U.S. Department of Energy
Building Energy Codes Program

Provider Number: I014

Insulation Requirements in the IECC®

Course Number: EC15-TH03

Jason Toves

Date: March 26, 2015

Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

This course is registered with AIA CES

for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Course Description

This session will give an overview of the compliance paths in the IECC® with respect to the building envelope and insulation specifically. Participants in this session will gain an understanding of both the U-value table (402.1.2) and R-Value table (402.2) in the IECC. Technical concepts will be reinforced through specific examples in successful implementation.

Learning Objectives

At the end of the this course, participants will be able to:

- Develop an understanding of the compliance paths of the IECC with respect to the building envelope in general and insulation specifically.
- Understand the basics and terminology of insulation.
- Understand how to use Tables C402.1.2 (U-Value) and C402.2 (R-Value).
- Review examples in successful implementation of the insulation requirements contained in the energy codes.

Session Outline

I. Compliance Paths
II. Residential
III. Commercial
    I. Additional Efficiency Packages and Commissioning
    II. Insulation Basics
IV. Material Properties
V. IECC Options
    I. R-Value (Table C402.2)
    II. U-Value (Table C402.1.2)
    III. Examples
VI. Changes in the 2015 IECC

2012 IECC Compliance Paths

- Section R401.1 IECC 2012

I. Residential Buildings

   I. One- and two- family dwellings

   II. Townhouses (Three stories or less)

   III. R-2, R-3 and R-4 buildings (Three stories or less)

- Section C401.1 IECC 2012

I. Commercial Buildings

   I. All other buildings

   II. Residential buildings (More than three stories)

Residential Compliance Paths

- Mandatory (R402.4)
  - Air Barrier
    - Installation (Table R402.4.1.1)
    - Testing (R402.4.1.2)
  - Fireplaces, fenestration and recessed lighting
  - Fenestration maximums (R402.5)
- Prescriptive (R402.1, R402.2 and R402.3)
- Performance (R405)

Residential Compliance Paths

- Prescriptive Envelope Alternatives
  - U-factor (Table R402.1.3)
  - UA Alternative (R402.1.4)

Commercial Compliance Paths

- 2012 IECC (C401.2 Options 2 and 3)
  - Prescriptive
  - Total Building (Performance Path)
- ASHRAE 90.1-2010 (C401.2 Option 1)
  - Prescriptive
  - Energy Cost Budget Method (Performance Path)
- Above Code Programs (C102.1.1)
- Alternative Means and Method (C102.1)

IECC Commercial Performance Path

Total Building Compliance

- Proposed Design ≤ 85% Standard Reference Design
- Software Requirements
  - Base Analysis Tool
    - ASHRAE Standard 140
    - C407 Capabilities
      - Energy Users (C407.1)
      - Thermal blocks (C407.5.2)
  - Limited scope tools

IECC Commercial Performance Path

Total Building Compliance

- Mandatory Requirements
  - Building envelope air leakage (C402.4)
  - Mechanical (C403.2)
  - Service water heating (C404)
  - Lighting (C405.2, C405.3, C405.4, C405.6 and C405.7)

IECC Commercial Prescriptive Path

- Envelope (C402)
- Mechanical (C403)
- Service Water Heating (C404)
- Lighting Power and Controls (C405)

IECC Commercial Prescriptive Path

- Additional Efficiency Packages
  - HVAC Performance (C406.2)
  - Lighting Performance (C406.3)
  - On-Site Renewable Energy (C406.4)
- Commissioning
  - Mechanical (C403.2.9 and C408.2)
  - Lighting (C408.3)

IECC Prescriptive Envelope

- Prescriptive R-Value (C402.2)
- Alternate U-Value (C402.1.2)

R-Value Requirements (Table C402.2)

- Nashville, Tennessee
- Metal and wood framed office buildings

R-Value Requirements (Table C402.2)

- Climate Zone 4A
- R-13 + R-7.5 ci Wall insulation (Metal Framed)
- R-13 + R-3.8 ci Wall insulation (Wood Framed)
- R-20 (Wood Framed)

IECC Prescriptive Envelope

TABLE C402.2 OPAQUE THERMAL ENVELOPE REQUIREMENTS[a]

