Webinar Training

Overview of the Commercial Provisions of the 2021 Oregon Energy Efficiency Specialty Code

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Acknowledgements

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ASHRAE Oregon Chapter

https://www.energycodes.gov

https://www.orashrae.org/

State of Oregon Building Codes Division

Better Buildings for Oregon

https://www.oregon.gov/bcd/codes-stand/Pages/index.aspx

Commercial Energy Code

Oregon **Building Codes Division** is moving towards quick adoption of ASHRAE 90.1 as state code within a year of publication

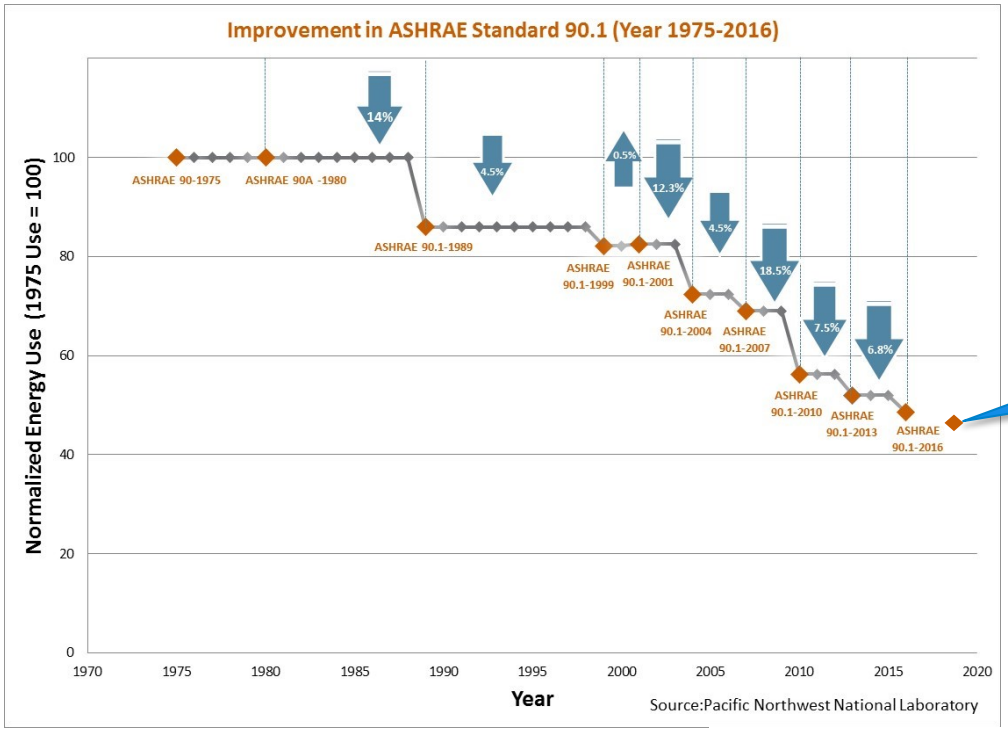
- ASHRAE 90.1-2016 in October 2019
- ASHRAE 90.1-2019 in April 2021

Incorporation of Architecture 2030 Framework for estimating energy consumption and renewables for a Zero Net Energy Building

Benefits of 90.1 Include

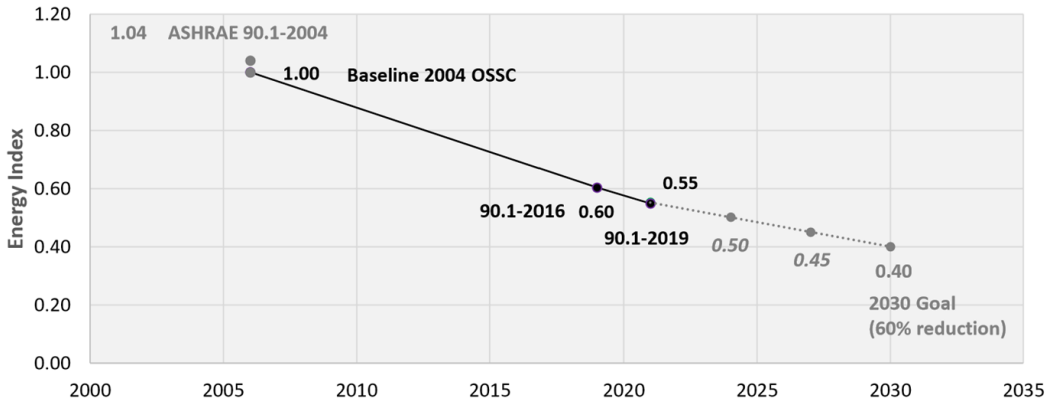
- Quicker, less resource-intensive, streamlined adoption (i.e. more buildings under advanced code)
- More predictable
- Comprehensive cost analysis
- Federal declaration/certification becomes easy

ASHRAE Historic Savings

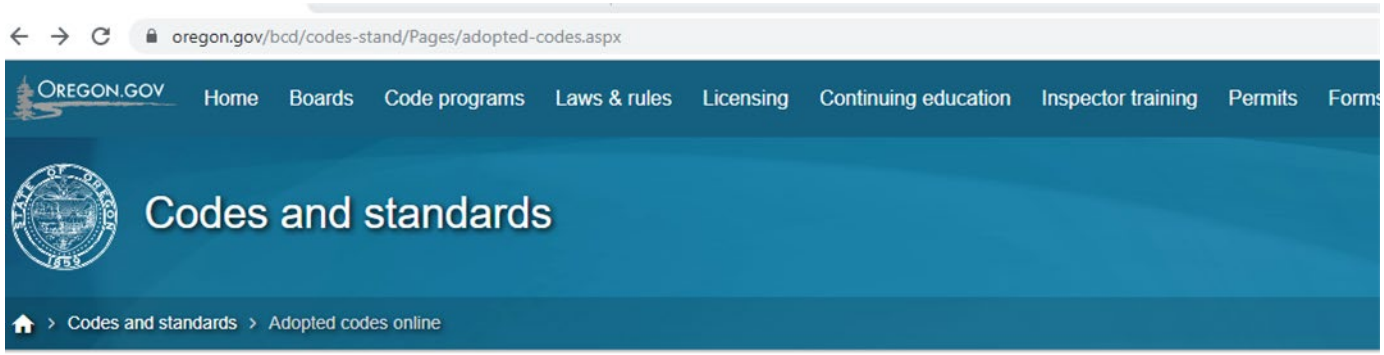


90.1-2019 found to be ~5% better than 90.1-2016

Code Progression, Code-Regulated Loads Only (PNNL Regulated Site Energy Results)



Current Oregon Energy Code



2021 Oregon Energy Efficiency Specialty Code (OEESC)

Effective April 1, 2021 | Grace period ends Oct. 1, 2021

Based on ASHRAE Standard 90.1-2019

Significant changes summary

- https://www.oregon.gov/bcd/codes-stand/Pages/adopted-codes.aspx
- Read only versions of 90.1 are available

Compliance Pathways

OR Code Compliance Pathways

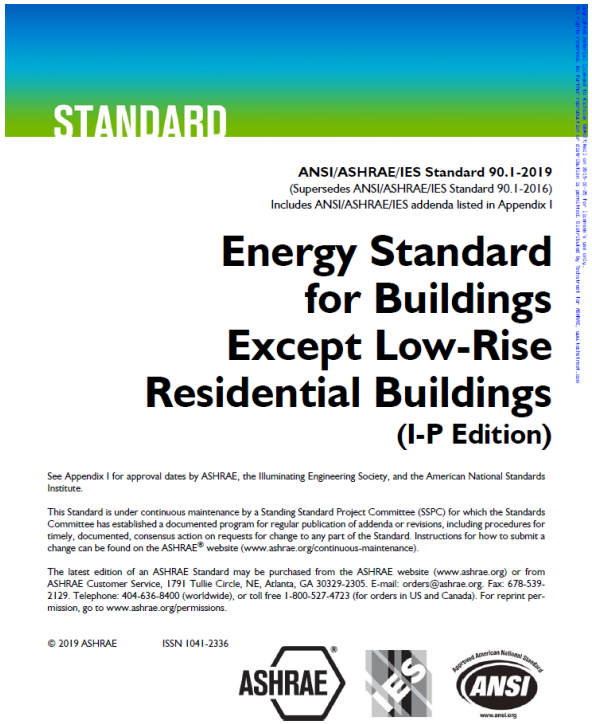
2021 OEESC

(based on 90.1-2019 with state amendments)

Effective April 1,2021
6-month grace period for projects
Mandatory beginning October 1, 2021

90.1-2019 Chapter Organization

- 1 Purpose
- 2 Scope
- 3 Definitions, Abbreviations & Acronyms
- 4 Administration & Enforcement
- 5 Building Envelope
- 6 Heating, Ventilating & Air Conditioning
- 7 Service Water Heating
- 8 Power
- 9 Lighting
- 10 Other Equipment
- 11 Energy Cost Budget Method
- 12 Normative References
- Normative Appendices A-H



Significant Change Summary from 90.1-2016: https://www.oregon.gov/bcd/codes-stand/Documents/21oeesc-summary-matrix.pdf

Three Paths Through 90.1

Mandatory Requirements

Plus One

Prescriptive Requirements

Chapter 11 Performance (ECB)

Appendix G Performance (PRM)

Two Performance Paths

Chapter 11 Performance (ECB)

- **Energy Cost Budget Method (ECB) - Chapter 11**
  - Used for minimum code compliance for buildings that do not meet 90.1 prescriptive requirements
  - Requires no greater energy cost than a building that meets those prescriptive requirements

Appendix G Performance (PRM)

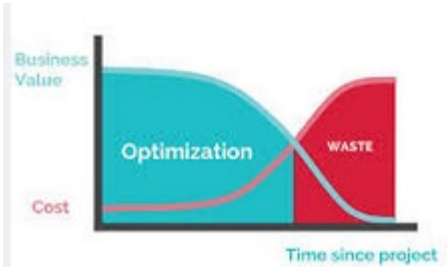
- **Performance Rating Method - Appendix G**
  - Previously used to rate building performance "beyond code".
    - » LEED, EPACT tax credits, utility programs, ASHRAE Standard 189.1, IgCC
  - % improvement = 100 x (baseline – proposed) ÷ baseline

Performance Pathways

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Ch. 11, Appendix G	506

- Previous 2014 Oregon code contained Section 506 Whole Building Approach, based on 90.1 Ch. 11 Energy Cost Budget
- 90.1 includes two performance paths for code compliance, Ch.11 and Appendix G
  - Both based on energy simulation
  - Both compare a proposed building design to a baseline building meeting the prescriptive requirements of the code
  - Both compare the annual energy cost ($) of the proposed building to the baseline building

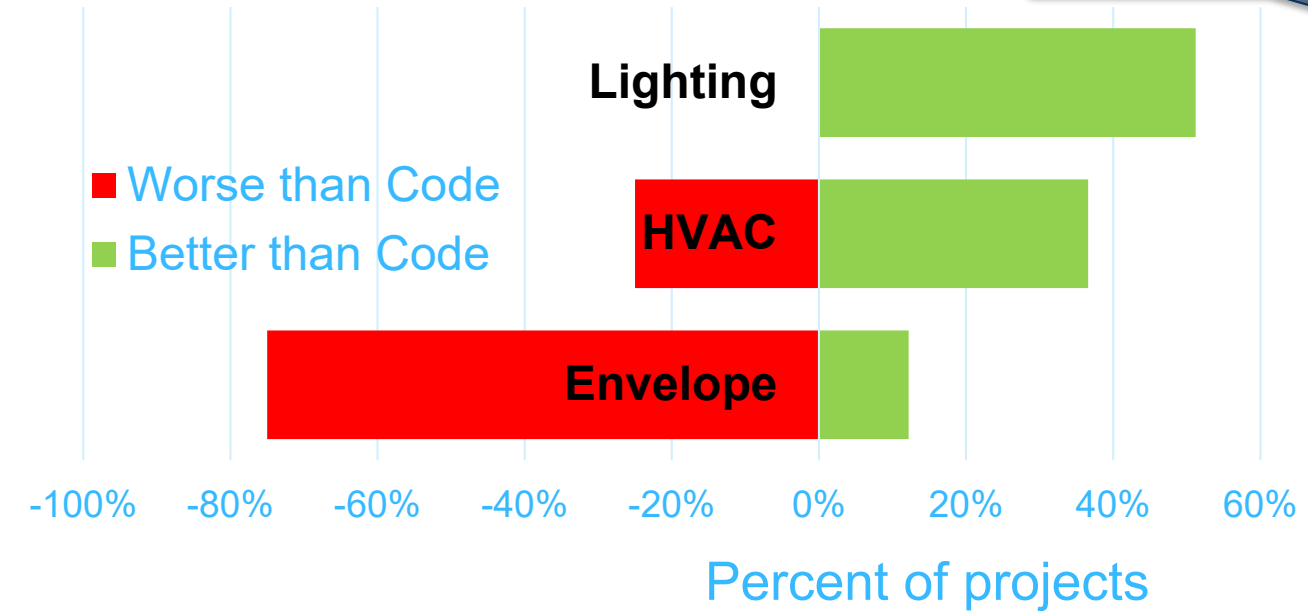
Why use a Performance Path?



- To demonstrate compliance for projects that cannot use the prescriptive path
- To make-up for systems not meeting prescriptive requirements of 90.1 by exceeding requirements for other systems
- To evaluate building performance in terms of energy cost
  - Impact of design decisions on future utility bills
  - Economic analysis of various options
- To document above-code performance

Common Trade-offs

Based on a national survey, most projects that use modeling to comply with code trade off worse-than-code envelope for better-than-code lighting and HVAC



What to Look for?

- Trade off Limits
  - Mandatory Provisions (Sections 5.4, 6.4, 7.4, 8.4, 9.4, 10.4)
  - Operating Schedules

- Except where specifically instructed, all building systems and equipment shall be modeled identically for both the proposed design and baseline building design

Special Cases

- **Retrofit Projects**
  - Same baseline as new construction projects
  - Proposed design modeled as it exists after renovation is completed

- **Core and Shell Projects**
  - Same baseline as new construction projects
  - When energy-related features have not yet been designed (e.g., a lighting system), those yet-to-be-designed features must be modeled in the proposed design to comply with but not exceed the applicable requirements of the current edition of 90.1

Appendix G Performance Rating Method Resources

- 90.1-2016 Performance Rating Method Reference Manual
- https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-26917.pdf
- Modelers: Use to build proposed design model
- Code Officials: Use to understand modeling requirements and interpretations

Mainly Focus on Prescriptive Path

Prescriptive Requirements

Mandatory Requirements

Plus One

Chapter 11 Performance (ECB)

Appendix G Performance (PRM)

Compliance and COMcheck

COMcheck Background

COMcheck Resources

COMcheck

Commercial Compliance Using COM*check*™

The COM*check* software product group makes it easy for architects, builders, designers, and contractors to determine whether new commercial or high-rise residential buildings, additions, and alterations meet the requirements of the IECC and ASHRAE Standard 90.1, as well as several state-specific codes. COM*check* also simplifies compliance for building officials, plan checkers, and inspectors by allowing them to quickly determine if a building project meets the code.

COM*check* Desktop may be downloaded and installed directly to your desktop, while COM*check-Web*™ is accessible directly from the website without having to download and install.

View a list of supported software versions for code compliance tools

See if your state or county can use COM*check* to show compliance

COM*check-Web*

Start COMcheck-Web

COM*check-Web* simplifies commercial and high-rise residential energy code compliance. It performs just like the desktop version of COM*check*, but you don't need to download or install any software on your computer.

Latest version release: March 8, 2021
View Release Notes to see what's new in this version.

Supported Codes:
2009, 2012, 2015 and 2018 IECC.
ASHRAE Standard 90.1-2007, 2010, 2013, 2016, 2019
Various state-developed energy codes including: Colorado (Boulder and Denver), Florida, Massachusetts, New York City (NYCECC), New York State (NYECCC), NYStretch, Vermont; as well as Ontario and Puerto Rico.

COM*check*™ for Windows®

Download COMcheck for Windows

Runs on Windows 7/8/10 in either single, multi-user, or network environments.
Note that the Mac version of COM*check* has been discontinued. Mac users are advised to use COM*check*-Web.

Version 4.1.5 (Build Version: 4.1.5.1)
View Release Notes to see what's new in this version.

Supported Codes:
2009, 2012, 2015 and 2018 IECC.
ASHRAE Standard 90.1-2007, 2010, 2013, 2016
Various state-developed energy codes including: Colorado (Boulder and Denver), Florida, Massachusetts, New York City (NYCECC), NYStretch, Vermont; as well as Ontario and Puerto Rico.

COM*check* Support

Have a compliance question or need assistance with the software?
BECP's team of building energy codes experts is available to answer specific questions submitted through our web-based help desk .

Com*check* Software Support Documents

- Technical Support Document for Version 3.9.1 of the COM*check* Software

Link

https://www.energycodes.gov/comcheck

neea

Building Envelope

Space-conditioning Categories

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
5.1.2	101.5.2, 502.1

Separate envelope component requirements apply to three types of spaces

- *Nonresidential conditioned*
- *Residential conditioned*
- *Semiheated*

- *Nonresidential:* all occupancies other than residential.
  - Defining characteristic is that no one is there at night and whether it is a dwelling unit

- *Residential*: *spaces* in buildings used primarily for living and sleeping
  - ex. dwelling units, hotel/motel guest rooms, hostels, prisons, fire stations

- *Semiheated: spaces* have a heating system with system greater than 3.4 Btu/h·ft^2 but not heated to comfort levels, and not cooled.

Unconditioned Spaces

- *Unconditioned space:* an *enclosed space* within a *building* that is not a *conditioned space* or a *semiheated space*.
  - Crawlspaces, attics, and parking garages with natural or mechanical *ventilation* are not considered *enclosed spaces*.

- Unconditioned spaces are not automatically exempt from all building envelope requirements

- *How to identify:*
  - *An unconditioned space* does not have a space cooling system and either does not have a space heating system or the space heating system has a capacity that is less than 3.4 Btu/h·ft^2. The default assumption is that all spaces are conditioned or semiheated.

