall be modeled as in the *proposed design* with clarifications and simplifications as described in Table ((~~D601.11.2~~)) D601.10.2. System parameters not described in the following sections shall be simulated to meet the minimum requirements of Section C403.

All zones within a *block* shall be served by the same HVAC system type as described in Section ((~~D601.2.1~~)) D601.1.1 item 2. Where multiple system components serve a block, average values weighed by the appropriate metric as described in this section shall be used. Heat loss from ducts and pipes shall not be modeled.

((~~EXCEPTION: Where the building permit applies to only a portion of an HVAC system and remaining components will be designed under a future building permit, the future components shall be modeled to meet, but not exceed, the requirements of Section C403.~~))

1. Where multiple fan systems serve a single block, fan power shall be based on weighted average using the design supply air cfm.

2. Where multiple cooling systems serve a single block, COP shall be based on a weighted average using cooling capacity. DX coils shall be entered as multi-stage if more than 50% of coil capacity serving the block is multi-stage with staged controls.

3. Where multiple heating systems serve a single block, thermal efficiency or heating COP shall be based on a weighted average using heating capacity.

4. Where multiple boilers or chillers serve a heating water or chilled water loop, efficiency shall be based on a weighted average for using heating or cooling capacity.

5. When multiple cooling towers serving a condenser water loop are combined, the cooling tower efficiency, cooling tower design approach and design range are based on a weighted average of the design water flow rate through each cooling tower.

6. Where multiple pumps serve a heating water, chilled water or condenser water loop, pump power shall be based on a weighted average for using design water flow rate.

7. When multiple system types with and without economizers are combined, the economizer maximum outside air fraction of the combined system shall be based on weighted average of 100% supply air for systems with economizers and design outdoor air for systems without economizers.

8. Multiple systems with and without ERVs cannot be combined.

9. Systems with and without supply air temperature reset cannot be combined.

10. Systems with different fan control (constant volume, multi-speed or VAV) for supply fans cannot be combined.

11. Demand Controlled Ventilation (DCV) shall be modeled using a simplified approach that adjusts the design outdoor supply air flow rate based on the area of the building that is covered by DCV.

Table ((~~D601.11.2~~)) D601.10.2
Proposed Building System Parameters

Category	Parameter	Fixed or User Defined	Required	Applicable Systems
HVAC System Type	System Type	User Defined	Selected from Table ((~~D601.11.1~~)) D601.10.1	All
System Sizing	Design Day Information	Fixed	99.6 percent heating design and 1 percent dry-bulb and 1 percent wet-bulb cooling design	All
	Zone Coil Capacity	Fixed	Sizing factors used are 1.25 for heating equipment and 1.15 for cooling equipment	All
	Supply Airflow	Fixed	Based on a supply-air-to-room-air temperature *set-point* difference of 20°F	1-11
		Fixed	Equal to required outdoor air ventilation	12
Outdoor Ventilation Air	Portion of Supply Air with Proposed Filter ≥ MERV 13	User Defined	Percentage of supply air flow subject to higher filtration (Adjusts baseline fan power higher. Prorated)	All

Category	Parameter	Fixed or User Defined	Required	Applicable Systems
	Outdoor Ventilation Air Flow Rate	Fixed	As specified in ASHRAE Standard 90.1 Normative Appendix C, adjusted for proposed DCV control	All
	Outdoor Ventilation Supply Air Flow Rate Adjustments	Fixed	Based on ASHRAE Standard 62.1 Section 6.2.4.3 system ventilation efficiency (E_VS) is 0.75	9-11
		Fixed	System ventilation efficiency (E_VS) is 1.0	1-8, 12
		Fixed	Base is 1.0 zone air distribution effectiveness	All
System Operation	Space Temperature Setpoints	Fixed	As specified in ASHRAE Standard 90.1 Normative Appendix C, except multifamily which shall use 68°F heating and 76°F cooling setpoints	1-11
	Fan Operation - Occupied	User Defined	Runs continuously during occupied hours or cycled to meet load. Multispeed fans reduce airflow related to thermal loads	1-11
	Fan Operation - Occupied	Fixed	Fan runs continuously during occupied hours	12
	Fan Operation - Night Cycle	Fixed	Fan cycles on to meet setback temperatures	1-11
Packaged Equipment Efficiency	DX Cooling Efficiency	User Defined	Cooling COP without fan energy calculated in accordance with ASHRAE Standard 90.1 Section 11.5.2c.[b]	1, 2, 3, 4, 5, 7, 8, 9, 11, 12
	DX Coil Number of Stages	User Defined	Single state or multistage	3, 4, 9
	Heat Pump Efficiency	User Defined	Heating COP without fan energy calculated in accordance with ASHRAE Standard 90.1 Section 11.5.2c.[c]	2, 4, 5, 7, 8
	Furnace Efficiency	User Defined	Furnace thermal efficiency[c]	3, 11
Heat Pump Supplemental Heat	Control	Fixed	Supplemental electric heat locked out above 40°F. Runs in conjunction with compressor between 40°F and 0°F.	2, 4
System Fan Power and Controls	Part-Load Fan Controls	User Defined	Constant volume or two speed	1-8
	Part-Load Fan Controls[a]	User Defined	Constant volume or variable air volume	12
	Part-Load Fan Controls[a]	Fixed	Variable air volume. VFD with static pressure reset.	9-11
	Design Fan Power (W/cfm)	User Defined	Input electric power for all fans is required to operate at *fan system design conditions* divided by the supply airflow rate. This is a "wire to air" value including all drive, motor efficiency and other losses.	All
	((~~Single Zone System Fan Power During Deadband (W/cfm)~~)) Low-Speed Fan Power	User Defined	((~~W/cfm during deadband for VAV or multispeed single zone fans~~)) Low speed input electric power for all fans required to operate at low speed conditions divided by the low speed supply airflow rate. This is a "wire to air" value including all drive, motor efficiency and other losses.	((~~3, 4, 5, 6, 7, 8~~)) 1-8

