

THE ROOM WHERE IT HAPPENS

NRCA'S INVOLVEMENT IN ASHRAE STANDARDS DEVELOPMENT HELPS PROTECT THE ROOFING INDUSTRY'S INTERESTS

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ASHRAE® was founded in 1894 through the merger of the American Society of Heating and Air-Conditioning Engineers and American Society of Refrigerating Engineers. The goal of ASHRAE is the betterment of building systems, indoor air quality, energy efficiency and sustainability. To accomplish this, ASHRAE has developed 28 standards and guidelines, many of which are referenced in the International Code Council®'s suite of codes.

Two standards in particular are important to the roofing industry: ASHRAE Standard 90.1, "Energy Standard for Buildings Except Low-Rise Residential Buildings," and ASHRAE Standard 189.1, "Standard for the Design of High-Performance Green Buildings." In addition, local jurisdictions reference one or both of these standards depending on the ordinances or laws of the specific jurisdiction. NRCA has been intimately involved with the drafting of both standards.



ASHRAE STANDARD 90.1

In August 1975, ASHRAE published its first energy conservation standard, ASHRAE Standard 90, "Energy Conservation in New Buildings," which applied to commercial and residential buildings. The need for an energy conservation code or standard arose out of the concern for U.S. dependency and vulnerability on foreign energy during the 1973 oil embargo. This realization led all 50 states to develop energy codes or regulations during the 1970s that were either based on ASHRAE Standard 90 or used the standard as a technical source.

ASHRAE Standard 90.1 and its predecessor, ASHRAE Standard 90, are not standalone building codes. Therefore, code bodies, particularly the Council of American Building Officials, developed and published the Code for Energy Conservation in New Building Construction in 1977, which later became the Model Energy Code in 1983 and was based on the requirements within ASHRAE

Standard 90.

Later versions of the code were developed jointly by the Building Officials and Code Administrators, International Conference of Building Officials, National Conference of States on Building Codes and Standards and the Southern Building Code Congress International all of which are, by way of merger, now known as ICC.

In 1989, ASHRAE Standard 90.1 first was published. Its companion document, ASHRAE Standard 90.2, “Energy-Efficient Design of New Low-Rise Residential Buildings,” was not published until 1993 and is infrequently referenced by codes. The latest edition of ASHRAE Standard 90.1 was published in October 2019 and will be referenced in the 2021 International Energy Conservation Code.®

The committee responsible for maintaining ASHRAE Standard 90.1 is composed of five subcommittees: Envelope, Lighting, Mechanical, Format and Compliance and Energy Cost Budget. Issues related to roofing, such as R-value and insulation, air barriers and thermal bridging are addressed in the Envelope Subcommittee of which NRCA is a voting member.

The scope of ASHRAE Standard 90.1 is to provide minimum energy-efficient requirements for the design and construction of new commercial buildings, as well as additions to existing commercial buildings. The standard also provides requirements for the plan and operation of new systems and equipment in new commercial buildings, existing buildings and new additions to existing buildings. New equipment or building systems that are part of industrial or manufacturing processes that are specifically identified in the standard also are addressed. In addition, ASHRAE Standard 90.1 provides criteria for determining compliance with the requirements contained within the standard.

The standard specifically states the requirements do not apply to single-family homes, multifamily buildings of three stories or fewer above grade, manufactured houses (mobile homes) or manufactured houses (modular homes). Buildings that do not use electricity or fossil fuels also are not covered by the standard.

ASHRAE Standard 90.1-2019 is composed of 12 sections, seven appendices and one annex. Of the appendices, three are normative, which are considered integral parts of the mandatory requirements of the standard, and the other four are informative and provided as additional information in the standard. The annex of the standard is a reproduction of the climate zone information contained in ASHRAE Standard 169, “Climatic Data for Building Design Standards,” which is required information needed to comply with ASHRAE Standard 90.1.

ASHRAE Standard 90.1 contains mandatory provisions that must be met in addition to the requirements of the specific compliance path (prescriptive or performance) used for compliance. The prescriptive roof requirements are contained in Section 5—Building Envelope. Section 11—Energy Cost Budget Method, Normative Appendix C—Methodology for Building Envelope Trade-Off Option in Section 5.6 and Normative Appendix G—Performance Rating Method provide performance path compliance requirements.

ASHRAE STANDARD 189.1

ASHRAE Standard 189.1 is the other standard important to the roofing industry. It was developed in response to the demand for consensus green standards and code-enforceable language arising from the increased awareness of green rating systems. ASHRAE Standard 189.1 addresses a broader scope of the built environment beyond energy-related matters such as building site sustainability, building materials and water use efficiency, to list a few. Many of its requirements are increased or stricter than the identical requirements contained in ASHRAE Standard 90.1.