Semiheated Spaces

- A semiheated space:
  - Has a heating system with a capacity ≥ 3.4 Btu/h.ft^2 of floor area but is not conditioned space
  - Space is not cooled at all
- Spaces are no longer considered semiheated (become "conditioned" space) if heating thresholds exceed the following:

"Conditioned Space" Heating Thresholds, btu/h-ft^2		
Climate Zone	2021 Oregon / 90.1-2019	2014 OEESC
4C	>8	>10
5	>12	>15

Reduced thresholds for "conditioned" space means fewer buildings can qualify as "semiheated"

- Spaces are assumed to be *conditioned space* and comply with requirements of *conditioned space* at time of construction regardless of whether the mechanical or electrical equipment is included in the building permit application or installed at that time
- Exceptions:
  - » Space is designated as semiheated or unconditioned and
  - » Approved as such by the building official
  - » A space with limited radiant heating system meeting the requirements of Section 6.5.8.2 shall be considered an *unconditioned space*.

Alteration Exceptions

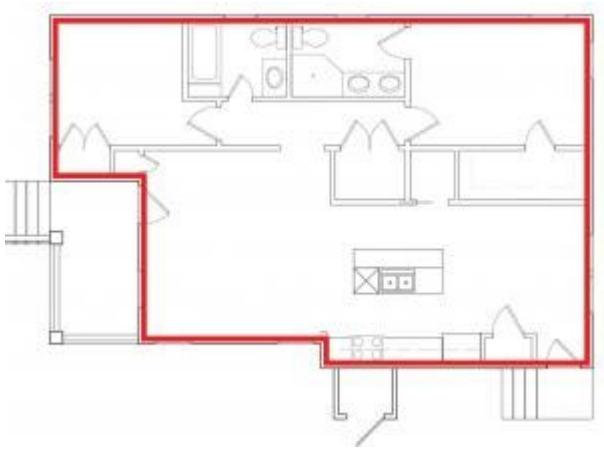
There are a number of exceptions where alterations to envelope are not required to meet code for insulation, air leakage, and fenestrations, provided the alteration will not increase the energy use of the building

- Storm windows over existing glazing (low emissivity coating)
- Replacement of glazing in existing sash and frame, provided U-factor and SHGC are same or better
- Alterations to the roof, wall, or floor cavities that are insulated to full depth with R-3 per inch
- Alterations to walls and floors without framing cavities and no new cavities are created
- Roof recovering
- Removal and replacement of roof membrane where there is existing roof insulation either integral to or below the roof deck
- Replacement of doors does not require the installation of a vestibule
- Replacement of existing fenestration up to 25% of existing building fenestration and provided that U-factor and SHGC are the same or better

Air-Leakage

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
5.4.3	502.4

Mandatory air-leakage requirements exist for:



Continuous Air Barriers

Loading dock weather seals

Vestibules and revolving doors

Air-Leakage

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
5.4.3	502.4

- Continuous air barrier required in all buildings covered by the Standard except *Semiheated* spaces
  - Measured whole building air-leakage rate not to exceed 0.40 cfm/ft^2 (at a pressure differ. of 0.3 in. of water)
- New exception in 90.1-2019 that was not in 90.1-2016:
  - Not required if meeting *Continuous air barrier* design and installation verification program meeting requirements of 5.9.1.2

Verification of Air Barrier Design & Installation

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
5.9.1.2	N/A

Verification of the Design and Installation of the Continuous Air Barrier

- Verification of the design and installation of the continuous air barrier shall be determined in accordance with the following by an independent third party when using Exception 3 of Section 5.4.3.1.1:
  a. A design review shall be conducted to verify and document compliance with the requirements in Sections 5.4.3 and 5.8.3.2.
  b. Periodic field inspection of the continuous air barrier materials and assemblies shall be conducted during construction while the continuous air barrier is still accessible for inspection and repair to verify and document compliance with the requirements of Sections 5.4.3.1.2 and 5.8.3.
  c. Reporting shall comply with Section 4.2.5.1.2.

Vestibules

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
5.4.3.3	502.4.6

- Vestibules are generally required in commercial spaces, but there are a number of exceptions:
  - **Exceptions to 5.4.3.3**

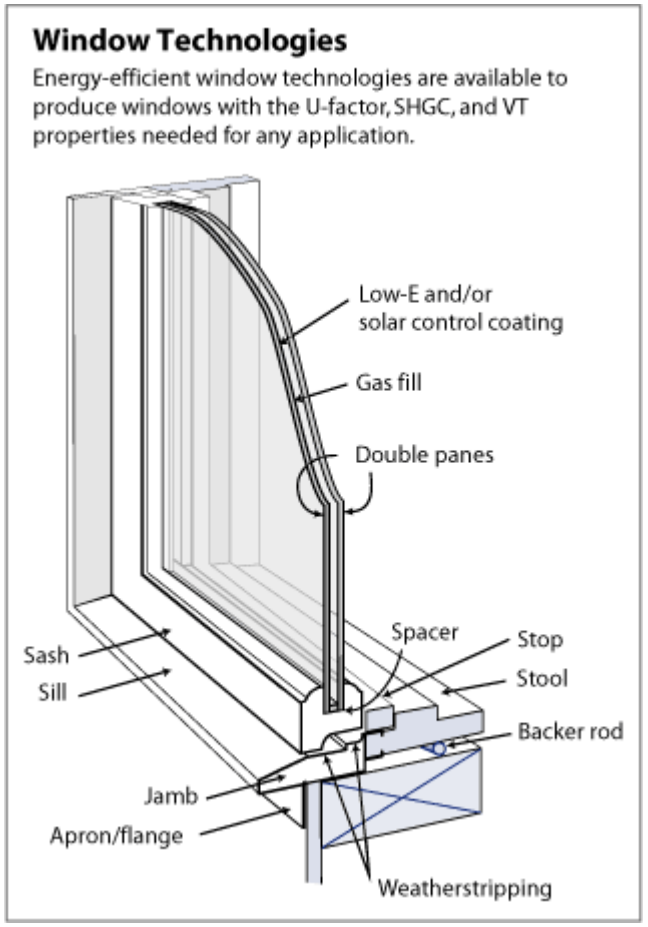
1. *Doors* not intended to be used as a *building entrance.*
2. *Doors* opening directly from a *dwelling unit.*
3. *Building entrances* in *buildings* located in Climate Zone 1 or 2.
4. *Doors* opening into *semiheated spaces*.
5. Enclosed elevator lobbies for *building entrances* directly from parking garages.
6. *Building entrances* in *buildings* that are located in Climate Zone 3, where the *building* is less than four stories above *grade* and less than 10,000 ft^2 in *gross conditioned floor area.*
7. *Building entrances* in *buildings* that are located in Climate *Zone* 0, 4, 5, 6, 7, or 8, where the *building* is less than 1,000 ft^2 in *gross conditioned floor area.*
8. *Doors* that open directly from a *space* that is less than 3,000 ft^2 in area and is separate from the *building entrance.*
9. Self-closing *doors* in *buildings* in Climate Zones 0, 3, and 4 that have an air curtain complying with Section 10.4.5.
10. Self-closing *doors* in *buildings* 15 stories or less in Climate Zones 5 through 8 that have an air curtain complying with Section 10.4.5.
11. Buildings under 25,000 ft^2 (2,322 m^2) meeting the requirements of Section 5.4.3.1.1 with a leakage rate less than 0.30 cfm/ft^2.

Opaque Assemblies & Fenestration

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Tables 5.5-4, 5.5-5	Tables 502.1.1, 502.1.2

- 90.1-2016 and 2019 included comprehensive updates to the fenestration prescriptive requirements

Example	ASHRAE 90.1-2019	OEESC 2014	Reduction
Frame Wall	U-0.064	U-0.064	0.0%
Roof Deck	U-0.032	U-0.048	33.3%
Fixed Windows	U-0.36	U-0.45	20.0%
SHGC	0.36	0.40	10.0%



Opaque Assemblies & Fenestration

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Tables 5.5-4, 5.5-5	Tables 502.1.1, 502.1.2

- Fenestration is now based on type, not material

Fenestration	Assembly Max. U	Assembly Max. *SHGC*	Assembly Min. *VT/SHGC*
Vertical Fenestration, 0% to 40% of *Wall*			
Fixed	0.36	0.36	1.10 (for all types)
Operable	0.45	0.33	
Entrance door	0.63	0.33	

Fenestration	Assembly Max. U	Assembly Max. *SHGC*
Vertical F 0% to 40		l frame
Nonmetal framin		0.45
Metal framin		
Metal fra	0.35	
Metal framing, entrance door	0.68	

Opaque Assemblies & Fenestration

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Tables 5.5-4, 5.5-5	Tables 502.1.1, 502.1.2

- Fenestration is now based on type, not material
- Categories for “non-metal framed” and “metal framed” products were combined. Single U-factor requirement, regardless of frame construction material. Fixed frame metal requires better performance; non-metal frames have less restrictive requirement.

SHGC Change for a Fixed, Metal Framed Window

SHGC	0	1	2	3	4	5	6	7	8
2016	0.22	0.25	0.25	0.25	0.36	0.38	0.40	0.45	0.45
2019	0.22	**0.23**	0.25	0.25	0.36	**0.36**	**0.38**	**0.40**	**0.40**

U-Factor Change for a Fixed, Metal Framed Window

U-factor	0	1	2	3	4	5	6	7	8
2016	0.50	0.57	0.54	0.45	0.38	0.38	0.36	0.33	0.29
2019	0.50	**0.50**	**0.45**	**0.42**	**0.36**	**0.36**	**0.34**	**0.29**	**0.26**

Example of stringency improvements –
note this comparison is based on both a window type and frame material

Minimum Skylight Fenestration Area

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
5.5.4.2, Tables 5.5-4, 5.5-5	N/A

- In any enclosed space in a building that is
  - 2,500 ft^2 and greater;
  - directly under a roof with ceiling heights greater than 15 ft; and
  - one of the following space types: **office, lobby, atrium, concourse, corridor, storage (including nonrefrigerated warehouse), gymnasium, fitness/exercise area, playing area, gymnasium seating area, convention exhibit/event space, courtroom, automotive service, fire station engine room, manufacturing corridor/transition and bay areas, retail, library reading and stack areas, distribution/sorting area, transportation baggage and seating areas, or workshop,**
- the total daylight area under skylights shall be a minimum of half the floor area and either
  - provide a minimum skylight area to daylight area under skylights of 3% with a skylight VT of at least 0.40 or
  - provide a minimum skylight effective aperture of at least 1%.
- These skylights shall have a glazing material or diffuser with a measured haze value greater than 90% when tested according to ASTM D1003. General lighting in the daylight area shall be controlled as described in Section 9.4.1.1(f).

Minimum Skylight Fenestration Area

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
5.5.4.2, Tables 5.5-4, 5.5-5	N/A

- Exceptions:
  - *Enclosed spaces* in Climate Zones 6 through 8
  - *Enclosed spaces* where it is documented that existing structures or natural objects block direct-beam sunlight on at least half of the roof over the enclosed space for more than 1500 daytime hours per year between 8 a.m. and 4 p.m.
  - Enclosed spaces where the daylight area under roof monitors is greater than 50% of the enclosed space floor area.
  - Enclosed spaces where it is documented that 90% of the skylight area is shaded on June 21 in the Northern Hemisphere (December 21 in the Southern Hemisphere) at noon by permanent architectural features of the building.
  - Enclosed spaces where the total area minus the primary sidelighted area and secondary sidelighted area is less than 2500 ft^2 and where the lighting is controlled according to sidelighting requirements described in Section 9.4.1.1(e).

Overhang Adjustments

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
5.5.4.4	N/A

- 90.1 credits permanent overhangs by adjustment to SHGC
- Size of overhang is determined by projection factor

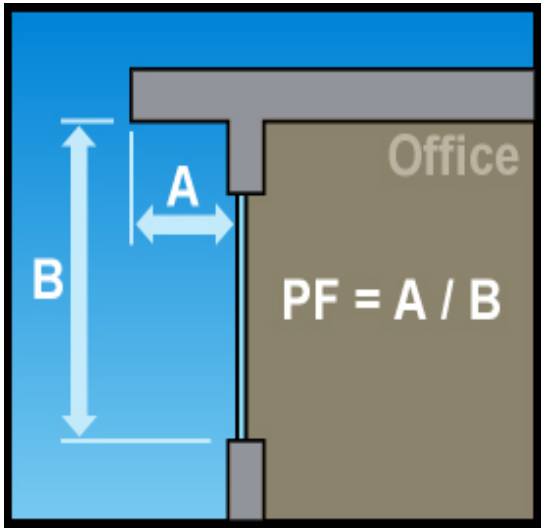
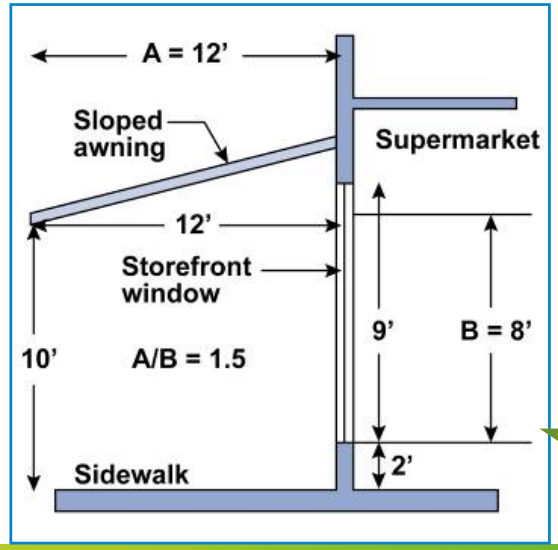


Table 5.5.4.4.1 ***SHGC*** **Multipliers for Permanent Projections**

Projection Factor	*SHGC* Multiplier (South, East, and West Orientations)
0 to 0.10	1.00
>0.10 to 0.20	0.91
>0.20 to 0.30	0.82
>0.30 to 0.40	0.74
>0.40 to 0.50	0.67
>0.50 to 0.60	0.61
>0.60 to 0.70	0.56
>0.70 to 0.80	0.51
>0.80 to 0.90	0.47
>0.90 to 1.00	0.44

PF is a COMcheck entry

Projection Factor	
0.50	
0.00	



Changes in Window-to-Wall Ratio (WWR)

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Tables 5.5-4, 5.5-5	Table 502.3

- One large energy saver from 2014 OEESC was limiting WWR to 30%
- ASHRAE 90.1 allows up to 40% WWR in Climate Zones 4C & 5B (CZ4 shown below)

Table 5.5-4 *Building Envelope* Requirements for Climate Zone 4 (A,B,C)*

	Nonresidential			*Residential*			Semiheated	
Fenestration	Assembly Max. U	Assembly Max. *SHGC*	Assembly Min. *VT/SHGC*	Assembly Max. U	Assembly Max. SHGC	Assembly Min. *VT/SHGC*	Assembly Max. U	Assembly Max. *SHGC*
Vertical Fenestration, 0% to 40% of *Wall*								
Fixed	0.36	0.36	1.10 (for all types)	0.36	0.36	1.10 (for all types)	0.50	NR (for all types)
Operable	0.45	0.33		0.45	0.33		0.65	
Entrance door	0.63	0.33		0.63	0.33		0.77	
Skylight, 0% to 3% of *Roof*								
All types	0.50	0.40	NR	0.50	0.40	NR	0.75	NR

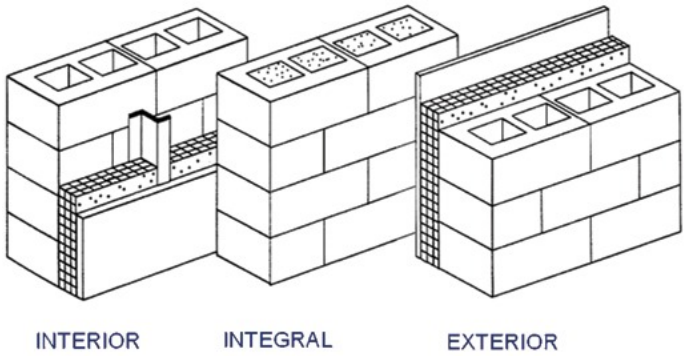
Mass Walls

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
5.5.3.2, Tables 5.5-4, 5.5-5	502.2.3, Tables 502.1.1, 502.1.2

- Exception in 2014 OEESC for above-grade mass walls (commonly single-wythe CMU) if they are mostly open and/or semiheated spaces
  - Ex. gymnasium, auditorium, arena, kennel, warehouse

	90.1 Climate Zone 4	*90.1 Climate Zone 4*	*OESSC 2014 (5B/4C)*
	Nonresidential	*Semiheated*	*Nonresidential*
Opaque Elements	Assembly Maximum	Assembly Maximum	Assembly Maximum
Walls, above Grade			
Mass	U-0.104	U-0.580	U-0.150
Metal building	U-0.060	U-0.162	U-0.069
Steel-framed	U-0.064	U-0.124	U-0.064
Wood-framed and other	U-0.064	U-0.089	U-0.064

Semiheated space: an enclosed space within a building that is heated by a heating system whose output capacity is greater than or equal to 3.4 Btu/h·ft^2 of floor area but is not a conditioned space
Semiheated spaces are heated, but not to comfort levels, and not cooled



Slab-on-Grade Insulation Comparison

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Tables 5.5-4, 5.5-5	Tables 502.1.1, 502.1.2

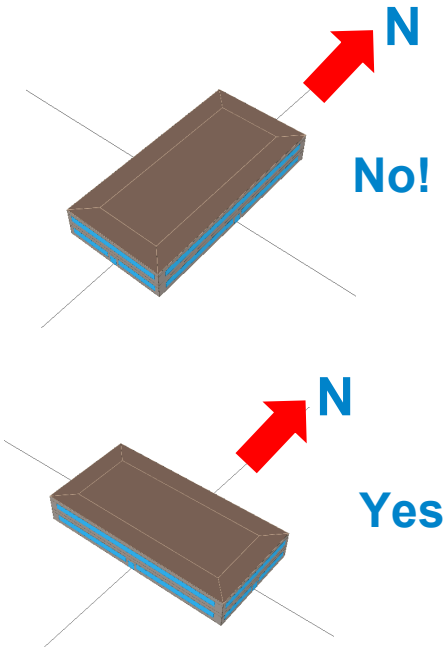
	OEESC-2014	90.1-2019		90.1-2019	
	CZ 5 & Marine 4	CZ 4 (non-res)	CZ 5 (non-res)	CZ 4 (semiheated)	CZ 5 (semiheated)
Insulation					
Unheated Slabs	NR	R-15 for 24" below	R-15 for 24" below	NR	NR
Heated Slabs	R-15 for 24" below	R-20 for 24" below	R-20 for 48" below	R-10 for 24" below	R-10 for 24" below
Assembly Maximum					
Unheated Slabs	F-0.730	F-0.520	F-0.520	F-0.730	F-0.730
Heated Slabs	F-0.860	F-0.843	F-0.688	F-0.900	F-0.900

- New required insulation for un-heated slabs for non-residential buildings
- Increase in insulation R-value (and/or depth) for heated slabs

Fenestration Orientation

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
5.5.4.5	N/A

- Compliance requires following 1 of 2 paths:
  - Option 1 – Area Method
    - East & West fenestration areas are each less than 25% of building total
  - Option 2 – SHGC Weighted Method
    - East & West area weighted SHGC is each less than average area weighted SHGC.
- Several exemptions related to large amounts of shade being present, alterations with no increase in vertical fenestration, buildings where vertical fenestration area does not exceed 20% of gross wall area on east or west facades, or street-side façade where street level story is less than 20 feet, has larger overhangs, and the total window area is <75% of the street-side wall area



Envelope Trade-Off Path

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
5.6	502.1.3

- May provide more design flexibility when compared to prescriptive table requirements.
- Can use COMcheck (or other simulation program) to demonstrate compliance.
  - 90.1 includes Normative Appendix C to assist with what is required to be modeled.
- The *building envelope* complies with the standard if:
  a. the *proposed design* satisfies the provisions of Sections 5.1, 5.4, 5.7, 5.8, and 5.9 and
  b. the *proposed envelope performance factor* of the *proposed design* is less than or equal to the *envelope performance factor* of the *base design*.