Category	Parameter	Fixed or User Defined	Required	Applicable Systems
Variable Air Volume Systems	((~~Part Load Fan Controls~~	~~User Defined~~	~~VFD included. User specifies presence of static pressure reset~~	~~9, 10, 11~~))
	Supply Air Temperature (SAT) Controls	User Defined	If not SAT reset, constant at 55°F. ((~~SAT reset results in 60°F SAT during low load conditions~~)) Options for reset based on outdoor air temperature (OAT) or warmest zone. If warmest zone, then the user can specify the minimum and maximum temperatures. If OAT reset, SAT is reset higher to 60°F at outdoor low of 50°F. SAT is 55°F at outdoor high of 70°F.	9, 10, 11
	Minimum Terminal Unit Airflow Percentage	User Defined	Average minimum terminal unit airflow percentage for *block* weighted by cfm	9, 10, 11
	Terminal Unit Heating Source	User Defined	Electric or hydronic	9, 10, 11
	Dual Set Point Minimum VAV Damper Position	User Defined	Heating maximum airflow fractions	9, 10
	Fan Powered Terminal Unit (FPTU) Type	User Defined	Series or parallel FPTU	11
	Parallel FPTU Fan	Fixed	Sized for 50 percent peak primary air at 0.35 W/cfm	11
	Series FPTU Fan	Fixed	Sized for 50 percent peak primary air at 0.35 W/cfm	11
Economizer	Economizer Presence	User Defined	Yes or No	3, 4, 9, 10, 11
	Economizer ((~~High Limit~~)) Control Type	Fixed	((~~75°F fixed~~)) Differential dry-bulb	3, 4, 9, 10, 11
Energy Recovery	Sensible Effectiveness	User Defined	Heat exchanger sensible effectiveness at design heating and cooling conditions	3, 4, 9, 10, 11, 12
	Latent Effectiveness	User Defined	Heat exchanger latent effectiveness at design heating and cooling conditions	3, 4, 9, 10, 11, 12
	Economizer Bypass	User Defined	If ERV is bypassed during economizer conditions	3, 4, 9, 10, 11, 12
	((~~Energy Recovery Temp Control~~)) Bypass SAT Setpoint	User Defined	If bypass, target supply air temperature	3, 4, 9, 10, 11, 12
	Fan Power Reduction during Bypass (W/cfm)	User Defined	If ERV system include bypass, static pressure setpoint and variable speed fan, fan power can be reduced during economizer conditions	3, 4, 9, 10, 11, 12
Demand Controlled Ventilation	DCV Application	User Defined	Percent of block floor area under DCV control	3, 4, 9, 10, 11, 12

Category	Parameter	Fixed or User Defined	Required	Applicable Systems
DOAS	DOAS Fan Power W/cfm	User Defined	Fan electrical input power in W/cfm of supply airflow((a))	12
	DOAS Supplemental Heating and Cooling	User Defined	Heating source, cooling source	12
	Minimum SAT Setpoint (Cooling)	User Defined	SAT setpoint if DOAS includes supplemental cooling	12
	((~~DOAS Supply Air Temperature Control~~)) Minimum SAT Setpoint (Heating)	User Defined	SAT setpoint if DOAS includes supplemental heating ((~~or cooling and active temperature controls~~))	12
Heating Plant	Boiler Efficiency((d))	User Defined	Boiler thermal efficiency	1, 6, 7, 9, 10, 11, 12
	Heating Water Loop Configuration[a]	User Defined	Constant flow primary only; variable flow primary only; constant flow primary-variable flow secondary	1, 6, 7, 9, 10, 11, 12
	Heating Water Primary Pump Power (W/gpm)	User Defined	Heating water primary pump input W/gpm heating water flow	1, 6, 7, 9, 10, 11, 12
	Heating Water Secondary Pump Power (W/gpm)	User Defined	Heating water secondary pump input W/gpm heating water flow (if primary/secondary)	1, 6, 7, 9, 10, 11, 12
	Heating Water Loop Temperature	Fixed	180°F supply, 130°F return	1, 6, 9, 10,11
	Boiler Type	Fixed	Noncondensing boiler where input thermal efficiency is less than 86%; condensing boiler otherwise	1, 6, 7, 9, 10, 11, 12

Category	Parameter	Fixed or User Defined	Required	Applicable Systems
Chilled Water Plant	Chiller Compressor Type	User Defined	Screw/scroll, centrifugal or reciprocating	6,10, 11, 12
	Chiller Condenser Type	User Defined	Air cooled or water cooled	6, 10, 11, 12
	Chiller Full Load Efficiency((d))	User Defined	Chiller COP	6, 10, 11, 12
	Chilled Water Loop Configuration[a]	User Defined	Variable flow primary only, constant flow primary - variable flow secondary	6, 10, 11, 12
	Chilled Water Primary Pump Power (W/gpm)	User Defined	Primary pump input W/gpm chilled water flow (if primary/secondary)	6, 10, 11, 12
	Chilled Water Secondary Pump Power (W/gpm)	User Defined	Secondary pump input W/gpm chilled water flow	6, 10, 11, 12
	Chilled Water Temperature Reset Included	User Defined	Yes/No	6, 10, 11, 12
	Chilled Water Temperature Reset Schedule (if included)	Fixed	Outdoor air reset: CHW supply temperature of 44°F at 80°F outdoor air dry-bulb and above, CHW supply temperature of 54°F at 60°F outdoor air dry-bulb temperature and below, ramped linearly between	6, 10, 11, 12
	Condenser Water Pump Power (W/gpm)	User Defined	Pump input W/gpm condenser water flow	6, 7, 8, ((~~9,~~)) 10, 11, 12
	Condenser Water Pump Control	User Defined	Constant speed or variable speed	6, 7, 8, 10, 11, 12
	Cooling Tower Efficiency	User Defined	gpm/hp tower fan	6, 7, 10, 11, 12
((~~Cooling Tower~~))	Cooling Tower Fan Control	User Defined	Constant or variable speed	6, 7, 10, 11, 12
	Cooling Tower Approach and Range	User Defined	Design cooling tower approach and range temperature	6, 7, 10, 11, 12
Heat Pump Loop Flow Control	Loop Flow and Heat Pump Control Valve	Fixed	Two position valve with VFD on pump. Loop flow at 3 gpm/ton	7, 8
Heat Pump Loop Temperature Control		Fixed	Set to maintain temperature between 50°F and 70°F	7
GLHP Well Field		Fixed	Bore depth = 250 feet Bore length 200 feet/ton for greater of cooling or heating load Bore spacing = 15 feet Bore diameter = 5 inches 3/4 inch Polyethylene pipe Ground and grout conductivity = 4.8 Btu-in/h-ft^2-°F	8

