2024 Minnesota Commercial Energy Code: Climate Zone 7

BuildUp MN

Quick Reference Guide for New Construction Projects following the ASHRAE 90.1 Prescriptive Compliance Path

This tool is intended to be a quick reference for design, engineering, and code review professionals and includes high-impact requirements in the 2024 Minnesota Commercial Energy Code. **This list of measures is not comprehensive.** Additional code requirements may apply to your project scope. Please reference the 2024 Minnesota Commercial Energy Code for a full list of requirements.

All measures require that design compliance is documented in construction documents and/or in submitted specifications so that compliance can be reviewed and documented by plan reviewers.

* Denotes measures that are either completely new 2024 commercial energy code requirements within the State of Minnesota or are dramatically tighter than previous codes.

^ Denotes measures that are mandatory for all projects regardless of compliance path.

For additional resources on the MN Commercial Energy Code, visit buildupmn.org.

MEASURE	INTENT	TECHNICAL REQUIREMENTS & CODE SECTION REFERENCES	APPLICABILITY	NOTABLE EXCEPTIONS
		ENVELOPE REQUIREMENTS		
Roof Insulation R-Value	Ensures adequate roof insulation is installed, saving energy by reducing heat gain and loss through the roof.	**Min R-Values** **OR** **Max U-Values** Insulation above deck: R-35 c.i. U-0.028 Metal building: R-30 + R-11 *Ls* U-0.029 Attic and other: R-60 U-0.017 c.i. - continuous insulation *Ls* - liner system; top-most layer draped above and between purlins *References:* ***Table 5.5-6, Sections 5.5.3.1, A2***	Applies to all new or replacement roofs.	Requirements are waived for historical buildings with a roof slope of 2:12 or less.
Above Grade Wall Insulation	Ensures adequate wall insulation is installed, saving energy by reducing heat gain and loss through walls.	**Min R-Values** **OR** **Max U-Values** Mass wall: R-15.2 c.i. U-0.071 Metal building: R-0 + 12.1 c.i. U-0.044 Steel-framed: R-13 + 12.5 c.i. U-0.049 Wood-framed and other: R-13 + 7.5 c.i. or R-19 + 5 c.i. U-0.051 *References:* ***Table 5.5-6, Sections 5.5.3.2, A3***	Applies to all exterior walls that are at least partially above-grade. For partially below-grade walls: 1) If insulation is within the structural wall or outside of it, then these R-values only apply to the above-grade part of the wall. 2) If the insulation is inside of the supporting structure, then these R-values apply to the whole wall.	N/A
Slab Edge Insulation	Ensures adequate insulation is installed around the perimeter of floors on or slightly below grade, saving energy by eliminating a potentially-overlooked heat loss path.	**Minimum R-Values** **Min R-Values** **OR** **Max F-Factors** Unheated slab (non-group I/R): R-20 for 24" F-0.510 Unheated slab (group I/R): R-20 for 48" F-0.434 Heated slab: R-25 for 48" F-0.671 *References:* ***Table 5.5-6, Sections 5.5.3.5, A6***	Applies to buildings with slab floors in contact with the ground that are above grade or ≤24 inches below grade	N/A
Window U-Factor*	Limits the U-factor of windows, saving energy by reducing the rate of conductive heat gain or loss through windows.	**Max Values** Fixed windows: U-0.29 Operable windows: U-0.36 Entrance doors: U-0.63 Skylights: U-0.44 *References:* ***Table 5.5-6, Section 5.5.4.3***	Applies to all exterior windows and skylights. Each product can comply individually or a weighted average of all products in a category can comply.	Skylight U-factor can be increased to U-0.75 if all the following are met: 1) Glazing material/diffuser has a haze value >90% 2) VT is >0.40 3) All general lighting under skylights is controlled by photocontrols
Window SHGC*	Limits the solar heat gain coefficient, saving energy in summer months by reducing solar heat gain through windows.	**Max Values** Fixed windows: SHGC-0.40 Operable windows: SHGC-0.36 Entrance doors: SHGC-0.36 Skylights: No requirement *References:* ***Table 5.5-6, Section 5.5.4.4***	Applies to all exterior windows and skylights. Each product can comply individually or a weighted average of all products in a category can comply. Dynamic glazing must meet requirements at minimum SHGC and cannot be used in a weighted average.	South, east, and west walls can apply a multiplier to their SHGC based on the projection factor (PF) of structures providing permanent shading. Requirements are waived for street-side, street-level windows where the street-level story is ≤20 feet, the window has a continuous overhang with weighted-average PF >0.5, and the window area is <75% of the gross wall area. If this exemption is used, this area cannot be used for any weighted average calculations. Requirements are waived for skylights that meet the criteria for the increased U-factor allowance detailed in the Window U-Factor section.
Window Area	Limits the window area, saving energy by reduce heat gain and loss, which is much higher through windows than through opaque walls.	**Max Values** Window area: 40% of wall area Skylight area: 3% of roof area *References:* ***Table 5.5-6, Sections 5.5.4.2, 5.5.4.4.1 [exception 3]***	Applies to all exterior windows and skylights.	Requirements are waived for street-side, street-level windows where the street-level story is ≤20 feet, the window has a continuous overhang with weighted-average PF >0.5, and the window area is <75% of the gross wall area. If this exemption is used, this area cannot be used for any weighted average calculations.

