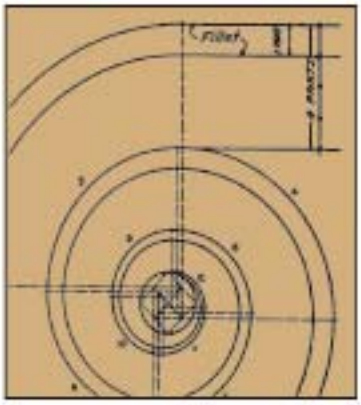
OREGON



non-residential
ENERGY
CODE

NON-RESIDENTIAL ENERGY CODE
COMPLIANCE MANUAL

PUBLISHED BY OREGON DEPT OF ENERGY AND BUILDING CODES DIVISION

A special thanks to both the Northwest Energy Efficiency Alliance and United States Department of Energy (under Contract DE-FG51-02R021378) for providing funds that made this publication available

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SUMMARY

Project

1. Project Name			
2. Project Address			
3. City/Town		5. County	
4. Building, Gross Area (ft2)		6. No. of Floors	
7. Construction Site Elevation Above 2,000 ft?		❑ YES ❑ NO	

Attached Forms and Worksheets

Check boxes to indicate attached forms and worksheets

*** In lieu of 3b**

Chapter	Type	ID	Description	Attach
Building Envelope	Form	3a	Building Envelope - General	❑
		3b	Prescriptive Path - All Climate Zones	❑
		*	CodeComp Report for Simplified Trade-off	❑
		*	Floppy disc with **.occ** CodeComp file	❑
	Worksheet	3a	Wall U-factor	❑
		3b	Roof U-factor	❑
		3c	Floor U-factor	❑
		3d	Window/Skylight Schedule	❑
Systems	Form	4a	Systems - General	❑
		4b	Complex Systems	❑
	Worksheet	4a	Unitary Air Conditioners - Air Cooled	❑
		4b	Unitary Air Cond. - Water & Evap Cooled	❑
		4c	Unitary Heat Pump - Air Cooled	❑
		4d	Unitary Heat Pump - Water Cooled	❑
		4e	Packaged Terminal A.C. - Air Cooled	❑
		4f	Packaged Terminal Heat Pump - Air Cooled	❑
		4g	Water Chilling Pkgs - Water & Air Cooled	❑
		4h	Heat Rejection Equipment	❑
		4i	Boiler - Gas-Fired and Oil-Fired	❑
		4j	Furnace & Unit Heaters - Gas and Oil-Fired	❑
		4k	Simultaneous Heating and Cooling	❑
		4l	Air Transport Energy	❑
		4m	Natural Ventilation	❑
Lighting	Form	5a	Lighting - General	❑
		5b	Interior Lighting Power - Tenant Method	❑
		5c	Int. Ltng. Power - Space-by-Space Method	❑
	Worksheet	5a	Lighting Schedule	❑
		5b	Interior Lighting Power	❑

Applicant

7. Name		10. Telephone	
8. Company		11. Date	
9. Signature			

Attached Documentation

No. of Pages	Description of Documentation

SUMMARY

Example of Completed Form

1. Project Name	ABC Printing Corporation		
2. Project Address	100 Starwalk Way		
3. City/Town	Eugene	5. County	Lane
4. Building, Gross Area (ft2)	12,000	6. No. of Floors	3
7. Construction Site Elevation Above 2,000 ft?		☐ YES	☑ NO

Chapter	Type	ID	Description	Attach
Building Envelope	Form	3a	Building Envelope - General	☑
		3b	Prescriptive Path - All Climate Zones	☑
;		*	CodeComp Report for Simplified Trade-off	☐
* *In lieu of 3b*		*	Floppy disc with **.occ** CodeComp file	☐
	Worksheet	3a	Wall U-factor	☐
		3b	Roof U-factor	☐
		3c	Floor U-factor	☐
		3d	Window/Skylight Schedule	☑
Systems	Form	4a	Systems - General	☑
		4b	Complex Systems	☐
	Worksheet	4a	Unitary Air Conditioners - Air Cooled	☑
		4b	Unitary Air Cond. - Water & Evap Cooled	☐
		4c	Unitary Heat Pump - Air Cooled	☐
		4d	Unitary Heat Pump - Water Cooled	☐
		4e	Packaged Terminal A.C. - Air Cooled	☐
		4f	Packaged Terminal Heat Pump - Air Cooled	☐
		4g	Water Chilling Pkgs - Water & Air Cooled	☐
		4h	Heat Rejection Equipment	☐
		4i	Boiler - Gas-Fired and Oil-Fired	☐
		4j	Furnace & Unit Heaters - Gas and Oil-Fired	☑
		4k	Simultaneous Heating and Cooling	☐
		4l	Air Transport Energy	☐
		4m	Natural Ventilation	☐
Lighting	Form	5a	Lighting - General	☑
		5b	Interior Lighting Power - Tenant Method	☑
		5c	Int. Ltng. Power - Space-by-Space Method	☐
	Worksheet	5a	Lighting Schedule	☑
		5b	Interior Lighting Power	☑

Attached Forms and Worksheets

Form 2a serves as a cover letter for all the attached documents.

Most applicants will need to fill out Form 2a at the end of the process, after completing the forms in Chapters 3 through 5. At that point you will have a better sense of what forms, worksheets and other submittals you will need to provide.

SUMMARY

7. Name	James Smith	10. Telephone	541-543-1234
8. Company	Smart Engineering	11. Date	01/02/05
9. Signature	James Smith		

No. of Pages	Description of Documentation
1	PPG Manufacturer's Spec Sheet - Glazing U and SC

Applicant – Lines 9 through 11

Sign on line 9 if you are the permittee. The permittee is the person who applies for a permit.

Each applicant for a building permit for a building or structure governed by the code shall submit code compliance forms.

If there are two or more permits for the same building, each permittee shall submit:

1. The summary (Form 2a)

2. Other relevant compliance forms and documentation

Example. You are responsible for the lighting permit for a project. The building envelope and systems will be handled by other applicants. In this case you must complete and submit Form 2a and lighting forms required in Chapter 5. The other responsible parties will apply for separate permits. Each will submit Form 2a plus the appropriate forms from Chapters 3 and 4.

Other Documents

Enter all supporting documents to show how you comply with the code, such as test reports, catalog cuts, and calculations.

Example. Plans specify a lower shading coefficient than shown in Table 3f. Attach the manufacturer's test report.

Example. You use ASHRAE procedures to determine U-factors. Attach your calculations.

Example. You use a ballast catalog in place of Table 5b to determine luminaire power. Attach the catalog cuts.

SUMMARY

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Form 3a Project Name: Page:

BUILDING ENVELOPE - GENERAL

Check all boxes that apply.

Exceptions
Discussion of qualifying exceptions in instructions section.

Plans/Specs
Show compliance by including a drawing sheet, detail number, specification section and/or subparagraph.

1. Exceptions (Section 1312)

- ❑ **No Envelope Components**. The building plans do not call for new or altered building envelope components, e.g., walls, floors or roof/ceilings.
- ❑ **A Non-conditioned Building.** The proposed structure has no spaces heated or cooled by an HVAC system.
- ❑ **Exception.** All new or altered building envelope components do not comply with the requirements, Section 1312, but qualify for Exception: ❑ -1 ❑ -2 ❑ -3 ❑ -4 ❑ -5
  Portions of the building that qualify:

The plans/specs show compliance in the following locations:

2. Air Leakage (Section 1312.1.1)

- ❑ **Complies**. Plans require penetrations in building envelope are sealed and windows and doors are caulked, gasketed or weatherstripped.
  The plans/specs show compliance in the following locations:

3. Suspended Ceiling (Section 1312.1.2.1)

- ❑ **Complies**. Building plans do not show suspended ceilings used to separate conditioned space from unconditioned space. No exceptions permitted.

4. Recessed Light Fixtures (Section 1312.1.2.2)

- ❑ **Complies**. The building plans do not show recessed light fixtures installed in ceilings separating conditioned spaces from unconditioned spaces.
- ❑ **Exception.** The building plans require that fixtures installed in direct contact with insulation be insulation coverage (IC) rated. The plans/specs show compliance in the following locations:

5. Moisture Control (Section 1312.1.4)

- ❑ **Complies**. A one-perm vapor retarder is installed on the warm side (in winter) of all exterior floors, walls and ceilings, and a ground cover installed in the crawl space of both new and existing buildings where insulation is installed.
  The plans/specs show compliance in the following locations:
- ❑ **Exception.** All new or altered building envelope components do not comply with the vapor retarder requirements of the code, but qualify for an exception. Note applicable exception.
  Section 1312.1.4, Exception: ❑ -1 ❑ -2
  Portions of the building that comply:

Climate Zones

6. Climate Zones

- ❑ **Zone 1 -** A building site is in Climate Zone 1 if its elevation is less than 3000 feet above sea level and it is in one of the following counties: Benton, Columbia, Clackamas, Clatsop, Coos, Curry, Douglas, Jackson, Josephine, Lane, Lincoln, Linn, Marion, Multnomah, Polk, Tillamook, Yamhill, or Washington
- ❑ **Zone 2 -** Building sites not in Zone 1, or where construction site elevation is 3000 feet or higher in Zone 1, are in Zone 2.

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Form 3b | Project Name: | Page:

PRESCRIPTIVE PATH

Part 1 of 4

CLIMATE

Zone ❑-1 or ❑-2 (*select one*)

Glazing Percent Calculation

See instruction section for a discussion of glazing percent calculation.

	Window Area (total rough frame ft2)		Exterior Wall Area (gross ft2)		Glazing %	Maximum Glazing Fraction Complies
Conditioned Space		÷		X 100 =		
Semi-Conditioned Space		÷		X 100 =		
Conditioned Mechanical Penthouse		÷		X 100 =		

Windows

From Worksheet 3d, place the highest Overall Window U-factor and highest Center-of-Glass SC. Or check minimum assembly and identify window.

Window (from Worksheet 3d)	Max U-Factor[1]	Minimum Assembly
		❑
U-Value Complies		
Required Minimum Assembly (Fixed Windows)		
Required Minimum Assembly (Operable Windows and Curtainwall)		

Window (from Worksheet 3d)	Shading Coefficient[2]	Minimum Assembly
		❑
SC Complies		
Required Minimum Assembly		

The plans/specs show window compliance in the following locations:

Notes

[1] From Worksheet 3d, place the highest Overall Window U-factor or check (Minimum Assembly). See "Window Requirements" in table on the following page for specific MA requirements. Excel version will automatically insert minimum assembly requirements or greatest U-value from

[2] From Worksheet 3d, place the highest "center-of-glass" shading coefficient (SC) for glass or check MA (Minimum Assembly). See "Window Require-ments" in following table for specific MA requirements. Excel version will automatically insert minimum assembly requirements or greatest SC from Worksheet 3d. Shading Coefficient (SC) can be calculated from Solar Heat Gain Coefficient using the equation: SC = SHGC ÷ 0.87. Manufacturers data may also be used to document SC.

Walls

See instructions for a discussion of wall require-ments.

Wall / Insulation Type	R-Value Insulation Only		U-Factor[3]
		or	
		or	
		or	
		or	
		or	
		or	

Below-Grade Walls

See instructions for a discussion of requirements.

Below-Grade Walls	R-Value Insulation Only (Min. R-7.5)		U-Factor[3] (Max. 0.11)
		or	

Notes

[3] Submit Worksheet 3a for each calculated assembly U-factor

Form 3b | Project Name: | Page:

PRESCRIPTIVE PATH

Part 2 of 4

Code Requirements - Zone 1

Discussion of these requirements in the instruction section.

ZONE 1						
		Wall Requirements			Window Requirements	
Max. Glazing Fraction[4]	Wall / Insulation Type	R-Value Insulation Only		U-Factor	Max. U-Factor	Max. Shading Coefficient
Up to 15%	CMU 'Masonry[5], w/integral loose fill[6] insulation	N/A	or	0.300	0.540[7]	0.57[7]
	Masonry or concrete[5], w/cont. exterior insulation	1.4	or	0.300		
Up to 30%	CMU Masonry[5], w/integral rigid[8] fill insulation	N/A	or	0.210	0.540[7]	0.57[7]
	Masonry or concrete[5], w/interior insulation	11	or	0.130		
	Masonry or concrete[5], w/cont. exterior insulation	2.8	or	0.210		
	Frame[9] (wood or metal framing)	13	or	0.130		
	Other *(provide short description)*	13	or	0.130		
Up to 40%	CMU Masonry[5], w/integral rigid[8] fill insulation	N/A	or	0.210	0.370[10]	0.35[10]
	Masonry or concrete[5], w/interior insulation	11	or	0.130		
	Masonry or concrete[5], w/cont. exterior insulation	2.8	or	0.210		
	Frame[9] (wood or metal framing)	13	or	0.130		
	Other *(provide short description)*	13	or	0.130		

Code Requirements - Zone 2

Discussion of these requirements in the instruction section.

ZONE 2						
		Wall Requirements			Window Requirements	
Max. Glazing Fraction[4]	Wall / Insulation Type	R-Value Insulation Only		U-Factor	Max. U-Factor	Max. Shading Coefficient
Up to 15%	CMU 'Masonry[5], w/integral loose fill[6] insulation	N/A	or	0.300	0.500[11]	0.57[11]
	Masonry or concrete[5], w/cont. exterior insulation	1.8	or	0.270		
Up to 25%	CMU Masonry[5], w/integral rigid[8] fill insulation	N/A	or	0.160	0.500[11]	0.57[11]
	Masonry or concrete[5], w/interior insulation	13	or	0.090		
	Masonry or concrete[5], w/cont. exterior insulation	4.3	or	0.160		
	Frame[9] (wood or metal framing)	19	or	0.090		
	Other *(provide short description)*	19	or	0.090		
Up to 33%	CMU Masonry[5], w/integral rigid[8] fill insulation	N/A	or	0.160	0.370[12]	0.43[12]
	Masonry or concrete[5], w/interior insulation	13	or	0.090		
	Masonry or concrete[5], w/cont. exterior insulation	4.3	or	0.160		
	Frame[9] (wood or metal framing)	19	or	0.090		
	Other *(provide short description)*	19	or	0.090		

Notes

[4] The Simplified Trade-off Approach must be used if glazing fraction exceeds allowable percentages.

[5] Minimum weight of masonry and concrete walls = 45 lb/ft2 of wall face area

[6] All cores to be filled. At least 50% of cores must be filled with vermiculite or equivalent fill insulation.

[7] Prescriptive MA (Minimum Assembly) - For **Fixed Windows:** double-glazed window with a 0.5 inch air space, low-e coating and aluminum frame. MA shading coefficient description is a tinted outboard pane of glass. For **Operable Windows or Curtainwall:** double-glazed window with a 0.5 inch air space, low-e coating and thermally broken frame. MA shading coefficient description is a tinted outboard pane of glass.

[8] All cores except bond beams must contain rigid insulation inserts approved for use in reinforced masonry walls

[9] Batt insulation installed in metal or wood frame walls shall be insulated to the full depth of the cavity, up to 6 inches in depth.

[10] Prescriptive MA (Minimum Assembly) - For **Fixed Windows:** double-glazed window with a 0.5 inch argon filled space, low-e coating (e<= 0.05) and thermal break frame. For **Operable Windows or Curtainwall:** only use Max U-Factor. MA shading coefficient description is a 0.25-inch thick glass with low-e coating (e<= 0.05) with a tinted outboard pane.

[11] Prescriptive MA (Minimum Assembly) - For **Fixed Windows:** double-glazed window with a 0.5 inch air space, low-e coating and aluminum frame. For **Operable Windows or Curtainwall:** double-glazed window with a 0.5 inch air space, low-*e* coating (*e* <= 0.1) and thermally broken frame. MA maximum shading coefficient description is a tinted outboard pane of glass.

[12] Prescriptive MA (Minimum Assembly) - For **Fixed Windows**, a double-glazed window with a 0.5 inch argon filled space, low-e coating (e<= 0.05) and thermal break frame. For **Operable Windows or Curtainwall**, only use Max U-Factor. MA shading coefficient description is a 0.25-inch thick glass with low-e coating (e<= 0.05).

PRESCRIPTIVE PATH

Roofs/ Ceilings

See instructions for a dicussion of roofs/ceilings.

Roof / Ceiling[11]	R-Value Insulation Only (Min. R-19)		U-Factor[12] (Max. 0.050)
		or	

Notes

[11] Write-in a short description for assembly with the lowest insulation R-value or the highest assembly U-factor.

[12] Submit Worksheet 3b for each calculated roof/ceiling assembly U-factor.

Skylights

Includes glazed smoke vents.

See instructions for a dicussion of skylights.

	Skylight Area (total rough frame ft2)		Roof Area (gross ft2)		Skylight % [13]	Maximum Skylight Fraction Complies
Conditioned Space		÷		X 100 =		
Semi-Conditioned Space		÷		X 100 =		
Conditioned Mechanical Penthouse		÷		X 100 =		
	Skylight Area (total rough frame ft2)		Roof/Ceiling Area (gross ft2)		Skylight Percent[13]	

Skylights

From Worksheet 3d, place highest Overall Vertical Window U-factor and highest Center-of-Glass SC.

Skylights (from Worksheet 3d)	Max U-Factor[14]	Minimum Assembly
		❑
U-Value Complies		
Required Minimum Assembly		

Skylights (from Worksheet 3d)	Shading Coefficient[15]	Minimum Assembly
		❑
SC Complies		
Required Minimum Assembly		

The plans/specs show window compliance in the following locations:

Code Require-ments

Compliance Option	Thermal Performance Overall Vertical U-Factor	Shading Coefficient Center of Glass SC
Performance	U-1.230 for overall assembly in overhead plane	SC-0.47 center-of-glass
Min. Assembly (MA)	Double glazed, 0.5-inch airspace	N/A

Notes

[13] Skylight percentage area is based on total skylight and smoke vent rough frame area divided by total conditioned roof area. Percentage must not exceed 6 percent of total roof/ceiling area in conditioned building space. The Simplified Trade-off Approach must be used if glazing fraction exceeds allowable percentages.

[14] From Worksheet 3d, place the highest Overall Vertical U-factor or write-in MA (Minimum Assembly). See "Skylight Requirements" in table above for specific MA requirements.

[15] From Worksheet 3e, place the highest "center-of-glass" shading coefficient (SC) for glass. See "Skylight Requirements" in table above for specific MA requirements. Shading Coefficient (SC) can be calculated from the Solar Heat Gain Coefficient using the equation: SC = SHGC ÷ 0.87. Manufacturers data may also be used to document SC.

PRESCRIPTIVE PATH

Part 4 of 4

Floors

See instructions for a dicussion of floors.

Floors over Unconditioned Spaces[16]	R-Value Insulation Only		U-Factor
		or	

Heated Concrete Slab Edge	R-Value Insulation Only

Heated Slab-on-Grade (Section 1312.1.2.4)

☐ **Complies**. Building plans show insulation extending downward from the top of the slab a minimum distance of 24 inches or downward and under the slab for a combined minimum distance of 24 inches or to the bottom of the thickened edge of the of slabs used as a foundation.

The plans/specs show compliance in the following locations:

Notes

[16] Write-in a short description for assembly with the lowest insulation R-value or the highest assembly U-factor.

[17] Submit Worksheet 3c for each calculated floor assembly U-factor.

[18] Write-in a short description for Heated Slab, which has heat, integrated into slab such as hydronic heat. If more than one floor type, enter the lowest insulation R-value or the highest component U-factor of any floor.

Code Requirements

Component	Compliance Options: Min. R-Value Insulation Only		Max. U-Factor
Floor over Unconditioned Spaces	11	or	0.070

Component	Climate Zone 1		Climate Zone 2
Heated Concrete Slab Edge, Min. R-Value	7.5	or	10.0

Doors

See instructions for a dicussion of doors.

Doors[19] opaque, with leaf width greater than 4'	R-Value Insulation Only (Min. R-5)		U-Factor Center-of-Panel (Max. 0.20)
		or	

Notes

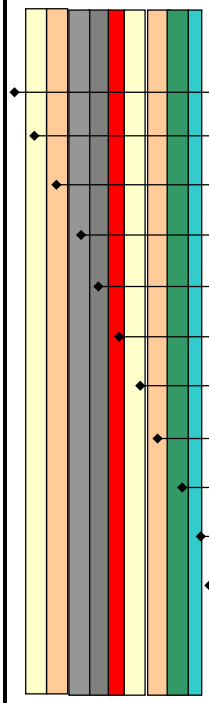
[19] Write-in a short description for Doors. If more than one door type, enter the lowest insulation R-value or the highest center-of-panel U-factor of any door. The following doors are exempt from door and window U-factor and shading coefficient requirement

Worksheet 3a | Project Name: | Page:

Wall U-factors

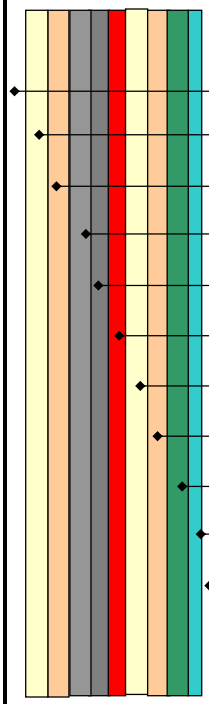
See Tables 3a through 3d for R-Values of building materials

Wall Assembly 1 - ID



(a) Layer	(b) Description	(c) Detail	(d) R-value
Exterior	Moving Air		0.17
A			
B			
C			
D			
E			
F			
G			
H			
I			
J			
Interior	Still Air		0.68
1. Total column (d)			
2. Assembly U-factor (Invert the amount in line 1)			

Wall Assembly 2 - ID



(a) Layer	(b) Description	(c) Detail	(d) R-value
Exterior	Moving Air		0.17
A			
B			
C			
D			
E			
F			
G			
H			
I			
J			
Interior	Still Air		0.68
1. Total column (d)			
2. Assembly U-factor (Invert the amount in line 1)			

Worksheet 3b Project Name: Page:

Roof U-factors

See Tables 3a through 3d for R-Values of building materials

Roof Assembly 1 - ID

(a) Layer	(b) Description	(c) Detail	(d) R-value
Exterior	Moving Air		0.17
A			
B			
C			
D			
E			
F			
G			
H			
I			
J			
Interior	Still Air		0.61
1. Total column (d)			
2. Assembly U-factor (Invert the amount in line 1)			

Roof Assembly 2 - ID

(a) Layer	(b) Description	(c) Detail	(d) R-value
Exterior	Moving Air		0.17
A			
B			
C			
D			
E			
F			
G			
H			
I			
J			
Interior	Still Air		0.61
1. Total column (d)			
2. Assembly U-factor (Invert the amount in line 1)			

Worksheet 3c | Project Name: | Page:

Floor U-factors

See Tables 3a through 3d for R-Values of building materials

Floor Assembly 1 - ID

	(a) Layer	(b) Description	(c) Detail	(d) R-value
	Interior	Still Air		0.92
	A			
	B			
	C			
	D			
	E			
	F			
	G			
	H			
	I			
	J			
	Exterior	Moving Air		0.17
1. Total column (d)				
2. Assembly U-factor (Invert the amount in line 1)				

Floor Assembly 2 - ID

	(a) Layer	(b) Description	(c) Detail	(d) R-value
	Interior	Still Air		0.92
	A			
	B			
	C			
	D			
	E			
	F			
	G			
	H			
	I			
	J			
	Exterior	Moving Air		0.17
1. Total column (d)				
2. Assembly U-factor (Invert the amount in line 1)				

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Worksheet 3d

Project Name:

Page:

Window Schedule

Window Properties - List All Window Types in Project

(a) Name	(b) Documentation Source	(c) Manufacturer's Model / No.	(d) Window Type/Class	(e) Frame Type	(f) Glass Tint	(g) Glass Thickness	(h) Other (# panes, air space, argon, low E)	(i) Center of Glass U-factor	(j) Overall Window U-factor	(k) Center of Glass SC

Column Instructions

(a) Enter the name of the window product. It is recommended that you choose a name that corresponds with that used on project plans and specifications.

(b) Provide documentation source.

Write-in "NFRC" if window is rated through NFRC 100-97 Procedure for Determining Fenestration Product Thermal Performance. Enter all columns except (i).

Write-in "ASHRAE Default W/Mfg COG" if Center-of-Glass U-factor and Shading Coefficient is available from glass manufacturer. Enter all columns. Columns (i) and (k) from manufacturer's data sheet.

Write-in "ASHRAE Default" if only descriptive parameters of window are known. Enter all columns. Columns (i), (j), and (k) from ASHRAE default table.

(c) If Document Source is either "NFRC" or "ASHRAE Default W/Mfg COG," enter the manufacturer's model number.

(d) Choices are Fixed, Operable, or Curtain Wall.

(e) Choices are wood, vinyl, reinforced vinyl, aluminum clad, insulated fiberglass, aluminum, aluminium w/thermal break (see definitions for thermal break requirements.)

(f) Enter glass tint. Write "clear" if there is no tint.

(g) Enter glass thickness

(h) Include window properties such as argon fill, low-e coating, insulating spacers, etc.

(i) COG U-factor from manufacture's data or ASHRAE 2001 Fundamentals Handbook, Chapter 30, Table 4. For NFRC rated products leave blank.

(j) Overall U-factor from NFRC rating orASHRAE 2001 Fundamentals Handbook, Chapter 30, Table 4. For skylights value must be for horizontal position.

(k) COG Shading Coefficient from manufacture's data or ASHRAE 2001 Fundamentals Handbook, Chapter 30, Table 4. For NFRC rated products SHGC is provided.

To convert SHGC to SC. SC = SHGC/0.87.

Worksheet 3e | Project Name: | Page:

Skylight Schedule

Skylight Properties - List All Skylight Types in Project

(a) Name	(b) Documentation Source	(c) Manufacturer's Model / No.	(d) Skylight Type/Class	(e) Frame Type	(f) Glass Tint	(g) Glass Thickness	(h) Other (# panes, air space, argon, low E	(I) Center of Glass U-factor	(j) Overall Skylight U-factor	(k) Center of Glass SC

Column Instructions

(a) Enter the name of the window product. It is recommended that you choose a name that corresponds with that used on project plans and specifications.

(b) Provide documentation source.

Write-in "NFRC" if window is rated through NFRC 100-97 Procedure for Determining Fenestration Product Thermal Performance. Enter all columns except (i).

Write-in "ASHRAE Default W/Mfg COG" if Center-of-Glass U-factor and Shading Coefficient is available from glass manufacturer. Enter all columns. Columns (i) and (k) from manufacturer's data sheet.

Write-in "ASHRAE Default" if only descriptive parameters of window are known. Enter all columns. Columns (i), (j), and (k) from ASHRAE default table.

(c) If Document Source is either "NFRC" or "ASHRAE Default W/Mfg COG," enter the manufacturer's model number.

(d) Choices are Manufactured or Site Built.

(e) Choices are wood, vinyl, reinforced vinyl, aluminum clad, insulated fiberglass, aluminum, aluminium w/thermal break (see definitions for thermal break requirements.)

(f) Enter glass tint. Write "clear" if there is no tint.

(g) Enter glass thickness

(h) Include skylight properties such as argon fill, low-e coating, insulating spacers, etc.

(i) COG U-factor from manufacture's data or ASHRAE 2001 Fundamentals Handbook, Chapter 30, Table 4. For NFRC rated products leave blank.

(j) Overall U-factor from NFRC rating orASHRAE 2001 Fundamentals Handbook, Chapter 30, Table 4. For skylights value must be for horizontal position.

(k) COG Shading Coefficient from manufacture's data or ASHRAE 2001 Fundamentals Handbook, Chapter 30, Table 4. For NFRC rated products SHGC is provided.

To convert SHGC to SC. SC = SHGC/0.87.

BUILDING ENVELOPE – GENERAL

General Instructions

Form 3a contains several spaces that require the applicant to complete. The information provided is either a description of the portions of qualify for a specific exemption or entering the specific location where the requirements is specified, either on the plans or in the specifications. When a specification is provided, provide the exact location. This means the specific Section must be provides as well as subparagraph – 08800 is not acceptable, 08800, 2, 2 is acceptable.

Example

1. Exceptions (Section 1312)

☐ **No Envelope Components**. The building plans do not call for new or altered building envelope components, e.g., walls, floors or roof/ceilings.

☐ **A Non-conditioned Building.** The proposed structure has no spaces heated or cooled by an HVAC system.

☑ **Exception.** All new or altered building envelope components do not comply with the requirements, Section 1312, but qualify for Exception: ☐-1 ☑-2 ☐-3 ☐-4 ☐-5

Portions of the building that qualify:

Auto repair area and adjacent work areas

The plans/specs show compliance in the following locations: Drawing A-2

Line 1. Exceptions

No Envelope Components. If your building plans do not call for any new or altered building envelope components, check this box. Skip the rest of this form and all other forms and worksheets in Chapter 3.

A Non-Conditioned Building. If the space within your project is not heated or cooled by an HVAC system, check this box. Skip the rest of this form and all other forms and worksheets in Chapter 3.

Exceptions. If your project meets one of the five exceptions cited below, check the appropriate box number that applies. See below for a discussion of code exceptions. ***Next, indicate in the text box if your entire building or only a portion of your building qualifies for the exception***. In some cases you will need to complete part of the Prescriptive Path form. You can skip the rest of Form 3a if the exception applies to the entire building.

Exceptions 1 and 2 are not blanket exceptions to the envelope requirements. In both cases, the code sets requirements that are unique to the exception. Read these requirements carefully to be certain that your plans meet the code.

Section 1312, Exception 1 is for semi-conditioned spaces. To qualify as a semi-conditioned space in Climate Zone 1, the heating system output capacity for the space shall not exceed 15 Btu/hr/ft^2 or 4 Watts/ft^2 of heated floor area. In Climate Zone 2, the heating system output capacity for the space shall not exceed 20 Btu/hr/ft^2 or 6 Watts/ft^2 of heated floor area. In both zones, only the wall insulation requirements are exempt from prescriptive path requirements. A thermostat shall control the heating system with a maximum setpoint capacity of 45 degrees F, mounted no lower than the heating unit. If you qualify for this exception, check the Exception box and box 1, and complete lines the Prescriptive Path form (Forms 3b) to show you meet all requirements except wall insulation. Submit the Prescriptive Path form along with this form.

Section 1312, Exception 2 applies to motor vehicle service station occupancies only (Group S-3 or H-3), in spaces where the temperature is maintained below 55 degrees F. These spaces often have large, overhead doors that are open during operating hours. Code requires the roof/ceiling assembly meet the Prescriptive Path for that climate zone and heating system be controlled by a thermostat having a maximum setpoint capacity of 55 degrees F. If you qualify for this exception, check the Exception box and box 2, and complete the Prescriptive Path form (Form 3b) to show you meet the roof/ceiling requirement.

BUILDING ENVELOPE – GENERAL

Section 1312, Exception 3 is for windows installed in demising walls. If you qualify for this exception, check the Exception box and box 3.

Section 1312, Exception 4 is for buildings whose sole source of space conditioning energy is from on-site solar or wind resources. If you qualify for this exception, check the Exception box and box 4.

Section 1312, Exception 5 is for greenhouses intended primarily for plant propagation. If you qualify for this exception, check the Exception box and box 5.

Example

2. Air Leakage (Section 1312.1.1)

☑ **Complies**. Plans require penetrations in building envelope are sealed and windows and doors are caulked, gasketed or weatherstripped.
The plans/specs show compliance in the following locations:

Drawing A-6 and specifications section 08710.4.a

Line 2. Air Leakage

Complies. The code requires that all penetrations or through openings in the building envelope be caulked, gasketed, weatherstripped, or otherwise sealed to limit infiltration and exfiltration. Exterior joints around windows and door frames, between wall cavities and window or door frames, between wall and foundation, between wall and roof, between wall panels, at penetrations or utility services through walls, floors and roofs, and all other openings in the exterior envelope shall be sealed in a manner approved by the building official. If the building plans specify how this requirement is met, check the Complies box and indicate where on your plans and specifications you show compliance with this requirement.

Example

3. Suspended Ceiling (Section 1312.1.2.1)

☑ **Complies**. Building plans do not show suspended ceilings used to separate conditioned space from unconditioned space. No exceptions permitted.

Line 3. Suspended Ceiling

Complies. Since suspended ceilings are not permanent building features, placing insulation over (directly on top of) suspended ceilings does not qualify as exterior building envelope insulation. If the requirement is met, check the Complies box.

Example

4. Recessed Light Fixtures (Section 1312.1.2.2)

☐ **Complies**. The building plans do not show recessed light fixtures installed in ceilings separating conditioned spaces from unconditioned spaces.

☑ **Exception.** The building plans require that fixtures installed in direct contact with insulation be insulation coverage (IC) rated. The plans/specs show compliance in the following locations:

Drawing E-3, Luminaire Schedule and specifications section 16000.4.a

Line 4. Recessed Light Fixtures

Complies. The code prohibits, with one exception, recessed light fixtures installed in ceilings separating conditioned space from unconditioned space. If your building plans comply with this requirement, check the Complies box. An example of a ceiling that complies is a ceiling with recessed fixtures, with insulation on top of the roof deck or located in the roof structure and not in contact with, or penetrated by light fixtures.

Exception. Light fixtures with an insulation coverage (IC) rating may have insulation placed on top of them. If your building plans

specify IC-rated fixtures in an insulated ceiling, check the Exception box and indicate where on your plans and specifications you show compliance with this requirement. Placing insulation on non-IC-rated fixtures is a fire hazard.

Example

5. Moisture Control (Section 1312.1.4)

☐ **Complies**. A one-perm vapor retarder is installed on the warm side (in winter) of all exterior floors, walls and ceilings, and a ground cover installed in the crawl space of both new and existing buildings where insulation is installed.
The plans/specs show compliance in the following locations:

☑ **Exception.** All new or altered building envelope components do not comply with the vapor retarder requirements of the code, but qualify for an exception. Note applicable exception.
Section 1312.1.4, Exception: ☑ -1 ☐ -2
Portions of the building that comply:

North wing, ground floor

Line 5. Moisture Control

Complies. If your plans specify a one-perm vapor retarder on the warm side (in winter) in all exterior floors, walls and ceilings, and a ground cover in the crawl space (if applicable), check the Complies box and indicate where on your plans and specifications you show compliance with this requirement. The ground cover shall be installed as specified in Section 1312.1.4.

Exception. There are several exceptions to the requirements for vapor barriers: 1) Masonry walls with exposed interior surfaces. If your building qualifies for this exception, check the Exception box, and box 1, as the basis for the exception.

2) Slab-on-grade floors. If your building qua-lifies for this exception, check the Exception box and, and box 2, as the basis for the exception.

The building official may accept designed moisture-control systems that may include vapor barriers, ventilation, dehumidification or combinations of these. If you think you qualify for this exception, check with your permit granting agency. The building official also may require designed moisture-control systems for refrigerated buildings, buildings covering swimming pools, or similar buildings with unusual potential for moisture damage.

Example

6. Climate Zones

☑ **Zone 1 -** A building site is in Climate Zone 1 if its elevation is less than 3000 feet above sea level and it is in one of the following counties: Benton, Columbia, Clackamas, Clatsop, Coos, Curry, Douglas, Jackson, Josephine, Lane, Lincoln, Linn, Marion, Multnomah, Polk, Tillamook, Yamhill, or Washington.

☐ **Zone 2 -** Building sites not in Zone 1, or where construction site elevation is 3000 feet or higher in Zone 1, are in Zone 2.

Line 6. Climate Zones

Zone 1 - Indicates building is sited in climate zone 1. Zone 1 requirements in Form 3b must be used to show compliance with the prescriptive path.

Zone 2 - Indicates building is sited in climate zone 2. Zone 2 requirements in Form 3b must be used to show compliance with the prescriptive path

Excel Spreadsheet Note: You must select either Zone 1 or Zone 2 or the algorithms on Form 3b will not function properly.

BUILDING ENVELOPE – PRESCRIPTIVE PATH

Form 3b Instructions

Example

	Window Area (total rough frame ft2)		Exterior Wall Area (gross ft2)		Glazing %	Maximum Glazing Fraction Complies
Conditioned Space	3,000	÷	20,000	X 100 =	15.0%	Yes
Semi-Conditioned Space	0	÷	10,000	X 100 =	0.0%	Yes
Conditioned Mechanical Penthouse		÷		X 100 =	0.0%	Yes

Check the appropriate checkbox for the Climate Zone where the project is located.

Excel Spreadsheet Note: There are **four** worksheets/pages that must be completed for Form 3a. Unless an "other" wall type requires a description, there may be nothing to complete on Form 3b-2.

Based on the selection made on the bottom of Form 3b, The appropriate Climate Zone will propagate on Form 3b.

More than one glazing percent needs to be calculated whenever glazing is installed in two or more different conditions: the glazing percent in conditioned space, the glazing percent in semi-conditioned space or glazing percent in conditioned mechanical penthouse.

The window area consists of the entire window assembly (glass and framing) in square feet. Enter the total area of all windows in exterior walls in the first box (Window Area).

The total building exterior wall area includes all elements that separate conditioned spaces from the exterior. Enter this gross exterior wall area in the second box (Total Building Exterior Wall Area). Do not subtract windows and doors from this area.

Glazing Percent Calculation

Divide "total building window area" by "total building exterior wall area." Multiply this sum by 100 and insert value into third box (Glazing Percent).

Repeat calculation for Semi-Conditioned Space if applicable.

Repeat calculation for Conditioned Mechanical Penthouse if applicable.

Excel Spreadsheet Note: The user only needs to enter applicable Window Area and gross Exterior Wall Area. The Glazing Percentage and Compliance with Maximum Glazing Fraction will automatically propagate. Maximum Glazing Fraction Compliance **IS NOT** tied to compliance with U-factor or Shading Coefficient. This compliance is determining maximum window area allowed for your Climate Zone. **This glazing Fraction DOES NOT take into consideration which prescriptive window performance or wall type is used.**

Window (from Worksheet 3d)	Max U-Factor[1]	Minimum Assembly
N/A	N/A	☑
U-Value Complies	N/A	
Required Minimum Assembly (Fixed Windows)	Double-glazed with 0.5 inch airspace, low-e coating, alum frame	
Required Mini-mum Assembly (Operable Windows and Curtainwall)	Double-glazed window with a 0.5 inch air space, low-e coating and thermally broken frame	

Example

Window (from Worksheet 3d)	Shading Coefficient[2]	Minimum Assembly
Storefront	0.530	☐
SC Complies	Yes	
Required Minimum Assembly	N/A	

BUILDING ENVELOPE – PRESCRIPTIVE PATH

Windows

Windows

The U-factor (Thermal Performance) requirement is for overall window. The Shading Coefficient (SC) requirement is based on a center-of-glass value.

There are three options for complying with window U-Factor and SC code requirements.

NFRC Certification
Windows may have U-factor and SHGC determined by the NFRC Rating, Certification and Labeling program. SHGC value can be converted to SC values using the equation, SHGC/0.87=SC. Center of glass SC values may also be obtained from manufacturer data.

Default Tables
U-factor and SC values can be found in Table 3e and 3f. Values these tables are from ASHRAE Handbook, 2001, Fundamentals. Center of Glass U-factors shall have factors adjusted for specific type of window frame.

Minimum Assembly (MA)
Windows comply with either U-factor and SC requirements if they meet the descriptions provided in Notes 7, 10, 11 and 12 in Form 3b, page 3-3. This description is called "MA" (Minimum Assembly).

Worksheet 3d must be completed, which describes all windows in a project. Both U-factor (or matching MA) AND Shading Coefficient (or matching MA) must comply for the "worst case" window.

All glazing used in a project must be listed in Worksheet 3d. If there is more than one type of glazing used, each type of glazing must comply. If a project contains both Fixed and Operable or Curtainwall, assure that both operator styles meet the MA requirements. A combination of Fixed may comply with MA and Operable/Curtainwall may comply with overall U-factor.

In either the Required Minimum Assembly for Fixed Windows or Operable Windows/ Curtainwall, write-in the complying description for that product from the applicable Notes at the bottom of page 3-3.

For "Shading Coefficient," either write-in "MA" (if applicable AND acceptable for that product) or provide the highest center-of-glass SC value from Worksheet 3d.

Code-required fire-rated windows and other windows that constitute no more than one percent of exterior wall area can be exempt from U-factor and SC requirements.

***Window Area Percentage cannot exceed maximum window percentage allowed for corresponding wall type with lowest allowable percentage*.**

Excel Spreadsheet Note: The user must complete Worksheet 3d to describe all windows in the project. You have the option of using the values provided (overall U and center SC) to determine compliance OR check the Minimum Assembly checkbox if it is applicable/acceptable for this product.

Walls

Walls

Example

Wall / Insulation Type	R-Value Insulation Only		U-Factor[3]
CMU Masonry, w/integral loose fill insulation		or	MA
Frame (wood or metal framing)	13	or	
		or	
		or	
		or	
		or	

BUILDING ENVELOPE – PRESCRIPTIVE PATH

Walls (Cont.)

Enter energy conservation requirements for each exterior wall assembly in building. Wall/Insulation Types are described on Form 3b, Part 2 of 4, page 3-3. Write-in under Wall/Insulation Type each wall in proposed building. Write-in a short description for "Other" Wall Types (see example). Exterior walls include those separating conditioned from unconditioned spaces. Walls separating conditioned from semi-heated space are also considered exterior walls.

There are two compliance options for each exterior wall assembly: Insulation R-value *or* wall assembly U-factor. Insulation R-value is for the insulation only. Appropriate Worksheet(s) 3a must be completed for each wall assembly U-factor entered on Forms 3b. It is not necessary to enter both Insulation R-value and Component U-factor. Each wall assembly must comply with code.

If there are similar wall types, wall with highest U-factor can be submitted as the representative value. Example: 4-inch steel stud, 16-inches on-center, R-13 batt insulation; one assembly with wood siding and the second assembly with brick veneer. The wall assembly with wood siding can be the representative value for both types of construction.

Except for below-grade walls, every wall on this form has a maximum allowed glazing percent. The amount of glass for any wall type cannot exceed maximum allowed for wall type with lowest allowed glazing percentage. Example: Building has CMU walls with open cells insulated (up to 15% window allowed, Zone 1) and 2x6 wood framing with R-19 batt (up to 30% windows allowed, Zone 1). Total exterior window area in this building cannot exceed 15 percent of total exterior wall area.

If a building does not comply with Prescriptive Path requirements, or cannot be redesigned to pass, the Simplified Trade-off Approach using CodeComp software is the alternative methodology to determine compliance.

Insulation R-values shall be taken from the tables on page 3 of these forms. When not listed in these tables, value may be taken from 2001 ASHRAE Handbook of Fundamentals. When not listed in either the tables or ASHRAE, submit manufacturer's literature including certified test reports to the building official for approval.

Masonry, Integral w/Loose Fill

Minimum Assembly wall: 8-inch CMU with at least 50% of the cores filled with vermiculite or equivalent fill insulation. If proposed wall meets or exceeds this construction, "MA" can be written-in the U-Factor column (see Example).

Most CMU walls, 8 inches thick or thicker, with perlite or vermiculite insulation in all unreinforced cells, meet the requirements for this wall. Except in rare cases having large numbers of reinforced and grouted cells, there should be no need to calculate the percent of insulated cells, as long as specifications require that unreinforced cells are not grouted. The percent of insulated cells was set low to avoid this calculation.

Other qualifying walls of this type are 10-inch or 12-inch CMU walls with integral loose-fill insulation or any qualifying wall with an applied exterior or interior insulation layer.

CMU walls less than 8 inches thick do not meet the requirement for 45 lb/ft^2 of wall weight and are not allowed. Table 3b in this chapter gives wall weights in lb/ft^2 of face area for building materials.

Masonry, Integral w/Rigid Fill

Minimum Assembly wall: 8-inch CMU. Each block has a pre-installed, individually molded insert of expandable polystyrene. With insert in place, the insulated non-grouted unit should have a maximum U-factor of 0.21 in Zone 1 and 0.16 in Zone 2, assuming a density of 100 lb/ft^3 for the concrete used in the block. CMU walls less than 8 inches thick do not meet the 45 lb/ft^2 weight requirement and are not allowed. If proposed wall meets or exceeds this construction, "MA" can be written in the U-Factor column.

Enter the U-factor for your wall on line 2, column (e). You must demonstrate this U-factor by showing test reports or engineering calculations. Calculations must account for grouted cells. Several products are available that meet or exceed the U-factor requirement for this wall. Note that all cells (except bond beams) must be insulated.

BUILDING ENVELOPE – PRESCRIPTIVE PATH

Walls (Cont.)

Masonry or Concrete w/Interior Insulation

Minimum Assembly wall: Walls equal to or greater than 4-inch concrete or 8-inch CMU with 4-inch metal stud furring on inside. R-11 fiberglass batt insulation is required in Zone 1 and R-13 insulation in Zone 2.

A CMU wall does not require insulating the block itself. All insulation is within a furred interior cavity. Any interior, continuous rigid insulation with the required R-value or assembly U-factor also qualifies.

Concrete walls less than 4 inches thick or CMU walls less than 8 inches thick do not meet the 45-lb/ft^2 wall weight requirement and are not allowed.

If your R-value meets or exceeds the requirement, enter the value in the cell under proposed R-value. Otherwise, attach Worksheet 3a with wall U-factor calculations.

Masonry or Concrete w/Continuous Exterior Insulation

Minimum Assembly wall for up to and including 15 percent glazing fraction: Concrete or CMU wall with a minimum weight of 45 lbs per square foot with continuous insulation board, R-1.4 in Zone 1 and R-2.8 in Zone 2. Insulation requirement can be met with 1/2-inch cellular glass insulation board (R-2.86/inch) in Zone 1, and 1-inch molded polystyrene board (R-3.85/inch) in Zone 2.