In 2015, ICC joined with ASHRAE, The American Institute of Architects, Illuminating Engineering Society and U.S. Green Building Council to co-sponsor ASHRAE Standard 189.1, which reflected a Memorandum of Understanding signed in 2014 to better align green building goals through ASHRAE Standard 189.1, the International Green Construction Code® and the LEED® certification system. As part of the agreement, IgCC’s technical content is based on provisions in the

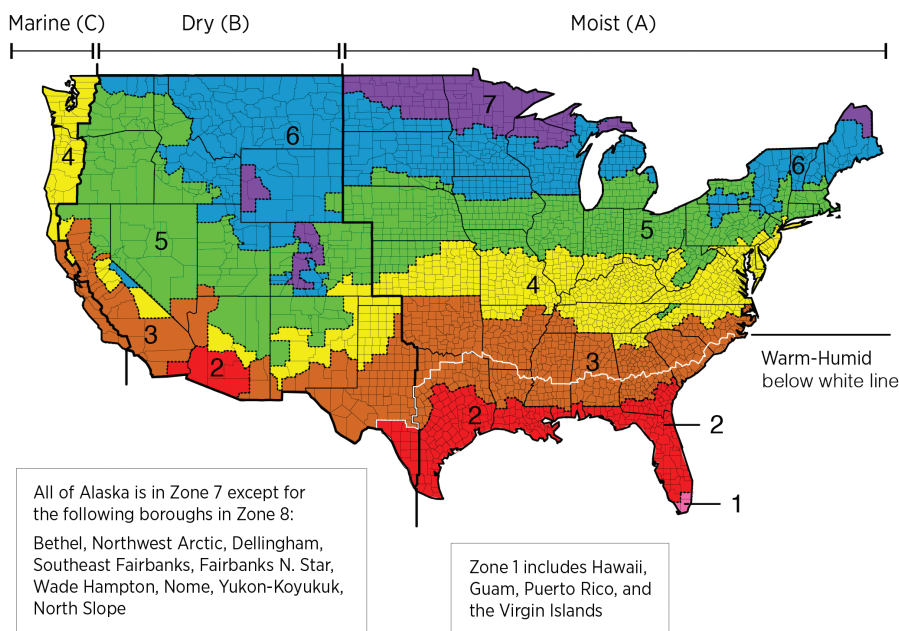


Figure 1: U.S. climate zones

Climate Zone		Minimum Insulation R-value or Maximum Assembly U-factor					
		Nonresidential		Residential		Semiheated	
		ASHRAE 189.1-2017	ASHRAE 90.1-2019	ASHRAE 189.1-2017	ASHRAE 90.1-2019	ASHRAE 189.1-2017	ASHRAE 90.1-2019
4	Insulation entirely above deck	R - 35 c.i. U - 0.030	R - 30 c.i. U - 0.032	R - 35 c.i. U - 0.030	R - 30 c.i. U - 0.032	R - 11 c.i. U - 0.088	R - 10 c.i. U - 0.093
	Attic and other	R - 60 U - 0.020	R - 49 U - 0.021	R - 60 U - 0.020	R - 49 U - 0.021	R - 38 U - 0.032	R - 30 U - 0.034
5	Insulation entirely above deck	R - 35 c.i. U - 0.030	R - 30 c.i. U - 0.032	R - 35 c.i. U - 0.030	R - 30 c.i. U - 0.032	R - 17 c.i. U - 0.060	R - 15 c.i. U - 0.063
	Attic and other	R - 60 U - 0.020	R - 49 U - 0.021	R - 60 U - 0.020	R - 49 U - 0.021	R - 38 U - 0.032	R - 30 U - 0.034
6	Insulation entirely above deck	R - 35 c.i. U - 0.030	R - 30 c.i. U - 0.032	R - 35 c.i. U - 0.030	R - 30 c.i. U - 0.032	R - 17 c.i. U - 0.060	R - 15 c.i. U - 0.063
	Attic and other	R - 60 U - 0.020	R - 49 U - 0.021	R - 60 U - 0.020	R - 49 U - 0.021	R - 38 U - 0.032	R - 30 U - 0.034
7	Insulation entirely above deck	R - 40 c.i. U - 0.027	R - 35 c.i. U - 0.028	R - 40 c.i. U - 0.027	R - 35 c.i. U - 0.028	R - 26 c.i. U - 0.037	R - 25 c.i. U - 0.039
	Attic and other	R - 71 U - 0.016	R - 60 U - 0.017	R - 71 U - 0.016	R - 60 U - 0.017	R - 49 U - 0.026	R - 38 U - 0.027
8	Insulation entirely above deck	R - 40 c.i. U - 0.027	R - 35 c.i. U - 0.028	R - 40 c.i. U - 0.027	R - 35 c.i. U - 0.028	R - 26 c.i. U - 0.037	R - 25 c.i. U - 0.039
	Attic and other	R - 71 U - 0.016	R - 60 U - 0.017	R - 71 U - 0.016	R - 60 U - 0.017	R - 49 U - 0.026	R - 38 U - 0.027

