



U.S. Department of Energy
**Energy Efficiency
and Renewable Energy**

Bringing you a prosperous future where energy
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 Building Energy Codes Program

2009 IECC

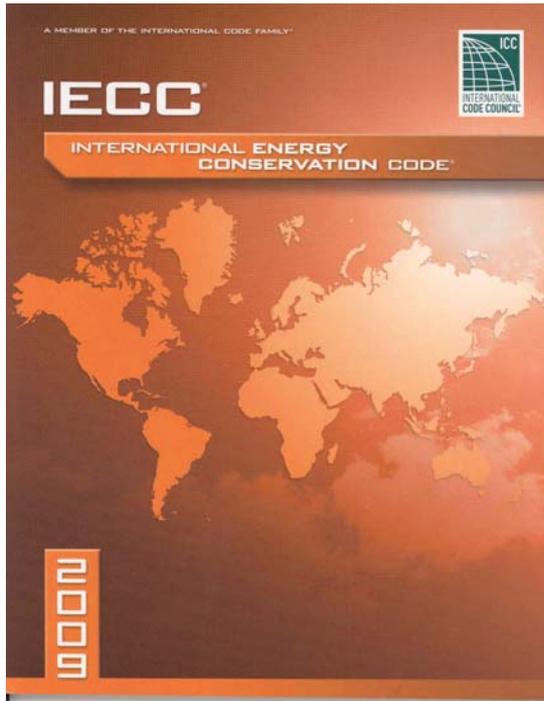
Commercial Envelope Requirements

U.S. Department of Energy
Building Energy Codes Program

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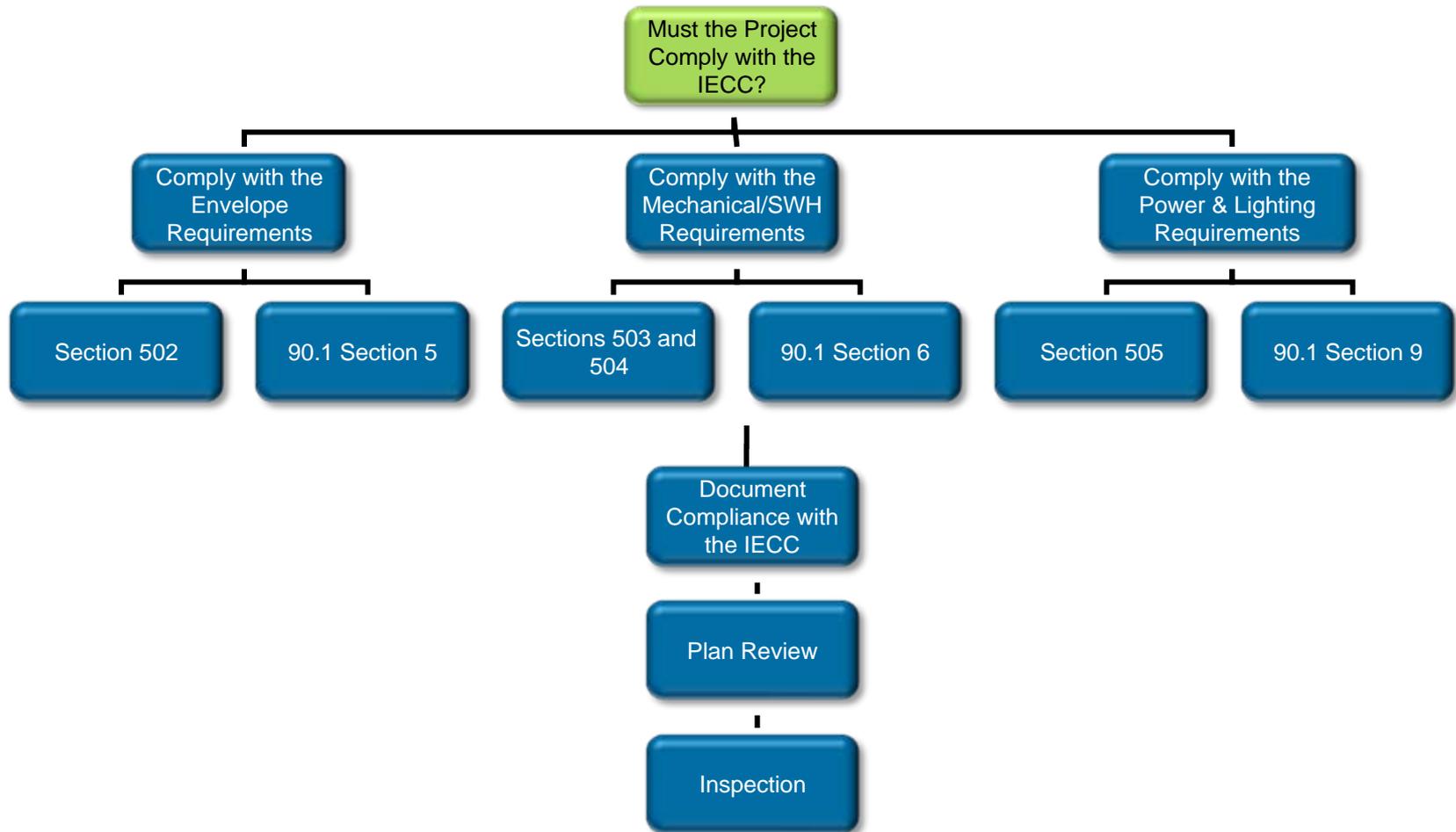


Major Changes to the Envelope Requirements



- Commercial Provisions Contained in Chapter 5
 - IECC
 - ASHRAE 90.1-2007
- Tables 502.2(1) and Table 502.2(2) Building Envelope Requirements – Opaque Assemblies

Introduction to the Energy Code Compliance Process



Does My Project Need to Comply with the Commercial Provisions in the IECC?

