

Significant Changes from the 2018 to 2021 IECC: Residential

3.19.2024



SEDAC

SMART ENERGY DESIGN ASSISTANCE CENTER

Providing effective energy strategies for buildings and communities



SEDAC

SMART ENERGY DESIGN ASSISTANCE CENTER

Presenters:

Shawn Maurer



Robert Schlorff



Who We Are



SEDAC

SMART ENERGY DESIGN ASSISTANCE CENTER

Our mission: Reduce the energy footprint of Illinois and beyond



What We Do

We are an applied research program at the University of Illinois.

We assist buildings and communities in achieving energy efficiency, saving money, and becoming more sustainable.

We help facilities become more energy efficient.

We educate.

We research.

We advocate for a greener future.



SEDAC is the Illinois Energy Conservation Code Training Provider



This training program is sponsored by **Illinois EPA Office of Energy**

SEDAC is a Preferred Education Provider with the International Code Council (ICC). Credits earned on completion of this program will be reported to ICC for ICC members. Certificates of Completion will be issued to all participants.



This workshop is approved for 1 LU/HSW CES credits from the American Institute of Architects (AIA). Credits earned on completion will be reported for AIA members.



Energy Code Assistance

Technical support

- energycode@illinois.edu
- 800.214.7954

Online resources at

smartenergy.illinois.edu/energy-code

- Workshops
- Webinars
- Online on-demand training modules



SEDAC Energy Code Training Series

Energy Code Webinar Schedule

08.22.23 – ARCHIVED – Energy Code Basics

09.26.23 – ARCHIVED - Existing Residential Buildings

11.14.23 – ARCHIVED - Residential Stretch Code

12.12.23 – ARCHIVED Q&A Review – How We Answer Energy Code Questions

02.20.24 – ARCHIVED - Commercial Stretch Energy Code

04.09.24 – Simplified Code Compliance

05.21.24 – Existing Commercial Buildings

06.11.24 – Q&A Review – How We Answer Energy Code Questions

Registration: <https://smartenergy.illinois.edu/events>

SEDAC Energy Code Upcoming Events

Based on popular demand we have added (2) upcoming webinars to cover changes between the 2018 IECC and 2021 IECC

03.19.24 – 2021 IECC Updates: Residential TODAY!

03.20.24 – 2021 IECC Updates: Commercial

Registration: <https://smartenergy.illinois.edu/events>

Illinois Energy Conservation Code



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Illinois Energy Conservation Code

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Click [here](#) for the [2022 Chicago Energy Transformation Code](#).

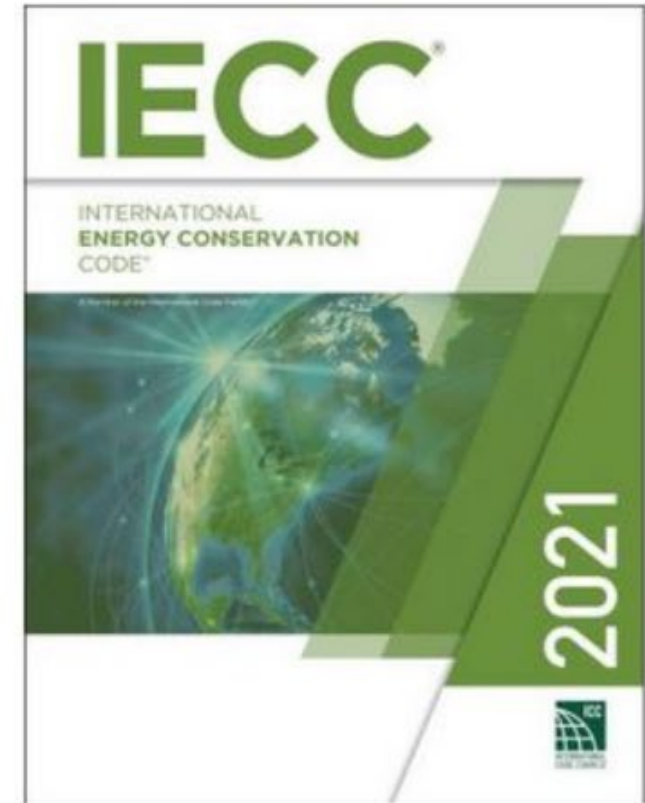
New Energy Code Coming to Illinois January 1, 2024

In accordance with the [Energy Efficient Building Act](#), the [Capital Development Board](#) (CDB) is required to review and adopt the most current version of the International Energy Conservation Code (IECC) within one year of its publication date. The Code will then become effective in Illinois within 6 months following its adoption by the CDB. The CDB, in conjunction with the [Illinois Environmental Protection Agency](#) and the [Illinois Energy Conservation Advisory Council](#), initiates the cycle for the Illinois Energy Conservation Code to be updated every three years.

At its November 7 meeting, JCAR approved the new rules to update the Illinois Energy Conservation Code from the 2018 IECC with amendments to the 2021 IECC with amendments. On November 14, the Capital Development Board set the effective date for the changes as January 1, 2024. Any projects applying for a permit on or after January 1, 2024 will need to comply with the new code.

The 2021 Illinois Energy Conservation Code can be accessed here:

- [2021 IECC](#)
- [Illinois Amendments](#)



Access to 2021 IECC & IL Amendments

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All Codes <

Legend Information

CODE SECTIONS MY NOTES

2021 INTERNATIONAL ENERGY CONSERVATION CODE (IECC)

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PREFACE

▶ ARRANGEMENT AND FORMAT OF THE 2021 IECC

ABBREVIATIONS AND NOTATIONS

IECC—COMMERCIAL PROVISIONS

▶ CHAPTER 1 [CE] SCOPE AND ADMINISTRATION

▶ CHAPTER 2 [CE] DEFINITIONS

▶ CHAPTER 3 [CE] GENERAL REQUIREMENTS

▶ CHAPTER 4 [CE] COMMERCIAL ENERGY EFFICIENCY

2021 International (IECC) Add to Favorites

The 2021 IECC® addresses energy efficiency on several resources and the impact of energy usage on the environment.

Related Titles

2021 Complete Revision History to the 2021 I-Codes - IECC: Successful Changes and Public Comments >

2021 Significant Changes to the International Energy Conservation Code >

<https://cdb.illinois.gov/business/codes/illinois-energy-codes/illinois-energy-conservation-code.html>

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Illinois Energy Codes

Illinois Energy Conservation Code

Illinois Stretch Energy Code

Advisory Council Meetings

Illinois Energy Conservation Code (20 ILCS 3125/15)

State Funded Facilities must comply with the IECC per 20 ILCS 3125. See Subpart B of the [Illinois Energy Conservation Code](#) for more information. The 2021 edition of the IECC as amended went into effect on 1/1/24.