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ENVELOPE REQUIREMENTS				
Window Orientation	Limits window areas on east and west building faces, saving energy by reducing solar heat gain through windows.	East- and west-facing window areas must both be equal to or lesser than either of the following: 1) 25% of the total window area $A_{window,east} \leq A_{window,total} \times 25\%$ **AND** $A_{window,west} \leq A_{window,total} \times 25\%$ 2) 20% of the total window area times the ratio of the code-required SHGC to the specified SHGC $A_{window,east} \leq A_{window,total} \times 20\% \times \frac{SHGC_{code}}{SHGC_{window,east}}$ **AND** $A_{window,west} \leq A_{window,total} \times 20\% * \frac{SHGC_{code}}{SHGC_{window,west}}$ *References:* ***Table 5.5-6, Sections 5.5.4.5, 5.5.4.4.1 [exception 3]***	Applies to all exterior windows on east-facing and west-facing walls.	Requirements are waived for street-side, street-level windows where the street-level story is ≤20 feet, the window has a continuous overhang with weighted-average PF >0.5, and the window area is <75% of the gross wall area. If this exemption is used, this area cannot be used for any weighted average calculations. Alterations with no increase in window area are exempt. Buildings with east-facing and west-facing walls with window areas ≤20% of the total wall area of each face and a SHGC ≤90% of the code-required SHGC are exempt. Requirements are waived for buildings with permanent shade on 75% of the east-facing window area at 9 a.m. on the summer solstice and 75% of the west-facing window area at 3 p.m. on the summer solstice.
Air Leakage Testing*^	Ensures air-tightness of the building, saving energy by reducing the amount of conditioned air that needs to be supplied to maintain space conditioning.	Buildings without Group R or Group I occupancies must either: 1) Have a third-party conduct whole-building pressurization testing with a measured air leakage rate ≤0.40 cfm/sf at 0.3 inches of water OR 2) Have a third-party conduct continuous air barrier design and installation verification, which includes a design review and periodic field inspections during construction Buildings with Group R or Group I occupancies must conduct unit pressurization testing with an average measured air leakage rate ≤0.30 cfm/sf at 0.2 inches of water. 1) If <8 units, all units must be tested. 2) If ≥8 units, the greater of 7 units or 20% of the total unit count must be tested, including at least one unit on the top floor, at least one unit on the bottom floor, and the largest unit. For each unit that exceeds the maximum leakage rate, two more units must be tested. *References:* ***Sections 5.4.3.1.1, 5.9.1.2 & 4.2.5.1.2***	Applies to all buildings.	Buildings > 50,000 sf can test less than the whole building, as long as all floors that have a roof, all floors with a building entrance/loading dock, and 25% of the remaining wall area (not including the previously required floors) are tested and are compliant with the maximum leakage rate. If the measured leakage is <40% and ≤60%, a visual inspection and a diagnostic evaluation (such as a smoke tracer or infrared imaging) can be conducted and all noted leaks that are able to be sealed without destroying existing builing components can be sealed to comply. A report regarding the leak sealing process must be submitted to the code official and owner.
MECHANICAL REQUIREMENTS				
Economizers	Requires certain mechanical systems to have economizers, saving energy by utilizing outdoor air for cooling when possible.	All applicable systems must have an air economizer capable of providing 100% of the supply air as outdoor air for cooling. While fluid economizers are also permitted, they are generally not considered to be effective in this climate zone. *Reference:* ***Section 6.5.1***	All non-residential systems with a cooling capacity ≥54,000 Btu/h and all residential systems with a cooling capacity ≥ 270,000 Btu/h. Note that the definition of a residential system does not include corridors in multifamily buildings.	Systems may ignore the economizer requirement if their cooling efficiency is 72% higher than the prescriptive baseline. Chilled water systems without a fan with a total capacity <1,400,000 Btu/h are exempt. Systems expected to operate fewer than 20 hours per week are exempt. Some computer rooms, supermarket areas, hospitals, and surgery centers may be exempt if they meet certain operational requirements. See Section 6.5.1 for a full list of exceptions.
Economizer High Limit Shutoff	Sets requirements for when economizers should be shut off, saving energy by ensuring economizers are only running when they save energy.	All air economizers must automatically reduce the outdoor intake to the design level when additional outdoor air will not reduce cooling energy use. The set point(s) for each allowed type of shutoff control are listed below (note that enthalpy control is only allowed in parallel with a fixed dry-bulb temperature control): **Fixed dry-bulb temperature:** shut off when outdoor air temperature is >75°F **Differential dry-bulb temperature:** shut off when outdoor air temperature exceeds return air temperature **Fixed enthalpy w/fixed dry-bulb temperature:** shut off when outdoor air enthalpy is >28 Btu/lb **OR** when outdoor air temperature >75°F **Differential enthalpy w/fixed dry-bulb temperature:** shut off when outdoor air enthalpy exceeds return air enthalpy **OR** when outdoor air temperature >75°F Note that the limit must be set to exactly match the requirements unless the economizer does not allow for fully adjustable set points; in this case, the set points should be within 2°F and/or 2 BTU/lb of the listed set points. *Reference:* ***Section 6.5.1.1.3***	Applies to all air economizers.	N/A
Economizer Fault Detection and Diagnostics (FDD)^	Sets requirements for economizer FDD systems, saving energy by ensuring that economizers are operating correctly.	All applicable systems must include an FDD system that complies with the list of requirements shown in Section 6.4.3.12, such as displaying temperature sensor readings, providing system status indications, and reporting faults. *Reference:* ***Section 6.4.3.12***	Applies to all air-cooled DX cooling units with an air economizer.	N/A