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-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal buildings (with R-5 thermal blocks)[a, b]	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-25 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-49	R-49	R-49	R-49	R-49	R-49	R-49
Walls, Above Grade																
Mass	R-5.7ci	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	R-13+ R-6.5ci	R-13 + R-6.5ci	R13 + R-6.5ci	R-13 + R-13ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13+ R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13+ R-19.5ci	R-13 + R-13ci	R-13+ R-19.5ci
Metal framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-15.6ci	R-13 + R-7.5ci	R-13+ R17.5ci
Wood framed and other	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-15.6ci or R-20 + R-10ci	R-13 + R-15.6ci or R-20 + R-10ci
Walls, Below Grade																
Below-grade wall[d]	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-10ci	R-10ci	R-12.5ci
Floors																
Mass	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	R-12.5ci	R-12.5ci	R-15ci	R-16.7ci	R-15ci	R-16.7ci
Joist/framing	NR	NR	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30[e]	R-30[e]	R-30[e]	R-30[e]	R-30[e]
Slab-on-Grade Floors																
Unheated slabs	NR	NR	NR	NR	NR	NR	R-10 for 24 below	R-10 for 24 below	R-10 for 24 below	R-10 for 24 below	R-10 for 24 below	R-15 for 24 below	R-15 for 24 below	R-15 for 24 below	R-15 for 24 below	R-20 for 24 below
Heated slabs[d]	R-7.5 for 12 below	R-7.5 for 12 below	R-7.5 for 12 below	R-7.5 for 12 below	R-10 for 24 below	R-10 for 24 below	R-15 for 24 below	R-15 for 24 below	R-15 for 36 below	R-15 for 36 below	R-15 for 36 below	R-20 for 48 below	R-20 for 24 below	R-20 for 48 below	R-20 for 48 below	R-20 for 48 below
Opaque Doors																
Swinging	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37
Roll-up or sliding	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75

IECC Prescriptive Envelope

TABLE C402.2 OPAQUE THERMAL ENVELOPE REQUIREMENTS[a]

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-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal buildings (with R-5 thermal blocks)[a, b]	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-25 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-49	R-49	R-49	R-49	R-49	R-49	R-49
Walls, Above Grade																
Mass	R-5.7ci	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	R-13+ R-6.5ci	R-13 + R-6.5ci	R13 + R-6.5ci	R-13 + R-13ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13+ R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13+ R-19.5ci	R-13 + R-13ci	R-13+ R-19.5ci
Metal framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-15.6ci	R-13 + R-7.5ci	R-13+ R17.5ci
Wood framed and other	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-15.6ci or R-20 + R-10ci	R-13 + R-15.6ci or R-20 + R-10ci
Walls, Below Grade																
Below-grade wall[d]	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-10ci	R-10ci	R-12.5ci
Floors																
Mass	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	R-12.5ci	R-12.5ci	R-15ci	R-16.7ci	R-15ci	R-16.7ci
Joist/framing	NR	NR	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30[e]	R-30[e]	R-30[e]	R-30[e]	R-30[e]
Slab-on-Grade Floors																
Unheated slabs	NR	NR	NR	NR	NR	NR	R-10 for 24 below	R-10 for 24 below	R-10 for 24 below	R-10 for 24 below	R-10 for 24 below	R-15 for 24 below	R-15 for 24 below	R-15 for 24 below	R-15 for 24 below	R-20 for 24 below
Heated slabs[d]	R-7.5 for 12 below	R-7.5 for 12 below	R-7.5 for 12 below	R-7.5 for 12 below	R-10 for 24 below	R-10 for 24 below	R-15 for 24 below	R-15 for 24 below	R-15 for 36 below	R-15 for 36 below	R-15 for 36 below	R-20 for 48 below	R-20 for 24 below	R-20 for 48 below	R-20 for 48 below	R-20 for 48 below
Opaque Doors																
Swinging	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37
Roll-up or sliding	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75

IECC Prescriptive Envelope

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE	
	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R
Roofs								
Insulation entirely above deck	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-25ci	R-25ci
Metal buildings (with R-5 thermal blocks)[a, b]	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38
Walls, Above Grad								
Mass	R-5.7ci	R-5.7ci	R-5.7ci	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11.4ci
Metal building	R-13+ R-6.5ci	R-13 + R-6.5ci	R13 + R-6.5ci	R-13 + R-13ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci
Metal framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci

IECC Prescriptive Envelope

TABLE C402.2 OPAQUE THERMAL ENVELOPE REQUIREMENTS[a]

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-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal buildings (with R-5 thermal blocks)[a, b]	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-25 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-49	R-49	R-49	R-49	R-49	R-49	R-49
Walls, Above Grade																
Mass	R-5.7ci	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	R-13+ R-6.5ci	R-13 + R-6.5ci	R13 + R-6.5ci	R-13 + R-13ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13+ R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13+ R-19.5ci	R-13 + R-13ci	R-13+ R-19.5ci
Metal framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-15.6ci	R-13 + R-7.5ci	R-13+ R17.5ci
Wood framed and other	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-15.6ci or R-20 + R-10ci	R-13 + R-15.6ci or R-20 + R-10ci
Walls, Below Grade																
Below-grade wall[d]	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-10ci	R-10ci	R-12.5ci
Floors																
Mass	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	R-12.5ci	R-12.5ci	R-15ci	R-16.7ci	R-15ci	R-16.7ci
Joist/framing	NR	NR	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30[e]	R-30[e]	R-30[e]	R-30[e]	R-30[e]
Slab-on-Grade Floors																
Unheated slabs	NR	NR	NR	NR	NR	NR	R-10 for 24 below	R-10 for 24 below	R-10 for 24 below	R-10 for 24 below	R-10 for 24 below	R-15 for 24 below	R-15 for 24 below	R-15 for 24 below	R-15 for 24 below	R-20 for 24 below
Heated slabs[d]	R-7.5 for 12 below	R-7.5 for 12 below	R-7.5 for 12 below	R-7.5 for 12 below	R-10 for 24 below	R-10 for 24 below	R-15 for 24 below	R-15 for 24 below	R-15 for 36 below	R-15 for 36 below	R-15 for 36 below	R-20 for 48 below	R-20 for 24 below	R-20 for 48 below	R-20 for 48 below	R-20 for 48 below
Opaque Doors																
Swinging	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37
Roll-up or sliding	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75