- Limitations of the Envelope Trade-off Approach
  - If the building permit application applies to less than the whole building, then all parameters relating to unmodified existing conditions or future building components shall be identical when calculating the proposed EPF and base EPF.
  - Any future components must meet prescriptive requirements of Section 5.5

HVAC

New Oregon-specific amendments

- ANSI/ASHRAE Standard 90.4-2019, Energy Standard for Data Centers
- Radiant spot heating

Section 6.5.8.3 Radiant Heating for Enclosed Unconditioned Spaces

Overhead radiant heating systems shall be allowed in *unconditioned spaces* for spot heating of occupied areas. Spot heating shall be limited to 500 ft^2 (46 m^2) or 10 percent of the space floor area, whichever is greater. Control shall be automatic complying with either Section 6.4.3.3.1 (b) or 6.4.3.3.1 (c).

- Packaged HVAC equipment with electric heat

b. Section 6.4.3.5.1 Packaged HVAC Equipment with Electric Heat

HVAC equipment for new buildings with a cooling capacity less than 241,000 Btu/h from Table 6.8.1-1 shall not have electric supplemental heat exceeding 21,500 Btu/h (6 kW). Equipment shall have heat pump operation for the first stage of heating and shall be selected from Table 6.8.1-2.

Compliance Paths

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.2.2	N/A

- Expanded exceptions for Data Centers to require them to comply with ASHRAE 90.4 under these conditions:
  1. *Data Centers* in new buildings shall comply with ASHRAE Standard 90.4 for the HVAC Systems serving the heating, cooling or ventilating needs of the data center.
  2. New HVAC systems added to existing buildings serving only the heating, cooling or ventilating needs of a *data center* shall meet the requirements of ASHRAE Standard 90.4 in accordance with Section 6.5.12.

HVAC Compliance Pathways

HVAC Section 6: 6.1 General, 6.7 Submittals, 6.8 Equipment Efficiency Tables

6.3 Simplified Building Approach

OR

6.4 Mandatory Requirements

Plus One

6.5 Prescriptive Requirements

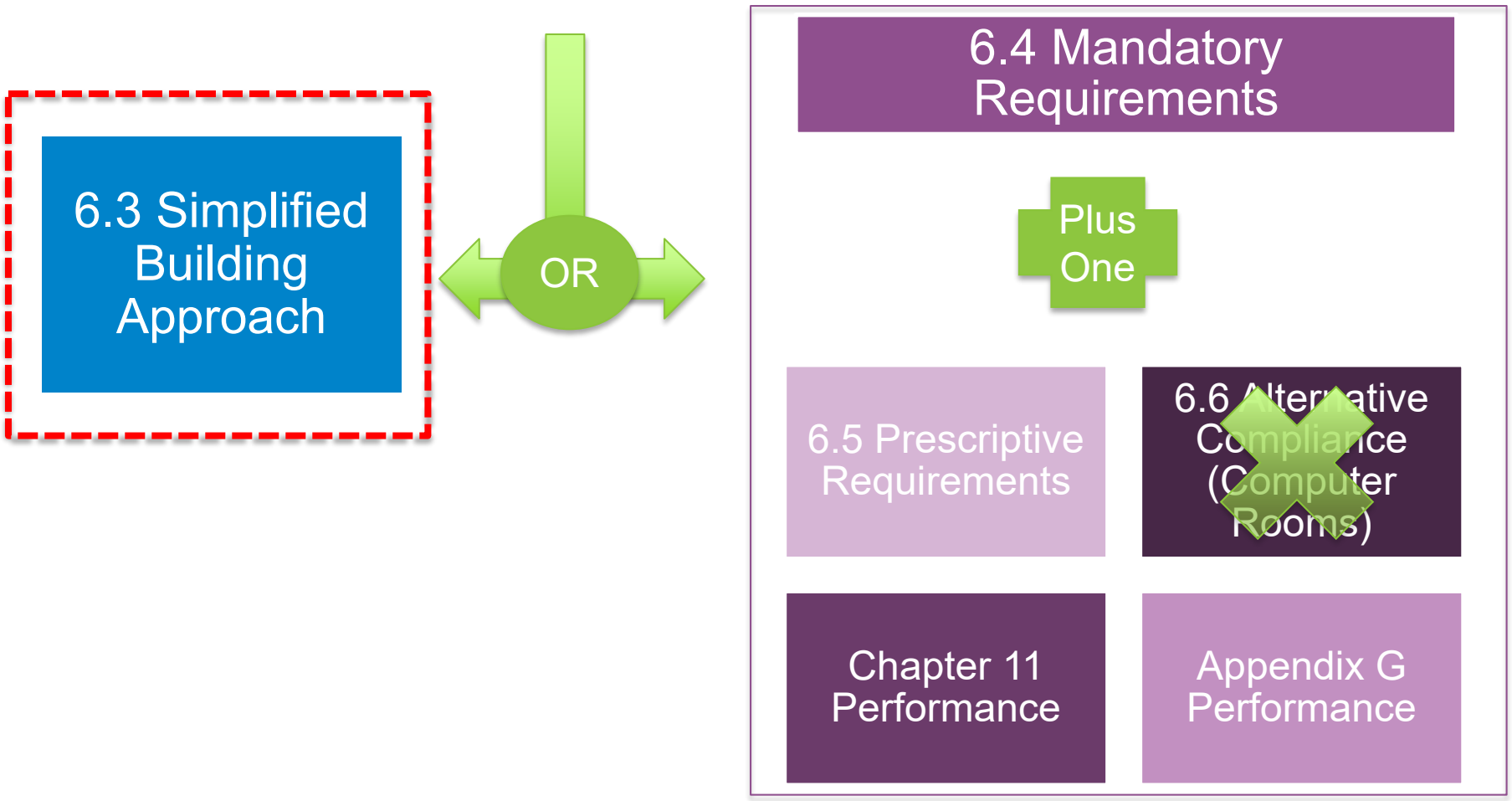
6.6 Alternative Compliance (Computer Rooms)

Chapter 11 Performance

Appendix G Performance

HVAC Compliance Pathways

HVAC Section 6: 6.1 General, 6.7 Submittals, 6.8 Equipment Efficiency Tables



6.3 Simplified Path

- Available if systems and **building meet certain criteria**
  - 2 stories or fewer
  - Floor area < 25,000 ft^2
  - Each HVAC system complies with a list of requirements in 6.3.2 (ALL must be met)

- The **HVAC system must meet the following requirements:**
  - Single zone HVAC
  - Cooling and heating with unitary packaged or split system that meets efficiency tables
  - Supply fan variable flow if >65,000 Btu/h
  - Economizer if >54,000 Btu/h
  - Electric resistance heat limitations for heat pumps
  - Piping and ductwork insulation in accordance with other sections
  - Exhaust air energy recovery in accordance with other sections
  - Manual changeover or dual set-point thermostat
  - No reheat/simultaneous heating and cooling
  - >10,000 CFM requires optimum start controls
  - Plus additional requirements….

HVAC Compliance Pathways

HVAC Section 6: 6.1 General, 6.7 Submittals, 6.8 Equipment Efficiency Tables

6.3 Simplified Building Approach

OR

6.4 Mandatory Requirements

Plus One

6.5 Prescriptive Requirements

6.6 Alternative Compliance (Computer Rooms)

Chapter 11 Performance

Appendix G Performance

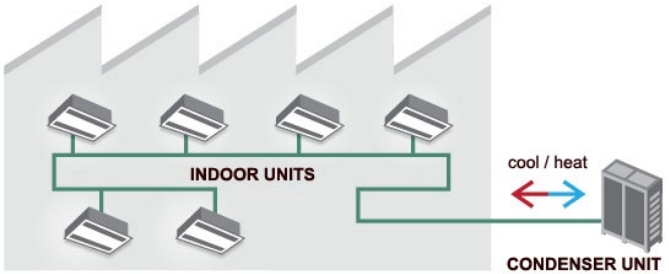
6.4 Mandatory Requirements – Equipment Efficiencies

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.4.1, Tables 6.8.1-x	503.2.3, Tables 503.2.3(x)

Updated equipment efficiencies

6.8.1 Efficiency Tables

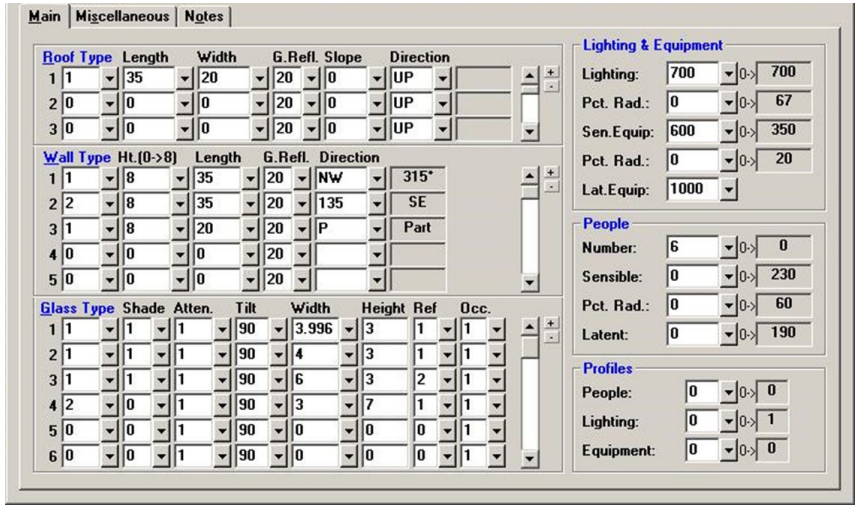
Expansion of tables. New product types covered. Tables combined, added and deleted to align with latest federal regulations.



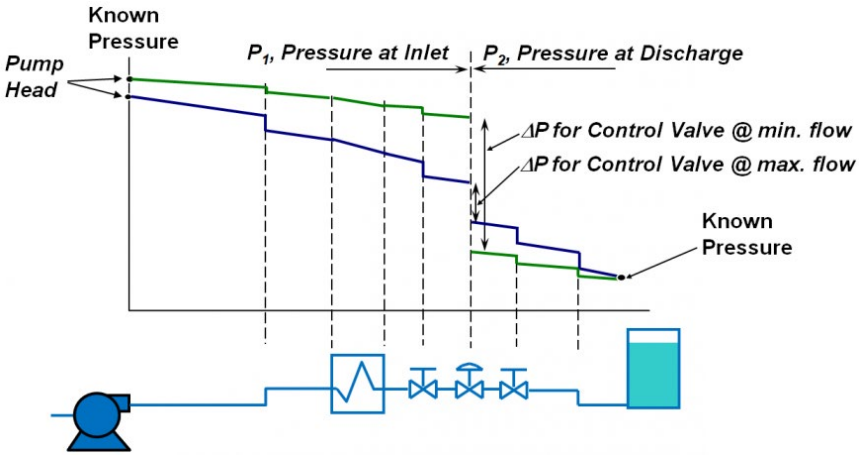
6.4 Mandatory Requirements – Load Calculations

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.4.2	503.2.1

- Similar requirement for calculation of heating and cooling loads for the purpose of sizing systems and equipment to be done in accordance with ANSI/ASHRAE/ACCA Standard 183



- New general requirement for pump differential pressure (head) to be determined in accordance with generally accepted engineering standards. Calculate drop at each device in critical circuit.



6.4 Mandatory Requirements – Dead Band/Setpoint Overlap Restriction

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.4.3.2, 6.4.3.1.2	503.2.4.2

- Similar requirements
- Where used to control both heating and cooling, zone thermostatic controls shall be ***capable and configured to*** a 5°F deadband
- Where heating and cooling are controlled by separate zone thermostatic controls, provide means to prevent heating setpoint from exceeding the cooling setpoint

"Capable and configured to" change throughout the code

6.4 Mandatory Requirements – Off Hour Controls

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.4.3.3	503.2.4.3, 503.2.4.4, 503.2.4.7

- Automatic Shutdown
  - Time schedule controls (7 day) **OR** occupant sensor **OR** timer (up to 2 hours) **OR** security system interlock
- Setback controls
  - **2014 OEESC**: specified setback capabilities down to 55°F (heating) or up to 85°F (cooling)
  - **90.1-2019**: capable and configured to 10°F below heating setpoint and 5°F above cooling setpoint (or to prevent high humidity levels)
- Optimum start controls
  - **2014 OEESC**: general requirement for optimum start
  - **90.1-2019**: systems with setback controls and DDC shall have optimum start.
    - » **Requires algorithm to be a function of difference between space T, occupied setpoint, OAT, and time until occupancy**
- Zone Isolation – similar requirements, some new exception language

6.4 Mandatory Requirements – Hotel Controls

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.4.3.3.5	N/A

If > 50 guest rooms, controls capable of and configured to:

- **Unoccupied**: within 20 minutes of guest leaving, automatically raise/lower setpoint by 4°F
- **Unrented and unoccupied**: setpoints automatically reset to 80°F or higher cooling and 60°F or lower heating
- Unrented and unoccupied determined by either:
  - Continuously unoccupied for up to 16 hours
  - Networked guest room control system indicates room is unrented and is unoccupied for 30 minutes
- Ventilation shut off within 20 minutes of occupants leaving room

6.4 Mandatory Requirements – Ventilation Fan Controls

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.4.3.4.4	N/A

- Fans with motors > 0.75 hp shall have automatic controls complying with 6.4.3.3.1 to turn off fans when not required, unless they are intended to operate continuously
- Controls can be time schedules, occupant sensors, manual timer, or security system interlock

6.4 Mandatory Requirements – Enclosed Parking Garage Ventilation

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.4.3.4.5	503.2.5.3

Requirements are mostly similar

2021 Oregon / ASHRAE 90.1-2019

- Automatically detect contaminant levels and reduce flow by
  - Staging fans or
  - Modulating fan airflow
- References Section 404 of Mechanical Code
- Exceptions:
  - Garages <30,000 ft^2 with no mechanical cooling or heating
  - Where not permitted by AHJ

2014 OEESC

- Group S-2 only
- Same 30,000 ft^2 threshold
- Specified contaminant (CO) and ppm to maintain
- Minimum ventilation rate specified

6.4 Mandatory Requirements – Heat Pump Auxiliary Control

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.4.3.5	503.2.4.1.1

- Requires heat pumps with internal resistance heat to have controls that prevent supplemental heater operation when the heat pump alone can meet the load:
  - During both steady-state operation and setback recovery
  - Supplemental heat is okay during defrost cycles
- And as previously mentioned, Oregon-specific requirement for packaged HVAC equipment electric heat limits

b. Section 6.4.3.5.1 Packaged HVAC Equipment with Electric Heat

HVAC equipment for new buildings with a cooling capacity less than 241,000 Btu/h from Table 6.8.1-1 shall not have electric supplemental heat exceeding 21,500 Btu/h (6 kW). Equipment shall have heat pump operation for the first stage of heating and shall be selected from Table 6.8.1-2.

6.4 Mandatory Requirements – Demand Controlled Ventilation

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.4.3.8	503.2.5.1

- Similar requirements
- Continues to apply to spaces > 500 ft^2, with design occupancy for ventilation of >= 25 people per 1,000 ft^2 and served by systems with either
  - Air-side economizer
  - Automatic modulating control of OA damper, or
  - Design OA flow > 3000 cfm
- Slightly different exceptions
- 90.1 exceptions are:

Exceptions to 6.4.3.8

1. *Systems* with exhaust air *energy* recovery complying with Section 6.5.6.1.
2. Multiple-zone *systems* without *DDC* of individual zones communicating with a central *control* panel.
3. *Systems* with a design outdoor airflow less than 750 cfm.
4. *Spaces* where >75% of the *space* design outdoor airflow is required for *makeup air* that is exhausted from the *space* or *transfer air* that is required for *makeup air* that is exhausted from other *spaces*.
5. *Spaces* with one of the following occupancy categories as defined in ASHRAE Standard 62.1: correctional cells, daycare sickrooms, science labs, barbers, beauty and nail salons, and bowling alley seating.

6.4 Mandatory Requirements – Heated or Cooled Vestibules

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.4.3.9	N/A

- Automatic off required for vestibule heating when OAT > 45°F
- Maximum 60°F heating setpoint, minimum 85°F cooling setpoint
  - Exceptions: if energy used to condition the vestibule is from site-recovered energy or transfer air that would otherwise be exhausted

6.4 Mandatory Requirements – DDC

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.4.3.10	N/A

DDC required in many situations (6.4.3.10)

Table 6.4.3.10.1 *DDC* Applications and Qualifications

Building Status	Application	Qualifications
New *building*	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 *systems* and fan coils 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% 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

6.4 Mandatory Requirements – DDC Requirements

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.4.3.10	N/A

- Where DDC IS required, certain capabilities are required:

6.4.3.10.2 DDC Controls

Where *DDC* is required by Section 6.4.3.10.1, the *DDC system* shall be capable of and configured with all of the following, as required, to provide the *control* logic required in Section 6.5:

a. Monitoring zone and *system demand* for fan pressure, pump pressure, heating, and cooling.

b. Transferring zone and *system demand* information from zones to air *distribution system* controllers and from air *distribution systems* to heating and cooling plant controllers.

c. Automatically detecting those zones and *systems* that may be excessively driving the *reset* logic and generate an alarm or other indication to the *system* operator.

d. Readily allowing operator removal of zones from the *reset* algorithm.

