

BACKGROUND

The 2015 Houston Commercial Energy Conservation Code with local Amendments, effective December 9th, 2016, contains mandatory cool roofing provisions for new commercial buildings and alterations to existing commercial buildings. Cool roofs are highly reflective and limit heat absorption in a roof to reduce temperatures as much as 60 degrees lower than a typical roof. Per the *Cool Roof Rating Council* <http://www.coolroofs.org/>, there are hundreds of products that have been tested to meet the Houston criteria and more continue to be tested. Qualified roof covering materials include a broad spectrum from coatings to modified bitumen, metal, single ply, and the exposed surface of a built-up roof.

DEFINITIONS

Building Envelope (ASHRAE 90.1-2013). The exterior plus the semi-exterior portions of a building. For the purposes of determining building envelope requirements, the classifications are defined as follows:

Exterior building envelope: the elements of a building that separate conditioned spaces from the exterior.

Semi-exterior building envelope: the elements of a building that separate conditioned space from unconditioned space or that enclose semi heated spaces through which thermal energy may be transferred to or from the exterior, or to or from unconditioned spaces, or to or from conditioned spaces.

Positive Roof Drainage (IBC 2012). The drainage condition in which consideration has been made for all loading deflections of the roof deck, and additional slope has been provided to ensure drainage of the roof within 48 hours of precipitation.

Roof (ASHRAE 90.1-2013). The upper portion of the building envelope, including opaque areas and fenestration, that is horizontal or tilted at an angle of less than 60° from horizontal. For the purposes of determining building envelope requirements, the classifications are defined as follows:

Attic and other roofs: all other roofs, including roofs with insulation entirely below (inside of) the roof structure (i.e., attics, cathedral ceilings, and single rafter ceilings), roofs with insulation both above and below the roof structure, and roofs without insulation but excluding metal building roofs.

Metal building roof: a roof that

- a. is constructed with a metal, structural, weathering surface,
- b. has no ventilated cavity, and
- c. has the insulation entirely below deck (i.e., does not include composite concrete and metal deck construction nor a roof framing system that is separated from the superstructure by a wood substrate) and whose structure consists of one or more of the following configurations:
 1. Metal roofing in direct contact with the steel framing members
 2. Metal roofing separated from the steel framing members by insulation
 3. Insulated metal roofing panels installed as described in sub-items (a) or (b) above.

Roof with insulation entirely above deck: a roof with all insulation:

- a. installed above (outside of) the roof structure and
- b. continuous (i.e., uninterrupted by framing members).

Roof Assembly (IECC 2015 and IBC 2012). A system designed to provide weather protection and resistance to design loads. The system consists of a roof covering and roof deck or a single component serving as both the roof covering and the roof deck. A roof assembly includes the roof deck, vapor retarder, substrate or thermal barrier, insulation, vapor retarder and roof covering.

Roof covering (ASHRAE 90.1-2013 and IBC 2012). the topmost component of the roof assembly intended for weather resistance, fire classification or appearance.

Roof Recover (IECC 2015 and IBC 2012). The process of installing an additional roof covering over an existing roof covering without removing the existing roof covering.

Roof Replacement (IECC 2015 and IBC 2012). The process of removing the existing roof covering, repairing any damaged substrate & installing a new roof covering.

Reroofing (IECC 2015 and IBC 2012). The process of recovering or replacing an existing roof covering. See "Roof recover" and "Roof replacement."

ROOF REPAIR AND COOL ROOF GUIDELINES

Roof Repair (IECC 2015 and IBC 2012). Reconstruction or renewal of any part of an existing roof for the purposes of its maintenance.

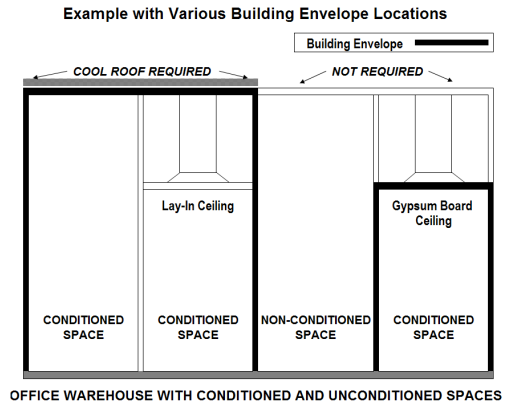
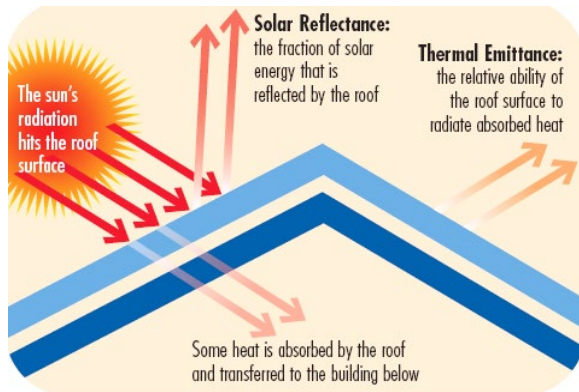
Single-rafter roof: a subcategory of attic roofs where the roof above and the ceiling below are both attached to the same wood rafter and where insulation is in the space between these wood rafters.

REQUIREMENT

The three (3) basic tests which classify the roof covering material are Solar Reflectance, Thermal Emittance, and Solar Reflectance Index. Results range from 0.0 to 1.0:

Reflectance: the ratio of the light reflected by a surface to the light incident upon it. Refer to: *Sections 3 and 5.5.3.1.1 ASHRAE 90.1-2013 and Section C402.3 IECC (2015).*

Emittance: the ratio of the radiant heat flux emitted by a specimen to that emitted by a blackbody at the same temperature and under the same conditions. Refer to: *Sections 3 and 5.5.3.1.1 ASHRAE 90.1-2013 and Section C402.3 IECC (2015).*



EXISTING BUILDING ENVELOPE

When there is no change to the status of an existing roof building envelope it does not need to meet the new guidelines. If the roof is already a building envelope and is not being reconstructed it may remain. For example, where a retail strip center has a change of occupancy to a restaurant and the roof is unaffected, it is not required to meet new provisions. If the existing roof was not a building envelope and will not become part of the building envelope due to changing the space below to conditioned space, the existing roof may remain.