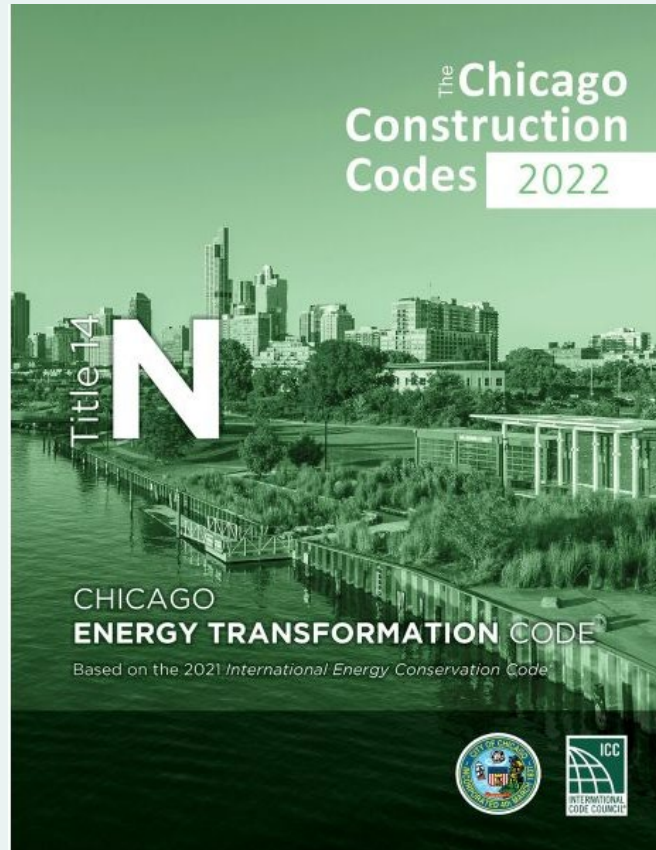
Privately Funded Commercial Facilities must comply with IECC per 20 ILCS 3125. See Subpart C of the [Illinois Energy Conservation Code](#) for more information. The 2021 edition of the IECC as amended went into effect on 1/1/24.

Residential Buildings must comply with IECC per 20 ILCS 3125. See Subpart D of the [Illinois Energy Conservation Code](#) for more information. The 2021 edition of the IECC as amended went into effect on 1/1/24.

- 2021
 - [Illinois Specific Amendments](#)
 - [Illinois Specific Amendments with Modifications Shown](#)

<https://codes.iccsafe.org/content/IECC2021P2>

Access to Chicago Energy Transformation Code



<https://codes.iccsafe.org/codes/illinois/Chicago>

ARTICLE XIII. **CHICAGO ENERGY CONSERVATION CODE**

SECTION 1. The Municipal Code of Chicago is hereby amended by inserting a new Title 14N, as follows:

TITLE 14N ENERGY CONSERVATION CODE

PART I – COMMERCIAL PROVISIONS

CHAPTER 14N-C1 SCOPE AND PURPOSE

14N-C1-C001 Adoption of the commercial provisions of the International Energy Conservation Code by reference.

The commercial provisions of the *International Energy Conservation Code*, 2018 edition, second printing, and all erratum thereto identified by the publisher (hereinafter referred to as "IECC-CE"), except Appendix CA, are adopted by reference and shall be considered part of the requirements of this title except as modified by the specific provisions of this title.

If a conflict exists between a provision modified by this title and a provision adopted without modification, the modified provision shall control.

14N-C1-C002 Citations.

Provisions of IECC-CE which are incorporated into this title by reference may be cited as follows:

14N-C[IECC-CE chapter number]-[IECC-CE section number]

14N-C1-C003 Global modifications.

The following modifications shall apply to each provision of IECC-CE incorporated into this title:

1. Replace each occurrence of "*International Codes*" with "*Chicago Construction Codes*."
2. Replace each occurrence of "*International Building Code*" with "*Chicago Building Code*."
3. Replace each occurrence of "ASME A17.1" or "ASME A17.1/CSA B44" with "the *Chicago Conveyance Device Code*."
4. Replace each occurrence of "NFPA 70" with "the *Chicago Electrical Code*."

Learning Objectives

1. Describe the key changes in the updated Illinois Energy Conservation Code (2018 IECC to 2021 IECC).
2. Explain the significant challenges for residential buildings in meeting the Illinois Energy Conservation Code and ways to overcome those challenges.
3. Explain how compliance with the Illinois Energy Conservation Code will lead to safer, healthier, and more comfortable buildings.
4. Describe the Illinois Amendments to the 2021 IECC for residential buildings that lead to a reduction in source air pollution.

Residential Definitions

2018 IECC:

“Demand Recirculation Water System: A water distribution system having one or more recirculation pumps that pump water from a heated water supply pipe back to the heated water source *through a cold water supply pipe*”

2021 IECC:

“Demand Recirculation Water System: A water distribution system where one or more pumps prime the service hot water piping with heated water upon demand for hot water.”

Refer to **R403.5.1.1.1** for Demand Recirculation Water System Requirements.

New Definitions:

“**On-site Renewable Energy:** Energy from renewable energy sources harvested at the building site.”

“**Renewable Energy Certificate (REC):** An Instrument that represents the environmental attributes of one megawatt hour of renewable energy; also known as an energy attribute certificate (EAC).”

“**Renewable Energy Resources:** Energy derived from solar radiation, wind, waves, tides, landfill gas, biogas, biomass or extracted from hot fluid or steam heated within the earth.”

2018 IECC:

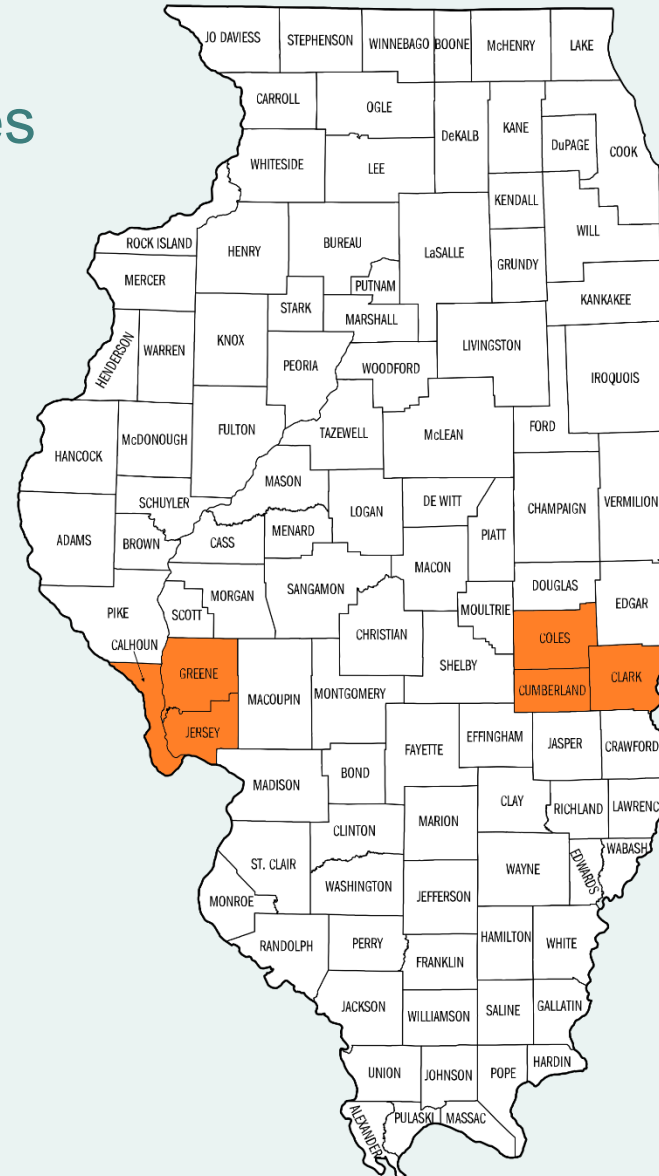
“Roof Re-cover: The process of installing an additional roof covering over a *prepared* existing roof covering without removing the existing roof covering.”