IECC Prescriptive Envelope

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE	
	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R
							Roofs	
Insulation entirely above deck	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-25ci	R-25ci
Metal buildings (with R-5 thermal blocks)[a, b]	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38
							Walls, Above Grad	
Mass	R-5.7ci	R-5.7ci	R-5.7ci	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11.4ci
Metal building	R-13+ R-6.5ci	R-13 + R-6.5ci	R13 + R-6.5ci	R-13 + R-13ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci
Metal framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci

IECC Prescriptive Envelope

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE	
	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R
Roofs								
Insulation entirely above deck	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-25ci	R-25ci
Metal buildings (with R-5 thermal blocks)[a, b]	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38
Walls, Above Grad								
Mass	R-5.7ci	R-5.7ci	R-5.7ci	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11.4ci
Metal building	R-13+ R-6.5ci	R-13 + R-6.5ci	R13 + R-6.5ci	R-13 + R-13ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci
Metal framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci

IECC Prescriptive Envelope

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE	
	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R
							Roofs	
Insulation entirely above deck	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-25ci	R-25ci
Metal buildings (with R-5 thermal blocks)[a, b]	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38
							Walls, Above Grad	
Mass	R-5.7ci	R-5.7ci	R-5.7ci	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11.4ci
Metal building	R-13+ R-6.5ci	R-13 + R-6.5ci	R13 + R-6.5ci	R-13 + R-13ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci
Metal framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci

R-Value Requirements (Table C402.2)

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE	
	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R
Roofs								
Insulation entirely above deck	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-25ci	R-25ci
Metal buildings (with R-5 thermal blocks)[a, b]	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38
Walls, Above Grad								
Mass	R-5.7ci	R-5.7ci	R-5.7ci	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11.4ci
Metal building	R-13+ R-6.5ci	R-13 + R-6.5ci	R13 + R-6.5ci	R-13 + R-13ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci
Metal framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci

IECC Prescriptive Envelope Alternative

- R13 between the framing members and 7.5 ci
- Other Options
  - Total Building
  - U-Value Alternative (C402.1.2)

Terms

- Table C402.2
  - R-Value for most assemblies
- Table C402.1.2
  - U-Factor
  - C-Factor
  - F-Factor

R-Value (Thermal Resistance)

The inverse of the time rate of heat flow through a body from one of its bounding surfaces to the other surface for a unit temperature difference between the two surfaces, under steady state conditions, per unit area.

$(h \bullet ft^2 \bullet °F/Btu)$ $[(m^2 \bullet K)/W]$

C-Factor (Thermal Conductance)

The coefficient of heat transmission (surface to surface) through a building component or assembly, equal to the time rate of heat flow per unit area and the unit temperature difference between the warm side and cold side surfaces

(Btu/h • ft^2 • °F) [W/(m^2 × K)]

U-Factor (Thermal Transmittance)

The coefficient of heat transmission (air to air) through a building component or assembly, equal to the time rate of heat flow per unit area and unit temperature difference between the warm side and cold side air films

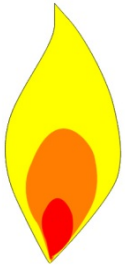
(Btu/h • ft^2 • °F) [W/(m^2 • K)].

Can I do this?

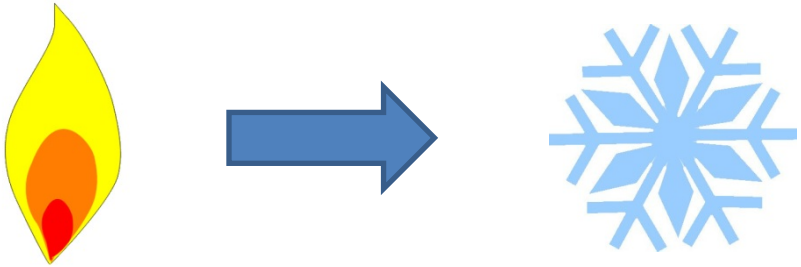
- Table C402.2
  - R-Value for most assemblies
- ~~Table C402.1.2~~
  - ~~U-Factor~~
  - ~~C-Factor~~
  - ~~F-Factor~~