APPLICABILITY

Commercial Buildings or Multi-Family Residential Buildings over 3 stories, with a roof having a slope less than 2:12 pitch when any of the following occur:

- 1. New building** (or addition) enclosing conditioned space where the roof serves as a portion of the building envelope.
- 2. Conversion of a building** (or space) from unconditioned to conditioned space where the roof serves as a portion of the building envelope.
- 3. Alteration or Repair** (re-roof) to existing roofs where the roof serves as a portion of the building envelope. Alterations made to an existing roof that affect the existing building envelope must comply and those that do not affect an existing building envelope may remain. There are several situations that affect whether the cool roof requirement applies:

SCOPE OF WORK	EXISTING ROOF COVERING	EXISTING INSULATION	REQUIREMENT
1. COMPLETE REMOVAL OF ROOF MATERIALS TO DECK	Removed	Above Deck Removed	Roof Insulation and Cool Roof
		Below Deck Remains	No Requirement
2. REPLACE PORTIONS OF ROOF FULL DEPTH (THICKNESS) ^a	Patches	Patches	Repair affected area to existing
	Edge-to-edge, and Corner-to-corner	Removed	Replace that portion of the roof, above deck insulation and cool roof
	NOT an Edge-to-edge, or Corner-to-corner but > 50 % total area	Removed	Above Deck Roof Insulation and Cool Roof
3. REMOVE ROOF COVERING LAYER(S) ONLY AND RECOVER	Removed	Exposed	Roof Insulation and Cool Roof
		Not Exposed	No Requirement
4. APPLY COATINGS ONLY	Remains	Remains or None	No Requirement

a. The roof area will be between expansion joints or between area dividers such as parapets or edges.

ROOF REPAIR AND COOL ROOF GUIDELINES

EXEMPTIONS

The provisions of this code do not apply to: (a) single-family houses, multi-family structures of three stories or fewer above grade, manufactured houses (mobile homes) and manufactured houses (modular), (b) buildings that do not use either electricity or fossil fuel, or where specifically noted as exempt. Refer to: *Section 2.2 ASHRAE Standard 90.1-2013*.

REFERENCES

Insulation

The Houston Commercial Energy Conservation Code requires roof insulation to be installed meeting the following criteria based on where the insulation is to be installed and the type of building or space as follows:

Opaque Elements	Nonresidential		Residential		Semiheated	
	Assembly Maximum (Table C402.1.4)	Insulation Min. R-Value	Assembly Maximum (Table C402.1.4)	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value
<i>Roofs</i>						
Insulation Entirely Above Deck	U-0.039	R-25 ci	U-0.039	R-25 ci	U-0.173	R-5 ci
Metal Buildings ^a	U-0.035	R-11 LS + R-19 ^b	U-0.035	R-11 LS + R-19 ^b	U-0.096	R-16
Attic and Other	U-0.027	R-38	U-0.027	R-38	U-0.053	R-19

ci = Continuous insulation, NR = No requirement, LS = Liner system.

a. See section A2.3.2 ASHRAE 90.1-2013.

b. Where using R-value compliance method, a thermal spacer block shall be provided, otherwise use the U-factor compliance method in Table C402.1.4.

Gravel Roofs

Crushed stone and gravel roof coverings are prohibited in the City of Houston. This does not apply to ballast rock with minimum 1 ½ inch nominal diameter.

Lay-in Ceilings

Lay-in ceilings with insulation are not considered part of the building envelope because they allow air infiltration.

Re-roofs

Roof covering replacements require positive drainage.

Cool Roof Code Language

ASHRAE 90.1-2013

5.5.3.1.1 Roof Solar Reflectance and Thermal Emittance. Roofs in Climate Zones 1 through 3 shall have one of the following:

- A minimum three-year-aged solar reflectance of 0.55 and a minimum three-year-aged thermal emittance of 0.75 when tested in accordance with CRRC-1 Standard
- A minimum Solar Reflectance Index of 64 when determined in accordance with the Solar Reflectance Index method in ASTM E1980 using a convection coefficient of 2.1 Btu/h·ft²·°F, based on three-year-aged solar reflectance and three-year-aged thermal emittance tested in accordance with CRRC-1 Standard
- Increased roof insulation levels found in Table 5.5.3.1.1

Exceptions:

- Ballasted roofs with a minimum stone ballast of 1½ inches nominal diameter
- Vegetated roof systems that contain a minimum thickness of 2.5 in. of growing medium and covering a minimum of 75% of the roof area with durable plantings
- Roofs where a minimum of 75% of the roof area
 - is shaded during the peak sun angle on June 21 by permanent components or features of the building;
 - is covered by offset photovoltaic arrays, building-integrated photovoltaic arrays, or solar air or water collectors; or
 - is permitted to be interpolated using a combination of 1 and 2 above
- Steep-sloped roofs
- Low-sloped metal building roofs in Climate Zones 2 and 3.
- Roofs over ventilated attics, roofs over semi-heated spaces, or roofs over conditioned spaces that are not cooled spaces
- Asphaltic membranes in Climate Zones 2 and 3

The values for three-year-aged solar reflectance and three-year-aged thermal emittance shall be determined by a laboratory accredited by a nationally recognized accreditation organization and shall be labeled and certified by the manufacturer.