2021 IECC:

“Roof Re-cover: The process of installing an additional roof covering over an existing roof covering without removing the existing roof covering.”

Updated Climate Zones

- Counties moved to warmer climate zones (5A to 4A)
 - Calhoun
 - Clark
 - Coles
 - Cumberland
 - Greene
 - Jersey



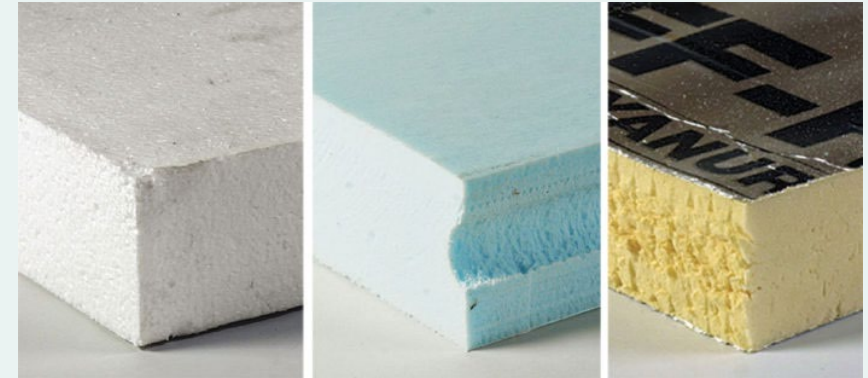
Air-impermeable insulation

R303.1.5 is a new section for 2021 giving a precise definition for materials considered 'air-impermeable insulation' which must meet the requirement below.

- Insulation having air permeability not greater than 0.004 cfm/sf at 0.3 inch water gauge (75 pascals)
- Must be tested in accordance with ASTM E2178



Permeable insulation examples: Cellulose, Mineral Wool, Fiberglass
https://energyeducation.ca/encyclopedia/Fibrous_insulation



Impermeable insulation examples: EPS, XPS, Polyiso
<https://www.greenbuildingadvisor.com/article/choosing-rigid-foam>

Residential: General

R401.2.5 lays out requirements for improving efficiency over base compliance paths: Targets 5% improvement over base code-compliance building using R408.2 options

- **Prescriptive Compliance:**

- Select an additional efficiency package from R408 to implement

- **Total Building Performance Compliance:**

- Include R408 package but do not model in proposed design
- Include R408 package in proposed design, and achieve 5% energy cost reduction over standard reference design

- **Energy Rating Index Compliance:**

- ERI value shall be 5% less than specified in Table R406.5 (i.e. must model R408 options)
- ERI targets return to 2015 IECC levels (more stringent!)



Passive House Certified: No additional requirements (IL Amendment)

- **Efficient Envelope Performance**
 - 5% reduction in UA over Table R402.1.2.
 - SHGC shall be 5% less than Table R402.1.2 values
- **Efficient HVAC Equipment Performance**
 - 95% AFUE/10 HSPF heating with 16 SEER cooling
 - 3.5 COP ground-source heat pump
 - All systems must comply for multi-system residences
- **Reduced Service Hot Water Energy**
 - 0.82 EF gas, 2.0 EF electric, and 0.4 solar fraction water heaters



Image source:
<https://basc.pnnl.gov/>

Image source:
SEDAC



- **Efficient Duct Thermal Distribution**
 - 100% of ducts within thermal envelope
 - 100% ductless or hydronic within thermal envelope
 - 100% within conditioned space per R403.3.2
 - Already common best-practice! (Easy to achieve)
- **Improved Air Sealing and Ventilation**
 - Air leakage of 3.0 ACH₅₀ or less with ERV or HRV
 - 75% sensible recovery + 50% latent recovery when applicable
 - 1.1 cfm/watt or more fan efficacy
 - Cannot use recirculation for defrost (maintain fresh air supply)



Image source:
<https://basc.pnnl.gov/>

The Total Building Performance Compliance path has been reorganized and clarified.

R405.2: A proposed design must meet the following requirements:

1. Meet requirements of all sections indicated in Table R405.2
2. Proposed design has an annual energy cost that is less than or equal to the annual energy cost of the standard reference design.

Any proposed design must also meet the following envelope **performance backstop**.

- Building thermal envelope shall be greater than or equal to levels of efficiency and SHGCs in Table R402.1.1 or R402.1.3 of the **2009 IECC**.

Maximum Energy Rating Index

Climate Zone	2018 ERI Target	2021 ERI Target
4	62	54
5	61	55

Return to 2015
IECC ERI Targets!

Recall with Additional Efficiency Packages:

1. Meet this score and then include one package OR
2. Model the efficiency package and have 5% reduction in ERI

Envelope performance backstop requirement if renewables not included: $UA_{\text{proposed}} \leq 1.15 \times UA_{\text{reference}}$

With renewables, envelope performance backstop is 2018
IECC

Mandatory Requirements

General	
R401.2.5	Additional energy efficiency
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installations
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.5	Maximum fenestration <i>U</i> -factor and SHGC
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls

Listing of section includes all subsections!

Mechanical	
R403.1	Controls
R403.3, including R403.3.1, except Sections R403.3.2, R403.3.3 and R403.3.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water circulation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas

PHIUS Compliance Option



Documentation to be provided prior to issuance of building permit

- List of compliance features
- PHIUS precertification letter

Documentation to be provided prior to issuance of certificate of occupancy

- PHIUS 2021 (or later) project certificate

The Passive House Institute US Awards
The Designation of

PHIUS+ 2015 CERTIFIED PROJECT

No. 1421
577 W. 161st St
577 W. 161 St
New York, NY 10032

• INTERIOR CONDITIONED FLOOR AREA	11,757	ft ²
• ANNUAL HEATING DEMAND	2.79	kBTU/ft ² ·yr
• ANNUAL COOLING DEMAND	5.35	kBTU/ft ² ·yr
• PEAK HEATING LOAD	3.72	BTU/ft ² ·hr
• PEAK COOLING LOAD	2.82	BTU/ft ² ·hr
• AIR-TIGHTNESS TEST RESULTS	0.06	CFM50/ft ²
• SOURCE ENERGY	6,942 5,392 (PV)	kWh/person.yr
• SITE ENERGY USE INDEX (EUI)	567	kBTU/ft ² ·yr

Rohan Development LLC
PROJECT OWNER

February 10, 2021
DATE

Carmel Pratt
CPHC®

PM Architecture PC
ARCHITECT

Technocraft Inc
CONSTRUCTION

Jordan Dentz
ON-SITE VERIFICATION

Carmel S.
Executive Director

PHIUS
Passive House Institute US


Image source: pmarchitecture.com

Energy Certificate

Added requirement to list on-site PV capacity, inverter efficiency, and panel tilt/orientation if installed.