Minimum Assembly wall for up to and including 40 percent glazing fraction: Concrete or CMU wall with a minimum weight of 45 lbs. per square foot with continuous insulation board, R-2.8 in Zone 1 and R-4.3 in Zone 2. Insulation requirement can be met with 1-inch cellular glass insulation board (R-2.86/inch) in Zone 1 and 1½-inch molded polystyrene board (R-3.85/inch) in Zone 2.

The insulation on this wall type must be continuous over entire wall area. If R-value meets or exceeds requirement, enter value in cell under proposed R-value. Otherwise, attach Worksheet 3a with your wall U-factor calculations and enter the calculated number in U-factor column.

Frame

Minimum Assembly wall, Zone 1: 4-inch (nominal) metal studs with R-13 fiberglass batt insulation in all framing cavities.

Minimum Assembly wall, Zone 2: 6-inch (nominal) metal studs with R-19 fiberglass batt insulation in all framing cavities.

Any frame wall, regardless of framing material, thickness, spacing of framing, or finish material, qualifies as long as cavity insulation satisfies R-value requirement.

If R-value meets or exceeds requirement, enter value in the cell under proposed R-value. Otherwise, attach Worksheet 3a with wall U-factor calculations.

Other

This covers any leftover, oddball wall types, e.g., prefabricated metal panels, sandwich panels of pre-cast concrete, and structural insulated panels.

If R-value meets or exceeds requirement, enter value in the cell under proposed R-value. Otherwise, attach Worksheet 3a with wall U-factor calculations.

Example

Below-Grade Walls	R-Value Insulation Only (Min. R-7.5)		U-Factor[3] (Max. 0.11)
Continuous rigid board insulation	7.5	or	

Below-Grade Walls

Below-grade Walls

The only way to comply with this requirement is to meet or exceed requirement for R-7.5 insulation. This insulation can be a continuous rigid board or insulation placed inside or outside the wall, or insulation placed within a furred wall, e.g., R-13 insulation in a 4-inch furred interior cavity.

BUILDING ENVELOPE – PRESCRIPTIVE PATH

If R-value meets or exceeds requirement, enter value in the cell under proposed R-value.

Otherwise, attach Worksheet 3a with wall U-factor calculations.

Below-Grade Walls (cont.)

Example

Roof / Ceiling[11]	R-Value Insulation Only (Min. R-19)	or	U-Factor[12] (Max. 0.050)
2x10 wood joists, 24" o.c.	19	or	

Roof/Ceilings

Roof/Ceiling

Minimum Assembly roofs in both Zone 1 and Zone 2: is R-19 insulation. Any roof with R-19 insulation within framing or as a continuous layer meets code requirements.

It is possible to meet U-factor requirement by using a continuous insulation less than R-19, but compliance must be demonstrated on Worksheet 3b.

Example

	Skylight Area (total rough frame ft2)		Roof Area (gross ft2)		Skylight % [13]	Maximum Skylight Fraction Complies
Conditioned Space	280	÷	10,000	X 100 =	2.8%	Yes
Semi-Conditioned Space	0	÷	2,000	X 100 =	0.0%	Yes
Conditioned Mechanical Penthouse	25	÷	500	X 100 =	5.0%	Yes
	Skylight Area (total rough frame ft2)		Roof/Ceiling Area (gross ft2)		Skylight Percent[13]	

Skylights

Skylights

Skylight percentage, including glazed smoke vents (also referred to as “skylight”), must be calculated whenever skylight is installed in two or more different conditions: the skylight percent in conditioned space, the skylight percent in semi-conditioned space or skylight percent in conditioned mechanical penthouse.

The window area consists of the entire window assembly in square feet. Enter the total area of all windows in exterior walls in the first box (Conditioned Space Window Area).

Enter this gross roof/ceiling area in the second box (Total Roof/Ceiling Area).

Divide “total skylight area” by “total roof/ceiling area.” Multiply this sum by 100 and insert value into third box (Skylight Percent).

Glazing Percent Calculation

Repeat calculation for Semi-Conditioned Space.

Repeat calculation for Conditioned Mechanical Penthouse.

Excel Spreadsheet Notes: The user only needs to enter applicable Skylight Area and gross Exterior Roof Area. The Glazing Percentage and Compliance with Maximum Skylight Fraction will automatically propagate.

The combined skylight and glazed smoke vent area under conditioned space cannot exceed 6 percent of total roof area under Prescriptive Path approach. Use rough opening dimension for manufactured skylights. For other overhead glazing, use the area of the glazing and frame. There are three options for complying with window U-Factor and SC code requirements.

BUILDING ENVELOPE – PRESCRIPTIVE PATH

Skylights (Cont.)

NFRC Certification
Skylight may have horizontal U-factor and SHGC determined by the NFRC Rating, Certification and Labeling program. SHGC value can be converted to SC values using the equation, SHGC/0.87=SC. Center of glass SC values may also be obtained from manufacturer data.

Default Tables
U-factor and SC values can be found in Table 3e (second page) and 3f. Values in these tables are from ASHRAE Handbook, 2001, Fundamentals. Skylight U-factor is for overall assembly in the overhead position

Minimum Assembly (MA)
Minimum Assembly skylight in both Zone 1 and Zone 2: double-glazed, with a 0.5-inch air space and one pane tinted. Any skylight with these or better properties meets code requirements. Examples of better thermal properties are low-e coating, glazing with insulated spacers, thermal break frames and gas fills.

Worksheet 3e must be completed, which describes all skylights in a project. Both U-factor (or matching MA) AND Shading Coefficient must comply for the "worst case" skylight.

All skylights and glazed smoke vents used in a project must be listed in Worksheet 3e. If there is more than one type of skylight used, each type of skylight must comply.

If project has more than 6 percent skylights, the Simplified Trade-off Approach using CodeComp software is an alternate compliance method.

Excel Spreadsheet Note: The user must complete Worksheet 3e to describe all skylights in the project. You have the option of using the values provided (overall U-factor) to determine compliance OR check the Minimum Assembly checkbox if applicable/acceptable for this product.

Example

Floors over Unconditioned Spaces[16]	R-Value Insulation Only		U-Factor
Floors over Unconditioned Spaces	11	or	

Heated Concrete Slab Edge	R-Value Insulation Only
Concrete slab, hydronic heat	7.5

Floors & Heated Slabs

Floors Over Conditioned Space

Minimum Assembly floor in both Zone 1 and Zone 2: R-11 insulation. Any floor with R-11 insulation within framing or as a continuous layer meets the code. It is possible to comply with U-factor requirement by using a continuous insulation panel less than R-11, but compliance must be demonstrated on Worksheet 3c.

Heated Concrete Slabs

The requirement for insulating slab edges applies only to heated slabs, i.e., slabs with embedded sources of heat such as electric coils or piping with circulating hot water.

Confirm and check the compliance box indicating that Insulation for heated slabs-on-grade extends downward from top of slab (24 inches min) or downward and under the slab for 24 inches or to the bottom of thickened slab edge. Above grade insulation should be protected from physical and solar damage. Non-heated slabs-on-grade do not have insulation requirements.

BUILDING ENVELOPE – PRESCRIPTIVE PATH

Code Requirement

Component	Compliance Options: Min. R-Value Insulation Only		Max. U-Factor
Floor over Unconditioned Spaces	11	or	0.070

Component	Climate Zone 1		Climate Zone 2
Heated Concrete Slab Edge, Min. R-Value	7.5	or	10.0

Doors

Doors

The code establishes a maximum U-factor requirement for doors other than entry/exit doors with a leaf width of 4 feet or less and overhead coil doors. U-factor requirement applies to center of door panel (U-0.20 or R-5).

Most insulated overhead and sliding doors use polyurethane or polystyrene insulation and meet these requirements. If these doors (not doors with a leak width of 4 feet or less) are glazed, they must be included with Windows and must comply with Window U-factor and SC requirements.

Definitions

BUILDING ENVELOPE (EXTERIOR ENVELOPE) is that element of a building that encloses conditioned spaces through which thermal energy may be transmitted to or from the exterior or to or from unconditioned spaces.

CLIMATE ZONE. One of two geographic areas of the state with similar winter climate conditions. A building site is in Climate Zone 1 if its elevation is less than 3,000 ft above sea level and it is within one of the following counties: Benton, Columbia, Clackamas, Clatsop, Coos, Curry, Douglas, Jackson, Josephine, Lane, Lincoln, Linn, Marion, Multnomah, Polk, Tillamook, Yamhill or Washington. Building sites not in Zone 1 are in Zone 2.

GROSS AREA OF EXTERIOR WALLS consists of wall areas, as measured on the exterior, including foundation walls above grade; peripheral edges of floors; window areas, including sash; and door areas, where such surfaces are exposed to outdoor air and enclose a heated or mechanically cooled space. This includes wall(s) separ-ating conditioned from semi-heated spaces.

HEATED SLAB ON-GRADE is a concrete slab on-grade with embedded electric heating coils or embedded piping designed to carry a heated circulating fluid.

SEMI-CONDITIONED SPACES, CLIMATE ZONE 1: Spaces that have a heating system output capacity that does not exceed 15 Btu/hr.ft.2 (43 W/m2) or 4 Watts/ft.2 (43 W/m2) of heated floor area and where each heating system is controlled by a thermostat with a maximum setpoint capacity of 45ºF (7ºC), mounted no lower than heating unit.

SEMI-CONDITIONED SPACES, CLIMATE ZONE 2: Spaces that have a heating system output capacity that does not exceed 20 Btu/hr.ft.2 (64 W/m2) or 6 Watts/ft.2 (64 W/m2) of heated floor area and where each heating system is controlled by a thermostat with a maximum setpoint capacity of 45ºF (7ºC), mounted no lower than heating unit.

THERMAL BREAK is a non-metallic element of low heat conductivity placed in such a way as to eliminate all contact between interior and exterior framing members. Some metal-framed windows are designed with thermal breaks to improve their overall thermal performance.

THERMAL RESISTANCE (R) is the measure of the resistance of a material or building component to the passage of heat, has the value of (hr- ft2-ºF)/Btu, and is the reciprocal of thermal conductance.

THERMAL TRANSMITTANCE (U) is the coefficient of heat transfer. It is the time rate of heat flow per unit area under steady state conditions from the fluid on the warm side of the barrier to the fluid on the cold side, per unit temperature difference between the two fluids, Btu/(hr-ft2-ºF)

WALL FRAMING & INSULATION R-VALUES

Wall Framing

This table can be used to find R-value for wall framing with insulation. Values can be added to R-values of other layers to calculate total R-value (Rt) of wall.

Wood framing values are based on 20 and 15 percent framing factors for 16- and 24-inch spacing with compression of insulation if necessary. Framing factor is the percentage of a wall surface backed by framing. R-value for wood is based on fir, pine and similar softwood.

Metal framing values from ASHRAE 90.1-1999 Table 402.1.2.1b

Type of Framing	Spacing	Insulation R-value	Effective R-value
Wood, 2x2.	16" o.c	5	3.75
		7	4.55
	24" o.c.	5	4
		7	4.97
Wood, 2x4	16" o.c.	11	8.47
		13	9.36
		15	10.13
	24" o.c.	11	8.99
		13	10.06
		15	11.03
Wood, 2x6	16" o.c.	19	13.64
		21	14.94
	24" o.c.	19	14.52
		21	16.1
Wood, 2x8	16" o.c.	19	15.81
		21	16.88
		30	20.51
	24" o.c.	19	16.5
		21	17.75
		30	22.13
Metal[1], 2x4	16" o.c.	11	5.5
		13	6
	24" o.c.	11	6.6
		13	7.2
Metal[1], 2x6.	16" o.c	19	7.1
	24" o.c.	19	8.6

Notes

[1] Insulation specified shall be full-width batts to accommodate full module spacing afforded by metal framing.

Cavity Filled

Some R-values are not included because Oregon code requires wall cavities 6-inches or less be filled completely.

ROOF & FLOOR FRAMING R-VALUES

Type of Framing	Spacing	Insulation R-value	Effective R-value
Wood, 2x6	16" o.c.	11	10.39
		13	11.95
		15	13.44
		19	15.52
		21	17.46
	24" o.c.	11	10.63
		13	12.35
		15	14.02
		19	16.43
		21	18.72
Wood, 2x8	16" o.c.	13	12.53
		19	17.26
		25	20.12
	24" o.c.	13	12.71
		19	17.91
		25	21.18
Wood, 2x10	16" o.c.	19	17.95
		25	22.55
		30	26.07
		38	31.21
	24" o.c.	19	18.35
		25	23.47
		30	27.51
		38	33.61
Wood, 2x12	16" o.c.	19	18.43
		25	23.31
		30	27.1
		38	32.7
	24" o.c.	19	18.65
		25	23.96
		30	28.19
		38	34.63

Roof/Ceiling & Floor Framing

Use this table to find the R-value for insulation and framing in roofs, ceilings or floors. The values in this table can be added to R-values of other layers to calculate total effective R-value of framing assembly.

Wood framing values are based on 10 and 6 percent framing factors for 16- and 24-inch spacing with compression of insulation if necessary. R-value for wood is based on fir, pine and similar softwood.

ROOF & FLOOR FRAMING R-VALUES

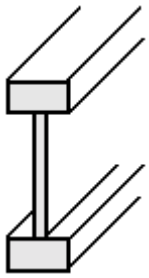
Roof/Ceiling & Floor Framing

Use this table to find R-value for framing and framing cavity in roofs, ceilings or floors. The values in this table can be added to R-values of other layers to calculate total effective R-value of framed assembly.

For compressed type batt insulation, see page 3-25 for effective U-factors.

Metal truss values from ASHRAE 90.1-1999, Table 402.1.2.1a. Values are based on 0.66-inch diameter cross members every one foot.

Engineered wood composite I-beams (e.g., "silent floor") are composite wood materials with an I-beam cross section. These are typically made of strandboard or plywood with small dimensional lumber on top and bottom cords.

Type of Framing	Spacing	Insulation R-value	Effective R-value
Metal Truss	4'0" o.c. or greater	5	4.8
		10	9.2
		15	13.2
		20	17
		25	20.3
		30	23.7
		35	26.6
		40	29.2
Engineered wood composite. I-beam 	16" o.c.	11	10.2
		13	12
		19	17.5
		25	23
		30	27.6
	24" o.c.	11	10.5
		13	12.3
		19	18
		25	23.7
		30	28.4
	48" o.c.	11	10.7
		13	12.7
		19	18.5
		25	24.3
		30	29.2

BUILDING MATERIAL R-VALUES

Description	Detail	R-value	lb/ft^2
Building Board			
Cement Board			
Asbestos-cement board	0.125"	0.03	1.25
Asbestos-cement board	0.25"	0.06	2.50
Cement board	0.375”	0.09	3.75
Ceiling Finishes			
Acoustic tile	3/8” mineral fiberboard	0.95	0.56
Acoustic tile	¾” mineral fiberboard	2.48	1.31
Gypsum or Plaster board			
Gypsum or plaster board	0.375"	0.32	1.56
Gypsum or plaster board	0.5"	0.45	1.56
Gypsum or plaster board	0.625"	0.56	2.60
Hardboard			
Medium density	¼”	1.37	4.17
High density service grade	¼”	1.22	4.58
High density standard grade	½”	1.00	5.25
Particleboard			
Low density	1” (per inch value)	1.41	3.08
Medium density	1” (per inch value)	1.06	4.17
High density	1” (per inch value)	0.85	2.20
Underlayment	5/8” underlayment	0.82	2.08
Waferboard	1” (per inch value)	1.59	3.08
Plywood			
Plywood (Douglas Fir)	0.25"	0.31	0.71
Plywood (Douglas Fir)	0.375"	0.47	1.06
Plywood (Douglas Fir)	0.5"	0.62	1.42
Plywood (Douglas Fir)	0.625"	0.77	1.77
Plywood (Douglas Fir)	0.75"	0.93	2.13
Vegetable Fiber Board			
Sheathing, regular density	0.5"	1.32	0.75
Sheathing, regular density	0.78125"	2.06	1.17
Sheathing intermediate density	0.5"	1.09	0.92
Nail-base sheathing	0.5"	1.06	1.04
Shingle backer	0.375"	0.94	0.56
Shingle backer	0.3125"	0.78	0.47
Sound deadening board	0.5"	1.35	0.63
Tile and lay-in panels, plain or acoustic	0.5"	1.25	0.75
Tile and lay-in panels, plain or acoustic	0.75"	1.89	1.13
Laminated paperboard		2.00	2.50
Homogeneous board from repulped paper		2.00	2.50
Building Membrane			
Vapor permeable felt		0.06	-
Vapor seal	2 layers of mopped 15lb felt	0.12	-
Finish Flooring Materials			
Floor Finishes			
Carpet	fibrous pad	2.08	-
Carpet	rubber pad	1.23	-
Cork tile		0.28	-
Terrazzo		0.08	11.67
Tile ceramic		0.05	-
Wood, hardwood finish		0.68	2.00

Insulating Materials

Description	Detail	R-value	Lb/ft^2
Batt and blanket insulation - uncompressed			
Mineral fiber batt	2 to 2.75"	7	0.25
Mineral fiber batt	3 to 4"	11	0.30
Mineral fiber batt	3.5"	13	0.35
Mineral fiber batt	3.5"	15	0.40
Mineral fiber batt	5.5 to 6.5"	19	0.60
Mineral fiber batt	5.5"	21	0.65
Mineral fiber batt	6 to 7.5"	22	0.65
Mineral fiber batt	8.25 to 10"	30	0.95
Mineral fiber batt	10 to 13"	38	1.20
Board and slab insulation			
Cellular glass 1"	1”	3.03	0.67
Glass fiber, organic bonded 1"	1”	4	0.50
Expanded perlite, organic bonded 1"	1”	2.78	0.09
Expanded rubber (rigid) 1"	1”	4.55	0.35
Foamed urethane board 1"	1”	7.15	0.54
Fiberglass urethane board 1"	1”	5.56	0.36
Polystyrene, extruded (smooth skin)	1", 1.8 to 3.5 lb/ft3	5	0.22
Expanded polystyrene, molded beads	1", 1.0 lb/ft3	3.85	0.08
Expanded polystyrene, molded beads	1", 1.25 lb/ft3	4	0.10
Expanded polystyrene, molded beads	1", 1.5 lb/ft3	4.17	0.13
Expanded polystyrene, molded beads	1", 1.75 lb/ft3	4.17	0.15
Expanded polystyrene, molded beads	1", 2.0 lb/ft3	4.35	0.17
Cellular polyisocyanurate	1", with foil face, 2.0 lb/ft3	7.04	0.17
Cellular polyisocyanurate	1", gas-perm. facers, 1.5 lb/ft3	5.56	0.13
Cellular polyisocyanurate	1" unfaced, 1.5 lb/ft3	5.56	0.13
Cellular phonolic	1", 3.0 lb/ft3 closed cell	8.2	0.25
Cellular phonolic	1", 1.8 to 2.2 lb/ft3 open cell	4.4	0.16
Mineral fiber	1", 15.0 lb/ft 3 with resin binder	3.45	1.25
Mineral fiber	1", 16 to 17 lb/ft3 , not felted	2.94	1.35
Cement fiber slabs (shredded wool)	1", 25 to 27 lb/ft3 with Portland cement	1.89	2.12
Cement fiber slabs (shredded wool)	1", 22 lb/ft3 with magnesia oxysulfide	1.75	1.86
Loose fill			
Cellulosic (milled paper and wood pulp)	1" loose fill	3.2	0.24
Mineral fiber (rock, slab or glass)	approx. 3.75 to 5", 0.6 to 2.0 lb/ft3	11	0.40
Mineral fiber (rock, slab or glass)	approx. 6.5 to 8.75", 0.6 to 2.0 lb/ft3	19	0.80
Mineral fiber (rock, slab or glass)	approx. 7.5 to 10", 0.6 to 2.0 lb/ft3	22	1.00
Mineral fiber (rock, slab or glass)	approx. 10.25 to 13.75 ", 0.6 to 2.0 lb/ft3	30	1.20
Perlite, expanded	1", 7.4 to 11.0 lb/ft3	2.4	0.48
Vermiculite	1" exfoliated 7 to 8.2 lb/ft3	2.13	0.63
Vermiculite	1" exfoliated 4 to 6 lb/ft3	2.27	0.42
Spray applied			
Ureaformaldehyde foam	1" sprayed, 0.7 to 1.6 lb/ft3	3.57	0.07
Cellulosic fiber	1" spray applied	2.94	0.30
Polyurethane foam	1" sprayed	5.56	0.20
Glass fiber	1" sprayed		0.30

BUILDING MATERIAL R-VALUES

Masonry Materials

Description	Detail	R-value	lb/ft^2
Brick			
Brick, fired clay, 6-inches	150 lb/ft3	0.65	75
Brick, fired clay, 4-inches	140 lb/ft3	0.49	45
Brick, fired clay, 6-inches	140 lb/ft3	0.73	70
Brick, fired clay, 6-inches	130 lb/ft3	0.85	65
Brick, fired clay, 4-inches	120 lb/ft3	0.65	40
Brick, fired clay, 6-inches	120 lb/ft3	0.97	60
Brick, fired clay, 6-inches	110 lb/ft3	1.11	55
Brick, fired clay, 6-inches	100 lb/ft3	1.29	50
Brick, fired clay, 6-inches	90 lb/ft3	1.52	45
Brick, fired clay, 6-inches	80 lb/ft3	1.79	40
Brick, fired clay, 6-inches	70 lb/ft3	2.14	35
Concrete			
h.w. aggregate concretes, 6-inches	150 lb/ft3 Sand & gravel or stone	0.40	75
h.w. aggregate concretes, 6-inches	140 lb/ft3 Sand & gravel or stone	0.44	70
h.w. aggregate concretes, 6-inches	130 lb/ft3 Sand & gravel or stone	0.60	65
Limestone concrete h.w., 6-inches	140 lb/ft3	0.54	70
Limestone concrete m.w., 6-inches	120 lb/ft3	0.76	60
Limestone concrete l.w., 6-inches	100 lb/ft3	1.09	50
Gypsum-fiber concrete	6 inches thick	3.61	25.5
Cement/lime, mortar, and stucco m.w., 6”	120 lb/ft3	0.62	60
Cement/lime, mortar, and stucco l.w., 6”	100 lb/ft3	0.90	50
Cement/lime, mortar, and stucco l.w., 6”	80 lb/ft3	1.33	40
l.w. aggregate concretes, 6-inches	120 lb/ft3	0.77	60
l.w. aggregate concretes, 6-inches	100 lb/ft3	1.10	50
l.w. aggregate concretes, 6-inches	80 lb/ft3	1.62	40
l.w. aggregate concretes, 6-inches	60 lb/ft3	2.61	30
l.w. aggregate concretes, 6-inches	40 lb/ft3	4.62	20
Perlite, vermiculite, and polystyrene beads	50 lb/ft3 – 6 inches thick	3.24	25
Perlite, vermiculite, and polystyrene beads	40 lb/ft3 – 6 inches thick	4.14	20
Perlite, vermiculite, and polystyrene beads	30 lb/ft3 – 6 inches thick	5.46	15
Perlite, vermiculite, and polystyrene beads	20 lb/ft3 – 6 inches thick	7.50	10
Foam concretes, 6-inches	120 lb/ft3	1.11	60
Foam concretes, 6-inches	100 lb/ft3	1.46	50
Foam concretes, 6-inches	80 lb/ft3	2.00	40
Foam concretes, 6-inches	70 lb/ft3	2.40	35
Foam concretes and cellular concretes	60 lb/ft3 – 6 inches thick	2.86	30
Foam concretes and cellular concretes	40 lb/ft3 – 6 inches thick	4.27	20
Foam concretes and cellular concretes	20 lb/ft3 – 6 inches thick	7.50	10
Clay tile, hollow			
Clay Tile, 3 inches, 1 Cell		0.8	17.5
Clay Tile, 4 inches, 1 Cell		1.11	23.33
Clay Tile, 6 inches, 2 Cell		1.52	35
Clay Tile, 8 inches, 2 Cell		1.85	46.67
Clay Tile, 10 inches, 2 Cell		2.22	58.33
Clay Tile, 12 inches, 3 Cell		2.5	70
Glass block			
4” thick block	8”x8”x4”	0.51	-

Plastering

Description	Detail	R-value	lb/ft^2
Gypsum plaster			
Cement plaster, sand aggregate	0.375"	0.08	3.63
Cement plaster, sand aggregate	0.75"	0.15	7.25
Gypsum plaster, lightweight aggregate	0.5"	0.32	1.56
Gypsum plaster, lightweight aggregate	0.625"	0.39	1.56
Gypsum plaster, lightweight aggregate on metal lath	0.75"	0.47	2.60
Perlite aggregate, sand aggregate	0.5"	0.09	4.38
Perlite aggregate, sand aggregate	0.625"	0.11	5.47
Perlite aggregate, sand aggregate on metal lath		0.13	-
Perlite aggregate, vermiculite aggregate		0.44	2.81

CMU Block

Concrete-filled cores may contain rebar or other reinforcements. Grout fill used is assumed to have a density of 140 lb/ff3.

R-values for CMU blocks are based on National Concrete and Masonry Association publication: "R-values for Single Wythe Concrete Masonry Walls, TEK 6-2A." Values are based upon the mid-range values.

Loose-fill insulation values are based on vermiculite.

Horizontal bond-beams (grout/steel) located every 48".

Description		Detail	R-Value	lbs/ft^2
CMU Block – Lightweight (100 lb/ft^3 concrete)				
6" block	all cores filled	solid grouted	0.70	55.81
8" block	48" o.c.	with no fill (hollow)	1.25	46.22
		with vermiculite fill	2.42	47.45
		with perlite fill	2.51	47.45
		with foamed-in-place fill	2.63	47.45
	40" o.c.	with no fill (hollow)	1.23	47.37
		with vermiculite fill	2.31	48.55
		with perlite fill	2.39	48.55
		with foamed-in-place fill	2.50	48.55
	32" o.c.	with no fill (hollow)	1.21	49.09
		with vermiculite fill	2.16	50.20
		with perlite fill	2.23	50.20
		with foamed-in-place fill	2.32	50.20
	24" o.c.	with no fill (hollow)	1.17	51.96
		with vermiculite fill	1.94	52.94
		with perlite fill	1.99	52.94
		with foamed-in-place fill	2.05	52.94
	16" o.c.	with no fill (hollow)	1.10	57.56
		with vermiculite fill	1.59	58.30
		with perlite fill	1.61	58.30
		with foamed-in-place fill	1.65	58.30
	all cores filled	solid grouted	0.90	74.91
12" block	48" o.c.	with no fill (hollow)	1.55	74.37
		with vermiculite fill	3.49	76.44
		with perlite fill	3.60	76.44
		with foamed-in-place fill	3.74	76.44
	40" o.c.	with no fill (hollow)	1.54	76.93
		with vermiculite fill	3.33	78.92
		with perlite fill	3.43	78.92
		with foamed-in-place fill	3.55	78.92
	32" o.c.	with no fill (hollow)	1.53	80.78
		with vermiculite fill	3.11	82.64
		with perlite fill	3.19	82.64
		with foamed-in-place fill	3.29	82.64
	24" o.c.	with no fill (hollow)	1.51	87.19
		with vermiculite fill	2.78	88.85
		with perlite fill	2.85	88.85
		with foamed-in-place fill	2.92	88.85

BUILDING MATERIAL R-VALUES

Description		Detail	R-Value	lbs/ft^2
12" block	16" o.c.	with no fill (hollow)	1.47	99.71
		with vermiculite fill	2.29	100.96
		with perlite fill	2.32	100.96
		with foamed-in-place fill	2.36	100.96
	all cores filled	solid grouted	1.35	115.40
CMU Block – Medium weight (120 lbs/ft^3 concrete)				
6" block	all cores filled	solid grouted	0.55	60.61
8" block	48" o.c.	with no fill (hollow)	1.02	52.49
		with vermiculite fill	1.85	53.72
		with perlite fill	1.88	53.72
		with foamed-in-place fill	1.95	53.72
	40" o.c.	with no fill (hollow)	1.00	53.63
		with vermiculite fill	1.77	54.82
		with perlite fill	1.80	54.82
		with foamed-in-place fill	1.87	54.82
	32" o.c.	with no fill (hollow)	0.98	55.36
		with vermiculite fill	1.66	56.47
		with perlite fill	1.69	56.47
		with foamed-in-place fill	1.74	56.47
	24" o.c.	with no fill (hollow)	0.94	58.22
		with vermiculite fill	1.50	59.21
		with perlite fill	1.52	59.21
		with foamed-in-place fill	1.56	59.21
	16" o.c.	with no fill (hollow)	0.88	63.83
		with vermiculite fill	1.24	64.57
		with perlite fill	1.25	64.57
		with foamed-in-place fill	1.27	64.57
	all cores filled	solid grouted	0.70	81.18
12" block	48" o.c.	with no fill (hollow)	1.30	83.69
		with vermiculite fill	2.70	85.75
		with perlite fill	2.75	85.75
		with foamed-in-place fill	2.83	85.75
	40" o.c.	with no fill (hollow)	1.29	86.30
		with vermiculite fill	2.59	88.29
		with perlite fill	2.64	88.29
		with foamed-in-place fill	2.71	88.29
	32" o.c.	with no fill (hollow)	1.28	90.22
		with vermiculite fill	2.43	92.08
		with perlite fill	2.47	92.08
		with foamed-in-place fill	2.53	92.08
	24" o.c.	with no fill (hollow)	1.26	96.75
		with vermiculite fill	2.20	98.41
		with perlite fill	2.23	98.41
		with foamed-in-place fill	2.28	98.41
	16" o.c.	with no fill (hollow)	1.22	109.50
		with vermiculite fill	1.83	110.76
		with perlite fill	1.85	110.76
		with foamed-in-place fill	1.88	110.76
	all cores filled	solid grouted	1.10	124.18

CMU Block (cont.)

Concrete-filled cores may contain rebar or other reinforcements. Grout fill used is assumed to have a density of 140 lb/ff3.

R-values for CMU blocks are based on National Concrete and Masonry Association publication: "R-values for Single Wythe Concrete Masonry Walls, TEK 6-2A." Values are based upon the mid-range values.

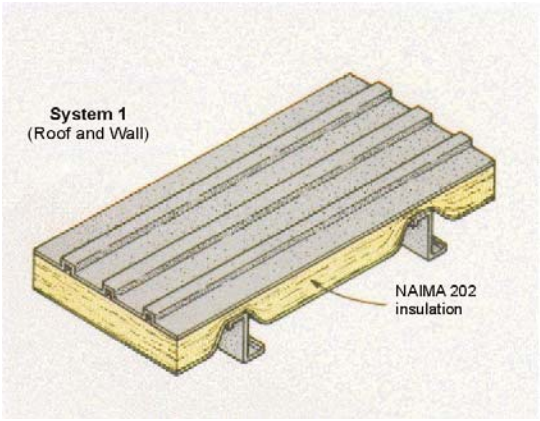
Loose-fill insulation values are based on vermiculite.

Horizontal bond-beams (grout/steel) located every 48".

BUILDING MATERIAL R-VALUES

	Description	Detail	R-Value	lbs/ft^2
Roofing	Roofing			
	Asbestos shingles	-	0.21	0.00
	Asphalt roll	-	0.15	0.00
	Asphalt shingles	-	0.44	0.00
	Built-up roofing	3/8”	0.33	2.19
	Slate	½”	0.05	0.00
	Wood shingles	Plain and plastic film faced	0.94	0.00
Siding Materials	Shingles			
	Asbestos-cement		0.21	7.50
	Wood	16", 7.5 exposure	0.87	1.30
	Wood double	16", 12" exposure asbestos-cement	1.19	2.30
	Wood "	Plus insulated backer board, 0.312"	1.40	2.00
	Siding			
	Asbestos-cement,	0.25" lapped	0.21	8.00
	Asphalt roll		0.15	10.00
	Asphalt insulating		1.46	-
	Hardwood	0.4375"	0.67	-
	Wood drop	0.125"	0.79	2.13
	Wood bevel	0.075"	0.81	1.30
	Wood bevel	0.0625"	1.05	2.00
	Wood plywood	0.375" lapped	0.59	1.00
	Aluminum, steel or vinyl	over sheathing hollow-backed	0.61	-
	Aluminum, steel or vinyl	over 0.375" shtg insul-board	1.82	-
	Aluminum, steel or vinyl	over 0.375"shtg insul-board foil bckd	2.96	-
	Architectural (soda-lime float) glass		-	3.29
Wood & Wood Products	Plywood			
	Plywood (Douglas Fir)	0.25"	0.31	0.71
	Plywood (Douglas Fir)	0.375"	0.47	1.06
	Plywood (Douglas Fir)	0.5"	0.62	1.42
	Plywood (Douglas Fir)	0.625"	0.77	1.77
	Plywood (Douglas Fir)	0.75"	0.93	2.13
	Woods			
	Hardwood finish		0.68	-
	Hardwood Oak		-	3.67
	Hardwood Birch		-	3.67
	Hardwood Maple		-	3.50
	Hardwood Ash		-	3.33
	Softwood Southern Pine		-	3.20
	Softwood Southern Douglas Fir-Larch		-	2.91
	Softwood Southern Cypress		-	2.65
	Softwood Hem-Fir, Spruce-Pine-Fir		-	2.33
	Softwood Coast Woods, Cedars		-	2.21
	Softwood California Redwood		-	2.19

METAL BUILDING U-FACTORS

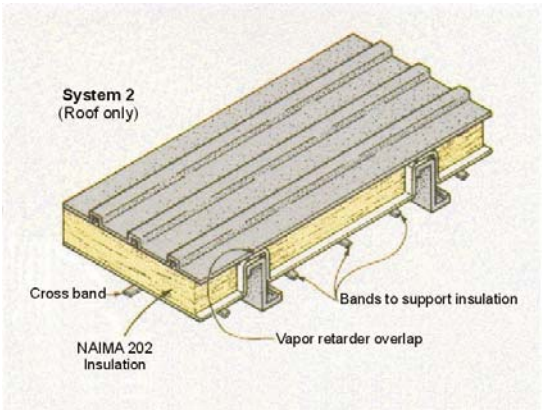


System 1

In this system, NAIMA 202 fiberglass blanket insulation is rolled out over, and perpendicular to the structural frame. The metal covering sheets are fastened to the frame, holding the insulation in place.

U-factors

R10	R11	R13	R-19
0.133	0.127	0.114	0.091

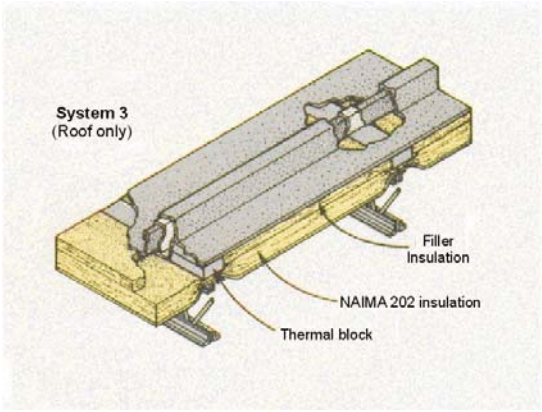


System 2

This method accommodates thicker insulation without compression at the structural members by applying the faced NAIMA 202 between the purlins rather than perpendicular to them. There is, however the problem of thermal bridging through the structural members in direct contact with the metal covering sheets.

U-factors

R10	R11	R13	R-19
0.131	0.123	0.107	0.079

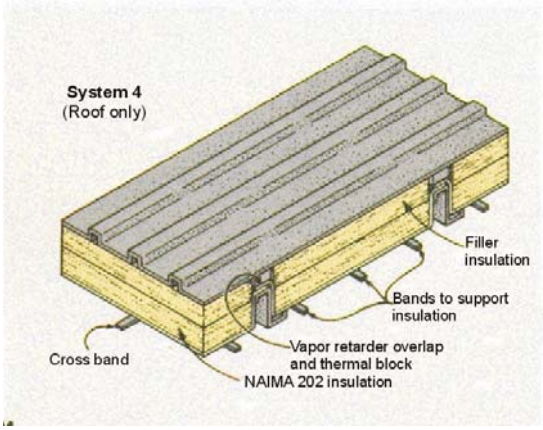


System 3

Vapor retarder faced NAIMA 202 insulation is installed over and perpendicular to the structure (joists or purlins) prior to applying the roof. Additional unfaced fiberglass blanket filler insulation can then be applied between the purlins and over the first later to fill the space formed by the roof sheet standoffs. Thermal blocks of rigid foam are placed over joists or purlins where faced insulation will be compressed.

U-factors

R10	R11	R13	R-19
0.102	0.096	0.084	0.065



System 4

This system uses a vapor retarder faced NAIMA 202 blanket between the purlins with the retarder overlapping on the top face of the purlins. Plain filler blanket is installed as a second layer, also between the purlins. Rigid foam thermal blocks are placed on top of the purlins to create a thermal break at the structural member.

U-factors

R10	R11	R13	R-19	R30
0.099	0.093	0.080	0.059	0.041

SURFACE & AIR SPACE R-VALUES

	Description	Detail	R-value	lb/ft²
Surfaces	Still air to surface			
	Wall		0.68	–
	Roof		0.61	–
	Floor		0.92	–
	Vaulted ceiling		0.62	–
Air Spaces	Moving air to surface			
	15 mph		0.17	–
	7.5 mph		0.25	–
	Walls	¾"	0.94	–
		1½"	0.9	–
		3½"	0.91	–
	Roofs	¾"	0.77	–
		1½"	0.8	–
		3½"	0.84	–
	Floors	¾"	1.02	–
		1½"	1.14	–
		3½"	1.22	–
	Vaulted Ceiling	¾"	0.82	–
		1½"	0.84	–
		3½"	0.86	–

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DEFAULT WINDOW U-FACTORS

Part 1 of 3

U-Factor

Values are based on the 2005 ASHRAE Handbook of Fundamentals, Table 30-4.

Interpolate between emissivities when needed. When manufacturer's data is not available, assume that glass with a pyrolytic (hard) coating has an emmisivity of 0.40 and glass with a sputtered (soft) coating has an emissivity of 0.10.

Krypton gas fills, or krypton/argon combinations can be substituted for argon.

For glazing airspace between ¼ inch and ½ inch, use ¼ inch.

For glazing airspace over ½ inch, use ½ inch.

Product Type	Glass Only	Operable					Fixed					Curtain Wall		
Frame Type	n/a	Alum w.o. Therm Break	Alum with Therm Break	Re-inforced Vinyl/ Alum Clad Wood	Wood/ Vinyl	Insul Fibrglas /Vinyl	Alum w.o. Therm Break	Alum with Therm Break	Re-inforced Vinyl/ Alum Clad Wood	Wood/ Vinyl	Insul Fibrglas /Vinyl	Alum w.o. Therm Break	Alum with Therm Break	Struct Glzg
Glazing Type	Cntr-of-Glass													
Single Glazing														
1/8 in. glass	1.04	1.27	1.08	0.90	0.89	0.81	1.13	1.07	0.98	0.98	0.94	1.22	1.11	1.11
1/4 in. acrylic/polycarbonate	0.88	1.14	0.96	0.79	0.78	0.71	0.99	0.92	0.84	0.84	0.81	1.08	0.96	0.96
1/8 in. acrylic/polycarbonate	0.96	1.21	1.02	0.85	0.83	0.76	1.06	1.00	0.91	0.91	0.87	1.15	1.04	1.04
Double Glazing														
1/4 in. airspace	0.55	0.87	0.65	0.57	0.55	0.49	0.69	0.63	0.56	0.56	0.53	0.79	0.68	0.63
1/2 in. airspace	0.48	0.81	0.60	0.53	0.51	0.44	0.64	0.57	0.50	0.50	0.48	0.73	0.62	0.57
1/4 in. argon space	0.51	0.84	0.62	0.55	0.53	0.46	0.66	0.59	0.53	0.52	0.50	0.75	0.64	0.60
1/2 in. argon space	0.45	0.79	0.58	0.51	0.49	0.43	0.61	0.54	0.48	0.48	0.45	0.70	0.59	0.55
Double Glazing, e=0.40 surface 2 or 3														
1/4 in. airspace	0.49	0.82	0.61	0.53	0.51	0.45	0.64	0.58	0.51	0.51	0.49	0.74	0.63	0.58
1/2 in. airspace	0.40	0.75	0.54	0.48	0.45	0.40	0.57	0.50	0.44	0.44	0.41	0.66	0.55	0.51
1/4 in. argon space	0.43	0.78	0.57	0.50	0.47	0.41	0.59	0.53	0.46	0.46	0.44	0.69	0.57	0.53
1/2 in. argon space	0.36	0.72	0.52	0.45	0.43	0.37	0.53	0.47	0.41	0.40	0.38	0.63	0.51	0.47
Double Glazing, e=0.20 surface 2 or 3														
1/4 in. airspace	0.45	0.79	0.58	0.51	0.49	0.43	0.61	0.54	0.48	0.48	0.45	0.70	0.59	0.55
1/2 in. airspace	0.35	0.71	0.51	0.44	0.42	0.36	0.53	0.46	0.40	0.39	0.37	0.62	0.51	0.46
1/4 in. argon space	0.38	0.74	0.53	0.46	0.44	0.38	0.55	0.48	0.42	0.42	0.40	0.64	0.53	0.49
1/2 in. argon space	0.30	0.67	0.47	0.41	0.39	0.33	0.48	0.41	0.36	0.35	0.33	0.57	0.46	0.42
Double Glazing, e=0.10 surface 2 or 3														
1/4 in. airspace	0.42	0.77	0.56	0.49	0.47	0.41	0.59	0.52	0.46	0.45	0.43	0.68	0.57	0.52
1/2 in. airspace	0.32	0.69	0.49	0.42	0.40	0.35	0.50	0.43	0.37	0.37	0.35	0.59	0.48	0.44
1/4 in. argon space	0.35	0.71	0.51	0.44	0.42	0.36	0.53	0.46	0.40	0.39	0.37	0.62	0.51	0.46
1/2 in. argon space	0.27	0.65	0.45	0.39	0.37	0.31	0.46	0.39	0.33	0.33	0.31	0.55	0.44	0.39
Double Glazing, e=0.05 surface 2 or 3														
1/4 in. airspace	0.41	0.76	0.55	0.48	0.46	0.40	0.58	0.51	0.45	0.44	0.42	0.67	0.56	0.51
1/2 in. airspace	0.30	0.67	0.47	0.41	0.39	0.33	0.48	0.41	0.36	0.35	0.33	0.57	0.46	0.42
1/4 in. argon space	0.33	0.70	0.49	0.43	0.41	0.35	0.51	0.44	0.38	0.38	0.36	0.60	0.49	0.44
1/2 in. argon space	0.25	0.63	0.44	0.38	0.36	0.30	0.44	0.37	0.32	0.31	0.29	0.53	0.42	0.38

DEFAULT WINDOW U-FACTORS

Part 2 of 3

U-Factor

Values are based on the 2005 ASHRAE Handbook of Fundamentals, Table 30-4.

Interpolate between emissivities when needed. When manufacturer's data is not available, assume that glass with a pyrolytic (hard) coating has an emmisivity of 0.40 and glass with a sputtered (soft) coating has an emissivity of 0.10.

Krypton gas fills, or krypton/argon combinations can be substituted for argon.

For glazing airspace between ¼ inch and ½ inch, use ¼ inch.

For glazing airspace over ½ inch, use ½ inch.

Product Type	Glass Only	Operable					Fixed					Curtain Wall		
Frame Type	n/a	Alum w.o. Therm Break	Alum with Therm Break	Re-inforced Vinyl/ Alum Clad Wood	Wood/ Vinyl	Insul Fibrglas /Vinyl	Alum w.o. Therm Break	Alum with Therm Break	Re-inforced Vinyl/ Alum Clad Wood	Wood/ Vinyl	Insul Fibrglas /Vinyl	Alum w.o. Therm Break	Alum with Therm Break	Struct Glzg
Glazing Type	Cntr-of-Glass													
Triple Glazing														
1/4 in. air spaces	0.38	0.72	0.51	0.44	0.43	0.38	0.55	0.48	0.42	0.41	0.40	0.63	0.52	0.47
1/2 in. air spaces	0.31	0.67	0.46	0.40	0.39	0.34	0.49	0.42	0.36	0.35	0.34	0.57	0.46	0.41
1/4 in. argon spaces	0.34	0.69	0.48	0.42	0.41	0.35	0.51	0.45	0.39	0.38	0.36	0.60	0.49	0.43
1/2 in. argon spaces	0.29	0.65	0.44	0.38	0.37	0.32	0.47	0.40	0.34	0.34	0.32	0.55	0.45	0.39
Triple Glazing, e=0.20 [a]														
1/4 in. air spaces	0.33	0.69	0.47	0.41	0.40	0.35	0.50	0.44	0.38	0.37	0.36	0.59	0.48	0.42
1/2 in. air spaces	0.25	0.62	0.41	0.36	0.35	0.30	0.43	0.37	0.31	0.30	0.29	0.52	0.41	0.35
1/4 in. argon spaces	0.28	0.65	0.44	0.38	0.37	0.32	0.46	0.40	0.34	0.33	0.32	0.54	0.44	0.38
1/2 in. argon spaces	0.22	0.60	0.39	0.34	0.33	0.28	0.41	0.34	0.29	0.28	0.27	0.49	0.38	0.33
Triple Glazing, e=0.20 [b]														
1/4 in. air spaces	0.29	0.65	0.44	0.38	0.37	0.32	0.47	0.40	0.34	0.34	0.32	0.55	0.45	0.39
1/2 in. air spaces	0.20	0.58	0.38	0.32	0.31	0.27	0.39	0.33	0.27	0.26	0.25	0.48	0.37	0.31
1/4 in. argon spaces	0.23	0.61	0.40	0.34	0.33	0.29	0.42	0.35	0.30	0.29	0.28	0.50	0.39	0.34
1/2 in. argon spaces	0.17	0.56	0.36	0.30	0.29	0.25	0.37	0.30	0.25	0.24	0.23	0.45	0.34	0.29
Triple Glazing, e=0.10 [a]														
1/4 in. air spaces	0.27	0.64	0.43	0.37	0.36	0.31	0.45	0.39	0.33	0.32	0.31	0.54	0.43	0.37
1/2 in. air spaces	0.18	0.57	0.36	0.31	0.30	0.25	0.37	0.31	0.25	0.25	0.23	0.46	0.35	0.29
1/4 in. argon spaces	0.21	0.59	0.39	0.33	0.32	0.27	0.40	0.34	0.28	0.27	0.26	0.48	0.38	0.32
1/2 in. argon spaces	0.14	0.54	0.33	0.28	0.27	0.23	0.34	0.28	0.22	0.21	0.20	0.42	0.32	0.26

DEFAULT OVERHEAD FENESTRATION U-FACTORS

Part 3 of 3

U-Factor

Values are based on the 2005 ASHRAE Handbook of Fundamentals, Table 30-4.