Heat Transfer

Energy (British Thermal Unit), BTU



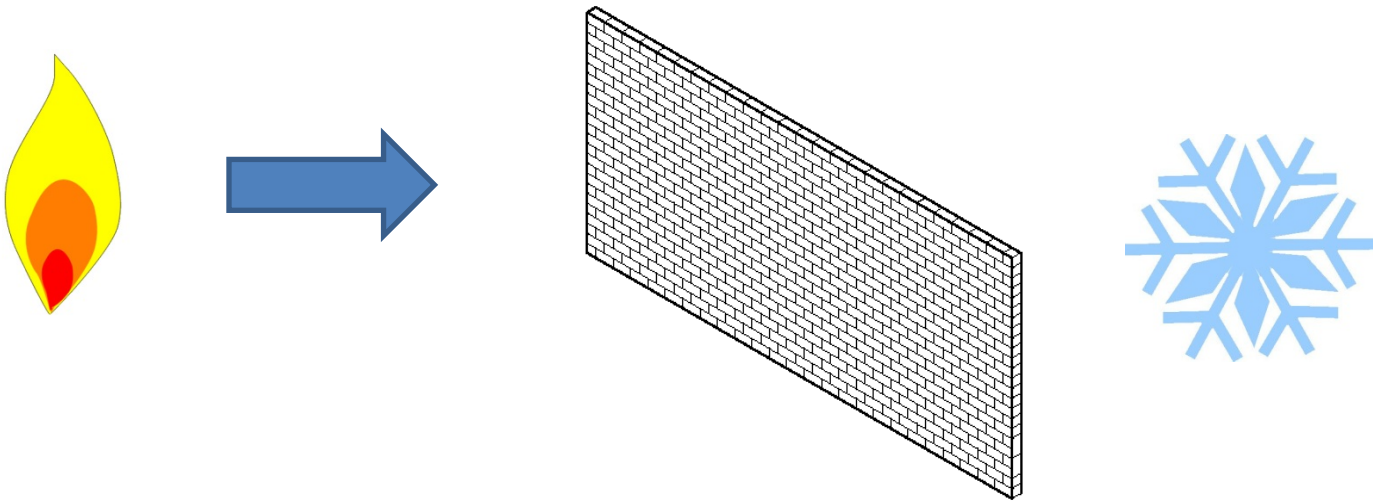
Heat Transfer (BTU/hour)



C-Factor

Thermal Conductance

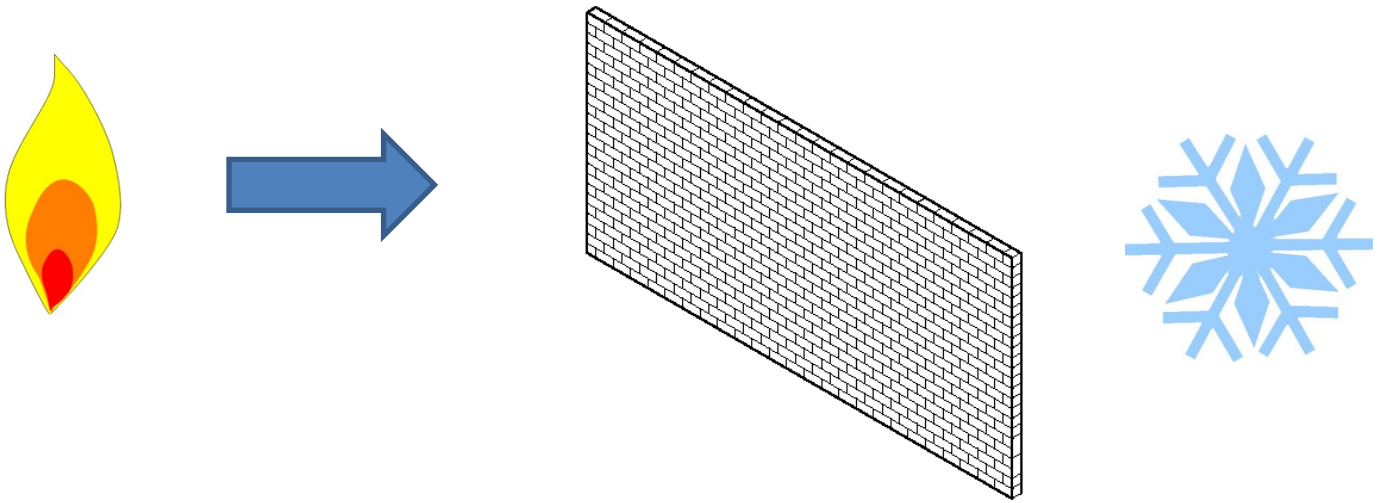
(Btu/(hr · °F ·ft²))