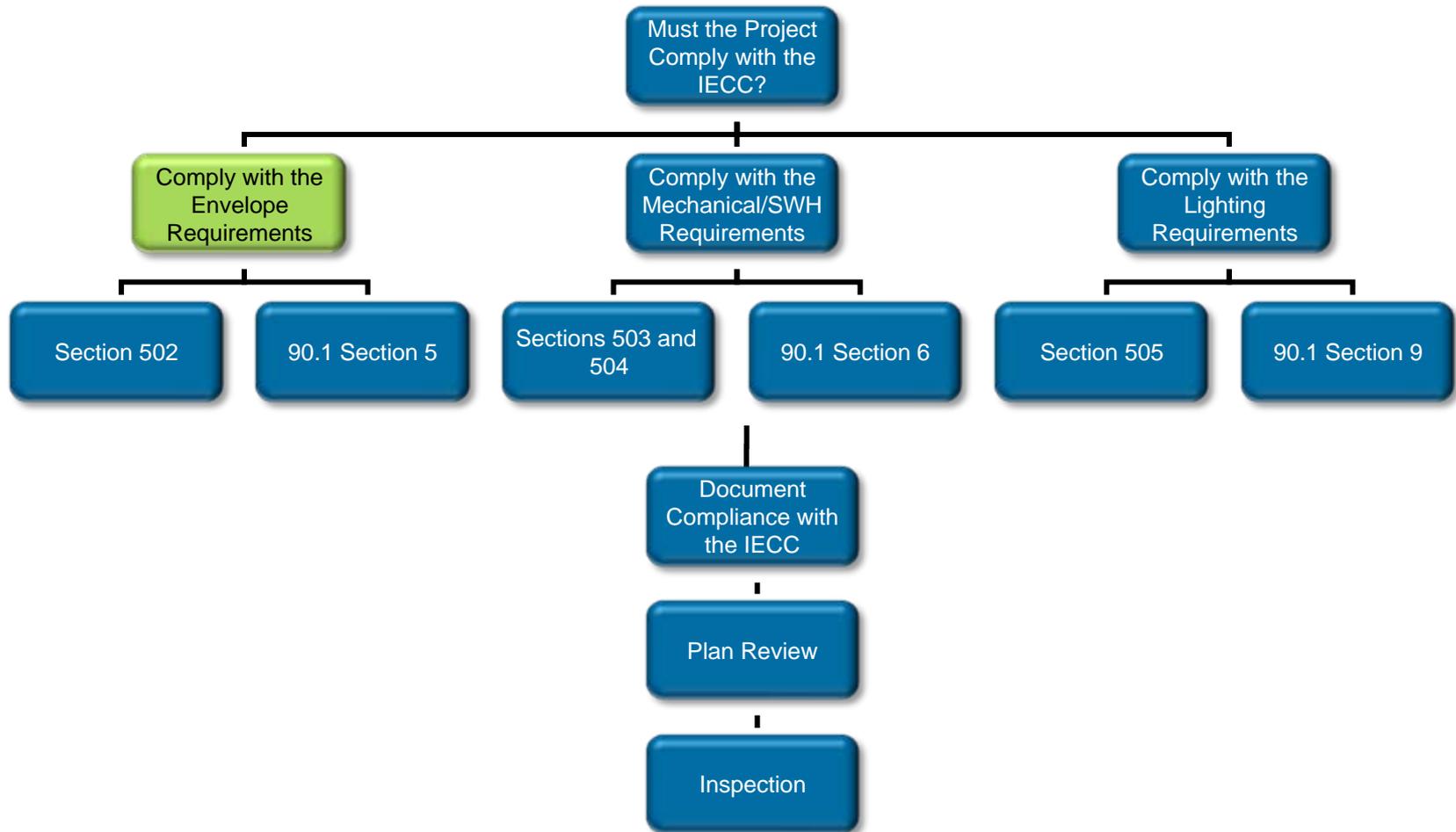


All Buildings Other Than:

- One- and two-family residential
- R-2, R-3, R-4 three stories or less in height



Introduction to the Commercial Energy Code Compliance Process

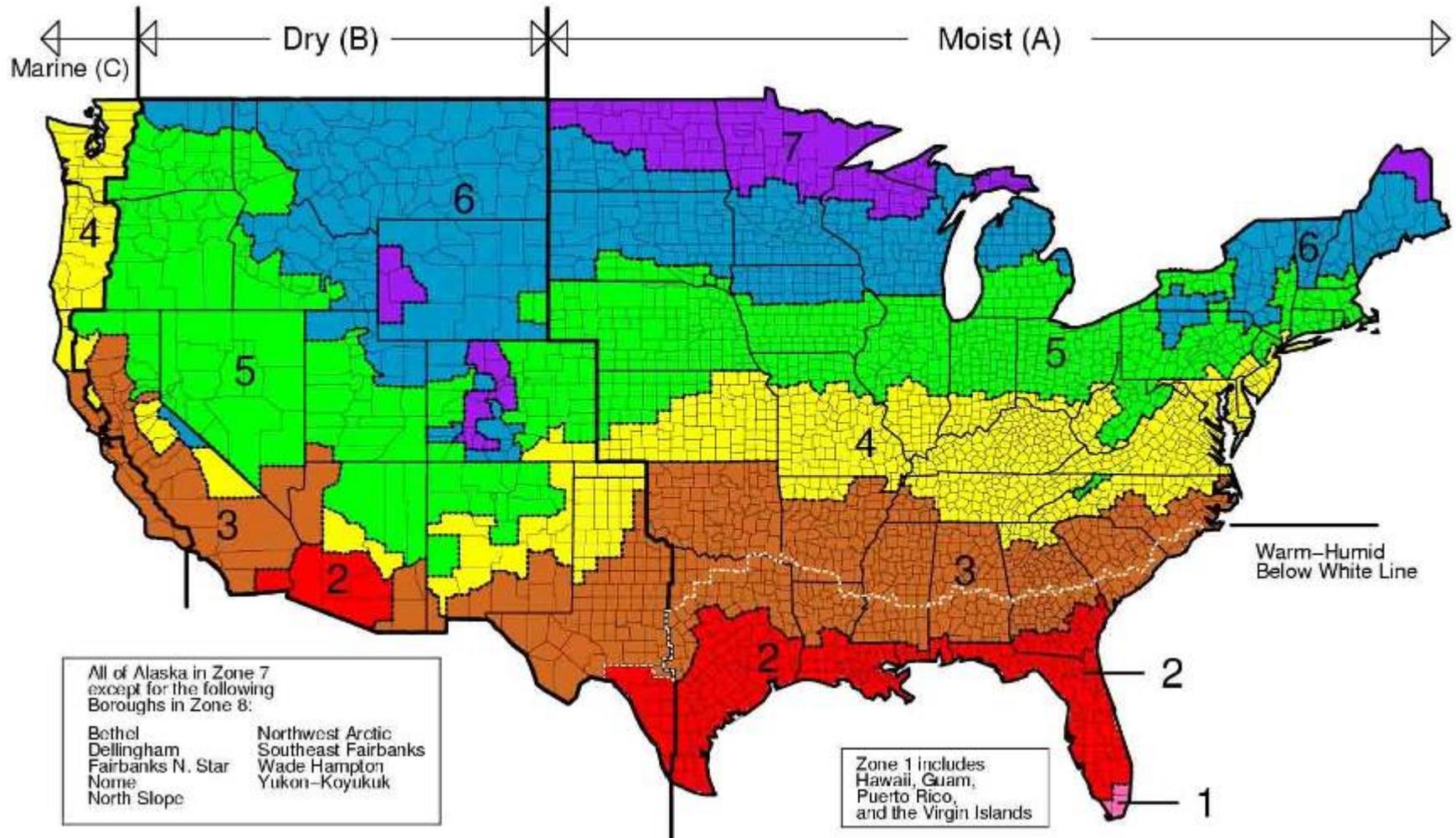


What are My Options for Complying with the IECC?



- Chapter 5 of the IECC General Prescriptive Approach
 - Use for $\leq 40\%$ of gross wall area in vertical fenestration
 - Use for $\leq 3\%$ of gross roof area in skylights
- Section 506 Total Building Performance Approach
- ASHRAE/IESNA Standard 90.1-2007
 - Section 501.2 “Application” requires 90.1 to be used in its entirety (Envelope, Lighting, Mechanical) if used as an alternate compliance path

Climate Zones—2009 IECC



Determining Your Climate Zone is the First Step in the Process

Changes to Tables 502.1.2 and 502.2(1)

- Table now separated by occupancy type
 - Group R occupancies use “Group R” column
 - Non-Group R occupancies use “All other” column

