Insulating and Air Sealing Existing Non-ICAT Recessed Lights

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Scope

Install a sealed enclosure over a non-IC rated recessed light fixture to air seal the can and to prevent insulation from touching the recessed can light.

Air seal non-insulation contact (IC) rated recessed can lights by covering the can light with a protective covering to prevent conditioned air from escaping into the attic and to keep insulation from touching the recessed can light.

- Purchase or construct a can light enclosure made from material with a 1-hr fire rating, that has a maximum R-value of \( R-0.5 \) at the top to allow heat to dissipate, that provides a clearance of at least 3 inches on all sides of the fixture, and that extends above the height of the surrounding attic insulation (per the Standard Work Specifications for Home Upgrades).
- Install the air barrier enclosure over the recessed lighting fixture so that it is centered and sits flush to the top side of the ceiling drywall.
- Seal around the base of the enclosure with spray foam.

Or, replace the non-IC rated fixture with an ICAT-rated fixture.

For more information, see the U.S. Department of Energy’s Standard Work Specifications regarding non-insulation contact (IC) recessed light.

See the Compliance Tab for related codes and standards, and criteria to meet national programs such as ENERGY STAR, DOE’s Zero Energy Ready Home program, and EPA’s Indoor airPLUS.
Description

In existing homes, older recessed can lights are likely not rated for direct contact with insulation. In addition, these fixtures have holes in the top of the light fixture to allow heat to escape (because they were designed for high-heat-output incandescent bulbs). These fixtures are referred to as non-IC (Insulation Contact) or non-ICAT (Insulation Contact and Air Tight) recessed can lights.

Non-ICAT rated recessed can lights are energy intensive in three ways (see Figure 1). If they are installed in an insulated ceiling, insulation has to be kept at least 3 inches from the fixture all the way around, leaving about 1 square foot of uninsulated ceiling space. (If insulation is in contact with non-ICAT rated lamps, a fire hazard exists.) Second, many homeowners and contractors install incandescent bulbs or R-lamps in the fixtures; these bulbs use four times the electricity of fluorescents and six times the electricity of LEDs, as well as generating heat that adds to air-conditioning loads. Third, if the cans are not airtight, they allow conditioned air to escape from the living area into unconditioned spaces such as the attic. Leaky recessed cans are like a hole in the ceiling, only worse. A non-ICA-rated recessed can light with an incandescent bulb can draw 3 to 5 times more air through holes in the fixture when the light is on versus when it is off due to the stack effect. When the lamp inside the can is turned on, the heat it generates turns the can fixture into a chimney, pulling air from the house up into the attic (McCullough and Gordon 2002). For more on recessed can lights, see the Building America Solution Center guide Air Sealing Recessed Light Fixtures Below Unconditioned Space.

![Figure 1. Non-airtight non-insulation contact rated recessed can light fixtures waste energy and create a potential fire hazard.](image)

To address the issue of air leakage and insulation contact, enclosures can be purchased or constructed to cover existing non-IC rated recessed can lights. The covers are made of fire-rated materials such as 5/8-inch fire-code gypsum wallboard or fsk (foil/scrim kraft) material. Joints and penetrations are sealed with fire-rated caulk or taped and spackled.

A better option is to replace the old non-IC fixtures with new ICAT-rated light fixtures. IC-rated fixtures have a thermal safety switch that will shut off the fixture if it overheats and won't turn it back on until it cools sufficiently. The newer ICAT-rated fixtures are made with fewer holes and equipped with gaskets to eliminate most of the air leakage pathways. Because they are insulation contact-rated, attic insulation can be installed over and around them so there is no slow down in insulation installation. There are also LED based ceiling-mounted light fixtures that look like recessed can lights but are actually mounted to the ceiling surface; i.e., there is no can extending up into the attic.

If the non-IC recessed can light is to remain and if it currently uses an incandescent bulb, replace the light bulb with a lower heat output bulb, such as a light-emitting diode (LED) or compact fluorescent bulb, prior to installing an air barrier enclosure over the recessed can light. Incandescent or halogen bulbs should not be used with non-IC rated recessed can lights after enclosures are installed because excessive heat build-up can occur, causing a potential fire hazard.