Use these values for demonstrating compliance with a default U-factor, not the NFRC procedure.

When a product has a U-factor that has been certified through the NFRC U-factor in the Overhead Plane may be used.

Product Type	Glass Only	Manufactured Skylights				Site-Assembled Sloped/Overhead Glazing		
Frame Type	n/a	Alum w.o. Therm Break	Alum with Therm Break	Reinforced Vinyl/Alum Clad Wood	Wood/ Vinyl	Alum w.o. Therm Break	Alum with Therm Break	Structural Glazing
Glazing Type	Cntr-of-Glass							
Single Glazing								
1/8 in. glass	1.19	1.98	1.89	1.75	1.47	1.36	1.25	1.25
1/4 in. acrylic/polycarbonate	1.03	1.82	1.73	1.60	1.31	1.21	1.10	1.10
1/8 in. acrylic/polycarbonate	1.11	1.90	1.81	1.68	1.39	1.29	1.18	1.18
Double Glazing								
1/4 in. airspace	0.58	1.31	1.11	1.05	0.84	0.82	0.70	0.66
1/2 in. airspace	0.57	1.30	1.10	1.04	0.84	0.81	0.69	0.65
1/4 in. argon space	0.53	1.27	1.07	1.00	0.80	0.77	0.66	0.62
1/2 in. argon space	0.53	1.27	1.07	1.00	0.80	0.77	0.66	0.62
Double Glazing, e=0.40 surface 2 or 3								
1/4 in. airspace	0.51	1.25	1.05	0.99	0.78	0.76	0.64	0.60
1/2 in. airspace	0.50	1.24	1.04	0.98	0.77	0.75	0.64	0.59
1/4 in. argon space	0.44	1.18	0.99	0.92	0.72	0.70	0.58	0.54
1/2 in. argon space	0.46	1.20	1.00	0.94	0.74	0.71	0.60	0.56
Double Glazing, e=0.20 surface 2 or 3								
1/4 in. airspace	0.46	1.20	1.00	0.94	0.74	0.71	0.60	0.56
1/2 in. airspace	0.46	1.20	1.00	0.94	0.74	0.71	0.60	0.56
1/4 in. argon space	0.39	1.14	0.94	0.88	0.68	0.65	0.54	0.50
1/2 in. argon space	0.40	1.15	0.95	0.89	0.68	0.68	0.55	0.51
Double Glazing, e=0.10 surface 2 or 3								
1/4 in. airspace	0.44	1.18	0.99	0.92	0.72	0.70	0.58	0.54
1/2 in. airspace	0.44	1.18	0.99	0.92	0.72	0.70	0.58	0.54
1/4 in. argon space	0.36	1.11	0.91	0.85	0.65	0.63	0.52	0.47
1/2 in. argon space	0.38	1.13	0.93	0.87	0.67	0.65	0.53	0.49
Double Glazing, e=0.05 surface 2 or 3								
1/4 in. airspace	0.42	1.17	0.97	0.91	0.70	0.68	0.57	0.52
1/2 in. airspace	0.43	1.17	0.98	0.91	0.71	0.69	0.58	0.53
1/4 in. argon space	0.34	1.09	0.89	0.83	0.63	0.61	0.50	0.45
1/2 in. argon space	0.36	1.11	0.91	0.85	0.65	0.63	0.52	0.47

Skylight Conversion

When a vertical tested U-factor for skylights is available, use formula to the right to convert to overhead U-factor

Vertical to Overhead Equation | Skylight U-Factor = 0.08 + 1.62 X U-Factor

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Part 1 of 2 DEFAUL FENESTRATION SHADING

Shading Coefficient

Oregon code requires center-of-glass shading coefficient equal to or less than 0.57, 0.47, 0.43, or 0.35 as the performance requirement

SC_c = Shading Coefficient for glazing system (center-of-glass)

$$SC_c = \frac{SHGC_c}{0.87}$$

$SHGC_c$ = Solar Heat Gain Coefficient (center-of-glass)

e = Infrared emissivity of glazing layer

Values are from the 2005 ASHRAE Fundamentals Handbook, Table 30-13. Unless otherwise noted, tinted glass and reflective glass coatings are on the outer pane and low-e coatings are applied to inner pane (surface 3) in double glazed systems.

When double-glazing has both tint and low-e, low-e is on surface 3, unless noted.

Glazing Description	Center-of-Glass Shading Coefficient (SC_c)	Equivalent $SHGC_c$
Single – $^1/_8$" thick		
Glazing, Clear	0.99	0.86
Glazing, Bronze	0.84	0.73
Glazing, Green or Gray	0.80	0.70
Single acrylic or polycarbonate clear	0.98	0.85
Single – $^1/_4$" thick		
Glazing, Clear	0.93	0.81
Glazing, Bronze	0.71	0.62
Glazing, Green	0.69	0.60
Glazing, Gray	0.68	0.59
Glazing, Bluegreen	0.71	0.62
Stainless steel reflective on clear 20%	0.36	0.31
Stainless steel reflective on green 14%	0.29	0.25
Titanium reflective on clear 30%	0.45	0.39
Single acrylic or polycarbonate clear	0.98	0.85
Glass Block		
Clear	0.66	0.57
Frosted	0.51	0.44
Double Glazing – $^1/_8$" thick		
Clear	0.87	0.76
Clear, low-*e* on surface 2 or 3 with *e*=0.4*	0.86	0.75
Clear, low-*e* with *e*=0.2	0.80	0.70
Clear, low-*e* on outer pane (surface 2) with *e*=0.2	0.75	0.65
Clear, low-*e* with *e*=0.1	0.69	0.60
Clear, low-*e* on outer pane (surface 2) with *e*=0.1	0.75	0.65
Clear, low-*e* on outer pane (surface 2) with *e*=0.05	0.47	0.41
Bronze	0.71	0.62
Green or Gray	0.69	0.60
Bronze, low-*e* with *e*=0.4*	0.71	0.62
Green, low-*e* with *e*=0.4*	0.69	0.60
Gray, low-*e* with *e*=0.4*	0.68	0.59
Bronze, low-*e* with *e*=0.2	0.66	0.57
Green, low-*e* with *e*=0.2	0.63	0.55
Gray, low-*e* with *e*=0.2	0.62	0.54
Bronze, low-*e* with *e*=0.1	0.55	0.48
Green or Gray, low-*e* with *e*=0.1	0.53	0.46
Double Glazing – $^1/_4$" thick		
Clear	0.80	0.70
Clear, low-*e* on surface 2 or 3 with *e*=0.4*	0.80	0.70
Clear, low-*e* with *e*=0.2	0.75	0.65
Clear, low-*e* on outer pane (surface 2) with *e*=0.2	0.69	0.60
Clear, low-*e* with *e*=0.1	0.64	0.56
Clear, low-*e* on outer pane (surface 2) with *e*=0.1	0.69	0.60
Clear, low-*e* on outer pane (surface 2) with *e*=0.05	0.43	0.37
Bronze or Green	0.56	0.49
Gray	0.54	0.47
Bluegreen	0.57	0.50
Hi-performance Green	0.45	0.39

Note: glazing is still required to comply with either prescriptive overall window U-factor or minimum assembly requirements.

* Values are from 2005 ASHRAE Fundamentals Handbook

DEFAUL FENESTRATION SHADING

Part 1 of 2

Glazing Description	Center-of-Glass Shading Coefficient (SC_c)	Equivalent $SHGC_c$
Double Glazing – $^1/_4$" thick *cont.*		
Bronze, low-*e* with *e*=0.4*	0.58	0.51
Green, low-*e* with *e*=0.4*	0.53	0.46
Gray, low-*e* with *e*=0.4*	0.50	0.44
Bluegreen, low-*e* with *e*=0.4*	0.57	0.50
Hi-performance Green, low-*e* with *e*=0.4*	0.45	0.40
Bronze, low-*e* with *e*=0.2	0.52	0.45
Green, low-*e* with *e*=0.2	0.47	0.41
Gray, low-*e* with *e*=0.2	0.45	0.39
Bluegreen, low-*e* with *e*=0.2	0.52	0.45
Hi-performance Green, low-*e* with *e*=0.2	0.39	0.34
Bronze, low-*e* with *e*=0.1	0.45	0.39
Green, low-*e* with *e*=0.1	0.41	0.36
Gray, low-*e* with *e*=0.1	0.39	0.34
Bluegreen, low-*e* with *e*=0.1	0.45	0.39
Hi-performance Green, low-*e* with *e*=0.1	0.36	0.31
Bronze, low-*e* on outer pane (surface 2) with *e*=0.05	0.30	0.26
Green, low-*e* on outer pane (surface 2) with *e*=0.05	0.36	0.31
Gray, low-*e* on outer pane (surface 2) with *e*=0.05	0.28	0.24
Blue, low-*e* on outer pane (surface 2) with *e*=0.05	0.31	0.27
Hi-perf. Green, low-*e* on outer pane (surface 2) with *e*=0.05	0.31	0.27
Stainless steel reflective on clear 20%	0.25	0.22
Titanium reflective on clear 30%	0.33	0.29
Triple Glazing – $^1/_8$" thick		
Clear	0.77	0.67
Clear, low-*e* on outer pane (surface 2) with *e*=0.4*	0.69	0.60
Clear, low-*e* on outer pane (surface 2) with *e*=0.2	0.69	0.60
Clear, low-*e* on inner pane (surface 5) with *e*=0.2	0.71	0.62
Clear, low-*e* on surfaces 2 and 5 with *e*=0.1	0.47	0.41
Clear, low-*e* on surfaces 2 and 4 with *e*=0.05	0.31	0.27
Triple Glazing – $^1/_4$" thick		
Clear	0.70	0.61
Clear, low-*e* on outer pane (surface 2) with *e*=0.4*	0.70	0.61
Clear, low-*e* on outer pane (surface 2) with *e*=0.2	0.61	0.53
Clear, low-*e* on inner pane (surface 5) with *e*=0.2	0.64	0.56
Clear, low-*e* on surfaces 2 and 5 with *e*=0.1	0.41	0.36
Clear, low-*e* on surfaces 2 and 4 with *e*=0.05	0.30	0.26
Hi-performance Green	0.37	0.32

Note: glazing is still required to comply with either prescriptive overall window U-factor or minimum assembly requirements.

* Values are from 2005 ASHRAE Fundamentals Handbook

Shading Coefficient

Oregon code requires center-of-glass shading coefficient equal to or less than 0.57, 0.47, 0.43, or 0.35 as the performance requirement

SC_c = Shading Coefficient for glazing system (center-of-glass)

$$SC_c = \frac{SHGC_c}{0.87}$$

$SHGC_c$ = Solar Heat Gain Coefficient (center-of-glass)

e = Infrared emissivity of glazing layer

Values are from the 2005 ASHRAE Fundamentals Handbook, Table 30-13. Unless otherwise noted, tinted glass and reflective glass coatings are on the outer pane and low-e coatings are applied to inner pane (surface 3) in double glazed systems.

When double-glazing has both tint and low-e, low-e is on surface 3, unless noted.

SYSTEMS - GENERAL

Applicability
Discussion of qualifying exceptions on page 4-25

Plans/Specs
Show compliance by including a drawing sheet, detail number, specification section and subparagraph.

1. Applicablity (Section 1317)

Is this form required?

❑ **Form Required.** Complete form if a new HVAC system is being installed, or components of an existing HVAC system are being replaced (I.e., equipment, controls, ductwork, and insulation.)

❑ **Exception.** The building or part of the building qualifies for an exception from HVAC code requirements. Applicable code exception is Section 1317.1. Portions of the building that qualify:

Area: Exception ❑ -1 ❑ -2 ❑ -3

Area: Exception ❑ -1 ❑ -2 ❑ -3

Area: Exception ❑ -1 ❑ -2 ❑ -3

❑ **Form Not Required.** This project does not contain work required to comply with code.

2. Simple or Complex Systems (Section 1317.9 or 1317.10)

❑ **Simple System**. Building contains only Simple HVAC System(s). Complete this form (4a) and equipment efficiency worksheets as required. Form 4b is not required.

❑ **Complex System**. Project includes a Complex System. Complete this form (4a), form 4b and equipment efficiency worksheets as required.

3. Equipment Performance (Section 1317.5)

❑ **No New HVAC Equipment.** The building plans do not call for new electrical HVAC equipment, combustion heating equipment, or heat-operated cooling equipment.

❑ **Complies**. All new HVAC equipment have efficiencies not less than those required by code. The following equipment efficiency worksheets are attached:

❑ -4a ❑ -4b ❑ -4c ❑ -4d ❑ -4e ❑ -4f ❑ -4g ❑ -4h ❑ -4i ❑ -4j

4. Duct Insulation and Sealing (Sections 1317.7 & 1317.8)

❑ **No Ducts.** The building plans and specifications do not call for new HVAC ducts or plenums.

❑ **Complies**. The plans and specifications call for all air-handling ducts and plenums to be insulated and sealed as required by Sections 1317.7 &1317.8.

5. Distribution Transformers (Section 1316.1)

❑ **No Distribution Transformers.** The plans/specs do not call for new distribution transformers.

❑ **Complies**. All new distribution transformers comply with efficiency, testing, and labeling requirements of Section 1316.1.1.

❑ **Exception.** The project qualifies for an exception per Section 1316.1.1, Exceptiion:

❑-1 ❑-2 ❑-3 ❑-4 ❑-5 ❑-6 ❑-7 ❑-8 ❑-9 ❑-10 ❑-11 ❑-12 ❑-13 ❑-14

Attach relevant documentation for appropriate exception. The plans/specs show compliance in the following locations:

6. HVAC Controls (Section 1317.4)

6.1 System Thermostat/Zone Controls (Section 1317.4.1)

❑ **Complies**. All new HVAC systems include at least one temperature control device responding to temperatures within the zones.

❑ **Exception.** HVAC system qualifies for an exception from zone control requirements.
The applicable code exception is Section 1317.4.2, Exception ❑ -1 ❑ -2

Portions of the building that qualify:

The plans/specs show compliance in the following locations:

6.2 Off-hour Controls - Auto Setback or Shutdown (Section 1317.4.3)

❑ **Complies.** Systems must have **at least one** of the following features:

❑ **Control Setback Complies.** Each system is equipped with automatic control capable of reducing energy through control setback during periods of non-use or alternate use of spaces

❑ **Equipment Shutdown Complies.** Each system is equipped with controls capable of reducing energy use through automatic shutdown during periods of non-use or alternate use of spaces.

- ❑ HVAC systems with equipment shutdown are equipped with at least one of the following:
- ❑ Programmable controls (1317.4.3.1 (1))
- ❑ Occupant sensor (1317.4.3.1 (2))
- ❑ Interlocked to a security system (1317.4.3.1 (3))
- ❑ Manually activated timers with 2-hour operation max (1317.4.3.1 (4))

❑ **Exception.** The building qualifies for an exception to the requirement for automatic setback or shutdown controls. The applicable code exception is Section 1317.4.3 Exception ❑ -1 ❑ -2

The plans/specs show compliance in the following locations:

6.3 Control Capabilities (Sec. 1317.4.2.1)

❑ **Complies.** Zone thermostats are capable of being set to the temperatures described in Sec. 1317.4.2.1. Where used to control both heating and cooling, zone controls shall be capable of providing a temperature range or deadband of at least 5 degrees F within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum.

❑ **Exception.** The building qualifies for an exception to the deadband requirements.
The applicable code exception is Section 1317.4.2.1 Exception ❑ -1 ❑ -2

Portions of the building that qualify:

The plans/specs show compliance in the following locations:

6.4 Optimum Start Controls (Section 1317.4.3.2)

❑ **Complies.** Separate HVAC systems have controls capable of varying start-up time of system to just meet temperature set point at time of occupancy.

❑ **Exception.** HVAC systems have a design supply air capacity not exceeding 10,000 cfm.
The plans/specs show compliance in the following locations:

6.5 Heat Pump Controls (Section 1317.4.4)

❑ **No Heat Pump.** The plans/specs do not call for a new heat pump

❑ **Complies**. All new heat pumps equipped with supplementary heaters are controlled to minimize the use of supplemental heat as defined in Section 1317.4.4.
The plans/specs show compliance in the following locations:

7. Economizer Cooling (Section 1317.3)

❑ **No Cooling.** The building plans do not call for a new fan system with mechanical cooling.

❑ **Complies**. Each new fan system has an air economizer capable of modulating outside-air and return-air dampers to provide up to 100 percent of the design supply air as outside air.

❑ **Exception** At least one new fan system qualifies for an exception. The applicable code exception is Section 1317.3, Exception ❑ -1 ❑ -2 ❑ -3 ❑ -4 ❑ -5 ❑ -6

If Exception 3 is selected complete the following:

(a) Total cooling capacity of exempt units (Btu/hr)

(b) Total installed building cooling capacity (Btu/hr)

❑ **Complies.** Sum of exempt units rated at less than 54,000 Btu/hr is <240,000 or a/b < 0.10 (10% of total building cooling capacity).

Unit Identifier of exempt units:

The plans/specs show compliance in the following locations:

8. Economizer Pressure Relief & Integration (Section 1317.3.1 and 1317.3.2)

❑ **No Economizers Required.** Project does not contain a new fan system requiring economizers.

❑ **Overpressurization Complies**. The drawings specifically identify a pressure relief mechanism for each fan system that will relieve the extra air introduced by the economizer.

❑ **Integration Complies**. Economizer is capable of providing partial cooling even when additional mechanical cooling is required to meet the remainder of the cooling load.

❑ **Exception.** The applicable exception is Section 1317.3.2, Exception ❑ -1 ❑ -2

The plans/specs show compliance in the following locations:

9. Hot Gas Bypass (Section 1317.5)

❑ **No Hot Gas Bypass**

❑ **Complies**. See allowable amount of hot gas bypass as a percentage of total cooling capacity in table below.

Unit ID	Rated Cooling Capacity	Hot Gas Bypass Capacity

Allowable Hot Gas Bypass	
Rated Cooling Capacity	**Max Hot Gas Bypass**
≤240,000 Btu/hr	**50%**
>240,000 Btu/hr	**25%**

❑ **Exception.** Unitary packaged system with cooling capacity no greater than 90,000 Btu/h

SYSTEMS - GENERAL

10. Shutoff Dampers (1317.4.3.3)

❑ **Not Required.** Shutoff dampers are not required on this project.
❑ **Complies.** Each outdoor air supply & exhaust system shall be equipped with motorized dampers
❑ **Exception.** The building qualifies for an exception to the motorized damper requirement. The applic-able code exception is Section 1317.4.3.3 Exception ❑ -1 ❑ -2 ❑ -3 ❑ -4 ❑ -5

The plans/specs show compliance in the following locations:

10.1. Shutoff Damper Controls (Section 1317.4.3.3.1)

❑ **Complies.** Outdoor air supply and exhaust systems shall be provided dampers that automatically shut when systems or spaces served are not in use or during building warm-up, cooldown, or setback.
❑ **Complies.** Stair and shaft vents are capable of being automatically closed during normal building operation and interlocked to open as required by fire and smoke detection systems.

The plans/specs show compliance in the following locations:

10.2. Motorized Damper Leakage (1317.4.3.3.2)

❑ **Complies.** Motorized outdoor air supply and exhaust air dampers have a maximum leakage rate of 4 cfm/ft2 at 1.0 in w.g. when tested in accordance with AMCA Standard 500-1998.
❑ **Exception.** Packaged HVAC equipment may have maximum leakage rate of 20 cfm/ft^2 at 1.0 in w.g. when tested in accordance with AMCA Standard 500–1998.

The plans/specs show compliance in the following locations:

11. Piping Insulation (Section 1314)

❑ **No New Piping.** The building plans and specifications do not call for new piping serving a heating or cooling system or part of a circulating service water heating system.
Complies. All new piping serving a heating or cooling system or part of a circulating service water heating system complies with the requirements of the Code, Section 1314.1.
Exception. New piping qualifies for exception: Section 1314.1, Exception ❑ -1 ❑ -2

12. Occupancy Ventilation

❑ **Complies.** Mechanical ventilation systems provide the required amount of ventilation specified in Chapter 4 of the Oregon Mechanical Specialty Code.
❑ **Complies**. Natural ventilation systems provide required amount of ventilation as certified by a reg-istered architect or engineer as specified by Section1203.4.1, Exception. Attach worksheet

The plans/specs show compliance in the following locations:

The plans/specs show compliance on the following pages:

SYSTEMS - GENERAL

13. High Occupancy Ventilation (Section 1317.2.2)

❑ **Complies.** HVAC systems with ventilation air capacities of 1,500 CFM or greater that serve areas having an average occupant load of 20 square feet per person or less from Table 1004.1.2 have a means to automatically reduce outside air intake.

Identify applicable systems:

Plans/specs indicate where equipment (i.e. carbon dioxide sensor) and sequence is specified:

❑ **Exception.** HVAC systems are equipped with an energy recovery device with at least 50% recovery effectiveness.

❑ **No High Occupancy Systems.** Project does not contain an HVAC system as described above.

14. Exhaust Air Heat Recovery (Section 1318.3)

❑ **Not Regulated.** HVAC system does not have: 1) design supply air cap. of ≥10,000 cfm, **and** 2) min. outside air supply ≥70%, **and** 3) at least 1 exhaust fan rated at 75% of min outside air

❑ **Complies.** Heat recovery system increases outside air temperature by 20°F (Climte Zone 1) or 30°F (Zone 2) and has provision to provide bypass during air economizer mode.

❑ **Exception.** An HVAC system qualifies for an exception to this requirement. Applicable exception from Section 1318.3 Exception ❑ -1 ❑ -2 ❑ -3 ❑ -4 ❑ -5 ❑ -6 ❑ -7

The plans/specs show compliance in the following locations:

15. Large Volume Fan Systems (Section 1318.4.2.4)

❑ **Not Regulated.** The building plans or specifications do not call for fan systems over 15,000 CFM that serve a single zone and function for the purpose of temperature control.

❑ **Complies.** Fan systems are equipped with variable frequency drive or two speed motor to reduce airflow as required by Section 1318.4.2.3.

The plans/specs show compliance in the following locations:

16. Variable Speed Drives (Section 1317.10.3.1)

❑ **Not Regulated.** The building plans or specifications do not call for fan and pump motors 10 horsepower and greater that serve variable-flow air or liquid systems.

❑ **Complies.** All fan and pump motors 10 hp and greater which serve variable-flow air or liquid systems are controlled by a variable-speed drive.

❑ **Exception.** The building qualifies for an exception to the variable-speed drive requirement.

Portions of the building that qualify:

Applicable code exception is Section 1317.10.3.1, Exception

The plans/specs show compliance in the following locations:

17. Service Water Heating (Sec. 1315)

❑ **No New Water Heating.** The building plans and specifications do not call for new water heaters, hot water storage tanks or service hot water distribution systems.

❑ **Complies.** All new water heaters, hot water storage tanks or service hot water distribution systems comply with the requirements of the Section 1315.

❑ **Exception.** The applicable code exception is Section: Exception:

Portions of the building that qualify:

The plans/specs show compliance in the following locations:

SYSTEMS - GENERAL

18. Swimming Pools, Spas and Hot Tubs (Section 1315.5)

- ❑ **No New Pools.** The building plans and specifications do not call for new, swimming pools, spas or hot tubs.
- ❑ **On/Off Controls Complies.** Spa and hot tub heaters are equipped with a readily accessible ON/OFF switch as required by Section 1315.5.1.
- ❑ **Ventilation Controls Complies.** Pool ventilation system is controlled based on humidity.
- ❑ **Cover Complies.** All heated pools, hot tubs and spas are equipped with a cover.
- ❑ **Heat Recovery Complies.** Pools, Spas, and hot tubs, over 200 ft^2 utilize recovered heat as required by Section 1315.5.3.
  - ❑ **Exception.** Heat recovery is not necessary as pool is heated by renewable energy or waste heat recovery sources capable of providing at least 70 percent of the heating energy required over an operating season.

19. Fume Hoods (Section 1317.2.1.)

- ❑ **No Fume Hoods.** The building plans do not call for fume hood systems that have a total exhaust rate greater than 15,000 cfm.
- ❑ **Complies**. Fume hood systems have **at least one** of the following features:
  - ❑ Variable air volume hood exhaust and room supply systems capable of reducing exhaust and makeup air volume to 50% or less of design values.
  - ❑ Direct makeup (auxiliary) air supply equal to at least 75% of the exhaust rate, heated no warmer than 2° F below room set point, cooled no cooler than 3° F above room set point, no humidification added, and no simultaneous heating and cooling used for dehumidification control.
  - ❑ Heat recovery systems to precondition makeup air from fume hood exhaust in accordance with 1318.3 - Exhaust Air Energy Recovery, without using any exception.

The plans/specs show compliance in the following locations:

20. Parking Garage Ventilation (Section 1317.2.3)

- ❑ **No Enclosed Garages.** The building plans and specifications do not call for enclosed Group S-2 parking garages with a ventilation exhaust rate greater than 30,000 CFM.
- ❑ **Complies**. The plans and specifications call for carbon monoxide sensing devices as required by Section 1317.2.3.
- ❑ **Exception.** Open parking garages.

21. Kitchen Hoods (Section 1317.11)

- ❑ **Not Regulated.** The plans/specs do not call for any new kitchen hoods with exhaust capacity greater than 5,000 cfm each.
- ❑ **Complies**. All new kitchen hoods with a total exhaust capacity greater than 5,000 cfm have at least 50 percent of the required makeup air; (a) unheated or heated to no more than 60°F; and (b) uncooled or evaporatively cooled.

The plans/specs show compliance in the following locations:

22. Outside Heating Systems (Section 1317.12)

- ❑ **No Outside Heating Systems.** The plans/specs do not call for new permanently installed heating systems outside the building.
- ❑ **Complies**. All new permanently installed outside heating systems are radiant gas fired systems controlled by an occupancy sensor or timer switch as required by Section 1317.12.

COMPLEX HVAC SYSTEMS

Part 1 of 3

Applicability
Discussion of qualifying exceptions in instructions section.

Fan Motor Energy
See Section 1318.4.2 for maximum horsepower allowed.

1. Simple or Complex Systems (Section 1317.9, 1317.10 and 1318)

Note: This form is required for complex systems only. If your plans qualify as a simple system as defined by the code, this form is not required.

2. Air Transport Energy (Section 1318.4.2)

- ❑ **Not Regulated.** Each HVAC system does not have total fan nameplate horsepower of 7.5 HP or greater (include sum of all supply, return, & exhaust fans operating at design conditions).
- ❑ **Brake Horsepower Complies.** The energy demand of all HVAC fan systems meets code requirements. Complete and attach Worksheet 4l.
- ❑ **Nameplate Horsepower Complies.** Selected fan motors have nameplate ratings no larger than is allowed by Section 1318.4.2.3. (Complete Worksheet 4L.)
- ❑ **Exception.** Section 1318.4.2, Exception ❑ -1 ❑ -2 ❑ -3 ❑ -4

Portions of the building that qualify:

The plans/specs show compliance in the following locations:

Cooling Tower Fans

3. Cooling Tower Fans (Section 1317.5.4.1)

- ❑ **No Cooling Tower** There is no cooling tower in this project.
- ❑ **Complies.** Cooling tower fans have control devices that vary flow by controlling leaving fluid temperature or condenser temperature/pressure of the heat rejection device.

The plans/specs show compliance in the following locations:

4. Simultaneous Heating and Cooling (Section 1318.2.1)

- ❑ **No Cooling.** The building HVAC system has no cooling.
- ❑ **Complies**. Controls prevent reheating, recooling or mixing of mechanically heated and mechanically cooled air.
- ❑ **Exception.** Code exception is Section 1318.2.1, Exception ❑ -1 ❑ -2 ❑ -3 ❑ -4 ❑ -5
  If exception 1 is used, complete and attach Worksheet 4k

Portions of the building that qualify:

The plans/specs show compliance in the following locations:

5. Electric Motor Efficiency (Section 1317.10.3 & Table 13-T)

- ❑ **Not Regulated.** There are no NEMA Design A&B squirrel cage,T-frame induction, permanently wired polyphase motors of one horsepower or more which serve built up HVAC
- ❑ **Complies**. The efficiency of all regulated motors meets code requirements.
- ❑ **Exception.** Section 1317.10.3, Exception ❑ -1 ❑ -2

Exceptions
Discussion of qualifying exceptions in instructions

Portions of the building that qualify:

The plans/specs show compliance in the following locations:

6. VAV System Static Pressure Reset Controls (Section 1318.2.3)

- ❑ **Not Regulated.** The building plans or specifications do not call for a VAV system controlled by a static pressure sensor or direct digital control of individual zone boxes.
- ❑ **Complies.** The system static pressure set point automatically resets to the lowest point possible while still providing the required air flow to the zones with the greatest demand.
- ❑ **Exception.** Section 1318.2.3, Exception

The plans/specs show compliance in the following locations:

COMPLEX HVAC SYSTEMS Part 2 of 3

7. VAV Terminal Units (Section 1317.4.2.1)

❑ **Not Regulated.** Project does not contain VAV terminal units.

❑ **Complies.** VAV terminal units are programmed to operate at the minimum airflow setting without addition of reheat when the zone temperature is within the set deadband. Complete Worksheet 4k.

❑ **Exception.** Section 1317.4.2.1, Exception ❑ -1 ❑ -2
The plans/specs show compliance in the following locations:

8. Supply-Air Temperature Reset Controls (Section 1318.2.5)

❑ **Not Regulated.** The building plans or specifications do not call for multiple zone HVAC systems.

❑ **Complies.** Multiple zone HVAC systems include controls that automatically reset the supply-air temperatures in response to building loads or outside air temperature.

❑ **Exception.** The building qualifies for an exception to the supply-air reset controls requirement. Applicable code exception is Section 1318.2.5, Exception ❑ -1 ❑ -2 ❑ -3

Portions of the building that qualify:

The plans/specs show compliance in the following locations:

9. Chilled and Hot Water Temperature Reset Controls (Section 1318.2.4)

❑ **Not Regulated.** The building plans or specifications do not call for chilled or hot water systems with a design capacity exceeding 300,000 Btu/hr.

❑ **Complies.** Chilled and hot water systems include controls that automatically reset supply water temperatures by representative building loads or by outside air temperature.

❑ **Exception.** Section 1318.2.4, Exception ❑ -1 ❑ -2

Portions of the building that qualify:

The plans/specs show compliance in the following locations:

10. Separate Air Distribution Systems (Section 1318.2.7)

❑ **Not Regulated.** The building plans or specifications do not call for zones with special process temperature or humidity requirements.

❑ **Complies.** Separate air distribution systems serve zones with special process temperature or humidity requirements from those zones serving only comfort conditions, or supplementary control provisions are included so primary systems are specifically controlled for comfort purposes only.

❑ **Exception.** Section 1318.2.7, Exception ❑ -1 ❑ -2
Identify zones with special process requirements:

The plans/specs show compliance in the following locations:

11. Zone Isolation Controls (Section 1318.2.6)

❑ **Not Regulated.** Building plans or specifications do not call for HVAC systems serving multiple occupancies or floors with ≥240,000 Btu/hr cooling capacity, or ≥300,000 Btu/hr heating capacity.

❑ **Complies.** HVAC systems serving multiple occupancies or floors with >240,000 Btu/hr cooling capacity, or >300,000 Btu/hr heating capacity are equipped with isolation devices capable of automatically shutting off supply air to and from each isolated area. Each isolated area is controlled independently and satisfies temperature setback (Section 1317.4.2) and optimum start control requirements. Central fan system air volume is reduced through fan speed reduction.

The plans/specs show compliance in the following locations:

COMPLEX HVAC SYSTEMS

Part 3 of 3

12. Humidity Controls (Section 1318.2.2)

- ❑ **No Moisture Added to Building.** The building plans do not call for means to add moisture to maintain specific humidity levels.
- ❑ **Complies**. All new humidity control systems equipped with a humidistat when required. All humidifier preheating devices have an automatic value to shut off preheat when humidification

The plans/specs show compliance in the following locations:

13. Hydronic System Controls (Section 1318.2.8)

- ❑ **No Hydronic System.** The building plans or specifications do not call for a new hydronic system.
- ❑ **Complies.** The hydronic system complies as follows:

13.1 Variable Flow Controls (Section 1318.2.8.4)

- ❑ System does not have a 10 hp or greater motor
- ❑ Complies. System has controls capable of varying pump flow

The plans/specs show compliance in the following locations:

13.2 Three-Pipe System (Section 1318.2.8.1)

- ❑ System does not have a common return system (a three-pipe system) for both hot water and chilled water.

13.3 Two-Pipe Changeover System (Section 1318.2.8.2)

- ❑ System is not a Two-Pipe Changeover System
- ❑ Complies. System is:
  a. Designed to allow a deadband between changeover from one mode to the other of at least 15°F outside air temperature.
  b. Designed to operate and provided with controls that will allow operation in one mode for at least four hours before changing over to the other mode.
  c. Provided with reset controls that allow heating and cooling supply temperatures at the changeover point to be no more than 30°F apart.

The plans/specs show compliance in the following locations:

13.4 Hydronic (Water Loop) Heat Pump System (Section 1318.2.8.3)

- ❑ System is not a Hydronic (Water Loop) Heat Pump System
- ❑ Complies. Hydronic heat pumps connected to a common heat pump water loop with central devices for heat rejection (e.g., cooling tower) and heat addition (e.g., boiler) have the following:
  a. Controls installed capable of providing a heat pump water supply temperature deadband of at least 20°F between initiation of heat rejection and heat addition by the central devices (e.g., tower and boiler).
  b. Closed-circuit tower (fluid cooler) has either an automatic valve installed to bypass all but a minimal flow of water around the tower (for freeze protection), or low-leakage positive closure dampers.
  c. Open-circuit tower installed directly in the heat pump loop has an automatic valve installed to bypass all heat pump water flow around the tower. Open-circuit towers used in conjunction with a separate heat exchanger to isolate the tower from the heat pump loop are controlled by shutting down the circulation pump on the cooling tower loop.
  d. A two-position valve at each hydronic heat pump for hydronic systems having a total pump system power exceeding 10 hp.

The plans/specs show compliance in the following locations:

Worksheet 4a | Project Name: | Page:

UNITARY AIR CONDITIONER - AIR COOLED

Equipment

Discussion of equipment ratings and equipment definitions on page 4-19.

(a) Equip. ID	(b) Model Designation	(c) Cooling Capacity	(d) Steady State	(d) Seasonal or Part Load	(e) Compliance Schedule (A-E)

Required Documentation

Indicate source of information

- ❑ ARI Unitary Directory, Section AC, page:
- ❑ ARI Applied Products directory, Section ULE, page:
- ❑ Product data (Attach data furnished by the equipment supplier, I.e., "cut sheets")

Code Required Efficiencies

This schedule of equipment efficiencies was reformatted from code, Table 13-L.

Compliance Schedule	Equipment Type	Cooling Capacity (btu/hr) Over	Cooling Capacity (btu/hr) But not over -	Minimum Rating Steady State	Minimum Rating Seasonal or Part Load
A	Single Package Without a Heating Section or With Electric Resistance Heat	0	65,000	na	9.7 SEER
		65,000	135,000	10.3 EER	n/a
		135,000	240,000	9.7 EER	n/a
		240,000	760,000	9.5 EER	9.7 IPLV
		760,000	-	9.2 EER	9.4 IPLV
B	Split System Without a Heating Section or With Electric Resistance Heat	0	65,000	na	10 SEER
		65,000	135,000	10.3 EER	n/a
		135,000	240,000	9.7 EER	n/a
		240,000	760,000	9.5 EER	9.5 IPLV
		760,000	-	9.2 EER	9.2 IPLV
C	Single Package With a Heating Section Other Than Electric Resistance	0	65,000	na	9.7 SEER
		65,000	135,000	10.1 EER	n/a
		135,000	240,000	9.5 EER	n/a
		240,000	760,000	9.3 EER	9.5 IPLV
		760,000	-	9.0 EER	9.2 IPLV
D	Split System With a Heating Section Other Than Electric Resistance	0	65,000	na	10 SEER
		65,000	135,000	10.1 EER	n/a
		135,000	240,000	9.5 EER	n/a
		240,000	760,000	9.3 EER	9.7 IPLV
		760,000	-	9.0 EER	9.4 IPLV
E	Condensing Unit Only	135,000	-	10.1 EER	11.2 IPLV

Worksheet 4b | Project Name: | Page:

UNITARY AIR COND. - WATER & EVAPORATIVELY COOLED

Equipment

Discussion of equipment ratings and equipment definitions on page 4-19.

(a) Equip. ID	(b) Model Designation	Cooling Capacity (Btu/h)	(d) Proposed Performance: Steady State	(d) Proposed Performance: Seasonal or Part Load	(e) Compliance Schedule (A-E)

Required Documentation

Indicate source of information

- ❑ ARI Unitary Directory, Section AC, page:
- ❑ ARI Applied Products directory, Section ULE, Page:
- ❑ Product data (Attach data furnished by the equipment supplier, I.e., "cut sheets")

Code Required Efficiencies

This equipment efficiencies schedule was reformatted from code, Table 13-L.

Compliance Schedule	Equipment Type	Cooling Capacity (btu/hr) Over	Cooling Capacity (btu/hr) But not over -	Minimum Rating: Steady State	Minimum Rating: Seasonal or Part Load
A	Single Packaged and Split AC Without a Heating Section or With Electric Resistance Heat	0	65,000	12.1 EER	n/a
		65,000	135,000	11.5 EER	na
		135,000	240,000	11.0 EER	n/a
		240,000	-	11.0 EER	10.3 IPLV
B	Single Packaged and Split AC With a Heating Section Other Than Electric Resistance	0	65,000	12.1 EER	n/a
		65,000	135,000	11.3 EER	na
		135,000	240,000	10.8 EER	n/a
		240,000	-	10.8 EER	10.1 IPLV
C	Condensing Units	135,000	-	13.1 EER	13.1 IPLV

Worksheet 4c | Project Name: | Page:

UNITARY HEAT PUMP - AIR COOLED

Equipment

Discussion of equipment ratings and equipment definitions on page 4-19.

(a)	(b)	(c)	(d) Proposed Rating		(e) Proposed Heating Rating			(f)
Equip. ID	Model Designation	Cooling Capacity (Btu/h)	SEER	EER	HSPF	COP (47ºF)	COP (17ºF)	Compliance Schedule (A-E)

Required Documentation

Indicate source of information

- ❑ ARI Unitary Directory, Section AC, page:
- ❑ ARI Applied Products directory, Section ULE, Page:
- ❑ Product data (Attach data furnished by the equipment supplier, I.e., "cut sheets")

Code Required Efficiencies

This schedule of equipment efficiencies was reformatted from the code, Table 13-M.

Compliance Schedule	Equipment Type	Cooling Capacity (btu/hr) Over	Cooling Capacity (btu/hr) But not over	Minimum Cooling Rating EER	Minimum Cooling Rating Seasonal or Part Load	Minimum Heating Rating HSPF	Minimum Heating Rating COP (@ 47ºF)	Minimum Heating Rating COP (@ 17ºF)
A	Single Package Without a Heating Section or With Electric Resistance Heat	0	65,000	-	9.7 SEER	6.6	-	-
		65,000	135,000	10.1	n/a	-	3.2	2.2
		135,000	240,000	9.3	n/a	-	3.1	2.0
		240,000	-	9.0	9.2 IPLV	-	3.1	2.0
B	Split System Without a Heating Section or With Electric Resistance Heat	0	65,000	-	10 SEER	6.8	-	-
		65,000	135,000	10.1	n/a	-	3.2	2.2
		135,000	240,000	9.3	n/a	-	3.1	2.0
		240,000	-	9.0	9.2 IPLV	-	3.1	2.0
C	Single Package With a Heating Section Other Than Electric Resistance	0	65,000	-	9.7 SEER	6.6	-	-
		65,000	135,000	9.9	n/a	-	3.2	2.2
		135,000	240,000	9.1	n/a	-	3.1	2.0
		240,000	-	8.8	9.0 IPLV	-	3.1	2.0
D	Split System With a Heating Section Other Than Electric Resistance	0	65,000	-	10 SEER	6.8	-	-
		65,000	135,000	9.9	n/a	-	3.2	2.2
		135,000	240,000	9.1	n/a	-	3.1	2.0
		240,000	-	8.8	9.0 IPLV	-	3.1	2.0

Worksheet 4d Project Name: Page:

UNITARY HEAT PUMP - WATER COOLED

Equipment

Discussion of equipment ratings and equipment definitions on page 4-19.

(a) Equip. ID	(b) Model Designation	(c) Cooling Capacity (Btu/hr)	(d) Entering Water Temp. EWT (ºF)	(e) Proposed EER	(f) Proposed COP	(g) Compliance Schedule (A, B, or C)

Required Documentation

Indicate source of information

- ❑ ARI Unitary Directory, Section AC, page:
- ❑ ARI Applied Products directory, Section ULE, Page:
- ❑ Product data (Attach data furnished by the equipment supplier, I.e., "cut sheets")

Code Required Efficiencies

This schedule of equipment efficiencies was reformatted from the code, Table 13-M.

Compliance Schedule	Equipment Type	Cooling Capacity (btu/hr) Over	But not over	Minimum Cooling Rating EER	@EWT	Minimum Heating Rating COP	@ EWT
A	Water Source	0	17,000	11.2	86ºF	4.2	68ºF
		17,000	65,000	12.0	86ºF	4.2	68ºF
		65,000	135,000	12.0	86ºF	4.2	68ºF
B	Ground Water Source	0	135,000	16.2	59ºF	3.6	50ºF
C	Ground Source	0	135,000	13.4	77ºF	3.1	32ºF

Worksheet 4e Project Name: Page:

PACKAGED TERMINAL A.C. - AIR COOLED

Equipment

Enter the cooling capacity in column (c). If capacity is less than 7,000 Btu/hr, use 7,000. If above 15,000, use 15,000.

Discussion of equipment ratings and equipment definitions on page 4-19.

Type of Equipment	(a) Equip. ID	(b) Model Designation	(c) Cooling Capacity (Btu/hr)	(d) Proposed EER (95ºF db)	(e) Code Minimum EER (95ºF db)
Units Installed in New Construction					
Replacement of Existing Units (installed prior to 10/01/03)					

Required Documentation

Indicate source of information

- ❑ ARI Unitary Directory, Section AC, page:
- ❑ ARI Applied Products directory, Section ULE, Page:
- ❑ Product data (Attach data furnished by the equipment supplier, I.e., "cut sheets")

Code Required Efficiencies

Calculate the code minimum EERs from the formulas below using the cooling capacity in column (c).

Enter the results in column (e).

New Construction: EER @ 95F Test Conditions = 12.5–(0.213x Cap/1000)

Replacement Units : EER @ 95F Test Conditions = 10.9–(0.213x Cap/1000)

Worksheet 4f Project Name: Page:

PACKAGED TERMINAL HEAT PUMP - AIR COOLED

Equipment

Enter the cooling capacity in column (c). If capacity is less than 7,000 Btu/hr, use 7,000. If above 15,000, use 15,000.

Calculate the code minimum EER's from formulas below using cooling capacity in the column (c). Enter results in column (e).

Discussion of equipment ratings and equipment definitions on page 4-19.

Type of Equipment	(a) Equip. ID	(b) Model Designation	(c) Cooling Capacity (Btu/hr)	(d) Proposed Cooling Rating EER (95ºF db)	(d) Proposed Heating	(e) Code Minimum Cooling Rating EER (95ºF db)	(e) Code Minimum Heating
Units Installed in New Construction							
Replacement of Existing Units (installed prior to 10/01/03)							

Required Documentation

Indicate source of information

- ❑ ARI Unitary Directory, Section AC, page:
- ❑ ARI Applied Products directory, Section ULE, Page:
- ❑ Product data (Attach data furnished by the equipment supplier, I.e., "cut sheets")

Code Required Efficiencies

Calculate the code minimum EERs and COP's from the formulas below using the cooling capacity in column (c).
Enter the results in column (e).

New Construction EER: EER @ 95F Test Conditions = 12.3–(0.213x Cap/1000)
New Construction COP: COP = 3.2 - (0.026 x Cap/1000)
Replacement Units EER: EER @ 95F Test Conditions = 10.8–(0.213x Cap/1000)
Replacement Units COP: COP = 2.9 - (0.026 x Cap/1000)

Worksheet 4g Project Name: Page:

WATER CHILLING PKGS. - WATER & AIR COOLED

Equipment

Discussion of equipment ratings and equipment definitions on page 4-19.