C-Factor

Thermal Conductance

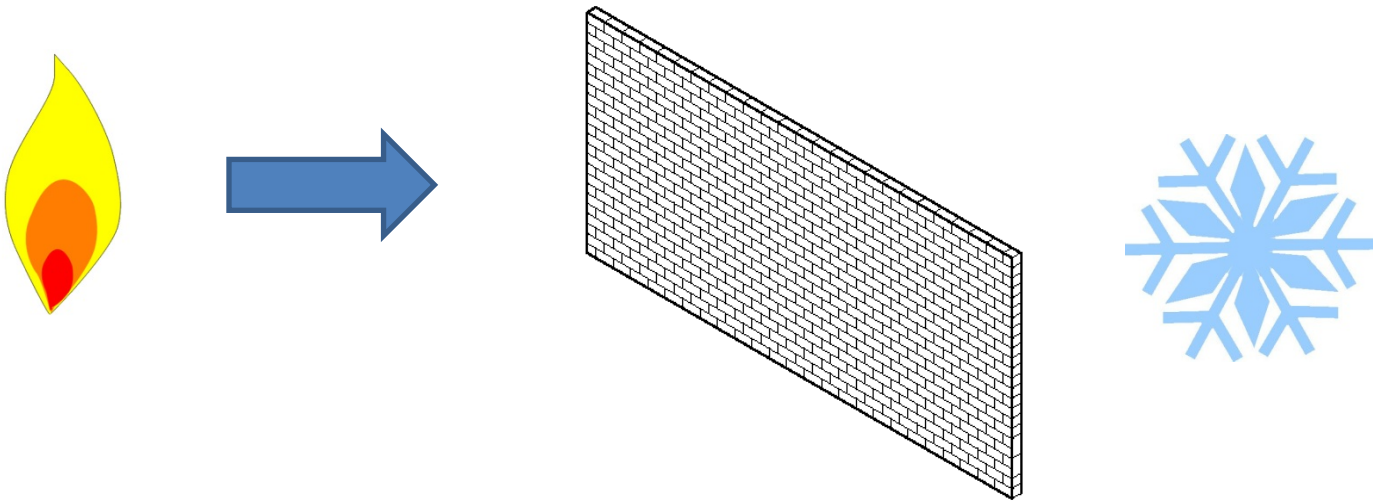
((Btu/hr) / °F ·ft²)