While enclosure boxes made out of rigid foam insulation have been a common field constructed solution for weatherization contractors and do-it-yourselfers, these enclosures do not have a 1-hour fire-rating. The rigid foam can also provide too much insulation, reducing heat dissipation through conduction. According to a study by the Pennsylvania Housing Research/Resource Center (PHRC), NEC code compliant type NM-B (non-metallic sheathed cable) wiring for a recessed can light remained within the acceptable temperature limit of 194°F when enclosed by an airtight enclosure. However, in older existing homes, there is the potential for the lighting fixture wiring to be NM (without the B suffix), which has a lower temperature limit of 140°F and can deteriorate from exposure to high heat within the airtight enclosure. If a lower heat output bulb is used, this may not be an issue, but it is still not a best practice, as some older fixtures may not have a thermal safety switch integrated into
the fixture to prevent overheating.

Heavily insulated enclosures could be used with recessed can lights that are IC-rated but not AT-rated. Again, low heat output bulbs are required in any of these enclosure approaches.

**How to Air Seal Non-IC Recessed Fixtures**

Because this will require accessing the attic, please first see the assessment guide, Site Assessment of Ceilings, Attics, and Roofs, for health and safety information related to accessing the attic.

1. Remove insulation from around the recessed can fixture. See Figures 2 and 3.
2. Construct or purchase a fire-rated cover for the fixture that is made of a fire-rated material. See Figure 4.
3. Install the cover by centering it over the fixture with a minimum clearance of 3 inches on all sides of the recessed can light. See Figure 5.
4. Make slits as required around wiring and hanger brackets to allow the enclosure to sit flush to the gypsum board. See Figure 6.
5. Cut the cover if necessary to fit around ceiling joist framing. See Figure 7.
6. Use expanding spray foam to air seal the enclosure to the gypsum board on all four sides and to any ceiling joists. Also use spray foam to seal any penetrations in the cover. Be extremely careful to not get any spray foam on the can or any surfaces that will be hot. See Figures 8, 9, and 10.
7. Allow the spray foam to fully cure and ensure that the enclosure is fully air sealed (see Figure 11). One simple way to test this is to turn on the recessed can lights then go into the attic and turn off the attic lights. Light will be visible through any cracks where the enclosure isn’t completely sealed to the drywall.
8. Insulate attic to desired R-value, but ensure that top of the enclosure remains exposed above the attic insulation. See Figures 12 and 13.
9. Do not air seal a non-IC rated recessed can light from inside (the living space side of the fixture). The holes will allow for natural convection to dissipate heat away from the lighting fixture.
Figure 2. Remove insulation around the non-IC rated recessed light fixture before installing a cover. (All Images courtesy of Steven Winter Associates, Inc.)

Figure 3. Make sure all insulation is held back from any contact with a non-IC rated recessed light fixture.
Figure 4. Build or select an enclosure that will maintain a minimum of 3 inches clearance on all sides of the light fixture.

Figure 5. Center the enclosure to maintain a minimum of 3 inches clearance on all sides of the of the non-IC rated recessed light fixture.
Figure 6. Make slits in the recessed can enclosure for wiring and hanger brackets to allow the enclosure to sit flush to the gypsum board.
Figure 7. If the light fixture is off center, cut the enclosure as needed to fit around ceiling joists.
Figure 8. Use canned expanding spray foam to air seal the recessed can light enclosure to the gypsum board on all four sides and to seal any penetrations.
Figure 9. Use canned expanding spray foam to air seal the recessed can light enclosure to the ceiling joists.

Figure 10. Use expanding spray foam to air seal the recessed can light enclosure to the gypsum board.
Figure 11. Allow the spray foam to fully cure around the recessed can light cover and ensure that the enclosure is fully air sealed.

Figure 12. Insulate attic to the desired R-value, but ensure that top of enclosure over the recessed can light remains exposed above the attic insulation.
Figure 13. Attic insulation can come in contact with the recessed can light enclosure but should not cover the top of it.
Ensuring Success

Best Solution: Replace non-IC rated recessed can lights with ICAT-rated recessed can lights or even better, ceiling-mounted light fixtures. Use low-heat-output bulbs such as LEDs.