(a) Equip. ID	(b) Model Designation	(c) Cooling Capacity (Btu/hr)	(d) Proposed Steady State COP	(e) Proposed Part Load IPLV	(f) Compliance Schedule (A - I)

Required Documentation

Indicate source of information

- ❑ ARI Unitary Directory, Section AC, page:
- ❑ ARI Applied Products directory, Section ULE, Page:
- ❑ Product data (Attach data furnished by the equipment supplier, I.e., "cut sheets")

Code Required Efficiencies

This schedule of equipment efficiencies was reformatted from code, Table 13-O.

Compliance Schedule	Equipment Type	Cooling Capacity (Tons)	Minimum Rating COP	Minimum Rating IPLV
A	Air Cooled, With Condenser, Electrically Operated	All Capacities	2.80	2.80
B	Air Cooled, Without Condenser, Electrically Operated	All Capacities	3.10	3.10
C	Water Cooled, Electrically Operated, Positive Displacement (Reciprocating)	All Capacities	4.20	4.65
D	Water Cooled, Electrically Operated, Positive Displacement (Rotary, Screw and Scroll)	< 150 tons	4.45	4.50
		≥150, <300 tons	4.90	4.95
		≥300 tons	5.50	5.60
E	Water Cooled, Electrically Operated, Centrifugal	< 150 tons	5.00	5.00
		≥150, <300 tons	5.50	5.50
		≥300 tons	6.10	6.10
F	Air Cooled Absorption, Single Effect	All Capacities	0.60	--
G	Water Cooled Absorption, Single Effect	All Capacities	0.70	--
H	Absorption Double Effect, Indirect Fired	All Capacities	1.00	1.05
I	Absorption Double Effect, Direct Fired	All Capacities	1.00	1.00

Worksheet 4h Project Name: Page:

HEAT REJECT. EQUIPMT. - COOLING TOWERS & AIR COOLED CONDENSERS

Equipment-Cooling Towers

Discussion of equipment ratings and equipment definitions on page 4-19.

Cooling Tower - Equip. ID		**Design Entering Water Temperature (EWT)**					
Compliance Schedule		**Design Leaving Water Temperature (LWT)**				**Fan Type**	
		Design Wet Bulb Temperature (WB)					
Location of Equipment Schedule for EWT, LWT and WB							

(a) Model Designation	(b) Tower Pump GPM at Design Conditions	(c) Tower Fan HP at Design Conditions	(d) GPM/HP ((b)/(c)) at Design Conditions	(e) Tower Pump GPM at CTI Rated Conditions	(f) Tower Fan HP at CTI Rated Conditions	(g) GPM/HP ((e)/(f)) at CTI Rated Conditions	(h) Complies [1]

[1] Column (g) is less than value stated in table below

Cooling Tower - Equip. ID		**Design Entering Water Temperature (EWT)**					
Compliance Schedule		**Design Leaving Water Temperature (LWT)**				**Fan Type**	
		Design Wet Bulb Temperature (WB)					
Location of Equipment Schedule for EWT, LWT and WB							

(a) Model Designation	(b) Tower Pump GPM at Design Conditions	(c) Tower Fan HP at Design Conditions	(d) GPM/HP ((b)/(c)) at Design Conditions	(e) Tower Pump GPM at CTI Rated Conditions	(f) Tower Fan HP at CTI Rated Conditions	(g) GPM/HP ((e)/(f)) at CTI Rated Conditions	(h) Complies [1]

[1] Column (g) is less than value stated in table below

Equipment-Air Cooled Condensers

Discussion of equipment ratings and equipment definitions on page 4-19.

Air-Cooled Condenser-Equip. ID		**Condenser Temperature (CT)**					
Compliance Schedule		**Air Temp. Entering Condenser (ATEC)**					
Location of CT & ATEC Schedule							

(a) Model Designation	(b) Heat Rejected (Btu/h) at Design Conditions	(c) Condenser Fan HP at Design Conditions	(d) Btu/h-HP ((b)/(c)) at Design Conditions	(e) Heat Rejected (Btu/h) at ARI Rated Conditions	(f) Condenser Fan HP at ARI Rated Conditions	(g) Btu/h-HP ((e)/(f)) at ARI Rated Conditions	(h) Complies [1]

[1] Column (g) is greater than value stated in table below

Air-Cooled Condenser-Equip. ID		**Condenser Temperature (CT)**					
Compliance Schedule		**Air Temp. Entering Condenser (ATEC)**					
Location of CT & ATEC Schedule							

(a) Model Designation	(b) Heat Rejected (Btu/h) at Design Conditions	(c) Condenser Fan HP at Design Conditions	(d) Btu/h-HP ((b)/(c)) at Design Conditions	(e) Heat Rejected (Btu/h) at ARI Rated Conditions	(f) Condenser Fan HP at ARI Rated Conditions	(g) Btu/h-HP ((e)/(f)) at ARI Rated Conditions	(h) Complies [1]

[1] Column (g) is greater than value stated in table below

Required Documentation

Indicate source of information
- ❑ ARI Directory, Section, Page (for air cooled condensers only)
- ❑ Product data (Attach data furnished by the equipment supplier: I.e., "cut sheets")

Code Required Efficiencies

This schedule of equipment efficiencies was reformatted from code, Table 13-R.

Compliance Schedule	Equipment Type	Total System Heat Rejection Capacity at Rated Conditions	Subcategory or Rating Conditions	Performance Required [2, 3] gpm/hp		Btu/h-hp
A	Propeller or Axial Fan Cooling Towers	All	95°F Entering Water 85°F Leaving Water 75°F wb Outdoor Air	>38.2		
B	Centrifugal Fan Cooling Towers	All	95°F Entering Water 85°F Leaving Water 75°F wb Outdoor Air	>20.0		
C	Air Cooled Condensers	All	125°F Condenser Temp. R-22 Test Fluid 190°F Entering Gas Temperature 15°F Subcooling 95°F Entering db			>176,000

[2] For purposes of this table, cooling tower performance is defined as maximum flow rating of tower divided by the fan nameplate rated motor horsepower

[3] For purposes of this table, air-cooled condenser performance is defined as heat rejected from refrigerant divided by the fan nameplate rated motor horsepower

Worksheet 4i Project Name: Page:

BOILER - GAS-FIRED & OIL-FIRED

Equipment

Discussion of equipment ratings and equipment definitions on page 4-19.

(a) Equip. ID	(b) Model Designation	(c) Heating Capacity (Btu/hr)	(d) Proposed Minimum AFUE (%)	(e) Proposed Minimum E_c or E_T (%)	(f) Compliance Schedule (A-D)

Required Documentation

Indicate source of information

❑ GAMA Consumer Directory, page(s):

❑ Product data (Attach data furnished by the equipment supplier, I.e., "cut sheets").

Code Required Efficiencies

This schedule of equipment efficiencies was reformatted from code, Table 13-Q.

Compliance Schedule	Equipment Type	Heating Capacity (Btu/hr) Over	But not over	Minimum Efficiency
A	Gas Fired Hot Water	0	300,000	80% AFUE
		300,000	2,500,000	75% E_t
		2,500,000	-	80% Ec
B	Gas Fired Steam	0	300,000	75% AFUE
		300,000	2,500,000	75% E_t
		2,500,000	-	80% E_c
C	Oil Fired Hot Water, Steam	0	300,000	80% AFUE
		300,000	2,500,000	78% E_t
		2,500,000	-	83% Ec
D	All Oil Fired Residual Hot Water Steam	300,000	2,500,000	78% E_t
		2,500,000	-	83% E_c
		2,500,000	-	83% E_c

Worksheet 4j Project Name: Page:

FURNACE & UNIT HEATERS - GAS & OIL-FIRED

Equipment

Discussion of equipment ratings and equipment definitions on page 4-19.

(a) Equip. ID	(b) Model Designation	(c) Heating Capacity (Btu/hr)	(d) Proposed Minimum E_C (%)	(d) Proposed Minimum E_T (%)	(d) Proposed Minimum AFUE (%)	(e) Compliance Schedule (A-E)

Required Documentation

Indicate source of information

❑ GAMA Consumer Directory, page(s):

❑ Product data (Attach data furnished by the equipment supplier, I.e., "cut sheets").

Code Required Efficiencies

This schedule of equipment efficiencies was reformatted from code, Table 13-P.

Compliance Schedule	Equipment Type	Capacity (Btu/hr) Over	But not over	Minimum Efficiency
A	Gas Fired Warm-Air Furnaces & Combustion Furnace/AC	0	225,000	78% AFUE or 80% E_t
		225,000	-	80% E_c
B	Oil-Fired Warm-Air Furnaces & Combustion Furnace/AC	0	225,000	78% AFUE or 80% E_t
		225,000	-	81% E_t
C	Gas Fired Duct Furnaces	ALL		80% E_c
D	Gas Fired Unit Heaters	ALL		80% E_c
E	Oil-Fired Unit Heaters	ALL		80% E_c

Simultaneous Heating and Cooling

than there are lines in this form. If needed use Add New Worksheet button
at bottom

Complete this form for all terminal units with reheat to verify compliance with Section 1318.2.1 exception 1.

Terminal Unit (Variable Air Volume (VAV) Box) CFM Design Conditions								
Required Information					Comply			
Terminal Unit ID or Description/Location	Sq. ft Area Served	Max. Cooling Airflow-CFM	Max. Heating Airflow-CFM	Occupancy Ventilation-CFM	Ht CFM < or = to 30% of Max	Ht. CFM < or = to 0.4 CFM per sq. ft	Ht. CFM < or = to Occupancy Ventilation	Maximum Airflow is < or = to 300 CFM

Worksheet 4l - Project Name: Page:

AIR TRANSPORT ENERGY

Complete one worksheet for each fan system > 7.5 horsepower. Fan system horsepower is the sum of motor brake horsepower of all supply, return, and exhaust fans (including series fan-powered terminal units) that operate during design conditions.

Fan System ID: **Areas Served:**

❑ **System serves hospital or laboratory and include flow control device for maintaining precise pressure control.**

Fan Identifier (Tag)	Fan Type (Supply, Return, Exhaust, Series VAV)	CFM	Constant Volume or VAV	Motor Brake HP	Nameplate Motor HP	Maximum Nameplate Motor HP Allowed

The Plans/Specs show brake hp, nameplate hp, and CFM in the following locations:

Total System Supply Fan CFM	Constant Volume, VAV, or Hospital/Lab	Total System Brake HP	Total System Max Brake HP Allowed	Brake HP Complies	Nameplate HP Complies

Additional Pressure Drop Credit (all systems). Complete the section below if system contains filtration with a pressure drop at design flow in excess of 1" w.c. (when filters are clean), heat recovery, or direct evaporative humidifier/cooler.

Additional Pressure Drop Credit for Hospitals and Laboratories. Complete the section below if system serves a hospital or laboratory and contains rully ducted return/exhaust, return/exhaust air flow control devices, or individual filter system efficiencie

	Additional Pressure Drop Credits	Pressure Drop, Inches, W.C.
All Systems	☐ Filtration Pressure Drop >1" w.c.	
	☐ Heat Recovery	
	☐ Direct Evaporative Humidifier/Cooler	
Hospital and Laboratory Systems Only	☐ Fully Ducted Return/Exhaust (0.5" credit)	
	☐ Return/Exhaust Flow Control Device (0.5" credit)	
	☐ Individual Filter Efficiency > or = 85% (0.5" credit)	
Total Additional Pressure Drop Credit:		

❑ Manufacturer's product data sheet(s) is attached and design values are shown in plans/specs in the following locations

Supply CFM	Constant Volume or VAV (Use VAV for Hospital or Lab Systems)	Total Additional Pressure Drop	Adjusted Max Allowed Brake HP	Total Brake HP (from above)	Adjusted Brake HP Complies

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Worksheet 4m | Project Name: | | Page: |

NATURAL VENTILATION

1. Fill in worksheet for all spaces that will be provided with natural ventilation.

(a) Space (Room # or name from plans)	(b) Room Area (sqft)	(C) Estimated Max Occupant Load from OMSC Table 403.3 (persons/1000sqft.	(d) Check if Smoking Area	(e) Actual Max Load used to determine ventilation requirements (persons/1000sqft.	(f) Required CFM/person (from Table 403.3)	(g) Required CFM/Sqft (from Table 403.3)[1]	(h) Required Ventilation CFM	(I) Net Free Area of Outside Air Openings	(j) Opening Area / Floor Area	(k) Calculated Natural Ventilation to Space (design conditions)2
			❑							
			❑							
			❑							
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			❑							
			❑							

1 Use this column when ventilation requirement is based on CFM/sq ft per OMSC Table 4.3.3.
2 Complete this column if net free opening is less than 5% of floor area or 20% of floor area for smoking areas, otherwise enter N/A. Attach calculations.

Number of Additional Worksheets 4m:

2. Describe calculation method used to determine ventilation delivered. Attach additional sheets as necessary

3. Attach manual calculations, spreadsheets, computer model input and outputs, and other technical documentation that verifies required ventilation will be provided to each space.

4. I certify that to the best of my knowledge, the natural ventilation calculations provided are correct.

This line to be signed and stamped by Architect or Engineer Registered in the State of Oregon.

Worksheet 4m-2 Project Name: Page:

NATURAL VENTILATION

1. Fill in worksheet for all spaces that will be provided with natural ventilation.

(a) Space (Room # or name from plans)	(b) Room Area (sqft)	(C) Estimated Max Occupant Load from OMSC Table 403.3 (persons/1000sqft.	(d) Check if Smoking Area	(e) Actual Max Load used to determine ventilation requirements (sqft/person)	(f) Required CFM/person (from Table 403.3)	(g) Required CFM/Sqft (from Table 403.3)[1]	(h) Required Ventilation CFM	(I) Net Free Area of Outside Air Openings	(j) Opening Area / Floor Area	(k) Calculated Natural Ventilation to Space (design conditions)[2]
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1 Use this column when ventilation requirement is based on CFM/sq ft per OMSC Table 4.3.3.
2. Complete this column if net free opening is less than 5% of floor area or 20% of floor area for smoking areas, otherwise enter N/A. Attach calculations.

SYSTEMS – GENERAL

General

There are several areas in the forms where the user is asked to identify the location on plans or specifications where a requirement is called out. Usually the statement "The plans/specs show compliance in the following locations:" will be followed by a blank space. For instance Line 5 asks the user to identify compliance details for transformer requirements. The user should input what drawing number and detail or specification section and paragraph shows the relevant transformer requirements. This is meant to enable the plan reviewer to easily verify compliance.

Example

1. Applicablity (Section 1317)

Is this form required?

☑ **Form Required.** Complete form if a new HVAC system is being installed, or components of an existing HVAC system are being replaced (I.e., equipment, controls, ductwork, and insulation.)

❑ **Exception.** The building or part of the building qualifies for an exception from HVAC code requirements. Applicable code exception is Section 1317.1. Portions of the building that qualify:

Area: _____ Exception ❑ -1 ❑ -2 ❑ -3

Area: _____ Exception ❑ -1 ❑ -2 ❑ -3

Area: _____ Exception ❑ -1 ❑ -2 ❑ -3

❑ **Form Not Required.** This project does not contain work required to comply with code.

Line 1. Applicability

Check the **Form Required** box if a new HVAC system is being installed, or components of an existing HVAC system is being replaced (i.e., equipment, controls ductwork, and insulation.)

Exceptions – Section 1317 has three exceptions to HVAC code requirements:

Exception 1, Systems for the removal of flammable vapors or residues;

Exception 2, Systems for conveying dust, stock or refuse by means of air currents;

Exception 3, Systems for manufacturing and industrial processes.

If any of the HVAC systems in your project qualifies for any of these exceptions, check appropriate box and identify which systems and portions of the building qualify for the exception. Check the **Form Not Required** if no new HVAC system is being installed, and components of an existing HVAC system are not being replaced or exception applies to entire project.

Example

2. Simple or Complex Systems (Section 1317.9 or 1317.10)

❑ **Simple System**. Building contains only Simple HVAC System(s). Complete this form (4a) and equipment efficiency worksheets as required. Form 4b is not required.

☑ **Complex System**. Project includes a Complex System. Complete this form (4a), form 4b and equipment efficiency worksheets as required.

Line 2. Simple or Complex System

Simple System. The following systems qualify as Simple Systems:

1) air cooled, constant volume packaged unitary equipment, packaged terminal air conditioners and packaged terminal heat pumps that provide heating, cooling, or both and that require only external connection to ductwork and energy services;

2) air cooled, constant volume split systems that provide heating, cooling, or both with cooling capacity of 54,000 Btu/hr or less

3) ground-coupled heat pumps with cooling capacity of 54,000 Btu/hr or less;

4) heating only systems with 5,000 cfm maximum airflow or minimum outside air supply of less than 70 percent of total air circulated.

SYSTEMS – GENERAL

* Note: While a VVT (variable air volume and variable temperature) system has a constant volume fan, they are variable air volume and not categorized as a Simple System.

Complex System. All systems that do not qualify as Simple Systems are considered Complex Systems. Projects containing Complex Systems must complete Form B in addition to Form A.

Simple/ Complex System (cont.)

Example

3. Equipment Performance (Section 1317.5)

☐ **No New HVAC Equipment.** The building plans do not call for new electrical HVAC equipment, combustion heating equipment, or heat-operated cooling equipment.

☑ **Complies**. All new HVAC equipment have efficiencies not less than those required by code. The following equipment efficiency worksheets are attached:

☑ -4a ☐ -4b ☐ -4c ☐ -4d ☐ -4e ☐ -4f ☐ -4g ☐ -4h ☐ -4i ☑ -4j

Line 3. Equipment Performance

Use worksheets 4a through 4j to list all equipment that will be installed. Code-compliant equipment efficiency values are provided on the worksheets. Include the worksheets that pertain to your building. The national rating organization listed on the form, such as the Air-conditioning and Refrigeration Institute (ARI) or the Gas Appliance Manufacturers Association (GAMA) must certify the efficiencies claimed.

Attach a copy of manufacturer's catalog sheet, which contains the pertinent required performance information for each piece of equipment.

Leave this section blank if new HVAC equipment is not installed.

Equipment Efficiency

Heating and cooling equipment shall have a minimum efficiency at a specified rating condition not less than values shown in tables located on the bottom of each worksheet, which are derived from Tables 13-G, 13-H, 13-I, or 13-J of the Oregon Structural Specialty Code.

Electric thermal resistance heating is assumed to operate at 100 percent thermal efficiency. Room air conditioners are portable units and are not normally shown on drawings. Therefore, tables and worksheets do not list electric resistance air heaters or room air conditioners.

Data furnished by the equipment supplier or certified under a nationally recognized certification program or rating procedure satisfy these requirements.

Equipment Definitions

Equipment Definitions

CONDENSING UNITS. A commercial and industrial air-conditioning condensing unit is a factory-made assembly of refrigeration components designed to compress and liquefy a specific refrigerant. It consists of one or more refrigerant compressors, refrigerant condensers (cooling coil), condenser fans and motors (where used) and factory-supplied accessories.

GROUND-WATER-SOURCE HEAT PUMP. A water source heat pump that exchanges heat to and from a loop thermally connected to ground temperature (several feet below grade).

HEAT-OPERATED COOLING EQUIPMENT Heat-operated cooling equipment refers to a chiller that consists of absorption, engine-driven and turbine-driven equipment.

PACKAGED TERMINAL AIR-CONDITIONER. An air-conditioner that installs in a wall sleeve and a separate unencased combination of heating and cooling assemblies specified by the builder and intended for mounting through the wall. It includes a prime source of refrigeration, separable outdoor louvers, forced ventilation, and heating availability by builder's choice of hot water, steam or electric resistance heat.

PACKAGED TERMINAL HEAT PUMP. A heat pump installed in a cabinet of similar function and configuration to that of a packaged terminal air-conditioner. It uses reverse-cycle refrigeration as its primary heat source and should have a supplementary heat source: hot water, steam or electric resistance heat.

Equipment Definitions (cont.)

SPLIT SYSTEM. Where such equipment is provided in more than one assembly, the separate assemblies are to be designed to be used together. The ratings are based on the use of matched assemblies.

UNITARY AIR CONDITIONER. A unitary air conditioner consists of one or more factory-made assemblies that normally include an evaporator (cooling coil), a compressor and condenser combination, and may include a heating function.

UNITARY HEAT PUMP. A unitary heat pump consists of one or more factory-made assemblies that normally include an indoor coil (heating coil), compressor and outdoor coil. It may provide a cooling function.

WATER-SOURCE HEAT PUMP. A heat pump consists of one or more factory-made assemblies that normally include an indoor conditioning coil, compressor and a refrigerant-to-water heat exchanger. It provides both heating and cooling.

ARI

The Air-conditioning and Refrigeration Institute (ARI) provides a complete product listing of capacity and efficiency ratings for certain heating and cooling equipment.

To get a copy of the ARI product directory, write to ARI, 1501 Wilson Boulevard, 6th Floor, Arlington, VA 22209, or visit ARI's Web site: *www.ari.org.*

GAMA

The Gas Appliance Manufacturers Association (GAMA) provides complete product listings of capacity and efficiency ratings for oil- and gas-fired residential heating equipment up to 135,000 Btu/hr capacity.

To get a copy of the GAMA consumers' directory, write to GAMA Efficiency Certification Program, ETL Testing Laboratories, Inc., Industrial Park, Route 11, Cortland, NY 13045, or visit GAMA's Web site: *www.gamanet.org*

Example

4. Duct Insulation and Sealing (Sections 1317.7 & 1317.8)

❑ **No Ducts.** The building plans and specifications do not call for new HVAC ducts or plenums.

☑ **Complies**. The plans and specifications call for all air-handling ducts and plenums to be insulated and sealed as required by Sections 1317.7 &1317.8.

Line 4. Duct Insulation and Sealing

Check the **No Ducts** box if project does not call for new HVAC ducts or plenums.

Insulation – Complies: All air–handling ducts and plenums installed as part of an HVAC air distribution system shall be thermally insulated according to Table 13-S based on ductwork type and location. This does not include factory-installed plenums, casings or ductwork furnished as a part of HVAC equipment. For ducts that convey both heated and cooled air, duct insulation shall be the highest R-value specified in Table 13-S. Insulation for ducts located outside of the insulated building envelope shall be covered by a vapor barrier having a perm rating not exceeding 0.5 perm.

Where a plenum incorporates an exterior wall, ceiling, or floor of a building, those elements shall be insulated either as required for that building envelope component or Table 13-S, whichever have the highest specified R-value.

Insulation is not required on heating, cooling, return air ducts or plenums that are contained within fully conditioned spaces. Ducts conveying outside air, which are within fully conditioned spaces shall be insulated to a minimum R-value of 3.5 .

Sealing – Complies: All joints, longitudinal and transverse seams, and connections in ductwork, shall be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or approved quality tapes (UL 181A-98 and UL181B-98). Cloth backed, rubber adhesive tape does not comply.

SYSTEMS – GENERAL

Example

5. Distribution Transformers (Section 1316.1)

☐ **No Distribution Transformers.** The plans/specs do not call for new distribution transformers.

☑ **Complies**. All new distribution transformers comply with efficiency, testing, and labeling requirements of Section 1316.1.1.

☐ **Exception.** The project qualifies for an exception per Section 1316.1.1, Exceptiion:

☐-1 ☐-2 ☐-3 ☐-4 ☐-5 ☐-6 ☐-7 ☐-8 ☐-9 ☐-10 ☐-11 ☐-12 ☐-13 ☐-14

Attach relevant documentation for appropriate exception. The plans/specs show compliance in the following locations:

Line 5. Distribution Transformers

Complies. All new distribution transformers comply with efficiency, testing, and labeling requirements of minimum efficiency levels specified in Table 13-J and Table 13-K and the testing and labeling requirements of Sections 1316.1.2 and 1316.1.3.

Exceptions. Section 1316.1.1 contain 14 exceptions under which the transformer efficiency requirements do not apply:

1. Liquid-filled transformers below 10 kVA.
2. Dry-type transformers below 15 kVA.
3. Drive transformers designed only to operate electronic variable speed AC and DC drives.
4. Rectifier transformers designed only to power rectifier circuits that have nameplate ratings for fundamental frequency and RMS.
5. High harmonic transformers with a K-rating of K-4 or greater that are designed to supply loads with higher than normal harmonic current levels. A licensed engineer shall submit verification of need for harmonic current control.
6. Autotransformers in which the primary and secondary windings are not electrically isolated, and in which secondary voltage is derived from at least a portion of the primary winding as specified by a licensed engineer.
7. Non-distribution transformers, such as those designed as an integral part of an uninterruptible power system (UPS).
8. Transformers with special impedance outside the following ranges: 1.5% to 7.0% for 15 kVA – 150 kVA units, 3.0% to 8.0% for 167 kVA - 500 kVA units, and 5.0% to 8.0% for 667 kVA –2500 kVA units.
9. Voltage regulating transformers with load tap changing gear.
10. Sealed transformers that are designed to remain hermetically sealed and non-ventilated transformers designed to prevent airflow through the transformer.
11. Replacement of an existing transformer where a qualified TP-1 transformer will not fit in the space provided.
12. Transformers feeding circuits dedicated to machine tools and/or welders.
13. Transformers with tap ranges greater than 15% or with frequencies other than 50 to 60 Hz.
14. Grounding transformers that only provide a system ground reference point, or testing transformers that are part of, or supply power to, electrical test equipment.

Example

6.1 System Thermostat/Zone Controls (Section 1317.4.1)

☑ **Complies**. All new HVAC systems include at least one temperature control device responding to temperatures within the zones.

☐ **Exception.** HVAC system qualifies for an exception from zone control requirements.

The applicable code exception is Section 1317.4.2, Exception ☐-1 ☐-2

Portions of the building that qualify:

The plans/specs show compliance in the following locations:

Sheet M2.1 and Section 15500, 2.3, A

Line 6.1 System Thermostatic/Zone Controls

Complies. The code requires each new HVAC zone to be controlled by individual thermostatic controls responding to temperature within each zone.

Exceptions. Independent perimeter systems that offset only envelope heat losses or gains, or both, may serve one or more zones also served by an interior system with the following limitations:

Exception 1, The perimeter system shall include at least one thermostatic control zone for each building exposure having exterior walls facing only one orientation for 50 contiguous feet or more; or

Exception 1, The perimeter system heating and cooling supply shall be controlled by thermostat(s) located within the zone(s) served by the system.

If your project qualifies for any of these exceptions, check appropriate box and identify which portions of the building qualify for the exception.

Identify the location in the plans and *specific location within* specifications where the zone and system controls are specified. For example – Sheet M2.1 and Section 15500, 2.3, A, simply inserting Section 15500 is not acceptable. Leave this section blank if new System or Zone Controls are not installed.

Example

6.2 Off-hour Controls - Auto Setback or Shutdown (Section 1317.4.3)

☑ **Complies.** Systems must have **at least one** of the following features:

☑ **Control Setback Complies.** Each system is equipped with automatic control capable of reducing energy through control setback during periods of non-use or alternate use of spaces served.

❑ **Equipment Shutdown Complies.** Each system is equipped with controls capable of reducing energy use through automatic shutdown during periods of non-use or alternate use of spaces.

- ❑ HVAC systems with equipment shutdown are equipped with at least one of the following:
- ❑ Programmable controls (1317.4.3.1 (1))
- ❑ Occupant sensor (1317.4.3.1 (2))
- ❑ Interlocked to a security system (1317.4.3.1 (3))
- ❑ Manually activated timers with 2-hour operation max (1317.4.3.1 (4))

❑ **Exception.** The building qualifies for an exception to the requirement for automatic setback or shutdown controls. The applicable code exception is Section 1317.4.3 Exception ❑ -1 ❑ -2

The plans/specs show compliance in the following locations:

Sheet M2.1 and Section 15500, 2.3, B

Line 6.2 Off-hour Controls – Automatic Setback or Shutdown

Complies. The Code requires new HVAC systems to be equipped with automatic controls capable of accomplishing a reduction of energy use through control setback or equipment shutdown during periods of nonuse or alternate use of the spaces served by the system.

To provide **automatic shutdown**, the HVAC system shall be equipped with at least one of the following:

(a) Controls that can start and stop the system under different time schedules for seven different day-types per week, are capable of retaining programming and time setting during loss of power for a period of at least 10 hours, and that include an accessible manual override, or equivalent function, that allows temporary operation of the system for up to two hours.

(b) An occupant sensor that is capable of shutting the system off when no occupant is sensed for a period of up to 30 minutes.

(c) An interlock to a security system that shuts the system off when the security system is activated.

Automatic shutdown is not required for systems controlled only by manually activated timers with a maximum of two-hour operation.

SYSTEMS – GENERAL

Exceptions. The code has two exceptions to the requirement for automatic control setback or equipment shutdown:

Exception 1, Equipment with full load demand of 2 kW (6,826 Btu/hr.) or less may be controlled by readily accessible manual off-hour controls.

Exception 2, Systems intended to operate continuously.

If your project qualifies for any of these exceptions, check appropriate box and identify which portions of the building qualify for the exception.

Identify the location in the plans and *specific location within* specifications where the off-hour controls or specific sequence of operations are specified. For example – Sheet M2.1 and Section 15500, 2.3, A, simply inserting Section 15500 is not acceptable.

Leave this section blank if new System or Zone Controls are not installed.

Example

6.3 Control Capabilities (Sec. 1317.4.2.1)

☑ **Complies.** Zone thermostats are capable of being set to the temperatures described in Sec. 1317.4.2.1. Where used to control both heating and cooling, zone controls shall be capable of providing a temperature range or deadband of at least 5 degrees F within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum.

❑ **Exception.** The building qualifies for an exception to the deadband requirements.
The applicable code exception is Section 1317.4.2.1 Exception ❑ -1 ❑ -2

Portions of the building that qualify:

The plans/specs show compliance in the following locations:

Sheet M2.1 and Section 15500, 2.3, C

Line 6.3 Control Capabilities

Complies. The Code requires each new HVAC zone to be equipped with a thermostatic control capable of being set locally or remotely down to 55ºF (13ºC) for heating. Where used to control comfort cooling, it must be capable of being set locally or remotely up to 85ºF (29ºC). Where used to control both comfort heating and cooling, zone thermostatic controls shall be capable of providing a temperature range or dead band of at least 5ºF (3ºC).

Exceptions. The code has two exceptions to the thermostat deadband requirements:

Exception 1, Special occupancy, special usage, or code requirements where deadband controls are not appropriate (such as process applications and areas of hospitals normally used by patients).

Exception 1, Thermostats that require manual changeover between heating and cooling modes.

If your project qualifies for any of these exceptions, check appropriate box and identify which portions of the building qualify for the exception.

Identify the location in the plans and *specific location within* specifications where the control capabilities are specified. For example – Sheet M2.1 and Section 15500, 2.3, A, simply inserting Section 15500 is not acceptable.

Leave this section blank if new System or Zone Controls are not installed.

6.4 Optimum Start Controls (Section 1317.4.3.2)

☑ **Complies.** Separate HVAC systems have controls capable of varying start-up time of system to just meet temperature set point at time of occupancy.

❑ **Exception.** HVAC systems have a design supply air capacity not exceeding 10,000 cfm.
The plans/specs show compliance in the following locations:

Sheet M2.1 and Section 15500, 2.3, D

Line 6.4 Optimum Start Controls

Complies. Separate HVAC systems, with a design supply air capacity exceeding 10,000 cfm, have controls that are capable of varying start-up time of system to just meet temperature set point at time of occupancy.

Exception. Check the exception box if HVAC systems have a design supply air capacity not exceeding 10,000 cfm.

Identify the location in the plans and *specific location within* specifications where the optimum start controls or specific sequence of operations are specified. For example – Sheet M2.1 and Section 15500, 2.3, A, simply inserting Section 15500 is not acceptable.

Leave this section blank if new Off-hour Controls are not installed.

6.5 Heat Pump Controls (Section 1317.4.4)

☑ **No Heat Pump.** The plans/specs do not call for a new heat pump

☐ **Complies**. All new heat pumps equipped with supplementary heaters are controlled to minimize the use of supplemental heat as defined in Section 1317.4.4.

The plans/specs show compliance in the following locations:

Line 6.5 Heat Pump Controls

Complies. Heat pumps equipped with supplementary heaters must be installed with controls to prevent heater operation when the heating load can be met by the heat pump alone. Controls shall include microprocessor controls that minimize supplemental heat usage during start-up, set-up and defrost conditions. These controls shall anticipate need for heat and use compression heating as the first stage of heat. Controls shall indicate when supplemental heating is being used through visual means (e.g., LED indicators). A two-stage room thermostat that controls the supplementary heat in its second stage meets this requirement.

Supplementary heating is allowed during periods of less than 15 minutes for start-ups and defrost cycles.

Identify the location in the plans and *specific location within* specifications where the heat pump supplemental heat controls or specific sequence of operations are specified. For example – Sheet M2.1 and Section 73500, 2.3, A, simply inserting Section 73500 is not acceptable.

Leave this section blank if a new Heat Pump or Heat Pump Controls are not installed.

7. Economizer Cooling (Section 1317.3)

☐ **No Cooling.** The building plans do not call for a new fan system with mechanical cooling.

☑ **Complies**. Each new fan system has an air economizer capable of modulating outside-air and return-air dampers to provide up to 100 percent of the design supply air as outside air.

☐ **Exception** At least one new fan system qualifies for an exception. The applicable code exception is Section 1317.3, Exception ☐ -1 ☐ -2 ☐ -3 ☐ -4 ☐ -5 ☐ -6

If Exception 3 is selected complete the following:

(a) Total cooling capacity of exempt units (Btu/hr)

(b) Total installed building cooling capacity (Btu/hr)

☐ **Complies.** Sum of exempt units rated at less than 54,000 Btu/hr is <240,000 or a/b < 0.10 (10% of total building cooling capacity).

Unit Identifier of exempt units:

The plans/specs show compliance in the following locations:

Sheet M2.1 and Section 73500, 2.3, A

SYSTEMS – GENERAL

Line 7. Economizer Cooling

. Check the **No Cooling** box if project does not call for a mechanical cooling.

. **Complies.** Section 1317.3 of the code requires that each fan system with mechanical cooling has an outside air economizer and that the economizer be capable of providing partial cooling even when additional mechanical cooling is required to meet the remainder of the cooling load. There are, however, a number of exceptions to this requirement.

Exceptions – The following exceptions from Section 1317.3 apply to both Simple and Complex Systems:

Exception 1, Systems at locations where the quality of the outdoor air is so poor as to require extensive treatment of the air. Supporting documentation regarding air quality inadequacies should be submitted.

Exception 2, Systems serving only residential spaces and hotel or motel guest rooms.

Exception 3, Cooling equipment with direct expansion coils rated at less than 54,000-Btu/hr. (15,827 W) total cooling capacity. It is important to note that the total capacity of all such units without economizers shall not exceed 240,000 Btu/hr per building area served by one utility meter or service, or 10% of the building's total installed cooling capacity, whichever is greater. For example a building with 300 tons (3,600,000 Btu/hr) total cooling capacity would be allowed to install a maximum of 360,000 Btu/hr (10% of building total) of equipment that meets this exception. That portion of the equipment serving dwelling units and guestrooms is not included in determining the total capacity of units without economizers allowed by this exception.

Exception 4, Systems having a water economizer system capable of cooling air by direct and/or indirect evaporation and providing 100 percent of the expected systems cooling load at outside air temperatures of 50ºF (10ºC) dry bulb and 45ºF (7ºC) wet bulb and below.

Exception 5, Ground-coupled heat pumps with cooling capacity of 54,000 Btu/hr. (15,827 W) or less.

Exception 6, Internal/external zone heat recovery is used. An example of a system that would qualify for this exception would be water source heat pumps with both interior and exterior zones served off of the same hydronic loop. This system removes heat from interior zones during cooling and transfers it to the loop where it can be used by perimeter zones in heating mode. Similarly, systems in which a heat recovery chiller is used to provide cooling for interior zones and heating for perimeter zones may also qualify.

If your project qualifies for any of these exceptions, check appropriate box and identify which portions of the building qualify for the exception.

Identify the location in the plans and *specific location within* specifications where the economizer is specified. For example – Sheet M2.1 and Section 73500, 2.3, A, simply inserting Section 15500 is not acceptable.

Example

8. Economizer Pressure Relief & Integration (Section 1317.3.1 and 1317.3.2)

❑ **No Economizers Required.** Project does not contain a new fan system requiring economizers.

❑ **Overpressurization Complies**. The drawings specifically identify a pressure relief mechanism for each fan system that will relieve the extra air introduced by the economizer.

☑ **Integration Complies**. Economizer is capable of providing partial cooling even when additional mechanical cooling is required to meet the remainder of the cooling load.

❑ **Exception.** The applicable exception is Section 1317.3.2, Exception ❑ -1 ❑ -2

The plans/specs show compliance in the following locations:

Sheet M2.1 and Section 15500, 2.3, A

Line 8. Economizer Cooling – Pressure Relief and Integration

. Check the **No Economizers Required** box if project does not call for a fan system requiring economizers.

Overpressurization Complies. A means to preventing over-pressurization of the building during air economizer operation is required. Buildings can meet this requirement several ways. Most rooftop units have built-in pressure relief. This will be indicated in the manufacturer's

Economizer Cooling (cont.)

literature. For systems without built-in pressure relief, relief dampers can be installed virtually anywhere in the building envelope.

There are no exceptions to the requirement for relief from economizer over-pressurization.

Integration Complies. The economizer must be capable of providing partial cooling even when additional mechanical cooling is required to meet remainder of cooling load.

Exceptions – The exceptions in Section 1317.3.2 apply to both Simple and Complex Systems There are four exceptions in Section 1317.3 to the requirement for integrating mechanical cooling with economizer cooling:

> Exception 1, Direct–expansion systems may include controls to reduce the quantity of outdoor air as required to prevent coil frosting, but not less than required for ventilation purposes, at the lowest step of compressor unloading.
>
> Exception 2, Individual direct–expansion units that have a cooling capacity of 15 tons (53 kW) (nominal) or less may use economizer controls that preclude economizer operation whenever mechanical cooling is required simultaneously.

If your project qualifies for any of these exceptions, check appropriate box and identify which systems and portions of the building qualify for the exception.
Identify the location in the plans and *specific location within* specifications where the economizer operation or sequence of operations is specified. For example – Sheet M2.1 and Section 15500, 2.3, A, simply inserting Section 15500 is not acceptable.

Line 9. Hot Gas Bypass

No Hot Gas Bypass: Check this box if no cooling equipment in the project utilizes hot gas bypass or there is no cooling equipment.

Complies: The use of hot gas bypass is limited. Indicate the Unit ID, Rated Cooling Capacity, and Hot Gas Bypass Capacity in the provided table within the form. The capacity of hot gas bypass shall be limited as indicated below (this table is also in the form). Cooling systems shall not use hot gas bypass or other evaporative pressure control systems unless the system is designed with multiple steps of unloading or continuous capacity modulation.

Rated Capacity	Max Hot Gas Bypass Capacity (% of total capacity)
≤240,000 Btu/hr	50%
>240,000 Btu/hr	25%

Exception: Check this box there is hot gas bypass only in unitary packaged systems with cooling capacity no greater than 90,000 Btu/hr.

Example

10. Shutoff Dampers (1317.4.3.3)

☐ **Not Required.** Shutoff dampers are not required on this project.
☑ **Complies.** Each outdoor air supply & exhaust system shall be equipped with motorized dampers.
☐ **Exception.** The building qualifies for an exception to the motorized damper requirement. The applicable code exception is Section 1317.4.3.3 Exception ☐ -1 ☐ -2 ☐ -3 ☐ -4 ☐ -5 ☐ -6

The plans/specs show compliance in the following locations:

Sheet M2.1 and Section 15500, 2.3, A

Line 10. Shutoff Dampers

Not Required. Check this box if there are no outside air supply or exhaust systems.

Complies. Check this box if outdoor air supply and exhaust systems are equipped with motorized control dampers.

Exceptions: The code has seven exceptions to the requirement for motorized dampers:

1. .Systems with a design outside air intake or exhaust capacity of 300 cfm (141.6 L/s) or less.

2. Combustion air intake.

3. Cooling equipment rated at less than 54,000 Btu/hr (15,827 W) total cooling capacity.

4. Power relief fans with gravity dampers for packaged HVAC systems under 300,000 Btu/h cooling capacity.

5. Hood vents or ventilators with gravity dampers in buildings less than three stories in height above grade.

6. Ventilation systems serving unconditioned spaces.

7. Type 1 kitchen exhaust hoods.

SYSTEMS – GENERAL

If your project qualifies for any of these exceptions, check appropriate box and identify which portions of the building qualify for the exception. Identify the location in the plans and *specific location within* specifications where the shutoff damper controls are specified. For example – Sheet M2.1 and Section 15500, 2.3, A, simply inserting Section 15500 is not acceptable.

Identify the location in the plans and *specific location within* specifications where the motorized dampers are shown.

Example

10.1. Shutoff Damper Controls (Section 1317.4.3.3.1)

☑ **Complies.** Outdoor air supply and exhaust systems shall be provided dampers that automatically shut when systems or spaces served are not in use or during building warm-up, cooldown, or setback.

☐ **Complies.** Stair and shaft vents are capable of being automatically closed during normal building operation and interlocked to open as required by fire and smoke detection systems.

The plans/specs show compliance in the following locations:

Sheet M2.1 and Section 15500, 2.3, A

Line 10.1 Shutoff Damper Controls

Complies (General): Outdoor air supply and exhaust systems dampers are controlled to automatically shut when systems or spaces served are not in use or during building warm-up, cool down, or setback.

Stair and shaft vents, and gravity hoods, vents and ventilators have controls to automatically close dampers when the building is not occupied.

Complies (Stair and shaft vents): Stair and elevator shaft vents are provided with dampers that automatically close during normal building operation and are interlocked to open as required by fire and smoke detection systems. Identify the location in the plans and *specific location within* specifications where the shutoff damper controls are called out.

Example

10.2. Motorized Damper Leakage (1317.4.3.3.2)

☐ **Complies.** Motorized outdoor air supply and exhaust air dampers have a maximum leakage rate of 4 cfm/ft2 at 1.0 in w.g. when tested in accordance with AMCA Standard 500-1998.

☑ **Exception.** Packaged HVAC equipment may have maximum leakage rate of 20 cfm/ft^2 at 1.0 in w.g. when tested in accordance with AMCA Standard 500–1998.

The plans/specs show compliance in the following locations:

Sheet M2.1 and Section 15500, 2.3, A

Line 10.2 Motorized Damper Leakage

Complies. Check this box if outdoor *air supply and exhaust air dampers* have a maximum leakage rate of 4 cfm/ft^2 at 1.0 in w.g. when tested in accordance with AMCA Standard 500 - 1998.

Exception: The code has one exception to the requirement for motorized damper leakage. Packaged HVAC equipment 20 cfm/ft2 (10 L/c per m2) at 1.0 in w.g. when tested in accordance with AMCA standard 500D 1998.

Identify the location in the plans and *specific location within* specifications where the damper leakage rate is specified. For example – Sheet M2.1 and Section 15500, 2.3, A, simply inserting Section 15500 is not acceptable.

Example

11. Piping Insulation (Section 1314)

☑ **No New Piping.** The building plans and specifications do not call for new piping serving a heating or cooling system or part of a circulating service water heating system.

❑ **Complies.** All new piping serving a heating or cooling system or part of a circulating service water heating system complies with the requirements of the Code, Section 1314.1.

❑ **Exception.** New piping qualifies for exception: Section 1314.1, Exception ❑ -1 ❑ -2

Line 11. Piping Insulation

Check the **No New Piping** box if project does not call for new piping serving a heating or cooling system, or part of a circulating service water heating system.

Complies: All new piping serving a heating or cooling system or part of a circulating service water heating system complies with the requirements of the Code, Section 1314.1. and Table 13-D.

Exceptions – Piping insulation, except when needed to prevent condensation, is not required in any of the following:

Exception 1, Factory-installed piping within HVAC equipment or

Exception 2, Piping that conveys fluids with a design operating temperature range between 55 and 105 degrees F.

If your project qualifies for any of these exceptions, check appropriate box and identify which portions of the building qualify for the exception.

Example

12. Occupancy Ventilation

☑ **Complies.** Mechanical ventilation systems provide the required amount of ventilation specified in Chapter 4 of the Oregon Mechanical Specialty Code.

❑ **Complies**. Natural ventilation systems provide required amount of ventilation as certified by a registered architect or engineer as specified by Section1203.4.1, Exception. Attach worksheet 4m.

The plans/specs show compliance in the following locations:	Sheet M2.1 and Section 15500, 2.3, A
The plans/specs show compliance on the following pages:	

Line 12, Occupancy Ventilation

Complies (Mechanical): Mechanical ventilation systems providing the required amount of ventilation specified in Chapter 4 (Section 403.3) of the Oregon Mechanical Specialty Code are provided. The anticipated ventilation occupancy load and occupancy ventilation design methods are documented on plans and specifications. *Most systems incorporate outside air distributed through a mechanical system.*

Complies (Designed Natural): A designed natural ventilation systems provides the amount of ventilation required by Chapter 4 (Section 403.3) of the Oregon Mechanical Specialty Code as demonstrated by standard calculations provided by a licensed Professional Engineer or Architect. Attach a completed Worksheet 4m along with the calculations that are signed and stamped by a Professional Engineer.

Complies (Prescriptive Natural): A natural ventilation systems meets the requirements of Chapter 12 (Section 1203.4.4.2)

Specify the location in the plans and *specific location within* specifications where the anticipated ventilation occupancy load and occupancy ventilation design methods are documented. For example – Sheet M2.1 and Section 15500, 2.3, A, simply inserting Section 15500 is not acceptable.

Leave this section blank if a new HVAC is not being installed.