6.4 Mandatory Requirements – CHW Plant Monitoring

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.4.3.11	N/A

- For electric motor-driven CHW plants
  - In new buildings
  - New plants in existing buildings

- Monitoring and measurement for energy use and efficiency (kW/ton) is required for all chiller plants over a certain capacity, which for Oregon climate zones is:
  - Water-cooled CHW plants: > 1500 tons peak cooling capacity
  - Air-cooled CHW plants: > 860 tons peak cooling capacity

6.4 Mandatory Requirements – Economizer Fault Detection and Diagnosis

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.4.3.12	N/A

- Air cooled DX units with an economizer installed in accordance with 6.5.1 shall include fault detection and diagnostics (FDD) with a host of required sensors and capabilities

6.4.3.12 Economizer Fault Detection and Diagnostics (FDD)

Air-cooled direct-expansion cooling units listed in Tables 6.8.1-1 and 6.8.1-2, wher *economizer* is installed in accordance with Section 6.5.1, shall include a fault detec diagnostics (FDD) *system* complying with the following:

a. The following temperature sensors shall be *permanently installed* to monito operation:
   1. *Outdoor air*
   2. Supply air
   3. Return air, where required for economizer *control*

b. The *system* shall have the capability of displaying the value of each sensor.

c. The FDD *system* or unit *controls* shall be capable of and configured to provide *system* status by indicating the following:
   1. Free cooling available
   2. Economizer enabled
   3. Compressor enabled
   4. Heating enabled
   5. Mixed-air low-limit cycle active

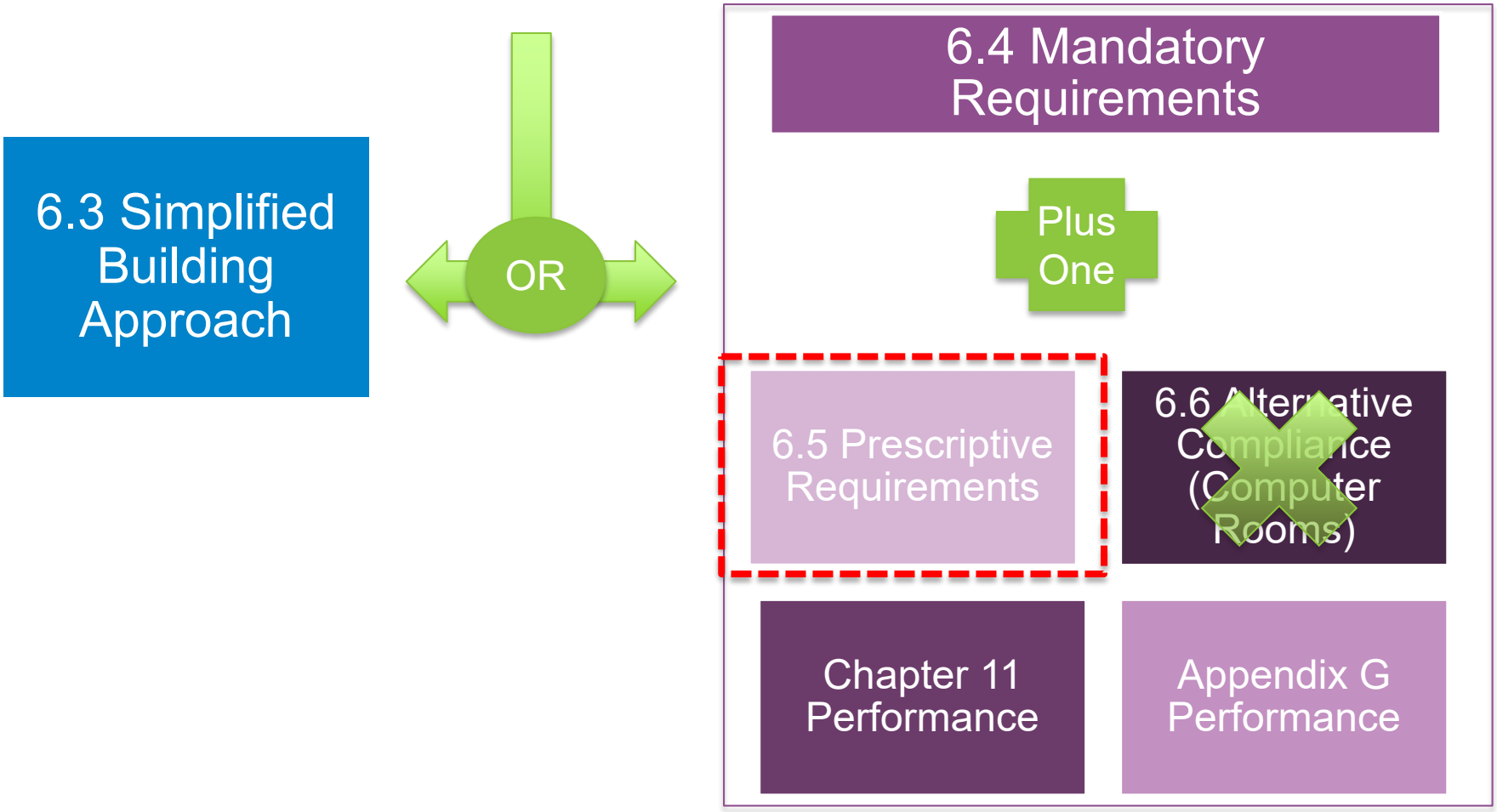
d. The FDD *system* or unit *controls* shall have provisions to manually initiate each operating mode so that the operation of compressors, economizers, fans, and the heating *system* can be independently tested and verified.

e. The FDD *system* shall be capable of and configured to detect the following faults:
   1. Air temperature sensor failure/fault
   2. Not economizing when the unit should be economizing
   3. Economizing when the unit should not be economizing
   4. Damper not modulating
   5. Excess *outdoor air*

f. The FDD *system* shall be capable of and configured to report faults to a fault management application or *DDC system* accessible by operating or *service* personnel, or annunciated locally on zone *thermostats*.

HVAC Compliance Pathways

HVAC Section 6: 6.1 General, 6.7 Submittals, 6.8 Equipment Efficiency Tables



Economizer Requirements

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.5.1	503.3.1, 503.4.1

- Same general threshold for economizer requirement **(capacity ≥ 54,000 btu/hr)**
- Mandatory FDD
- New high efficiency cooling equipment exemptions
- Other exceptions related to specific scenarios
- New required economizer controls (6.5.1.1.2)
  - Can't be controlled by MAT alone (except single-zone systems)
  - Economizer enabled when OAT<75F
  - Sensor calibration and accuracy requirements
- Integrated economizer controls (6.5.1.3)
  - Economizer interlocked with mechanical cooling to provide partial cooling even when some mechanical cooling is required.

Economizer Requirements

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.5.1	503.3.1, 503.4.1

- Computer rooms in existing buildings: old requirements allowed exceptions for up to 600,000 Btu/hr (existing rooms) or 240,000 Btu/hr (new rooms)
- 90.1 computer room exceptions are a little more involved:

11. *Systems* primarily serving *computer rooms* where
    a. the total design cooling load of all *computer rooms* in the *building* is less than 3,000,000 Btu/h and the *building* in which they are located is not served by a centralized chilled water plant;
    b. the room total design cooling load is less than 600,000 Btu/h and the *building* in which they are located is served by a centralized chilled water plant;
    c. the local water authority does not allow cooling towers; or
    d. less than 600,000 Btu/h of *computer-room* cooling *equipment* capacity is being added to an *existing building*.

12. Dedicated *systems* for *computer rooms*, where a minimum of 75% of the design load serves
    a. those *spaces* classified as an *essential facility*,
    b. those *spaces* having a design of Tier IV as defined by ANSI/TIA-942,
    c. those *spaces* classified under NFPA 70 Article 708—*Critical Operations Power Systems* (COPS), or
    d. those *spaces* where core clearing and settlement *services* are performed such that their failure to settle pending financial transactions could present systemic risk as described in "The Interagency Paper on Sound Practices to Strengthen the Resilience of the U.S. Financial System" (April 7, 2003).

Economizer Requirements

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.5.1	503.3.1, 503.4.1

- New efficiency improvement alternative to economizers
- Other exceptions related to specific scenarios:
  - Chilled-water cooling systems without a fan or that use induced airflow, where the total capacity of these systems is less than 1,000,000 Btu/h in Climate Zone 4; less than 1,400,000 Btu/h in Climate Zones 5
  - Non-particulate air treatment
  - Hospitals and processes with humidity requirements
  - Condenser heat recovery is present
  - Smaller residential systems
  - Low load or load operating hours
  - Supermarkets with affected open refrigeration

Table 6.5.1-2 Eliminate Required Economizer for Comfort Cooling by Increasing Cooling *Efficiency*

Climate Zone	*Efficiency* Improvement[a]
2A	17%
2B	21%
3A	27%
3B	32%
3C	65%
4A	42%
4B	49%
4C	64%
5A	49%
5B	59%
5C	74%
6A	56%
6B	65%
7	72%
8	77%

a. If a unit is rated with an *IPLV*, *IEER*, or *SEER*, then to eliminate the required 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* cooling then these must be increased by the percentage shown.

Integrated Economizer Control

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.5.1.3	N/A

- Economizer interlocked with mechanical cooling to provide partial cooling even when some mechanical cooling is required.
- Units with economizers must also have:
  - Interlocking to limit OA damper closing for frost protection until leaving air temperature is less than 45°F
  - > 65,000 btu/hr units that control the capacity of mechanical cooling based on occupied space temperature shall have minimum 2 stages of cooling
  - All other DX units that control space temperature by modulating airflow to the space shall comply with:

Table 6.5.1.3 DX Cooling Stage Requirements for Modulating Airflow Units

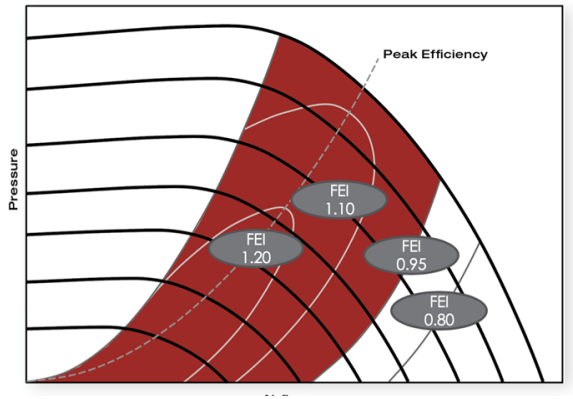
Rating Capacity, Btu/h	Minimum Number of Mechanical Cooling Stages	Minimum Compressor Displacement[a]
≥65,000 and <240,000	3	≤35% of full load
≥240,000	4	≤25% full load

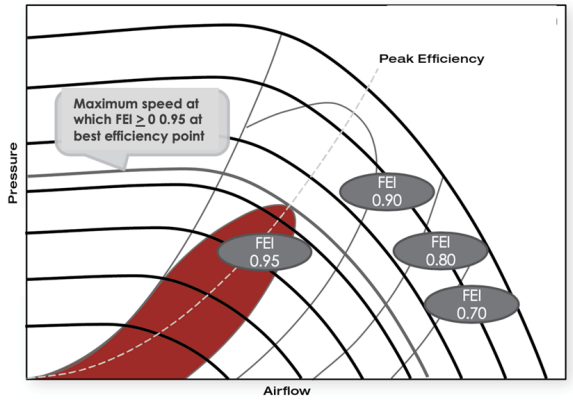
a. For mechanical cooling stage *control* that does not use variable compressor displacement the percent displacement shall be equivalent to the mechanical cooling capacity reduction evaluated at the full load rating conditions for the compressor.

Fan Efficiency

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.5.3.1.3	N/A

- Replaced Fan Efficiency Grade (FEG) efficiency metric with Fan Energy Index (FEI)
- FEG mainly requires good fan peak efficiency; does not concentrate as much on good selections
- FEI mainly requires good fan selections
  - kW input must be below a calculated value AT THE SCHEDULED OPERATING POINT
  - So the fan must be fairly good too
  - Manufacturers selection software should tell you “Compliant with FEI” or NOT or just not list non-compliant products
- Exceptions for embedded fans, safety fans, ceiling fans, fans outside scope of AMCA 208
  - No exception for powered roof ventilators
- Power threshold lowered from 5 HP to 1 HP





Images courtesy of AMCA

Fan Efficiency

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.5.3.1.3	N/A

- FEI is a true wire-to-air method
- Requirement:
  - Constant speed: FEI ≥ 1.0
  - VAV – FEI ≥ 0.95

$$FEI = \frac{\text{Reference Fan Electrical Input Power}}{\text{Fan Electrical Input Power}}$$

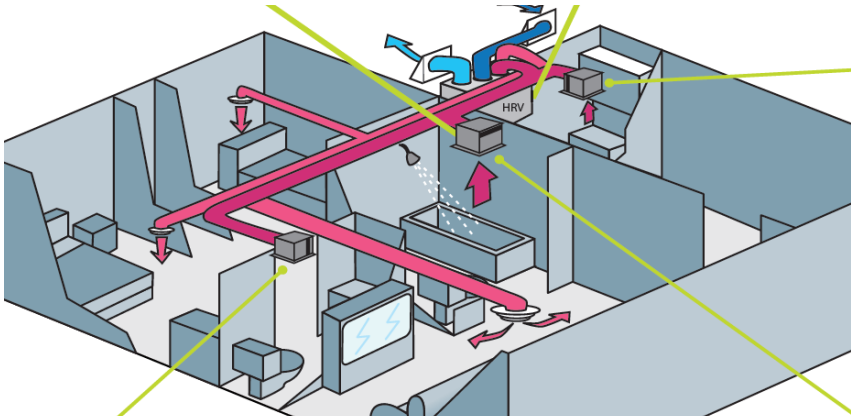
Images courtesy of AMCA

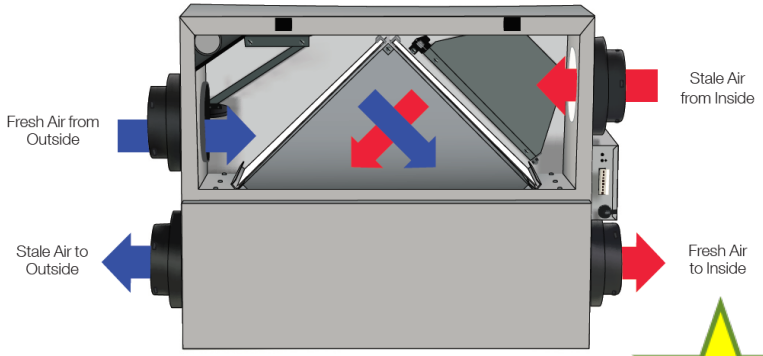
Exhaust Air Energy Recovery Non-Transient Dwelling Units

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.5.6.1.1	N/A

- New energy recovery requirements for *nontransient* dwelling units (apartments & condos)
  - Enthalpy recovery ratio (ERR) at design conditions
    - ≥50% ERR at cooling
    - ≥ 60% ERR at heating
    - Unless one of the modes is not required
    - ERR is different than AHRI efficiency rating
  - Exceptions based on unit floor area and CZs

Images courtesy of American Aldes





Fan System Power Limitation

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.5.3.1.1, 6.5.3.1.2	503.2.10.1, 503.2.10.2

- Still applies to systems with total fan system motor nameplate hp > 5
- Same Fan Power Limitation equation

Table 6.5.3.1-1 Fan Power Limitation[a]

	Limit	Constant Volume	Variable Volume
Option 1: Fan *system* motor nameplate hp	Allowable *motor nameplate hp*	$hp \le cfm_S \times 0.0011$	$hp \le cfm_S \times 0.0015$
Option 2: Fan *system* bhp	Allowable fan *system* bhp	$bhp \le cfm_S \times 0.00094 + A$	$bhp \le cfm_S \times 0.0013 + A$

  - Pressure drop adjustments:
    - » Credits mostly the same (change for ERV credit)
    - » New deductions required for systems without central cooling, heating, or with central electric resistance heat
- Still requirement to select fan motor no larger than the first available motor size greater than the bhp, with indication of bhp on design documents
  - Same exceptions as before, plus **new exception for fans with nameplate < 1 hp**

Fan Control

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.5.3.2.1	503.2.10.3

90.1-2019

- Required to vary fan speed as a function of load for:
  - DX: units ≥ **65,000 btu/hr**, for any fan size
  - CHW/Evap: Required for any capacity and ≥ $^1/_4$ **hp** fans
- If DX/CHW unit capacity is controlled based on space T, minimum 2 stages
- If units control space temperature by modulating airflow to the space, shall have modulating airflow
- Low speed required during low-cooling, ventilation operation
- Exceptions: < 1 hp, CHW/evap, and if not used for ventilation and cycles with load, also exceptions to accommodate minimum ventilation

OEESC-2014

- Required to vary fan speed (2-speed or VFD) for:
  - DX: single zone units with capacity ≥ **110,000 btu/hr**
    - » Reduce to 66% airflow
  - Without DX: fan systems > 8,000 cfm
    - » Reduce to 60% airflow
- VAV fan ≥ 10 hp control with VFD

Temperature Control	Typical Zones	Minimum fan speed	Fan power at min speed	Fan control
Space T by modulating airflow	Multiple	≤ 50%	≤ 30%	Modulating
Capacity based on room T	Single	≤ 66%	≤ 40%	Two-speed, Multi-speed or Modulating

VAV Systems

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.5.3.2	503.4.2

VAV static pressure setpoint

- Multi-zone VAV systems with fans >5 HP required to have static pressure setpoint re-set (6.5.3.2.3)
- Other systems required to locate static pressure sensors such that the setpoint is ≤ 1.2” (wg 6.5.3.2.2)

Multizone VAV ventilation optimization control (6.5.3.3)

- Systems with DDC to zone level must include a means to reduce OA rates below design rates in response to changes in system ventilation efficiency (from 62.1 Appendix A)
- Exceptions:
  - » VAV systems with zonal transfer fans, dual-duct dual-fan VAV systems, and systems with fan-powered terminal units
  - » Systems where design exhaust is > 70% of total design OA rate

Ventilation Design

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.5.3.7	N/A

Requires one of the following for OA ventilation systems:

- Design ventilation limited to 135% of the required minimum OA rate (larger or 62.1, exhaust, or other applicable codes/standards.
- Dampers, ductwork, and controls required to allow the system to supply no more than the required minimum OA rate with a single set-point adjustment
- System includes exhaust air energy recovery in compliance with other parts of 90.1

Pipe Sizing

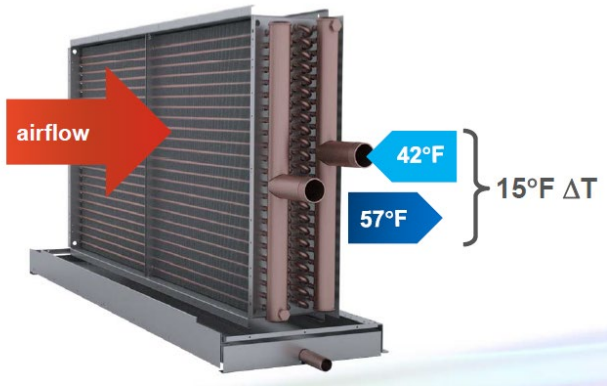
2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.5.4.6	N/A

- Applies to CHW and condenser water piping
- Maximum flow rates shall not exceed the value provided for the given pipe size and operating hours
- Increased maximum values (allowances) for variable flow/variable speed systems
- Exceptions
  - Piping sections not in the critical circuit at design conditions (and not expected to be in critical circuit for more than 30% of operating hours)
  - Other piping systems with same or less total pressure drop than values in table as applied to standard weight steel pipe

Chilled Water Coil Selection

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.5.4.7	N/A

- Minimum 15°F water temperature delta T
- Minimum 57°F LWT at design conditions
- Exceptions
  1. Coils with an air-side 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 5,000 cfm and less.
  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 temperatures of 50°F and higher.
  7. Coils with design entering air dry-bulb temperatures of 65°F and lower.