MEASURE	INTENT	TECHNICAL REQUIREMENTS & CODE SECTION REFERENCES	APPLICABILITY	NOTABLE EXCEPTIONS
MECHANICAL REQUIREMENTS				
Demand Control Ventilation (DCV)^	Requires certain areas to have controls that modulate ventilation air based on need, saving energy by reducing the time that ventilation fans are running.	All applicable ventilation systems must have the capability to automatically reduce the system's outdoor air intake below the design rate when the actual occupancy of a space is less than the design occupancy, typically through a CO2 sensor on the space's return vent. *Reference:* ***Section 6.4.3.8***	Applies to the spaces below* if they are >500 sf and served by a system with **one or more of:** an air economizer, automatic outdoor air damper controls, or a design outdoor airflow >3,000 cfm. **Correctional:** booking/waiting rooms, dayrooms **Educational:** classrooms (except art and wood/metal shop), computer labs, daycare, lecture halls, media centers, multiuse assembly areas **Food Service:** bars/lounges, cafeterias, dining rooms **General:** break rooms, conference/meeting rooms, transportation waiting **Hospitality:** multipurpose assembly areas **Office:** reception areas, telephone/data entry areas **Public Assembly:** auditoriums, courtrooms, legislative chambers, lobbies, museums, galleries, worship areas **Retail:** mall common areas **Sports/Entertainment:** dance floors, casinos, health club aerobics rooms, spectator areas, stages, studios * Requirement applies to spaces with a design occupancy for ventilation of ≥25 people per 1,000 sf as given in ASHRAE 62.1-2019.	Systems with a design outdoor airflow <750 cfm are exempt. If a system is required to have exhaust air energy recovery (Section 6.5.6.1, see below), DCV is not required as long as the energy recovery system meets the requirements of that section. Multi-zone systems without direct digital controls are exempt. Spaces where >75% of the outdoor airflow is used for makeup air or transfer air are exempt.
Residential Energy Recovery Ventilation (ERV)*	Requires certain residential systems to have equipment that uses exhaust air to preheat/precool outdoor air, saving energy by reducing the system's heating and cooling loads.	All applicable spaces must have an energy recovery ventilation system with an enthalpy recovery ratio of ≥60% at the heating design condition. *Reference:* ***Section 6.5.6.1.1***	Applies to nontransient dwelling units (apartments, condominiums, dormitories) with >750 sf of conditioned floor space.	N/A
Non-Residential Energy Recovery Ventilation (ERV)	Requires certain non-residential systems to have equipment that uses exhaust air to preheat/precool outdoor air, saving energy by reducing the system's heating and cooling loads.	All applicable systems must have an energy recovery ventilation system with an enthalpy recovery of ≥50% at the heating design condition. The system must include bypass controls to allow for economizer operation. *Reference:* ***Section 6.5.6.1.2***	Applies to mechanical systems based on the amount of outdoor air (OA) the system is designed to provide relative to the total supply air (SA). **If OA-to-SA ratio is:** / **ERV is required if supply air quantity is:** <20% / Never required ≥20% and <30% / ≥4,000 cfm ≥30% and <40% / ≥2,500 cfm ≥40% and <50% / ≥1,000 cfm ≥50% and <60% / ≥140 cfm ≥60% and <70% / ≥120 cfm ≥70% and <80% / ≥100 cfm ≥80% / ≥80 cfm	Systems where the sum of exhaust and relief airflow rates, excluding exhaust air used for another energy recovery system or exhaust air that could be potentially hazardous (Class 4 air via ASHRAE 62.1 or listed in Section 6.8.3 of ASHRAE 170), exhausted >20 ft away from each other is >25% of the total design airflow are exempt. Systems serving spaces that are not cooled and are heated to <60°F are exempt. Systems where >60% of the energy used to heat outdoor air is provided from on-site solar or on-site waste energy recovery are exempt. Laboratory exhaust systems and pool dehumidifiers may be exempt if they meet the requirements of other sections (6.5.7.3 and 6.5.6.4, respectively). Systems expected to operate less than 20 hours per week at the design outdoor air rate are exempt.
Thermostat Dead Band^	Requires systems to have a range of temperatures where no heating or cooling is provided, saving energy by preventing systems from cycling back and forth between heating and cooling operation.	All applicable systems must have a ≥5°F range between heating and cooling set points where heating and cooling energy is either shut off completely or reduced to a minimum. *Reference:* ***Section 6.4.3.1.2***	Applies to all systems that automatically switch between heating and cooling.	Systems serving special applications where wide temperature ranges are not acceptable (retirement homes, museums, hospitals) may be exempt if explicity permitted by the code official.
Off-Hour Temperature Setback^	Requires systems to have controls that reduce the heating and cooling energy to a space when it is unoccupied, saving energy by reducing heating and cooling loads when not needed.	Heating systems must have controls that automatically restart the system during off-hours and operate the system at an unoccupied set point ≥10°F lower than the occupied set point. Cooling systems must have controls that automatically restart the system during off-hours and operate the system at an unoccupied set point ≥5°F higher than the occupied set point (or to maintain humidity below a high level). Fully shutting off equipment during unoccupied hours is compliant with this provision. *Reference:* ***Section 6.4.3.3.2***	Applies to all heating and cooling systems that are not intended to operate continuously.	Non-residential systems with a heating and cooling capacity both under 7,000 Btu/h are exempt if they have a readily accessible manual on/off control. Radiant heating systems are only required to have a heating setback of ≥4°F.
Optimum Start^	Requires systems to have controls that bring the space up to temperature right before occupancy, saving energy by reducing heating and cooling loads when not needed.	All applicable systems must have optimum start controls that automatically adjust the start time of the system each day to bring the space up to the temperature set point just before occupancy. The control algorithm must be a function of space temperature, occupied set point, outdoor temperature, and time prior to scheduled occupancy. *Reference:* ***Section 6.4.3.3.3***	Applies to all systems that have off-hour temperature setback controls **AND** digital direct controls.	Systems serving residential spaces are exempt.