R-Value

- Thermal Resistance

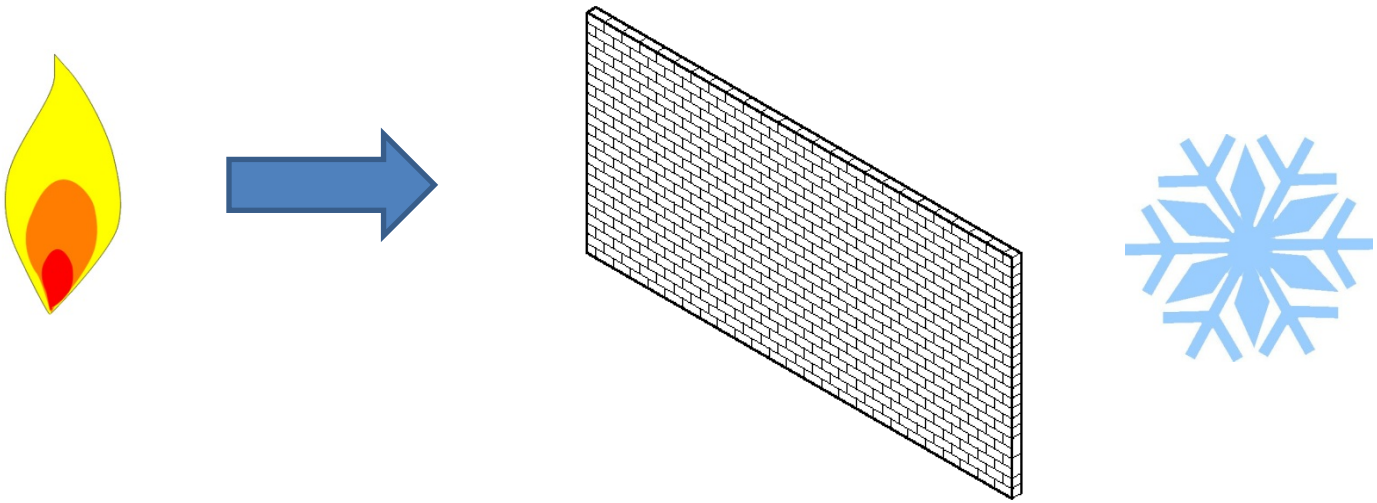
  $(hr \cdot ft^2 \cdot °F / Btu)$



R-Value

- Thermal Resistance

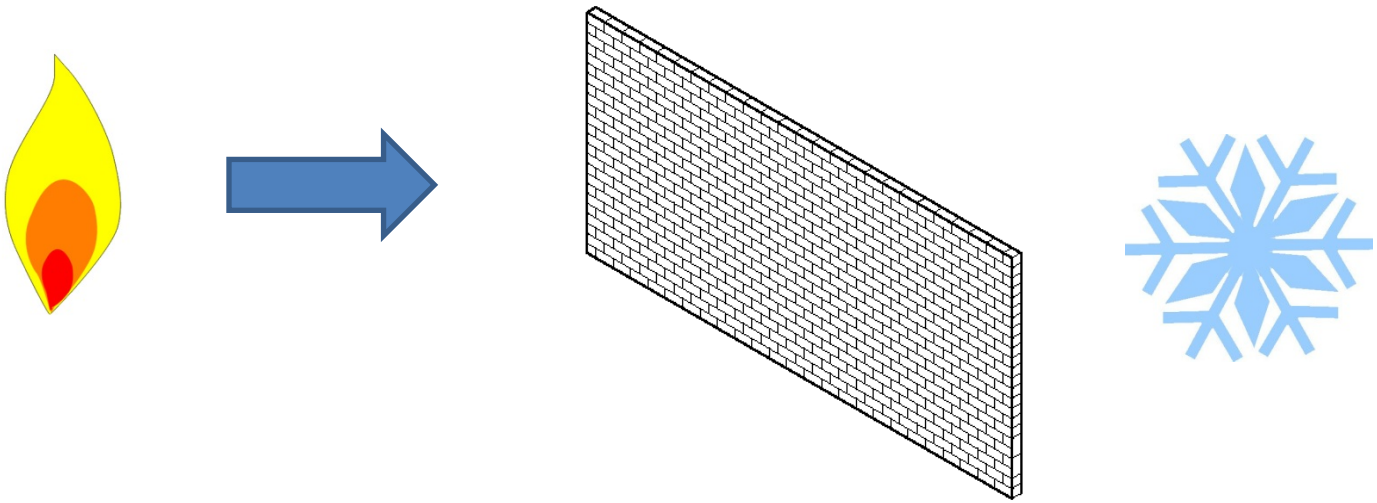
  ($°F \cdot ft^2$ /(Btu /hr))



R-Value

- Thermal Resistance = 1 / C-Factor

  ($°F \cdot ft^2$ /(Btu /hr))



R-Value

- Thermal Resistance, R-Value

  Thicker material or higher Resistivity

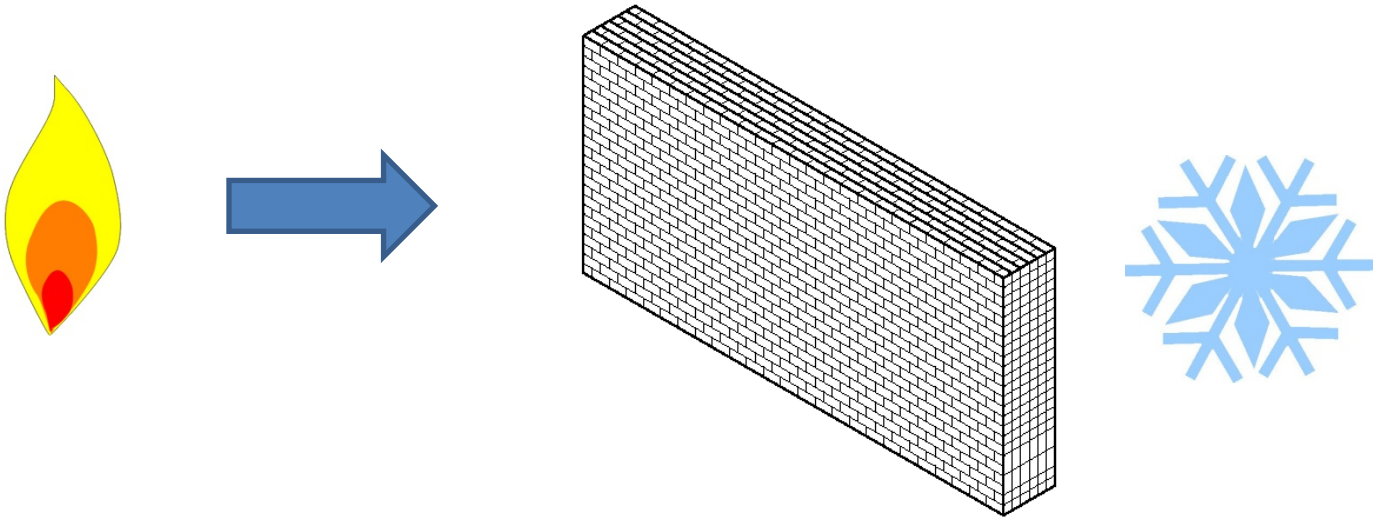


Table C402.1.2

U-factor alternative.

An assembly with a U-factor, C-factor, or F-factor equal or less than that specified in Table C402.1.2 shall be permitted as an alternative to the R-value in Table C402.2.

U-Factor vs. C-Factor

(Btu/h • ft^2 • °F) vs. (Btu/h • ft^2 • °F)

((Btu/hr) / °F ·ft^2) vs. ((Btu/hr) / °F ·ft^2)

(air to air) vs. (surface to surface)