Ensure certificate does not cover other safety or informational tags when installed!
Other requirements unchanged. Display:

- Weighted average or largest portion R-values
- Display window U-factors and SHGCs
- Air & duct leakage test results
- Type and Efficiency of HVAC systems
- Code version for compliance

Energy Code Certificate			
Name of Designer/Builder:		DATE:	
Energy Code edition:		Compliance Path:	
1. Insulation Rating		R-Value	R-Value
Ceiling /Roof	Attic	<input type="text"/>	Vaulted <input type="text"/>
Walls	Frame	<input type="text"/>	Mass <input type="text"/>
	Basement	<input type="text"/>	Crawl space <input type="text"/>
Floors	Over unconditioned space	<input type="text"/>	Slab edge <input type="text"/>
Ducts	Attic	<input type="text"/>	Other <input type="text"/>
2. Fenestration Rating		NFRC U-Factor	NFRC SHGC
Window		<input type="text"/>	<input type="text"/>
Opaque door		<input type="text"/>	<input type="text"/>
Skylight		<input type="text"/>	<input type="text"/>
3. Air Leakage Test Results			
Blower door	<input type="text"/>	ACH/50 Pa.	Duct testing <input type="text"/>
			Cfm/100 ft ²
4. Equipment Performance		Type	Size
Heating system		<input type="text"/>	<input type="text"/>
Cooling system		<input type="text"/>	<input type="text"/>
Water heater		<input type="text"/>	<input type="text"/>
Indicate if the following have been installed:			
<input type="checkbox"/>	Electric furnace	<input type="checkbox"/>	Gas-fire unvented room heater
<input type="checkbox"/>		<input type="checkbox"/>	Baseboard electric heater
5. Photovoltaic Panel Systems			
Array capacity	<input type="text"/>	Panel tilt	<input type="text"/>
Inverter efficiency	<input type="text"/>	Orientation	<input type="text"/>
6. Energy Rating Index Score		Structure Permit	
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
smartenergy.illinois.edu/energy-code/ 800.214.7954 energycode@illinois.edu			
Smart Energy Design Assistance Center, 1 St Mary's Road, Champaign, IL 61820			


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Energy Code Checklists

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Check out our checklists to help with energy code site inspection and compliance!

1. Insulation Rating		R-Value	R-Value
Ceiling (Roof)	Attic	<input type="text"/>	Vaulted <input type="text"/>
Walls	Frame	<input type="text"/>	Mass <input type="text"/>
Floors	Basement	<input type="text"/>	Crawl space <input type="text"/>
	Over unconditioned space	<input type="text"/>	Slab edge <input type="text"/>
Ducts	Attic	<input type="text"/>	Other <input type="text"/>

2. Fenestration Rating		NFRC U-Factor	NFRC SHGC
Window		<input type="text"/>	<input type="text"/>
Opaque door		<input type="text"/>	<input type="text"/>
Skylight		<input type="text"/>	<input type="text"/>

3. Air Leakage Test Results			
Blower door	ACH/50 Pa	Duct testing	Cfm/100 ft ²
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

4. Equipment Performance			
	Type	Size	Efficiency
Heating system	<input type="text"/>	<input type="text"/>	<input type="text"/>
Cooling system	<input type="text"/>	<input type="text"/>	<input type="text"/>
Water heater	<input type="text"/>	<input type="text"/>	<input type="text"/>

Indicate if the following have been installed:

Electric furnace
 Gas-fired unvented room heater
 Baseboard electric heater

5. Photovoltaic Panel Systems	
<input type="text"/>	<input type="text"/>

Illinois Home Energy Code Checklist & Energy Certificate

🕒 June 16, 2022

For Homeowners and Realtors. Are you interested in buying an energy efficient home? Do you want to learn how to make your home more energy efficient? This checklist can help you quickly assess a home's energy performance and construction.



Residential Energy Code Checklist

🕒 March 2, 2021

For Building Code Officials, Architects, and Engineers. This Residential Energy Code Checklist is intended to assist with plan review and site inspection for the Illinois Energy Code.

Residential: Envelope

Table
R402.1.2

Maximum Assembly U-Factors

IECC Year	Climate Zone	Fenestration U-Factor	Skylight U-factor	Fenestration SHGC	Ceiling U-Factor	Wood Frame Wall U-Factor	Mass Wall U-Factor	Floor U-Factor	Basement Wall U-Factor	Crawl Space Wall U-Factor
2018	4	0.32	0.55	0.40	0.026	0.060	0.098	0.047	0.059	0.065
	5	0.30	0.55	NR	0.026	0.060	0.082	0.033	0.050	0.055
2021	4	0.30	0.55	0.40	0.026	0.045	0.098	0.047	0.059	0.065
	5	0.30	0.55	0.40	0.026	0.045	0.082	0.033	0.050	0.055

Note for mass wall U-factors: If any portion of insulation is on interior, if portion exceeds more than 50% of total insulation, then U-factor requirements are reduced.

- U-0.087 for CZ 4
- U-0.065 for CZ 5

Table
R402.1.3

Minimum Assembly R-Values

IECC Year	Climate Zone	Fenestration U-Factor	Skylight U-factor	Fenestration SHGC	Ceiling R-Value	Wood Frame Wall R-Value	Mass Wall R-value	Floor R-value	Basement Wall R-value	Slab R-value & Depth
2018	4	0.32	0.55	0.40	49	20 or 13+5	8/13	19	10/13	10, 2ft
	5	0.30	0.55	NR	49	20 or 13+5	13/17	30	15/19	10, 2ft
2021	4	0.30	0.55	0.40	49	30, 20+5, 13+10, or 0+20	8/13	19	10ci/13	10, 4ft
	5	0.30	0.55	0.40	49	30, 20+5*, 13+10, or 0+20	13/17	30	15ci/19/ 13+5ci	10, 4ft

*PHIUS notes for CZ-5 that R-20+R-5ci for framed walls can lead to condensation and moisture trapping, thus R-30, 13+10ci or 0+20ci is recommended!

R-value calculation section is expanded with much more clarifying content

- Cavity insulation materials added together to obtain total R-value for compliance with Table. Exclude air films and construction materials (sheathing board, membranes, drywall)
- Blown-in insulation shall use manufacturer's settled R-values
- Continuous insulation alone shall be used for continuous R-value compliance, excluding air films and other materials
- If insulated siding is used for R-value compliance, the rated R-value shall be reduced by R-0.6



Image source: energy.gov

Access Hatches and Doors

R402.2.4: Clarity added to requirements for pull-down stair and vertical door attic access insulation

- **Vertical doors** comply with Table R402.1.3 (*R-value*) requirements
- **Pull-down stairs** in Climate Zone 4 do not need to have insulation equivalent to attic if all of the following apply:
 - Hatch door is R-10 (U-0.10) or better
 - 75% of the panel area is R-13 or better
 - Opening net area is 13.5sf or less
 - Hatch perimeter is weather stripped