Correct enclosure height: First determine the amount of attic insulation desired. Once the R-value, insulation material, and equivalent depth to achieve the desired R-value are known, then purchase or build an enclosure that will extend above the attic insulation height.

Double and Triple Check that

- No insulation is in contact with the non-IC rated recessed can light.
- No foam or other sealant is in direct contact with the non-IC rated recessed can light.
- No high-heat-output bulbs, such as incandescent bulbs, are installed in the fixture.
Climate

No climate-specific information applies.
Training

Right and Wrong Images

Display Image: TE7311-AirSealExistRecessdCans-R-1_SWA_6-21-16.jpg
CAD
None Available
Compliance

The Compliance tab contains both program and code information. Code language is excerpted and summarized below. For exact code language, refer to the applicable code, which may require purchase from the publisher. While we continually update our database, links may have changed since posting. Please contact our webmaster if you find broken links.

ENERGY STAR Certified Homes, Version 3/3.1 (Rev. 09)

Rater Field Checklist

Thermal Enclosure System.

4. Air Sealing (Unless otherwise noted below, “sealed” indicates the use of caulk, foam, or equivalent material).

4.2 Recessed lighting fixtures adjacent to unconditioned space ICAT labeled and gasketed. Also, if in insulated ceiling without attic above, exterior surface of fixture insulated to ≥ R-10 in CZ 4-8.

Please see the ENERGY STAR Certified Homes Implementation Timeline for the program version and revision currently applicable in your state.

DOE Zero Energy Ready Home (Revision 07)

Exhibit 1 Mandatory Requirements.

Exhibit 1, Item 1) Certified under the ENERGY STAR Qualified Homes Program or the ENERGY STAR Multifamily New Construction Program.

2009 IECC

Section 402.4.5 Recessed lighting. Recessed lights in the building thermal envelope are 1) type IC rated and ASTM E283 labeled and 2) sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.

2012, 2015, and 2018 IECC

Table R402.4.1.1 Air Barrier and Insulation Installation, Recessed lighting: Recessed light fixtures installed in the building thermal envelope are airtight, IC rated, and sealed to the finished surface with gasket or caulk. “Air tight” is defined as not more than 2.0 cfm when tested in accordance with ASTM E 283 at a 75 Pascal pressure differential.


Section R101.4.3 (Section R501.1.1 in 2015 and 2018 IECC). Additions, alterations, renovations, or repairs shall conform to the provisions of this code, without requiring the unaltered portions of the existing building to comply with this code. (See code for additional requirements and exceptions.)

2009 IRC

Section N1102.4.5 Recessed lighting. Recessed lights in the building thermal envelope are 1) type IC rated and ASTM E283 labeled and 2) sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.

2012, 2015, and 2018 IRC

Table N1102.4.1.1 Air Barrier and Insulation Installation, Recessed lighting: Recessed light fixtures installed in the building thermal envelope are airtight, IC rated, and sealed to the finished surface with gasket or caulk. “Air tight” is defined as not more than 2.0 cfm when tested in accordance with ASTM E 283 at a 75 Pascal pressure differential.


E4004.8. A recessed luminaire that is not identified for contact with insulation shall have all recessed parts spaces at least 1/2 inch from combustible materials. The support and trim parts can be in contact with combustible materials. A recessed luminaire that is ICAT rated can be in contact with combustible materials.

E4004.9. Thermal insulation shall not be installed above a recessed luminaire or within 3 inches of the recessed luminaires enclosure, wiring, ballast, etc., unless the luminaire is ICAT rated.


Section N1101.3 (Section N1107.1.1 in 2015 and 2018 IRC). Additions, alterations, renovations, or repairs shall conform to the provisions of this code, without requiring the unaltered portions of the existing building to comply with this code. (See code for additional requirements and exceptions.)

Appendix J regulates the repair, renovation, alteration, and reconstruction of existing buildings and is intended to encourage their continued safe use.