Figure 2: Minimum required R-values contained in ASHRAE Standards 189.1-2017 and 90.1-2019

2017 edition of ASHRAE Standard 189.1 developed using the American National Standards Institute-approved ASHRAE consensus process. Now, ICC is responsible for maintaining Chapter 1, and Chapters 2-11, the appendices and the annex are the responsibility of the ASHRAE Standard 189.1 committee. Before the agreement, the 2012 and 2015 IgCC versions simply included ASHRAE Standard 189.1 as a project compliance option.

ASHRAE Standard 189.1 contains 11 sections, Appendices A-J and Annex 1. And similar to the appendices in ASHRAE Standard 90.1, the appendices of ASHRAE Standard 189.1 are normative and informative.

The parts of ASHRAE Standard 189.1 that directly apply to roofing are Section 5—Site Sustainability, Section 7—Energy Efficiency, Section 9—Materials and Resources, Normative Appendix A—Climate Zones and Prescriptive Building Envelope and Duct Insulation Tables, and Informative Appendix E—Building Envelope Tables.

Section 5.3.5.3—Roofs requires buildings and covered parking roof surfaces for building projects in Climate Zones 0, 1, 2 and 3 to have a minimum of 75% of the roof surface covered with products that have a minimum three-year-aged solar reflectance index of 64 for roof

systems with slopes less than or equal to 2:12 and a minimum three-year-aged SRI of 25 for roof systems with slopes of more than 2:12 (see Figure 1).

Areas to be excluded from the calculated required area include the area occupied by one or more of the following:

- Roof penetrations and associated equipment
- On-site renewable energy systems
- Portions of the roof used to capture heat for building energy technologies
- Roof decks and rooftop walkways
- Vegetative terraces and roof systems

The required SRI is determined in accordance with ASTM E1980, “Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.”

Section 5.3.5.5—Vegetative Terrace and Roof Systems requires plantings capable of surviving in the local microclimate and growing media that supports the plantings in the local microclimate. The installation of plantings also must meet the requirements of the roof covering manufacturer’s instructions and provide the intended coverage within two years of the issuance of the final certificate of occupancy. The use of potable or reclaimed water to irrigate plantings is prohibited after the plants are

Climate Zone	Minimum Insulation R-value or Maximum Assembly U-factor		
	Nonresidential	Residential	Semiheated
	ASHRAE 189.1-2017	ASHRAE 189.1-2017	ASHRAE 189.1-2017
0,1	R - 38 U - 0.029	R - 38 + R10 c.i. U - 0.022	R - 19 U - 0.055
2	R - 38 + R10 c.i. U - 0.022	R - 38 + R10 c.i. U - 0.022	R - 19 U - 0.055
3,4,5	R - 38 + R10 c.i. U - 0.022	R - 38 + R10 c.i. U - 0.022	R - 30 U - 0.036
6	R - 38 + R10 c.i. U - 0.022	R - 38 + R10 c.i. U - 0.022	R - 38 U - 0.029
7,8	R - 38 + R15 c.i. U - 0.020	R - 38 + R15 c.i. U - 0.020	R - 38 U - 0.029

Figure 3: ASHRAE Standard 189.1 Table A-1 in Appendix A

established or 18 months after the initial installation of the plants, whichever is less. After 18 months or once vegetation is established, the irrigation system for potable or reclaimed water must be removed unless the authority having jurisdiction approves the continued use of on-site reclaimed water for vegetative roof system irrigation.

To comply with Section 7—Energy Efficiency, a project must meet specific mandatory requirements and either the prescriptive or performance option. Section 7.3.2—On-Site Renewable Energy Systems is a mandatory provision and requires, with two exceptions, a building project design to show allocated space and pathways for future installation of on-site renewable energy systems that could affect the building’s roof if the roof were the designated allocated space.

The minimum R-value and U-factors for roof assemblies are contained in the prescriptive provisions of Section 7.4.2.1—Building Envelope Requirements, which references ASHRAE Standard 90.1. For Climate Zones 0, 1, 2 and 3, the minimum R-values and U-factors are published in ASHRAE Standard 90.1. In Climate Zones 4, 5, 6, 7 and 8, the U-factor values are reduced by 5% as shown in Figure 2 on page 39. The minimum R-values in the table for Climate Zones 4-8 do not apply. However, R-values are published in Informative Appendix E of ASHRAE Standard 189.1 and are not required to comply with the standard. For comparison, the minimum required R-values contained in ASHRAE Standard 90.1-2019 also are shown in Figure 2.