MEASURE	INTENT	TECHNICAL REQUIREMENTS & CODE SECTION REFERENCES	APPLICABILITY	NOTABLE EXCEPTIONS
		MECHANICAL REQUIREMENTS		
Door Switches	Requires spaces with exterior doors to have controls that reduce heating and cooling when the door is open for a long period of time, saving energy by reducing heating and cooling energy in spaces that are open to the outdoors.	All applicable spaces must have controls that, when a door is open, do the following within 5 minutes of the door being opened: **Heating:** turn off heating or reset the heating set point to ≤55°F **Cooling**: turn off cooling or reset the cooling set point to ≥90°F (unless the outdoor air temperature is below the space temperature, in which case cooling can remain on) *References:* ***Section 6.5.10***	Applies to all conditioned spaces with exterior doors in new construction projects; alterations to existing buildings are not required to comply.	Building entries with automatic closing devices are exempt. Spaces without thermostats are exempt. Loading docks are exempt.
Supply Air Temperature Reset Controls	Requires multi-zone systems to have controls that reset the supply air temperature when conditioning needs are low, saving energy by preventing air from needing reheating or recooling.	All applicable systems must have controls that reset the supply air temperature by at least 25% of the difference between the design zone air temperature and design supply air temperature in response to building loads, outdoor air temperature, or space humidity. $$T_{SA,reset} \geq T_{SA,design} + 25\% \times (T_{zone\ air} - T_{SA,design})$$ Zones with relatively constant loads (telecom rooms, interior zones) must be designed to operate at the fully-reset temperature. *Reference:* ***Section 6.5.3.5***	Applies to all multi-zone HVAC systems.	Systems that prevent any reheating, recooling, or mixing of heated and cooled supply air are exempt. Systems where ≥75% of the energy for reheating is provided from on-site solar or on-site waste energy recovery are exempt.
Occupied-Standby Controls*	Requires certain zones to have controls that shut off airflow to the space when unoccupied, saving energy by reducing the fan power and conditioning loads when spaces are unoccupied.	All applicable mechanical zones must have controls that do the following within 5 minutes of all rooms in that zone entering occupied-standby mode, meaning that an occupancy sensor indicates that the space is unoccupied during occupied hours: 1) Adjust heating setpoint down ≥1°F 2) Adjust cooling setpoint up ≥1°F 3) Shut off all airflow to the zone when the space temperature is between the heating and cooling set points *Reference:* ***Section 6.5.3.9*** , ***Table 9.6.1***	Applies to zones in multi-zone systems that only serve one or more of the following space types*: corridors (except in hospitals), conference/meeting rooms, break rooms, music/theater/dance classrooms, lobbies (except elevator, hotel, and movie theater lobbies), enclosed offices ≤ 250 sf. * Requirement applies to spaces that are required to have either automatic full or partial off lighting controls where ASHRAE 62.1-2019 permits ventilation air to be reduced to zero in occupied-standby mode.	Multi-zone systems without automatic control flow dampers are exempt.
VAV Ventilation Optimization	Requires multi-zone variable air volume (VAV) systems to automatically reduce outdoor air intake when ventilation efficiency is high, saving energy by reducing the amount of outdoor air that needs to be heated or cooled.	All applicable systems must have controls that reduce the amount of outdoor air that the system takes in based on the needs of the individual zones. This control logic should look at the primary airflow and outdoor air fraction for all zones to determine the highest outdoor air fraction, then calculate the quantity of outdoor air required and adjust the outdoor air damper accordingly. *Reference:* ***Section 6.5.3.3***	Applies to all multi-zone VAV systems with direct digital controls (DDC) of individual zone boxes that report to a central control panel.	Systems with a total design exhaust flow of ≥70% of the total design outdoor air intake flow are exempt. VAV systems with fan-powered terminal units are exempt. Systems with zonal transfer fans that recirculate air from other zones without directly mixing it with outdoor air are exempt. Dual-duct dual-fan VAV systems are exempt.
Fan Power Limitation	Sets limits for fan system power, saving energy by limiting the energy used to move air though the HVAC systems.	All applicable systems must have a total fan system horsepower (either nameplate horsepower or bhp) that complies with the requirements below based on the supply airflow rate (cfm). If using bhp, adjustments to the limit are allowed based on the pressure drop of system devices (indicated as A in the equations below). **Constant Air Volume (CAV) Systems** $$hp_{total} \leq cfm_{supply} \times 0.0011 \quad \textbf{OR} \quad bhp_{total} \leq cfm_{supply} \times 0.00094 + A$$ **Variable air volume (VAV) Systems:** $$hp_{total} \leq cfm_{supply} \times 0.0015 \quad \textbf{OR} \quad bhp_{total} \leq cfm_{supply} \times 0.0013 + A$$ Adjustments for systems using bhp are calculated by taking the pressure drop adjustment for a device (PD) from Table 6.5.3.1-2, multiplying it by the airflow rate (cfm) through that device, and dividing by 3,141. $$A = \sum \frac{PD_{device} + cfm_{device}}{3141}$$ Common credits for system adjustments include energy recovery devices, particulate filters, and fume hoods, while deductions to the allowance must be taken off if a system does not have a central heating or cooling device or if the system uses central electric resistance heat. *Reference:* ***Section 6.5.3.1***	Applies to all heating and cooling systems with a total fan nameplate horsepower of >5 hp, including all supply, return, and exhaust fans that operate at design conditions. Note that this excludes ventilation-only systems and fans that only recirculate air locally. One fan system is considered to be separate from another if they have different heating and cooling sources.	Individual (not packaged) exhaust fans can be excluded from calculations if they have a nameplate horsepower of ≤1 hp. Hospital, vivarium, and laboratory constant volume systems with flow control devices to maintain occupant safety or environmental control can comply with the VAV limitation.
Duct Sealing^	Ensures ductwork is properly sealed, saving energy by reducing the volume of conditioned air required to properly condition spaces.	All ductwork and all applicable plenums must be constructed to Seal Class A, as defined by the Sheet Metal and Air Conditioning Contractor's National Association (SMACNA). All duct pressure class ratings must be clearly labeled in the construction documents. *Reference:* ***Section 6.4.4.2.1***	Applies to all ductwork and all plenums with pressure class ratings.	Sealing that would void product listings is not required. Spiral lock seams do not need to be sealed.