Recessed Lighting - Code Compliance Brief

Overview:

The intent of this brief is to provide code-related information about recessed lighting to help ensure that the measure will be accepted as being in compliance with the code. Providing notes for code officials on how to plan review and conduct field...
inspections can help builders or remodelers with proposed designs and provide jurisdictional officials with information for acceptance. Providing the same information to all interested parties (e.g., code officials, builders, designers, etc.) is expected to result in increased compliance and fewer innovations being questioned at the time of plan review and/or field inspection.

Recessed lighting is a popular lighting choice for residential applications. The U.S. Department of Energy estimates that there are 435 million recessed lighting fixtures installed in residential applications as of 2007.¹ As their name implies, these lighting fixtures are recessed into ceilings, thus creating penetrations through otherwise continuous surfaces. While not an issue when installed within the building envelope (e.g., between floors) when installed under unconditioned spaces (e.g., attics), or soffits that are likely to leak into unconditioned spaces, the number of fixtures and the surface area affected can be a significant contributor to air leakage from the building envelope. For this reason, energy codes require the fixture used to be an “airtight” design. In addition, careful attention must be paid to the interface between the ceiling drywall and the fixture housing as up to 50% of the leakage takes place at this location. Manufacturers employ a number of different methods to address this issue. Some use gaskets adhered to baseplate around the aperture, some provide air sealing tape to be installed after the ceiling is installed and others use a corresponding trim ring that seals the interface. Regardless of the method used, it is critical that all the elements of leakage system be installed, undamaged and in place before the final inspection.

An additional requirement, not related to energy efficiency but rather safety, is the proximity of the fixture housing to insulation. Codes require fixtures installed in direct contact with insulation to be IC-rated. Many people believe the term IC refers to Insulation Contact or Insulation Cover however the acronym technically refers to the UL² thermal safety environment defined for fixtures installed in Insulated Ceilings.


²UL (Underwriters Laboratory) is a global independent safety science company that certifies, validates, tests, inspects, audits, advises, and trains.

Plan Review:

Per the 2015 IECC/IRC, Section R103.3/R106.3, Examination of Documents. The code official/building official must examine or cause to be examined construction documents for code compliance.

This section lists the applicable code requirements followed by details helpful for plan review regarding the provisions to meet the requirement for “recessed lighting.”

Construction Documentation. Review the construction documents to identify the equipment, system controls, design, and ventilation choices to the equipment.

- 2015 IECC/IRC, Section R103.2/N1101.5 Information on Construction Documents. Construction documents should include:
  - Insulation materials and their R-values
  - Fixture thermal rating
  - Air sealing details

- General Installation Provisions. Review the construction documents for equipment installation and mounting. In the IRC, the Electrical Part VIII is produced and copyrighted by the National Fire Protection Association (NFPA) and is based on the 2014 National Electrical Code (NEC) (NFPA 70-2014). The section numbers appearing in brackets after the IRC text are the section numbers of the corresponding text in the NEC (NFPA 70).
2015 IECC/IRC, Section R402.4.5/N1102.4.5 Recessed Lighting. Recessed luminaires should be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaires should be IC-rated and labeled as having an air leakage rate not more than 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E 283 at a 1.57 psf (75 Pa) pressure differential. All recessed lighting should be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.

2015 IRC, Section E4003.5 Recessed Incandescent Luminaires. Recessed incandescent luminaires should have thermal protection and should be listed as thermally protected [410.115(C)].

Exceptions:

1. Thermal protection should not be required in recessed luminaires listed for the purpose and installed in poured concrete [410.115 (C) Exception No 1].

2. Thermal protection should not be required in recessed luminaires having design, construction and thermal performance characteristics equivalent to that of thermal protect luminaires, and such luminaires are identified as inherently protected [410.115 (C) Exception No 2].