SYSTEMS – GENERAL

Example

13. High Occupancy Ventilation (Section 1317.2.2)

❑ **Complies.** HVAC systems with ventilation air capacities of 1,500 CFM or greater that serve areas having an average occupant load of 20 square feet per person or less from Table 1004.1.2 have a means to automatically reduce outside air intake.

Identify applicable systems:

Plans/specs indicate where equipment (i.e. carbon dioxide sensor) and sequence is specified:

❑ **Exception.** HVAC systems are equipped with an energy recovery device with at least 50% recovery effectiveness.

☑ **No High Occupancy Systems.** Project does not contain an HVAC system as described above.

Line 13. High Occupancy Ventilation

Complies: All HVAC systems with ventilation air capacities of at least 1,500 CFM and serving areas having an ***average*** occupant load factor of 20 or less (as established in Table 10-A of the *Oregon Structural Specialty Code*) include a means to automatically reduce outside air intake below design rates when spaces are partially occupied. Large rooms served by multiple systems with a combined ventilation air capacity of 1,500 CFM and an occupant load factor of 20 or less must also meet this requirement.

It is important to note that his requirement applies to each HVAC system that has *both* "ventilation air" (not supply air) capacity of 1,500 CFM or greater AND serves area(s) that have an *average* occupancy load of 20 square feet per person or less. Both of these conditions must exist for this requirement to apply.

For example; An HVAC system with 2,000 CFM of outside air supplying mostly office space (at 100 square feet per person) yet also serving a conference room (at 15 square feet per person) would not require High Occupancy Ventilation Control – as the *average* occupant load for area served by system is greater than 20 square feet. This requirement would be applicable if an HVAC system primarily served conference rooms and a small office area – where the *average* occupant load for area served by the system is less than 20 square feet.

Identify on the in the space provided, which systems this requirement is applies to.

Specify the location in the plans and *specific location within* specifications where ventilation control and sequence of operation are specified. For example – Sheet M2.1 and Section 15500, 2.3, A, simply inserting Section 15500 is not acceptable.

No High Occupancy Systems. Check this box if no HVAC systems have at least 1,500 CFM ventilation air and serve areas having an ***average*** occupant load factor of 20 or less

Example

14. Exhaust Air Heat Recovery (Section 1318.3)

❑ **Not Regulated.** HVAC system does not have: 1) design supply air cap. of ≥10,000 cfm, **and** 2) min. outside air supply ≥70%, **and** 3) at least 1 exhaust fan rated at 75% of min outside air supply.

❑ **Complies.** Heat recovery system increases outside air temperature by 20°F (Climte Zone 1) or 30°F (Zone 2) and has provision to provide bypass during air economizer mode.

☑ **Exception.** An HVAC system qualifies for an exception to this requirement. Applicable exception from Section 1318.3 Exception ☑ -1 ❑ -2 ❑ -3 ❑ -4 ❑ -5 ❑ -6 ❑ -7

The plans/specs show compliance in the following locations: Sheet M2.1 and Section 15500, 2.3, A

Exhaust Air Heat Recovery (cont.)

Line 14. Exhaust Air Heat Recovery

If a new HVAC system does not have all of the following:

1. A design supply air capacity of 10,000 cfm (4,720 L/s) or greater,
2. A minimum outside air supply of 70 percent or greater,
3. At least one exhaust fan rated at 75 percent of the minimum outside air supply.

Check the **Not Regulated** box.

Complies: If all of the conditions specified above apply to the system, an exhaust air heat recovery device must be installed. This system must be capable of increasing the outside air supply temperature at design heating conditions by 20°F in Climate Zone 1 and 30°F in Climate Zone 2. A provision shall be made to bypass or control the heat recovery system to permit air economizer operation as required by Section 1317.3.

Exceptions. Section 1317.10.3.1 has three exceptions to the variable speed drive requirements:

Exception 1, HVAC systems with ventilation controls for high occupancy areas per Section 1317.2.2; or

Exception 2, Laboratory systems meeting Section 1317.2.1; or

Exception 3, Systems serving spaces which are not cooled and which are heated to less than 55°F; or

Exception 4, Systems exhausting toxic, flammable, paint exhaust, corrosive fumes, or dust; or

Exception 5, Type 1 kitchen exhaust hoods; or

Exception 6, Where more than 60 percent of the outdoor heating energy is provided from site-recovered or site solar energy; or

Exception 7, Systems that only provide cooling; or

Example

15. Large Volume Fan Systems (Section 1318.4.2.4)

☐ **Not Regulated.** The building plans or specifications do not call for fan systems over 15,000 CFM that serve a single zone and function for the purpose of temperature control.

☑ **Complies.** Fan systems are equipped with variable frequency drive or two speed motor to reduce airflow as required by Section 1318.4.2.3.
The plans/specs show compliance in the following locations: Sheet M2.1 and Section 15500, 2.3, A

Line 15. Large Volume Fan Systems

If a new HVAC system does not call for fan systems over 15,000 CFM that serve a single zone and function for the purpose of temperature control, check the **Not Regulated** box.

Complies: A two-speed motor or variable frequency drive is required for fan systems over 15,000 CFM that serve single zone areas (including but not limited to gymnasiums, cafeterias, auditoriums, and warehouses). The two-speed motor or variable frequency drive is required to reduce airflow based on space thermostat heating and cooling demand, to a maximum 60% of peak airflow or minimum ventilation air requirement as required by Chapter 4 of the Oregon Mechanical Specialty Code, which ever is greater.

Systems where the function of the supply air is for purposes other than temperature control, such as maintaining specific humidity levels or supplying an exhaust system, are not required to comply with Section 1318.4.3.

Specify the location in the plans and *specific location within* specifications where all control, drives, and sequence of operation is specified. For example – Sheet M2.1 and Section 15500, 2.3, A, simply inserting Section 15500 is not acceptable.

SYSTEMS – GENERAL

Example

16. Variable Speed Drives (Section 1317.10.3.1)

☐ **Not Regulated.** The building plans or specifications do not call for fan and pump motors 10 horsepower and greater that serve variable-flow air or liquid systems.

☑ **Complies.** All fan and pump motors 10 hp and greater which serve variable-flow air or liquid systems are controlled by a variable-speed drive.

☐ **Exception.** The building qualifies for an exception to the variable-speed drive requirement.

Portions of the building that qualify: Sheet M2.1 and Section 15500, 2.3, A

Applicable code exception is Section 1317.10.3.1, Exception

The plans/specs show compliance in the following locations:

Line 16. Variable-Speed Drives

If a new HVAC system is not installed, or each HVAC system requires fan and pump motors of less than 10 horsepower, or fan and pump motors of 10 horsepower and greater serve constant flow systems, check the **Not Regulated** box.

Note that a pump serving a hydronic heating or cooling system with 2 or 3-way valves is a variable flow system and if the pump motor is 10 horsepower or greater, would require a variable speed drive. A fan serving an air distribution system with bypass dampers (such as a variable temperature variable volume system VVT) is a variable flow system and if the pump motor is 10 horsepower or greater, would also require a variable speed drive.

Complies. Fan and pump motors 10 horsepower and greater which serve variable-flow air or liquid systems shall be controlled by a variable-speed drive. This includes custom and packaged air handlers serving variable air volume fan systems, heating and cooling hydronic pumping systems with modulating control valves, and cooling tower fans. Variable inlet vanes, throttling valves (dampers), scroll dampers or bypass circuits shall not be allowed.

Exceptions. Section 1317.10.3.1 has three exceptions to the variable speed drive requirements:

Exception 1, Axial vane fans with variable pitch control; or

Exception 2, Dedicated equipment circulation pumps designed to meet minimum flow requirements established by manufacturer, such as boiler or chiller auxiliary circulation pumps; or

Exception 3, Cooling towers designed with two motors (main and small auxiliary motor) or multi-speed motors.

If your project qualifies for any of these exceptions, check appropriate box and identify which portions of the building qualify for the exception.

Specify the location in the plans and *specific location within* specifications where all applicable nameplate motor horsepower is specified. For example – Sheet M2.1 and Section 73500, 2.3, A, simply inserting Section 73500 is not acceptable.

Example

17. Service Water Heating (Sec. 1315)

☑ **No New Water Heating.** The building plans and specifications do not call for new water heaters, hot water storage tanks or service hot water distribution systems.

☐ **Complies.** All new water heaters, hot water storage tanks or service hot water distribution systems comply with the requirements of the Section 1315.

☐ **Exception.** The applicable code exception is Section: Exception:

Portions of the building that qualify:

The plans/specs show compliance in the following locations:

Line 17. Service Water Heating

Check the **No New Water Heating** box if project does not call for new water heaters, hot water storage tanks or service hot water distribution systems.

Complies: Check the Complies box if water heaters, hot water storage tanks or service hot water distribution systems meet the requirements of Section 1315 (reproduced below.)

Exception: There are several exceptions in this section. If one of the exceptions applies to the project, check the exception box, indicate which exception applies and identify the portion of the building or system that the exception applies to.

1315.1 Requirements. All water heaters and hot water storage tanks shall meet the efficiency criteria of Table 13-I. Where multiple criteria are listed in the table; all criteria shall be met.

> **Exception:** Storage water heaters and hot water storage tanks having more than 140 gallons of storage capacity need not meet the standby loss (SL) or heat loss (HL) requirements of Table 13-I if the tank surface area is thermally insulated to R-12.5 and if a standing pilot light is not used.

If your project qualifies for any of these exceptions, check appropriate box and identify which portions of the building qualify for the exception.

Integrated Systems. Service water heating equipment used to provide additional functions (e.g., space heating) as part of a combination (integrated) system shall comply with minimum performance requirements for water heating equipment. (See also Section 1318.4.1.)

1315.3 Non-circulating Systems. The first 8 feet of outlet piping from the hot water storage tank, and the piping between the storage tank and a heat trap, shall be insulated as specified in Table 13-D.

Storage water heaters for non-circulating systems which are not equipped with integral heat traps and which have vertical pipe risers shall be installed with insulated heat traps as close as possible to both the inlet and outlet connections.

Systems without a heat trap to prevent circulation due to natural convection shall be considered circulating systems.

1315.4.1 Pump Operation. Circulating service hot water systems shall be equipped with automatic time switches or other controls that can be set to turn off the system when use of hot water is not required.

Exceptions:

> Exception 1, Where public health standards require 24 hours per day operation of pumps for uses such as swimming pools, spas, and hospitals.
>
> Exception 2, Pumps required to operate solar or waste-heat-recovery pool heating systems.

1315.4.2 Electric Heat Tapes. Electric heat tapes installed to maintain water temperatures in pipes shall have automatic time switches or other controls that can be set to turn off the electricity to the heat tapes when use of hot water is not required.

> **Exception:** Heat tapes installed for freeze protection.

1315.6 Alterations. The requirements of this Section apply to new water heaters, hot water storage tanks, service hot water distribution systems, swimming pools, and spas installed in existing buildings.

If your system meets the terms of any exception, supply the appropriate code section and exception number. Specify those portions of your building that qualify.

Example

18. Swimming Pools, Spas and Hot Tubs (Section 1315.5)

- ☑ **No New Pools.** The building plans and specifications do not call for new, swimming pools, spas or hot tubs.
- ☐ **On/Off Controls Complies.** Spa and hot tub heaters are equipped with a readily accessible ON/OFF switch as required by Section 1315.5.1.
- ☐ **Ventilation Controls Complies.** Pool ventilation system is controlled based on humidity.
- ☐ **Cover Complies.** All heated pools, hot tubs and spas are equipped with a cover.
- ☐ **Heat Recovery Complies.** Pools, Spas, and hot tubs, over 200 ft^2 utilize recovered heat as required by Section 1315.5.3.
  - ☐ **Exception.** Heat recovery is not necessary as pool is heated by renewable energy or waste heat recovery sources capable of providing at least 70 percent of the heating energy required over an operating season.

SYSTEMS – GENERAL

Line 18. Swimming Pools

If there is now new swimming pool, spa or hot tub within the building, check the **No New Pools** box.

Check the **On/Off Complies** box when all Spas and Hot Tubs heaters are equipped with a readily accessible ON/OFF switch as required by Section 1315.5.1.

Check the **Ventilation Controls Complies** box when pool ventilation systems are controlled based on humidity.

Check the **Cover Complies** box when all heated Pools, Spas and Hot Tubs are equipped with a cover.

Check the **Heat Recovery Complies** box when all heated Pools, Spas and Hot Tubs greater than 200 $ft^2$are utilize a heat recovery system that meets on of the following requirements:

1. The ventilating system shall provide a heat recovery of 70 percent at winter design conditions;
2. Heat recovered through dehumidification shall be used to heat pool, spa or hot tub room supply air.

Check the **Exception** box if the pools, spa or hot tub is heated by renewable energy or waste heat recovery sources capable of providing at least 70 percent of the heating energy required over an operating season.

Example

19. Fume Hoods (Section 1317.2.1.)

☑ **No Fume Hoods.** The building plans do not call for fume hood systems that have a total exhaust rate greater than 15,000 cfm.

☐ **Complies**. Fume hood systems have **at least one** of the following features:

- ☐ Variable air volume hood exhaust and room supply systems capable of reducing exhaust and makeup air volume to 50% or less of design values.
- ☐ Direct makeup (auxiliary) air supply equal to at least 75% of the exhaust rate, heated no warmer than 2° F below room set point, cooled no cooler than 3° F above room set point, no humidification added, and no simultaneous heating and cooling used for de
- ☐ Heat recovery systems to precondition makeup air from fume hood exhaust in accordance with 1318.3 - Exhaust Air Energy Recovery, without using any exception.

The plans/specs show compliance in the following locations:

Line 19. Fume Hoods

If there are new fume hoods installed or the sum of the capacities of all fume hoods in the building has an exhaust rate of 15,000 CFM or less, check the **No Fume Hoods** box.

Check the **Complies** box when buildings with fume hood systems having a total exhaust rate greater than 15,000 cfm include at least one of the following features:

1. **Variable air volume hood exhaust** and room supply systems capable of reducing exhaust and makeup air volume to 50% or less of design values.
2. **Direct makeup** (auxiliary) air supply equal to at least 75% of the exhaust rate, heated no warmer than 2° F below room set point, cooled to no cooler than 3° F above room set point, no humidification added, and no simultaneous heating and cooling used for dehumidification control.
3. **Heat recovery** systems to precondition makeup air from fume hood exhaust in accordance with 1318.3 - Exhaust Air Energy Recovery, without using any exception.

If your project includes new fume hoods, select the appropriate check box and specify the location in the plans and *specific location within* specifications where fume hood compliance strategy is specified. For example – Sheet M2.1 and Section 15500, 2.3, A, simply inserting Section 15500 is not acceptable.

Example

20. Parking Garage Ventilation (Section 1317.2.3)

❑ **No Enclosed Garages.** The building plans and specifications do not call for enclosed Group S-2 parking garages with a ventilation exhaust rate greater than 30,000 CFM.

❑ **Complies**. The plans and specifications call for carbon monoxide sensing devices as required by Section 1317.2.3.

☑ **Exception.** Open parking garages.

Line 20. Parking Garage Ventilation

If there is no enclosed parking garages with a ventilation system having an exhaust rate of 30,000 CFM or less, check the **No Enclosed Garages** box.

Complies: Plans and specifications specify carbon monoxide sensing devices as required by Section 1317.2.3 (reproduced below).

> **Exception:** Open parking garages – select this box if the structure meets the requirements for a parking garage that is not enclosed.

1317.2.3 Enclosed parking garage ventilation controls. In Group S-2 parking garages, other than open parking garages, used for storing or handling automobiles operating under their own power having ventilation exhaust rates 30,000 cfm and greater shall employ automatic carbon monoxide sensing devices. These devices shall modulate the ventilation system to maintain a maximum average concentration of carbon monoxide of 50 parts per million during any eight-hour period, with a maximum concentration not greater than 200 parts per million for a period not exceeding one hour. Such system shall be designed to exhaust a minimum of 14,000 cfm (6,608 L/s) for each operating vehicle, but not less than 2.5 percent (or one vehicle) of the garage capacity. Failure of such devices shall cause the exhaust fans to operate in the on position.

Example

21. Kitchen Hoods (Section 1317.11)

☑ **Not Regulated.** The plans/specs do not call for any new kitchen hoods with exhaust capacity greater than 5,000 cfm each.

❑ **Complies**. All new kitchen hoods with a total exhaust capacity greater than 5,000 cfm have at least 50 percent of the required makeup air; (a) unheated or heated to no more than 60°F; and (b) uncooled or evaporatively cooled.

The plans/specs show compliance in the following locations:

Line 21. Kitchen Hoods

If there are new kitchen hoods installed or each kitchen hood system has an exhaust rate of 5,000 CFM or less, check the **Not Regulated** box.

Complies: Kitchen makeup air is required for each kitchen hood exhaust system with a total exhaust capacity greater than 5,000 cfm. Fifty percent of the required makeup air shall be (a) unheated or heated to no more than 60° F; and (b) uncooled or evaporatively cooled.

Specify the location in the plans and *specific location within* specifications where kitchen hood compliance strategy is specified. For example – Sheet M2.1 and Section 15500, 2.3, A, simply inserting Section 15500 is not acceptable.

SYSTEMS – GENERAL

Example

22. Outside Heating Systems (Section 1317.12)

☑ **No Outside Heating Systems.** The plans/specs do not call for new permanently installed heating systems outside the building.

❑ **Complies**. All new permanently installed outside heating systems are radiant gas fired systems controlled by an occupancy sensor or timer switch as required by Section 1317.12.

Line 22. Outside Heating Systems

If there is no new outside heating system (system that is located outside the building envelope) installed, check the **Not Regulated** box.

Complies: Permanently installed heating systems installed outside a building are required to be radiant, gas-fired systems. These heating systems are required to be controlled by an occupancy-sensing device or a timer switch, so that the system is automatically de-energized when no occupants are present.

These systems are most often located in outdoor eating areas and smoking areas of restaurants and bars. Another common location for this system may be at a loading dock.

SYSTEMS – COMPLEX HVAC SYSTEMS

Line 1. Simple or Complex System.

When a project contains a Complex System, Form 4b must be completed in addition to Form 4a. Systems that do not fit the definition of Simple Systems (see Form A, line 2), are considered Complex systems.

Example

2. Air Transport Energy (Section 1318.4.2)

- ❑ **Not Regulated.** Each HVAC system does not have total fan nameplate horsepower of 7.5 HP or greater (include sum of all supply, return, & exhaust fans operating at design conditions).
- ❑ **Brake Horsepower Complies.** The energy demand of all HVAC fan systems meets code requirements. Complete and attach Worksheet 4I.
- ❑ **Nameplate Horsepower Complies.** Selected fan motors have nameplate ratings no larger than is allowed by Section 1318.4.2.3. (Complete Worksheet 4L.)
- ❑ **Exception.** Section 1318.4.2, Exception ❑ -1 ❑ -2 ❑ -3 ❑ -4

Portions of the building that qualify:

The plans/specs show compliance in the following locations:

Line 2. Air Transport Energy

If a new HVAC system is not installed or each HVAC system has a total fan nameplate horsepower of less than 7.5 horsepower, check the **Not Regulated** box.

Brake Horsepower Complies. The energy demand of all HVAC fan systems shall be limited as specified in Sections 1318.4.2.1 and 1318.4.2.2 (of the *Oregon Structural Specialty Code*). For purposes of this requirement, energy demand of a fan system is the sum of motor brake horsepower of all fans operating at **design conditions**, including supply fans, return/exhaust fans and fan-powered terminal units.

If complies is checked, Air Transport Energy Worksheet 4L must be completed. See instructions for completions of Worksheets.

Exceptions. Section 1318.4.2 has four exceptions to the limitation on fan energy demand:

Exception 1, Systems with total fan system motor horsepower of 7.5 hp or less (total of supply and return/exhaust fans).

Exception 2, Individual exhaust fans with fan horsepower of 1 hp or less.

Exception 3, Induction/dilution exhaust fans used in hospitals and laboratories. These specialized fans used increased discharge velocity and often additional outside air to toxic exhaust air away from building air intakes.

Exception 4, Fan-powered, parallel airflow terminal units where the fan does not operate in cooling mode. (Series terminal units that operate when the main fan is running must be included.)

Also note that relief fans that operate only during economizer use to maintain building pressurization are not included since they are not operating at design conditions. There is no specific exception listed for these fans.

If your project qualifies for any of these exceptions, check appropriate box and identify which portions of the building qualify for the exception.

Specify the location in the plans and *specific location within* specifications where all applicable nameplate motor horsepower is specified. For example – Sheet M2.1 and Section 15500, 2.3, A, simply inserting Section 15500 is not acceptable.

Nameplate Horsepower Complies. Selected fan motors have nameplate ratings no larger than is allowed by Section 1318.4.2.3. (Complete Worksheet 4L).

SYSTEMS – COMPLEX HVAC SYSTEMS

Example

3. Cooling Tower Fans (Section 1317.5.4.1)

☐ **No Cooling Tower** There is no cooling tower in this project.

☑ **Complies.** Cooling tower fans have control devices that vary flow by controlling leaving fluid temperature or condenser temperature/pressure of the heat rejection device.

The plans/specs show compliance in the following locations:	Sheet M2.1 and Section 15500, 2.3, A

Line 3. Cooling Tower Fans

If a new cooling tower is not installed or new cooling tower fan or controls are not installed, check the **No Cooling Tower** box.

Complies. Cooling tower fans have control devices that vary airflow in order to control leaving fluid temperature or condenser temperature/pressure of the heat rejection device.

Specify the location in the plans and *specific location within* specifications where all applicable nameplate motor horsepower and sequence of operation is specified. For example – Sheet M2.1 and Section 15500, 2.3, A, simply inserting Section 15500 is not acceptable.

Example

4. Simultaneous Heating and Cooling (Section 1318.2.1)

☐ **No Cooling.** The building HVAC system has no cooling.

☑ **Complies**. Controls prevent reheating, recooling or mixing of mechanically heated and mechanically cooled air.

☑ **Exception.** Code exception is Section 1318.2.1, Exception ☑ -1 ☐ -2 ☐ -3 ☐ -4 ☐ -5
If exception 1 is used, complete and attach Worksheet 4k

Portions of the building that qualify:	All areas servered by VAV terminal units
The plans/specs show compliance in the following locations:	Sheet M2.1 and Section 73500, 2.3, A

Line 4. Simultaneous Heating and Cooling

If new systems do not provide cooling, check the **No Cooling** box.

Complies. The code states that zone thermostatic and humidistat controls shall be capable of sequencing the operation of heating and cooling energy to the zone. Such controls shall prevent: 1) reheating, 2) recooling, and 3) mixing or simultaneous supply of air that has been previously mechanically heated with air that has been previously mechanically cooled.

The simplest way to comply with this requirement is to use separate heating and air conditioning for each zone. Here are some single-zone systems that comply without additional controls, provided that the thermostat and humidity controls are capable of sequencing the supply of heating and cooling to the zone:

- Air handler. The supply fan is constant volume serving a single zone. The cooling and heating system uses chilled and heated water from a central plant.
- Water-source heat pump. The zone supply fan cycles on demand for heating and cooling. The cooling system consists of a cooling tower and circulating pump. The heating system is an electric or fossil fuel boiler.

For some buildings, individual units for each zone often become impractical or expensive. The most common multiple zone system is the Variable Air Volume (VAV) system.

Exceptions. Section 1318.2.1 has five exceptions to the prohibition against simultaneous heating and cooling.

Exception 1, (if exception 1 is taken, user must complete worksheet 4K, instructions below.) Variable air volume (VAV) systems which, during periods of occupancy, are designed to reduce the air supply to each zone to a minimum before reheating, recooling, or mixing takes place. This minimum volume shall be no greater than the larger of the following:

a) 30 percent of the peak supply volume

SYSTEMS – COMPLEX HVAC SYSTEMS

Simultaneous Heating & Cooling (cont.)

b) The minimum required to meet ventilation requirements of this code, unless increasing the volume to critical zones (zones with the highest ratio of outside air to total supply air) beyond the minimum ventilation requirements results in a decrease in overall outside air required by the HVAC system. An increase beyond minimum ventilation rates shall not be applied to more than 20 percent of the zones with reheat, on any one system.

The second part of the above exception was recently added to the code. This exception is provided to allow system designers to optimally solve Equation 6-1 in Standard 62-2001. These equations show that the amount of outdoor air required for a system is a function of how much air is supplied to the "critical zone" in the system. The higher the supply air rate to the critical zone, the less outdoor air is required at the air-handler. The designer would determine which is more energy efficient, increasing outdoor air intake and minimizing reheat at the critical zone, or increasing the supply air rate and reheat energy required at the critical zone and minimizing the outdoor air rate. This "upsizing" of the minimum flow may only be applied to 20% of the zones with reheat on each system. The designer should submit calculations demonstrating that increasing the volume to critical zones reduces overall outdoor air fraction.

c) 0.4 cfm/ft^2 of zone conditioned floor area

Exception 2, Zones where special pressurization relationships or cross-contamination requirements are such that variable-air volume systems are impractical, such as some areas of hospitals and laboratories. Systems which use this exception and supply heated or cooled air to multiple zones shall include controls which automatically reset supply air temperatures by representative building loads or by outside air temperature unless it can be shown that supply air temperature reset increases overall building annual energy costs.

Exception 3, At least 75 percent of the energy for reheating or for providing warm air in mixing systems is provided from a site-recovered or site-generated solar energy source.

Exception 4, Zones where specified humidity levels are required to satisfy process needs, such as computer rooms, museums and areas of hospitals. To claim this exception, these spaces must not be able to maintain required humidity levels with out reheating, recooling, or mixing beyond the amount allowed in exception 1.

Exception 5, Zones with a peak supply air quantity of 300 cfm or less.

If your project qualifies for any of these exceptions, check appropriate box and identify which portions of the building qualify for the exception.

Specify the location in the plans and *specific location within* specifications where all devices are located and sequence of operation is specified. For example – Sheet M2.1 and Section 73500, 2.3, A, simply inserting Section 73500 is not acceptable.

Example

5. Electric Motor Efficiency (Section 1317.10.3 & Table 13-T)

☑ **Not Regulated.** There are no NEMA Design A&B squirrel cage,T-frame induction, permanently wired polyphase motors of one horsepower or more which serve built up HVAC systems.

☐ **Complies**. The efficiency of all regulated motors meets code requirements.

☐ **Exception.** Section 1317.10.3, Exception ☐ -1 ☐ -2

Portions of the building that qualify:	
The plans/specs show compliance in the following locations:	

SYSTEMS – COMPLEX HVAC SYSTEMS

Line 5. Electric Motor Efficiency

If a new electric motor is not being installed, check the **Not Regulated** box.

Complies. NEMA Design A & B squirrel-cage, T-frame induction, permanently wired polyphase (generally three-phase) motors of one horse-power or more shall have a nominal full-load motor efficiency no less than the corresponding values for energy efficient motors provided in Table 13-T. Table 13-T is reproduced at the end of this chapter.

Exceptions. Section 1317.10.3 has two exceptions to the electric motor efficiency requirements:

Exception 1, Motors used in systems designed to use more than one speed of a multi-speed motor

Exception 2, Factory-installed motors for HVAC equipment meeting the equipment efficiency requirements of Section 1317.5 (packaged unitary equipment).

If your project qualifies for any of these exceptions, check appropriate box and identify which portions of the building qualify for the exception.

Specify the location in the plans and *specific location within* specifications where all applicable electric motor horsepower and efficiency is specified. For example – Sheet M2.1 and Section 15500, 2.3, A, simply inserting Section 15500 is not acceptable.

Example

6. VAV System Static Pressure Reset Controls (Section 1318.2.3)

- ☐ **Not Regulated.** The building plans or specifications do not call for a VAV system controlled by a static pressure sensor or direct digital control of individual zone boxes.
- ☑ **Complies.** The system static pressure set point automatically resets to the lowest point possible while still providing the required air flow to the zones with the greatest demand.
- ☐ **Exception.** Section 1318.2.3, Exception

The plans/specs show compliance in the following locations: Sheet M2.1 and Section 15500, 2.3, A

Line 6. Variable Air Volume System Static Pressure Reset Controls

If a new HVAC system does not call for variable air volume, check the **Not Regulated** box.

Complies: The system static pressure set point shall automatically reset to the lowest point possible while still providing the required air flow to the zones with the greatest demand. This is not required for systems that are not controlled by a static pressure sensor or systems without direct digital control of individual zone boxes.

Specify the location in the plans and *specific location within* specifications where all static pressure reset controls and sequence of operation is specified. For example – Sheet M2.1 and Section 15500, 2.3, A, simply inserting Section 15500 is not acceptable.

Example

7. VAV Terminal Units (Section 1317.4.2.1)

- ☐ **Not Regulated.** Project does not contain VAV terminal units.
- ☑ **Complies.** VAV terminal units are programmed to operate at the minimum airflow setting without addition of reheat when the zone temperature is within the set deadband. Complete Worksheet 4k.
- ☐ **Exception.** Section 1317.4.2.1, Exception ☐ -1 ☐ -2

The plans/specs show compliance in the following locations: Sheet M2.1 and Section 15500, 2.3, A

Line 7. Variable Air Volume Terminal Units

If no new HVAC systems call for variable air volume, check the **Not Regulated** box.

Complies: All VAV terminal units are programmed to operate at minimum airflow setting without addition of reheat when the zone temperature is within the set deadband per Section 1317.4.2.1.

SYSTEMS – COMPLEX HVAC SYSTEMS

Specify the location in the plans and *specific location within* specifications where all air terminal units and sequence of operation are specified. For example – Sheet M2.1 and Section 15500, 2.3, A, simply inserting Section 15500 is not acceptable.

Example

8. Supply-Air Temperature Reset Controls (Section 1318.2.5)

❑ **Not Regulated.** The building plans or specifications do not call for multiple zone HVAC systems.

☑ **Complies.** Multiple zone HVAC systems include controls that automatically reset the supply-air temperatures in response to building loads or outside air temperature.

❑ **Exception.** The building qualifies for an exception to the supply-air reset controls requirement. Applicable code exception is Section 1318.2.5, Exception ❑ -1 ❑ -2 ❑ -3

Portions of the building that qualify:	
The plans/specs show compliance in the following locations:	Sheet M2.1 and Section 15500, 2.3, A

Line 8. Supply-Air Temperature Reset Controls

If no new HVAC systems serve multiple zones, check the **Not Regulated** box.

Complies: Multiple zone HVAC systems include controls that automatically reset the supply-air temperature in response to representative building loads, or to outdoor air temperature. The controls must be capable of resetting the supply air temperature at least 25% of the difference between the design supply-air temperature and the design room air temperature. For example if the cooling design room temperature is 75 deg. F and the cooling design supply air temperature is 55 deg.F, the supply air temperature must be reset a minimum of 5 deg.F. (60 deg. F.), during periods of minimum load.

Exceptions:

Exception 1. Systems that prevent re-heating, re-cooling, or mixing of heated and cooled supply air.

Exception 2. 75% of the energy for reheating is from site-recovered or site solar energy sources.

Exception 3. Zones with peak supply air quantities of 300 cfm or less.

If your project qualifies for any of these exceptions, check appropriate box and identify which portions of the building qualify for the exception.

Specify the location in the plans and *specific location within* specifications where all applicable supply-air temperature reset control and sequence of operation is specified. For example – Sheet M2.1 and Section 15500, 2.3, A, simply inserting Section 15500 is not acceptable.

Example

9. Chilled and Hot Water Temperature Reset Controls (Section 1318.2.4)

☑ **Not Regulated.** The building plans or specifications do not call for chilled or hot water systems with a design capacity exceeding 300,000 Btu/hr.

❑ **Complies.** Chilled and hot water systems include controls that automatically reset supply water temperatures by representative building loads or by outside air temperature.

❑ **Exception.** Section 1318.2.4, Exception ❑ -1 ❑ -2

Portions of the building that qualify:	
The plans/specs show compliance in the following locations:	

Line 9. Chilled and Hot Water Temperature Reset Controls

If a new HVAC system does not call for chilled or hot water systems with a design capacity exceeding 300,000 Btu/hr, check the **Not Regulated** box.

Complies: Controls that automatically reset supply water temperatures by representative building loads (including return water temperature) or by outside air temperature are required for chilled and/or hot water systems with a design capacity exceeding 300,000 Btu/hr.

SYSTEMS – COMPLEX HVAC SYSTEMS

Exceptions. Section 1318.2.4 has two exceptions to this requirement:

Exception 1. Where the supply temperature reset controls cannot be implemented without causing improper operation of dehumidifying systems.

Exception 2. Hydronic systems that use variable flow to reduce pumping energy. Since all hydronic systems of 10 hp or greater require variable speed drives (discussed on form 4A, line 21), they should qualify for this exception.

If your project qualifies for any of these exceptions, check appropriate box and identify which portions of the building qualify for the exception.

Specify the location in the plans and *specific location within* specifications where all applicable chilled and hot water temperature reset control and sequence of operation is specified. For example – Sheet M2.1 and Section 15500, 2.3, A, simply inserting Section 15500 is not acceptable.

Example

10. Separate Air Distribution Systems (Section 1318.2.7)

☑ **Not Regulated.** The building plans or specifications do not call for zones with special process temperature or humidity requirements.

❑ **Complies.** Separate air distribution systems serve zones with special process temperature or humidity requirements from those zones serving only comfort conditions, or supplementary control provisions are included so primary systems are specifically controlled for comfort purposes only.

❑ **Exception.** Section 1318.2.7, Exception ❑ -1 ❑ -2

Identify zones with special process requirements:	
The plans/specs show compliance in the following locations:	

Line 10. Separate Air Distribution Systems

If a new HVAC system does not call for zones with special process temperature or humidity requirements, check the **Not Regulated** box.

Complies: Air distribution to zones with special process temperature requirements and/or humidity requirements, such as computer rooms, must be separated from those serving conventional zones that only require comfort conditions. This can be achieved through separate air distribution systems, or by inclusion of supplementary control provisions so that the primary systems may be specifically controlled for comfort purposes only. For instance, a system serving an office occupancy as well as a computer server room that needed additional dehumidification would be allowable, if the there was a secondary dehumidification coil on the branch duct serving server room controlled by a humidistat within the server room.

Exceptions. Section 1318.2.7 has two exceptions to this requirement:

Exception 1, The total supply air to those comfort zones is no more than 25% of the total system supply air.

Exception 2, The total conditioned floor area of the zones is less than 1,000 square feet.

If your project qualifies for any of these exceptions, check appropriate box and identify which portions of the building qualify for the exception.

Specify the location in the plans and *specific location within* specifications where all applicable systems and control, and sequence of operation are specified. For example – Sheet M2.1 and Section 15500, 2.3, A, simply inserting Section 15500 is not acceptable.

Example

11. Zone Isolation Controls (Section 1318.2.6)

❑ **Not Regulated.** Building plans or specifications do not call for HVAC systems serving multiple occupancies or floors with ≥240,000 Btu/hr cooling capacity, or ≥300,000 Btu/hr heating capacity.

☑ **Complies.** HVAC systems serving multiple occupancies or floors with >240,000 Btu/hr cooling capacity, or >300,000 Btu/hr heating capacity are equipped with isolation devices capable of automatically shutting off supply air to and from each isolated area. Each isolated area is controlled independently and satisfies temperature setback (Section 1317.4.2) and optimum start control requirements. Central fan system air volume is reduced through fan speed reduction.

The plans/specs show compliance in the following locations:	Sheet M2.1 and Section 15500, 2.3, A

Line 11. Zone Isolation Controls

If a new HVAC system does not call for systems serving multiple occupancy groups or floors with 240,000 Btu/hr or greater cooling capacity, or 300,000 Btu/hr or greater heating capacity, check the **Not Regulated** box.

Complies. Systems serving multiple occupancies or floors are required to be equipped with isolation devices capable of automatically shutting off the supply air (conditioned and outside) to and from each isolated area. Each isolated area must be controlled independently and satisfy temperature setback (Section 1317.4.2) and optimum start control requirements. The central fan system air volume is reduced through fan speed reduction. A typical VAV system could comply if terminal units serving different floors or occupancies are controlled to completely shut off supply air to each floor or occupancy independently while other floors or occupancies still receive supply air.

Specify the location in the plans and *specific location within* specifications where all applicable isolation control and sequence of operation is specified. For example – Sheet M2.1 and Section 15500, 2.3, A, simply inserting Section 15500 is not acceptable.

Example

12. Humidity Controls (Section 1318.2.2)

☑ **No Moisture Added to Building.** The building plans do not call for means to add moisture to maintain specific humidity levels.

❑ **Complies**. All new humidity control systems equipped with a humidistat when required. All humidifier preheating devices have an automatic value to shut off preheat when humidification is not required.

The plans/specs show compliance in the following locations:	

Line 12. Humidity Controls

If a new HVAC system does not add moisture to the supply air (humidify), check the **No Moisture Added to Building** box.

Complies. If a system is equipped with a means for adding moisture to maintain specific humidity levels in a zone or zones, a humidistat shall be provided. This device shall be capable of being set to prevent the use of fossil fuel or electricity to produce relative humidity in excess of 30 percent for comfort purposes. Where a humidistat is used for comfort dehumidification, it shall be capable of being set to prevent the use of fossil fuel or electricity to reduce relative humidity below 60 percent. Humidifiers with preheating devices mounted in the airstream shall be provided with an automatic valve to shut off preheat when humidification is not required.

Specify the location in the plans and *specific location within* specifications where all applicable humidity control is specified. For example – Sheet M2.1 and Section 15500, 2.3, A, simply inserting Section 15500 is not acceptable.

SYSTEMS – COMPLEX HVAC SYSTEMS

Example

13. Hydronic System Controls (Section 1318.2.8)
☐ **No Hydronic System.** The building plans or specifications do not call for a new hydronic system.
☑ **Complies.** The hydronic system complies as follows:

Line 13. Hydronic System Controls

If a new HVAC system does not call for a new hydronic system, check the **No Hydronic System** box.

If the system meets the required hydronic system controls as follows check the **Complies** box:

Each of the following requirements has its own **Complies** box which should be checked if the system meets the requirement.

Example

13.1 Variable Flow Controls (Section 1318.2.8.4)
☑ System does not have a 10 hp or greater motor
☐ Complies. System has controls capable of varying pump flow

The plans/specs show compliance in the following locations:	Sheet M2.1 and Section 15500, 2.3, A

13.1 Variable Flow Controls

If the hydronic system does not have a 10 hp or greater motor check the box stating "system does not have a 10 hp or greater motor"

If the hydronic system does have a 10 hp or greater motor that is controlled with a variable speed drive, check the box that says "**Complies. System has controls capable of varying pump flow"**

Example

13.2 Three-Pipe System (Section 1318.2.8.1)
☑ System does not have a common return system (a three-pipe system) for both hot water and chilled water.

13.2 Three-Pipe System.

If there is no three-pipe system in the building check the box that says, **"Hydronic systems that use a common return system for both hot water and chilled water *shall be prohibited*."**

Example

13.3 Two-Pipe Changeover System (Section 1318.2.8.2)
☑ System is not a Two-Pipe Changeover System
☐ Complies. System is:
a. Designed to allow a deadband between changeover from one mode to the other of at least 15°F outside air temperature.
b. Designed to operate and provided with controls that will allow operation in one mode for at least four hours before changing over to the other mode.
c. Provided with reset controls that allow heating and cooling supply temperatures at the changeover point to be no more than 30°F apart.

The plans/specs show compliance in the following locations:	

13.3 Two-Pipe Changeover System

(Systems that use a common distribution system to supply both heated and chilled water).

If there is no two pipe change over system in the building check the box that says **"System is not a two pipe change-over system."**

If there is a two pipe change over system it must meet the following requirements (each appropriate box should be checked):

1. The system is designed to allow a deadband between changeover from one mode to the other of at least 15°F outside air temperature.
2. The system is designed to operate and is provided with controls that will allow operation in one mode for at least four hours before changing over to the other mode.

3. Reset controls are provided that allow heating and cooling supply temperatures at the changeover point to be no more than 30°F apart.

Example

13.4 Hydronic (Water Loop) Heat Pump System (Section 1318.2.8.3)

☑ System is not a Hydronic (Water Loop) Heat Pump System

☐ Complies. Hydronic heat pumps connected to a common heat pump water loop with central devices for heat rejection (e.g., cooling tower) and heat addition (e.g., boiler) have the following:

13.4 Hydronic (Water Loop) Heat Pump Systems.

Hydronic heat pumps connected to a common heat pump water loop with central devices for heat rejection (e.g., cooling tower) and heat addition (e.g., boiler) shall meet the following requirements (each appropriate box should be checked):

1. Controls shall be installed that are capable of providing a heat pump water supply temperature deadband of at least 20°F between initiation of heat rejection and heat addition by the central devices (e.g., tower and boiler).
2. Closed-circuit tower (fluid cooler) shall have either an automatic valve installed to bypass all but a minimal flow of water around the tower (for freeze protection) or low-leakage positive closure dampers.
3. Open-circuit tower installed directly in the heat pump loop shall have an automatic valve installed to bypass all heat pump water flow around the tower. Shutting down the circulation pump on the cooling tower loop shall control open-circuit towers used in conjunction with a separate heat exchanger to isolate the tower from the heat pump loop.
4. A two-position valve at each hydronic heat pump for hydronic systems having a total pump system power exceeding 10 hp.

Specify the location in the plans and *specific location within* specifications where all applicable hydronic controls and sequence of operation is specified. For example – Sheet M2.1 and Section 15500, 2.3, A, simply inserting Section 15500 is not acceptable.

SYSTEMS – WORKSHEETS

Example Section of Worksheet 4a

(a) Equip. ID	(b) Model Designation	(c) Cooling Capacity (Btu/h)	(d) Steady State	(d) Seasonal or Part Load	(e) Compliance Schedule (A-E)

Example Section of Worksheet 4i

(a) Equip. ID	(b) Model Designation	(c) Heating Capacity (Btu/hr)	(d) Proposed Minimum AFUE (%)	(e) Proposed Minimum E_c or E_T (%)	(f) Compliance Schedule (A-D)

Worksheets 4a – 4g, 4i and 4j

These are simple worksheets that document code equipment efficiency requirements. Equipment efficiency requirements are based on rated conditions established by a rating authority (such as ARI or GAMA), not actual or design conditions. Equipment efficiency may be better or worse than rated conditions at actual or design conditions.

Insert the piece of HVAC equipment identification(s) as shown on plans or indicated in specifications in column (a). Insert the manufacturer's model designation each piece of HVAC equipment identified, in column (b).

For worksheets 4a through 4g, insert the cooling capacity at rated conditions (not actual/design conditions) in column (c). For worksheets 4i and 4j, insert the output rating of heating capacity. Enter the entering water temperature for each piece of equipment at rated entering water temperature column (d) for Worksheet 4e. The last column(s) on the right-hand side are the values required as code minimum requirements. The columns between these code compliant values (far right-side column(s)) and column (c) (column (d) on worksheets 4e) are the efficiency for each piece of equipment at rated conditions. The installed equipment efficiency must be equal to or better than code-required performance (smaller value).

The required documentation must accompany each worksheet for each piece of HVAC equipment. For worksheets 4a through 4g, provide either a copy of the appropriate sheet from the ARI directory with equipment identified by circling the line item(s) or highlighting them or attach a copy of the data sheet provided by the equipment manufacturer (i.e., "cut sheets"). For worksheets 4i and 4j, provide either a copy of the appropriate sheet from the GAMA Consumer Directory or attach a copy of the data sheet provided by the equipment manufacturer (i.e., "cut sheets").

When installing equipment that provides both heating and cooling, such as a unitary packaged air conditioner with gas fired heat, do not forget to provide worksheet 4j as well as 4a (or appropriate worksheet).

Worksheet 4l, Air Transport Energy

This worksheet is used to calculate the maximum energy demand of each HVAC system.

An individual Worksheet 4L must be completed for each HVAC system in the building with a total nameplate horsepower greater than 7.5. This includes the sum of all fans in the HVAC system operating at **design conditions,** including supply fans, return/exhaust fans and fan-powered terminal units.

The following types of fans are not included in this worksheet:

1. Individual exhaust fans with nameplate fan horsepower of 1 hp or less.
2. Induction/dilution exhaust fans used in hospitals and laboratories. These specialized fans used increased discharge velocity and often additional outside air to toxic exhaust air away from building air intakes.
3. Fan-powered, parallel airflow terminal units where the fan does not operate in cooling mode. (Series terminal units that operate when the main fan is running must be included.)

Worksheet 4l (cont.)

The energy demand of all HVAC fan systems is limited as specified in Sections 1318.4.2.1 and 1318.4.2.2 (of the *Oregon Structural Specialty Code*). For purposes of this requirement, energy demand of a fan system is the sum of motor brake horsepower of all fans operating at **design conditions**, including supply fans, return/exhaust fans and fan-powered terminal units.

The maximum energy demand for constant volume fan systems is limited as follows:

Constant volume fan systems. For fan systems which provide a constant air volume whenever the fans are operating, the power required by the motors for the combined fan system at design conditions shall not exceed Formula CV-1 shown below. This requirement includes 2-speed motors. Constant volume systems in hospitals and laboratories that include flow control devices on both the supply and return/exhaust for maintaining precise pressure control may use the formula for VAV systems.

Formula CV-1

$$BHP = \frac{\text{Design Airflow (CFM)} * 4.3}{4131}$$

Fan systems with filtration systems that have a pressure drop at design airflow in excess of one-inch w.c. **when the filters are clean**, heat recovery, or direct evaporative humidifier/cooler may use Formula CV-2:

Formula CV-2

$$BHP = \frac{\text{Design Airflow (CFM)} * (PD + 4.3)}{4131}$$

where: BHP = the maximum combined fan brake motor horsepower
CFM = the maximum design supply air flow in cubic feet per minute
PD = the combined pressure drop at design airflow of all filtering systems in excess of 1" w.c. when the filters are clean plus the pressure drop of heat recovery and direct evaporative humidifier/cooler in inches water gauge.