((~~[a] Where multiple fan systems serve a single *block*, fan power is based on weighted average using on supply air cfm.~~
~~[b] Where multiple cooling systems serve a single *block*, COP is based on a weighted average using cooling capacity.~~

~~[c] Where multiple heating systems serve a single *block*, thermal efficiency or heating COP is based on a weighted average using heating capacity.~~

~~[d] Where multiple boilers or chillers serve a heating water or chilled water loop, efficiency is based on a weighted average for using heating or cooling capacity.~~))

[a] Part load fan power and pump power modified in accordance with Table D601.10.3.

Table D601.10.3
Fan and Pump Power Curve Coefficients

Equation Term	Fan Power Coefficients	Pump Power Coefficients	
	VSD + SP Reset	Ride Pump Curve	VSD + DP/Valve Reset
b	0.0408	0	0
x	0.088	3.2485	0.0205
x^2	-0.0729	-4.7443	0.4101
x^3	0.9437	2.5295	0.5753

D602 Simulation of the standard reference design. The *standard reference design* shall be configured and analyzed as specified in this section.

D602.1 Utility rates. Same as proposed.

D602.2 Blocks. Same as proposed.

D602.3 Thermal zoning. Same as proposed.

D602.4 Occupancy type, schedule, density, and heat gain. Same as proposed.

D602.5 Envelope components. Same as proposed.

D602.6 Lighting. Same as proposed.

D602.7 Miscellaneous equipment. Same as proposed.

D602.8 Elevators. Not modeled. Same as proposed.

D602.9 Service water heating equipment. Not modeled. Same as proposed.

D602.10 On-site renewable energy systems. Not modeled. Same as proposed.

D602.11 HVAC equipment. The *standard reference design* HVAC equipment consists of separate space conditioning systems and dedicated outside air systems as described in Table D602.11 for the appropriate building occupancies.

Table D602.11
Standard Reference Design HVAC Systems

Parameter	Building Type				
	Large Office[a]	Small Office and Libraries[a]	Retail	School	Multifamily
System Type	Water-source Heat Pump	Packaged air-source Heat Pump	Packaged air-source Heat Pump	Packaged air-source Heat Pump	Packaged air-source Heat Pump
Fan Control[b]	Cycle on Load	Cycle on Load	Cycle on Load	Cycle on Load	Cycle on Load
Space Condition Fan Power (W/cfm) Proposed < MERV 13	0.528	0.528	0.522	0.528	0.528
Space Condition Fan Power (W/cfm) Proposed ≥ MERV 13	0.634	0.634	0.634	0.634	0.634

Heating/Cooling Sizing Factor[c]	1.25/1.15	1.25/1.15	1.25/1.15	1.25/1.15	1.25/1.15
Supplemental Heating Availability	NA	<40°F	<40°F	<40°F	<40°F
Modeled cooling COP (Net of Fan) [d]	4.46	3.83	4.25	3.83	3.83
Modeled heating COP (Net of Fan) [d]	4.61	3.81	3.57	3.81	3.86
Cooling Source	DX (Heat Pump)	DX (Heat Pump)	DX (Heat Pump)	DX (Heat Pump)	DX (Heat Pump)
Heat Source	Heat Pump	Heat Pump	Heat Pump	Heat Pump	Heat Pump
Number of Stages of Cooling	Single	Single	Two	Single	Single
OSA Economizer[e]	No	No	Yes	Yes	Yes
Occupied Ventilation Source[f]	DOAS	DOAS	DOAS	DOAS	DOAS
DOAS Fan Power (W/cfm of Outside Air)	0.819	0.819	0.730	0.742	0.780
DOAS Fan Power (W/cfm) Proposed ≥ MERV 13	1.042	1.042	0.928	0.944	0.944
DOAS Temperature Control[g, h]	Bypass	Wild	Bypass	Bypass	Wild
ERV Efficiency (Sensible Only)	70 percent	70 percent	70 percent	70 percent	70 percent
WSHP Loop Heat Rejection	Cooling Tower[i]	NA	NA	NA	NA
WSHP Loop Heat Source	Gas Boiler [j]	NA	NA	NA	NA
WSHP Loop Temperature Control[k]	50°F to 70°F	NA	NA	NA	NA
WSHP Circulation Pump W/gpm[l]	16	NA	NA	NA	NA
WSHP Loop Pumping Control[m]	HP Valves & Pump VSD	NA	NA	NA	NA

[a] Offices less than 50,000 square feet use "Small Office" parameters; otherwise use "Large Office" parameters.

[b] Space conditioning system shall cycle on to meet heating and cooling setpoint schedules as specified in ASHRAE Standard 90.1 Normative Appendix C. One space conditioning system is modeled in each zone. Conditioning system fan operation is not necessary for ventilation delivery.

[c] The equipment capacities (i.e., system coil capacities) for the *standard reference design* building design shall be based on design day sizing runs and shall be oversized by 15 percent for cooling and 25 percent for heating.

[d] COPs shown are direct heating or cooling performance and do not include fan energy use. See ASHRAE 90.1 Appendix G (G3.1.2.1) for separation of fan from COP in packaged equipment for units where the efficiency rating includes fan energy (e.g., SEER, EER, HSPF, COP).

[e] Economizer on space conditioning systems shall be simulated when outdoor air conditions allow free cooling. Economizer high limit shall be based on differential dry-bulb control. DOAS system continues to operate during economizer mode.

[f] Airflow equal to the outside air ventilation requirements is supplied and exhausted through a separate DOAS system including a supply fan, exhaust fan and sensible only heat exchanger. No additional heating or cooling shall be provided by the DOAS. A single DOAS system will be provided for each *block*. The DOAS supply and return fans shall

run whenever the HVAC system is scheduled to operate in accordance with ASHRAE 90.1 Normative Appendix C.