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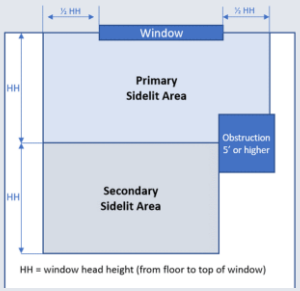
MECHANICAL REQUIREMENTS				
Duct Leakage Testing^	Sets limits for duct leakage on high-pressure ductwork, saving energy by reducing the volume of conditioned air required to properly condition spaces.	Applicable ductwork must be leak-tested according to industry standards (such as those from SMACNA). Representative sections of ductwork may be used as long as they total ≥25% of the total installed duct area for each pressure class. $Leakage \leq 4 \times P_{design\ class}^{0.65}$ *Reference:* ***Section 6.4.4.2.2***	Applies to all ductwork that is either designed to operate at static pressure >3 in. of water **OR** located outdoors.	N/A
Motorized Ventilation Dampers^	Requires motorized dampers for most ventilation systems, saving energy by reducing the leakage of outdoor air into the building and the leakage of conditioned air to the outside.	Outdoor air intake and exhaust systems must have motorized dampers that automatically shut when the systems are not in use. Dampers must automatically shut off during building warm-up, cooldown, and unoccupied setback (unless outdoor air is required to reduce energy cost or meet code ventilation requirements). *Reference:* ***Section 6.4.3.4.2***	All outdoor air and exhaust/relief dampers on systems serving conditioned spaces.	Systems with a design outdoor air intake, relief, or exhaust capacity of ≤ 300 cfm may use non-motorized dampers (intake dampers must be protected from direct exposure to wind). Exhaust systems serving Type 1 kitchen hoods do not require dampers. Systems intended for continuous operation do not require dampers.
Low-Leakage Ventilation Dampers	Sets maximum leakage requirements for dampers, saving energy by reducing the volume of air leakage between indoors and outside.	Dampers shall have a maximum leakage rate compliant with the requirements below. Motorized: leakage rate ≤ 4 cfm/sf at 1.0 in. of water Non-motorized: leakage rate ≤ 20 cfm/sf at 1.0 in. of water *References:* ***Section 6.5.1.1.4***	All outdoor air and exhaust/relief dampers.	Dampers on systems intended to operate continuously are exempt. Non-motorized dampers smaller than 24 in. in height, width, or diameter are allowed to have a leakage rate ≤ 40 cfm/sf at 1.0 in. of water.
Pool Cover^	Ensures heated pools are equipped with a pool cover, saving energy by reducing evaporative heat loss from an uncovered pool during unoccupied times.	Heated pools must have a vapor-retardant pool cover on or at the water surface. Pools heated to more than 90°F must have a pool cover with an insulation value of ≥ R-12. *Reference:* ***Section 7.4.5.2***	All heated pools.	Pools where >60% of the heating energy is provided from on-site solar or on-site waste energy recovery are exempt.
HVAC Commissioning*^	Requires that mechanical systems are reviewed regularly to ensure correct design and construction, saving energy by ensuring all systems are operating properly and compliant with the energy code.	