Energy Recovery

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.5.6.1	503.2.6

- Previous 2014 OEESC:
  - Required for systems ≥ 5,000 cfm and ≥ 70% OA
- New:
  - For systems operating < 8,000 hours/yr, **no requirement**
  - For systems operating ≥ 8,000 hours/yr, based on cfm and OA %. If cfm exceeds value, **energy recovery is required**

Table 6.5.6.1-2 Exhaust Air *Energy* Recovery Requirements for *Ventilation Systems* Operating Greater than or Equal to 8000 Hours per Year

Climate Zone	% *Outdoor Air* at Full Design Airflow Rate							
	≥10% and <20%	≥20% and <30%	≥30% and <40%	≥40% and <50%	≥50% and <60%	≥60% and <70%	≥70% and < 80%	≥80%
	Design Supply Fan Airflow Rate, cfm							
3C	NR	NR	NR	NR	NR	NR	NR	NR
0B, 1B, 2B, 3B, 4C, 5C	NR	≥19,500	≥9000	≥5000	≥4000	≥3000	≥1500	≥120
0A, 1A, 2A, 3A, 4B, 5B	≥2500	≥2000	≥1000	≥500	≥140	≥120	≥100	≥80
4A, 5A, 6A, 6B, 7, 8	≥200	≥130	≥100	≥80	≥70	≥60	≥50	≥40

NR—Not required

Energy Recovery

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.5.6.1	503.2.6

- Result is some cases that would have required ERV before may not now, and vice versa
- Recovery system effectiveness ≥ 50%
- Number of exceptions
  - Lab systems meeting 6.5.7.3
  - Systems serving uncooled spaces that are heated to < 60°F
  - Where > 60% of outdoor heating energy is provided from site-recovered or site solar energy
  - Cooling energy recovery in climate zones 3c, **4c, 5b,** 5c, 6b, 7, and 8
  - Where sum of airflow rates exhausted and relieved within 20 ft of each other is < 75% of the design outdoor airflow
  - Systems requiring dehumidification that employ energy recovery in series with the cooling coil
  - Systems operating < 20 hrs/week at outdoor air % in Table 6.5.6.1-1

Door Switches

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.5.10	N/A

- New requirement for controls that will, when door is open:
  - Disable heating or adjust setpoint to 55°F within 5 minutes
  - Disable cooling or adjust setpoint to 90°F within 5 minutes

- Exceptions:
  - Entries with automatically closing devices
  - Spaces with no thermostat
  - Alterations to existing buildings
  - Loading docks

Data Centers

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.5.12 ~~6.6.1~~	N/A

- 90.1-2019 introduced alternate compliance path for Data Centers (≥ 20 W/ft^2 **and** ≥ 10kW instant load) to follow 90.4
- 2021 OEESC moved this from alternate compliance path to mandatory (created new section 6.5.12)
  - Also referenced 90.4-2019 instead of 90.4-2016
  - Large change in MLC values between versions of 90.4
- Created clearer definitions for data center vs. computer room
  - ***computer room:*** a room whose primary function is to house *ITE* for the processing and storage of electronic data.
  - ***data center:*** a computer room (or series of computer rooms that share *data center systems*) serving a total *ITE* load greater than 10 kW and 20 W/ft^2 (215 W/m^2) of conditioned floor area.

Data Centers

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.5.12 ~~6.6.1~~	N/A

$$(Annualized\ Mechanical\ Load\ Component) = \frac{\left(\begin{array}{l}\text{Mech\_}Energy25\% + \text{Mech\_}Energy50\% + \\ \text{Mech\_}Energy75\% + \text{Mech\_}Energy100\%\end{array}\right)}{\left(\begin{array}{l}\text{Data Center } ITE\ Energy25\% + \\ \text{Data Center } ITE\ Energy50\% + \\ \text{Data Center } ITE\ Energy75\% + \\ \text{Data Center } ITE\ Energy100\%\end{array}\right)} \quad (6.5)$$

where

$$\text{Mech\_}EnergyX\% = \text{Total Annual } Cooling\ Energy + \text{Pump } Energy + \text{Heat Rejection Fan } Energy + \text{Air-Handler Fan } Energy$$

where each term is a constant value calculated at each of the following *ITE* loads: 25%, 50%, 75%, 100%.

Climate Zones as Listed in ASHRAE Standard 169	**HVAC Maximum *Annualized MLC* for *Data Center ITE Design Power* > 300 *kW***	**HVAC Maximum *Annualized MLC* for *Data Center ITE Design Power* □300 *kW***
4B	0.14	0.24
5C	0.14	0.23

A few other code requirements

- **Pipe insulation**
- **Duct leakage, insulation**
- **Boiler turndown**
- **Chiller & Boiler Isolation Controls**
  - Same requirements for buildings with more than 1 chiller or boiler to shut off all flow to the chiller/boiler when that equipment is shut down
- **Cooling tower fan speed control (>5 hp)**
- **Heat recovery for service water heating**
  - Same threshold requirements of 6MMBtu and service water heating load > 1 MMBtu
  - ASHRAE 90.1 requirement for 24 hours/day facility operation before requirement applies
- **Kitchen exhaust**
  - DCV and Energy recovery triggers for >5,000 CFM hoods
- **Laboratory exhaust**
- **Limits on Simultaneous Heating and Cooling**
- **Hydronic System Flow Reduction, Temperature Reset**
- **Hydronic Heat Pump System Controls**
- **Supply Air Temp Reset Controls**

Submittals / Completion

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
6.7, 6.9	503.2.9

90.1-2019

- Construction documents shall require that :
  - within 90 days after system acceptance, record drawings and O&M manual delivered to owner
  - All HVAC systems be balanced with generally accepted engineering standards, and air and hydronic systems first balanced to minimize losses and then to meet design flow conditions
  - Written TAB report be provided to owner for zones > 5,000 ft^2
- General requirement for plans and specs to include verification and testing requirements, but building official shall not require copies of any reports or record drawings

OEESC-2014

- Requirement to provide a means for system balancing
- Requirement to construction documents specify delivery of O&M manual to building owner

Service Water Heating

Service Water Heat Scope

- **New Buildings** required to comply
- **Additions** to existing buildings required to comply
  - Exception: When the *service water heating* to an addition is provided by existing *service water-heating systems* and *equipment* shall not be required to comply with this standard.
- **Alterations** where equipment is a direct replacement for existing equipment must comply
  - Compliance shall not be required where there is insufficient *space* or access to meet these requirements.

Combined Space/Water Heating

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
7.5.1	N/A

- A combination gas-fired (or oil-fired) *boiler system* providing space and water heat for a building must meet one of the following:
  - Standby loss doesn't exceed threshold determined by equation: $$SL_{max} = \frac{13.3 \times pmd + 400}{n}$$

Type of Building	Maximum Hourly	Maximum Daily	Average Daily
Nursing homes	4.5 gal (17 L)/bed	30.0 gal (114 L)/bed	18.4 gal (69.7 L)/bed
Office buildings	0.4 gal (1.5 L)/person	2.0 gal (7.6 L)/person	1.0 gal (3.8 L)/person

  - AHJ determines combination water/space heat system will use less than individual units
  - Total energy input is <150,000 btu/h

High Capacity Service Water Heating

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
7.5.3	N/A

- Large service water heating systems with total installed input capacity ≥ 1,000,000 Btu/hr are required to have:
  - Weighted average thermal efficiency ≥ 90% calculated as:

$$\text{Capacity Weighted Average Efficiency} = \frac{\sum(\text{Input Capacity} \times \text{Efficiency})}{\sum \text{Input Capacity}} = \frac{\text{Total Output Capacity}}{\text{Total Input Capacity}}$$

- Exceptions
  - Where 25% of annual service water heating requirement is provided by solar or site-recovered energy
  - Equipment is installed in individual dwelling units
  - Individual gas water heaters with input capacity < 100,000 btu/hr

Verification & Commissioning

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
7.9	N/A

- Need to verify or commission SHW controls
- Verify that they work in accordance with their respective sections for:
  - SHW temp controls
  - Recirc pumps or heat trace controls
  - Pool time switch controls

Misc. Equipment

Pressure Boost Systems

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
10.4.2	N/A

- *Service* water pressure-booster *systems* shall be designed such that the following apply:
  - 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 *set point* to simulate operation of remote sensors.
  - 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.
  - No booster *system* pumps shall operate when there is no *service* water flow.

Elevators

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
10.4.3	N/A

- OEESC referenced Oregon Elevator Specialty Code, primarily focused on life safety
- 90.1 lists several efficiency requirements:
  - **Lighting:** 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 lm/W
  - **Mechanical:** *ventilation* fans for elevators without air conditioning shall not consume over 0.33 W/cfm at maximum speed
  - **Standby Mode:** When stopped and unoccupied with *doors* closed for over 15 minutes, cab interior lighting and *ventilation* shall be de-energized until required for operation
  - **Documentation**: Design docs need to list use category and energy efficiency class A-G (per ISO 25745-2, Table 7)

Air Curtains

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
10.4.5	502.4.6

- Shall be tested in accordance with ANSI/AMCA 220 or ISO 27327-1 and installed and commissioned in accordance with the manufacturer's instructions to ensure proper operation
- Shall have a jet velocity of not less than 6.6 ft/s at 6.0 in. above the floor and direction not less than 20 degrees towards the opening.
- Automatic controls shall be provided that will operate the air curtain with the opening and closing of the door.

Whole Building Monitoring

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
10.4.6	N/A

- Measurement devices shall be installed to monitor the *building* use of the following types of *energy* supplied by a utility, *energy* provider, or plant that is not within the *building*:
  - Natural gas.
  - *Fuel* oil.
  - Propane.
  - Steam.
  - Chilled water.
  - Hot water.

Whole Building Monitoring – Recording & Reporting

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
10.4.6.2	N/A

- The *energy* use of each *building* on the *building* site shall be recorded at a minimum of every 60 minutes and reported at least hourly, daily, monthly, and annually. The *system* shall be capable of maintaining all data collected for a minimum of 36 months and creating user reports showing at least hourly, daily, monthly, and annual *energy* consumption and *demand*.
- **Exceptions**:
  - *Buildings* or additions < 25,000 ft^2.
  - Individual tenant *spaces* < 10,000 ft^2.
  - *Dwelling units*.
  - *Residential buildings* with < 10,000 ft^2 of common area.
  - *Fuel* used for on-site emergency *equipment*.

Clean Water Pumps

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
10.4.7	N/A

- Clean water pumps meeting the following criteria shall comply with the requirements shown in Table 10.8-6:

  a. A flow rate of 25 gal/min or greater at its best efficiency point (BEP) at full impeller diameter
  b. Maximum head of 459 ft at its BEP at full impeller diameter and the number of stages required for testing
  c. Design temperature range from 14°F to 248°F
  d. Designed to operate with either
     1. a 2- or 4-pole induction motor or
     2. a noninduction motor with a speed of rotation operating range that includes speeds of rotation between 2880 and 4320 rpm and/or 1440 and 2160 rpm, and
     3. in either (1) or (2), the driver and impeller must rotate at the same speed
  e. For submersible turbine pumps, a 6 in. or smaller bowl diameter
  f. For end-suction close-coupled pumps and end-suction frame-mounted/own bearings pumps, specific speed less than or equal to 5000 rpm when calculated using U.S. customary units

Clean Water Pumps

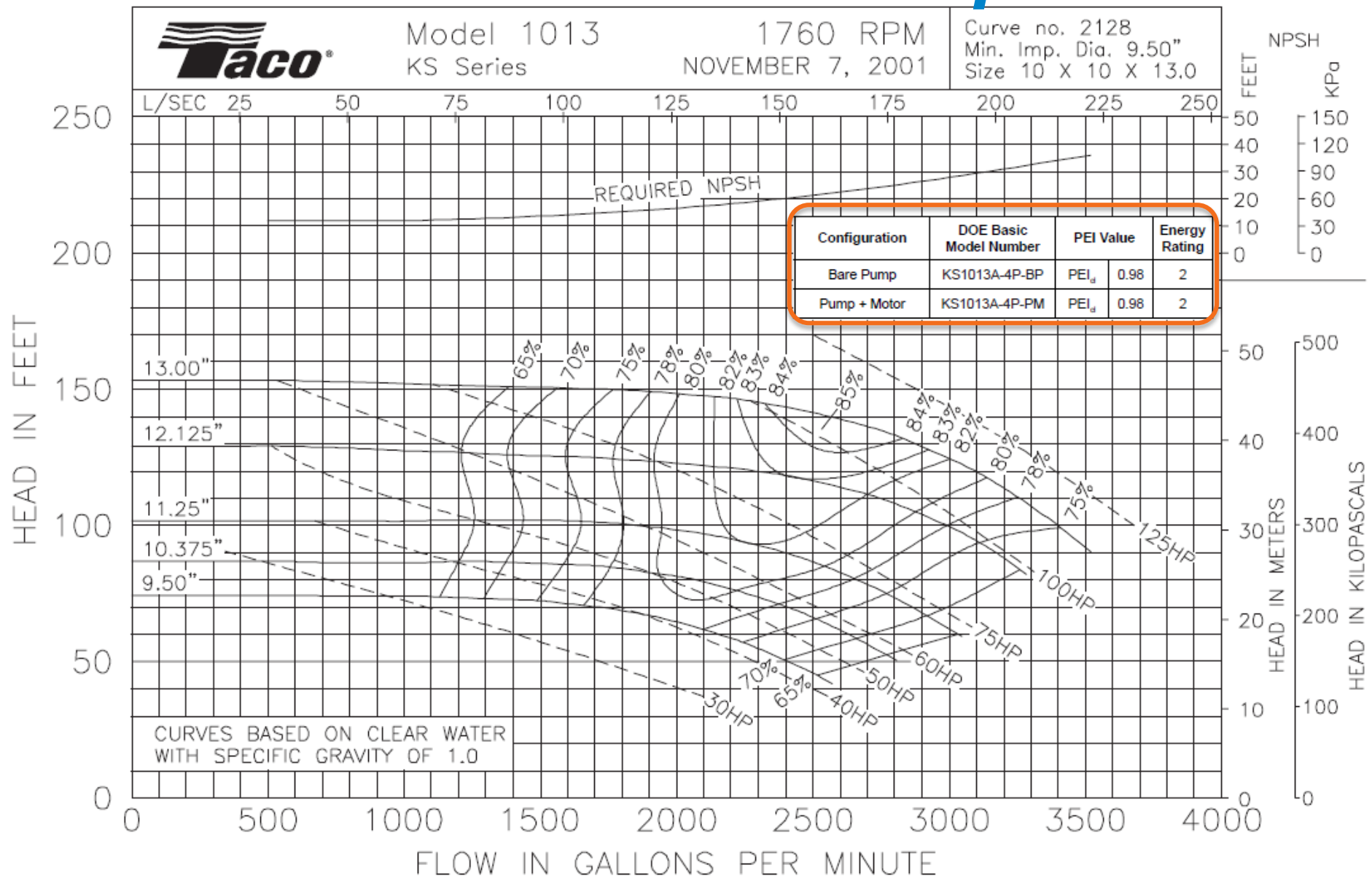
2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
10.4.7	N/A

- Table of maximum PEI values for given pumps
  - Use variable load for pumps sold with VFDs

Table 10.8-6 Maximum Pump Energy Index (PEI)

Maximum PEI for Pumps Manufactured on or after January 27, 2020					
Pump Type	**Nominal Speed of Rotation (RPM)**	**Operating Mode**	**Maximum PEI [a]**	**C-Value [b]**	**Test Procedure**
End suction, close coupled	1800	Constant load	1.00	128.47	10 CFR Part 431
End suction, close coupled	3600	Constant load	1.00	130.42	10 CFR Part 431
End suction, close coupled	1800	Variable load	1.00	128.47	10 CFR Part 431
End suction, close coupled	3600	Variable load	1.00	130.42	10 CFR Part 431
End suction, frame mounted	1800	Constant load	1.00	128.85	10 CFR Part 431
End suction, frame mounted	3600	Constant load	1.00	130.99	10 CFR Part 431
End Suction, frame mounted	1800	Variable load	1.00	128.85	10 CFR Part 431
End suction, frame mounted	3600	Variable load	1.00	130.99	10 CFR Part 431

Clean Water Pumps



Configuration	DOE Basic Model Number	PEI Value		Energy Rating
Bare Pump	KS1013A-4P-BP	PEI_d	0.98	2
Pump + Motor	KS1013A-4P-PM	PEI_d	0.98	2

Verification & Commissioning

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
10.9	N/A

- Need to verify or commission pressure boost systems, elevator standby controls, whole building energy monitoring
- Verify that they work in accordance with their respective sections.