Section E4004.8 Recessed Luminare Clearance. A recessed luminaire that is not identified for contact with insulation should have all recessed parts spaced at least ½ inch from combustible materials. The points of support and the finish trim parts at the opening in the ceiling, wall or other finished surface should be permitted to be in contact with combustible materials. A recessed luminaire that is identified for contact with insulation, Type IC, should be permitted to be in contact with combustible materials at recessed parts, points of support, and portions passing through the building structure and at finish trim parts at the opening in the ceiling or wall. [410.116(A)(1) and (A)(2)].

Section E4004.9 Recessed Luminare Installation. Thermal insulation should not be installed above a recessed luminaire or within 3 inches (76 millimeters) of the recessed luminaire’s enclosure, wiring compartment, ballast, transformer, light-emitting diode driver, or power supply except where such luminaire is identified for contact with insulation, Type IC. [410.116(B)].

Air Sealing/Air Leakage Control

Review the construction documents for any recessed light fixtures that will be installed in the building thermal envelope and confirm that the details show they will be air tight, IC rated, and sealed to the drywall. (Except for the actual section numbers in the codes, the requirements have not changed in the last three versions of the IECC/IRC.)

Additions and alterations to an existing electrical system should conform to the provisions as new construction.

3“Luminaire” is defined as a complete lighting unit consisting of a light source such as a lamp or lamps together with the parts designed to position the light source and connect it to the power supply. A luminaire can include parts to protect the light source or the ballast, or to distribute the light. A lamp-holder itself is not a luminaire.

4“Building Thermal Envelope” is defined as the basement walls, exterior walls, floor, roof, and any other building elements that enclose conditioned space or provide a boundary between conditioned space and exempt or unconditioned space.

5“Labeled” is defined as equipment, materials to which has been attached label, symbol or other identifying mark of an organization acceptable to the authority having jurisdiction and concerned with product evaluation that maintains periodic inspection of production of labeled equipment or materials and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

6“ASTM E 283-04” Test Method for Determining the Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen.

Field Inspection:

Per the 2015 IECC, Section R104, Inspections, construction, or work for which a permit is required is subject to inspection. Construction or work is to remain accessible and exposed for inspection purposes until approved. Required inspections include footing and foundation, framing and rough-in work, plumbing rough-in, mechanical rough-in, and final inspection.

Per the IRC, Section R108, Inspections, the wording is somewhat different in that for onsite construction, from time to time the building official, upon notification from the permit holder or his agent, can make or cause to be made any necessary inspections. Further details are provided for inspections regarding foundation, plumbing, mechanical, gas and electrical, floodplain, frame and masonry, and final inspection. Any additional inspections are at the discretion of the building official.
This section provides details for inspecting to the specific provisions for recessed lighting where one or more specific type of inspection per the IECC or IRC may be necessary to confirm compliance. Verifying code compliance for recessed lighting would typically be at the framing and rough-in stage of work and at final inspection. The following is a checklist of field inspection items that should be verified.

- Recessed lighting are properly located and mounted per the approved plans.
- Fixtures are labeled as for being IC-rated and having an air leakage rate of not more than 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E 283 at a 1.57 psf (75 Pa) pressure differential.
- The interface between the fixture housing and wall or ceiling covering is sealed via gasket, caulk, or other approved means.

**Technical Validation(s):**

This section provides additional information and helpful resources.


Dr. Energy Saver: "How to Seal and Insulate Can Lights," (video) [https://www.youtube.com/watch?v=OpKkWMkiYgk](https://www.youtube.com/watch?v=OpKkWMkiYgk)

Insulation Contractors Association of America (ICAA): "Type IC Recessed Lighting Fixtures Must be Specified in the Building Envelope," [https://www.insulate.org/tech3/](https://www.insulate.org/tech3/)


Access to some references may require purchase from the publisher. While we continually update our database, links may have changed since posting. Please contact our webmaster if you find broken links.

Case Studies
None Available

References and Resources*

1. **2009 IECC - International Energy Conservation Code**  
   **Author(s):** International Code Council  
   **Organization(s):** ICC  
   **Publication Date:** January, 2009
   Code establishing a baseline for energy efficiency by setting performance standards for the building envelope (defined as the boundary that separates heated/cooled air from unconditioned, outside air), mechanical systems, lighting systems and service water heating systems in homes and commercial businesses.