Compliance with Chapter 5 Prescriptive Approach - Insulation R-values

TABLE 502.2(1)
BUILDING ENVELOPE REQUIREMENTS - OPAQUE ASSEMBLIES

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs																
Insulation entirely above deck	R-15ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci
Metal buildings (with R-5 thermal blocks ^{a, b})	R-19	R-19	R-13 + R-13	R-13 + R-13	R-13 + R-13	R-19	R-13 + R-13	R-19	R-13 + R-13	R-19	R-13 + R-19	R-19	R-13 + R-19	R-19 + R-10	R-11 + R-19	R-19 + R-10
Attic and other	R-30	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-49	R-49
Walls, Above Grade																
Mass	NR	R-5.7ci	R-5.7ci	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci ^c	R-11.4ci	R-11.4ci	R-13.3ci	R-13.3ci	R-15.2ci	R-15.2ci	R-15.2ci	R-25ci	R-25ci
Metal building ^b	R-16	R-16	R-16	R-16	R-19	R-19	R-19	R-19	R-13 + R-5.6ci	R-13 + R-5.6ci	R-13 + R-5.6ci	R-13 + R-5.6ci	R-19 + R-5.6ci	R-19 + R-5.6ci	R-19 + R-5.6ci	R-19 + R-5.6ci
Metal framed	R-13	R-13	R-13	R-13 + 7.5ci	R-13 + R-3.8ci	R-13 + R-7.5ci	R-13 + 7.5	R-13 + R-7.5ci	R-13 + R-15.6ci	R-13 + R-7.5ci	R-13 + R-18.8ci					
Wood framed and other	R-13	R-13	R-13	R-13	R-13	R-13	R-13	R-13 + R-3.8ci	R-13 + R-3.8ci	R-13 + 3.8	R-13 + 7.5	R-13 + R-7.5	R-13 + R-7.5	R-13 + 7.5ci	R-13 + R-15.6ci	R-13 + 15.6ci
Walls, Below Grade																
Below grade wall ^d	NR	NR	NR	NR	NR	NR	NR	R-7.5ci	R-7.5ci	R-7.5ci	NR R-7.5ci	R-7.5ci	R-7.5ci	R-10ci	R-7.5ci	R-12.5ci
Floors																
Mass	NR	NR	R-6.3ci	R-8.3ci	R-6.3ci	R-8.3ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	R-12.5ci	R-14.6ci	R-15ci	R-16.7ci	R-15ci	R-16.7ci
Joist/framing Steel/wood	NR	NR	R-19	R-30	R-19	R-30	R-30	R-30	R-30	R-30	R-30	R-30 ^e	R-30	R-30 ^e	R-30 ^e	R-30 ^e
Slab-on-Grade Floors																
Unheated slabs	NR	NR	NR	NR	NR	NR	NR	R-10 for 24 in. below	NR	R-10 for 24 in. below	R-10 for 24 in. below	R-15 for 24 in. below	R-20 for 24 in. below			
Heated slabs	R-7.5 for 12 in. below	R-10 for 24 in. below	R-10 for 24 in. below	R-15 for 24 in. below	R-20 for 48 in. below	R-20 for 24 in. below	R-20 for 48 in. below	R-20 for 48 in. below	R-20 for 48 in. below							
Opaque doors																
Swinging	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.50				
Roll-up or sliding	U - 1.45	U - 1.45	U - 1.45	U - 1.45	U - 1.45	U - 1.45	U - 0.50									

For SI: 1 inch = 25.4 mm.

ci = Continuous insulation. NR = No requirement.

a. When using R-value compliance method, a thermal spacer block is required, otherwise use the U-factor compliance method. [see Tables 502.1.2 and 502.2(2)].

b. Assembly descriptions can be found in Table 502.2(2).

c. R-5.7 ci is allowed to be substituted with concrete block walls complying with ASTM C 90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with material having a maximum thermal conductivity of 0.44 Btu-in./h-ft² F.

d. When heated slabs are placed below grade, below-grade walls must meet the exterior insulation requirements for perimeter insulation according to the heated slab-on-grade construction.

e. Steel floor joist systems shall to be R-38.

Compliance with Chapter 5 Prescriptive Approach - Insulation R-values

TABLE 502.2(1)
BUILDING ENVELOPE REQUIREMENTS - OPAQUE ASSEMBLIES

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R

Roofs

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
Insulation entirely above deck	R-15ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci
Metal buildings (with R-5 thermal blocks ^{a,b})	R-19	R-19	R-13+ R-13	R-13+ R-13	R-13+ R-13	R-19	R-13+ R-13	R-19	R-13+ R-13	R-19	R-13+ R-19	R-19	R-13+ R-19	R-19+ R-19	R-11+ R-19	R-19+ R-10
Attic and other	R-30	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-49	R-49

Below grade wall ^d	NR	NR	NR	NR	NR	NR	NR	NR	R-7.5ci	R-7.5ci	R-7.5ci	NR R-7.5ci	R-7.5ci	R-7.5ci	R-10ci	R-7.5ci	R-12.5ci
Floors																	
Mass	NR	NR	R-6.3ci	R-8.3ci	R-6.3ci	R-8.3ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	R-12.5ci	R-14.6ci	R-15ci	R-16.7ci	R-15ci	R-16.7ci	
Joist/framing Steel/(wood)	NR	NR	R-19	R-30	R-19	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30 ^e	R-30	R-30 ^e	R-30 ^e	R-30 ^e
Slab-on-Grade Floors																	
Unheated slabs	NR	NR	NR	NR	NR	NR	NR	NR	R-10 for 24 in. below	NR	R-10 for 24 in. below	R-10 for 24 in. below	R-15 for 24 in. below	R-15 for 24 in. below	R-15 for 24 in. below	R-15 for 24 in. below	R-20 for 24 in. below
Heated slabs	R-7.5 for 12 in. below	R-7.5 for 12 in. below	R-7.5 for 12 in. below	R-7.5 for 12 in. below	R-10 for 24 in. below	R-10 24 in. below	R-15 for 24 in. below	R-20 for 48 in. below	R-20 for 24 in. below	R-20 for 48 in. below	R-20 for 48 in. below	R-20 for 48 in. below	R-20 for 48 in. below				
Opaque doors																	
Swinging	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.50				
Roll-up or sliding	U - 1.45	U - 1.45	U - 1.45	U - 1.45	U - 1.45	U - 1.45	U - 1.45	U - 0.50									

For SI: 1 inch = 25.4 mm.

ci = Continuous insulation. NR = No requirement.

a. When using R-value compliance method, a thermal spacer block is required, otherwise use the U-factor compliance method. [see Tables 502.1.2 and 502.2(2)].

b. Assembly descriptions can be found in Table 502.2(2).

c. R-5.7 ci is allowed to be substituted with concrete block walls complying with ASTM C 90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with material having a maximum thermal conductivity of 0.44 Btu-in./h-²-F.

d. When heated slabs are placed below grade, below-grade walls must meet the exterior insulation requirements for perimeter insulation according to the heated slab-on-grade construction.

e. Steel floor joist systems shall to be R-38.

Compliance with Chapter 5 Prescriptive Approach - Insulation R-values

TABLE 502.2(1)
BUILDING ENVELOPE REQUIREMENTS - OPAQUE ASSEMBLIES

CLIMATE ZONE	1		2		3	4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All other	Group R	All other	Group R		All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R

Walls, Above Grade

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
Mass	NR	R-5.7ci	R-5.7ci	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11.4ci	R-11.4ci	R-13.3ci	R-13.3ci	R-15.2ci	R-15.2ci	R-15.2ci	R-25ci	R-25ci
Metal building ^b	R-16	R-16	R-16	R-16	R-19	R-19	R-19	R-19	R-13+ 5.6ci	R-13+ 5.6ci	R-13+ 5.6ci	R-13+ 5.6ci	R-19+ 5.6ci	R-19+ 5.6ci	R-19+ 5.6ci	R-19+ 5.6ci
Metal framed	R-13	R-13	R-13+ 7.5ci	R-13+ 7.5ci	R-13+ 3.8ci	R-13+ 7.5ci	R-13+ 7.5ci	R-13+ 7.5ci	R-13+ 7.5ci	R-13+ 7.5ci	R-13+ 7.5ci	R-13+ 7.5ci	R-13+ 7.5ci	R-13+ 15.6ci	R-13+ 7.5ci	R-13+ 18.8ci
Wood framed and other	R-13	R-13	R-13	R-13	R-13	R-13	R-13	R-13+ 3.8ci	R-13+ 3.8ci	R-13+ 3.8ci	R-13+ 7.5ci	R-13+ 7.5ci	R-13+ 7.5ci	R-13+ 7.5ci	R-13+ 15.6ci	R-13+ 15.6ci