Image source: Energy.gov

R402.2.5: Access hatch insulation retention

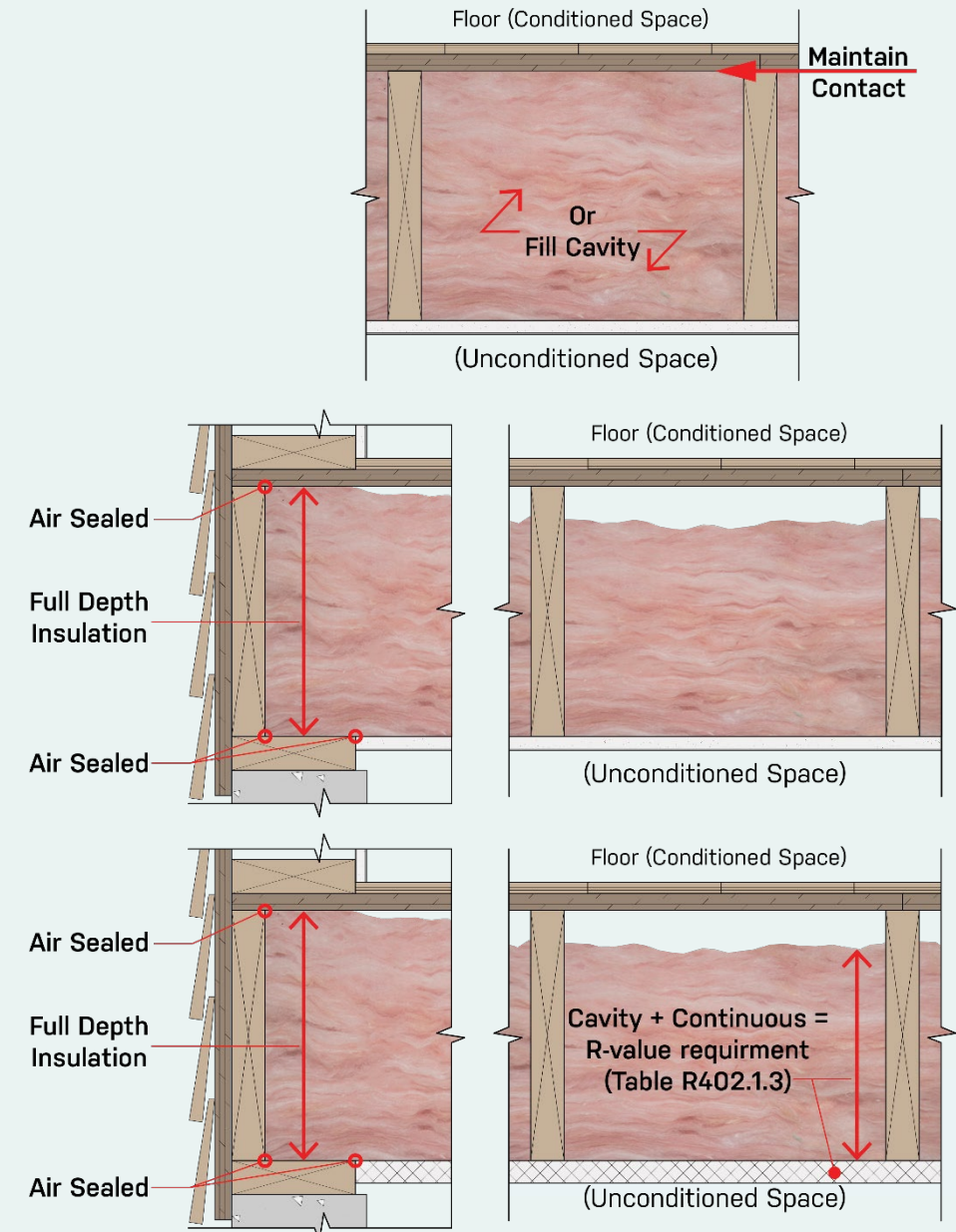
- Language clarified for retention of loose-fill insulation around hatch

Floor Cavity Insulation

Floor cavity insulation must comply with one of the following:

1. Insulation must maintain contact with underside of the subfloor decking, or fill the available cavity
2. Cavity insulation can contact top of sheathing separating unconditioned space below.
3. A combination of cavity and continuous insulation can be installed such that the combined R-value equals the required value for floors from Table R402.1.3.

* 2 & 3: Insulation must be full depth at all perimeter framing members and all framing members shall be air sealed.



Basement Walls

Large portion added explaining insulation for unconditioned basements

- Insulate floor over basement, including stairwell stringers
- Ensure **no uninsulated ducts** or hydronic systems, and no supply/return diffusers
- Walls surrounding stairway to be insulated
- Door insulated per R402.1.3 / R402.2 and weather stripped



Image source: <https://blog.delafleur.com/?p=5944>

Sunrooms and Heated Garages

Added heated garages to sunroom section as similar low-energy space types.

- Must be **thermally isolated** from other conditioned spaces
- CZ 4 minimum ceiling insulation: R-19
- CZ 5 minimum ceiling insulation: R-24
- Minimum wall insulation: R-13
- Wall separating sunroom or garage from other spaces **fully insulated** per Table R402.1.2



Image courtesy: www.energy.gov

Table R402.4.1.1 Air Barrier, Air Sealing, and Insulation reference table updated

- Expanded air sealing list for foundations
 - Exposed earth covered with Class 1 vapor retarder
 - Penetrations through slab shall be air sealed
 - Class 1 vapor retarders **SHALL NOT** be used as the air barrier on below-grade walls
 - Rim joists shall include an exterior air barrier **and** be air sealed to adjacent framing members
- Added detail for narrow cavities
 - Shall be air sealed if 1” or less and cannot be insulated.
 - Installed insulation shall be cut to fit or conform to cavity.
- Added air sealing note around plumbing and utility penetrations



Image source: https://basc.pnnl.gov/slab_penetrations

Air Leakage Testing Updated

Requirements added for heated attached and detached garages

- Must visually verify Table R402.4.1.1 air sealing and insulation has been achieved
- Can be completed by approved 3rd party, or the AHJ.
- Heated garages are still required to be thermally isolated from fully-conditioned spaces.
- Heated garages NOT required to be tested for air leakage.



Image source: energy.gov

Air Leakage Testing

Adds backstop to air leakage of 5.0 ACH for all compliance paths

Prescriptive compliance = 3.0 ACH at 50 Pa

Added testing exception for heated garages on 1- and 2-story homes and townhomes, must maintain thermal isolation.

Added specific procedure for **multi-family testing** (previously included as IL amendment)

- Enclosure area-based metric (0.30 cfm/sf) rather than ACH at 50 Pa
- Unguarded test – neighboring units not pressurized to same as test unit



Image source: <https://www.mncee.org/new-construction-services>

New section outlining air-sealing requirements for electrical and communications outlet boxes installed within the thermal envelope.

- Outlet boxes shall be tested in accordance with NEMA OS 4
- The tested air leakage rate shall not exceed 2.0 cfm at 75 Pa
- The outlet boxes shall be marked 'NEMA OS 4' or 'OS 4' and be installed per manufacturers instructions to achieve NEMA OS 4 compliance



Residential: Systems

Expansion of Hot Water Reset

2018 R403.2 stated “Hot water boilers supplying heat to building through one- and two-pipe heating systems shall have outdoor setback control...”

2021 update is more specific: “Manufacturer shall equip each gas, oil, and electric boiler (other than a boiler w/ tankless DWH coil) with automatic means to adjust water temperature...” Expands from outdoor reset only to outdoor reset or water temperature sensing to conduct reset.