2. **2009 IRC - International Residential Code for One and Two Family Dwellings**  
   **Author(s):** International Code Council  
   **Organization(s):** ICC  
   **Publication Date:** January, 2009
   Code for residential buildings that creates minimum regulations for one- and two-family dwellings of three stories or less. It brings together all building, plumbing, mechanical, fuel gas, energy and electrical provisions for one- and two-family residences.

   **Author(s):** International Code Council  
   **Organization(s):** ICC  
   **Publication Date:** January, 2012
   Code establishing a baseline for energy efficiency by setting performance standards for the building envelope (defined as the boundary that separates heated/cooled air from unconditioned, outside air), mechanical systems, lighting systems and service water heating systems in homes and commercial businesses.

4. **2012 IRC - International Residential Code for One and Two Family Dwellings**  
   **Author(s):** International Code Council  
   **Organization(s):** ICC  
   **Publication Date:** January, 2012
   Code for residential buildings that creates minimum regulations for one- and two-family dwellings of three stories or less. It brings together all building, plumbing, mechanical, fuel gas, energy and electrical provisions for one- and two-family residences.

5. **2015 IECC - International Energy Conservation Code**  
   **Author(s):** International Code Council  
   **Organization(s):** ICC  
   **Publication Date:** May, 2014
   Code establishing a baseline for energy efficiency by setting performance standards for the building envelope (defined as the boundary that separates heated/cooled air from unconditioned, outside air), mechanical systems, lighting systems and service water heating systems in homes and commercial businesses.

6. **2015 IRC - International Residential Code for One and Two Family Dwellings**  
   **Author(s):** International Code Council  
   **Organization(s):** ICC  
   **Publication Date:** May, 2014
   Code for residential buildings that creates minimum regulations for one- and two-family dwellings of three stories or less. It brings together all building, plumbing, mechanical, fuel gas, energy and electrical provisions for one- and two-family residences.

7.
Code establishing a baseline for energy efficiency by setting performance standards for the building envelope (defined as the boundary that separates heated/cooled air from unconditioned, outside air), mechanical systems, lighting systems, and service water heating systems in homes and commercial businesses.

8. **2018 IRC - International Residential Code for One and Two Family Dwellings**
   - **Author(s):** International Code Council
   - **Organization(s):** ICC
   - **Publication Date:** August, 2017
   - Code for residential buildings that creates minimum regulations for one- and two-family dwellings of three stories or less. It brings together all building, plumbing, mechanical, fuel gas, energy and electrical provisions for one- and two-family residences.

9. **Air Leakage in Recessed Lighting**
    - **Author(s):** Van der Meer
    - **Organization(s):** Pennsylvania Housing Research/Resource Center
    - **Publication Date:** May, 2002
    - Recessed lighting is here to stay. If installed incorrectly they may contribute to air leakage and compromise building integrity.

10. **High Hats, Swiss Cheese, and Fluorescent Lighting?**
    - **Author(s):** McCullough, Gordon
    - **Organization(s):** Pacific Northwest National Laboratory
    - **Publication Date:** January, 2002
    - Report discussing the potential energy savings of new high-efficiency downlights, and the results of product testing to date.

11. **Improving Recessed Lighting**
    - **Author(s):** Pacific Northwest National Laboratory
    - **Organization(s):** PNNL
    - **Publication Date:** January, 2011
    - Report providing information about techniques and approaches to improve the efficiency of recessed lighting.

    - **Author(s):** National Renewable Energy Laboratory
    - **Organization(s):** NREL
    - **Publication Date:** April, 2017
    - Standard Work Specification for non-insulation contact recessed lights in existing homes.

13. **Thermal Protection in Recessed Luminaires**
    - **Author(s):** Pierce
    - **Organization(s):** IAEI
    - **Publication Date:** July, 2001
    - Article on thermal protectors in recessed light fixtures.

*Publication dates are shown for formal documents. Dates are not shown for non-dated media. Access dates for referenced, non-dated media, such as web sites, are shown in the measure guide text.

**Contributors to this Guide**

The following authors and organizations contributed to the content in this Guide.

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