[g] "Wild" DOAS control indicates no active control of the supply air temperature leaving the DOAS system. Temperature will fluctuate based only on entering and leaving conditions and the effectiveness of ERV.

[h] "Bypass" DOAS control includes modulating dampers to bypass ERV with the intent to maintain supply air temperature at a maximum of 60°F when outside air is below 75°F. Once outside air is above 75°F, bypass dampers will be fully closed.

[i] Includes a single axial fan cooling tower with variable speed fans at 40.2 gpm/hp, sized for an approach of 10°F and a range of 10°F.

[j] Includes a single natural draft boiler with 80 percent E_t.

[k] Loop boiler and heat rejection shall be controlled to maintain loop temperature entering heat pumps between 50°F and 70°F.

[l] Pump motor input power shall be 16 W/gpm.

[m] Loop flow shall be variable with variable speed drive pump and unit fluid flow shutoff at each heat pump when its compressor cycles off.

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-90000 Appendix E—((~~Renewable energy~~)) Reserved.

((~~**Informational Note:** *The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.*~~

~~**E101.1 On-site renewable energy systems.** Each new commercial 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 kBtu of annual solar water heating energy production, per 1,000 square feet of conditioned floor area 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. If the on-site renewable energy option in C406 is selected, this energy shall be in addition to that required by C406.~~

~~EXCEPTION: Alternate means of achieving equivalent energy savings are permissible where approved by the code official, if the calculated net annual energy savings equals or exceeds the calculated annual energy production of the required on-site renewable energy system.~~))

AMENDATORY SECTION (Amending WSR 19-24-040, filed 11/26/19, effective 7/1/20)

WAC 51-11C-90500 Appendix F—Outcome-based energy budget.

Informational Note: *The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.*

F101.1 General. This section is an outcome-based energy budget compliance requirement pursuant to RCW 19.27A.160 to incrementally move toward achieving by 2031 a 70 percent reduction in annual net energy use

compared with 2006 baseline. As an outcome-based energy budget, this requirement uses a building's actual energy use to determine compliance.

F101.2 Scope. Buildings permitted under this section shall document one year of net energy use below an energy budget within 3 years after occupancy and every 5 years thereafter. Buildings and sites shall also be designed with the ability to offset in the future all estimated energy needs through renewable energy generation with minimum 40 percent on-site, maximum 40 percent off-site, and maximum 20 percent through green power purchase. Buildings that exceed the energy budget by up to 20 percent shall offset the excess amount through a green power purchase agreement. Buildings that exceed the energy budget by more than 20 percent shall, using a posted performance bond or financial security, offset the excess amount over 20 percent by installing renewable energy or with an energy retrofit.

F101.3 Building permit submittal. Building designs shall establish on the Washington State Outcome-Based Energy Budget form (Figure F101.3):

1. The anticipated building energy use is lower than the energy budget.
2. The energy generation ability in the future is greater than or equal to the anticipated building energy use.

F101.3.1 Anticipated building energy use. The total yearly energy use from all metered fuel sources is the anticipated building energy use. Any energy used from district energy, combined heat and power, renewable energy, or captured waste heat systems must be metered. Buildings with any nonmetered energy sources are not permitted for compliance with this section. All secondary spaces and services (examples: Exterior building and site lighting, surface parking, garages, and exterior swimming pools) associated with the building shall be included in the overall energy use total. The anticipated site Energy Use Intensity (EUI) for each fuel source shall be reported in units of kWh/ft^2/yr or kBtu/ft^2/yr using the conversions listed below:

Metered Fuel Source	to kWh:	to kBTU:
Electric	kWh × 1	kWh × 3.412
Gas	Therm × 29.308	Therm × 100
Propane	Cubic Foot × 0.738	Cubic Foot × 2.5185
Fuel Oil	Gallon × 43.872	Gallon × 149.6905

F101.3.2 Building use and occupancy types. Building use and occupancy types permitted are indicated in Table F101.3.2(1).

F101.3.3 Maximum site energy budget. Table F101.3.2(1) indicates the site EUI budget for each building use and occupancy type along with the building enclosure requirements for all use and occupancy types.

F101.3.3.1 Mixed-use buildings. For buildings that contain more than one building use or occupancy type, the overall energy budget shall be based on the individual floor area percentage totals of each use times the individual energy budget and summing the results of all individual areas.

F101.3.3.2 Energy budget level options. Development teams may commit to a future, more stringent energy budget level from Table

F101.3.2(1). Actual energy use and energy generation ability will be evaluated on this lower budget level.

F101.3.3.3 Energy modeling. A proposed building energy model is required for compliance with Section F101.3.2. A baseline energy model is not required. The proposed design model must show estimated energy use below the energy.

F101.3.4 Energy generation ability. Permit documents shall indicate the location, space allocated, and connection pathways for future installation of all potential energy generation systems. Only items defined by the Washington State Energy Code as on-site renewable energy shall be used to meet energy generation requirements.

F101.3.4.1 Energy generation categories. The development team shall complete the Washington State Outcome-Based Energy Budget form (Figure F101.3) to show the total renewable energy generation ability in the following categories:

1. Building integral: Renewable energy generation sources attached to the building. This value, combined with the on-site value, shall be at least 40 percent of the energy budget.
2. On-site: Renewable energy generation sources located on the building site property. This value, combined with the building integral value, shall be at least 40 percent of the energy budget.
3. Off-site: Renewable energy generation sources not located on the building site. This amount is limited to 40 percent of the energy budget. A specific off-site location does not need to be identified.
4. Green Power: Renewable energy purchased through the electric utility provider for the building. This amount is limited to 20 percent of the energy budget.

F101.3.4.2 Energy generation ability for building sites within a 2030 District. The development team for building sites within a designated 2030 District recognized by Architecture 2030 may use the Architecture 2030 Challenge 70 percent energy reduction target from the 2003 baseline as the energy budget. Building locations meeting this criteria and choosing this energy budget are exempt from the building integral and on-site requirements in Section F101.3.4.1. Green power remains capped at 20 percent. The generation requirements may be split, in any amount, among the building integral, on-site, or off-site categories. Actual energy use will be evaluated against the Architecture 2030 Challenge 70 percent energy reduction budget.