Floors																
Mass	NR	NR	R-6.3ci	R-8.3ci	R-6.3ci	R-8.3ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	R-12.5ci	R-14.6ci	R-15ci	R-16.7ci	R-15ci	R-16.7ci
Joist/framing Steel/(wood)	NR	NR	R-19	R-30	R-19	R-30	R-30	R-30	R-30	R-30	R-30	R-30 ^e	R-30	R-30 ^e	R-30 ^e	R-30 ^e
Slab-on-Grade Floors																
Unheated slabs	NR	NR	NR	NR	NR	NR	NR	R-10 for 24 in. below	NR	R-10 for 24 in. below	R-10 for 24 in. below	R-15 for 24 in. below	R-15 for 24 in. below	R-15 for 24 in. below	R-15 for 24 in. below	R-20 for 24 in. below
Heated slabs	R-7.5 for 12 in. below	R-7.5 for 12 in. below	R-7.5 for 12 in. below	R-7.5 for 12 in. below	R-10 for 24 in. below	R-10 24 in. below	R-15 for 24 in. below	R-20 for 48 in. below	R-20 for 24 in. below	R-20 for 48 in. below	R-20 for 48 in. below	R-20 for 48 in. below				
Opaque doors																
Swinging	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.50				
Roll-up or sliding	U - 1.45	U - 1.45	U - 1.45	U - 1.45	U - 1.45	U - 1.45	U - 0.50									

For SI: 1 inch = 25.4 mm.

ci = Continuous insulation. NR = No requirement.

a. When using R-value compliance method, a thermal spacer block is required, otherwise use the U-factor compliance method. [see Tables 502.1.2 and 502.2(2)].

b. Assembly descriptions can be found in Table 502.2(2).

c. R-5.7 ci is allowed to be substituted with concrete block walls complying with ASTM C 90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with material having a maximum thermal conductivity of 0.44 Btu-in./h-²-F.

d. When heated slabs are placed below grade, below-grade walls must meet the exterior insulation requirements for perimeter insulation according to the heated slab-on-grade construction.

e. Steel floor joist systems shall to be R-38.

Compliance with Chapter 5 Prescriptive Approach - Insulation R-values

TABLE 502.2(1)
BUILDING ENVELOPE REQUIREMENTS - OPAQUE ASSEMBLIES

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8		
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	
Insulation entirely above deck	R-15ci	R-20ci	R-20ci	R-20ci	R-							R-20ci	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci

Walls, Below Grade

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
Below grade wall	NR	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-10ci	R-7.5ci	R-12.5ci						

Metal building ^a	R-16	R-16	R-16	R-16	R-19	R-19	R-19	R-19	R-13 + R-5.6ci	R-13 + R-5.6ci	R-13 + R-5.6ci	R-13 + R-5.6ci	R-19 + R-5.6ci	R-19 + R-5.6ci	R-19 + R-5.6ci	R-19 + R-5.6ci
Metal framed	R-13	R-13	R-13	R-13 + 7.5ci	R-13 + R-3.8ci	R-13 + R-7.5ci	R-13 + 7.5	R-13 + R-7.5ci	R-13 + R-15.6ci	R-13 + R-7.5ci	R-13 + R-18.8ci					
Wood framed and other	R-13	R-13	R-13	R-13	R-13	R-13	R-13	R-13 + R-3.8ci	R-13 + R-3.8ci	R-13 + 3.8	R-13 + 7.5	R-13 + R-7.5	R-13 + R-7.5ci	R-13 + 47.5ci	R-13 + R-15.6ci	R-13 + R-15.6ci
Walls, Below Grade																
Below grade wall ^d	NR	NR	NR	NR	NR	NR	NR	R-7.5ci	R-7.5ci	R-7.5ci	NR	R-7.5ci	R-7.5ci	R-10ci	R-7.5ci	R-12.5ci
Floors																
Misc	NR	NR	R-6.3ci	R-8.3ci	R-6.3ci	R-8.3ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	R-12.5ci	R-14.6ci	R-15ci	R-16.7ci	R-15ci	R-16.7ci
Truss framing: Steel/wood	NR	NR	R-19	R-30	R-19	R-30										
Slab-on-Grade Floors																
Unfinished slab	NR	NR	NR	NR	NR	NR	NR	R-10 for 24 in. below	NR	R-10 for 24 in. below	R-10 for 24 in. below	R-15 for 24 in. below	R-20 for 24 in. below			
Heated slabs	R-7.5 for 12 in. below	R-10 for 24 in. below	R-10 for 24 in. below	R-13 for 24 in. below	R-15 for 24 in. below	R-20 for 48 in. below	R-20 for 24 in. below	R-20 for 48 in. below	R-20 for 48 in. below	R-20 for 48 in. below						
Opaque doors																
Swinging	U-0.70	U-0.20	U-0.70	U-0.20	U-0.20	U-0.20	U-0.20	U-0.20	U-0.20	U-0.20	U-0.20	U-0.20	U-0.20	U-0.20	U-0.20	U-0.20
Roll-up or sliding	U-1.45	U-1.45	U-1.45	U-1.45	U-1.45	U-1.45	U-0.50									

For SI: 1 inch = 25.4 mm.

ci = Continuous insulation. NR = No requirement.

a. When using R-value compliance method, a thermal spacer block is required, otherwise use the U-factor compliance method. [See Tables 502.1.2 and 502.2.3].

b. Assembly description can be found in Table 502.2.7.

c. R-7.5 ci is allowed to be substituted with concrete block walls complying with AS 1942.50, ungrouted or partially grouted to 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with mineral wool in the stud cavity of 0.44 Btu-in./h·ft·°F.

d. When heated slabs are placed below grade, below-grade walls must meet the exterior insulation requirements for polystyrene insulation according to the heated slab-on-grade construction.

e. Slab frame joint systems shall be R-10.

Compliance with Chapter 5 Prescriptive Approach - Insulation R-values

TABLE 502.2(1)
BUILDING ENVELOPE REQUIREMENTS - OPAQUE ASSEMBLIES

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs																
Insulation entirely above deck	R-15ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci
Metal buildings (with	R-13+	R-13+	R-13+	R-13+	R-13+	R-13+	R-13+	R-13+	R-13+	R-13+	R-13+	R-13+	R-13+	R-13+	R-13+	R-13+

Slab-on-Grade Floors

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
Unheated slabs	NR	NR	NR	NR	NR	NR	NR	R-10 for 24 in. below	NR	R-10 for 24 in. below	R-10 for 24 in. below	R-15 for 24 in. below	R-20 for 24 in. below			
Heated slabs	R-7.5 for 12 in. below	R-10 for 24 in. below	R-10 for 24 in. below	R-15 for 24 in. below	R-20 for 48 in. below	R-20 for 24 in. below	R-20 for 48 in. below	R-20 for 48 in. below	R-20 for 48 in. below							