Power

Data Center Power

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
8.2.1 & 8.5	N/A

- The 2021 OEESC changed the wording so that power systems serving new data centers also complied with 90.4. Section 8.2.1 states:
  - Power *distribution systems* and *equipment* serving a data center shall comply with Section 8.5.

- Then section 8.5 states:
  - Power *distribution systems* and *equipment* serving a data center shall comply with ASHRAE Standard 90.4, Energy Standard for Data Centers.

Data Center Power

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
8.2.1 & 8.5	N/A

Table 8.5 Maximum *Design Electrical Loss Component* (*Design ELC*) and ELC Segments *Systems* (IT Design Load <100 *kW*) [a]

***UPS Redundancy* Configuration**	**Single-Feed *UPS* (*N*, *N+1*, etc.) or No *UPS* [b]**		**Active Dual-Feed *UPS* (*2N*, *2N+1*, etc.) [c]**	
Calculation Percentage	100% of IT design load segment ELC	50% of IT design load segment ELC	50% of IT design load segment ELC	25% of IT design load segment ELC
Segments of ELC and Overall ELC	*Loss / efficiency*	*Loss / efficiency*	*Loss / efficiency*	*Loss / efficiency*
Incoming Electrical Service Segment	15.0% / 85.0%	11.0% / 89.0%	11.0% / 89.0%	10.0% / 90.0%
UPS Segment	8.0% / 92.0%	10.0% / 90.0%	10.0% / 90.0%	13.5% / 86.5%
ITE Distribution Segment	6.0% / 94.0%	4.0% / 96.0%	4.0% / 96.0%	3.0% / 97.0%
Electrical *Loss* / *Efficiency* Total	26.5% / 73.5%	23.1% / 76.9%	23.1% / 76.9%	24.5% / 75.5%
ELC	0.265	0.231	0.231	0.245

a. ***Informative Note:*** Example calculations are shown in Informative Appendix C.

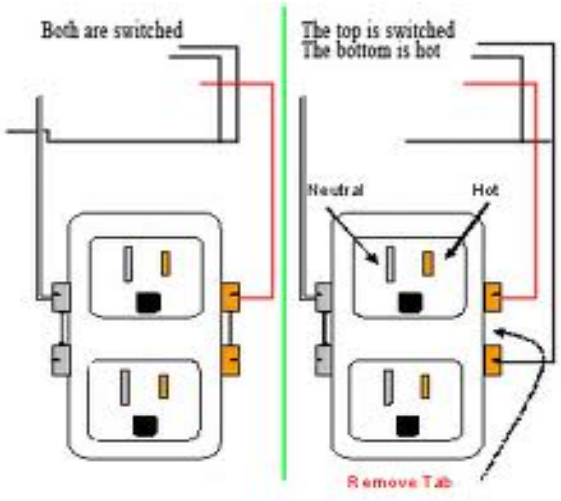
b. ***Informative Note:*** These columns apply to electrical configurations resulting in a single output feed from the *UPS* irrespective of the number of *UPS* modules that may be paralleled prior to the output feed or the number of branches or subfeeders into which that output feeder may be divided.

c. ***Informative Note:*** These columns apply to electrical configurations made up of two distinct and electrically separated *UPS systems* resulting in two distinct and electrically separate output feeds, either of which is capable of independently supporting the total design load. *Systems* that meet these criteria may be made up of any number of *UPS* modules that are paralleled prior to each output feed. Crossties and/or transfer switches downstream of the independent feeds shall not continually tie the two output sections together.

Automatic Receptacle Control

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
8.4.2	N/A

- Min 50% receptacles in private offices, conference rooms, printing rooms, break rooms, open offices and classrooms required to be controlled by auto device (timeclocks or occ sensors)
- 25% of branch circuits for modular furniture
- Power strips with integrated occ sensor doesn't comply
- Controlled receptacles must be marked and uniformly distributed



Automatic Receptacle Control

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
8.4.2	N/A

- Controlled by one of the following:
  - scheduled time-of-day that turns receptacles off at specific programmed times
    - » an independent program schedule shall be provided for controlled areas of no more than 5000 ft^2 and not more than one *floor* (the occupant shall be able to manually override the *control device* for up to two hours);
  - an *occupant sensor* to turn receptacles off within 20 minutes of all occupants leaving a *space*; or
  - *control* or alarm *system* that turns receptacles off within 20 minutes after determining that the area is unoccupied.
- Controlled receptacles must be clearly marked to differentiate from a standard receptacle

Automatic Receptacle Control

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
8.4.2	N/A

- A few exceptions
- Receptacles for the following shall not require an *automatic control device*:
  1. Receptacles specifically designated for *equipment* requiring continuous operation (24/day, 365 days/year).
  2. *Spaces* where an *automatic control* would endanger the safety or security of the room or *building* occupants.
  3. The building complies with one of the following:
     a. Results of performance compliance under Section 11 or Appendix G are at least 5% better than the minimum.
     b. COMcheck envelope compliance report passes by minimum of 3%.
     c. COMcheck lighting report passes by a minimum of 5%.

Unique Oregon Exception

Electrical Energy Monitoring

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
8.4.3.1	N/A

- Measurement devices shall be installed in new *buildings* to monitor the electrical *energy* use for each of the following separately:
  a. Total electrical energy
  b. HVAC systems
  c. Interior lighting
  d. Exterior lighting
  e. Receptacle circuits

- For buildings with multiple tenants, the above must be separately monitored for total building and for each tenant (excluding shared systems)

Exception:
- up to 10% of each separate load (other than total) can be from other electrical loads

Electrical Energy Reporting

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
8.4.3.2	N/A

- Energy use must be automatically recorded a minimum of every 15 minutes
- Use must be reported at least hourly, daily, monthly, and annually
- Data for tenants must be made available to that tenant
- Buildings with BMS need to graphically display energy use data and retain data for at least 36 months

Electrical Energy Monitoring & Reporting

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
8.4.3.2	N/A

- **Exceptions to Sections 8.4.3.1 and 8.4.3.2**
  1. *Building* less than 25,000 ft^2.
  2. Individual tenant *spaces* less than 10,000 ft^2.
  3. *Dwelling units*.
  4. *Residential buildings* with less than 10,000 ft^2 of common area.
  5. Critical and *Equipment* branches of NEC Article 517.

Lighting

New Construction

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Section 9.1.1	Section 505.1

- Interior spaces of buildings

- Exterior lighting powered through building's electrical service

Exceptions:

- *Emergency lighting (auto off)*
- *Required by health/safety statute, ordinance, regs*

New Compliance Method for Lighting in Simple Buildings

2021 Oregon / ASHRAE 90.1-2019

Table 9.3

- Allowed if at least 80% of floor area is office, retail, or school
- Can be used for new buildings or tenant improvements < 25,000 ft^2
- Single interior and exterior LPD targets that cover the entire building, LPAs are lower than other methods
- Requires occupancy sensor lighting control in most spaces with some exemption where life safety concerns apply
- All power from all lights must be counted towards the Interior Lighting Power Allowance (ILPA) **No Exemptions** ⇦

New Compliance Method for Lighting in Simple Buildings

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Table 9.3.1	N/A

Table 9.3.1-3 Simplified Building Method for School *Buildings*

Interior *Space* Type	Interior Lighting Power Allowance	*Controls* [a]
All *spaces* in school *buildings* other than parking garages, stairwells, and corridors	0.70 W/ft^2	All lighting shall be *automatically* controlled to turn off when the *building* is either unoccupied or scheduled to be unoccupied. (**Exception:** Lighting load not exceeding 0.02 W/ft^2 multiplied by the gross lighted area of the *building* shall be permitted to operate at all times.) Each *space* shall have a *manual control* device that allows the occupant to reduce lighting power by a minimum of 50% and to turn the lighting off.
Classrooms, offices *spaces*, conference rooms, meeting rooms, library, storage rooms, and break rooms	0.70 W/ft^2	These *spaces* shall also be controlled by *manual-ON occupant sensors*.
Gymnasiums and cafeterias	0.70 W/ft^2	These *spaces* shall also be controlled by *occupant sensors*.
Restrooms	0.70 W/ft^2	These *spaces* shall also be controlled by *occupant sensors*.
Stairwells and corridors in school *buildings* and parking garages	0.70 W/ft^2	These *spaces* shall also be controlled by *occupant sensors* that reduce the lighting power by a minimum of 50% when no activity is detected for not longer than 20 minutes and be controlled to turn off when the *building* is either unoccupied or scheduled to be unoccupied.
Parking garages	0.13 W/ft^2	All lighting shall be *automatically* controlled to turn off during garage nonoperating hours. Lighting shall also be controlled by *occupant sensors*. *Controls* shall reduce the power by a minimum of 50% when no activity is detected for not longer than 20 minutes. No device shall control more than 3600 ft^2.

a. All lights in the space shall be controlled.

New Compliance Method for Lighting in Simple Buildings

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Table 9.3.2	N/A

Table 9.3.2 Simplified Building Method for *Building* Exteriors

Exterior Area Type	*Exterior Lighting Power Allowance*[a,b]	*Controls*[c]
Base allowance	200 W	*Luminaires* shall be turned off or the power reduced by a minimum of 75% during nonoperating hours.
Façade lighting and special feature areas, walkways, plazas	0.10 W/ft^2	*Luminaires* shall be turned off or the power reduced by a minimum of 75% during nonoperating hours.
Landscape	0.04 W/ft^2	*Luminaires* shall be turned off or the power reduced by a minimum of 75% during nonoperating hours.
Entry doors	14 W/linear foot	*Luminaires* shall be turned off or the power reduced by a minimum of 75% during nonoperating hours.
Stairs and ramps	0.7 W/ft^2	No additional *controls* required.
Parking lots and drives	0.05 W/ft^2	*Luminaires* mounted 25 ft or less above grade shall be controlled to reduce the power by at least 50% when no activity is detected for not longer than 15 minutes.
All other areas not listed	0.20 W/ft^2	*Luminaires* shall be turned off or the power reduced by a minimum of 75% during nonoperating hours.

a. To calculate the exterior allowance, multiply the *space* or area square footage by the allowed W/ft^2 and sum the exterior allowances and the base allowance. Façade lighting shall be calculated separately by multiplying the façade area by the allowed W/ft^2. Façade allowance shall not be traded with other exterior areas or between separate *façade areas*.
b. For *buildings* in Lighting Zone 2, as defined in Table 9.4.2-1, decrease exterior allowances by 20%. For *buildings* in Lighting Zone 4, as defined in Table 9.4.2-1, increase exterior allowances by 25%.
c. All exterior lighting shall be automatically controlled by either a photocell or an astronomical time switch to shut off the lighting when daylight is available.

Interior Lighting Power

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Section 9.2.2.3	Section 505.5.1

- Primarily based on improved efficacy of LED lighting
- Installed interior lighting power must be ≤ lighting power allowance

  Installed interior lighting power calculation method
  - Calculation requirements
  - Lots of exemptions

- Two LPD calculation Methods:

  - **Building Area Method**
  - Simplified approach for demonstrating compliance

  - **Space-by-Space Method**
  - Alternative approach allows flexibility

Installed Lighting Power Calculation Requirements

These requirements apply to both interior and exterior

Installed Lighting Power shall include all power used by the luminaires, including lamps, ballasts/drivers, transformers, and controls

- **Exception**: where two independent lighting systems exist in the same space or area and are controlled to prevent simultaneous operation, only the system with the highest total wattage must be included

Luminaire Wattage for various systems shall be determined in accordance with details in Section 9.1.4

Luminaire Wattage Calculation Requirements

These requirements apply to both interior and exterior

- Wattage of lighting equipment connected to line voltage = manufacturers' labeled max. wattage
- Luminaires with ballasts/drivers or transformers = total input wattage of all components. For luminaires with factory adjustable ballast factors (not user changeable), apply the ballast factor to be used in the space)
- Line voltage track = actual wattage with a min. 30 W per foot OR wattage limit of system's circuit breaker OR wattage limit of other permanent-current-limiting device(s) on the system
- Low voltage track = transformer wattage
- DC low-voltage with flexible cabling for plug-in connection and remote power supply = labeled maximum wattage of power supply minus wattage of connected non-lighting equipment
- All others as specified on equipment

Installed Interior Lighting Power Calculation Exemptions

Lighting that does not have to be included in the installed lighting power calculation:

- Theatrical, stage, broadcast studio, film, and video production
- Medical and dental procedures
- Exhibit displays for museums, monuments, and galleries
- Integral to equipment, medical equipment or instrumentation installed by manufacturer
- Integral to both open and glass-enclosed refrigerator and freezer cases
- Retail display windows, provided the display is enclosed by ceiling-height partitions
- Food warming and food preparation equipment
- Interior spaces specifically designated as registered interior historic landmarks
- Integral part of advertising or directional signage
- Exit signs
- Sale or lighting educational demonstration systems
- Lighting in sporting activity areas for television broadcasting
- Casino gaming areas
- Furniture-mounted supplemental task lighting
- For use in areas specifically designed for life support of nonhuman life forms
- Mirror lighting in dressing rooms
- Accent lighting in religious pulpit and choir areas
- Parking garage transition lighting
- Photographic processes

Building Area Method of Calculating Interior Lighting Power Allowance

Can be used for entire building or separate building type occupancies

Advantages

- Fewer calculations

Limitations

- Limited building area type selection - use reasonably equivalent type
- Insensitive to specific space functions and room configurations
- Generally more restrictive that space-by-space method

Calculation Process

1) Determine gross lighted area for each building type area using:
   - Exterior faces of exterior walls
   - Centerline of interior walls
2) Calculate the area power allowance by multiplying the gross lighted area by the applicable building type allowance from Table 9.5.1
3) Sum all the allowances (if more than one building type area)

LPD - Building Area Method

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Table 9.5.1	Table 505.5.2(a)

- **2014 OEESC → ASHRAE 90.1-2016**

Almost all reduced, as much as **34%** with overall avg reduction across all building types of **12%**

Table 9.5.1 *Lighting Power Density* Allowances Using the *Building* Area Method

Building Area Type[a]	*LPD*, W/ft²
Automotive facility	~~0.79~~ 0.71
Convention center	~~1.08~~ 0.76
Courthouse	~~1.05~~ 0.90
Dining: Bar lounge/leisure	~~0.99~~ 0.90
Dining: Cafeteria/fast food	~~0.90~~ 0.79
Dining: Family	~~0.89~~ 0.78
Dormitory	~~1.00~~ 0.61
Exercise center	~~0.88~~ 0.65
Fire station	~~0.74~~ 0.53
Gymnasium	~~1.00~~ 0.68
Health-care clinic	~~0.89~~ 0.82
Hospital	~~1.08~~ 1.05
Hotel/motel	~~1.00~~ 0.75
Library	~~1.17~~ 0.78
Manufacturing facility ~~(Data Center)~~	~~1.24~~ 0.90
Motion picture theater	0.83
Multifamily	~~0.58~~ 0.68
Museum	~~1.04~~ 1.06
Office	~~0.91~~ 0.79
Parking garage	~~0.25~~ 0.15
Penitentiary	~~1.00~~ 0.75
Performing arts theater	~~1.39~~ 1.18
Police station	~~0.89~~ 0.80
Post office	~~0.98~~ 0.67
Religious facility	~~1.05~~ 0.94
Retail	~~1.32~~ 1.06
School/university	~~1.01~~ 0.81
Sports arena	~~0.78~~ 0.87
Town hall	~~0.94~~ 0.80
Transportation	~~0.77~~ 0.61
Warehouse	~~0.66~~ 0.48
Workshop	~~1.20~~ 0.90

- **ASHRAE 90.1-2016 → 90.1-2019**

Continued reduction in some LPDs (Sample)

Building Area Method – Lighting Power Densities (w/sq. ft.)

Building Type	90.1 2016	→	90.1 2019
Office	0.79	→	0.64
Hotel/Motel	0.75	→	0.56
Manufacturing Facility	0.90	→	0.82
Parking Garage	0.15	→	0.18
Retail	1.06	→	0.84
School/University	0.81	→	0.72
Warehouse	0.48	→	0.45

LPD - Space-By-Space Method

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Table 9.6.1	Table 505.5.2(b)

Space-by-Space LPDs – Average LPD reduction from 2016: **5%**

The *control* functions below shall be implemented in accordance with the descriptions found in the referenced paragraphs within Section 9.4.1.1 For each *space* type:
(1) All REQs shall be implemented.
(2) At least one ADD1 (when present) shall be implemented.
(3) At least one ADD2 (when present) shall be implemented.

Informative Note: This table is divided into two sections; this first section covers *space* types that can be commonly found in multiple *building* types. The second part of this table covers *space* types that are typically found in a single *building* type.

Common *Space* Types[1]	*LPD* Allowances, W/ft²	*RCR* Threshold	a	b						*Automatic* Full OFF (See Section 9.4.1.1[h])	Scheduled Shutoff (See Section 9.4.1.1[i])
			Local *Control* (See Section 9.4.1.1[a])	Restricted *Manual* O (See Sect 9.4.1.1[b])						h	i
Atrium											
<20 ft in height	0.39	NA	REQ	ADD1						ADD2	ADD2
≥20 ft and ≤40 ft in height	0.48	NA	REQ	ADD1						ADD2	ADD2
>40 ft in height	0.60	11	REQ	ADD1						ADD2	ADD2
Audience Seating Area											
Auditorium	0.61	6	REQ	ADD1						ADD2	ADD2
Gymnasium	0.23	6	REQ	ADD1						ADD2	ADD2
Motion picture theater	0.27	4	REQ	ADD1						ADD2	ADD2
Penitentiary	0.67	4	REQ	ADD1						ADD2	ADD2
Performing arts theater	1.16	8	REQ	ADD1	ADD1	REQ	REQ	REQ		ADD2	ADD2
Religious facility	0.72	4	REQ	ADD1	ADD1	REQ	REQ	REQ		ADD2	ADD2
Sports arena	0.33	4	REQ	ADD1	ADD1		REQ	REQ		ADD2	ADD2
All other audience seating areas	0.23	4	REQ	ADD1	ADD1		REQ	REQ		ADD2	ADD2

Space-by-Space Method – Lighting Power Densities (w/sq. ft.)