U-Factor vs. C-Factor

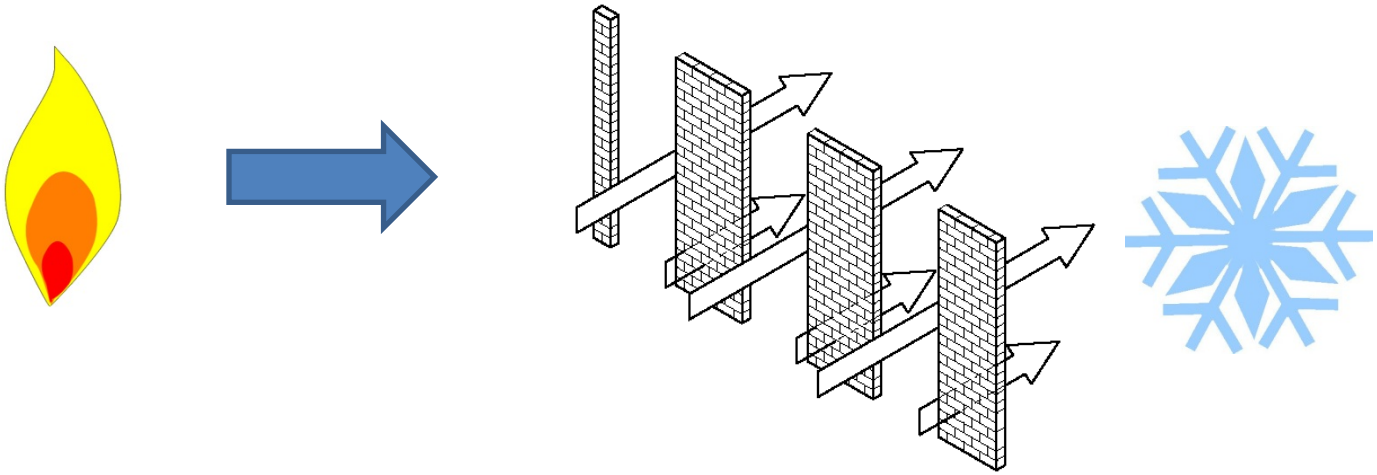
C402.1.2 U-factor alternative.

An assembly with a U-factor, C-factor, **or** F-factor equal or less than that specified in Table C402.1.2 shall be permitted as an alternative to the R-value in Table C402.2.

Composite Assembly

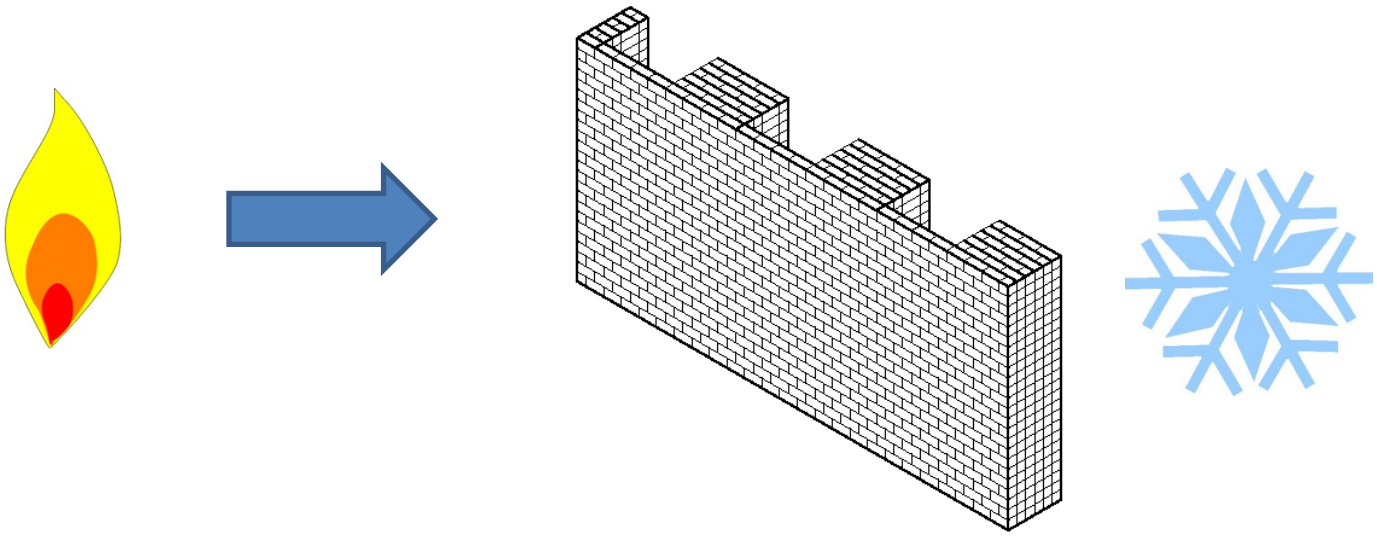
- Thermal Resistance, R-Value

  Gaps in insulation



Composite Assembly

- Same material with differing thicknesses or different materials (U-Value)



F-Factor

The perimeter heat loss factor for slab-on-grade floors

(Btu/h · ft · °F) [W/(m · K)]

Or

((Btu/hr) / ft · °F)

U-Factor Alternative (Table C402.1.2)

- Climate Zone 4A
- U-0.064
- C-factor (R-Value equivalent)
  - R-Value = 1/0.064 ((Btu/hr) / °F ·ft²)
  - R-Value of 15.6 (°F · ft² /(Btu /hr))
  - continuous insulation
  - R-13 + R-3.8 ci Wall insulation