F101.4 Actual energy use submittal. The building owner or representative shall submit energy use documentation summary from all energy source providers or from an energy benchmarking service to the building code official. Code compliance is achieved with net energy use below the energy budget for any continuous 12-month span within the first 3 years of occupancy.

F101.4.1 Energy use monitoring period and occupancy. The energy use monitoring time frame shall start on the first full-month billing cycle of the utility or energy source provider(s) 6 months after a certificate of occupancy is issued. Buildings shall be deemed substantially occupied when a minimum 85 percent of the floor area, including all common areas, is occupied. The energy monitoring start time may be delayed up to an additional 6 months from certificate of occupancy (up to 12 months total) if 85 percent occupancy is not yet achieved. Buildings not 85 percent occupied after 12 months shall start the monitoring period for the portions occupied with an energy budget based on the spaces occupied and all common areas combined.

F101.4.2 Change of occupancy use during monitoring period. If an area within the building changes from one occupancy use to another with a different target EUI energy budget or if the building occupancy level drops below 50 percent, the target EUI energy budget shall be recalculated to become the new energy budget against which the building energy use shall be compared for compliance.

F101.4.3 Energy metering. All building spaces and uses subject to an energy budget or a portion of the energy budget shall be metered separately for all energy uses.

F101.4.4 Energy budget responsibility. The building owner is responsible for the compliance of the whole building. At the building owner's discretion, responsibility for the energy use budget may be divided and transferred into portions attributable to the occupant, operator or controller of each energy budget space. Common area spaces not under the control of an occupant or tenant may not be transferred.

F101.5 Actual energy use above the energy budget. Buildings exceeding the energy budget are not in compliance with the energy code and the building owner shall complete one of the following measures within 1 year:

1. Owners of buildings with actual energy use that exceeds the energy budget by up to 20 percent may offset the excess energy amount through annual green power purchase agreement from the utility provider at a rate of 1.1 times the excess energy amount until future code compliance is demonstrated.
2. Owners of buildings with actual energy use that exceeds the energy budget by more than 20 percent and up to 40 percent shall complete item 1 and either install on-building, on-site, or off-site energy generation equipment or invest in an energy conservation retrofit using the performance bond or financial security for energy amount remaining above 20 percent.
3. Owners of buildings with actual energy use that exceeds the energy budget by more than 40 percent shall complete item 1, item 2, and post a replacement performance bond or financial security equal to the first bond or security amount.

F101.5.1 Continued energy monitoring. Upon completing the necessary compliance measure(s) in Section F101.5 the building owner is provided another 3-year time frame to achieve and document net energy use below the energy budget for any continuous 12-month span. Owners of buildings that remain more than 20 percent above the energy budget shall repeat the measures in Section F101.5, up to 3 times maximum, using the performance bond or financial security to install energy generation equipment or to install an energy retrofit and post a new performance bond equal to the first.

F101.5.2 Tradable certificate for energy savings. As an alternate to the requirements of Section F101.5 a building owner may, when this market-based instrument becomes available, purchase a Tradable Certificate for Energy Savings (TCES) or "white certificates" from a building or entity with energy savings. The building owner shall purchase TCES's equal to 1.1 times the amount that the building's actual energy use exceeds the energy budget.

F101.6 Performance bond or financial security. A building developer must secure and submit to the code official a performance bond or an irrevocable financial security letter of credit from a state of Wash-

ington financial institution prior to certificate of occupancy issuance. The bond or security shall have a value equal to $4.00 per square foot of gross conditioned floor area. The bond or security shall be used only to install renewable energy on the building or for investment into energy conservation measures as part of an energy retrofit. The bond or security may also be held for one additional 3-year energy-monitoring period if green power is purchased. Upon demonstrated compliance with the energy budget, the bond or security requirement shall be released.

F101.6.1 Failure to submit energy use data. Building owners that fail to submit energy use data at the end of the 3-year monitoring period shall forfeit the full amount of the performance bond or financial security as payment to the local jurisdiction. Building owners that fail to submit energy use data at the end of each continuing five-year monitoring period shall be fined an amount equal to the original bond or financial security by the local jurisdiction.

F101.7 Continued energy budget certification. After achieving code compliance buildings shall be required every 5 years to document a continuous 12-month span with net energy use that is lower than the required energy budget. Owners of buildings with actual energy use that is at least 2.5 percent below their energy budget (from year permitted baseline, not voluntary year) may sell, when a future market-based instrument becomes available, their unused energy equivalents in the form of a "white certificate" or Tradable Certificate for Energy Savings.

F101.8 Local amendments. Local jurisdictions may amend the current code cycle EUI maximum energy budget by adopting a more stringent future code year value stated in Table F101.3.2(1).

Table F101.3.2(1)
Washington State Outcome-Based Energy Budget

((~~**Zone 4C:**~~

	~~**Site EUI**~~	~~**Base**~~	~~**Current**~~	~~**Future**~~			
~~**Building Occupancy/Use**~~	~~**ft²/year**~~	~~**2003**~~	~~**2018**~~	~~**2021**~~	~~**2024**~~	~~**2027**~~	~~**2030**~~
~~A-3~~							
~~Library~~	~~kWh~~	~~30.5~~	~~14.6~~	~~13.3~~	~~11.9~~	~~10.5~~	~~9.1~~
	~~kBtu~~	~~104~~	~~49.9~~	~~45.3~~	~~40.6~~	~~35.9~~	~~31.2~~
~~B~~							
~~Office/Bank~~	~~kWh~~	~~19.7~~	~~8.5~~	~~7.8~~	~~7.2~~	~~6.6~~	~~5.9~~
	~~kBtu~~	~~67.3~~	~~28.9~~	~~26.7~~	~~24.5~~	~~22.4~~	~~20.2~~
~~Medical Office (nondiagnostic)~~	~~kWh~~	~~14.8~~	~~7.1~~	~~6.4~~	~~5.8~~	~~5.1~~	~~4.4~~
	~~kBtu~~	~~50.4~~	~~24.2~~	~~21.9~~	~~19.6~~	~~17.4~~	~~15.1~~
~~E~~							
~~School K-12~~	~~kWh~~	~~17.1~~	~~8.2~~	~~7.4~~	~~6.7~~	~~5.9~~	~~5.1~~
	~~kBtu~~	~~58.4~~	~~28.0~~	~~25.4~~	~~22.8~~	~~20.2~~	~~17.5~~
~~I-2~~							
~~Hospital (in-patient)~~	~~kWh~~	~~51.6~~	~~24.8~~	~~22.5~~	~~20.1~~	~~17.8~~	~~15.5~~
	~~kBtu~~	~~176.1~~	~~84.5~~	~~76.6~~	~~68.7~~	~~60.8~~	~~52.8~~
~~M~~							