The maximum energy demand for VAV systems is limited as follows:

Variable air volume (VAV) fan systems. For fan systems which are able to vary system air volume automatically as a function of load, the power required by the motors for the combined fan system shall not exceed Formula VAV-1 shown below.

Formula VAV-1

$$BHP = \frac{\text{Design Airflow (CFM)} * 6.0}{4131}$$

Fan systems with filtration systems that have a pressure drop at design airflow in excess of one-inch w.c. **when the filters are clean**, heat recovery, or direct evaporative humidifier/cooler may use Formula VAV-2:

Formula VAV-2

$$BHP = \frac{\text{Design Airflow (CFM)} * (PD + 6.0)}{4131}$$

where: HP = the maximum combined fan brake motor horsepower
CFM = the maximum design supply air flow in cubic feet per minute
PD = the combined pressure drop at design airflow of all filtering systems in excess of 1" w.c. when the filters are clean plus the pressure drop of heat recovery and direct evaporative humidifier/cooler in inches water gauge and additional pressure drops for hospitals and laboratories that have fully ducted return and/or systems or return and/or exhaust airflow control devices or high filtration as specified in the following table.

Additional Pressure Drop for Hospitals and Laboratories	
Measure	**Additional PD**
Fully ducted return and/or exhaust air systems	0.5 in w.c.
Return and/or exhaust air flow control devices	0.5 in w.c.
Filter systems of individual filter efficiency > or = 85%	0.5 in w.c.

Selecting and sizing nameplate motor horsepower: Selected fan motor shall be no larger than the first available motor size greater than the brake horsepower.

SYSTEMS – WORKSHEETS

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Form 5a Project Name: Page:

LIGHTING - GENERAL

Exceptions
Discussion of qualifying exceptions in instructions section.

Plans/Specs
Show compliance by including a drawing sheet, detail number, and/or specification section and subparagraph.

1. Interior Exceptions (Section 1313.1)

☐ **No Interior Lighting.** The building plans and specifications do not call for new or altered interior lighting. Skip to item 5, Exterior building Lighting - General, below.

☐ **Exceptions.** 1. The building or part of the building qualifies for an exception from code lighting requirements. Applicable code exception is number:

2. Lighting equipment that qualifies for an exception - in addition to general lighting and is separately controlled. Applicable code exception is number:

Areas of the building and equipment that qualify for any exceptions:

2. Local Shut-off controls (Section 1313.3.1.1)

☐ **Complies**. At least one local shut-off lighting control for every 2,000 square feet of lighted floor area and for all spaces enclosed by walls or ceiling height partitions. This control is detailed in the building plans on drawing number:

☐ **Exception.** The building or part of the building qualifies for an exception. Applicable code exception is Section 1313.3.1.1, Exception:

Portions of the building that qualify:

3. Automatic Shutoff Controls (Section 1313.3.1.2)

☐ **Not Applicable.** Office floor area is not over 2,000 square feet of contiguous office floor area or permitted space is not over 5,000 square feet. No offices less than 300 square feet, meeting or conference rooms, or school classrooms.

☐ **Complies**. All interior lighting systems are equipped with a separate automatic control to shut off lighting during unoccupied periods. Offices less than 300 square feet, meeting and conference rooms, and school classrooms are equipped with occupancy sensors that comply with Section 1313.3.1.2.1. Compliance details in plans/specs:

☐ **Exception.** The building or part of the building qualifies for an exception. Applicable code exception is Section 1313.3.1,2, Exception:

Portions of the building that qualify:

4. Daylighting Controls (1313.3.1.3)

☐ **No classrooms or atriums with skylights or window to wall ratio greater than 50%.**

☐ **Complies**. All classrooms and atriums with window to wall ratio greater than 50% and/or skylights are equipped with automatic daylight sensing controls, as required by Section 1313.3.1.3.1 and Section 1313.3.1.3.2. The daylight sensors specified comply with Section 1313.3.1.3.3. Compliance details in plans/specs:

Exterior Building Lighting
is lighting directed to illuminate the exterior of the building and adjacent walkways and loading areas with or without canopies.

Clock Switches
shall be astronomic (seasonal correcting) type with separate programs for each day of the week and shall store energy to maintain timekeeping during power outages.

5. Exterior Lighting (Section 1313.5)

☐ **Complies**. The plans do not call for use of incandescent or mercury vapor lamps for use on building exterior.

☐ **Exception.** The building plans indicate luminaires with incandescent or mercury vapor lamps, but are specified for use in or around swimming pools, water features, or other locations subject to requirements of Article 680 of the 2002 National Electrical Code.

6. Exterior and Canopy Lighting Controls (Section 1313.3.2)

☐ **Complies**. The building plans and specifications include photoelectric and/or clock switches on all exterior lighting systems which are designed and programmed to extinguish lights when daylight is present, as required by Section 1313.3.2.

7. Connected Lighting Power (Section 1313.4)

☐ **Complies**. The lighting power does not exceed the power allowance established in either the Tenant Space Method (Form 5b) or the Space-by-Space Method (Form 5c).

❑ Tenant Space Method (Form 5b) ❑ Space-by-Space Method (Form 5c)

Form 5b Project Name: Page:

INTERIOR LIGHTING POWER - Tenant Space Method

Lighting Budget

Occupancy/ Use Types
See instructions for description of occupancy types

	(a) Tenant or Building Type (Table-13G)	(b) Floor Area (sq ft)	(c) Max Power Density (W/ft^2)	(d) Lighting Power Budget (W)
1.	**Total Interior Lighting Power Budget (Watts) for Building.**			

Lighting Power Budget

Track Lighting Power

2.	Total length of track lighting (ft)		-
3.	Line 2 multiplied by 50 Watts/ft		
4.	Total amperage of circuit breaker(s) serving track lighting (amps)		
5.	Voltage of circuit breaker serving track lighting (volts)		
6.	Maximum wattage of track lighting (multiply line 4 by line 5)		
7.	VA rating of the inline current limiter or the low voltage transformers		
8.	Track Lighting Power (the lesser value of line 3, 6 or 7)		

Building's Interior Lighting Power

9.	Total Interior Lighting Power from Worksheet 5b-1 (Sum of Column (m))	+	
10.	**Total Adjusted Interior Lighting Power** (line 8 + line 9)	=	
11.	**Does Interior Lighting Design Meet Budget?** Line 10 must be no greater than line 1.		

Exterior Canopy Parking Garage Lighting Power

12.	**Do Exterior Canopies Meet Budget** (Worksheets 5c)?	
13.	**Does Parking Garage Meet Budget** (Worksheets 5c)?	

Form 5c Project Name: Page:

INTERIOR LIGHTING POWER - Space-by-Space Method

Lighting Power Budget	1.	**Total Interior Lighting Power Budget from Worksheet 5b-1 (Sum of Column (l))**	
Track Lighting Power	2.	Total length of track lighting (ft)	
	3.	Line 2 multiplied by 50 Watts/ft	
	4.	Total amperage of circuit breaker(s) serving track lighting (amps)	
	5.	Voltage of circuit breaker serving track lighting (volts)	
	6.	Maximum wattage of track lighting (multiply line 4 by line 5)	
	7.	VA rating of the inline current limiter or the low voltage transformers	
	8.	Track Lighting Power (the lesser value of line 3, 6 or 7)	
Building's Interior Lighting Power	9.	Total Interior Lighting Power from Worksheet 5b-1 (Sum of Column (m)) +	
	10.	**Total Adjusted Lighting Power** (line 8 + line 9) =	
	11.	**Does Interior Lighting Design Meet Budget?** Line 10 must be no greater than line 1.	
Exterior Canopy Parking Garage Lighting Power	12.	**Do Exterior Canopies Meet Budget** (Worksheets 5c)?	
	13.	**Does Parking Garage Meet Budget** (Worksheets 5c)?	
Retail Display Lighting Power	14.	**Does Each Space With Retail Display Lighting Meet Budget** (Worksheets 5d)?	
	15.	**Is The Total Retail Display Lighting Additional Power Less Than 17,500 W** (sum of line 9 on Worksheets 5d)?	
	16.	**Does Retail Display Lighting Meet Budget?**	

Worksheet 5a Project Name: Page:

LIGHTING FIXTURE SCHEDULE (see Table 5c in instructions for default luminaire power).

(a) Lum ID	(b) Luminaire	(c) Lamp		(d) Ballasts		(e) Luminaire Power (watts)	(f) Is Luminaire From Table 5c
	Type/Description	No.	Description	No.	Description		

Worksheet 5b-1 Project Name: Page:

INTERIOR LIGHTING POWER

Each room must be identified. Describe luminaires for each individual room in plans.

For track lighting enter lineal feet in column column (g).

Column (k), enter sum of column (j) for each room only once at first entry for the room. See example in instructions.

	Space-by-Space Method Only Skip to column (f) if using the Tenant Space Method									
(a) Room ID (do not leave any blanks)	(b) Area (ft^2)	(c) Space Type (Table 13-H) (enter space type only once per room)	(d) Space Type LPD	(e) Lighting Power Budget (b) x (d)	(f) Lum ID from Worksheet 5a Column (a)	(g) Quantity of Luminaires (or lineal ft. for track lighting)	(h) Luminaire Power (Watts)	(i) Exempt Fixtures	(j) Lighting Power (g) x (h)	(k) Room Total Ltg. Power
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Wrksht 5b- Total Sq Ft		Worksheet 5b-___ Total Budget			Wksht 5b-___ Total Lighting Power (excluding exempt/track fixtures)					

Other Pages List additional worksheets necessary to catalog all luminaires in building

Total Number of Additional Worksheet 5b -

WORKSHEET NUMBER Complete this section when more than one Worksheet 3b is completed	(l) Lighting Power Budget: Space-by-Space only (Total of column (e))	(m) Proposed Buiding Lighting Power (Total of column (k), excluding exempt/track)	(n) Area Sqft. (not required for Tenant Method)
5b-1			
5b-2			
5b-3			
Sum of additional 5b worksheets			
Total Budget (of all worksheets)			

Worksheet 5b-2 Project Name: Page:

INTERIOR LIGHTING POWER

Each room must be identified. Describe luminaires for each individual room in plans.

For track lighting enter lineal feet in column column (g) .

Column (k), enter sum of column (j) for each room only once at first entry for the room . See example in instructions.

	Space-by-Space Method Only Skip to column (f) if using the Tenant Space Method									
(a) Room ID (do not leave any blanks)	(b) Area (ft^2)	(c) Space Type (Table 13-H) (enter space type only once per room)	(d) Space Type LPD	(e) Lighting Power Budget (b) x (d)	(f) Lum ID from Worksheet 5a Column (a)	(g) Quantity of Luminaires (or lineal ft. for track lighting)	(h) Luminaire Power (Watts)	(i) Exempt Fixtures	(j) Lighting Power (g) x (h)	(k) Room Total Ltg. Power
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	-	Worksheet 5b-2 Total Budget			Wrksht 5b-2 Total Lighting Power (excluding exempt/track fixtures)					

Worksheet 5c Project Name: Page:

EXTERIOR CANOPY AND PARKING GARAGE LIGHTING POWER

Exterior Canopy Lighting

Each room must be identified. Describe luminaires for each individual room in plans.

For track lighting enter lineal feet in column column (g) .

Column (k), enter sum of column (j) for each room only once at first entry for the room . See example in instructions.

(a) Room ID (do not leave any blanks)	(b) Area (ft^2)	(c) Canopy	(d) Space Type LPD	(e) Lighting Power Budget (b) x (d)	(f) Lum ID from Worksheet 5a Column (a)	(g) Quantity of Luminaires (or lineal ft. for track lighting)	(h) Luminaire Power (Watts)	(i) Exempt Fixtures	(j) Lighting Power (g) x (h)	(k) Room Total Ltg. Power
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		Total Exterior Canopy Budget				Total Exterior Canopy Lighting Power (excluding exempt fixtures)				

Parking Garage Lighting

(a) Room ID (do not leave any blanks)	(b) Area (ft^2)	(c) Parking Garage	(d) Space Type LPD	(e) Lighting Power Budget (b) x (d)	(f) Lum ID from Worksheet 5a Column (a)	(g) Quantity of Luminaires (or lineal ft. for track lighting)	(h) Luminaire Power (Watts)	(i) Exempt Fixtures	(j) Lighting Power (g) x (h)	(k) Room Total Ltg. Power
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	-	Total Parking Garage Budget				Total Parking Garage Lighting Power (excluding exempt fixtures)				

Does Canopy Lighting Power Comply?	
Does Parking Garage Lighting Power Comply?	

Worksheet 5d-1 Project Name: | Page:

Retail Display Lighting Power

Complete one worksheet for each room (space) for retail display lighting that is specifically directed to highlight merchandise, and is controlled separately from the general lighting system within the room. General lighting should be included on Worksheet 5b.

1. Room # or Space ID	
2. Room Area (ft^2)	
3. Retail Space Type	

Describe luminaires for each individual room in plans.

For track lighting enter lineal feet in column (b).

(a) Lum ID from Worksheet 5a Column (a)	(b) Quantity of Luminaires (or lineal ft. for track lighting)	(c) Luminaire Power (Watts)	(d) Lighting Power (b) x (c)

1.	Space Display Lighting Power (total d column excluding track fixtures)	
2.	Total length of track lighting (ft)	
3.	Line 2 multiplied by 50 Watts/ft	
4.	Total amperage of circuit breaker(s) serving track lighting (amps)	
5.	Voltage of circuit breaker serving track lighting (volts)	
6.	Maximum wattage of track lighting (multiply line 4 by line 5)	
7.	VA rating of the inline current limiter or the low voltage transformers	
8.	Track Lighting Power (the lesser value of line 3, 6 or 7)	
9.	Total Space Display Lighting Power (Watts) (line 1 + line 8)	
10.	Total Space Display Lighting Power Budget (Watts) (room area x 1.75 to max of 17,500)	
11.	**Does Space Retail Display Meet Space Budget (Line 9 less than line 10 and less than 17,500 W)?**	

Total Number of Additional Worksheet 5d

LIGHTING – GENERAL

General

There are several areas in the forms where the user is asked to identify the location on plans or specifications where a requirement is called out. For instance Line 4 asks the user to identify compliance details for daylighting requirements. The user should input which drawing number and detail shows the daylight controller, controlled fixtures, and photocell, and what section and subsection of specifications identifies the required control sequence. This is meant to enable the plan reviewer to easily verify compliance.

Should I use the Tenant Space Method (Form 5b) or the Space by Space Method (Form 5c)?

Both methods establish a lighting power budget for the building. The Tenant Space method is the simpler of the two methods, while the Space by Space Method may provide a higher lighting power budget for some buildings. The Space by Space method will require entering areas for each room in the project. It will also require determining what each room's Space Type Category is (from Table 3b). See discussion of Forms 5b and 5c for more detail about the two methods).

When utilizing the Retail Display Lighting Power allowance, the Space by Space Method must be used.

> ***Excel Spreadsheet Users Note*:** Users of the Excel spreadsheet may wish to fill out all required information for Space by Space Method on Worksheet 5b. This will enable the user to check compliance using either method on Form 5a.

Line 1. Exceptions

No Interior Lighting. If your building plans do not call for new or altered interior lighting, check this box and go to Item 5, Exterior Building Lighting – General. If there is no exterior building lighting to be installed, these forms are not required.

Exceptions. Section 1313.1 allows a number of exceptions to the code requirements for interior lighting:

1. Lighting for the following areas:
   - 1.1. Outdoor athletic facilities.
   - 1.2. Dwelling units, lodging houses, one or two family dwellings and guest rooms.
   - 1.3. Industrial plants—manufacturing spaces only.
   - 1.4. Paint shops and painting spray booths.
   - 1.5. High-risk security areas such as detention facilities, automatic teller machines (ATMs), and night drops.
   - 1.6. Areas specifically designed for visually disabled people.
   - 1.7 Tunnels.
2. Lighting equipment used for the following shall be exempt provided that it is **in addition to general lighting** and is **controlled by an independent control device**:
   - 2.1 Production lighting for theatrical, television, spectator sports and like performance areas.
   - 2.2 Decorative, special effect and production lighting for those portions of entertainment facilities such as theme parks, night clubs, discos and casinos where lighting is an essential technical element for the function performed.
   - 2.3 Lighting equipment that is for sale.
   - 2.4 Task lighting for medical and dental purposes.
   - 2.5 Bench lighting for research laboratories.
   - 2.6 Lighting to be used solely for indoor plant growth during the hours of 10 p.m. to 6 a.m.
   - 2.7 Emergency lighting that is automatically off during normal building operation.
   - 2.8 Art accent lighting required for art exhibits or displays in galleries, museums and monuments.
   - 2.9 Sign lighting.
   - 2.10 Nonpermanent lighting.

If the project qualifies for one of these exceptions, enter section and exception number. For example, if you claim an exception for paint booth, under the appropriate exception category, enter Exception 1.4. Next, describe the area(s) of the building that qualify for the exception. Paint booth – Room 104.

Exception 2.1 is specifically for production lighting used for performance of productions, such as theatrical spotlights highlighting a stage. This exception would not apply to production lighting used in a non-production task such as theatrical spotlights used in a retail environment.

Exception 2.4 is specifically for medical and dental task lighting. An example would be a light used by a dentist that shines into the mouth or the light in an X-ray viewing panel.

LIGHTING – GENERAL

Exception 2.9 is specifically for lighting used only for signage and is controlled by an independent control device. This does not include perimeter-wall lighting.

Exception 2.10 is for lighting that is not part of the permanent building lighting systems. This would include plugged-in under shelf lighting in modular office furniture or plugged-in under shelf lighting in modular retail shelving. Lighting in cases, such as in grocery store upright freezers and within display cases, such as for jewelry are considered nonpermanent lighting. Examples of plug-in lighting that would be considered part of the building lighting system for inclusion in Lighting Power Allowance include metal halide fixtures and clamp-on (and plugged-in) theatrical-type lighting used in spaces that are not for theatrical purposes.

Additions and alterations must comply with the code, but there are exceptions to that rule. Section 1313.6 covers the requirements and exceptions that apply to additions and alterations.

Alterations are exempt from the performance (power) requirements of the code if the alterations to existing lighting systems do not replace more than 50 percent of the luminaries in the permitted project **and** do not increase the existing total connected lighting power. This exception allows unlimited movement of existing luminaires and limited replacements or additions to the light fixtures. Also, new lighting controls must meet new code controls requirements.

If your building plans call for altered building lighting and you want to claim this exception, enter Section 1313.6, Exception. Next, describe the area(s) of the building that qualify for an exception.

Line 2. Local Shut-off Controls

Complies. The code requires that most spaces have some means for turning lights on and off. A wall toggle switch, an occupancy sensor or a dimmer can meet this requirement. The control must be within the room and available to the room occupants, and it cannot cover an area larger than 2,000 square feet. For example, a 3,000 square foot area must have at least two controls.

Exceptions. Section 1313.3.1.1 allows four exceptions to the code requirement for local shut-off controls.

Line 1 Exceptions – cont.

1. Lighting for warehouses, parking garages or spaces using less than 0.5 Watts/ft^2.
2. Lighting systems serving areas that must be continuously lit.
3. Public areas, such as concourses, with switches that are accessible only to authorized personnel.
4. Lighting for contiguous, single-tenant retail spaces.

If your project qualifies for one of these exceptions, enter the section and exception number. For example, if you claim an exception for lighting for a public restroom, enter Section 1313.3.1.1, Exception 3. Next, describe the area(s) of the building that qualify for the exception.

If your project is an existing building with existing local shutoff controls that meet these requirements, select complies. If your project is an existing building where lighting controls or distribution wiring is not being installed or replaced, leave these spaces blank.

Line 3. Automatic shutoff control

Automatic Shutoff Control

Not Applicable. If the permitted space is less than 5,000 square feet, **and** there are no office areas greater than 2,000 square feet of contiguous floor area, **and** there are no offices less than 300 square feet, **and** no meeting or conference rooms, **and** no school classrooms, check this box.

Complies. All buildings greater than 5,000 square feet **and** all offices over 2,000 square feet of contiguous floor area must be equipped with a separate automatic control to shut off the lighting. Automatic controls may include **occupancy sensors** (that comply with Section 1313.3.1.2.1), **automatic time switches** (that comply with 1313.3.1.2.2) or other devices capable of automatically shutting off the lighting during normally unoccupied periods.

Local Shutoff Controls

Additionally, all offices less than 300 square feet, all meeting and conference rooms, and all school classrooms, are required to be equipped with **occupancy sensors** that comply with Section 1313.3.1.2.1. This requirement is regardless of building size.

If your project complies with these requirements, check complies and indicate where on the plans or specifications the automatic shutoff controls

Automatic Shutoff Control – cont.

are called out. For example – Sheet E1.3 and Section 16510.4.3.C. If your project is an existing building where lighting controls or distribution wiring is not being installed or replaced, select not applicable.

Exceptions. Some lighting applications, because of safety or functional concerns, need not be automatically controlled. The code has seven exceptions to the requirement for automatic shut-off controls:

1. Emergency and pathway lights as required by code.
2. Where the system is serving an area that must be continuously lit.
3. Display and accent lighting, including plug-in, track and display case lighting, shall be separately controlled.
4. Switching for industrial or manufacturing process facilities as may be required for production.
5. Hospitals and laboratory spaces.
6. Areas in which medical or dental tasks are performed.
7. Mechanical and electrical equipment rooms

Daylighting Controls

If your project qualifies for one of these exceptions, enter the Section and Exception number. For example, if you have an area that must be continuously lit, such as a hotel lobby, and you do not want automatic shut-off controls, enter Section 1313.3.1.1.2, Exception 2. Next, describe the area(s) of the building that qualify for the exception.

The Code defines occupancy sensors and automatic time switches as follows:

Occupancy Sensors. Occupancy sensors shall be capable of automatically turning off all the lights in an area, no more than 30 minutes after the area has been vacated. Lighting fixtures controlled by occupancy sensors shall have a wall-mounted, manual switch capable of turning on and off lights when the space is occupied.

Automatic Time Switches. Automatic time switches shall have a minimum 7-day clock and be capable of being set for 7 different day types per week and incorporate an automatic holiday "shut-off" feature, which turns off all loads for at least 24 hours and then resumes normally scheduled operations. Automatic time switches shall also have program back-up capabilities, which prevent the loss of program and time settings for at least 10 hours, if power is interrupted.

Automatic time switches shall incorporate an over-ride switching device which:

1. is readily accessible,
2. is located so that a person using the device can see the effects of the control,
3. is manually operated,
4. allows the lighting to remain on for no more than 2 hours when an over-ride is initiated,
5. controls an area not exceeding 2,000 ft2.

Line 4. Daylighting Controls

No Classrooms or atriums with skylights or window-to-wall ratio greater than 50%. If the building does not contain any classroom or atrium with either a window to exterior wall ratio of at least 50% or any amount of skylight, check this box.

Complies. All classrooms and atriums with a window-to-exterior wall ratio exceeding 50 percent or with any amount of skylights are required to install automatic daylight sensing controls meeting all the requirements listed in this section. If daylighting controls are included and meet these requirements, check complies, and identify the location in the plans and *specific location within* specifications where the daylighting controls are specified. For example – Sheet E1.3 and Section 16510.4.3.C.

Classrooms/atriums with windows: Class-rooms and atriums with a window to exterior wall ratio of 50% or greater shall use automatic daylight sensing controls for all permanently installed luminaries 15 feet inward and 5 feet on each side of the windows. For the purpose of this section, window-to-wall ratio is measured on inside of room, on exterior walls.

Classrooms/atriums with skylights: In class-rooms and atriums with skylights, monitors, or other fenestration at or above ceiling level, all permanent luminaries within an area equal to the footprint of the ceiling opening plus the floor to ceiling height in each direction of the opening, shall be controlled by automatic daylight sensing controls.

The Code requires that automatic daylight sensing controls:

1. Be capable of reducing the light output of the controlled luminaries by at least one half while maintaining a uniform level of illuminance,
2. Provide continuous dimming of the controlled luminaries,

LIGHTING – GENERAL

3. Control only luminaires within the daylit area, and
4. Incorporate time-delay circuits to prevent cycling of light level changes of less than three minutes.

Exception: Atriums can utilize step switching or other non-continuous dimming devices provided they have adjustable separation (deadband) of on and off points to prevent short cycling.

Line 5. Exterior Building Lighting Power

Complies. If the building plans do not call for lighting the exterior of the building with incandescent or mercury vapor lights, check this box. This requirement promotes the more efficient lighting sources such as fluorescent and metal halide.

Exception. This exception allows the use of incandescent or mercury vapor lamps, but only for swimming pools, water features, and other locations subject to the requirements of Article 680 of the 2002 National Electrical Code.

Note. If the building has a parking garage or an exterior canopy, complete Worksheet 5c.

If your project does not contain any exterior building lighting, check the **Complies** box.

Line 6. Exterior and Canopy Lighting Controls

Complies. Section 1313.3.2 states that exterior building lighting be automatically controlled by a timer or photocell or both, which is designed and programmed to extinguish lights when daylight is present.

Daylighting Controls – cont.

Clock switches must be astronomic (seasonal correcting) type with separate programs for each day of the week and must store energy to maintain time keeping during power outages.

A motion sensor, if used, must employ a photo-electric switch to prevent operation during daytime.

Interior & Exterior Lighting Power

If your project meets these requirements, check complies. If your project does not contain any exterior building or canopy lighting, leave these spaces blank.

Line 7. Connected Lighting Power

Complies. The building lighting power shall not exceed the interior power allowance established in either the Tenant Space Method or the Space-by-Space Method. Select either “Tenant Space Method” or “Space-by-Space Method,” whichever is used to demonstrate compliance. Insert YES if project complies and NO if project does not comply with the appropriate method. If the building has illuminated exterior canopies or a parking garage, those must also comply and the resultant answer must be YES.

Where multiple, independently operating lighting systems serve the same space and are controlled to prevent simultaneous operation, connected lighting power shall be based only on system with highest connected lighting power.

Exterior & Canopy Lighting Controls

***Excel Spreadsheet Notes*:** By selecting either “Tenant Space Method” or “Space-by-Space Method,” the appropriate Form will become available and a “Yes” or “No” will be automatically generated based on inputs provided.

INTERIOR LIGHTING POWER – TENANT SPACE METHOD

The Tenant Space Method - Form 5b

Form 5b, based on the Tenant Space Method, is the simpler of two methods in the code for setting a building's interior lighting power budget. The other method is the Space-by-Space Method. The Space-by-Space Method is described later in these instructions.

The Tenant Space Method is a combined space method where the lighting power budget for an entire building or tenant space is the product of the Maximum Power Density (Watts per ft^2) and area of the occupancy (ft^2), expressed in Watts. The budget may be distributed throughout the building in any way a designer chooses (traded off), so long as total tenant space or building budget is not exceeded.

If a building or tenant space does not comply with the assigned budget for the predominant occupancy, or there are many spaces that require a higher budget than the predominant use (such as offices adjoining warehouse, which is the predominant use), the Space-by-Space Method may provide a higher budget.

If the building contains any retail display lighting and that code provision is to be utilized, you must use the Space-by-Space Method.

Unused wattage inside a building cannot be used to increase the exterior building lighting power.

Example:
Budget (column (d)) = Max. Power Density (column (c)) x Floor Area (column (b))

Example

(a) Tenant or Building Type (Table-13G)	(b) Floor Area (sq ft)	(c) Max Power Density (W/ft^2)	(d) Lighting Power Budget (W)
Office	10,000	1.0	10,000
1. **Total Interior Lighting Power Budget (Watts) for Building.**			**10,000**

Tenant or Building Type (a). Enter the appropriate tenant or building type from Table 5a.Table 5a consists of Table 13-G from the Building Code and provides a list of tenant space or building types for use in Tenant Space Method. If a building or tenant space has multiple occupancies, the budget for building or tenant space is determined by the predominant occupancy.

Floor Area (b). Enter the floor area for entire building or tenant space. (Floor area is measured from the outside surface of exterior walls, and from center of interior partition walls.)

Maximum Power Density (c) From Table 5a enter the appropriate Lighting Power Density ($Watts/ft^2$), for the tenant or building type. *Excel spreadsheet automatically enters this value.*

Lighting Power Budget. Budget (d) = (b) x (c). *Excel spreadsheet automatically calculates this value.*

Line 1. Enter the value from column (d) above – results of formula. *Excel spreadsheet calculates automatically.*

INTERIOR LIGHTING POWER – TENANT SPACE METHOD

Example

2.	Total length of track lighting (ft)	20
3.	Line 2 multiplied by 50 Watts/ft	1,000
4.	Total amperage of circuit breaker(s) serving track lighting (amps)	15
5.	Voltage of circuit breaker serving track lighting (volts)	120
6.	Maximum wattage of track lighting (multiply line 4 by line 5)	1,800
7.	VA rating of the inline current limiter or the low voltage transformers	800
8.	Track Lighting Power (the lesser value of line 3, 6 or 7)	800

Lines 2 through 8

The code requires that lighting power used for track lighting be calculated as either 50 Watts per linear foot or maximum circuit load of over-current protection device (circuit breaker) serving track lighting, or inline current limiter or low voltage transformers whichever is less. See section 1313.2.3.

Line 2. Sum and enter the total lineal footage of all track lighting from Worksheet 5b.

Line 3. Multiply Line 2 by 50 W/linear ft.

Line 4. Enter the total amperage of the circuit breakers serving the track lighting circuits.

Line 5. Enter the voltage circuit breakers serving the track lighting circuits.

Line 6. Enter the product of line 4 multiplied by line 5.

Line 7. If the track lighting system includes low voltage transformers or in-line current limiters you may enter the sum of the listed VA rating values for the inline current limiters or low voltage transformers in line 6. Leave this cell blank if an inline current limiter or low voltage transformer is not used.

Line 8. Enter the lesser of the values from line 3 or line 6 or line 7.

Example

9.	Total Interior Lighting Power from Worksheet 5b-1 (Sum of Column (m))		+	8,990
10.	**Total Adjusted Interior Lighting Power**	(line 8 + line 9)	=	**9,790**
11.	**Does Interior Lighting Design Meet Budget?**	Line 10 must be no greater than line 1.		***YES***

Line 9. Enter the value from Worksheet 5b-1 (Sum of Column (m)).

***Excel Spreadsheet Notes*:** Lines 8 & 9 will be calculated automatically. Line 9 will not include fixtures identified as track lighting or fixtures identified as exempt.

Line 10. Enter the total interior lighting power from line 8 and line 9.

***Excel Spreadsheet Notes*:** Lines 2, 3, 6, 10, & 11 will be calculated automatically.

Line 11. If line 10 is equal to or less than line 1, insert "YES" or "NO" if line 10 is greater than line 1.

***Excel Spreadsheet Note*:** The value for Line 11 will be automatically propagated.

12.	**Do Exterior Canopies Meet Budget** (Worksheets 5c)?	***YES***
13.	**Does Parking Garage Meet Budget** (Worksheets 5c)?	***YES***

Line 12. Whenever there are lighted exterior canopies, complete Worksheet 5c. If total of Worksheet 5c, column (k) is equal to or less than total of column (e), insert "YES" or "NO" if total of column (k) is greater than total of column (e) in line 12.

Line 13. Whenever there are lighted parking garages, complete Worksheet 5c. If total of Worksheet 5c, column (k) is equal to or less than total of column (e), insert "YES" or "NO" if total of column (k) is greater than total of column (e) in line 13.

***Excel Spreadsheet Notes*:** Lines 12, & 13 will be automatically propagated.

INTERIOR LIGHTING POWER – SPACE-BY- SPACE METHOD

The Space-by-Space Method – Form 5c

While the Tenant Space Method is a more simple way to comply with code, Space-by-Space Method may provide a higher budget for certain projects. The Space-by-Space method is different from Tenant Space Method in the following ways:

The space-by-space method assigns a budget to each space in the project. The sum of those individual space budgets becomes the budget for the entire tenant space or building. Although a budget is established for each space type, total may be distributed throughout the building in any way a designer chooses (traded off), so long as the total tenant space or building budget is not exceeded.

When utilizing the Retail Display Lighting Power Allowance, complete Worksheet 4d. This allowance can only be used within the retail sales floor area. Any unused wattage cannot be applied to the remainder of space types.

***Excel Spreadsheet Notes*:** Worksheet 5d will automatically appear when the Space-by-Space radio button is checked on bottom of Form 5a.

Example

1.	**Total Interior Lighting Power Budget from Worksheet 5b-1 (Sum of Column (l))**	**9,500**

2.	Total length of track lighting (ft)	20
3.	Line 2 multiplied by 50 Watts/ft	1,000
4.	Total amperage of circuit breaker(s) serving track lighting (amps)	15
5.	Voltage of circuit breaker serving track lighting (volts)	120
6.	Maximum wattage of track lighting (multiply line 4 by line 5)	1,800
7.	VA rating of the inline current limiter or the low voltage transformers	800
8.	Track Lighting Power (the lesser value of line 3, 6 or 7)	800

Line 1. Enter the lighting power budget from Worksheet 5b-1 (sum of column (l)).

***Excel Spreadsheet Note*:** The value for Line l will be automatically calculated from total of all Worksheets 5b completed.

Lines 2 through 8

The code requires that lighting power used for track lighting be calculated as either 50 Watts per linear foot or the maximum circuit load of the over-current protection device (circuit breaker) serving track lighting (when track lighting is served by separate breakers), or inline current limiter or low voltage transformers whichever is less. See section 1313.2.3.

Line 2. Sum and enter the total lineal footage of all track lighting from Worksheet 5b.

Line 3. Multiply Line 2 by 50 W/lf.

Line 4. Enter the total amperage of the circuit breakers serving the track lighting circuits.

Line 5. Enter the voltage circuit breakers serving the track lighting circuits.

Line 6. Enter the product of line 4 multiplied by line 5.

Line 7. If the track lighting system includes low voltage transformers or in-line current limiters you may enter the sum of the listed VA rating values for the inline current limiters or low voltage transformers in line 6. Leave this cell blank if an inline current limiter or low voltage transformer is not used.

Line 8. Enter the lesser of the values from line 3 or line 6 or line 7.

***Excel Spreadsheet Notes*:** Lines 2, 3, 6, and 8 will be calculated automatically.

INTERIOR LIGHTING POWER – SPACE-BY- SPACE METHOD

Example

9. Total Interior Lighting Power from Worksheet 5b-1 (Sum of Column (m))	+	9,311
10. **Total Adjusted Lighting Power** (line 8 + line 9)	=	**10,500**
11. **Does Interior Lighting Design Meet Budget?** Line 10 must be no greater than line 1.		***NO***

Line 9. Enter the total interior lighting power (excluding exempt fixtures and track lighting) from Worksheet 5b-1 (Sum of Column (m)).

***Excel Spreadsheet Notes*:** Line 9 will be calculated automatically, and will not include fixtures identified as track lighting or fixtures identified as exempt.

Line 10. Total Adjusted Lighting Power. Enter the sum of line 8 plus line 9. Total Adjusted Lighting Power must be less than the building's budget as calculated in line 1 in order for your building to be in compliance.

Line 11. If line 10 is equal to or less than line 1, insert "YES" or "NO" if line 10 is greater than line 1.

***Excel Spreadsheet Notes*:** The value for Line 10 will be automatically propagated.

12. **Do Exterior Canopies Meet Budget** (Worksheets 5c)?	***YES***
13. **Does Parking Garage Meet Budget** (Worksheets 5c)?	***YES***

Line 12. Whenever there are lighted exterior canopies, complete Worksheet 5c. If total of Worksheet 5c, column (k) is equal to or less than total of column (e), insert "YES" or "NO" if total of column (k) is greater than total of column (e) in line 12.

Line 13. Whenever there are lighted parking garages, complete Worksheet 5c. If total of Worksheet 5c, column (k) is equal to or less than total of column (e), insert "YES" or "NO" if total of column (k) is greater than total of column (e) in line 13.

***Excel Spreadsheet Notes*:** Lines 12, & 13 will be automatically propagated.

LIGHTING SCHEDULE

Worksheet 5a

Worksheet 5a provides the plans examiner and inspector with a list of luminaires in the project and their power consumption. Fixture schedules usually describe luminaires in detail. They may include such items as types of luminaires, manufacturer model numbers, number of lamps, and their voltage and wattage. However, they seldom indicate the power used by the luminaire.

It is essential to know the number of luminaires and their wattages in order to find the total installed or connected lighting load.

Example

(a)	(b)		(c)		(d)		(e)	(f)
Lum ID	Luminaire		Lamp		Ballasts		Luminaire Power (watts)	Is Luminaire From Table 5c
	Type	Description	No.	Description	No.	Description		
A	Fluorescent T8 - 4 foot	2-F32T8-ELECT NO-62W	2	F32T8	1	Electronic Normal Output. RS	62	YES
B	Fluorescent T8 - 4 foot	3-F32T8-ELECT NO-93W	3	F32T8	1.5	Electronic Normal Output. RS	93	YES
C	Compact Fluorescent Twin	2-CFT5W/G23-MAG STD-18W	2	CFT5W/G23	2	Magnetic Standard	18	YES
D	User Defined	8-lamp CFL High Bay	8	CFT5W/E23	4	Magnetic Standard	72	NO
E	Track Lighting	Track Lighting	--	--	--	--	37.5	YES

Column (a) - Luminaire Identification. Use the letter or symbol that identifies each fixture type from the electrical plan or the lighting schedule.

Column (b)-Luminaire Type and Description. Describe the type of fixture. Luminaire types and descriptions are provided on Table 5c.

When fluorescent luminaires are used, be sure to include length of fixture in feet. When using fixture configurations not listed on Table 5c include the manufacturer's catalog cut-sheet, showing fixture wattage

***Excel Spreadsheet Notes*:** Luminaire type and description are available from pull down lists, representing all the fixtures in Table 5c. If the project contains a fixture not included in Table 5c, select "User Defined" for type and manually enter the fixture description.

Column (c) - Lamp Number and Description Enter the number and type of lamps in luminaire. Wattage of lamps is especially important information to provide. Use descriptions provided on Table 5c or lamp manufacturer's ordering codes (see Figure 5b for examples). They are fairly standard and usually contain all the required information. For fluorescent and high intensity discharge lamps, see Figure 5b for typical codes. Lamp descriptions are also provided on Table 5c. If track lighting is selected, do not enter any lamp number or description in column (c).

***Excel Spreadsheet Note*:** Column (c) will be automatically propagated based on user selection, unless a "User Defined" fixture is selected, in which case the number of lamps and description should be manually entered.

Column (d) - Ballast Number and Description. Enter the number and description or the abbreviations for the type of ballast. For fluorescent and high intensity discharge lamps, typical abbreviations are provided on Table 5c, examples include:

- MAG STD — standard magnetic
- MAG EE — energy efficient magnetic
- ELECT — electronic
- Elec NO — Electronic Normal Output
- Elec RO — Electronic Reduced Output
- Elec HO — Electronic High Output
- Elec Dim — Electronic Dimming

Fluorescent fixtures generally have one or more ballasts per fixture. Most HID luminaires have a single lamp per ballast. Most low voltage halogen luminaires have a single lamp per transformer. For fixtures without ballasts (such as incandescent), enter "none" in the description. When wiring for HID luminaires are plugged-in and mounted for ambient lighting, fixtures shall be considered permanently installed.

***Excel Spreadsheet Note*:** Column (d) will be automatically propagated based on user selection, unless a "User Defined" fixture is selected, in which case the number of ballasts and description should be manually entered.

LIGHTING SCHEDULE

Column (e) - Luminaire Power. For fluorescent and HID luminaires, enter the ballast input wattage for the lamp and ballast combination used in the luminaire. Table 5c provides default values for various lamp and ballast combinations.

When a particular lamp and ballast wiring combination is not in Table 5c, provide manufacturer's catalog cut-sheet showing tested values. See "How to Figure Luminaire Power From Catalog Cuts" in the Technical Notes section of this chapter, page 5-32.

For incandescent luminaires without transformers, multiply lamp wattage by number of lamps.

***Excel Spreadsheet Note*:** The value for column (e) will be automatically propagated based on user selection, unless a "User Defined" fixture is selected, in which case the luminaire power should be manually entered.

Column (f) - Data from Table 5b? If your entry in column (e) is taken from Table 5b, enter "YES". If information in column (e) is from manufacturer's catalog cut-sheet enter "NO" in column (f). If NO is entered, be sure and attach manufacturer's catalog cut-sheet for each different fixture described.

***Excel Spreadsheet Note*:** The result for column (f) will be automatically propagated.

INTERIOR LIGHTING POWER

Worksheet 5b

Worksheet 5b is used for both the Tenant Space Method and Space-by-Space Method. Worksheet 5b is where you list all the luminaries in your project by room. This is used to calculate the total connected lighting power in your project. If using the Space-by-Space Method, this worksheet determines a lighting power budget for the project. Additional copies of Worksheet 5a may be used if necessary.

> ***Excel Spreadsheet Note*:** To automatically generate additional copies of Worksheet 5b, select the required number of additional worksheets from the pulldown box toward the bottom of the sheet.

Example

(a)	Space-by-Space Method Only Skip to column (f) if using the Tenant Space Method				(f)	(g)	(h)	(i)
Room ID (do not leave any blanks)	(b) Area (ft^2)	(c) Space Type (Table 13-H) (enter space type only once per room)	(d) Space Type LPD	(e) Lighting Power Budget (b) x (d)	Lum ID from Worksheet 5a Column (a)	Quantity of Luminaires (or lineal ft. for track lighting)	Luminaire Power (Watts)	Exempt Fixtures
100	250	Office-enclosed	1.1	275	A	4	62	☐
100			--	--	B	2	93	☐
102	200	Office-enclosed	1.1	220	A	4	62	☐
104	500	Museum - General Exhibition	1	500	A	10	62	☐
104			--	--	C	5	18	☑
104			--	--	E	100	38	☑
105	75	Restrooms	0.9	68	C	2	18	☐
			--	--			-	☐

Column (a) – Room ID. Enter a short description for each room in column (a). In most instances, this will usually be a room number or other room ID. Do not leave any lines blank. If more than one luminaire type is in a room, that room will need multiple lines, so the same Room ID may be entered on several lines. If additional worksheets 5b are required, do not split individual rooms onto two separate worksheets.

Columns (b), (c), (d), and (e). These columns only need to be filled out if the compliance method is the Space-By-Space method. Projects using the Tenant or Building Method may also fill in these columns, however it is not required. If you are unsure which method you wish to use, you may fill these columns in and calculate compliance using either method.

Column (b) – Area. Enter the area of the room in square feet. (Floor area is measured from the outside surface of exterior walls, and from the center of interior partition walls.) Enter the square footage only once per room. At the bottom of the Column (b) enter the sum of all the areas for this worksheet.

Column (c) – Space Type. Enter the space type category for the room from Table 5a. (also Table 13H from the Building Code).Enter the space type only once per room. If a specific description is not listed, use the most similar description. Example: Truck – Service/Repair is not listed but Automotive – Service/Repair would be used as it is the most similar description for that space.

> ***Excel Spreadsheet Note*:** Space type for column (c) can be chosen from a pull-down list (but only after room ID or area is entered).

Column (d) – Space Type LPD. Enter the space type lighting power density for the room from Table 5a. Enter Space Type LPD only once per room.

> ***Excel Spreadsheet Note*:** Space type LPD will be automatically propagated.

Column (e) – Lighting Power Budget. Multiply columns (b) x (d) to generate the room lighting power budget. Enter the budget only once per room. At the bottom of Column (e) enter the sum of all budgets for this worksheet. Note that as discussed previously, the budget does not need to be met on a room-by-room basis. Rather, the sum of the room budgets creates a tenant space or building budget.

> ***Excel Spreadsheet Note*:** Budget will be automaticallv calculated.

INTERIOR LIGHTING POWER

Column (f) - Luminaire ID. Enter the Luminaire ID from Worksheet 5a column (a).

Column (g) - Quantity of Luminaires. Enter the number of luminaires in the room. For track lighting, enter the lineal feet of track and do not include fixtures mounted on the track.

> ***Excel Spreadsheet Note*:** Select the luminaire ID for column (f) from the pulldown menu.

> ***Excel Spreadsheet Note*:** The value for column (h) will be automatically propagated based on the fixture selected in column (f).

Column (h) - Luminaire Power. Enter the luminaire power from Worksheet 5a column (e).

Column (i) – Exempt Fixtures. Check the box in column (e) if the luminaire is exempt from the budget.

Exempt lighting fixtures include the following provided that they are **in addition to general lighting** and **controlled by an independent control device**: (from Section 1313.1).

2.1 Production lighting for theatrical, television, spectator sports and like performance areas.
2.2 Decorative, special effect and production lighting for those portions of entertainment facilities such as theme parks, night clubs, discos and casinos where lighting is an essential technical element for the function performed.
2.3 Lighting equipment that is for sale.
2.4 Task lighting for medical and dental purposes.
2.5 Bench lighting for research laboratories.
2.6 Lighting to be used solely for indoor plant growth during the hours of 10 p.m. to 6 a.m.
2.7 Emergency lighting that is automatically off during normal building operation.
2.8 Art accent lighting required for art exhibits or displays in galleries, museums and monuments.
2.9 Sign lighting.
2.10 Nonpermanent lighting.

Exception 2.1 is specifically for production lighting used for the performance of productions, such as theatrical spotlights highlighting a stage. This exception would not apply for production lighting used in a non-production task such as theatrical spotlights used in a retail environment.

Exception 2.4 is specifically for medical and dental task lighting. An example would be a light used by a dentist that shines into the mouth or the light in an X-ray viewing panel.