Additionally, Section 7.4.2.2—Single-Rafter Roof Insulation requires single-rafter roof systems (commonly referred to as cathedral ceiling roofs) comply with the requirements of Table A-1 in Appendix A as shown in Figure 3. These requirements supersede the

requirements contained in ASHRAE Standard 90.1’s Table A2.4.2.

However, Section 7.4.2.8—Building Envelope Trade-Off Option permits a trade-off based on improved performance of the building envelope over a theoretical base design if the requirements previously discussed in Section 7.4.2 are incorporated into the proposed design of the roof assembly. The performance option provisions are contained in Section 7.5 and include the requirements contained in Appendix C for renewable, recoverable and purchased energy in addition to building performance calculations. There is one additional compliance path for meeting energy efficiency in ASHRAE Standard 189.1’s Appendix H, which references the IECC prescriptive path. However, Appendix H is informative only unless specifically adopted by the local jurisdiction.

The mandatory provisions in Section 9—Materials and Resources have requirements that will affect new roof system installations as well as roof system replacements. In Section 9.3.1.1—Diversion, a minimum of 50% of non-hazardous construction and demolition waste material generated before the issuance of the final certificate of occupancy must be diverted from disposal in landfills and incinerators by reuse, recycling, repurposing and/or composting. Not included in the calculation is excavated soil, land-clearing debris and waste-to-energy incineration. All diversion calculations will be based on either weight or volume (but not both) throughout the construction process. However, reuse can include donating materials to charitable organizations; salvaging existing materials on-site; reclaiming products by manufacturers; and returning packaging materials to the manufacturer, shipper or other source for reuse as packaging in future shipments.

THE INTENT OF NRCA'S INVOLVEMENT IS TO PROMOTE CLEAR, TECHNICALLY SOUND ADVANCEMENT OF ASHRAE STANDARDS

For new building projects on sites with less than 5% existing buildings, structures or hardscape, Section 9.3.1.2—Total Waste, requires the total amount of construction waste generated before the issuance of the final certificate of occupancy on the project not to exceed 42 cubic yards or 12,000 pounds per 10,000 square feet of new building floor area. This requirement applies to all waste, whether diverted, landfilled, incinerated or otherwise disposed. The amount of waste must be tracked throughout the construction process in accordance with the construction waste management plan.

Related requirements in Section 10—Construction and Plans for Operation include the commissioning and functional and performance testing of a building. Additional informative provisions of the commissioning process are contained in Appendix I. The commissioning process typically is performed by an independent third party to review design documents, installation of materials and systems, and verify performance or compliance testing with project documents. Section 7 requires buildings in all climate zones to have a continuous air barrier; therefore, part of Section 10 permits the pressurization testing of the whole building for airtightness. If a building fails the airtightness requirements and the failure point is attributed to its roof assembly, tear-off and replacement may be required to correct the issue.

Additionally, Section 10 requires roof surface materials selected to comply with the requirements of Section 5.3.5.3 to include maintenance procedures for keeping roof surfaces clean in accordance with manufacturers' recommendations. The care needed to promote healthy plant growth and maintain roof membranes for vegetative terraces and roof systems, as well as replacement procedures of plantings, also must be provided. Nonvegetative roof area borders and clearances must comply with provisions of the International Fire Code.®

WRITING THE STANDARDS

There are similarities between the development of the I-Codes and ASHRAE standards. All go through a public

review and comment period. The I-Codes are presented to a committee of about 15 members, and final approval is voted on by more than 2,000 code officials across the U.S. ASHRAE standards are approved for publication by larger committees of about 30-50 members depending on the standard.

The significant difference is I-Codes are updated and/or modi-

fied every three years, which is the only time changes may be submitted. ASHRAE standards are referred to as continuous maintenance documents meaning though ASHRAE Standards 90.1 and 189.1 also are published every three years and ahead of the associated I-Codes, ASHRAE standards can be revised or updated at any time. A proposed change to an ASHRAE standard may be submitted between publication dates and, if approved, is published as an addendum that can be immediately adopted by a jurisdiction as a mandatory requirement. Then, at the next publication date, all approved addendums since the previous publication date automatically are incorporated into the new published standard.

NRCA participates in ASHRAE standards development for the same reason it participates with the ICC code development process: to protect the roofing industry's interests. Although ASHRAE Standard 90.1 is not a code, compliance with its requirements become codified by reference in the I-Codes or a state's or local jurisdiction's specific adopted code. The same was true for ASHRAE Standard 189.1 until the publication of the 2018 IgCC, which is now the technical portion of the IgCC. The intent of NRCA's involvement is to promote clear and/or easily interpretable, technically sound advancement of ASHRAE standards related to the roofing industry. 🌐🔗

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