Space Type	90.1 2016	⇨	90.1 2019
Office, open plan	0.81	⇨	0.61
Guest room	0.77	⇨	0.41
Lobby, hotel	1.06	⇨	0.51
Parking area, interior	0.14	⇨	0.15
Retail sales Area	1.22	⇨	1.05
Classroom/lecture/training	0.92	⇨	0.71
Warehouse, med. To bulky items	0.35	⇨	0.33

Interior Lighting Controls

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Table 9.6.1	Section 505.2

- ASHRAE table format that includes Space-By-Space LPDs and control requirements (small part shown below)

Informative Note: This table is divided into two sections; this first section covers space types that can be commonly found in multiple building types. The second part of this table covers space types that are typically found in a single building type.			The control functions below shall be implemented in accordance with the descriptions found in the referenced paragraphs within Section 9.4.1.1. For each space type: (1) All REQs shall be implemented. (2) At least one ADD1 (when present) shall be implemented. (3) At least one ADD2 (when present) shall be implemented.								
Common Space Types[1]	LPD	RCR	Local Control (See Section 9.4.1.1[a])	Restricted to Manual ON (See Section 9.4.1.1[b])	Restricted to Partial Automatic ON (See Section 9.4.1.1[c])	Bilevel Lighting Control (See Section 9.4.1.1[d])	Automatic Daylight Responsive Controls for Sidelighting (See Section	Automatic Daylight Responsive Controls for Toplighting (See Section	Automatic Partial OFF (See Section 9.4.1.1[g] [Full Off complie	Automatic Full OFF (See Section 9.4.1.1[h])	Scheduled Shutoff (See Section 9.4.1.1[i])
			a	b	c	d	e	f	g	h	i
Atrium											
<20 ft in height	0.03/ft total	NA	REQ	ADD1	ADD1		REQ	REQ		ADD2	ADD2
≥20 ft and ≤40 ft in height	0.03/ft total	NA	REQ	ADD1	ADD1	REQ	REQ	REQ		ADD2	ADD2
>40 ft in height	0.40 + 0.02/ft total height	NA	REQ	ADD1	ADD1	REQ	REQ	REQ		ADD2	ADD2
Audience Seating Area											
Auditorium	0.63	6	REQ	ADD1	ADD1	REQ	REQ	REQ		ADD2	ADD2
Convention center	0.82	4	REQ	ADD1	ADD1	REQ	REQ	REQ		ADD2	ADD2
Gymnasium	0.65	6	REQ	ADD1	ADD1	REQ	REQ	REQ		ADD2	ADD2
Motion picture theater	1.14	4	REQ	ADD1	ADD1	REQ	REQ	REQ		ADD2	ADD2
Penitentiary	0.28	4	REQ	ADD1	ADD1		REQ	REQ		ADD2	ADD2
Performing arts theater	2.03	8	REQ	ADD1	ADD1	REQ	REQ	REQ		ADD2	ADD2
Religious building	1.53	4	REQ	ADD1	ADD1	REQ	REQ	REQ		ADD2	ADD2
Sports arena	0.43	4	REQ	ADD1	ADD1		REQ	REQ		ADD2	ADD2
All other audience seating areas	0.43	4	REQ	ADD1	ADD1		REQ	REQ		ADD2	ADD2
Banking Activity Area	0.86	6	REQ	ADD1	ADD1	REQ	REQ	REQ		ADD2	ADD2
Breakroom (See Lounge/Breakroom)											
Classroom/Lecture Hall/Training Room											

Local Control

REQ'D

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Section 9.4.1.1 [a]	Section 505.2

- Local ON/OFF manual control
- One or more control per space
- Max 2,500 ft^2 controlled area per device (<10k sf space)
- Max 10,000 ft^2 controlled area per device (>10k sf space)
- Readily accessible
- Can see lighting being controlled

- Exceptions: safety & security

Restricted to Manual ON

ADD1

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Section 9.4.1.1 [b]	Section 505.2

- None of the lighting shall be automatically turned on
- ADD1 choice for all space types
- Vacancy sensors comply: manual ON, auto OFF

- Exception: Safety & security

Restricted to Partial Auto ON

ADD1

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Section 9.4.1.1 [c]	Section 505.2

- Max 50% of general lighting to be auto ON
- No remaining ltg to be auto ON
- ADD1 choice for most space types

- Exception:

  Open office allowed to be auto ON to more than 50%, when control zone is no larger than 600 sf

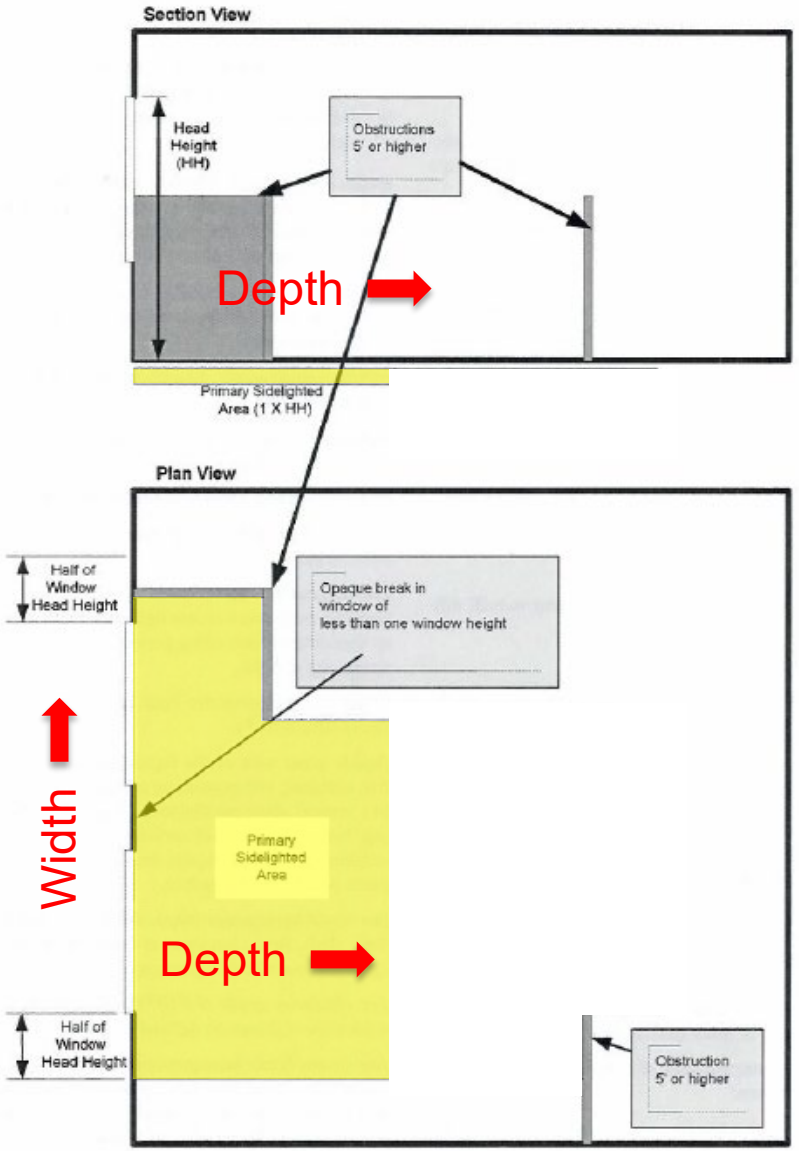
Bilevel Lighting Control

REQ'D

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Section 9.4.1.1 [d]	Section 505.2

- General lighting controlled to provide min ONE intermediate step or continuous dimming in addition to full ON/OFF
- Intermediate step between 30% and 70% of full lighting power
- Required in most spaces, with exception of some specific task spaces like sports venues, hospitals, manufacturing, corridors, restrooms, storage, theater

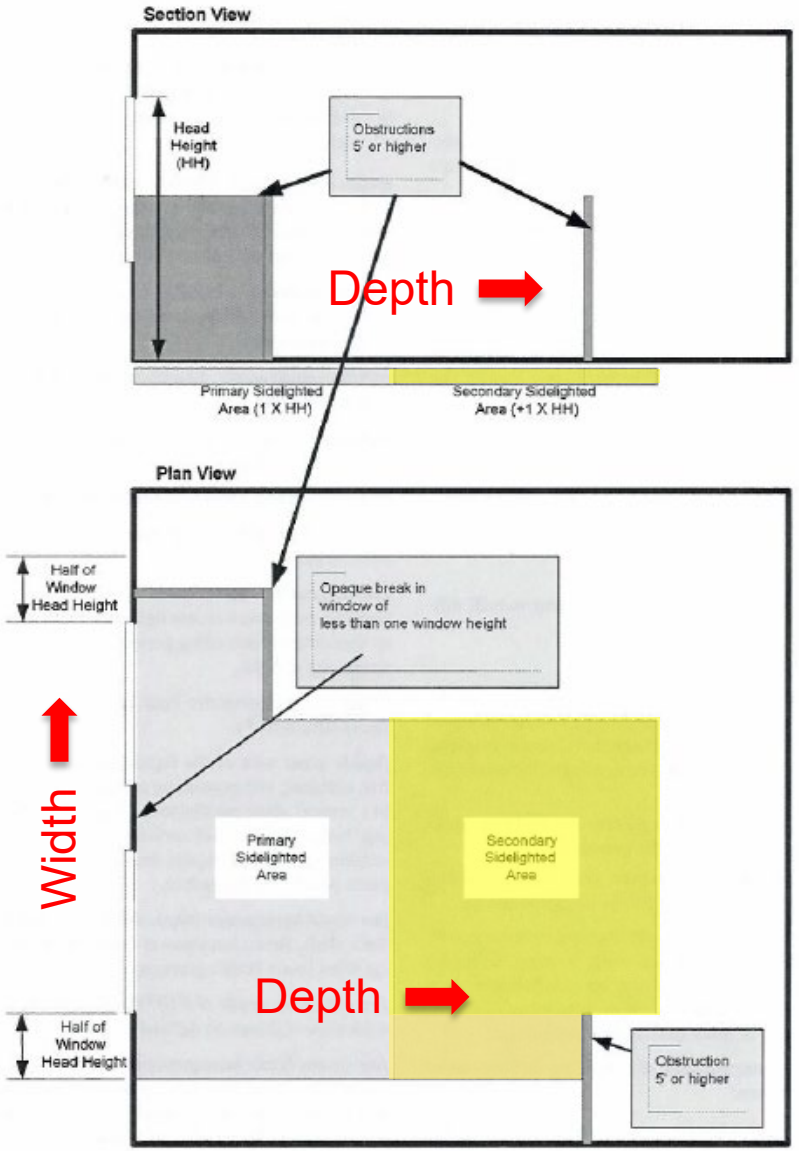
Primary Sidelighted Area



2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Section 9.4.1.1 [e] & [f]	Section 505.2

- **Width** = width of vertical fenestration plus, on each side, the smaller of:
  - half of vertical fenestration floor-to-head height or
  - the distance to any 5 ft or higher vertical obstruction
- **Depth** = horizontal distance perpendicular to vertical fenestration; begins at glazed wall, ends at the smaller of:
  - one vertical fenestration floor-to-head height or
  - the distance to any 5 ft or higher opaque vertical obstruction.

Secondary Sidelighted Area



2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Section 9.4.1.1 [e] & [f]	Section 505.2

- **Width** = width of vertical fenestration plus, on each side, the smaller of:
  - half of vertical fenestration floor-to-head height or
  - the distance to any 5 ft or higher vertical obstruction
- **Depth** = horizontal distance perpendicular to vertical fenestration; begins at edge of primary sidelighted area depth, ends at the smaller of:
  - one vertical fenestration floor-to-head height or
  - the distance to any 5 ft or higher opaque vertical obstruction.

Automatic Daylight Responsive Controls for Sidelighting

REQ'D

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Section 9.4.1.1 [e] & [f]	Section 505.2

- Apply photocontrols if the combined input power of all general lighting completely or partially within the
  - Primary sidelighted areas is ≥ 150 W
  - Primary and secondary sidelighted areas is ≥ 300 W

  Secondary sidelighted area controlled independently of primary sidelighted area

Automatic Daylight Responsive Controls for Sidelighting

REQ'D

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Section 9.4.1.1 [e] & [f]	Section 505.2

- Control system must have following characteristics
  - Calibration adjustment located ≤ 11ft above finished floor
  - Photocontrol to reduce electric lighting in response to available daylight using
    - » Continuous dimming to ≤ 20% and off
    - » Calibration doesn't require physical presence of a person at sensor while calibration is processing

Step control removed

Auto Partial OFF

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Section 9.4.1.1 [g]	Section 505.2

- Automatic min 50% reduction of general lighting within 20 mins of no occupancy – full OFF complies
  - Warehouses
  - Stairwells
  - Corridors
  - Library stacks
  - Lobbies
  - Storage Rooms

  ADD2 REQ'D

  - Hospitals
- Occ sensor with multi-level or dimmable fixtures
- 600 ft^2 control zone max for open office
- Some exceptions

Auto Full OFF

ADD2

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Section 9.4.1.1 [h]	Section 505.2

- All lighting automatically shut off within 20 minutes of all occupants leaving the space
- Control device to control < 5,000 ft^2

Exceptions

- Shop and lab classrooms
- Areas where auto shutoff causes safety or security concerns
- Lighting for 24/7 operation
- Lighting load < 0.02 W/ft^2 multiplied by the gross lighted floor area

Scheduled Shutoff

ADD2

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Section 9.4.1.1 [i]	Section 505.2

Control lights on a scheduled basis (automatic time switch)

- Time-of-day controller or
- Signal from another control or alarm

Controller or system provide independent control sequences that

- Controls ≤ 25,000 ft^2
- Not more than one floor
- Accounts for weekend and holidays

Manual override control

- < 2 hours during scheduled off
- Control ≤ 5,000 ft^2

Exceptions

- Lighting for 24/7 operation
- Patient care spaces
- Areas where auto shutoff causes safety or security concerns
- Lighting load ≤ 0.02 W/ft^2 multiplied by gross lighted area of the building

Scheduled Off During Non-Business Hours

ADD2

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Section 9.4.1.1 [j]	N/A

- Lights scheduled off at end of business hours using either:
  - Time-of-day control automatically turns lighting off as programmed OR
  - Signal from another automatic control or alarm/security system

- Any manual, override control to not turn lighting on > 2 hours during scheduled off

Parking Garage Lighting Control

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Section 9.4.1.2	Section 505.6

- Scheduled automatic lighting shutoff per 9.4.1.1(i)

- Must reduce lighting power by minimum of 50% when no activity is detected for 10 minutes within a lighting zone ≤ 3,600 ft^2

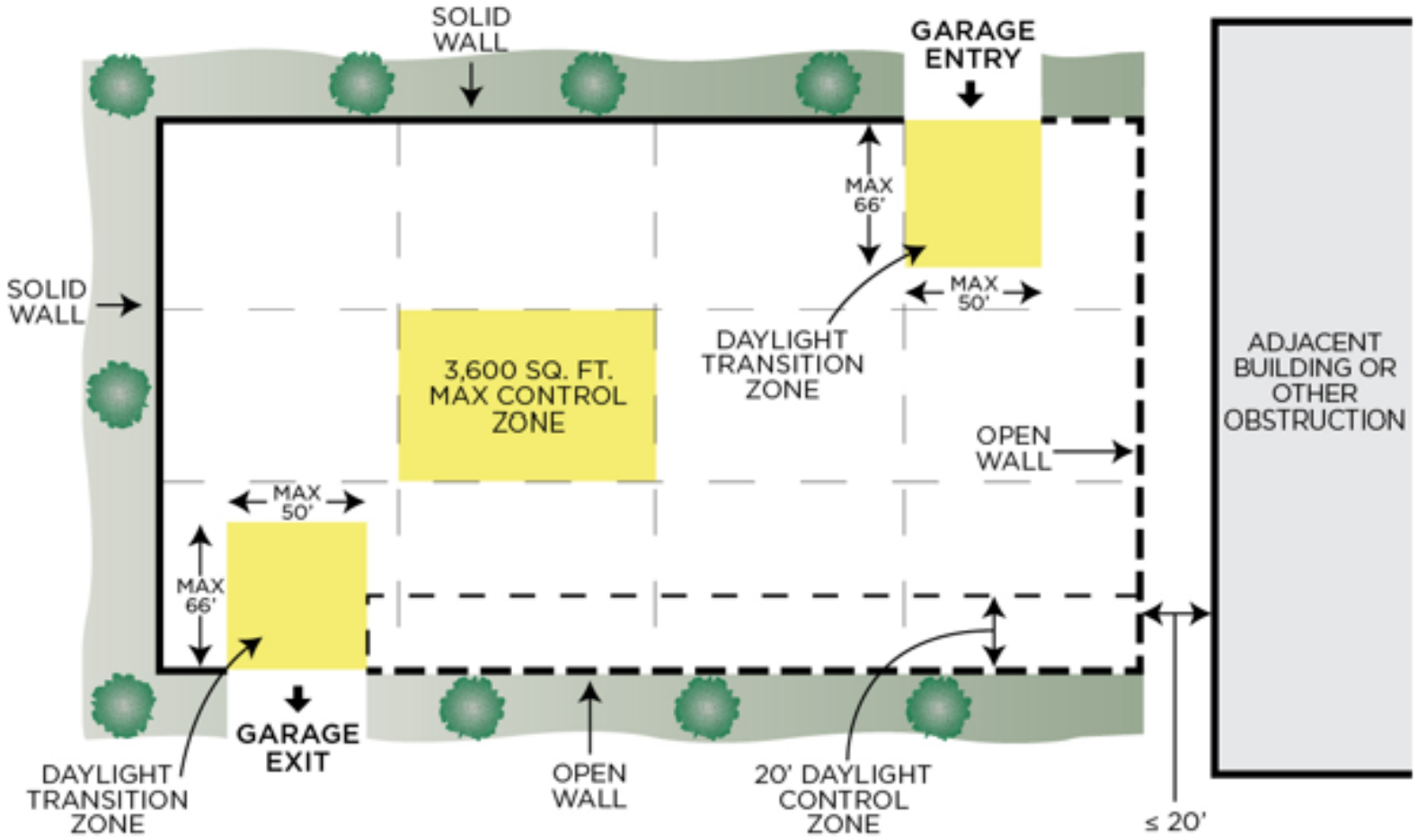
- Parking garage daylight transition lighting exempt per Section 9.2.3.1 to be separately controlled to automatically reduce lighting to no more than general light level from sunset to sunrise
- Automatically reduce power through continuous dimming in response to daylight for luminaires within 20 ft of any perimeter wall openings totaling at least 24 ft^2

Exceptions to perimeter continuous dimming

- Parking garage daylight transition lighting exempt per 9.2.3.1
- Where permanent screens or architectural elements obstruct > 50% of opening
- Where top of any existing adjacent structure or natural object is at least twice as high above the openings as its horizontal distance from opening

Parking Garage Lighting Control

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Section 9.4.1.2	Section 505.6



Exterior Lighting Controls

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Section 9.4.1.4	Section 505.6

- Auto Daylight shutoff required – dawn to dusk
- Decorative façade and landscape ltg requires auto shutoff between midnight or closing, and 6am or opening time.
- Other lighting & signage req's auto reduction by min 50% from midnight to 6am, or when no activity detected for 15 mins
- Parking lot poles 24 ft or less auto controlled so that ltg is reduced by min 50% when no activity detected for 15 min
- 1500 W limit to controlled lighting groups
- Astronomical timeclocks, time switches, daylight and motion sensors

Exterior Lighting Power

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Section 9.4.2	Section 505.6

Exterior Building Lighting Power must meet prescribed power limits.