Exception 2.9 is specifically for lighting used only for signage and is controlled by an independent control device. This does not include perimeter-wall lighting.

Exception 2.10 is for lighting that is not part of the permanent building lighting systems. This would include plugged-in under shelf lighting in modular office furniture or plugged-in under shelf lighting in modular retail shelving. Lighting in cases, such as in grocery store upright freezers and within display cases, such as for jewelry are considered nonpermanent lighting. Examples of plug-in lighting that would be considered part of the building lighting system for inclusion in Lighting Power Allowance include metal halide fixtures and clamp-on (and plugged-in) theatrical-type lighting used in spaces that are not for theatrical purposes.

Column (j) - Lighting Power. Enter the product of column (g) and column (h). Include exempt fixtures and track lighting.

> ***Excel Spreadsheet Note*:** The value for column (j) will be automatically calculated from column (g) and (h).

Column (k) –Room Total Lighting Power. Enter sum of lighting power for each luminaire within a specific room – sum of column (j) for that Room ID. **Include exempt fixtures and track lighting**. At the bottom of the Column (k) enter the total lighting power sums for all rooms on this worksheet. Do not include exempt fixtures and track lighting in this total.

> ***Excel Spreadsheet Note*:** The value for column (k) will be automatically calculated from sum of column (j) for that Room ID. The total at the bottom of column (k) will not include exempt fixtures or track lighting.

INTERIOR LIGHTING POWER

Example

Total Number of Additional Worksheet 5b: 0

Worksheet Number	(l) Lighting Power Budget: Space-by-Space only (Total of column (e))	(m) Proposed Buiding Lighting Power (Total of column (k), excluding exempt/track)	(n) Area Sqft. (not required for Tenant Method)
5b-1	1,063	1,338	1,025
5b-2			
5b-3			
Sum of additional 5b worksheets			
Total Budget (of all worksheets)	**1,063**	**1,338**	**1,025**

Column (l) – Lighting Power Budget Space-By-Space. If using the Space-By-Space method, enter lighting power budget for all rooms for each worksheet from bottom of column (e). If more than 3 Worksheets 5b are needed, enter sum for all additional worksheets on the row "Sum of additional 5b Worksheets." Sum the total of all worksheets in the last row of Column (j).

> ***Excel Spreadsheet Note*:** The values for column (l) will be automatically inserted in Column (l).

Column (m) – Building Total Lighting Power. Enter the sum from the bottom of Column (k) from each Worksheet 5b in the appropriate row. If more than 3 Worksheets 5b are needed, enter the sum for all additional worksheets on the row "Sum of additional 5b Worksheets." Sum the total of all worksheets in the last row of Column (j). Enter this value in Line 9 of Form 5b (Tenant Space Method) or Line 8 of Form 5c (Space-by-Space Method).

> ***Excel Spreadsheet Note*:** The values for column (m) will be automatically propagated and inserted on in Line 9 of Form 5b (Tenant Space Method) or Line 8 of Form 5c (Space-by-Space Method).

Column (n) – Area Square Footage. (for Space-By-Space Method only). Enter the sum from bottom of Column (b) from each Worksheet 5b in the appropriate row. If more than 3 Worksheets 5b are needed, enter the sum for all additional worksheets on the row "Sum of additional 5b Worksheets." Sum the total of all worksheets in the last row of Column (j).

> ***Excel Spreadsheet Note*:** The values for column (n) will be automatically calculated.

INTERIOR LIGHTING POWER

Worksheet 5c – Exterior Canopy and Parking Garage Lighting

Worksheet 5c is used for both the Tenant Space Method and Space-by-Space Method. Worksheet whenever an exterior canopy contains lighting fixtures or the building includes a parking garage.

Complete all of the information on Worksheet 5c and insert the appropriate result (Yes or No) on line 12 of Form 5b or 5c.

Exterior Canopy Lighting

(a) Room ID (do not leave any blanks)	(b) Area (ft^2)	(c) Canopy	(d) Space Type LPD	(e) Lighting Power Budget (b) x (d)	(f) Lum ID from Worksheet 5a Column (a)	(g) Quantity of Luminaires (or lineal ft. for track lighting)	(h) Luminaire Power (Watts)	(i) Exempt Fixtures	(j) Lighting Power (g) x (h)	(k) Room Total Ltg. Power
Front	100	Canopies Under 15 feel in height	15	150	**1a**	12	10	❑	120	120
								❑		
								❑		
								❑		
								❑		
								❑		
								❑		
								❑		
								❑		
								❑		
								❑		
								❑		
								❑		
								❑		
		Total Exterior Canopy Budget		**150**		Total Exterior Canopy Lighting Power (excluding exempt fixtures)				**120**

Column (a) – Room ID. Enter a short description for each illuminated canopy in column (a). In most instances, this will usually be a canopy description or other ID as specified on the plans. Do not leave any lines blank. If more than one luminaire type is in a canopy, that canopy will need multiple lines, so the same Room ID may be entered on several lines.

Column (b) – Area. Enter the area of canopy in square feet. (Canopy area is measured from the outside surface of canopy, and to the exterior surface of exterior walls.) Enter the square footage only once per canopy. At the bottom of the Column (b) enter the sum of all the areas for this worksheet.

Column (c) – Canopy. Enter the canopy type category from Table 5b. (also Table 13H from the Building Code). Enter the canopy type only once per room. Provide either "Canopies Under 15 feel in height" or "Canopies 15 feet and over in height."

***Excel Spreadsheet Note*:** Space type for column (c) can be chosen from a pull-down list (but only after room ID or area is entered).

Column (d) – Space Type LPD. Enter the space type lighting power density of 1.5 for Canopies Under 15 feel in height or 2.0 for Canopies 15 feet and over in height.

***Excel Spreadsheet Note*:** Space type LPD will be automatically propagated.

Column (e) – Lighting Power Budget. Multiply columns (b) x (d) to generate the canopy lighting power budget. Enter the budget only once per room. At the bottom of Column (e) enter the sum of all budgets for this worksheet. Note that the budget does not need to be met on a canopy-by-canopy basis. Rather, the sum of the canopy budgets creates a canopy budget.

***Excel Spreadsheet Note*:** Budget will be automatically calculated.

Column (f) - Luminaire ID. Enter the Luminaire ID from Worksheet 5a column (a).

***Excel Spreadsheet Note*:** Select the luminaire ID for column (f) from the pulldown menu.

INTERIOR LIGHTING POWER

Column (g) - Quantity of Luminaires. Enter the number of luminaires in the room. For track lighting, enter the lineal feet of track and do not include fixtures mounted on the track.

Column (h) - Luminaire Power. Enter the luminaire power from Worksheet 5a column (e).

> ***Excel Spreadsheet Note*:** The value for column (h) will be automatically propagated based on the fixture selected in column (f).

Column (i) – Exempt Fixtures. Check the box in column (e) if the luminaire is exempt from the budget.

Exempt lighting fixtures include the following provided that they are **in addition to general lighting** and **controlled by an independent control device**: (from Section 1313.1).

2.1 Production lighting for theatrical, television, spectator sports and like performance areas.
2.2 Decorative, special effect and production lighting for those portions of entertainment facilities such as theme parks, night clubs, discos and casinos where lighting is an essential technical element for the function performed.
2.3 Lighting equipment that is for sale.
2.4 Task lighting for medical and dental purposes.
2.5 Bench lighting for research laboratories.
2.6 Lighting to be used solely for indoor plant growth during the hours of 10 p.m. to 6 a.m.
2.7 Emergency lighting that is automatically off during normal building operation.
2.8 Art accent lighting required for art exhibits or displays in galleries, museums and monuments.
2.9 Sign lighting.
2.10 Nonpermanent lighting.

Exception 2.1 is specifically for production lighting used for the performance of productions, such as theatrical spotlights highlighting a stage. This exception would not apply for production lighting used in a non-production task such as theatrical spotlights used in a retail environment.

Exception 2.4 is specifically for medical and dental task lighting. An example would be a light used by a dentist that shines into the mouth or the light in an X-ray viewing panel.

Exception 2.9 is specifically for lighting used only for signage and is controlled by an independent control device. This does not include perimeter-wall lighting.

Exception 2.10 is for lighting that is not part of the permanent building lighting systems. This would include plugged-in under shelf lighting in modular office furniture or plugged-in under shelf lighting in modular retail shelving. Lighting in cases, such as in grocery store upright freezers and within display cases, such as for jewelry are considered nonpermanent lighting. Examples of plug-in lighting that would be considered part of the building lighting system for inclusion in Lighting Power Allowance include metal halide fixtures and clamp-on (and plugged-in) theatrical-type lighting used in spaces that are not for theatrical purposes.

Column (j) - Lighting Power. Enter the product of column (g) and column (h). Include exempt fixtures and track lighting.

> ***Excel Spreadsheet Note*:** The value for column (j) will be automatically calculated from column (g) and (h).

Column (k) –Room Total Lighting Power. Enter sum of lighting power for each luminaire within a specific canopy – sum of column (j) for that Room ID. **Include exempt fixtures and track lighting**. At the bottom of the Column (k) enter the total lighting power sums for all rooms on this worksheet. Do not include exempt fixtures and track lighting in this total.

> ***Excel Spreadsheet Note*:** The value for column (k) will be automatically calculated from sum of column (j) for that Room ID. The total at the bottom of column (k) will not include exempt fixtures or track lighting.

Does Canopy Lighting Power Comply?	*YES*

If the sum of column (k) is equal to or less than sum of column (e), insert “YES” or “NO” if sum of column (k) is greater than sum of column (e).

> ***Excel Spreadsheet Notes*:** The values for sum of columns (e) and (k) will be automatically propagated.

INTERIOR LIGHTING POWER

Parking Garage Lighting

(a) Room ID (do not leave any blanks)	(b) Area (ft^2)	(c) Parking Garage	(d) Space Type LPD	(e) Lighting Power Budget (b) x (d)	(f) Lum ID from Worksheet 5a Column (a)	(g) Quantity of Luminaires (or lineal ft. for track lighting)	(h) Luminaire Power (Watts)	(i) Exempt Fixtures	(j) Lighting Power (g) x (h)	(k) Room Total Ltg. Power
Garage	2500	Parking Garage – Garage Area	0.2	500	**2a**	8	62	❑	496	496
								❑		
								❑		
								❑		
								❑		
								❑		
								❑		
								❑		
								❑		
								❑		
								❑		
								❑		
								❑		
								❑		
	2,500	Total Parking Garage Budget		**500**	Total Parking Garage Lighting Power (excluding exempt fixtures)					**496**

Column (a) – Room ID. Enter a short description for each parking garage in column (a). In most instances, this will usually be a parking garage description or other ID as specified on the plans. Do not leave any lines blank. If more than one luminaire type is in a parking garage, that parking garage will need multiple lines, so the same Room ID may be entered on several lines.

Column (b) – Area. Enter the area of parking garage in square feet. Enter the square footage only once per parking garage. At the bottom of the Column (b) enter the sum of all the areas for this worksheet.

Column (c) – Space Type. Enter "Parking Garage" in this cell.

***Excel Spreadsheet Note*:** Space type for column (c) can be chosen from a pull-down list (but only after room ID or area is entered).

Column (d) – Space Type LPD. Enter the space type lighting power density of 0.2 for Parking Garage – Garage Area.

***Excel Spreadsheet Note*:** Space type LPD will be automatically propagated.

Column (e) – Lighting Power Budget. Multiply columns (b) x (d) to generate the parking garage lighting power budget. Enter the budget only once per room/area. At the bottom of Column (e) enter the sum of all budgets for this worksheet. Note that the budget does not need to be met on a garage-by-garage basis. Rather, the sum of the parking garage budgets creates a parking garage budget.

***Excel Spreadsheet Note*:** Budget will be automatically calculated.

Column (f) - Luminaire ID. Enter the Luminaire ID from Worksheet 5a column (a).

***Excel Spreadsheet Note*:** Select the luminaire ID for column (f) from the pulldown menu.

Column (g) - Quantity of Luminaires. Enter the number of luminaires in the room/area. For track lighting, enter the lineal feet of track and do not include fixtures mounted on the track.

Column (h) - Luminaire Power. Enter the luminaire power from Worksheet 5a column (e).

Column (i) – Exempt Fixtures. Check the box in column (e) if the luminaire is exempt from the budget.

Exempt lighting fixtures include the following provided that they are **in addition to general lighting** and **controlled by an independent control device**: (from Section 1313.1).

2.1 Production lighting for theatrical, television, spectator sports and like performance areas.

INTERIOR LIGHTING POWER

2.2 Decorative, special effect and production lighting for those portions of entertainment facilities such as theme parks, night clubs, discos and casinos where lighting is an essential technical element for the function performed.
2.3 Lighting equipment that is for sale.
2.4 Task lighting for medical and dental purposes.
2.5 Bench lighting for research laboratories.
2.6 Lighting to be used solely for indoor plant growth during the hours of 10 p.m. to 6 a.m.
2.7 Emergency lighting that is automatically off during normal building operation.
2.8 Art accent lighting required for art exhibits or displays in galleries, museums and monuments.
2.9 Sign lighting.
2.10 Nonpermanent lighting.

Exception 2.1 is specifically for production lighting used for the performance of productions, such as theatrical spotlights highlighting a stage. This exception would not apply for production lighting used in a non-production task such as theatrical spotlights used in a retail environment.

Exception 2.4 is specifically for medical and dental task lighting. An example would be a light used by a dentist that shines into the mouth or the light in an X-ray viewing panel.

Exception 2.9 is specifically for lighting used only for signage and is controlled by an independent control device. This does not include perimeter-wall lighting.

Exception 2.10 is for lighting that is not part of the permanent building lighting systems. This would include plugged-in under shelf lighting in modular office furniture or plugged-in under shelf lighting in modular retail shelving. Lighting in cases, such as in grocery store upright freezers and within display cases, such as for jewelry are considered nonpermanent lighting. Examples of plug-in lighting that would be considered part of the building lighting system for inclusion in Lighting Power Allowance include metal halide fixtures and clamp-on (and plugged-in) theatrical-type lighting used in spaces that are not for theatrical purposes.

Column (j) - Lighting Power. Enter the product of column (g) and column (h). Include exempt fixtures and track lighting.

> ***Excel Spreadsheet Note*:** The value for column (j) will be automatically calculated from column (g) and (h).

Column (k) –Room Total Lighting Power. Enter sum of lighting power for each luminaire within a specific parking garage – sum of column (j) for that Room ID. **Include exempt fixtures and track lighting**. At the bottom of the Column (k) enter the total lighting power sums for all rooms/areas on this worksheet. Do not include exempt fixtures and track lighting in this total.

> ***Excel Spreadsheet Note*:** The value for column (k) will be automatically calculated from sum of column (j) for that Room ID. The total at the bottom of column (k) will not include exempt fixtures or track lighting.

Does Parking Garage Lighting Power Comply?	*YES*

If the sum of column (k) is equal to or less than sum of column (e), insert “YES” or “NO” if sum of column (k) is greater than sum of column (e).

> ***Excel Spreadsheet Notes*:** The values for sum of columns(e) and (k) will be automatically propagated.

INTERIOR LIGHTING POWER

Worksheet 5d - Retail Display Lighting

Worksheet 5d can only be used with the Space-by-Space Method. Worksheet 5d is used to identify all the luminaries that are specifically for retail display lighting. Retail display lighting used in this allowance must highlight retail merchant-dise and be switched (controlled) separately from the general retail sales lighting.

The area for this allowance is calculated on the footprint, floor area of the sales room where the display lighting is located. Do not use or include wall area or display area such as shelves, racks or vertical display areas. This display lighting allowance is calculated for each retail space separately and cannot be traded with other retail spaces or utilized in other parts of the building. Each retail space or room must use a separate Worksheet 5d.

> ***Excel Spreadsheet Note*:** Worksheet 5d will automatically propagate when "Space-by-Space Method" is selected on Line 7 of Form 5a
>
> To automatically generate additional copies of Worksheet 5a, select the required number of additional worksheets from the pulldown box toward the bottom of the sheet.

1. Room # or Space ID	Retail Sales Floor
2. Room Area (ft^2)	1500
3. Retail Space Type	Other Merchandise Sales Area

Line 1 – Room # or Space ID. Enter room number or a short description for each retail sales area where the retail display lighting is located within Line 1. In most instances, this will usually be the same description or other ID as specified on the plans

Line 2 – Room Area (ft^2). Enter the square footage of the sales floor area's footprint. Do not include vertical surface areas or shelving area.

Line 3 – Retail Space Type. Enter one of the four specific Retail Space Types specified from Table 5b.

> ***Excel Spreadsheet Note*:** Select the luminaire ID for Line 3 from the pulldown menu.

(a) Lum ID from Worksheet 5a Column (a)	(b) Quantity of Luminaires (or lineal ft. for track lighting)	(c) Luminaire Power (Watts)	(d) Lighting Power (b) x (c)
1a	**10**	27	270
T	**40**	50	2,000
		-	-
		-	-

Column (a) - Luminaire ID. Enter the Luminaire ID from Worksheet 5a column (a).

> ***Excel Spreadsheet Note*:** Select the luminaire ID for column (f) from the pulldown menu.

Column (b) - Quantity of Luminaires. Enter the number of luminaires in the room/area. For track lighting, enter the lineal feet of track and do not include fixtures mounted on the track.

Column (c) - Luminaire Power. Enter the luminaire power from Worksheet 5a column (e).

INTERIOR LIGHTING POWER

Column (d) - Lighting Power. Enter the product of column (b) and column (c). Include exempt fixtures and track lighting.

***Excel Spreadsheet Note*:** The value for column (d) will be automatically calculated from column (b) and (c).

1.	Space Display Lighting Power (total d column excluding track fixtures)	270
2.	Total length of track lighting (ft)	40
3.	Line 2 multiplied by 50 Watts/ft	2000
4.	Total amperage of circuit breaker(s) serving track lighting (amps)	20
5.	Voltage of circuit breaker serving track lighting (volts)	120
6.	Maximum wattage of track lighting (multiply line 4 by line 5)	2400
7.	VA rating of the inline current limiter or the low voltage transformers	
8.	Track Lighting Power (the lesser value of line 3, 6 or 7)	2000

Lines 1 through 8

The code requires that lighting power used for track lighting be calculated as either 50 Watts per linear foot or the maximum circuit load of the over-current protection device (circuit breaker) serving track lighting (when track lighting is served by separate breakers), or inline current limiter or low voltage transformers whichever is less. See section 1313.2.3.

Line 1 – Space Display Lighting Power. Enter the total of column (d) above and do not include any track lighting that was entered on this table.

***Excel Spreadsheet Note*:** Track lighting that was entered in column (b) will automatically propagate.

Line 2 – Total length of track. Enter the total length of track lighting, in linear feet, from total that is track of column (b) above.

Line 3. Enter the product of line 2 multiplied by 50.

Line 4. Enter the total amperage of the circuit breakers serving the track lighting circuits.

Line 5. Enter the voltage circuit breakers serving the track lighting circuits.

Line 6. Enter the product of line 4 multiplied by line 5.

Line 7. If the track lighting system includes low voltage transformers or in-line current limiters, you may enter the sum of the listed VA rating values for the inline current limiters or low voltage transformers in line 6. Leave this cell blank if an inline current limiter or low voltage transformer is not used.

Line 8. Enter the lesser of the values from line 3 or line 6 or line 7.

***Excel Spreadsheet Notes*:** Lines 2, 3, 6, and 8 will be calculated automatically.

INTERIOR LIGHTING POWER

8.	Track Lighting Power (the lesser value of line 3, 6 or 7)	2000
9.	Total Space Display Lighting Power (Watts) (line 1 + line 8)	2270
10.	Total Space Display Lighting Power Budget (Watts) (room area x 1.75 to max of 17,500)	2625
11.	**Does Space Retail Display Meet Space Budget (Line 9 less than line 10 and less than 17,500 W)?**	***YES***

Line 9. Enter the sum of line 1 and line 8.

Line 10. Enter the product of line 1 multiplied by 1.75 and **do not enter a value** that exceeds 17,500. If the product is greater than 17,500, enter 17,500.

Line 11. If line 9 is equal to or less than line 10, insert “YES” or “NO” if line 9 is greater than line 10.

***Excel Spreadsheet Notes*:** Lines 9, 10, and 11 will be calculated automatically.

***Excel Spreadsheet Notes*:** If more than one Worksheet 5d is necessary, select the total number of sheets with the pulldown box at bottom of worksheet where provided for “Total Number of Additional Worksheet 5d”.

TABLE 5a(13-G)
TENANT SPACE METHOD
MAXIMUM ALLOWABLE LIGHTING POWER DENSITY (LPD)[1]

Tenant or Building Type[1]	Lighting Power Density (W/ft^2)
Automotive Facility	0.9
Convention Center	1.2
Court House	1.2
Dining: Bar Lounge/Leisure	1.3
Dining: Cafeteria/Fast Food	1.4
Dining: Family	1.5
Exercise Center	1.0
Fire Station	0.8
Gymnasium	1.1
Healthcare – Clinic	1.0
Hospital	1.2
Hotel[2]	1.0
Library	1.3
Manufacturing Facility, Non-process Areas[3]	1.3
Motel[2]	1.0
Motion Picture Theatre	1.2
Multi-Family[2]	0.7
Museum	1.1
Office	1.0
Parking Garage	0.3
Performing Arts Theater	1.6
Police Station	1.0
Post Office	1.1
Religious Building	1.3
Retail	1.5
School/University	1.1
Service station canopies, including all types of vehicle fueling and service (except enclosed garages)	2.0
Sports Arena	1.1
Town Hall	1.0
Transportation	1.0
Warehouse	0.8
Workshop	1.4

For **SI:** 1 foot = 304.8 mm, 1 square foot = 0.929 m^2.

[1] Attached canopies shall be included in the total building or tenant power allowance.

[2] Dwelling units and guestrooms are exempt from interior lighting power allowance requirements.

[3] Spaces used specifically for manufacturing process are exempt and shall not be included in the lighting power allowance calculations.

MAXIMUM POWER DENSITY

TABLE 5b (13-H)—SPACE-BY-SPACE METHOD
MAXIMUM ALLOWABLELIGHTING POWER DENSITY (LPD)

Common Space Types	LPD (W/ft^2)	Building Specific Space Types (continued)	LPD (W/ft^2)
Office-enclosed	1.1	Gymnasium/Exercise Center	
Office-open plan	1.1	Playing Area	1.4
Conference/Meeting/Multipurpose	1.3	Exercise Area	0.9
Classroom/Lecture/Training	1.4	Fire Stations	
Lobby	1.3	Fire Station Engine Room	0.8
For Hotel	1.1	Sleeping Quarters	0.3
For Performing Arts Theater	3.3	Post Office-Sorting Area	1.2
For Motion Picture Theater	1.1	Convention Center – Exhibit Space	1.3
Audience/Seating Area	0.9	Library	
For Gymnasium	0.4	Card File & Cataloging	1.1
For Exercise Center	0.3	Stacks	1.7
For Convention Center	0.7	Reading Area	1.2
For Religious Buildings	1.7	Hospital	
For Sports Arenas	0.4	Emergency	2.7
For Performing Arts Theater	2.6	Recovery	0.8
For Motion Picture Theater	1.2	Nurse Station	1.0
For Transportation	0.5	Exam/Treatment	1.5
Atrium-first three floors	0.6	Pharmacy	1.2
Atrium-each additional floors	0.2	Patient Room	0.7
Lounge/Recreation	1.2	Operating Room	2.2
For Hospital	0.8	Nursery	0.6
Dining Area		Medical Supply	1.4
For Hotel/Motel	1.3	Physical Therapy	0.9
For Bar Lounge/Leisure Dining	1.4	Radiology	0.4
For Family Dining	2.1	Laundry-Washing	0.6
Food Preparation	1.2	Automotive – Service/Repair	0.7
Laboratory	1.4	Museum	
Restrooms	0.9	General Exhibition	1.0
Dressing/Locker/Fitting Room	0.6	Restoration	1.7
Corridor/Transition	0.5	Bank/Office – Banking Activity Area	1.5
For Hospital	1.0	Religious Buildings	
For Manufacturing Facility	0.5	Worship-pulpit, choir	2.4
Stairs-active	0.6	Fellowship Hall	0.9
Active Storage	0.8	Retail	
For Hospitals	0.9	Grocery Sales Area	2.0
Inactive Storage	0.3	Jewelry & Art Sales Area	3.5
For Museum	0.8	Other Merchandise Sales Area	2.0
Electrical/Mechanical	1.5	Mall Concourse	1.5
Workshop[1]	1.9	Sports Arena	
		Ring Sports Area	2.7
		Court Sports Area	2.3
Building Specific Space Types		Indoor Plying Field Area	1.4
Canopies		Warehouse	
Under 15 feel in height	1.5	Fine Material Storage	1.4
15 feet and over in height	2.0	Medium/Bulky Material Storage	0.9
		Parking Garage – Garage Area	0.2
Courthouse/Police Station		Transportation	
Courtroom	1.9	Airport - Concourse	0.6
Judges Chambers	1.3	Air/Train/Bus – Baggage Area	1.0
		Terminal – Ticket Counter	1.5

For SI: 1 foot = 304.8 mm, 1 square foot = 0.929 m^2.

[1] Spaces used specifically for manufacturing are exempt.

LUMINAIRE POWER

	Lamp		Ballast			Watts/	
	No.	Designation	No.	Abbreviation	Description	Luminaire	Comments
Fluorescent Circline	**Fluorescent Circline, Rapid Start (20W)**						
	1	FC6T9	1	MAG STD	Magnetic Standard	25	6” OD
	Fluorescent Circline, Rapid Start (22 W)						
	1	FC8T9	1	MAG STD	Magnetic Standard	27	8" OD
	Fluorescent Circline, Rapid Start (32 W)						
	1	FC12T9	1	MAG STD	Magnetic Standard	45	12" OD
	Fluorescent Circline, Rapid Start (40 W)						
	1	FC16T9	1	MAG STD	Magnetic Standard	57	16" OD
	Fluorescent Circline, T5 Program Start (22 W)						
	1	FC9T5	1	ELECT NO	Electronic Normal Light	28	8" OD
	2	FC9T5	1	ELECT NO	Electronic Normal Light	53	8" OD
	Fluorescent Circline, T5 Program Start (40 W)						
	1	FC12T5	1	ELECT NO	Electronic Normal Light	41	12" OD
	2	FC12T5	1	ELECT NO	Electronic Normal Light	80	12" OD
	Fluorescent Circline, T5 Rapid Start (55 W)						
	1	FC12T5HO	1	ELECT NO	Electronic Normal Light	55	12" OD
	2	FC12T5HO	1	ELECT NO	Electronic Normal Light	103	12" OD
	1	FC12T5HO	1	ELECT DIM	Electronic Dimming	59	12" OD
	Fluorescent Circline, T5 Rapid Start (40 + 22 W)						
	1+1	FC12T5/FC9T5	1	ELECT NO	Electronic Normal Light	68	8” & 12" OD
Compact Fluorescent 2D	**Compact Fluorescent 2D (10W, GR10q-4 Four Pin Base)**						
	1	CFS10W/GR10q	1	MAG STD	Magnetic Standard	16	3.6" across
	1	CFS10W/GR10q	1	ELECT	Electronic	13	
	2	CFS10W/GR10q	1	ELECT	Electronic	26	
	Compact Fluorescent 2D (16W, GR10q-4 Four Pin Base)						
	1	CFS16W/GR10q	1	MAG STD	Magnetic Standard	23	5.5" across
	1	CFS16W/GR10q	1	ELECT	Electronic	15	
	2	CFS16W/GR10q	1	ELECT	Electronic	30	
	Compact Fluorescent 2D (21W, GR10q-4 Four Pin Base)						
	1	CFS21W/GR10q	1	MAG STD	Magnetic Standard	31	5.5" across
	1	CFS21W/GR10q	1	ELECT	Electronic	21	
	2	CFS21W/GR10q	1	ELECT	Electronic	42	
	Compact Fluorescent 2D (28W, GR10q-4 Four Pin Base)						
	1	CFS28W/GR10q	1	MAG STD	Magnetic Standard	38	8.1" across
	1	CFS28W/GR10q	1	ELECT	Electronic	28	
	2	CFS28W/GR10q	1	ELECT	Electronic	56	
	Compact Fluorescent 2D (38W, GR10q-4 Four Pin Base)						
	1	CFS38W/GR10q	1	ELECT	Electronic	37	8.1" across
	2	CFS38W/GR10q	1	ELECT	Electronic	74	
Compact Fluorescent Twin	**Compact Fluorescent Twin (5 W, G23 Two Pin Base - F5TT Lamp)**						
	1	CFT5W/G23	1	MAG STD	Magnetic Standard	9	4.1" MOL
	2	CFT5W/G23	2	MAG STD	Magnetic Standard	18	
	Compact Fluorescent Twin (7 W, G23 Two Pin Base - F7TT Lamp)						
	1	CFT7W/G23	1	MAG STD	Magnetic Standard	11	5.3" MOL
	2	CFT7W/G23	2	MAG STD	Magnetic Standard	22	
	Compact Fluorescent Twin (7 W, 2G7 Four Pin Base - F7TT Lamp)						
	1	CFT7W/2G7	1	ELECT	Electronic	8	5.3" MOL
	2	CFT7W/2G7	2	ELECT	Electronic	16	
	Compact Fluorescent Twin (9 W, G23 Two Pin Base - F9TT Lamp)						
	1	CFT9W/G23	1	MAG STD	Magnetic Standard	13	6.5" MOL
	2	CFT9W/G23	2	MAG STD	Magnetic Standard	26	

LUMINAIRE POWER

Lamp		Ballast			Watts/	
No.	Designation	No.	Abbreviation	Description	Luminaire	Comments
Compact Fluorescent Twin (9 W, 2G7 Four Pin Base - F9TT Lamp) (*Cont.*)						
1	CFT9W/2G7	1	ELECT	Electronic	10	6.5" MOL
2	CFT9W/2G7	2	ELECT	Electronic	20	
Compact Fluorescent Twin (13 W, GX23 Two Pin Base - F13TT)						
1	CFT13W/GX23	1	MAG STD	Magnetic Standard	17	7.5" MOL
2	CFT13W/GX23	2	MAG STD	Magnetic Standard	34	
Compact Fluorescent Twin (13 W, 2GX7 Four Pin Base - F13TT)						
1	CFT13W/2GX7	1	ELECT	Electronic	17	7.5" MOL
2	CFT13W/2GX7	2	ELECT	Electronic	34	
Compact Fluorescent Quad (9 W, G23-2 Two Pin Base - F9DTT Lamp)						
1	CFQ9W/G23-2	1	MAG STD 120	120 V Magnetic Standard	13	4.4" MOL
2	CFQ9W/G23-2	2	MAG STD 120	120 V Magnetic Standard	26	
Compact Fluorescent Quad (13 W, G24d-1 Two Pin Base - F13DTT Lamp)						
1	CFQ13W/G24d-1	1	MAG STD 120	120 V Magnetic Standard	18	6.0" MOL
2	CFQ13W/G24d-1	2	MAG STD 120	120 V Magnetic Standard	36	
1	CFQ13W/G24d-1	1	MAG STD 277	277 V Magnetic Standard	16	
2	CFQ13W/G24d-1	2	MAG STD 277	227 V Magnetic Standard	32	
Compact Fluorescent Quad (13 W, GX23-2 Two Pin Base)						
1	CFQ13W/GX23-2	1	MAG STD	Magnetic Standard	17	4.8" MOL
2	CFQ13W/GX23-2	2	MAG STD	Magnetic Standard	34	
Compact Fluorescent Quad (16W GX32d-1 Two Pin Base)						
1	CFQ16W/GX32d-1	1	MAG STD	Magnetic Standard	20	5.5" MOL
2	CFQ16W/GX32d-1	2	MAG STD	Magnetic Standard	40	
Compact Fluorescent Quad (18 W, G24d-2 Two Pin Base - F18DTT Lamp)						
1	CFQ18W/G24d-2	1	MAG STD 120	120 V Magnetic Standard	25	6.8" MOL
2	CFQ18W/G24d-2	2	MAG STD 120	120 V Magnetic Standard	50	
1	CFQ18W/G24d-2	1	MAG STD 277	227 V Magnetic Standard	22	
2	CFQ18W/G24d-2	2	MAG STD 277	227 V Magnetic Standard	44	
Compact Fluorescent Quad (22W, GX32d Two Pin Base)						
1	CFQ22W/GX32d-2	1	MAG STD	Magnetic Standard	27	6.0” MOL
2	CFQ22W/GX32d-2	2	MAG STD	Magnetic Standard	54	
Compact Fluorescent Quad (26 W, G24d-3 Two Pin Base - F26DTT Lamp)						
1	CFQ26W/G24d-3	1	MAG STD 120	120 V Magnetic Standard	37	7.6" MOL
2	CFQ26W/G24d-3	2	MAG STD 120	120 V Magnetic Standard	74	
1	CFQ26W/G24d-3	1	MAG STD 277	227 V Magnetic Standard	33	
2	CFQ26W/G24d-3	2	MAG STD 277	227 V Magnetic Standard	66	
1	CFQ26W/G24d-3	1	ELECT 277V	277 V Electronic	27	
2	CFQ26W/G24d-3	2	ELECT 277V	277 V Electronic	54	
Compact Fluorescent Quad (26W, G24q-3 Four Pin Base)						
1	CFQ26W/G24q-3	1	ELECT	Electronic	26	7.6” MOL
2	CFQ26W/G24q-3	2	ELECT	Electronic	52	
Compact Fluorescent Quad (28W GX32d Two Pin Base)						
1	CFQ28W/GX32d-3	1	MAG STD	Magnetic Standard	34	6.8" MOL
2	CFQ28W/GX32d-3	2	MAG STD	Magnetic Standard	68	
Compact Fluorescent Quad (10 W, G24q-1 Four Pin Base)						
1	CFQ10W/G24q-1	1	MAG STD 120	120 V Magnetic Standard	16	4.6" MOL
2	CFQ10W/G24q-1	2	MAG STD 120	120 V Magnetic Standard	32	
1	CFQ10W/G24q-1	1	MAG STD 277	227 V Magnetic Standard	13	
2	CFQ10W/G24q-1	2	MAG STD 277	227 V Magnetic Standard	26	
Compact Fluorescent Quad (13 W, G24q-1 Four Pin Base)						
1	CFQ13W/G24q-1	1	MAG STD 120	120 V Magnetic Standard	18	6.0" MOL
2	CFQ13W/G24q-1	2	MAG STD 120	120 V Magnetic Standard	36	
1	CFQ13W/G24q-1	1	MAG STD 277	227 V Magnetic Standard	16	

Compact Fluorescent Twin (*Cont.*)

Compact Fluorescent Quad

	Lamp		Ballast			Watts/	
	No.	Designation	No.	Abbreviation	Description	Luminaire	Comments
Compact Fluorescent Quad (*Cont.*)	**Compact Fluorescent Quad (13 W, G24q-1 Four Pin Base) (*Cont.*)**						
	2	CFQ13W/G24q-1	2	MAG STD 277	227 V Magnetic Standard	32	
	1	CFQ13W/G24q-1	1	ELECT	Electronic	14	
	2	CFQ13W/G24q-1	2	ELECT	Electronic	25	
	Compact Fluorescent Quad (13 W, GX7 Four Pin Base)						
	1	CFQ13W/GX7	1	MAG STD	Magnetic Standard	17	4.8" MOL
	2	CFQ13W/GX7	2	MAG STD	Magnetic Standard	34	
	Compact Fluorescent Quad (18 W, G24q-2 Four Pin Base)						
	1	CFQ18W/G24q-2	1	MAG STD 120	120 V Magnetic Standard	25	6.8" MOL
	2	CFQ18W/G24q-2	2	MAG STD 120	120 V Magnetic Standard	50	
	1	CFQ18W/G24q-2	1	MAG STD 277	227 V Magnetic Standard	22	
	2	CFQ18W/G24q-2	2	MAG STD 277	227 V Magnetic Standard	44	
	1	CFQ18W/G24q-2	1	ELECT	Electronic	21	
	2	CFQ18W/G24q-2	2	ELECT	Electronic	38	
	3	CFQ18W/G24q-2	1	ELECT	Electronic	50	
Compact Fluorescent Triple	**Compact Fluorescent Triple (13 W, GX24q-1 Four Pin Base)**						
	1	CFM 13W/GX24q-1	1	MAG STD	Magnetic Standard	18	4.2" MOL
	2	CFM 13W/GX24q-1	2	MAG STD	Magnetic Standard	36	
	Compact Fluorescent Triple (13 W, GX24q-1 Four Pin Base)						
	1	CFM 13W/GX24q-1	1	ELECT	Electronic	14	
	2	CFM 13W/GX24q-1	2	ELECT	Electronic	25	
	Compact Fluorescent Triple (18W, GX24q-2 Four Pin Base)						
	1	CFM 18W/GX24q-2	1	MAG STD	Magnetic Standard	25	5.0" MOL
	2	CFM 18W/GX24q-2	2	MAG STD	Magnetic Standard	50	
	1	CFM 18W/GX24q-2	1	ELECT	Electronic	21	
	2	CFM 18W/GX24q-2	2	ELECT	Electronic	38	
	Compact Fluorescent Triple (26W, GX24q-3 Four Pin Base)						
	1	CFTR26W/GX24q-3	1	MAG STD	Magnetic Standard	37	4.9 to 5.4" MOL
	2	CFTR26W/GX24q-3	2	MAG STD	Magnetic Standard	74	
	1	CFTR26W/GX24q-3	1	ELECT	Electronic	28	
	2	CFTR26W/GX24q-3	1	ELECT	Electronic	55	
	1	CFTR26W/GX24q-3	1	ELECT DIM	Electronic Dimming	29	
	2	CFTR26W/GX24q-3	1	ELECT DIM	Electronic Dimming	57	
	Compact Fluorescent Triple (32 W, GX24q-3 Four Pin Base)						
	1	CFTR32WGX24q-3	1	ELECT	Electronic	35	
	2	CFTR32WGX24q-3	1	ELECT	Electronic	69	
	1	CFTR32WGX24q-3	1	ELECT DIM	Electronic Dimming	38	BF~1.05
	2	CFTR32WGX24q-3	1	ELECT DIM	Electronic Dimming	76	BF~1.05
	Compact Fluorescent Triple or Quad (42W, GX24q-4 Four Pin Base)						
	1	CFTR42WGX24q-4	1	ELECT	Electronic	46	
	2	CFTR42WGX24q-4	1	ELECT	Electronic	94	
	1	CFTR42WGX24q-4	1	ELECT DIM	Electronic Dimming	49	BF~1.05
	2	CFTR42WGX24q-4	1	ELECT DIM	Electronic Dimming	98	BF~1.05
	Compact Fluorescent Triple or Quad (57W, GX24q-5 Four Pin Base)						
	1	CFTR57WGX24q-5	1	ELECT	Electronic	62	
	1	CFTR57WGX24q-5	1	ELECT DIM	Electronic Dimming	66	BF~1.05
	Compact Fluorescent Triple or Quad (70W, GX24q-6 Four Pin Base)						
	1	CFTR70WGX24q-6	1	ELECT	Electronic	75	
	1	CFTR70WGX24q-6	1	ELECT DIM	Electronic Dimming	80	BF~1.00
	1	CFTR70WGX24q-6	1	ELECT	Electronic	75	
	1	CFTR70WGX24q-6	1	ELECT DIM	Electronic Dimming	80	BF~1.00

LUMINAIRE POWER

Lamp		Ballast			Watts/	
No.	Designation	No.	Abbreviation	Description	Luminaire	Comments
Fluorescent T5 Twin (18W - F18TT Lamp)						
1	FT18W/2G11	1	MAGNETIC	Magnetic Energy Efficient	23	BF~1.0
2	FT18W/2G11	1	MAGNETIC	Magnetic Energy Efficient	46	BF~1.0
3	FT18W/2G11	1	MAGNETIC	Magnetic Energy Efficient	69	
3	FT18W/2G11	2	MAGNETIC	Magnetic Energy Efficient	69	
4	FT18W/2G11	2	MAGNETIC	Magnetic Energy Efficient	92	2-lamp ballasts
1	FT18W/2G11	1	ELECT	Electronic	24	
2	FT18W/2G11	1	ELECT	Electronic	35	
3	FT18W/2G11	1	ELECT	Electronic	52	
3	FT18W/2G11	2	ELECT	Electronic	52	
4	FT18W/2G11	2	ELECT	Electronic	70	2-lamp ballasts
Fluorescent T5 Twin (24-27W- F24TT or F27TT Lamp)						
1	FT24W/2G11	1	MAGNETIC	Magnetic Energy Efficient	32	
2	FT24W/2G11	1	MAGNETIC	Magnetic Energy Efficient	66	
3	FT24W/2G11	1.5	MAGNETIC	Magnetic Energy Efficient	99	Tandem Wired
3	FT24W/2G11	2	MAGNETIC	Magnetic Energy Efficient	98	
4	FT24W/2G11	2	MAGNETIC	Magnetic Energy Efficient	132	2-lamp Ballasts
1	FT24W/2G11	1	ELECT	Electronic	27	BF~1.0
2	FT24W/2G11	1	ELECT	Electronic	52	BF~1.0
3	FT24W/2G11	1.5	ELECT	Electronic	64	Tandem Wired
3	FT24W/2G11	2	ELECT	Electronic	64	
4	FT24W/2G11	2	ELECT	Electronic	88	2-lamp ballasts
Fluorescent T5 Twin (36-39W - F36TT or F39TT Lamp)						
1	FT36W/2G11	1	MAG EE	Magnetic Energy Efficient	51	
2	FT36W/2G11	1	MAG EE	Magnetic Energy Efficient	66	
3	FT36W/2G11	2	MAG EE	Magnetic Energy Efficient	117	
4	FT36W/2G11	2	MAG EE	Magnetic Energy Efficient	132	
1	FT36W/2G11	1	ELECT	Electronic	37	
2	FT36W/2G11	1	ELECT	Electronic	70	
3	FT36W/2G11	1.5	ELECT	Electronic	105	
Fluorescent T5 Twin (36-39W - F36TT or F39TT Lamp) (*Cont.*)						
3	FT36W/2G11	2	ELECT	Electronic	107	
4	FT36W/2G11	2	ELECT	Electronic	140	
1	FT36W/2G11	1	ELEC THO	Electronic High Output	46	BF~1.22
2	FT36W/2G11	1	ELEC THO	Electronic High Output	86	BF~1.20
Fluorescent T5 Twin (40 W - F40TT Lamp)						
1	FT40W/2G11	1	MAG EE	Magnetic Energy Efficient	43	
2	FT40W/2G11	1	MAG EE	Magnetic Energy Efficient	86	
3	FT40W/2G11	1.5	MAG EE	Magnetic Energy Efficient	129	
3	FT40W/2G11	2	MAG EE	Magnetic Energy Efficient	130	
4	FT40W/2G11	2	MAG EE	Magnetic Energy Efficient	172	
1	FT40W/2G11	1	ELECT NO*****	Electronic	41	BF~.90
2	FT40W/2G11	1	ELECT NO*****	Electronic	78	BF~.97
3	FT40W/2G11	1	ELECT NO*****	Electronic	103	BF~.86
1	FT40W/2G11	1	ELECT HO*****	Electronic High Output	50	BF~1.1
1	FT40W/2G11	1	ELECT DIM	Electronic Dimming	41	BF~1.0
2	FT40W/2G11	1	ELECT DIM	Electronic Dimming	80	BF~1.0
3	FT40W/2G11	2	ELECT	Electronic	107	
4	FT40W/2G11	2	ELECT	Electronic	142	

Fluorescent Twin

***** Key for ballast factor (BF). RO=Reduced Output – BF=.70 to .85 NO=Normal Output – BF=.85 to 1.0
HO=High Output – BF=>1.0