Commissioning must be performed on the building's mechanical systems by either a third party entity, the owner's qualified employees, or an individual not directly associated with the design or installation of the systems being tested. Commissioning includes the functional testing required in Section 6.9.1 as well as additional activites during design and construction of the building. Details on specific commissioning requirements can be found in Appendix H. **Prior to Building Permit Issuance:** 1) Commissioning provider must be designated and identified on construction documents 2) Commissioning plan (4.2.5.2.2(a)) and design review report (4.2.5.2.2(b)) must be submitted to owner 3) Commissioning requirements must be included in construction documents **Prior to Building Occupancy:** 1) Preliminary commissioning report (4.2.5.2.2(c)) must be provided to owner 2) Owner must provide building official a letter confirming receipt of preliminary commissioning report *Reference:* ***Section 6.9.2***	Applies to all buildings with ≥10,000 sf of conditioned space (or ≥960,000 Btu/h of combined heating, cooling, and service water heating loads) except dwelling units and nonrefrigerated warehouses. If a building contains dwelling units and/or nonrefrigerated warehouse areas in addition to other non-exempt areas, commissioning is only required if the non-exempt spaces combine to meet the requirements of ≥10,000 sf of conditioned space or ≥960,000 Btu/h of combined heating, cooling, and service water heating loads (with central systems serving the non-exempt spaces included the capacity total).	Buildings using the Simplified Approach to comply with HVAC requirements are exempt.
LIGHTING REQUIREMENTS				
Interior Lighting Power Density*	Limits total interior lighting power, saving energy by ensuring spaces aren't grossly overlit.	The total installed interior lighting power should not exceed the interior lighting power allowance for the project, which may be calculated using either the Building Area Method or the Space-by-Space Method. **Building Area Method (Section 9.5):** Lighting power allowance (W) is calculated using one lighting power density (LPD) value (W/sf) based on the primary building type (from Table 9.5.1), mutiplying the building area* by the LPD allowance. If there is more than one building type, the total lighting power allowance is the sum of the lighting power allowances of all building types. $W_{allowed,total} = \sum A_{building} \times LPD_{allowed,building}$ **Space-by-Space Method (Section 9.6):** Lighting power allowance (W) is calculated using lighting power density (LPD) values (W/sf) for each space in the project (from Table 9.6.1), multiplying the space area* by the LPD allowance. The total lighting power allowance for the project is the sum of the lighting power allowance of all spaces. Additional lighting power may be added to this allowance for art/exhibit areas, retail areas, areas with unusual geometry, and areas using lighting controls beyond code requirements (details for these applications can be found in Section 9.6). $W_{allowed,total} = \sum A_{space} \times LPD_{allowed,space} + \sum W_{allowed,additional}$ *Area values for buildings and spaces must be based on gross area measurements, which extend all the way to the outside edge of exterior walls and to the centerline of walls between spaces (or buildings). *References:* ***Sections 9.5 or 9.6, Tables 9.2.3.1, 9.5.1 & 9.6.1***	Applies to all spaces in all buildings except for multifamily dwelling units.	Alterations involving <20% of the total connected lighting load in a space or area are exempt from LPD requirements as long as they don't increase the lighting load. Some lighting equipment and applications are exempt from lighting power requirements if they meet certain control requirements. These applications include lighting for theatrical purposes, lighting in casino gaming areas, lighting for medical procedures, and lighting integral to certain equipment. A detailed list of these exceptions and their requirements can be found in Table 9.2.3.1.