Below grade wall	NR	NR	NR	NR	NR	NR	NR	NR	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-10ci	R-7.5ci	R-12.5ci
Floors																	
Mass	NR	NR	R-6.3ci	R-8.3ci	R-6.3ci	R-8.3ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	R-12.5ci	R-14.6ci	R-15ci	R-16.7ci	R-15ci	R-16.7ci	
Joist/framing Steel/(wood)	NR	NR	R-19	R-30	R-19	R-30	R-30	R-30	R-30	R-30	R-30	R-30 ^a	R-30	R-30 ^a	R-30 ^a	R-30 ^a	
Slab-on-Grade Floors																	
Unheated slabs	NR	NR	NR	NR	NR	NR	NR	R-10 for 24 in. below	NR	R-10 for 24 in. below	R-10 for 24 in. below	R-15 for 24 in. below	R-20 for 24 in. below				
Heated slabs	R-7.5 for 12 in. below	R-10 for 24 in. below	R-10 for 24 in. below	R-15 for 24 in. below	R-20 for 48 in. below	R-20 for 24 in. below	R-20 for 48 in. below	R-20 for 48 in. below	R-20 for 48 in. below								
Opaque doors																	
Swinging	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.50					
Roll-up or sliding	U - 1.45	U - 1.45	U - 1.45	U - 1.45	U - 1.45	U - 1.45	U - 0.50										

For SI: 1 inch = 25.4 mm.

ci = Continuous insulation. NR = No requirement.

a. When using R-value compliance method, a thermal spacer block is required, otherwise use the U-factor compliance method. [see Tables 502.1.2 and 502.2(2)].

b. Assembly descriptions can be found in Table 502.2(2).

c. R-5.7 ci is allowed to be substituted with concrete block walls complying with ASTM C 90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with material having a maximum thermal conductivity of 0.44 Btu-in./h-ft²-F.

d. When heated slabs are placed below grade, below-grade walls must meet the exterior insulation requirements for perimeter insulation according to the heated slab-on-grade construction.

e. Steel floor joist systems shall to be R-38.

Compliance with Chapter 5 Prescriptive Approach - Insulation R-values

TABLE 502.2(1)
BUILDING ENVELOPE REQUIREMENTS - OPAQUE ASSEMBLIES

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs																
Insulation entirely above deck	R-15ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci
Metal buildings (with R-5 thermal blocks ^{a, b})	R-19	R-19	R-13 + R-13	R-13 + R-13	R-13 + R-13	R-13 + R-13	R-19	R-19	R-13 + R-19	R-19 + R-10	R-11 + R-19	R-19 + R-10				
Attic and other	R-30	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38

Opaque Doors

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
Swinging	U-0.70	U-0.70	U-0.70	U-0.70	U-0.70	U-0.50	U-0.50	U-0.50	U-0.50	U-0.50						
Roll-up or sliding	U-1.45	U-1.45	U-1.45	U-1.45	U-1.45	U-1.45	U-0.50	U-0.50	U-0.50	U-0.50	U-0.50	U-0.50	U-0.50	U-0.50	U-0.50	U-0.50

other										R-3.8ci	R-3.8ci	3.8	7.5	R-7.5	R-7.5ci	+7.5ci	R-15.6ci	15.6ci
Walls, Below Grade																		
Below grade wall ^d	NR	NR	NR	NR	NR	NR	NR	NR	NR	R-7.5ci	R-7.5ci	R-7.5ci	NR R-7.5ci	R-7.5ci	R-7.5ci	R-10ci	R-7.5ci	R-12.5ci
Floors																		
Mass	NR	NR	R-6.3ci	R-8.3ci	R-6.3ci	R-8.3ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	R-12.5ci	R-14.6ci	R-15ci	R-16.7ci	R-15ci	R-16.7ci		
Joist/framing Steel/(wood)	NR	NR	R-19	R-30	R-19	R-30	R-30 ^e	R-30	R-30 ^e	R-30 ^e	R-30 ^e							
Slab-on-Grade Floors																		
Unheated slabs	NR	NR	NR	NR	NR	NR	NR	NR	R-10 for 24 in. below	NR	R-10 for 24 in. below	R-10 for 24 in. below	R-15 for 24 in. below	R-20 for 24 in. below				
Heated slabs	R-7.5 for 12 in. below	R-10 for 24 in. below	R-10 for 24 in. below	R-15 for 24 in. below	R-20 for 24 in. below													
Opaque doors																		
Swinging	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.70	U - 0.50					
Roll-up or sliding	U - 1.45	U - 1.45	U - 1.45	U - 1.45	U - 1.45	U - 1.45	U - 0.50											

For SI: 1 inch = 25.4 mm.

ci = Continuous insulation. NR = No requirement.

a. When using R-value compliance method, a thermal spacer block is required, otherwise use the U-factor compliance method. [see Tables 502.1.2 and 502.2(2)].

b. Assembly descriptions can be found in Table 502.2(2).

c. R-5.7 ci is allowed to be substituted with concrete block walls complying with ASTM C 90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with material having a maximum thermal conductivity of 0.44 Btu-in./h-²F.

d. When heated slabs are placed below grade, below-grade walls must meet the exterior insulation requirements for perimeter insulation according to the heated slab-on-grade construction.

e. Steel floor joist systems shall to be R-38.

Compliance with Chapter 5 Prescriptive Approach - Assembly U-factors

TABLE 502.1.2
BUILDING ENVELOPE REQUIREMENTS OPAQUE ELEMENT, MAXIMUM U-FACTORS

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8		
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	
Roofs																	
Insulation entirely above deck	U-0.063	U-0.048	U-0.048	U-0.048	U-0.048	U-0.048	U-0.048	U-0.048	U-0.048	U-0.048	U-0.048	U-0.048	U-0.048	U-0.039	U-0.039	U-0.039	U-0.039
Metal buildings	U-0.065	U-0.065	U-0.055	U-0.055	U-0.055	U-0.055	U-0.055	U-0.055	U-0.055	U-0.055	U-0.055	U-0.049	U-0.049	U-0.049	U-0.049	U-0.035	U-0.035
Attic and other	U-0.034	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027
Walls, Above Grade																	
Mass	U-0.058	U-0.151	U-0.151	U-0.123	U-0.123	U-0.104	U-0.104	U-0.090	U-0.90	U-0.80	U-0.080	U-0.071	U-0.071	U-0.071	U-0.071	U-0.071	U-0.052
Metal building	U-0.093	U-0.093	U-0.093	U-0.093	U-0.084	U-0.084	U-0.084	U-0.084	U-0.069	U-0.069	U-0.069	U-0.069	U-0.069	U-0.057	U-0.057	U-0.057	U-0.057
Metal framed	U-0.124	U-0.124	U-0.124	U-0.064	U-0.084	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.057	U-0.064	U-0.052	U-0.064	U-0.037
Wood framed and other	U-0.089	U-0.089	U-0.089	U-0.089	U-0.089	U-0.089	U-0.089	U-0.064	U-0.064	U-0.051	U-0.051	U-0.051	U-0.051	U-0.051	U-0.051	U-0.036	U-0.036
Walls, Below Grade																	
Below-grade wall ^a	C-1.140	C-1.140	C-1.140	C-1.140	C-1.140	C-1.140	C-1.140	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.092	C-0.119	C-0.075
Floors																	
Mass	U-0.322	U-0.322	U-0.107	U-0.087	U-0.107	U-0.087	U-0.087	U-0.074	U-0.074	U-0.064	U-0.064	U-0.057	U-0.064	U-0.051	U-0.057	U-0.051	U-0.051
Joist/Framing	U-0.282	U-0.282	U-0.052	U-0.052	—	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033
Slab-on-Grade Floors																	
Unheated slabs	F-0.730	F-0.730	F-0.730	F-0.730	F-0.730	F-0.730	F-0.730	F-0.540	F-0.730	F-0.540	F-0.540	F-0.520	F-0.520	F-0.520	F-0.520	F-0.520	F-0.510
Heated slabs	F-1.020	F-1.020	F-1.020	F-1.020	F-0.900	F-0.900	—	F-0.860	F-0.860	F-0.860	F-0.860	F-0.688	F-0.830	F-0.688	F-0.688	F-0.688	F-0.688

a. When heated slabs are placed below-grade, below grade walls must meet the *F*-factor requirements for perimeter insulation according to the heated slab-on-grade construction.