	Lamp		Ballast			Watts/	
	No.	Designation	No.	Abbreviation	Description	Luminaire	Comments
Fluorescent Twin (*Cont.*)	**Fluorescent T5 Twin (50 W - F50TT Lamp)**						
	1	FT50W/2G11	1	ELECT NO*	Electronic Normal Output	54	BF~.98
	2	FT50W/2G11	1	ELECT NO*	Electronic Normal Output	106	BF~.98
	3	FT50W/2G11	1	ELECT NO*	Electronic Normal output	98	BF~.98
	3	FT50W/2G11	2	ELECT	Electronic	160	
	4	FT50W/2G11	2	ELECT	Electronic	212	
	1	FT50W/2G11	1	ELECT HO*	Electronic High Output	61	BF~1.12
	2	FT50W/2G11	1	ELECT HO*	Electronic High Output	115	BF~1.10
	1	FT50W/2G11	1	ELECT DIM	Electronic Dimming	51	
	2	FT50W/2G11	1	ELECT DIM	Electronic Dimming	92	
	Fluorescent T5 Twin (55 W - F55TT Lamp)						
	1	FT55W/2G11	1	ELECT NO*	Electronic Normal Output	58	BF~.92
	2	FT55W/2G11	1	ELECT NO*	Electronic Normal Output	109	BF~.90
	1	FT55W/2G11	1	ELECT DIM	Electronic Dimming	59	BF~.90
	2	FT55W/2G11	1	ELECT DIM	Electronic Dimming	114	BF~.90
	Fluorescent T5 Twin (80 W – F80TT Lamp)						
	1	FT80W/2G11	1	ELECT NO	Electronic	91	BF~1.00
Fluorescent U-Tube	**2 ft. Fluorescent U-Tube T8 (32W - FBO31T8 or F32T8/U/6 Lamp)**						
	1	FB31T8/F32T8U	0.5	MAGNETIC	Magnetic Energy Efficient	35	Tandem wired
	1	FB31T8/F32T8U	1	MAGNETIC	Magnetic Energy Efficient	36	
	2	FB31T8/F32T8U	1	MAGNETIC	Magnetic Energy Efficient	69	
	3	FB31T8/F32T8U	1.5	MAGNETIC	Magnetic Energy Efficient	104	Tandem wired
	3	FB31T8/F32T8U	2	MAGNETIC	Magnetic Energy Efficient	105	
	1	FB31T8/F32T8U	1	ELECT NO*	Electronic Normal Output	39	
	2	FB31T8/F32T8U	1	ELECT NO*	Electronic Normal Output	62	
	3	FB31T8/F32T8U	1	ELECT NO*	Electronic Normal Output	92	
	4	FB31T8/F32T8U	1	ELECT NO*	Electronic Normal Output		
	1	FB31T8/F32T8U	1	ELECT DIM	Electronic Dimming	33	BF~.88
	2	FB31T8/F32T8U	1	ELECT DIM	Electronic Dimming	64	BF~.88
	3	FB31T8/F32T8U	1	ELECT DIM	Electronic Dimming	93	BF~.88
	4	FB31T8/F32T8U	1	ELECT DIM	Electronic Dimming	116	BF~.88
	2	FB31T8/F32T8U	1	ELECT IS	Electronic Instant Start	61	
	3	FB31T8/F32T8U	1	ELECT IS	Electronic Instant Start	88	
	2 ft. Fluorescent U-Tube T12 ("Energy Saving" 34W)						
	1	FB40T12/ES	0.5	MAGNETIC	Magnetic Energy Efficient	36	Tandem wired
	1	FB40T12/ES	1	MAGNETIC	Magnetic Energy Efficient	43	
	2	FB40T12/ES	1	MAGNETIC	Magnetic Energy Efficient	72	
	3	FB40T12/ES	1	MAGNETIC	Magnetic Energy Efficient	105	
	3	FB40T12/ES	1.5	MAGNETIC	Magnetic Energy Efficient	108	Tandem wired
	3	FB40T12/ES	2	MAGNETIC	Magnetic Energy Efficient	115	
	1	FB40T12/ES	0.5	ELECT	Electronic	30	Tandem wired
	1	FB40T12/ES	1	ELECT	Electronic	31	
	2	FB40T12/ES	1	ELECT	Electronic	59	
	3	FB40T12/ES	1	ELECT	Electronic	90	
	3	FB40T12/ES	1.5	ELECT	Electronic	88	Tandem wired
	3	FB40T12/ES	2	ELECT	Electronic	90	
	2 ft. Fluorescent U-Tube T-12 ("Standard" 40W)						
	1	FB40T12	0.5	MAGNETIC	Magnetic Energy Efficient	43	Tandem wired
	1	FB40T12	1	MAGNETIC	Magnetic Energy Efficient	48	

***** Key for ballast factor (BF). RO=Reduced Output – BF=.70 to .85 NO=Normal Output – BF=.85 to 1.0
HO=High Output – BF=>1.0

LUMINAIRE POWER

Lamp		Ballast			Watts/	
No.	Designation	No.	Abbreviation	Description	Luminaire	Comments
2 ft. Fluorescent U-Tube T-12 ("Standard" 40W) (*Cont.*)						
2	FB40T12	1	MAGNETIC	Magnetic Energy Efficient	86	
3	FB40T12	1	MAGNETIC	Magnetic Energy Efficient	127	
3	FB40T12	1.5	MAGNETIC	Magnetic Energy Efficient	129	Tandem wired
3	FB40T12	2	MAGNETIC	Magnetic Energy Efficient	134	
1	FB40T12	0.5	ELECT	Electronic	35	Tandem wired
1	FB40T12	1	ELECT	Electronic	36	
2	FB40T12	1	ELECT	Electronic	67	
3	FB40T12	1	ELECT	Electronic	100	
3	FB40T12	1.5	ELECT	Electronic	101	Tandem wired
3	FB40T12	2	ELECT	Electronic	103	
Fluorescent Preheat T5 (4W)						
1	F4T5	1	MAG STD	Magnetic Standard	8	6" MOL
Fluorescent Preheat T5 (6W)						
1	F6T5	1	MAG STD	Magnetic Standard	10	9" MOL
Fluorescent Preheat T5 (8W)						
1	F8T5	1	MAG STD	Magnetic Standard	12	12" MOL
Fluorescent Preheat T8 (15W)						
1	F15T8	1	MAG STD	Magnetic Standard	19	18" MOL
Fluorescent Preheat T12 (15W)						
1	F15T12	1	MAG STD	Magnetic Standard	19	18" MOL
Fluorescent Preheat T12 (20W)						
1	F20T12	1	MAG STD	Magnetic Standard	25	24" MOL
2	F20T12	1	MAG STD	Magnetic Standard	50	24" MOL
Fluorescent Preheat T8 (30W)						
1	F30T8	1	MAG STD	Magnetic Standard	46	30" MOL
2	F30T8	1	MAG STD	Magnetic Standard	79	30" MOL
Fluorescent Preheat T12 (30W)						
1	F30T12	1	MAG STD	Magnetic Standard	46	30" MOL
2	F30T12	1	MAG STD	Magnetic Standard	79	30" MOL
2	F30T12	1	MAGNETIC	Magnetic Energy Efficient	74	30" MOL
1	F30T12	1	ELECT	Electronic	31	30" MOL
2	F30T12	2	ELECT	Electronic	63	30" MOL
~23" Fluorescent Program Start T5 (14W)						
1	F14T5	1	ELECT	Elect. Program Start	18	BF~1.0
2	F14T5	1	ELECT	Elect. Program Start	34	BF~1.0
~34.5" Fluorescent Program Start T5 (21W)						
1	F21T5	1	ELECT	Elect. Program Start	27	BF~1.0
2	F21T5	1	ELECT	Elect. Program Start	50	BF~1.0
~46" Fluorescent Program Start T5 (28W)						
1	F28T5	1	ELECT	Elect. Program Start	30	BF~1.0
2	F28T5	1	ELECT	Elect. Program Start	60	BF~1.0
~58.5" Fluorescent Program Start T5 (35W)						
1	F35T5	1	ELECT	Elect. Program Start	40	BF~1.0
2	F35T5	1	ELECT	Elect. Program Start	78	BF~1.0
~23" Fluorescent Program Start T5 High Output (24W)						
1	F24T5HO	1	ELECT	Elect. Program Start	27	BF~1.0
2	F24T5HO	1	ELECT	Elect. Program Start	52	BF~1.0
~34.5" Fluorescent Program Start T5 High Output(39W)						
1	F39T5	1	ELECT	Elect. Program Start	43	BF~1.0
2	F39T5	1	ELECT	Elect. Program Start	85	BF~1.0

Fluorescent U-Tube (*Cont.*)

Fluorescent Linear Lamps - Preheat

Fluorescent Linear Lamps – T5

	Lamp		Ballast			Watts/	
	No.	Designation	No.	Abbreviation	Description	Luminaire	Comments
Fluorescent Linear Lamps – T5 (*Cont.*)	**~46" Fluorescent Program Start T5 High Output (54W)**						
	1	F54T5	1	ELECT	Elect. Program Start	62	BF~1.0
	2	F54T5	1	ELECT	Elect. Program Start	117	BF~1.0
	3	F54T5	2	ELECT	Elect. Program Start	176	BF~1.0
	4	F54T5	2	ELECT	Elect. Program Start	234	BF~1.0
	~57.5" Fluorescent Program Start T5 High Output (80W)						
	1	F80T5	1	ELECT	Elect. Program Start	89	BF~1
Fluorescent Rapid Start	**2 foot Fluorescent Rapid Start T8 (17W)**						
	1	F17T8	1	MAGNETIC	Magnetic Energy Efficient	24	
	2	F17T8	1	MAGNETIC	Magnetic Energy Efficient	45	
	1	F17T8	1	ELECT NO*	Electronic Normal Output	22	
	2	F17T8	1	ELECT NO*	Electronic Normal Output	33	
	3	F17T8	1	ELECT NO*	Electronic Normal Output	53	
	3	F17T8	2	ELECT NO*	Electronic Normal Output	55	
	4	F17T8	1	ELECT NO*	Electronic Normal Output	63	
	2 foot Fluorescent Rapid Start T8 (17W)						
	1	F17T8	1	ELECT DIM	Electronic Dimming	20	BF~.88
	2	F17T8	1	ELECT DIM	Electronic Dimming	37	BF~.88
	3	F17T8	1	ELECT DIM	Electronic Dimming	56	BF~.88
	4	F17T8	1	ELECT DIM	Electronic Dimming	69	BF~.88
	3 foot Fluorescent Rapid Start T8 (25W)						
	1	F25T8	1	MAGNETIC	Magnetic Energy Efficient	33	
	2	F25T8	1	MAGNETIC	Magnetic Energy Efficient	65	
	1	F25T8	1	ELECT NO*	Electronic Normal Output	27	
	2	F25T8	1	ELECT NO*	Electronic Normal Output	48	
	3	F25T8	1	ELECT NO*	Electronic Normal Output	68	
	4	F25T8	1	ELECT NO*	Electronic Normal Output	89	
	1	F25T8	1	ELECT RO*	Electronic Reduced Output	24	BF~.82
	2	F25T8	1	ELECT RO*	Electronic Reduced Output	41	BF~.78
	3	F25T8	1	ELECT RO*	Electronic Reduced Output	59	BF~.77
	4	F25T8	1	ELECT RO*	Electronic Reduced Output	77	BF~.76
	1	F25T8	1	ELECT HO*	Electronic High Output	29	BF~1.05
	2	F25T8	1	ELECT HO*	Electronic High Output	51	BF~1.05
	3	F25T8	1	ELECT HO*	Electronic High Output	74	BF~1.05
	1	F25T8	1	ELECT DIM	Electronic Dimming	25	BF~.94
	2	F25T8	1	ELECT DIM	Electronic Dimming	49	BF~.94
	3	F25T8	1	ELECT DIM	Electronic Dimming	76	BF~.94
	4	F25T8	1	ELECT DIM	Electronic Dimming	89	BF~.95
	3 foot Fluorescent Rapid Start T12 ("Energy Saving" 25W)						
	1	F25T12ES	1	ELECT NO*	Electronic Normal Output	27	
	2	F25T12ES	1	ELECT NO*	Electronic Normal Output	52	
	3	F25T12ES	1	ELECT NO*	Electronic Normal Output	77	
	4	F25T12ES	1	ELECT NO*	Electronic Normal Output	95	
Fluorescent Instant Start T8	**4 foot Fluorescent Instant Start T8 ("Energy Saving" 30W)**						
	1	F32T8/30ES	1	ELECT NO*	Electronic Normal Output	29	
	2	F32T8/30ES	1	ELECT NO*	Electronic Normal Output	54	

***** Key for ballast factor (BF). RO=Reduced Output – BF=.70 to .85 NO=Normal Output – BF=.85 to 1.0
HO=High Output – BF=>1.0

LUMINAIRE POWER

Lamp		Ballast			Watts/	
No.	Designation	No.	Abbreviation	Description	Luminaire	Comments
4 foot Fluorescent Instant Start T8 ("Energy Saving" 30W) (*Cont.*)						
3	F32T8/30ES	1	ELECT NO*	Electronic Normal Output	79	
4	F32T8/30ES	1	ELECT NO*	Electronic Normal Output	104	
1	F32T8/30ES	1	ELECT RO*	Electronic Reduced Output	27	BF~.75
2	F32T8/30ES	1	ELECT RO*	Electronic Reduced Output	48	BF~.75
3	F32T8/30ES	1	ELECT RO*	Electronic Reduced Output	70	BF~.75
4	F32T8/30ES	1	ELECT RO*	Electronic Reduced Output	91	BF~.75
1	F32T8/30ES	1	ELECT NO* EE	EE Normal Output	33	
2	F32T8/30ES	1	ELECT NO* EE	EE Normal Output	52	
4 foot Fluorescent Instant Start T8 ("Energy Saving" 30W) (*Cont.*)						
3	F32T8/30ES	1	ELECT NO* EE	EE Normal Output	77	
4	F32T8/30ES	1	ELECT NO* EE	EE Normal Output	101	
1	F32T8/30ES	1	ELECT RO* EE	EE Reduced Output	28	BF~.78
2	F32T8/30ES	1	ELECT RO* EE	EE Reduced Output	45	BF~.78
3	F32T8/30ES	1	ELECT RO* EE	EE Reduced Output	66	BF~.78
4	F32T8/30ES	1	ELECT RO* EE	EE Reduced Output	88	BF~.78
4 foot Fluorescent Rapid Start T8 (32W)						
1	F32T8	0.5	MAGNETIC	Magnetic Energy Efficient	35	Tandem wired
1	F32T8	1	MAGNETIC	Magnetic Energy Efficient	39	
2	F32T8	1	MAGNETIC	Magnetic Energy Efficient	70	
3	F32T8	1.5	MAGNETIC	Magnetic Energy Efficient	105	Tandem wired
3	F32T8	2	MAGNETIC	Magnetic Energy Efficient	109	
4	F32T8	2	MAGNETIC	Magnetic Energy Efficient	140	(2) two-lamp
4 foot Fluorescent Rapid Start T8 (32W)						
1	F32T8	0.5	ELECT NO*	Electronic Normal Output	31	
1	F32T8	1	ELECT NO*	Electronic Normal Output	32	
2	F32T8	1	ELECT NO*	Electronic Normal Output	62	
3	F32T8	1	ELECT NO*	Electronic Normal Output	93	
3	F32T8	1.5	ELECT NO*	Electronic Normal Output	93	Tandem wired
4	F32T8	1	ELECT NO*	Electronic Normal Output	114	
1	F32T8	1	EE NO*	EE Normal Output	35	
2	F32T8	1	EE NO*	EE Normal Output	55	
3	F32T8	1	EE NO*	EE Normal Output	82	
4	F32T8	1	EE NO*	EE Normal Output	107	
1	F32T8	1	ELECT RO*	Electronic Reduced Output	29	BF~.75
2	F32T8	1	ELECT RO*	Electronic Reduced Output	51	BF~.75
3	F32T8	1	ELECT RO*	Electronic Reduced Output	76	BF~.75
4	F32T8	1	ELECT RO*	Electronic Reduced Output	100	BF~.75
2	F32T8	1	ELECT HO*	Electronic High Output	77	BF~1.13
3	F32T8	1	ELECT HO*	Electronic High Output	112	BF~1.18
1	F32T8	1	EE RO*	EE Reduced Output	30	BF~.74
2	F32T8	1	EE RO*	EE Reduced Output	48	BF~.74

Fluorescent Instant Start T8 (*Cont.*)

***** Key for ballast factor (BF). RO=Reduced Output – BF=.70 to .85 NO=Normal Output – BF=.85 to 1.0
HO=High Output – BF=>1.0

	Lamp		Ballast			Watts/	
	No.	Designation	No.	Abbreviation	Description	Luminaire	Comments
Fluorescent Rapid Start T8 (*Cont.*)	**4 foot Fluorescent Rapid Start T8 (32W) (*Cont.*)**						
	3	F32T8	1	EE RO*	EE Reduced Output	73	BF~.74
	4	F32T8	1	EE RO*	EE Reduced Output	96	BF~.74
	2	F32T8	1	ELECT TL	Electronic Two Level (50 & 100%)	65	
	3	F32T8	1.5	ELECT TL	Electronic Two Level (50 & 100%)	98	Tandem wired
	4	F32T8	2	ELECT TL	Electronic Two Level (50 & 100%)	130	2-lamp ballasts
	1	F32T8	1	ELECT DIM	Electronic Dimming	35	BF~1.0
	2	F32T8	1	ELECT DIM	Electronic Dimming	68	BF~1.0
	3	F32T8	1	ELECT DIM	Electronic Dimming	102	BF~1.0
	4	F32T8	1	ELECT DIM	Electronic Dimming	116	BF~.88
	1	F40T8	1	MAGNETIC	Magnetic Energy Efficient	50	
	2	F40T8	1	MAGNETIC	Magnetic Energy Efficient	92	
	1	F40T8	1	ELECT	Electronic	46	
	2	F40T8	1	ELECT	Electronic	79	
	3	F40T8	1	ELECT	Electronic	112	
Fluorescent Rapid Start T12	**3 foot Fluorescent Rapid Start T12 ("Energy-Saving" 25W)**						
	1	F30T12/ES	1	MAG STD	Magnetic Standard	42	
	2	F30T12/ES	1	MAG STD	Magnetic Standard	74	
	3	F30T12/ES	1.5	MAG STD	Magnetic Standard	111	Tandem wired
	3	F30T12/ES	2	MAG STD	Magnetic Standard	116	
	2	F30T12/ES	1	MAGNETIC	Magnetic Energy Efficient	66	
	1	F30T12/ES	1	ELECT	Electronic	26	
	2	F30T12/ES	1	ELECT	Electronic	53	
	3 foot Fluorescent Rapid Start T12 ("Standard" 30W)						
	1	F30T12	1	MAG STD	Magnetic Standard	46	
	2	F30T12	1	MAG STD	Magnetic Standard	79	
	3	F30T12	1.5	MAG STD	Magnetic Standard	118	Tandem wired
	3	F30T12	2	MAG STD	Magnetic Standard	125	
	2	F30T12	1	MAGNETIC	Magnetic Energy Efficient	73	
	1	F30T12	1	ELECT	Electronic	30	
	2	F30T12	1	ELECT	Electronic	60	
	4 foot Fluorescent Rapid Start T12 ("Energy-Saving Plus"32W)						
	1	F40T12/ES Plus	0.5	MAGNETIC	Magnetic Energy Efficient	34	Tandem wired
	1	F40T12/ES Plus	1	MAGNETIC	Magnetic Energy Efficient	41	
	2	F40T12/ES Plus	1	MAGNETIC	Magnetic Energy Efficient	68	
	3	F40T12/ES Plus	1	MAGNETIC	Magnetic Energy Efficient	99	
	3	F40T12/ES Plus	1.5	MAGNETIC	Magnetic Energy Efficient	102	Tandem wired
	3	F40T12/ES Plus	2	MAGNETIC	Magnetic Energy Efficient	109	
	4	F40T12/ES Plus	2	MAGNETIC	Magnetic Energy Efficient	136	2-lamp ballasts
	1	F40T12/ES	0.5	MAG STD	Magnetic Standard	42	Tandem wired
	1	F40T12/ES	1	MAG STD	Magnetic Standard	48	
	2	F40T12/ES	1	MAG STD	Magnetic Standard	82	
	3	F40T12/ES	1.5	MAG STD	Magnetic Standard	122	Tandem wired
	3	F40T12/ES	2	MAG STD	Magnetic Standard	130	
	4	F40T12/ES	2	MAG STD	Magnetic Standard	164	2-lamp ballasts
	1	F40T12/ES	0.5	MAGNETIC	Magnetic Energy Efficient	36	Tandem wired
	1	F40T12/ES	1	MAGNETIC	Magnetic Energy Efficient	43	
	2	F40T12/ES	1	MAGNETIC	Magnetic Energy Efficient	72	
	3	F40T12/ES	1	MAGNETIC	Magnetic Energy Efficient	105	
	3	F40T12/ES	1.5	MAGNETIC	Magnetic Energy Efficient	108	Tandem wired
	3	F40T12/ES	2	MAGNETIC	Magnetic Energy Efficient	112	

***** Key for ballast factor (BF). RO=Reduced Output – BF=.70 to .85 NO=Normal Output – BF=.85 to 1.0
HO=High Output – BF=>1.0

LUMINAIRE POWER

Lamp		Ballast			Watts/	
No.	Designation	No.	Abbreviation	Description	Luminaire	Comments
4 foot Fluorescent Rapid Start T12 ("Energy-Saving"34W) (*Cont.*)						
4	F40T12/ES	2	MAGNETIC	Magnetic Energy Efficient	144	2-lamp ballasts
2	F40T12/ES	1	MAG HC	Magnetic Heater Cutout	58	
3	F40T12/ES	1.5	MAG HC	Magnetic Heater Cutout	87	Tandem wired
4	F40T12/ES	2	MAG HC	Magnetic Heater Cutout	116	2-lamp ballasts
2	F40T12/ES	1	MAG HC FO	Mag. Heater Cutout Full Light	66	
3	F40T12/ES	1.5	MAG HC FO	Mag. Heater Cutout Full Light	99	Tandem wired
4	F40T12/ES	2	MAG HC FO	Mag. Heater Cutout Full Light	132	2-lamp ballasts
1	F40T12/ES	0.5	ELECT	Electronic	30	Tandem wired
1	F40T12/ES	1	ELECT	Electronic	31	
2	F40T12/ES	1	ELECT	Electronic	62	
3	F40T12/ES	1	ELECT	Electronic	90	
3	F40T12/ES	1.5	ELECT	Electronic	93	Tandem wired
3	F40T12/ES	2	ELECT	Electronic	93	
4	F40T12/ES	1	ELECT	Electronic	121	
4	F40T12/ES	2	ELECT	Electronic	124	2-lamp ballasts
2	F40T12/ES	1	ELECT AO	Elec. Adjustable Output (to 15%)	60	
3	F40T12/ES	1.5	ELECT AO	Elec. Adjustable Output (to 15%)	90	Tandem wired
4	F40T12/ES	2	ELECT AO	Elec. Adjustable Output (to 15%)	120	2-lamp ballasts
4 foot Fluorescent Rapid Start Standard (40W)						
1	F40T12	0.5	MAG STD	Magnetic Standard	26	Tandem wired
1	F40T12	1	MAG STD	Magnetic Standard	52	
2	F40T12	1	MAG STD	Magnetic Standard	96	
3	F40T12	1.5	MAG STD	Magnetic Standard	144	Tandem wired
3	F40T12	2	MAG STD	Magnetic Standard	148	
4	F40T12	2	MAG STD	Magnetic Standard	192	2-lamp ballasts
1	F40T12	0.5	MAGNETIC	Magnetic Energy Efficient	44	Tandem wired
1	F40T12	1	MAGNETIC	Magnetic Energy Efficient	46	
2	F40T12	1	MAGNETIC	Magnetic Energy Efficient	88	
3	F40T12	1	MAGNETIC	Magnetic Energy Efficient	127	
3	F40T12	1.5	MAGNETIC	Magnetic Energy Efficient	132	Tandem wired
3	F40T12	2	MAGNETIC	Magnetic Energy Efficient	134	
4	F40T12	2	MAGNETIC	Magnetic Energy Efficient	176	2-lamp ballasts
2	F40T12	1	MAG HC	Magnetic Heater Cutout	71	
3	F40T12	1.5	MAG HC	Magnetic Heater Cutout	107	Tandem wired
4	F40T12	2	MAG HC	Magnetic Heater Cutout	142	2-lamp ballasts
2	F40T12	1	MAG HC FO	Magnetic Heater Cutout Full Light	80	
3	F40T12	1.5	MAG HC FO	Magnetic Heater Cutout Full Light	120	Tandem wired
4	F40T12	2	MAG HC FO	Magnetic Heater Cutout Full Light	160	2-lamp ballasts
1	F40T12	0.5	ELECT	Electronic	36	Tandem wired
1	F40T12	1	ELECT	Electronic	37	
2	F40T12	1	ELECT	Electronic	72	
3	F40T12	1	ELECT	Electronic	107	
3	F40T12	1.5	ELECT	Electronic	108	Tandem wired
3	F40T12	2	ELECT	Electronic	109	
4	F40T12	1	ELECT	Electronic	135	
4	F40T12	2	ELECT	Electronic	144	2-lamp ballasts
2	F40T12	1	ELECT RO	Electronic Reduce Output (75%)	61	
3	F40T12	1	ELECT RO	Electronic Reduce Output (75%)	90	
3	F40T12	1.5	ELECT RO	Electronic Reduce Output (75%)	92	Tandem wired
4	F40T12	2	ELECT RO	Electronic Reduce Output (75%)	122	2-lamp ballasts

Fluorescent Rapid Start T12 (*Cont.*)

	Lamp		Ballast			Watts/	
	No.	Designation	No.	Abbreviation	Description	Luminaire	Comments
Fluorescent Rapid Start T12 *(Cont.)*	**4 foot Fluorescent Rapid Start Standard (40W) (*Cont.*)**						
	2	F40T12	1	ELECT TL	Elec. Two Level (50 & 100%)	69	
	3	F40T12	1.5	ELECT TL	Elec. Two Level (50 & 100%)	104	Tandem wired
	4	F40T12	2	ELECT TL	Elec. Two Level (50 & 100%)	138	2-lamp ballasts
	2	F40T12	1	ELECT AO	Elec. Adjustable Output (to 15%)	73	
	3	F40T12	1.5	ELECT AO	Elec. Adjustable Output (to 15%)	110	Tandem wired
	4	F40T12	2	ELECT AO	Elec. Adjustable Output (to 15%)	146	2-lamp ballasts
	2	F40T12	1	ELECT DIM	Electronic Dimming (to 1%)	83	
	3	F40T12	1.5	ELECT DIM	Electronic Dimming (to 1%)	125	Tandem wired
	4	F40T12	2	ELECT DIM	Electronic Dimming (to 1%)	166	2-lamp ballasts
Fluorescent Rapid Start T10	**4 foot Fluorescent Rapid Start T10 Extended Output (42W)**						
	2	F40T10/EO	1	MAGNETIC	Magnetic Energy Efficient	92	
	3	F40T10/EO	1.5	MAGNETIC	Magnetic Energy Efficient	138	Tandem wired
	4	F40T10/EO	2	MAGNETIC	Magnetic Energy Efficient	184	2-lamp ballasts
	2	F40T10/EO	1	MAG HC	Magnetic Heater Cutout	74	
	3	F40T10/EO	1.5	MAG HC	Magnetic Heater Cutout	111	Tandem wired
	4	F40T10/EO	2	MAG HC	Magnetic Heater Cutout	148	2-lamp ballasts
	2	F40T10/EO	1	ELECT	Electronic	74	
	3	F40T10/EO	1.5	ELECT	Electronic	111	Tandem wired
	4	F40T10/EO	2	ELECT	Electronic	148	2-lamp ballasts
	2	F40T10/EO	1	ELECT RO	Electronic Reduce Output (75%)	63	
	3	F40T10/EO	1.5	ELECT RO	Electronic Reduce Output (75%)	95	Tandem wired
	4	F40T10/EO	2	ELECT RO	Electronic Reduce Output (75%)	126	2-lamp ballasts
	2	F40T10/EO	1	ELECT TL	Elec. Two Level (50 & 100%)	72	
	3	F40T10/EO	1.5	ELECT TL	Elec. Two Level (50 & 100%)	108	Tandem wired
	4	F40T10/EO	2	ELECT TL	Elec. Two Level (50 & 100%)	144	2-lamp ballasts
	2	F40T10/EO	1	ELECT AO	Elec. Adjustable Output (to 15%)	73	
	3	F40T10/EO	1.5	ELECT AO	Elec. Adjustable Output (to 15%)	110	Tandem wired
	4	F40T10/EO	2	ELECT AO	Elec. Adjustable Output (to 15%)	146	2-lamp ballasts
	2	F40T10/EO	1	ELECT DIM	Electronic Dimming (to 1%)	85	
	3	F40T10/EO	1.5	ELECT DIM	Electronic Dimming (to 1%)	128	Tandem wired
	4	F40T10/EO	2	ELECT DIM	Electronic Dimming (to 1%)	170	2-lamp ballasts
Fluorescent Rapid Start High Output	**8 foot Fluorescent Rapid Start T8 High Output (86W)**						
	1	F96T8/HO	1	ELECT	Electronic	88	
	2	F96T8/HO	1	ELECT	Electronic	160	
	8 foot Fluorescent Rapid Start T12 High Output ("Energy-Saving" 95W)						
	1	F96T12/HO/ES	1	MAG STD	Magnetic Standard	125	
	2	F96T12/HO/ES	1	MAG STD	Magnetic Standard	227	
	2	F96T12/HO/ES	1	MAGNETIC	Magnetic Energy Efficient	208	
	2	F96T12/HO/ES	1	ELECT	Electronic	170	
	8 foot Fluorescent Rapid Start T12 High Output ("Standard" 110W)						
	1	F96T12/HO	1	MAG STD	Magnetic Standard	140	
	2	F96T12/HO	1	MAG STD	Magnetic Standard	252	
	2	F96T12/HO	1	MAGNETIC	Magnetic Energy Efficient	237	
	1	F96T12/HO	1	ELECT	Electronic	119	
	2	F96T12/HO	1	ELECT	Electronic	205	
	8 foot Fluorescent Rapid Start T12 Very High Output ("Energy-Saving" 195W)						
	1	F96T12/VHO/ES	1	MAG STD	Magnetic Standard	200	
	2	F96T12/VHO/ES	1	MAG STD	Magnetic Standard	325	
	8 foot Fluorescent Rapid Start T12 Very High Output ("Standard" 215W)						
	1	F96T12/VHO	1	MAG STD	Magnetic Standard	230	
	2	F96T12/VHO	1	MAG STD	Magnetic Standard	440	

LUMINAIRE POWER

Lamp		Ballast			Watts/	
No.	Designation	No.	Abbreviation	Description	Luminaire	Comments
4 foot Fluorescent Slimline Energy-Saving T12 (32W)						
1	F48T12/ES	1	MAG STD	Magnetic Standard	51	
2	F48T12/ES	1	MAG STD	Magnetic Standard	82	
4 foot Fluorescent Slimline Standard T12 (39W)						
1	F48T12	1	MAG STD	Magnetic Standard	59	
2	F48T12	1	MAG STD	Magnetic Standard	98	
8 foot Fluorescent T8 Slimline (59W)						
1	F96T8	1	MAGNETIC	Magnetic Standard	58	
2	F96T8	1	MAGNETIC	Magnetic Standard	120	
2	F96T8	1	ELECT NO*	Electronic Normal Output	110	
1	F96T8	1	ELECT HO*	Electronic High Output	72	BF~1.10
2	F96T8	1	ELECT HO*	Electronic High Output	151	BF~1.20
8 foot Fluorescent T12 Slimline ("Energy-Saving" 60W)						
1	F96T12/ES	1	MAG STD	Magnetic Standard	74	
2	F96T12/ES	1	MAG STD	Magnetic Standard	131	
2	F96T12/ES	1	MAGNETIC	Magnetic Energy Efficient	112	
1	F96T12/ES	1	ELECT	Electronic	70	
2	F96T12/ES	1	ELECT	Electronic	107	
8 foot Fluorescent T12 Slimline ("Standard" 75W)						
1	F96T12	1	MAG STD	Magnetic Standard	92	
2	F96T12	1	MAG STD	Magnetic Standard	158	
2	F96T12	1	MAGNETIC	Magnetic Energy Efficient	144	
1	F96T12	1	ELECT	Electronic	85	
2	F96T12	1	ELECT	Electronic	132	
Mercury Vapor						
1	H40	1	MAG STD	Magnetic Standard	51	
1	H50	1	MAG STD	Magnetic Standard	63	
1	H75	1	MAG STD	Magnetic Standard	88	
1	H100	1	MAG STD	Magnetic Standard	119	
1	H175	1	MAG STD	Magnetic Standard	197	
1	H250	1	MAG STD	Magnetic Standard	285	
1	H400	1	MAG STD	Magnetic Standard	450	
1	H1000	1	MAG STD	Magnetic Standard	1080	
Metal Halide						
1	M32	1	MAG STD	Magnetic Standard	42	
1	M35/39	1	MAG STD	Magnetic Standard	48	
1	M35/39	1	ELECT	Electronic	44	
1	M50	1	MAG STD	Magnetic Standard	68	
1	M50	1	ELECT	Electronic	58	
1	M70	1	MAG STD	Magnetic Standard	92	
1	M70	1	ELECT	Electronic	86	
1	M100	1	MAG STD	Magnetic Standard	122	
1	M100	1	ELECT	Electronic	110	
1	M125	1	MAG STD	Magnetic Standard	150	
1	M150	1	MAG STD	Magnetic Standard	186	
1	M150	1	ELECT	Electronic	168	
1	M175	1	MAG STD	Magnetic Standard	205	
1	M200	1	MAG STD	Magnetic Standard	232	
1	M225	1	MAG STD	Magnetic Standard	258	
1	M250	1	MAG STD	Magnetic Standard	295	
1	M320	1	MAG STD	Magnetic Standard	365	

Fluorescent Instant Start

High Intensity Discharge

***** Key for ballast factor (BF). RO=Reduced Output – BF=.70 to .85 NO=Normal Output – BF=.85 to 1.0
HO=High Output – BF=>1.0

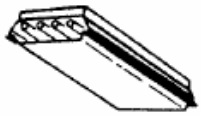
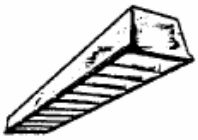
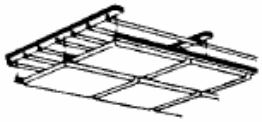
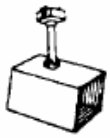
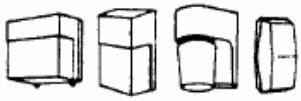
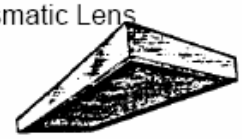
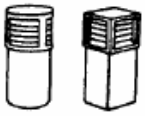
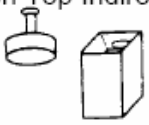
	Lamp		Ballast			Watts/	
	No.	Designation	No.	Abbreviation	Description	Luminaire	Comments
High Intensity Discharge (*Cont.*)	**Metal Halide (*Cont.*)**						
	1	M320	1	MAG LR	277v Linear Reactor	345	
	1	M320	1	ELECT	Electronic	345	
	2	M320	1	ELECT	Electronic Dimming	679	Dimming to 50%
	1	M350	1	ELECT	Electronic	375	
	2	M350	1	ELECT	Electronic Dimming	740	Dimming to 50%
	1	M360	1	MAG STD	Magnetic Standard	422	
	1	M360	1	MAG LR	277v Linear Reactor	388	
	1	M400	1	MAG STD	Magnetic Standard	461	
	1	M400	1	MAG LR	277v Linear Reactor	426	
	1	M400	1	ELECT	Electronic	430	
	2	M400	1	ELECT	Electronic Dimming	843	Dimming to 50%
	1	M450	1	MAG STD	Magnetic Standard	502	
	1	M450	1	MAG LR	277v Linear Reactor	478	
	1	M750	1	MAG STD	Magnetic Standard	820	
	1	M900	1	MAG STD	Magnetic Standard	990	
	1	M1000	1	MAG STD	Magnetic Standard	1080	
	2	M1000	1	ELECT	Electronic	2100	277 Volt
	1	M1500	1	MAG STD	Magnetic Standard	1650	
	1	M1650	1	MAG STD	Magnetic Standard	1810	
	High Pressure Sodium						
	1	S35	1	MAG STD	Magnetic Standard	44	
	1	S50	1	MAG STD	Magnetic Standard	61	
	1	S70	1	MAG STD	Magnetic Standard	93	
	1	S70	1	ELECT	Electronic Dimming	81	
	1	S100	1	MAG STD	Magnetic Standard	116	
	1	S100	1	ELECT	Electronic Dimming	114	
	1	S150	1	MAG STD	Magnetic Standard	173	
	1	S150	1	ELECT	Electronic Dimming	166	
	1	S200	1	MAG STD	Magnetic Standard	240	
	1	S250	1	MAG STD	Magnetic Standard	302	
	1	S250	1	ELECT	Electronic Dimming	285	
	1	S400	1	MAG STD	Magnetic Standard	469	
	1	S400	1	ELECT	Electronic Dimming	435	
	1	S1000	1	MAG STD	Magnetic Standard	1090	
	Low Pressure Sodium						
	1	LPS18	1	MAG STD	Magnetic Standard	30	
	1	LPS35	1	MAG STD	Magnetic Standard	60	
	1	LPS55	1	MAG STD	Magnetic Standard	80	
	1	LPS90	1	MAG STD	Magnetic Standard	125	
	1	LPS135	1	MAG STD	Magnetic Standard	178	
	1	LPS180	1	MAG STD	Magnetic Standard	220	
Tungsten Halogen	**12 Volt Tungsten Halogen Lamps Including MR16, Bi-pin, AR70, AR111, PAR36**						
	1	20 watt lamp	1	EPS	Electronic Power Supply	23	
	1	25 watt lamp	1	EPS	Electronic Power Supply	28	
	1	35 watt lamp	1	EPS	Electronic Power Supply	38	
	1	37 watt lamp	1	EPS	Electronic Power Supply	41	
	1	42 watt lamp	1	EPS	Electronic Power Supply	45	
	1	50 watt lamp	1	EPS	Electronic Power Supply	54	
	1	65 watt lamp	1	EPS	Electronic Power Supply	69	
	1	71 watt lamp	1	EPS	Electronic Power Supply	75	
	1	75 watt lamp	1	EPS	Electronic Power Supply	80	

LUMINAIRE POWER

Lamp		Ballast			Watts/	
No.	**Designation**	**No.**	**Abbreviation**	**Description**	**Luminaire**	**Comments**
12 Volt Tungsten Halogen Lamps Including MR16, Bi-pin, AR70, AR111, PAR36						
1	100 watt lamp	1	EPS	Electronic Power Supply	106	
1	20 watt lamp	1	MT	Magnetic Transformer	24	
1	25 watt lamp	1	MT	Magnetic Transformer	29	
1	35 watt lamp	1	MT	Magnetic Transformer	39	
1	37 watt lamp	1	MT	Magnetic Transformer	42	
1	42 watt lamp	1	MT	Magnetic Transformer	46	
1	50 watt lamp	1	MT	Magnetic Transformer	55	
1	65 watt lamp	1	MT	Magnetic Transformer	70	
1	71 watt lamp	1	MT	Magnetic Transformer	76	
1	75 watt lamp	1	MT	Magnetic Transformer	81	
1	100 watt lamp	1	MT	Magnetic Transformer	108	

Tungsten Halogen ***(Cont.)***

TYPES OF LIGHT FIXTURES

Roadway 	Fluorescent Troffer with Dropped Diffuser 	Recessed Baffle Downlight 
Parking Area 	Fluorescent Troffer with Plastic Egg-crate Diffuser 	Recessed Downlight with Regressed Fresnel Lens 
Area Post Tops 	Fluorescent Parabolic-louvered Troffer 	Recessed HID Parabolic-louvered 
Floodlight - HID and Incandescent 	Luminous Ceiling 	Track Light 
Wall Mount 	Fluorescent Modular with Prismatic Lens 	Drum Light 
Walkway Bollards 	Fluorescent Wraparound 	Pendant Sphere 
Garden/Walkway 	Fluorescent Strip 	Concentric Ring 
Landscape Uplights 	Industrial Fluorescent 	Industrial Dome 
Industrial HID - High Bay and Low Bay 	Fluorescent Open-Louvered 	HID Open Top Indirect Light 

TYPES OF LAMP CODES

Incandescent Lamps

Lamp Code	Lamp Description
75A19	75……..Lamp wattage A…….Bulb shape 19……..Bulb diameter in eighths of an inch

Fluorescent Lamps

Lamp Code	Lamp Description
F32T8 RE830	4 ft Energy-efficient, rapid start F……...Fluorescent 32…….Lamp wattage T8…….Tube diameter in eighths of an inch RE830..Lamp color
F40T12 WW	4 ft Common, rapid start F……...Fluorescent 40…….Nominal lamp wattage T12…..Tube diameter in eighths of an inch WW…..Lamp color
F40T12 CW/RS/ES	4 ft Energy saving, rapid start F……...Fluorescent 40…….Nominal lamp wattage CW.....Lamp color RS.……Rapid start ES.……Energy saving
F96T12 CW/ES	Slimline, normally 8 ft. F……...Fluorescent 96…….Lamp length in inches T12…..Tube diameter in eighths of an inch CW.....Lamp color ES.……Energy saving
F96T12 CW/HO/ES	High output, normally 8 ft. F……...Fluorescent 96…….Lamp length in inches T12…..Tube diameter in eighths of an inch CW.....Lamp color HO……...High output VHO.....Very high output ES.……..Energy saving

Lamp Color:
WW = Warm White
CW = Cool White
N = Natural
D = Daylight
41 = 4,100K
35 = 3,500K
30 = 3,000K
RE835 = Rare Earth, CRI over 80, 3,500K

Energy saving:
SS = Sylvania "Super-saver"
WM = GE "Watt-miser"
EW = Philips "Econ-o-watt"

HID Lamps

Lamp Code	Lamp Description
	LU…….Type of HID lamp code, see table below 150……Lamp wattage XXX…..Non-standard proprietary code

Lamp Type	Philips	Sylvania	GE
Mercury Vapor	H	H	HR
Metal Halide	MH	MS	MV
High Pressure Sodium	C	LU	LU

RAPID START BALLASTS for 34 and 40 Watt Rapid Start Lamp

Lamp Number and Type	Nom. Watts	Input Circuit (V)	Ballast Description*	Catalog Number	Cert.	Min. Temp.	Input Watts	Sound Rating	Fig. No.	Circuit Type
ONE LAMP, HIGH POWER FACTOR										
(1)F40T12/RS ENERGY SAVING	34	120	Maxi-Miser II	8G1078W	ETL	60	45	A	42	LEAD
		277	Maxi-Miser II	8G1088W	ETL		47			
		120	Optimiser	M28-120-1F	-		37			
		277	Optimiser	M28-277-1F	-		38			
(1)F40T12/RS	40								42	LEAD
		120	Watt-Miser	8G1074W	CBM	50	48		42	LEAD
		120	Maxi-Miser II	8G1078W	-	50	52	A	42	LEAD
		120	Low Temp.	8G3688W	-	0	54		22	LEAD
		120	Dimming	8G500AWF	-	50	50		15	LAG
		120	Optimiser	M28-120-1F	-	50	45		42	LEAD
TWO LAMP, HIGH POWER FACTOR										
(2)F40T12/RS ENERGY SAVING	34	277	Maxi-Miser II	8G1038W	ETL	60	77	A	14	SERIES L.
		120	Optimiser	M28-120	-		59			
		277	Optimiser	M28-277	-		60			
(2)F40T12/RS	40							A	14	SERIES L.
		120	Quick Change kit	8G1022W10	CBM	50	96	A	14	SERIES L.
		120	Watt-Miser	8G1024W	CBM	50	86	A	14	SERIES L.
		120	Low Temp	8G3905W	-	0	90	A	14	SERIES L.
		120	Dimming	8G5007W	-	50	103	B	29	LAG
		120	Optimiser	M28-120	-	50	71	A	14	SERIES L.
		120	Performance	E40-120-2	-	50	70	A	14	SERIES L.
		240	Standard	8G3917W	-	50	92	A	14	SERIES L.
		277	Standard	8G1032W	CBM	50	96	A	14	SERIES L.
THREE LAMP, HIGH POWER FACTOR										
(3)F40T12/RS Energy Saving	34	277	Watt-Miser	8G1334W	-	60	106	A	28	SERIES L.
(3)F40T12/RS	40	120	Performance	E40-120-3	-	50	109	A	28	SERIES L.
		277		E40-277-3	-		109			

This procedure determines the luminaire power using catalog cuts. Use this procedure if a particular lamp/ballast combination is not in Table 5a or you wish to claim a lower value. Attach the catalog cuts with your compliance forms.

To determine the luminaire power using catalog cuts, follow the steps below:

Step 1. Find the number and type of ballasts in each luminaire.

Fluorescent ballasts usually serve one or two lamps. Some serve three or four lamps. Luminaires may be wired in tandem. That means ballasts may serve lamps in two or more luminaires.

Example: A three-tube fluorescent luminaire may have the following combinations:

- (1) one-lamp ballast and (1) two-lamp ballast
- (1) three-lamp ballast, or
- (1) two-lamp ballast and (1) two-lamp tandem wired ballast, equivalent to (1.5) two-lamp ballast for each luminaire.

For HID lamps, each lamp usually has its own ballast.

Step 2. Find the input wattage for each ballast type.

Ballast catalogs provide tested input wattages for ballast and lamp combinations. In most catalogs, seven items are required to determine input wattages:

1. Circuit type, such as “rapid start.”
2. Number of lamps per ballast.
3. Ballast power factor – for example, “low” or “high” power factor.

4. Number and type of lamp, such as "(2)F40T12/RS Energy Saving."
5. Nominal lamp watts.
6. Input circuit voltage.
7. Ballast type, such as "standard," "electronic," "low temperature," "dimming," or a manufacturer's ordering code.

Ballast catalogs may list more than one input wattage for a lamp/ballast combination. Use the tested or the American National Standard Institute (ANSI) value.

HID input wattage may be found in a luminaire catalog or a ballast catalog.

Step 3. Calculate luminaire power.

Total the input wattage of each ballast type in the luminaire. If a ballast is tandem wired for two luminaires, use half the total ballast input.

Example 1

Three-tube fluorescent luminaire with:

- F40T12, 40 W lamps
- (1) one-lamp standard 120V magnetic ballast
- (1) two-lamp standard 120V magnetic ballast.

Using the figure above, ballast input wattages equal 52 and 96, respectively.

Luminaire Power = 52 + 96 = 148 W

Example 2

Three-tube fluorescent luminaire with:

- F40T12 energy-saving 34W lamps
- (1) Three-lamp energy-efficient (Watt-Miser*) 120V magnetic ballast

Using the figure above, ballast input wattages equal 105.

Luminaire power = 105 W

Example 3

Three-tube fluorescent luminaire with:

- F40T12 energy-saving 34W lamps
- (1) Two-lamp and (1) two-lamp tandem wired 120V energy efficient (Maxi-Miser) magnetic ballasts.

Number of ballasts = three ballasts / two luminaires = 1.5 ballast per luminaire

Using the example catalog cut-sheet, the ballast input wattage equals 76 Watts.

Luminaire power = 1.5 x 76 = 114W