MEASURE	INTENT	TECHNICAL REQUIREMENTS & CODE SECTION REFERENCES	APPLICABILITY	NOTABLE EXCEPTIONS
LIGHTING REQUIREMENTS				
Full Off Lighting Controls^	Provides controls that turn off lights when spaces are unoccupied, saving energy by ensuring lights aren't on when they aren't needed.	Controls that fully turn off lights when a space is unoccupied are required for most building spaces. These controls can either be based on occupancy sensor controls or an occupancy schedule. Automatic Full Off (9.4.1.1(h)): All lighting (including emergency circuits) must be shut off within 20 minutes of all occupants leaving the space. Each control device should control ≤5,000 sf. Scheduled Shutoff (9.4.1.1(i)): All lighting (including emergency circuits) must be shut off when the space is scheduled to be unoccupied, either via a programmed time clock in the space or a signal from another control device. These independent control sequences should control ≤25,000 sf, only control areas on one floor, and account for weekends and holidays. If manual override controls are provided, they should control ≤5,000 sf each and should only allow controls to be overridden for a maximum of 2 hours. *References:* ***Sections 9.4.1.1(h)/(i), 9.4.1.2, Table 9.6.1***	Applies to all space types except electrical/mechanical rooms, dwelling units, and interior parking areas (see below). Most space areas are able to meet this requirement with either automatic full off or scheduled shutoff controls except for the following space types, which require automatic full off controls: classrooms, conference rooms, restrooms, locker rooms, lounges/breakrooms, copy/print rooms, enclosed offices ≤250 sf, storage rooms ≥50 sf, dressing/fitting rooms, and performing arts dressing rooms. Parking garages require scheduled shutoff controls AND a 50% reduction in lighting power after 10 minutes without activity. Control zones should be ≤3,600 sf.	Lighting required for 24/7 operation is exempt. Lighting in shop or laboratory classrooms is exempt. Lighting in patient care spaces is exempt. Lighting required for occupant safety or security reasons is exempt. A lighting load of ≤0.02 W/sf for the total building area may be exempt if used for emergency egress purposes. Some lighting equipment and applications are exempt from lighting control requirements if they meet certain other control requirements. These applications include lighting for theatrical purposes, lighting in casino gaming areas, lighting for medical procedures, and lighting integral to certain equipment. A detailed list of these exceptions and their requirements can be found in Table 9.2.3.1.
Automatic Partial Off Lighting Controls^	Provides controls that turn off lights when spaces are unoccupied, saving energy by ensuring lights aren't on when they aren't needed.	Lighting control systems for applicable spaces must reduce the lighting power in the space by at least 50% within 20 minutes of all occupants leaving the space. Controls that fully turn off the lights are compliant with this requirement. *References:* ***Sections 9.4.1.1(g), 9.4.1.2, Table 9.6.1***	Applies to corridors, lobbies, stairwells, warehouses, library stacks, post office sorting areas, and interior parking areas (see below). Parking garages require scheduled shutoff controls AND a 50% reduction in lighting power after 10 minutes without activity. Control zones should be ≤3,600 sf.	Elevator, hotel, and movie theater lobbies are exempt. Corridors in hospitals may install scheduled shutoff controls instead of automatic partial off controls.
Exterior Photocell Controls^	Provides controls that turn off exterior lighting when daylight is available, saving energy by preventing redundant site lighting operation.	Exterior lighting must be automatically turned off when sufficient daylight is available. *Reference:* ***Section 9.4.1.4(a)***	Applies to all exterior lighting fixtures.	Covered vehicle entrance and exit lighting is exempt if required for safety, security, or eye adaptation. Lighting integral to signage is exempt if the lighting is installed in the signage by the manufacturer.
Exterior Overnight Controls^	Provides controls that turn off certain exterior lights overnight, saving energy by preventing decorative lighting from operating when not needed.	Lighting must be automatically shut off between the later of either midnight or business closing and the earlier of either 6 a.m. or business opening. *Reference:* ***Section 9.4.1.4(b)***	Applies to all building façade and landscape lighting fixtures.	N/A
Exterior Partial Off Controls^	Provides controls that reduce exterior lighting power when spaces aren't occupied, saving energy by ensuring lights aren't fully on when full power isn't needed.	Lighting power must be automatically reduced by at least 50% for at least one of the following conditions: 1) Between the later of either midnight or business closing and the earlier of either 6 a.m. or business opening 2) When no activity has been detected for no longer than 15 minutes Parking lot fixtures >78 W and mounted ≤24 ft above ground must use the second option above. Parking lot control zones must control ≤1500 W each. *Reference:* ***Section 9.4.1.4(c)/(d)***	Applies to all exterior lighting fixtures except building façade and landscape lighting fixtures.	Covered vehicle entrance and exit lighting is exempt if required for safety, security, or eye adaptation. Lighting integral to signage is exempt if the lighting is installed in the signage by the manufacturer.
Multi-Level Lighting^	Provides controls that allow the lighting level in a space to be set to partial power, saving energy by allowing occupants to dim lights as needed.	Applicable spaces must have controls that provide at least one intermediate step in lighting power in addition to full on and full off. At least one intermediate step must be between 30% and 70% of full power. Continuous dimming controls are compliant with this requirement. *Reference:* ***Section 9.4.1.1(d)***	Applies to all space types except atriums <20 ft in height, corridors, dwelling units, electrical/mechanical rooms, emergency vehicle garages, lobbies, restrooms, storage rooms, baggage areas and airport concourses.	Seating areas are exempt if they do not serve auditoriums, gymnasiums, movie/performing arts theaters, or religious facilities.