Compliance with Chapter 5 Prescriptive Approach

TABLE 502.2(2)
BUILDING ENVELOPE REQUIREMENTS—OPAQUE ASSEMBLIES

ROOFS	DESCRIPTION	REFERENCE
R-19	<p>Standing seam roof with single fiberglass insulation layer.</p> <p>This construction is R-19 faced fiberglass insulation batts draped perpendicular over the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins.</p>	ASHRAE/IESNA 90.1 Table A2.3 including Addendum "G"
R-13 + R-13 R-13 + R-19	<p>Standing seam roof with two fiberglass insulation layers.</p> <p>The first <i>R</i>-value is for faced fiberglass insulation batts draped over purlins. The second <i>R</i>-value is for unfaced fiberglass insulation batts installed parallel to the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins.</p>	ASHRAE/IESNA 90.1 Table A2.3 including Addendum "G"
R-11 + R-19 FC	<p>Filled cavity fiberglass insulation.</p> <p>A continuous vapor barrier is installed below the purlins and uninterrupted by framing members. Both layers of uncompressed, unfaced fiberglass insulation rest on top of the vapor barrier and are installed parallel, between the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins.</p>	ASHRAE/IESNA 90.1 Table A2.3 including Addendum "G"
WALLS		
R-16, R-19	<p>Single fiberglass insulation layer.</p> <p>The construction is faced fiberglass insulation batts installed vertically and compressed between the metal wall panels and the steel framing.</p>	ASHRAE/IESNA 90.1 Table A3.2 including Addendum "G"
R-13 + R-5.6 ci R-19 + R-5.6 ci	<p>The first <i>R</i>-value is for faced fiberglass insulation batts installed perpendicular and compressed between the metal wall panels and the steel framing. The second rated <i>R</i>-value is for continuous rigid insulation installed between the metal wall panel and steel framing, or on the interior of the steel framing.</p>	ASHRAE/IESNA 90.1 Table A3.2 including Addendum "G"

Compliance with Chapter 5 Prescriptive Approach

TABLE 502.2(2)
BUILDING ENVELOPE REQUIREMENTS—OPAQUE ASSEMBLIES

ROOFS	DESCRIPTION	REFERENCE
R-19	Standing seam roof with single fiberglass insulation layer. This construction is R-19 faced fiberglass insulation batts draped perpendicular over the purlins. A minimum R-3.5 thermal spacer block is	ASHRAE/IESNA 90.1 Table A2.3 including Addendum "G"

Standing seam roof with two fiberglass insulation layers.

R-13 + R-13
R-13 + R-19

The first R-value is for faced fiberglass insulation batts draped over purlins. The second R-value is for unfaced fiberglass insulation batts installed parallel to the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins.

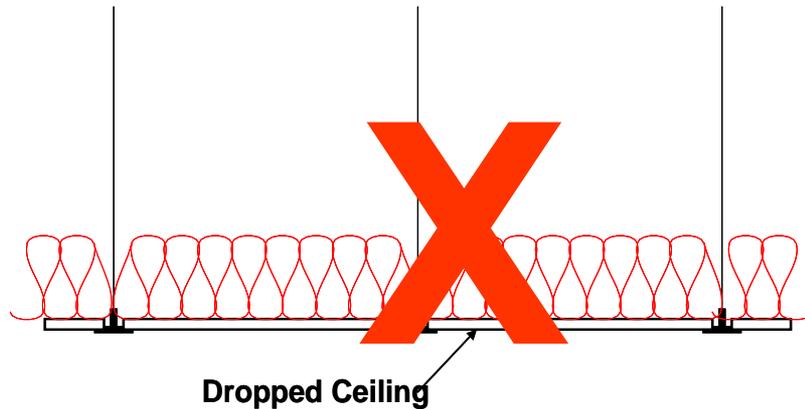
R-11 + R-19 FC	Filled cavity fiberglass insulation. A continuous vapor barrier is installed below the purlins and uninterrupted by framing members. Both layers of uncompressed, unfaced fiberglass insulation rest on top of the vapor barrier and are installed parallel, between the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins.	ASHRAE/IESNA 90.1 Table A2.3 including Addendum "G"
WALLS		
R-16, R-19	Single fiberglass insulation layer. The construction is faced fiberglass insulation batts installed vertically and compressed between the metal wall panels and the steel framing.	ASHRAE/IESNA 90.1 Table A3.2 including Addendum "G"
R-13 + R-5.6 ci R-19 + R-5.6 ci	The first R-value is for faced fiberglass insulation batts installed perpendicular and compressed between the metal wall panels and the steel framing. The second rated R-value is for continuous rigid insulation installed between the metal wall panel and steel framing, or on the interior of the steel framing.	ASHRAE/IESNA 90.1 Table A3.2 including Addendum "G"

Compliance with Chapter 5 Prescriptive Approach

TABLE 502.2(2)
BUILDING ENVELOPE REQUIREMENTS—OPAQUE ASSEMBLIES

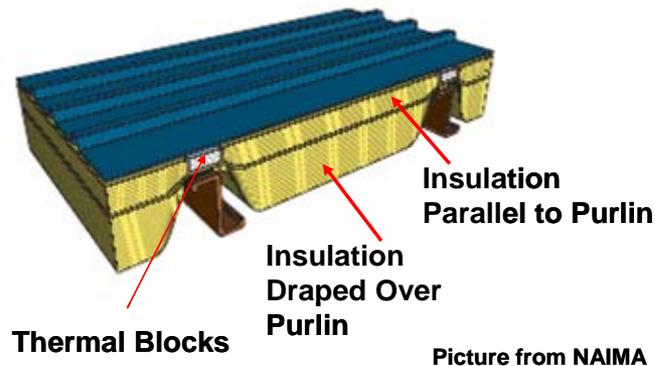
ROOFS	DESCRIPTION	REFERENCE
R-19	Standing seam roof with single fiberglass insulation layer. This construction is R-19 faced fiberglass insulation batts draped perpendicular over the purlins. A minimum R-3.5 thermal spacer block is	ASHRAE/IESNA 90.1 Table A2.3 including Addendum "G"
R-13 + R-5.6ci R-19 + R-5.6ci	The first R-value is for faced fiberglass insulation batts installed perpendicular and compressed between the metal wall panels and the steel framing. The second rated R-value is for continuous rigid insulation installed between the metal wall panel and steel framing, or on the interior of the steel framing.	
	to the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins.	
R-11 + R-19 FC	Filled cavity fiberglass insulation. A continuous vapor barrier is installed below the purlins and uninterrupted by framing members. Both layers of uncompressed, unfaced fiberglass insulation rest on top of the vapor barrier and are installed parallel, between the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins.	ASHRAE/IESNA 90.1 Table A2.3 including Addendum "G"
WALLS		
R-16, R-19	Single fiberglass insulation layer. The construction is faced fiberglass insulation batts installed vertically and compressed between the metal wall panels and the steel framing.	ASHRAE/IESNA 90.1 Table A3.2 including Addendum "G"
R-13 + R-5.6 ci R-19 + R-5.6 ci	The first R-value is for faced fiberglass insulation batts installed perpendicular and compressed between the metal wall panels and the steel framing. The second rated R-value is for continuous rigid insulation installed between the metal wall panel and steel framing, or on the interior of the steel framing.	ASHRAE/IESNA 90.1 Table A3.2 including Addendum "G"