	Site EUI	Base	Current	Future			
Building Occupancy/Use	**ft²/year**	**2003**	**2018**	**2021**	**2024**	**2027**	**2030**
Grocery/Food Market	kWh	66.6	32.0	29.0	26.0	23.0	20.0
	kBtu	227.4	109.1	98.9	88.7	78.5	68.2
Retail	kWh	25.7	12.3	11.2	10.0	8.9	7.7
	kBtu	87.5	42.0	38.1	34.1	30.2	26.3
S-1							
Parking							
Enclosed Garage[a]	kWh	3.8	2.3	2.0	1.7	1.4	1.1
	kBtu	13.0	8.0	7.0	5.9	4.9	3.9
Open Garage[a]	kWh	2.3	1.4	1.2	1.0	0.9	0.7
	kBtu	7.8	4.8	4.2	3.6	3.0	2.3
S-2							
NonRefrigerated Distribution/ Shipping[b]	kWh	8.6	4.1	3.7	3.3	3.0	2.6
	kBtu	29.2	14.0	12.7	11.4	10.1	8.8
R-2 Multi-Family (3+ stories)							
Lobby/Common Area	kWh	29.0	17.5	15.3	13.1	10.9	8.7
	kBtu	99	59.7	52.2	44.7	37.2	29.7
Studio/Micro-unit	kWh	9238	3284	3156	3028	2900	2771
	kBtu	31520	11205	10768	10331	9893	9456
One Bedroom	kWh	18476	6568	6312	6055	5799	5543
	kBtu	63040	22411	21536	20661	19787	18912
Two Bedroom	kWh	27714	9852	9468	9083	8699	8314
	kBtu	94560	33616	32304	30992	29680	28368
Three Bedroom	kWh	36952	13136	12624	12111	11598	11086
	kBtu	126080	44821	43072	41323	39573	37824
Additional Bedroom	kWh	9238	3284	3156	3028	2900	2771
	kBtu	31520	11205	10768	10331	9893	9456

All Occupancies/Use Types	**2003**	**2018**	**2021**	**2024**	**2027**	**2030**
	U-Factor					
Vertical Fenestration						
Nonmetal		0.28	0.27	0.25	0.24	0.23
Metal - Fixed		0.33	0.31	0.28	0.26	0.23
Metal - Operable		0.34	0.32	0.29	0.26	0.23
Roof		0.016	0.015	0.014	0.013	0.012
Wall (above/below grade)		0.031	0.028	0.024	0.021	0.018
Floors		0.024	0.023	0.021	0.020	0.018
	F-Value					
Slab on Grade		0.41	0.39	0.36	0.34	0.32
	CFM75/ft²					
Air Leakage		0.25	0.17	0.14	0.11	0.08

Zone 5B:

	Site EUI	Base	Current	Future			
Building Occupancy/Use	**ft²/year**	**2003**	**2018**	**2021**	**2024**	**2027**	**2030**
A-3							