Image source: energy.gov

Ducts in Unconditioned Space

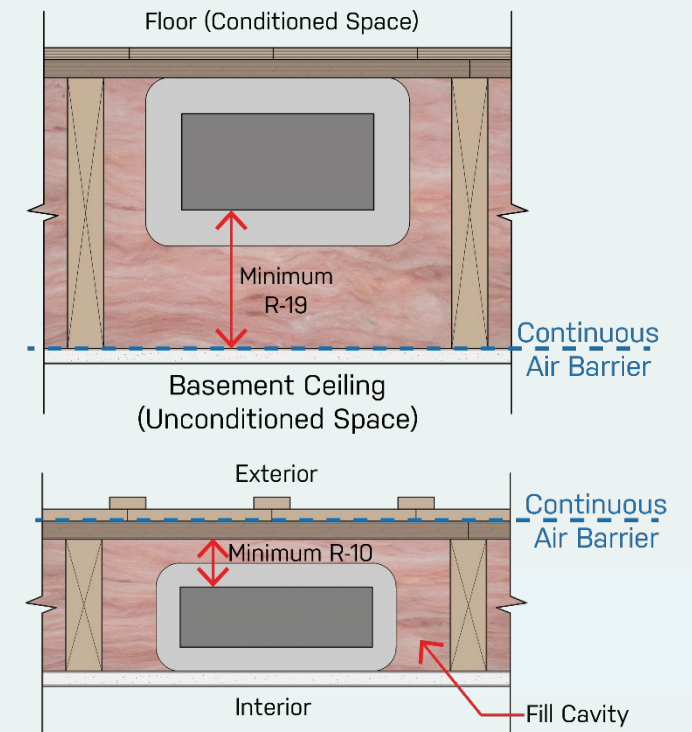
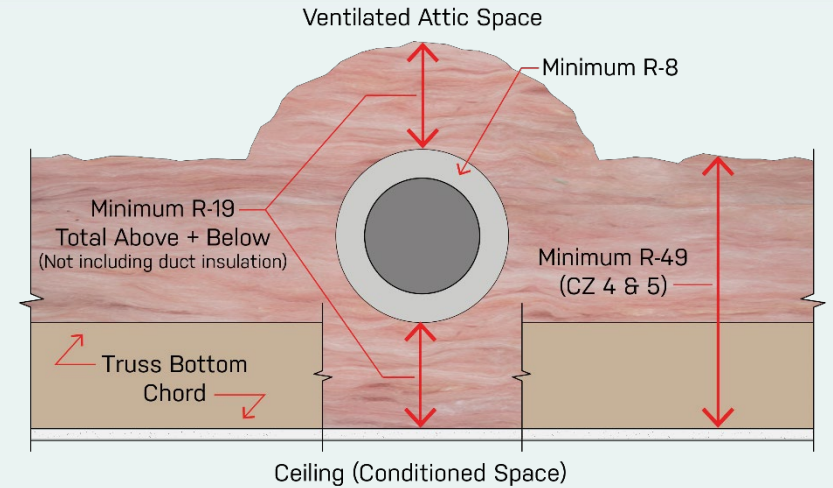
- No changes to duct insulation requirements
 - R-8 wrap on ducts if 3” or more in diameter
 - R-6 wrap if less than 3” in diameter
 - Ducts under slab insulated as above or have **equivalent Thermal Distribution Efficiency (TDE)**.
 - If using TDE method, must be labeled and listed with equivalent R-value.

	A	B	C	D
1	Draft ASHRAE standard 152 duct efficiency calculations			
2	Jan-03		modified by PRC (location index and lookup values)	
3	Mar-11		fixed typo "Qemen" --> "Qeman" (NREL)	
4				
5	INPUT PARAMETERS			CALCULATED PAF
6		Value used in calculation	Notes	
7	Location Index	65	Chicago, IL	
8	Conditioned floor area, (ft ²)	1761		
9	Number of Stories	2		
10	Number of return Registers	3		Ground Temperature for basements, and slabs
11	House Volume, (ft ³)	14440	has a default of 8.2*Floor Area	
12	Supply Duct Surface Area, (ft ²)	357	has default equation	Fraction of supply duct outside conditioned space
13	Return Duct Surface Area, (ft ²)	198	has default equation	Fraction of return duct outside conditioned space
14	Fraction of supply duct in attic	1		Design Supply Duct Zone temperature, Heating, (F)

- TDE can be calculated using ASHRAE 152 methods. A spreadsheet is available at <https://www.energy.gov/eere/buildings/downloads/ashrae-standard-152-spreadsheet>

Ducts in Conditioned Space

- Clarifies definitions of conditioned space for ducts
 - Entirely within thermal envelope
 - Ductless or hydronic system within thermal envelope
 - Ducting qualifies as within **conditioned space** if:
 - Buried in attic insulation and sealed to 1.5cfm/100sf floor area
 - Ducts in floor cavities must have R-19 between duct and unconditioned space
 - Ducts in exterior walls must have R-10 between duct and exterior sheathing; rest of cavity filled with insulation



Duct Testing & Leakage

- R403.3.5 Duct Testing
 - Duct test requirements unchanged: 25 Pa pressure test
 - Ducts serving non-integral ventilation systems (HRV/ERVs) exempted from testing
- R403.3.6 Duct Leakage
 - 4.0cfm/100sf floor area with air handler, 3.0 cfm without
 - **NEW REQUIREMENT:** 8.0 cfm/100sf floor area for ducts entirely within thermal envelope.



**DUCT TESTING NOW REQUIRED
REGARDLESS OF LOCATION!**



Duct Testing & Leakage Minimum

- R403.3.6 Duct Leakage: For units with the following conditioned areas:



- HVAC duct systems serving 1,500 sf or less if ducts not completely within thermal envelope
 - HVAC duct systems serving 750sf or less if ducts completely within thermal envelope
- Note: minimum of 60cfm or less is compliant with 4.0/100sf for ducts not within the thermal envelope and 8.0 cfm/100sf for ducts completely within thermal envelope and sets this as a floor for smaller buildings.



Hot water pipe insulation

This section states insulation for the following service hot water piping shall meet minimum thermal resistance of R-3:

- Piping $\frac{3}{4}$ " and larger in nominal diameter ***located inside conditioned space (Added in 2021 IECC)***
- Piping serving more than one dwelling unit
- Piping located outside the conditioned space
- Piping from the water heater to a distribution manifold
- Piping located under a floor slab
- Buried piping
- Supply and return piping in ***circulation and recirculation systems other than cold water pipe return demand recirculation systems (Added in 2021 IECC)***



Image source:
<https://basc.pnnl.gov/>

Ventilation Fan Efficacy

Fan Location	Min. Airflow Rate	Min. Efficacy [CFM/W]	Fan Location	Min. Airflow Rate	Min. Efficacy [CFM/W]
2018 IECC			2021 IECC		
HRV/ ERV	Any	1.2	HRV/ ERV	Any	1.2
In-Line	Any	2.8	In-Line	Any	3.8
Bath/Utility	<90	1.4	Other	<90	2.8
Bath/Utility	≥90	2.8	Other	≥90	3.5
Range Hood	Any	2.8	Integrated with HVAC	Any	1.2

Grouped all common fans as “Other” and generally increased efficacy

Added supply-only ventilation fans as “Integrated with HVAC”

Ventilation Fan Efficacy

Fan efficacy must be on fan label or in the product documentation

Can find fan information at HVI's website:

<https://www.hvi.org/hvi-certified-products-directory/section-i-complete-product-listing/>

Product Category	Brand Name	Model	SP	Rated CFM	Rated Watts	Efficacy (CFM/W)	2021 IECC
Bathroom Exhaust Fans	Homewerks Worldwide	7140-50-G3	0.1	50	17	2.9	YES
Bathroom Exhaust Fans	Homewerks Worldwide	7140-50-G3	0.1	80	28	2.9	YES
Bathroom Exhaust Fans	Hampton Bay	1000750751	0.1	70	50	1.4	NO
Bathroom Exhaust Fans	Hampton Bay	1000750752	0.1	110	31.8	3.5	YES
Bathroom Exhaust Fans	Delta	100F	0.1	100	12.6	7.9	YES
Bathroom Exhaust Fans	Uberhaus	30395000	0.1	70	24.7	2.8	YES
Bathroom Exhaust Fans	Uberhaus	30395001	0.1	90	56	1.6	NO
Bathroom Exhaust Fans	Utilitech	553457	0.1	70	13.2	5.3	YES



Ventilation Testing

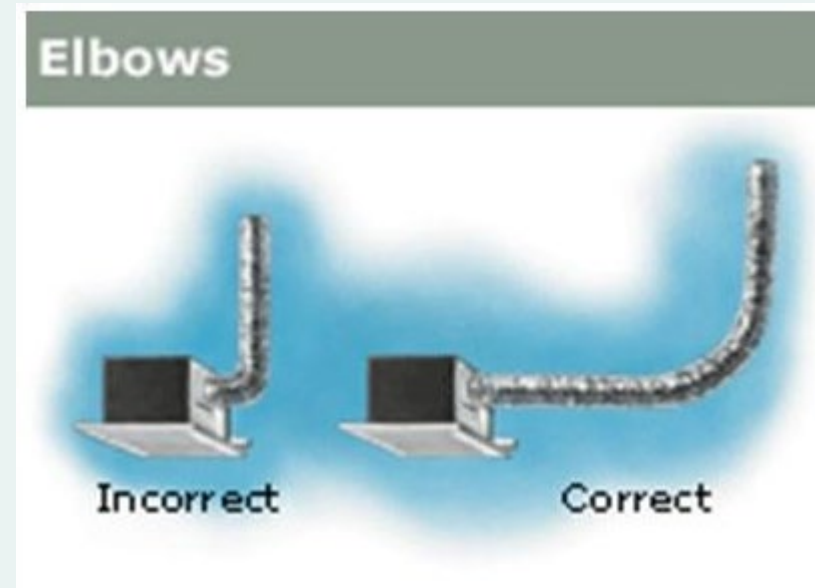


Installed fans must now be **TESTED** to verify airflow performance. Avoids issue of installing rated fan, but duct length and bends reduce flow rate.

- Exception for kitchen range hoods w/ 6" duct & at most 1 bend



<https://energyconservatory.com/applications/air-flow-devices/>



<https://basc.pnnl.gov/resource-guides/bathroom-exhaust-fans#edit-group-description>

Ventilation Testing

Minimum mechanical ventilation rate can be reduced by 30% if:



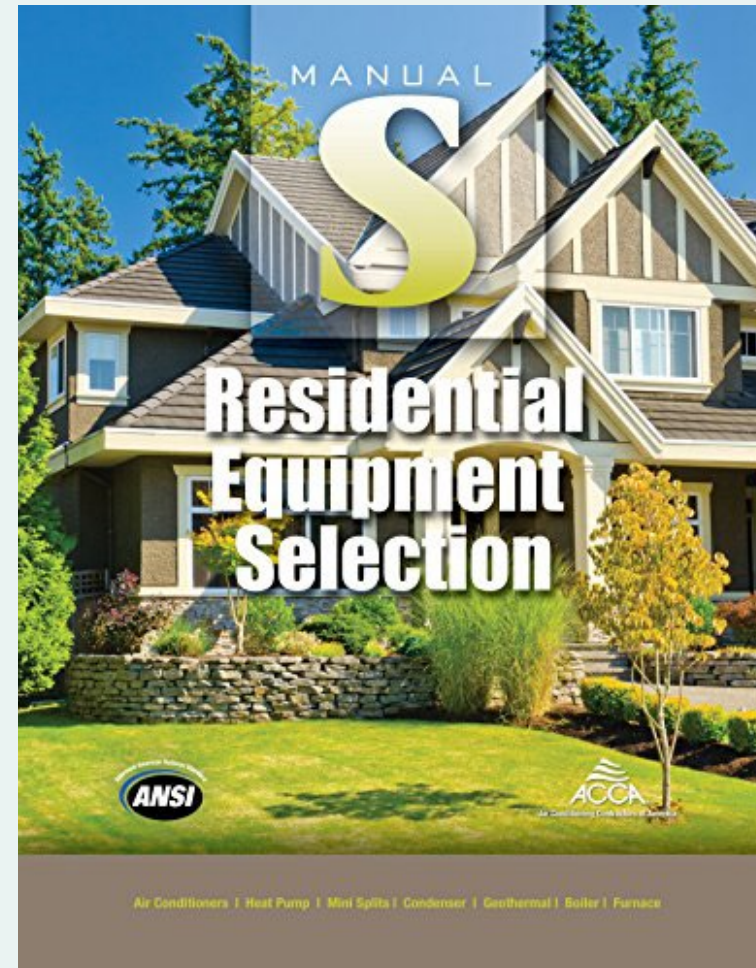
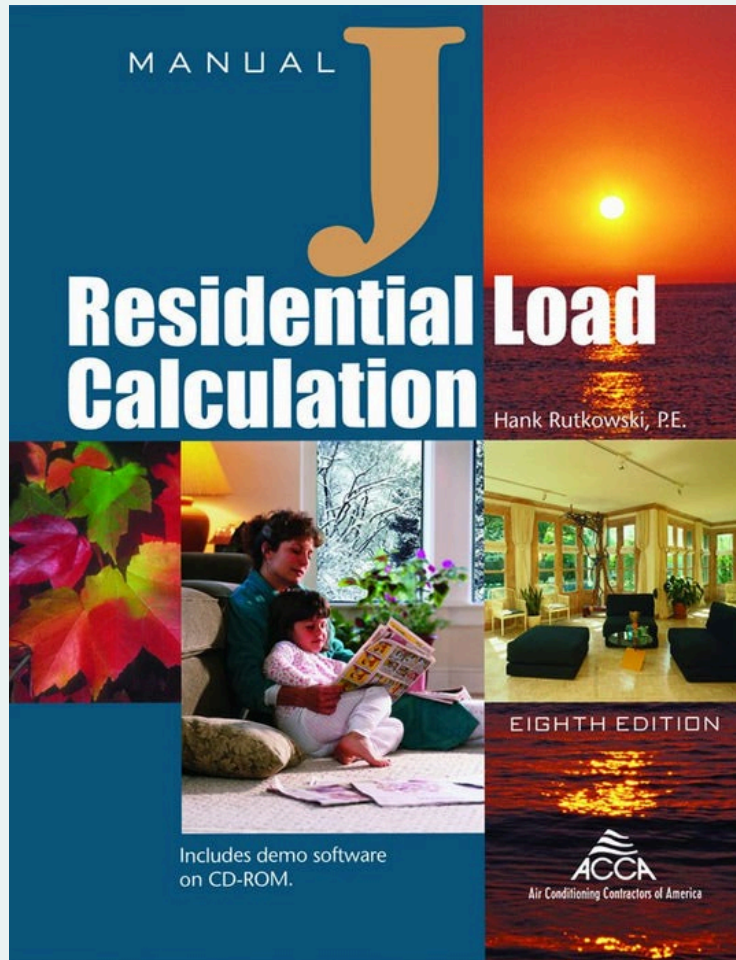
- Whole-house ventilation system is a balanced ventilation system