Roof R-Value – Insulation Placed on Suspended Ceiling with Removable Ceiling Tiles



- Will not count for code compliance
- Will not comply with Section 502.4.3 – “Sealing of the building envelope”

Roof R-Value – Metal Buildings



- R-5 thermal blocks required on all metal buildings or must use U-factor Compliance Method
- Climate Zones 2-8 require two layers of insulation for “all other”
 - CZ 2-5 and marine 4: R-13+R-13
 - CZ 6-7: R-13+R-19
 - CZ 8: R-11+R-19
- Example (R-13+R-19):
 - R-13 draped perpendicularly to the purlins
 - R-19 running parallel to the purlins supported by the R-13

Wall R-Value – Mass Walls



- Walls weighing at least 35 lbs/ft² of wall surface area, or
- 25 lbs/ft² of wall surface area if material weight is $\leq 120 \text{ lb/ft}^3$

Mass Walls – Concrete Masonry Units

- Climate Zones 1 (group R) and 2 (all other)– Can use integral insulation instead of R-5.7 ci
 - Concrete block walls must comply with ASTM C 90, and
 - UngROUTED or partially grouted @ 32 inch. o.c. or less vertically or 48 inch. o.c. or less horizontally, and
 - UngROUTED cells must be filled with insulation material \leq of 0.44 Btu-in./h-ft² F
- Climate Zone 1 “all other”
 - No insulation required for mass walls

Wall R-Value – Wood, Metal Frame, and Other

- Cavity insulation or cavity plus continuous (ci)
- Continuous insulation not broken up by framing members e.g. rigid board insulation

Metal Building Walls [Table 502.2(2)]



Picture from NAIMA

Climate Zone	R-Value
1-2	R-16
3-4 except Marine	R-19
Marine 4-6	R-13+R-5.6ci
7-8	R-19+R-5.6ci

Floors Over Outdoor Air or Unconditioned Space (502.2.5)



- Joist/Framing (Steel/Wood)
 - Insulation installed between framing
- Mass Floors
 - Materials weighing 35 lbs/ft², or
 - 25 lbs/ft² if material weight is ≤ 120 lbs/ft³
 - Insulation installed continuously
- Steel Floor Joist Systems [Footnote e to Table 502.2(1)]
 - R-38 in Climate Zones 6-8

Slab-on-Grade Floors (502.2.6)

- Unheated slab – insulation required:
 - All Other in Climate Zones 6 - 8
 - Group R in Climate Zones 4 - 8
- Heated slabs – insulation required in all Climate Zones

Compliance with Chapter 5 Prescriptive Approach

TABLE 502.3
BUILDING ENVELOPE REQUIREMENTS: FENESTRATION

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
Vertical fenestration (40% maximum of above-grade wall)								
<i>U</i>-factor								
Framing materials other than metal with or without metal reinforcement or cladding								
<i>U</i> -factor	1.20	0.75	0.65	0.40	0.35	0.35	0.35	0.35
Metal framing with or without thermal break								
Curtain wall/storefront <i>U</i> -factor	1.0	0.70	0.60	0.50	0.45	0.45	0.40	0.40
Entrance door <i>U</i> -factor	1.20	1.10	0.90	0.85	0.80	0.80	0.80	0.80
All other <i>U</i> -factor ^a	1.20	0.75	0.65	0.55	0.55	0.55	0.45	0.45
SHGC-all frame types								
SHGC: PF < 0.25	0.25	0.25	0.25	0.40	0.40	0.40	0.45	0.45
SHGC: 0.25 ≤ PF < 0.5	0.33	0.33	0.33	NR	NR	NR	NR	NR
SHGC: PF ≥ 0.5	0.40	0.40	0.40	NR	NR	NR	NR	NR
Skylights (3% maximum)								
<i>U</i> -factor	0.75	0.75	0.65	0.60	0.60	0.60	0.60	0.60
SHGC	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

NR = No requirement.

PF = Projection factor (see Section 502.3.2).

a. All others includes operable windows, fixed windows and nonentrance doors.

Compliance with Chapter 5 Prescriptive Approach

TABLE 502.3
BUILDING ENVELOPE REQUIREMENTS: FENESTRATION

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
Vertical fenestration (40% maximum of above-grade wall)								
<i>U</i> -factor								

Framing materials other than metal with or without metal reinforcement or cladding

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
<i>U</i> -factor	1.20	0.75	0.65	0.40	0.35	0.35	0.35	0.35

SHGC: PF < 0.25	0.25	0.25	0.25	0.40	0.40	0.40	0.45	0.45
SHGC: 0.25 ≤ PF < 0.5	0.33	0.33	0.33	NR	NR	NR	NR	NR
SHGC: PF ≥ 0.5	0.40	0.40	0.40	NR	NR	NR	NR	NR
Skylights (3% maximum)								
<i>U</i> -factor	0.75	0.75	0.65	0.60	0.60	0.60	0.60	0.60
SHGC	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

NR = No requirement.

PF = Projection factor (see Section 502.3.2).

a. All others includes operable windows, fixed windows and nonentrance doors.

Compliance with Chapter 5 Prescriptive Approach

TABLE 502.3
BUILDING ENVELOPE REQUIREMENTS: FENESTRATION

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
Vertical fenestration (40% maximum of above-grade wall)								
U-factor								
Framing materials other than								

Metal framing with or without thermal break

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
Curtain wall/ storefront U-Factor	1.0	0.7	0.60	0.50	0.45	0.45	0.40	0.40
Entrance door U-factor	1.20	1.10	0.90	0.85	0.80	0.80	0.80	0.80
All other U-factor	1.20	0.75	0.65	0.55	0.55	0.55	0.45	0.45

U-factor	0.75	0.75	0.65	0.60	0.60	0.60	0.60	0.60
SHGC	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

NR = No requirement.

PF = Projection factor (see Section 502.3.2).

a. All others includes operable windows, fixed windows and nonentrance doors.

Compliance with Chapter 5 Prescriptive Approach

TABLE 502.3
BUILDING ENVELOPE REQUIREMENTS: FENESTRATION

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
Vertical fenestration (40% maximum of above-grade wall)								
<i>U</i> -factor								
Framing materials other than metal w								
<i>U</i> -factor	1.20					0.35	0.35	0.35

SHGC – all frame types

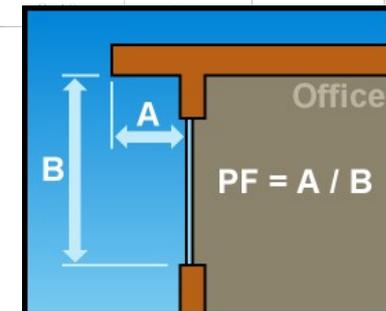
CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
SHGC: PF < 0.25	0.25	0.25	0.25	0.40	0.40	0.40	0.45	0.45
SHGC: $0.25 \leq \text{PF} < 0.5$	0.33	0.33	0.33	NR	NR	NR	NR	NR
SHGC: PF ≥ 0.5	0.40	0.40	0.40	NR	NR	NR	NR	NR

<i>U</i> -factor	0.75	0.75	0.65	0.60	0.60	0.60	0.60	0.60
SHGC	0.35	0.35	0.35	0.40	0.40			

NR = No requirement.

PF = Projection factor (see Section 502.3.2).

a. All others includes operable windows, fixed windows and nonentrance doors.



