

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.

¹U.S. Department of Energy. 2011. *Energy Savings Estimates of Lighting Emitting Diodes in Niche Lighting Applications*. http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/nichefinalreport_january2011.pdf [1].

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 luminaires³ installed in the building thermal envelope⁴ should be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaires should be IC-rated and labeled⁵ as having an air leakage rate not more than 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E 283⁶ 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 Luminaire 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 Luminaire 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.)
 - **2015 IECC/IRC, Table R402.4.1.1/N1102.4.1.1**
 - **2012 IECC/IRC, Table R402.4.1.1/N1102.4.1.1**
 - **2009 IECC/IRC, Table 402.4.2/N1102.4.2**

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 R109, 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.

Guide: "Recessed Can Fixtures Below Unconditioned Space," <https://basc.pnnl.gov/resource-guides/recessed-light-fixtures-below-unconditioned-space> [2].

The Pennsylvania Housing Research/Resource Center: "Air Leakage in Recessed Lighting – Builder Brief," <http://www.arizonasolarwave.com/docs/recessed-lights-air-leakage-phrc.pdf> [3]

Hammer & Hand (2010): "Leaky Lights on the Lam, Recessed Lighting and Energy Efficiency," <http://hammerandhand.com/field-notes/leaky-lights-on-the-lam-recessed-lighting-and-energy-efficiency/> [4]

"Advanced Air Sealing: Recessed Lights," Oikos Green Building Source: http://oikos.com/library/airsealing/recessed_lights.html [5]

Dr. Energy Saver: "How to Seal and Insulate Can Lights," (video) <https://www.youtube.com/watch?v=OpKkWMkiYgk> [6]

Insulation Contractors Association of America (ICAA): "Type IC Recessed Lighting Fixtures Must be Specified in the Building Envelope," <http://www.insulate.org/tech3.html> [7]

"Recessed Can of Worms," (2001) *The Home Performance Magazine*, Home Energy. <http://www.homeenergy.org/show/article/id/236> [8]

"Further Wrestling with Recessed Can Lights," (2005) *The Home Performance Magazine*, Home Energy. <http://www.homeenergy.org/show/article/id/122> [9]

Bennett SM and H Perez-Blanco. 1994. "Recessed Light Fixtures: Infiltration Energy Loss." *ASHRAE Journal* 36(6):82. ISSN 0001-2491.