AND

- Ducted system supplies ventilation directly to each bedroom and to one or more of the following:
 - Living room
 - Dining room
 - Kitchen

HVAC Load and Sizing Calculation

All HVAC systems required to have load calculation per ACCA Manual J
All Systems required to be sized per ACCA Manual S



HVAC Load and Sizing Calculation

Manual J determines building loads, and should be conducted for all new construction and renovation projects

Manual S uses Manual J results to determine properly sized HVAC system

Manual D sizes duct systems. Required by International Residential Code (Section M1601.1).

Be sure to use **approved** software or speed sheets!

<https://www.acca.org/standards/approved-software>



Image sources: Air Conditioning Contractors of America

- 2018 IECC: 90%+ of permanent lighting shall be high-efficacy
- 2021 IECC: **100%** of permanent lighting shall be high efficacy
- Does not impact plug-in lighting sources like floor and desk lamps

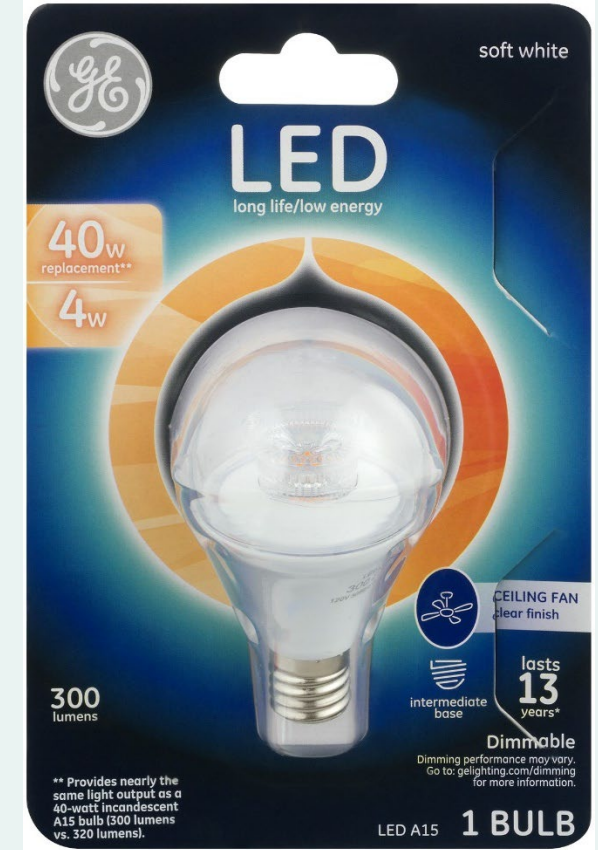


Image source: GE Lighting

Interior Lighting Controls

New requirement to 2021 IECC – Residential Lighting Controls

- **PERMANENTLY INSTALLED FIXTURES** shall have dimmer, occupant sensor control, or other control installed or built into fixture.
- Exceptions include
 - Bathrooms
 - Hallways
 - Exterior lighting fixtures*
 - Lighting for safety or security

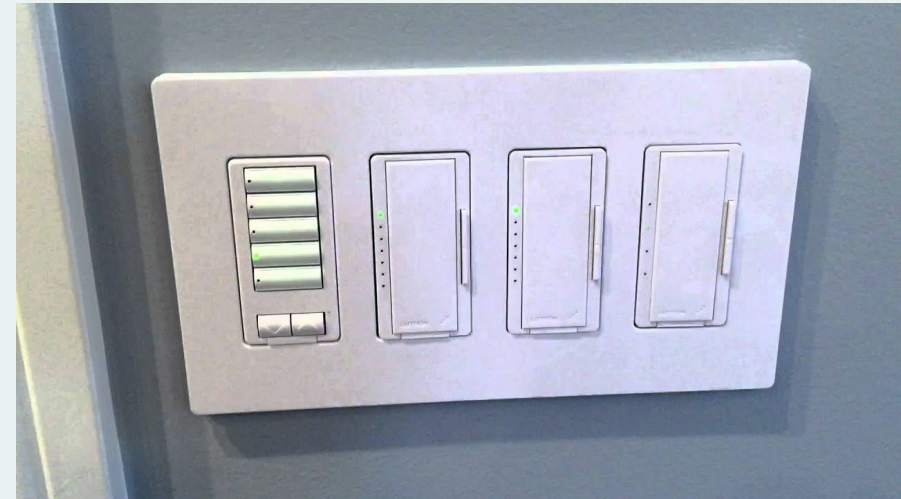


Image source: <https://manuals.plus/lutron/wireless-lighting-control-manual#axzz7Xos3cbjA>

*Controls are required if minimum wattage is exceeded, covered in next section.

New to 2021 IECC – Exterior Lighting Controls

NEW!

- **PERMANENTLY INSTALLED** outdoor lighting >30 W in total power required to turn off with adequate daylight
- Can be photocell or time clock
- Override permitted up to 24hrs
 - Must then return to automatic operation



Image source: cnet.com

Residential: Existing Buildings

Building Additions

Added clarification for change in space conditioning

- Examples: Converting garage to conditioned room, conditioning attic, etc...
 - **Performance Path:** If proposed design's annual energy cost is 110% of reference design, addition is compliant
 - **Performance Path:** If Addition + Original Building energy cost is less than Original Building alone
 - **UA Trade-off:** Where UA of building + addition is less than UA of original building

Removed restriction to exception for extending existing ducts to addition

- No longer must be <40ft in unconditioned space to qualify for exception



Image credit:
<https://www.greenbuildingadvisor.com/green-homes/a-fast-kitchen-addition-made-with-sips>

Like R502 Additions, the duct requirements have been relaxed

- **2018 IECC:** New HVAC ducts shall comply with R403,
 - If length of alteration <40ft in unconditioned space, don't need to test for leakage.
- **2021 IECC:** Altered HVAC ducts shall comply with R403,
 - If alteration is **extension of existing ducts to an addition**, exempt from R403



Change of Occupancy or Use

2018 IECC R505.1: Any space changing occupancy class that **increases demand** for energy shall comply with full energy code

2018 IECC R505.2: Any space converted to a dwelling unit...from another use or occupancy shall comply with this code

2021 IECC R505.1.1: Any unconditioned or low-energy space altered to become conditioned space shall comply with R502-Additions



Image Source: <https://www.feldcochicago.com/garage-living-space/>

Resources

Local design conditions:

- ashrae-meteo.info/v2.0/

Free view-only online ICC code books:

- Codes.iccsafe.org

Free view-only ASHRAE standards:

- www.ashrae.org/technical-resources/standards-and-guidelines/read-only-versions-of-ashrae-standards



Questions?

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