- The total exterior lighting power allowance is the sum of the base site allowance plus individual lighting power densities (LPD) for the applicable “lighting power zone”
- Trade-offs are allowed only among “Tradable Surfaces” applications
- Some exemptions apply

Exterior Lighting Power

ZONE 1
Developed areas of parks, forest, and rural areas.

ZONE 2
Residential and mixed use, neighborhood business, light industrial with limited night use.

ZONE 3
All other.

ZONE 4
High activity commercial in major metro as designated by AHJ.

In 2010, Zone 0 was introduced to represent undeveloped areas within national parks, forest land, and rural areas as defined by AHJ.

Functional Testing

2021 Oregon / ASHRAE 90.1-2019	2014 OEESC
Section 9.4.3	N/A

- Confirm devices have been functionally tested
- Occ sensors
- Photosensors
- Timeclocks/switches
- Testing party cannot be part of design or construction team. Ltg control manufacturer allowed to do the testing

COM*check*

- Summarizes components and practices contributing to compliance
- Typically completed by Architect or Designer
- Calculates Lighting Power Allowance based on space type and size
- Also calculates proposed luminaire load
- Checklist for control requirements

COM*check*

Project Information

Space Type, Size and Ltg Power Allowance

Luminaire Wattage and Quantity

COMcheck Software Version 4.0.2.3

Interior Lighting Compliance Certificate

Section 1: Project Information

Energy Code: 2014 Oregon Energy Efficiency Specialty Code
Project Title:
Project Type: New Construction
Construction Site:
Owner/Agent:
Designer/Contractor:

Section 2: Interior Lighting and Power Calculation

A	B Floor Area	C Allowed Watts / ft2	D Allowed Watts
Convention Center	39411	1.08	42564
Total Allowed Watts =			42564

Section 3: Interior Lighting Fixture Schedule

Fixture ID : Description / Lamp / Wattage Per Lamp / Ballast	A	B Lamps/ Fixture	C # of Fixtures	D Fixture Watt.	E (C X D)
Convention Center (39411 sq.ft.)					
LED 1: A: LED A Lamp 9W:	1	1	41	10	410
LED 2: B: LED A Lamp 11W:	1	1	8	10	80
LED 3: D: LED Linear 22W:	1	1	19	23	437
LED 4: E: LED Linear 33W:	1	1	4	50	200
LED 5: H: LED Other Fixture Unit 80W:	1	1	2	79	158
LED 6: J: LED Other Fixture Unit 36W:	1	1	8	34	272
LED 7: HB: LED Other Fixture Unit 103W:	1	1	45	112	5040
LED 7 copy 1: HBE: LED Other Fixture Unit 103W:	1	1	45	112	5040
LED 7 copy 2: TL: LED Other Fixture Unit 36W:	1	1	115	34	3910
LED 7 copy 3: SL: LED Other Fixture Unit 50W:	1	1	137	50	6850
LED 11: DL: LED A Lamp 11W:	1	1	12	10	120
LED 11 copy 1: CL: LED Linear 33W:	1	1	8	42	336
		Total Proposed Watts =			22853

Section 4: Requirements Checklist

In the following requirements, blank checkboxes identify requirements that the applicant has not acknowledged as being met. Checkmarks identify requirements that the applicant acknowledges are met or accepted from compliance. 'Plans reference page/section' identifies where in the plans/specs the requirement can be verified as being satisfied.

Lighting Wattage:

☐ 1. Total proposed watts must be less than or equal to total allowed watts.
Allowed Wattage: 42564 Proposed Wattage: 22853
Complies: YES

Mandatory Requirements:

✓ 2. Exit signs. Internally illuminated exit signs shall not exceed 5 watts per side.

Project Title:
Data filename:

neea

Oregon Energy Efficiency Specialty Code

Commercial Energy Code Compliance

COMcheck™

Yes, this still needs to be filled out when using Appendix G.

Code Compliance Form

State of Oregon
Building Codes Division
Better Buildings for Oregon

Part I COMcheck information

Compliance path:

- ❑ **Performance path**
- ❑ **Prescriptive path**

COMcheck (Standard 90.1) results:

- ❑ **Pass**
- ❑ **Fail** *If using the performance path, submit the energy model report with this form

Prepared by or under the supervisions of: _____ **Date:** _____

Part II Projected energy use

Enter the ZERO Code Calculator results for projected energy use.

Estimated building energy consumption: _____ MBtu/yr

Part III Estimated available renewables for the building

Enter the ZERO Code Calculator results for offsets.

Total renewable energy necessary to achieve Net Zero: _____ MBtu/yr

On-site potential PV rated capacity _____ kW

CHECKLIST AND APPLICANT SIGNATURE

COMcheck report and ZERO Code Calculator report must be submitted with this form.

- ❑ **COMcheck report is attached**
- ❑ **Energy model report is attached** (if COMcheck failed)
- ❑ **ZERO Code Calculator report is attached**

https://zero-code.org/energy-calculator/

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Oregon Code Construction Document Requirements

- **E104.2 Energy efficiency information on the construction documents.** *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, insulation materials and their *R*-values; fenestration *U*-factors and SHGCs; system design criteria; mechanical and service water heating system and equipment types, sizes and efficiencies; economizer description; equipment and system controls; fan motor horsepower (hp) and controls; duct sealing, duct and pipe insulation and location; daylight areas on floor plans; lighting fixture schedule with wattage and control narrative; air sealing details; and COM*check* compliance report. Supplemental information necessary to verify compliance with this standard, such as calculations, worksheets, compliance forms, vendor literature, or other data shall be made available when required by the *building official*. **Plans and specifications shall include applicable requirements for submittal information and record documents required by Sections 5.7, 6.7, 7.7, 8.7, 9.7, and 10.7 of Standard 90.1**. Plans and specifications shall include building commissioning requirements per Section 4.2.5.2 of Standard 90.1. Plans and specifications shall include verification and testing requirements per Section 4.2.5.1 of Standard 90.1. The *building official* shall not require or expect physical copies of record drawings, manuals, functional performance test reports, or energy reporting unless specifically noted in this section. Section 5.4.3.1.1 of Standard 90.1 building leakage test report shall be submitted to the *building official* where applicable. Materials shall be listed and labeled per Section 4.2.3 of Standard 90.1.

- **Exception:** The *building official* is authorized to waive the requirements for *construction documents*, COM*check* reports, or other supporting data if the code official determines these are not necessary to confirm compliance with this code

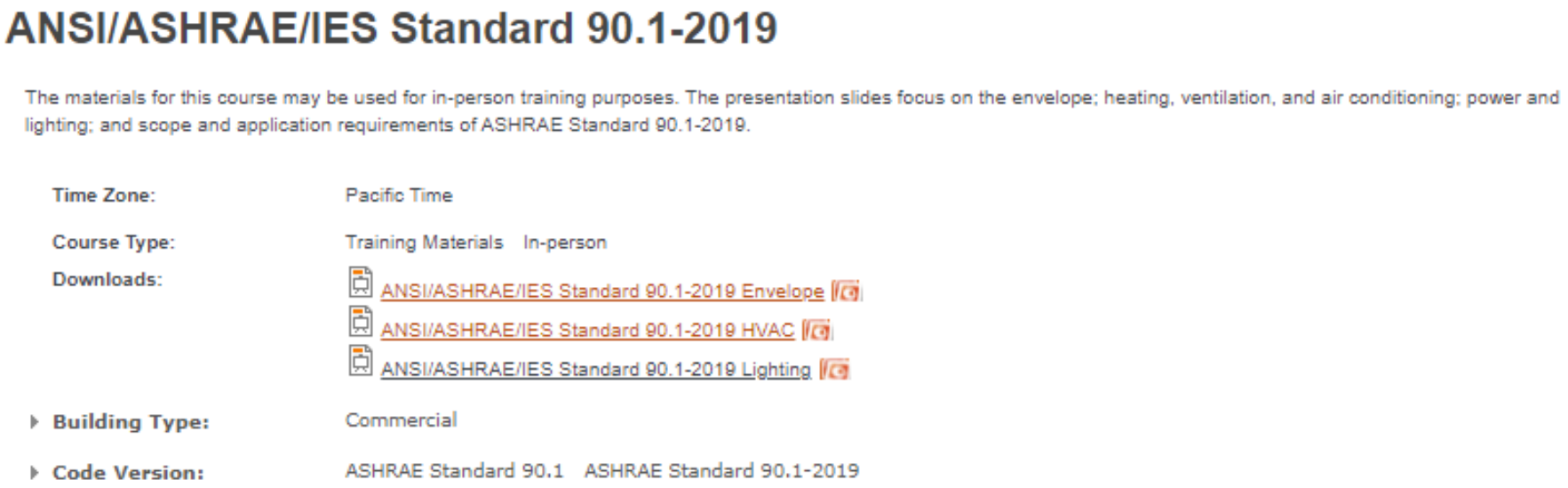
Oregon Code Construction Document Requirements

- **E104.2.1 Oregon Energy Compliance Form.** *Construction documents* for new buildings shall include the 2021 Oregon Energy Compliance Form, including a ZERO Code 2.0 Calculator report (See *ZERO-Code.org/energy-calculator/*)

Summary & Open Discussion

Helpful Resources

- US DOE Website for training materials



ANSI/ASHRAE/IES Standard 90.1-2019

The materials for this course may be used for in-person training purposes. The presentation slides focus on the envelope; heating, ventilation, and air conditioning; power and lighting; and scope and application requirements of ASHRAE Standard 90.1-2019.

Time Zone: Pacific Time

Course Type: Training Materials In-person

Downloads:

- ANSI/ASHRAE/IES Standard 90.1-2019 Envelope
- ANSI/ASHRAE/IES Standard 90.1-2019 HVAC
- ANSI/ASHRAE/IES Standard 90.1-2019 Lighting

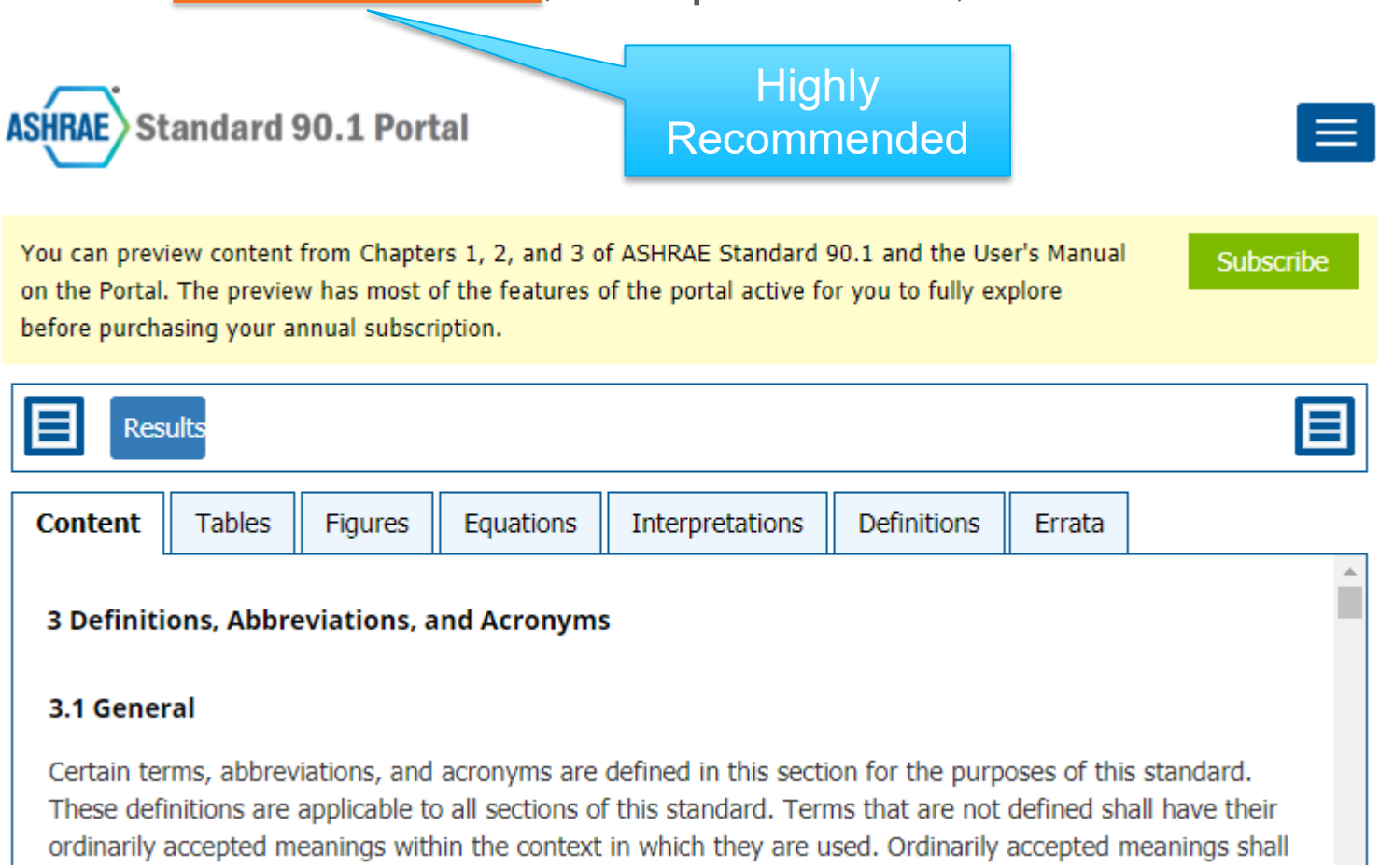
Building Type: Commercial

Code Version: ASHRAE Standard 90.1 ASHRAE Standard 90.1-2019

- https://www.energycodes.gov/resource-center/training-courses/ansiashraeies-standard-901-2019

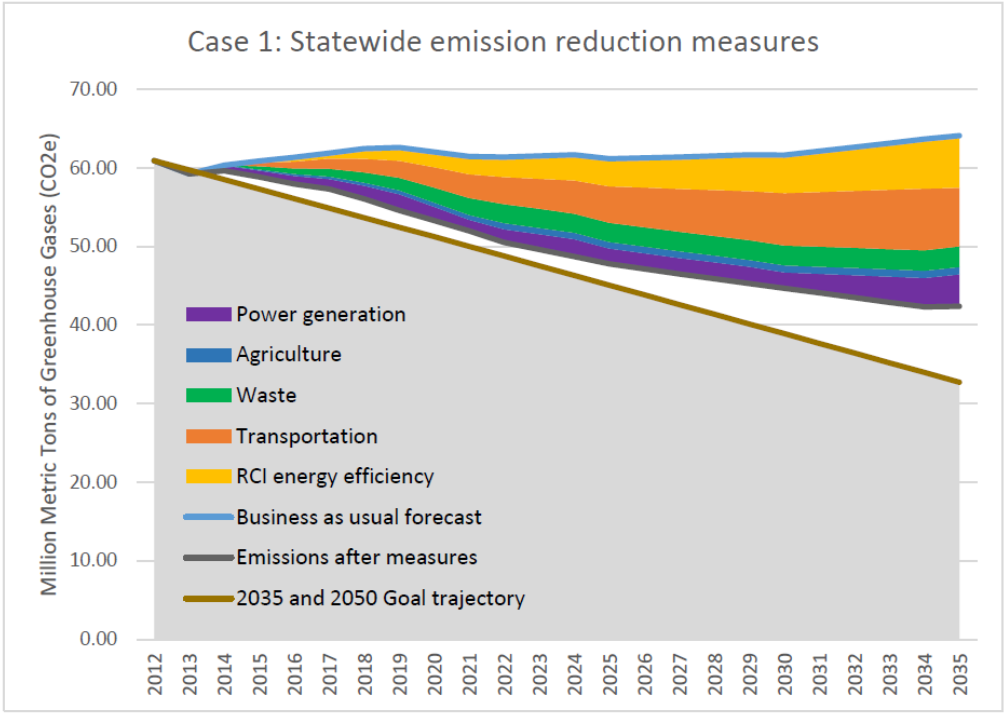
ASHRAE 90.1 Portal

ASHRAE 90.1 online portal (annual subscription)
https://www.ashrae.org/technical-resources/90-1-portal
Includes user's manual, interpretations, redline & notes



Why Building Code Updates Matter

- Improve the energy efficiency and reduce the associated GHG emissions of new building stock
- Critical piece of broader greenhouse gas reduction goals
- Combined with many other generation and demand side efficiency and renewable initiatives, contribute to progress toward goals



Oregon Global Warming Commission, Biennial Report to the Legislature 2015

Reduce GHG emissions to 80% below 1990 levels by 2050

Thank You!
Questions?

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