MEASURE	INTENT	TECHNICAL REQUIREMENTS & CODE SECTION REFERENCES	APPLICABILITY	NOTABLE EXCEPTIONS
		LIGHTING REQUIREMENTS		
Daylight Controls^	Provides controls that turn off or dim lights when daylight is available, saving energy by ensuring lights aren't on when they aren't needed.	Daylight controls for primary and secondary sidelighted areas must have the following characteristics: 1) Must be able to turn off lighting and provide continuous dimming down to 20% or less in response to available daylight levels 2) Calibration adjustment control must be no higher than 11 ft above the floor and must not require someone to be present to calibrate 3) If the space has automatic partial off controls, the daylight controls must not increase the lighting level above the level set by the automatic partial off controls **Primary Sidelighted Area** **Width:** width of window plus, on each side, the smaller of either half of the window's head height (distance from floor to top of glazing) or the distance to any 5 ft or higher opaque obstruction (such as a wall or partition) **Depth:** the smaller of either the window's head height or the distance to any 5 ft or higher opaque obstruction **Secondary Sidelighted Area** **Width:** same as primary area's width **Depth**: beginning at the end of the primary area's depth, the smaller of either the window's head height or the distance to any 5 ft or higher opaque obstruction  There are similar requirements for areas under skylights and roof monitors: details can be found in section 9.4.1.1(f). *References:* ***Sections 9.4.1.1(e)/(f), 9.4.1.2***	Applies to sidelighted areas with a combined lighting power >150 W in the primary sidelighted area or >300 W in the combined primary and secondary sidelighted areas. Daylight controls are required for all parking garage fixtures within 20 ft of perimeter wall openings >24 sf.	Controls are not required in sales areas, dwelling units, storage rooms <50 sf, medical imaging rooms, medical operating rooms, and retail dressing/fitting rooms. Sidelighted areas with a total glazing area of <20 sf are exempt. Primary sidelighted areas shaded by external projections, existing tall structures, or natural objects may be exempt: see Section 9.4.1.1(e) for details.
Lighting System Functional Testing^	Requires that lighting controls are tested before the building is operational, saving energy by ensuring that the lighting controls are operating as intended.	Lighting control systems must be tested to verify that the hardware and software are installed properly in accordance with the construction documents and manufacturer's instructions. Testing providers must be indicated on the construction documents, and cannot be individuals who performed the design or installation of the systems being testing. Functional testing must be conducted for control systems using occupancy sensors, automatic time switches, and daylight controls. Specific testing requirements for these systems are detailed in Section 9.9.1. Testing results must be provided to the owner before a certificate of occupancy is issued along with a detailed plan for any deferred testing (such as tests that require certain seasonal climatic conditions). The owner must provide the building official a letter confirming receipt of testing results. *References:* ***Sections 9.9.1, 4.2.5.1***	Applies to all spaces with occupancy sensors, time switches, and photosensors.	N/A
Lighting System Commissioning*^	Requires that lighting systems are reviewed regularly to ensure correct design and construction, saving energy by ensuring all systems are operating properly and compliant with the energy code.	Commissioning must be performed on the building's lighting systems by either a third party entity, the owner's qualified employees, or an individual not directly associated with the design or installation of the systems being tested. Commissioning includes the functional testing required in Section 9.9.1 as well as additional activites during design and construction of the building. Details on specific commissioning requirements can be found in Appendix H. **Prior to Building Permit Issuance:** 1) Commissioning provider must be designated and identified on construction documents 2) Commissioning plan (4.2.5.2.2(a)) and design review report (4.2.5.2.2(b)) must be submitted to owner 3) Commissioning requirements must be included in construction documents **Prior to Building Occupancy:** 1) Preliminary commissioning report (4.2.5.2.2(c)) must be provided to owner 2) Owner must provide building official a letter confirming receipt of preliminary commissioning report *References:* ***Sections 9.9.2, 4.2.5.2, Appendix H***	Applies to all buildings with ≥10,000 sf of conditioned space (or ≥960,000 Btu/h of combined heating, cooling, and service water heating loads) except dwelling units and nonrefrigerated warehouses. If a building contains dwelling units and/or nonrefrigerated warehouse areas in addition to other non-exempt areas, commissioning is only required if the non-exempt spaces combine to meet the requirements of ≥10,000 sf of conditioned space or ≥960,000 Btu/h of combined heating, cooling, and service water heating loads (with central systems serving the non-exempt spaces included the capacity total).	Buildings using the Simplified Approach to comply with HVAC requirements are exempt.

This material is based on work supported by the US Department of Energy's Energy Efficiency & Renewable Energy Office (EERE) under Award Number DE-EE0010933