	~~Site EUI~~	~~Base~~	~~Current~~	~~Future~~			
~~Building Occupancy/Use~~	~~ft²/year~~	~~2003~~	~~2018~~	~~2021~~	~~2024~~	~~2027~~	~~2030~~
~~Library~~	~~kWh~~	~~31.9~~	~~15.3~~	~~13.9~~	~~12.4~~	~~11.0~~	~~9.6~~
	~~kBtu~~	~~108.8~~	~~52.2~~	~~47.3~~	~~42.4~~	~~37.5~~	~~32.6~~
~~B~~							
~~Office/Bank~~	~~kWh~~	~~20.1~~	~~9.1~~	~~8.3~~	~~7.5~~	~~6.8~~	~~6.0~~
	~~kBtu~~	~~68.6~~	~~30.9~~	~~28.3~~	~~25.8~~	~~23.2~~	~~20.6~~
~~Medical Office (nondiagnostic)~~	~~kWh~~	~~15.0~~	~~7.2~~	~~6.5~~	~~5.9~~	~~5.2~~	~~4.5~~
	~~kBtu~~	~~51.3~~	~~24.6~~	~~22.3~~	~~20.0~~	~~17.7~~	~~15.4~~
~~E~~							
~~School K-12~~	~~kWh~~	~~18.3~~	~~8.8~~	~~8.0~~	~~7.1~~	~~6.3~~	~~5.5~~
	~~kBtu~~	~~62.4~~	~~30.0~~	~~27.2~~	~~24.3~~	~~21.5~~	~~18.7~~
~~I-2~~							
~~Hospital (in-patient)~~	~~kWh~~	~~48.5~~	~~23.3~~	~~21.1~~	~~18.9~~	~~16.7~~	~~14.6~~
	~~kBtu~~	~~165.5~~	~~79.4~~	~~72.0~~	~~64.5~~	~~57.1~~	~~49.7~~
~~M~~							
~~Grocery/Food Market~~	~~kWh~~	~~66.3~~	~~31.8~~	~~28.8~~	~~25.8~~	~~22.9~~	~~19.9~~
	~~kBtu~~	~~226.1~~	~~108.5~~	~~98.4~~	~~88.2~~	~~78.0~~	~~67.8~~
~~Retail~~	~~kWh~~	~~28.4~~	~~13.6~~	~~12.4~~	~~11.1~~	~~9.8~~	~~8.5~~
	~~kBtu~~	~~97.0~~	~~46.6~~	~~42.2~~	~~37.8~~	~~33.5~~	~~29.1~~
~~S-1~~							
~~Parking~~							
~~Enclosed Garage[a]~~	~~kWh~~	~~3.8~~	~~2.3~~	~~2.0~~	~~1.7~~	~~1.4~~	~~1.1~~
	~~kBtu~~	~~13.0~~	~~8.0~~	~~7.0~~	~~5.9~~	~~4.9~~	~~3.9~~
~~Open Garage[a]~~	~~kWh~~	~~2.3~~	~~1.4~~	~~1.2~~	~~1.0~~	~~0.9~~	~~0.7~~
	~~kBtu~~	~~7.8~~	~~4.8~~	~~4.2~~	~~3.6~~	~~3.0~~	~~2.3~~
~~S-2~~							
~~NonRefrigerated Distribution/ Shipping[b]~~	~~kWh~~	~~10.5~~	~~5.0~~	~~4.6~~	~~4.1~~	~~3.6~~	~~3.1~~
	~~kBtu~~	~~35.8~~	~~17.2~~	~~15.6~~	~~14.0~~	~~12.4~~	~~10.7~~
~~R-2 Multi-Family (3+ stories)~~							
~~Lobby/Common Area~~	~~kWh~~	~~29.0~~	~~18.8~~	~~16.3~~	~~13.8~~	~~11.2~~	~~8.7~~
	~~kBtu~~	~~99~~	~~64.2~~	~~55.6~~	~~46.9~~	~~38.3~~	~~29.7~~
~~Studio/Micro-unit~~	~~kWh~~	~~9238~~	~~3495~~	~~3314~~	~~3133~~	~~2952~~	~~2771~~
	~~kBtu~~	~~31520~~	~~11925~~	~~11308~~	~~10691~~	~~10073~~	~~9456~~
~~One Bedroom~~	~~kWh~~	~~18476~~	~~6990~~	~~6628~~	~~6267~~	~~5905~~	~~5543~~
	~~kBtu~~	~~63040~~	~~23851~~	~~22616~~	~~21381~~	~~20147~~	~~18912~~
~~Two Bedroom~~	~~kWh~~	~~27714~~	~~10485~~	~~9943~~	~~9400~~	~~8857~~	~~8314~~
	~~kBtu~~	~~94560~~	~~35776~~	~~33924~~	~~32072~~	~~30220~~	~~28368~~
~~Three Bedroom~~	~~kWh~~	~~36952~~	~~13980~~	~~13257~~	~~12533~~	~~11809~~	~~11086~~
	~~kBtu~~	~~126080~~	~~47701~~	~~45232~~	~~42763~~	~~40293~~	~~37824~~
~~Additional Bedroom~~	~~kWh~~	~~9238~~	~~3495~~	~~3314~~	~~3133~~	~~2952~~	~~2771~~
	~~kBtu~~	~~31520~~	~~11925~~	~~11308~~	~~10691~~	~~10073~~	~~9456~~

~~All Occupancies/Use Types~~	~~2003~~	~~2018~~	~~2021~~	~~2024~~	~~2027~~	~~2030~~
	~~U-Factor~~					
~~Vertical Fenestration~~						
~~Nonmetal~~		~~0.25~~	~~0.23~~	~~0.21~~	~~0.18~~	~~0.16~~
~~Metal - Fixed~~		~~0.31~~	~~0.27~~	~~0.23~~	~~0.20~~	~~0.16~~

~~All Occupancies/Use Types~~	~~2003~~	~~2018~~	~~2021~~	~~2024~~	~~2027~~	~~2030~~
~~Metal - Operable~~		~~0.32~~	~~0.28~~	~~0.24~~	~~0.20~~	~~0.16~~
~~Roof~~		~~0.016~~	~~0.015~~	~~0.014~~	~~0.013~~	~~0.012~~
~~Wall (above/below grade)~~		~~0.031~~	~~0.028~~	~~0.024~~	~~0.021~~	~~0.018~~
~~Floors~~		~~0.024~~	~~0.023~~	~~0.021~~	~~0.020~~	~~0.018~~
	~~F-Value~~					
~~Slab on Grade~~		~~0.41~~	~~0.39~~	~~0.36~~	~~0.34~~	~~0.32~~
	~~CFM75/ft^2~~					
~~Air Leakage~~		~~0.25~~	~~0.17~~	~~0.14~~	~~0.11~~	~~0.08~~))

Building Occupancy/Use		Site EUI							
		2021		2024		2027		2030	
		4c	5b	4c	5b	4c	5b	4c	5b
B	Office - small	19.48	20.60	16.79	17.74	14.09	14.87	11.40	12.00
	Office - medium	22.22	24.47	18.91	20.81	15.61	17.16	12.30	13.50
	Office - large	21.94	23.06	18.53	19.48	15.11	15.89	11.70	12.30
B	Health out-patient	69.75	70.88	58.90	59.85	48.05	48.83	37.20	37.80
E	School - primary	25.40	27.20	22.80	24.30	18.99	21.31	14.70	16.50
	School - secondary	24.75	28.13	20.90	23.75	17.05	19.38	13.20	15.00
I-2	Hospital	76.60	72.00	68.70	64.50	56.19	57.10	43.50	49.70
M	Grocery	98.90	98.40	88.70	88.20	75.56	78.00	58.50	62.70
M	Retail - stand alone	30.00	34.50	26.60	30.40	23.20	26.30	19.80	22.20
	Retail - strip mall	29.14	34.76	26.53	31.28	23.91	27.79	21.30	24.30
S-1	Garage - enclosed[a]	7.00	7.00	5.90	5.90	4.90	4.90	3.90	3.90
	Garage - open[a]	4.20	4.20	3.60	3.60	3.00	3.00	2.30	2.30
S-2	Warehouse (nonref)[b]	6.49	7.61	5.63	6.58	4.76	5.54	3.90	4.50
R-2	kWh/person/year	3,089	3,212	2,681	2,789	2,256	2,348	1,808	1,886
R-2	Common kWh/sf/yr	15.0	15.8	11.6	12.2	8.5	8.9	5.7	5.9

[a]Lighting power allowance must still comply with Table C405.4.2(2).
[b]Applicable to heated warehouses only.