Compliance with Chapter 5 Prescriptive Approach

TABLE 502.3
BUILDING ENVELOPE REQUIREMENTS: FENESTRATION

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
Vertical fenestration (40% maximum of above-grade wall)								
<i>U</i> -factor								
Framing materials other than metal with or without metal reinforcement or cladding								
<i>U</i> -factor	1.20					5	0.35	0.35
Skylights (3% maximum)								
Metal framing with or without thermal break								
<i>U</i> -factor								

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
U-factor	0.75	0.75	0.65	0.60	0.60	0.60	0.60	0.60
SHGC	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

<i>U</i> -factor	0.75	0.75	0.65	0.60	0.60	0.60	0.60	0.60
SHGC	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

NR = No requirement.

PF = Projection factor (see Section 502.3.2).

a. All others includes operable windows, fixed windows and nonentrance doors.

Vertical Fenestration Requirement (502.3.1)



- Based on above-grade wall area (gross)
 - Includes walls between conditioned space and unconditioned space or the great outdoors
 - Includes walls that are > 15% above grade
- Total fenestration area (includes frame and glazing)
 - Does not include opaque door area

Fenestration U-Factor (502.3.2)

Framing Materials Other Than Metal w/ or w/o metal reinforcement or cladding



Curtain Wall

Fenestration U-Factor – Storefront

Storefront



Entrance Door



Fenestration U-Factor – All Other



- Includes operable windows, fixed windows and non-entrance doors

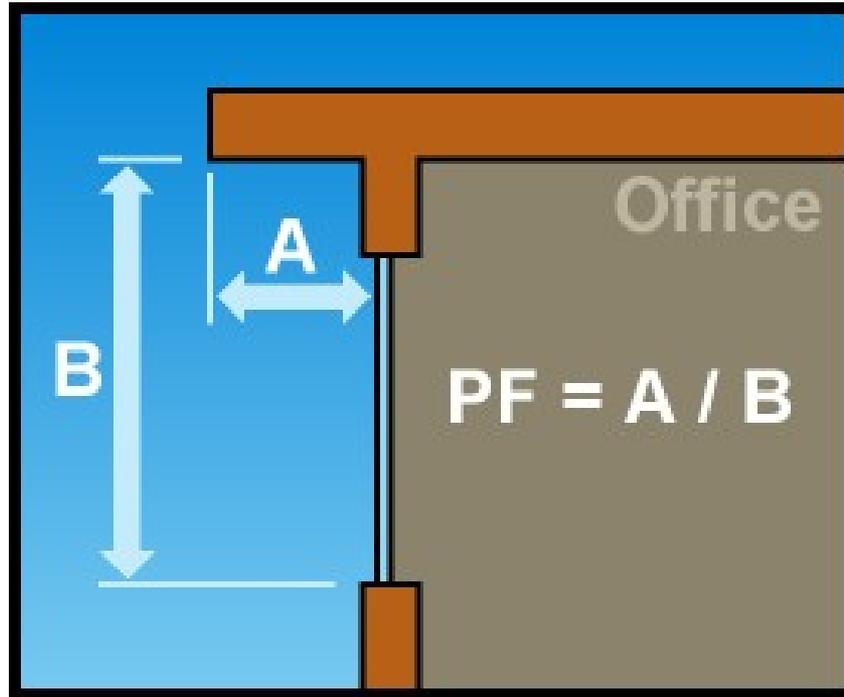
Glazed Fenestration SHGC (502.3.2)



What is Solar Heat Gain Coefficient?

“The ratio of the solar heat gain entering the space through the fenestration assembly to the incident solar radiation.”

Fenestration SHGC Requirements



The Effect of Overhangs on Fenestration SHGC

- Overhangs allow a higher SHGC product to be installed
- Projection factor must be calculated

CLIMATE ZONE	1	2	3	4	5	6	7	8
SHGC: $PF < 0.25$	0.25	0.25	0.25	0.40	0.40	0.40	0.45	0.45
SHGC: $0.25 \leq PF < 0.5$	0.33	0.33	0.33	NR	NR	NR	NR	NR
SHGC: $PF \geq 0.5$	0.40	0.40	0.40	NR	NR	NR	NR	NR

Mandatory Requirements – Sealing of the Building Envelope (502.4.3)

- All penetrations, openings, joints and seams in the building envelope must be sealed. Materials that can be used include:
 - Caulking
 - Gasketing
 - Tapes
 - Moisture vapor-permeable wrapping material
- Sealing materials spanning joints between dissimilar materials must allow for expansion and contraction



Mandatory Requirements – Outdoor Air Intakes and Exhaust Openings (502.4.5)



- Buildings ≥ 3 stories in height above grade
 - Class 1 motorized leakage-rated damper
 - Maximum leakage rate $\leq 4\text{cfm /ft}^2$ @ 1.0 inch w.g.
- Buildings < 3 stories in height
 - Gravity (nonmotorized) allowed

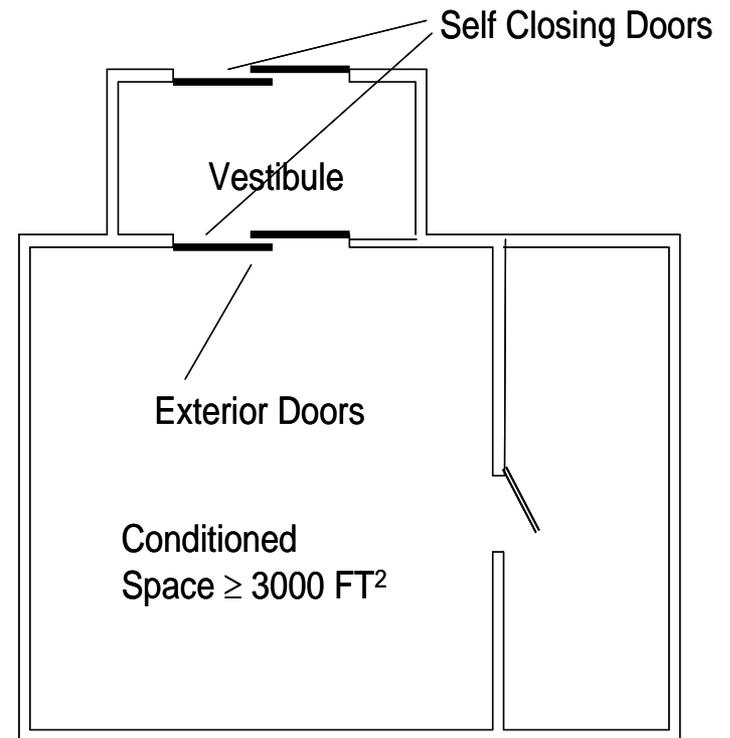
Mandatory Requirements – Loading Dock Weatherseals (502.4.6)



- Equip cargo doors and loading dock doors with weatherseals
- Goal is to restrict infiltration

Mandatory Requirements – Vestibules (502.4.7)

- Required to reduce infiltration into spaces
- Required on entrance doors leading into spaces $\geq 3,000$ ft²
- Doors must have self-closing devices
- Exceptions
 - Buildings in Climate Zones 1 and 2
 - Doors from a guest room or dwelling unit
 - Doors used primarily for vehicular movement, material handling and adjacent personnel doors



Mandatory Requirements – Recessed Lighting (502.4.8)

All recessed luminaires installed in the building envelope

- Type IC rated and sealed with gasket or caulk between housing and interior wall or ceiling covering
- Type IC rated and labeled in accordance with ASTM E 283 to allow ≤ 2.0 cfm of air movement from conditioned space to ceiling cavity