U-Factor Alternative (Table C402.1.2)

- Climate Zone 4A
- U-0.064 for metal framed walls
- U-0.064 for wood framed walls
- U-factor (Assembly Calculation)

U-Factor Alternative (Table C402.1.2)

- Wood Framed Wall
  - Wood bevel lapped siding
  - Rigid foam insulation
  - R-13 insulation
  - Wood studs (2x4)
  - Gypsum Board (0.5 inches)

U-Factor Alternative (Table C402.1.2)

- Wood Framed Wall
  - Outside Air film
  - Wood bevel lapped siding
  - Rigid foam insulation
  - R-13 insulation
  - Wood studs (2x4)
  - Gypsum Board (0.5 inches)
  - Inside Air Film

U-Factor Alternative (Table C402.1.2)

	Cavity ($°F \cdot ft^2$ /(Btu /hr))	Framing ($°F \cdot ft^2$ /(Btu /hr))	
Length (inches)	28	6	
Percent of Path	82	18	
Outside Air Film (15 mph)	0.17	0.17	
Wood bevel lapped siding	0.81	0.81	
Rigid foam insulation sheathing	3.8	3.8	
Batt Insulation	13		
Wood Studs		4.38	
Gypsum Wall Board	0.45	0.45	
Inside Air surface	0.68	0.68	
Thermal Resistance for Path	18.91	10.29	
U-Value for Path	0.053	0.097	0.061

U-Factor Alternative (Table C402.1.2)

- U_{av} = (0.82 x 0.053) + (0.18 x 0.097)
- U_{av} = 0.061 ((Btu/h)/ ft^2 • °F)
- Required is 0.064 ((Btu/h)/ ft^2 • °F)

U-Factor Alternative (Table C402.1.2)

	Cavity ($°F \cdot ft^2$ /(Btu /hr))	Framing ($°F \cdot ft^2$ /(Btu /hr))	
Length (inches)	28	6	
Percent of Path	82	18	
Outside Air Film (15 mph)	0.17	0.17	
Wood bevel lapped siding	0.81	0.81	
Rigid foam insulation sheathing	13	13	
Batt Insulation			
Wood Studs		4.38	
Gypsum Wall Board	0.45	0.45	
Inside Air surface	0.68	0.68	
Thermal Resistance for Path	15.11	19.49	
U-Value for Path	0.066	0.051	**0.064**

U-Factor Alternative (Table C402.1.2)

	Cavity ($°F \cdot ft^2$ /(Btu /hr))	Framing ($°F \cdot ft^2$ /(Btu /hr))	
Length (inches)	28	6	
Percent of Path	82	18	
Outside Air Film (15 mph)	0.17	0.17	
Wood bevel lapped siding	0.81	0.81	
Rigid foam insulation sheathing			
Batt Insulation	20		
Wood Studs		4.38	
Gypsum Wall Board	0.45	0.45	
Inside Air surface	0.68	0.68	
Thermal Resistance for Path	22.11	6.49	
U-Value for Path	0.045	0.154	0.064

Notes about Parallel Flow Calculation

- Issues
  - Usually low
  - Lateral flow not considered
  - To be rigorous you should consider both parallel and combined parallel-series calculations
  - Not reasonable for metal framed construction

  (Zone method)
- Benefit
  - Understandable

Changes in the 2015 IECC

- Residential
  - Energy Rating Index (ERI) (R406)
- Commercial
  - Thermal resistance of cold-formed steel (C402.1.4.1)
  - Component Performance alternative (C402.1.5)
- Existing Buildings (Chapter 5's)

U-Factor Alternative (Table C402.4.1)

TABLE C402.1.4.1
EFFECTIVE *R*-VALUES FOR STEEL STUD WALL ASSEMBLIES

NOMINAL STUD DEPTH (inches)	SPACING OF FRAMING (inches)	CAVITY *R*-VALUE (insulation)	CORRECTION FACTOR (F_c)	EFFECTIVE *R*-VALUE (ER) (Cavity *R*-Value × F_c)
$3^1/_2$	16	13	0.46	5.98
		15	0.43	6.45
$3^1/_2$	24	13	0.55	7.15
		15	0.52	7.80
6	16	19	0.37	7.03
		21	0.35	7.35
6	24	19	0.45	8.55
		21	0.43	9.03
8	16	25	0.31	7.75
	24	25	0.38	9.50

U-Factor Alternative (Table C402.1.4.1)

	Cavity ($°F \cdot ft^2$ /(Btu /hr))	Metal Framing ($°F \cdot ft^2$ /(Btu /hr))	
Outside Air Film (15 mph)	0.17		
Wood bevel lapped siding	0.81		
Rigid foam insulation sheathing	7.5		
Batt Insulation			
Wood Studs			
Gypsum Wall Board	0.45		
Inside Air surface	0.68		
Thermal Resistance for Path	9.61	5.98	
U-Value for Path			0.064

Contact Information

- (888) ICC-SAFE (422-7233) extension 5681
- jtoves@iccsafe.org