Table F101.3.2(2)
COMMERCIAL BUILDING TYPE DESCRIPTIONS
Commercial Building Prototype Descriptions Compared to CBSA Building Types

Commercial Prototypes	CBSA Detailed Building Type Included	Other Criteria
Small Office	office- admin, professional, government, financial; call center; city hall; retail banking; sales office; other office	Less than 20,000 square feet
Medium Office	office- admin, professional, government, financial; call center; city hall; retail banking; sales office; other office	20,001 - 100,000 square feet
Large Office	office- admin, professional, government, financial; call center; city hall; retail banking; sales office; other office	Greater than 100,000 square feet

Commercial Prototypes	CBSA Detailed Building Type Included	Other Criteria
Stand-alone Retail	auto parts; auto/boat dealer/show room; beauty/barber; car wash; clothing; department store; dry cleaner; electronics/ appliances; florist, nursery; hardware; home improvement; laundromat (self-service); pharmacy; post office; rental center; repair shop; studio/gallery; vehicle repair; warehouse club; other specialty merchandise	Single stand-alone building
Strip Mall	auto parts; auto/boat dealer/ show room; beauty/barber; car wash; clothing; department store; dry cleaner; electronics/ appliances; florist, nursery; hardware; home improvement; laundromat (self-service); pharmacy; post office; rental center; repair shop; studio/gallery; vehicle repair; warehouse club; other specialty merchandise	Part of larger mixed-use building
Supermarket	grocery	
Primary School	elementary school; middle school; pre-school; other k-12 school	
Secondary School	high school	
Small Hotel	motel; bed & breakfast; boarding/rooming house, apt hotel	
Large Hotel	hotel; hotel - resort	
Hospital	hospital	
Warehouse (non- refrigerated)	ministorage; warehouse, distribution; warehouse, storage; other warehouse	
Quick Service Restaurant	cafeteria; catering service; coffee, doughnut, or bagel shop; fast food restaurant; ice cream or frozen yogurt shop; take-out restaurant; truck stop	
Full-Service Restaurant	bar, pub, lounge; sit down restaurant; other restaurant	
Outpatient Health care	dental office; medical clinic/outpatient medical; medical office; medical urgent care clinic; outpatient rehab; veterinarian office/clinic	
Mid-rise Apartment	Not included in CBSA. Should represent all high rise (up to 4 stories) apartment buildings.	Census Data used to estimate number of apartments and square footage. Seattle Benchmarking Data used to estimate high rise to mid-rise split in urban area.
High-rise Apartment	Not included in CBSA. Should represent all low rise (greater than 4 story) apartment buildings.	Census Data used to estimate number of apartments and square footage. Seattle Benchmarking Data used to estimate high rise to mid-rise split in urban area.
Residential Care	assisted living; in-patient rehab; nursing home; retirement home; other residential care	

FIGURE F101.3.2

Washington State Outcome-based Energy Budget Form

WASHINGTON STATE OUTCOME-BASED ENERGY BUDGET FORM

(reserved for graphics)

Building occupancy/use _____

Conditioned floor area SF

Code maximum site EUI energy budget

Predicted EUI

Electric

Gas

Propane

Oil

Other (source/ generation)

Generation Potential EUI

Building Integral (combined must exceed 40%)

On-site

Off-site (max 40%)

Purchase (max 40%)

Percentage better than energy budget

Percentage potential EUI above predicted EUI

PROJECT SUMMARY

Building Name

Address

City

Owner

Address

City, State, Zip

PROJECT CERTIFICATION

Name

Firm

Date

(seal)

REPEALER

The following sections of the Washington Administrative Code are repealed:

WAC 51-11C-402131	Reserved.
WAC 51-11C-402132	Reserved.
WAC 51-11C-402133	Reserved.
WAC 51-11C-402134	Reserved.
WAC 51-11C-402200	Reserved.
WAC 51-11C-40242	Reserved.
WAC 51-11C-403231	Table C403.3.2(1)——Minimum efficiency requirements——Electrically operated unitary air conditioners and condensing units.
WAC 51-11C-403232	Table C403.3.2(2)——Minimum efficiency requirements——Electrically operated unitary and applied heat pumps.
WAC 51-11C-403233	Table C403.3.2(3)——Minimum efficiency requirements——Electrically operated PTAC, PTHP, SPVAC, SPVHP, room air conditioners.
WAC 51-11C-403234	Table C403.3.2(4)——Minimum efficiency requirements——Warm air furnaces and unit heaters.
WAC 51-11C-403235	Table C403.3.2(5)——Minimum efficiency requirements——Gas- and oil-fired boilers.
WAC 51-11C-403236	Table C403.3.2(6)——Reserved.
WAC 51-11C-403237	Table C403.3.2(7)——Minimum efficiency requirements——Water chilling packages.
WAC 51-11C-403238	Table C403.3.2(8)——Minimum efficiency requirements——Heat rejection equipment.
WAC 51-11C-403239	Table C403.3.2(9) and Table C403.3.2(10)——Minimum efficiency requirements.
WAC 51-11C-403241	Reserved.
WAC 51-11C-403242	Reserved.
WAC 51-11C-403243	Reserved.
WAC 51-11C-403244	Reserved.
WAC 51-11C-403245	Reserved.
WAC 51-11C-403246	Reserved.
WAC 51-11C-403247	Reserved.
WAC 51-11C-403248	Reserved.
WAC 51-11C-403249	Reserved.
WAC 51-11C-403251	Reserved.
WAC 51-11C-403252	Reserved.

WAC 51-11C-403253 Reserved.
WAC 51-11C-403254 Reserved.
WAC 51-11C-403261 Reserved.
WAC 51-11C-403281 Reserved.
WAC 51-11C-403291 Reserved.
WAC 51-11C-403292 Reserved.
WAC 51-11C-403293 Reserved.
WAC 51-11C-403294 Reserved.
WAC 51-11C-403295 Reserved.