

Chapter 2—Code Provisions Applicable to All Roof Assemblies

In this chapter, IBC 2012 code language containing requirements that pertain to all roof assemblies is quoted based on the following categories that are critical for code compliance:

- 2.1 Fire Resistance
- 2.2 Impact Resistance
- 2.3 Uplift Resistance
- 2.4 Weather Protection and Roof Drainage
- 2.5 Permitted Materials and Methods
- 2.6 Ventilation
- 2.7 Reroofing

2.1 FIRE RESISTANCE

IBC 2012 contains provisions for external and internal fire-resistance classifications of roof assemblies. The external fire-resistance classification provisions are found in Chapter 15—Roof Assemblies and Rooftop Structures, Section 1505—Fire Classification. The internal fire-resistance provisions are primarily concerned with roof insulation characteristics. Chapter 15, Section 1508—Roof Insulation contains provisions and references to other locations in the code where additional provisions addressing material- and construction-type-specific internal fire-resistance requirements are found. Chapter 23—Wood addresses cellulosic fiberboard roof insulation in fire-resistant roof assemblies. Chapter 26—Plastic addresses foam plastic roof insulation in fire-resistant roof assemblies.

External Fire Exposure Classification

Typically, only provisions for roof assembly performance against external fire exposure are within a roofing contractor’s scope of work. In Section 1505—Fire Classification, there are the following provisions for exterior roof covering materials:

“1505.1 General. Roof assemblies shall be divided

into the classes defined below. Class A, B and C roof assemblies and roof coverings required to be listed by this section shall be tested in accordance with ASTM E108 or UL 790. In addition, *fire-retardant-treated wood* roof coverings shall be tested in accordance with ASTM D2898. The minimum roof coverings installed on buildings shall comply with Table 1505.1 based on the type of construction of the building.

Exception: Skylights and sloped glazing that comply with Chapter 24 or Section 2610.”

TABLE 1505.1^{a, b}

MINIMUM ROOF COVERING CLASSIFICATION FOR TYPES OF CONSTRUCTION

IA	IB	IIA	IIB	IIIA	IIIB	IV	VA	VB
B	B	B	C ^c	B	C ^c	B	B	C ^c

For SI: 1 foot=304.8 mm, 1 square foot=0.0929m²

- a. Unless otherwise required in accordance with the *International Wildland-Urban Interface Code* or due to the location of the building within a fire district in accordance with Appendix D.
- b. Nonclassified roof coverings shall be permitted on buildings of Group R-3 and Group U occupancies, where there is a minimum fire-separation distance of 6 feet measured from the leading edge of the roof.
- c. Buildings that are not more than two stories above grade plane and having not more than 6,000 square feet of projected roof area and where there is a minimum 10-foot fire-separation distance from the leading edge of the roof to a lot line on all sides of the building, except for street fronts or public ways, shall be permitted to have roofs of No. 1 cedar or redwood shakes and No. 1 shingles.

Section 1505.1 references Table 1505.1 Minimum Roof Covering Classification For Types of Construction for minimum fire-classification requirements. When considering rooftop photovoltaic (PV) system installations, it is important to note the minimum fire classification for a rooftop-mounted PV system is determined according to type of construction as indicated in Table 1505.1 and not according to the fire-classification of the roof assembly serving as the platform for the PV system. This provision is found in Section 1505.8.

External fire-exposure classifications are assigned to roof assemblies tested using the protocols provided in ASTM E108, “Standard Test Methods for Fire Tests of Roof Coverings” or UL 790 of the same title. ASTM E108 and UL 790 are separate and independently maintained documents that provide the same test protocols and classification criteria. A roof covering material always is tested and classified as part of a complete roof assembly. The class designation thus obtained applies to the whole roof assembly and not the roof covering by itself.

Section 202—Definitions of IBC 2012 provides the following definitions for “roof assembly” and “roof covering”:

“ROOF ASSEMBLY (For application to Chapter 15 only). 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. The covering applied to the roof deck for weather resistance, fire classification or appearance.”

In ASTM E108/UL 790 testing, outer surfaces of roof assemblies of prescribed size and slope are exposed to gas flame and burning wood brands. Class A test protocols specify the most severe fire exposure, i.e., longest flame duration and/or largest standard burning wood brand. Under Class B test protocols, the fire exposure is less severe. Class C test protocols provide the lowest level of fire exposure. Roof covering material type and deck type determine the required number of duplicate test assemblies for a tested roof covering. The assemblies are subject to evaluation during and after testing. When the required minimum number of test assemblies meet the evaluation criteria, an assembly is classified according to the level of fire exposure used.

Investigations of fire-retardant-treated (FRT) wood roof coverings additionally include tests of assemblies exposed to accelerated weathering according to ASTM D2898, “Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing” and assemblies exposed outdoors for extended periods of time.

Table 1505.1 indicates the minimum roof covering classification requirement is based on construction type as defined in Chapter 6—Types of Construction of the IBC. An in-depth review of the code’s criteria for classifying construction types is beyond the scope of this guide. The following brief descriptions provide a general idea of the classifications:

- **Type IA, IB, IIA and IIB:** Major building elements are of noncombustible materials
- **Types IIIA and IIIB:** Exterior walls are of noncombustible materials and the interior building elements are of any material permitted by the code
- **Type IV:** Heavy timber construction
- **Types VA and VB:** Structural elements, exterior walls and interior walls are of any materials permitted by the code

Skylights and sloped glazing are required to meet separate specific requirements for individual assemblies found elsewhere in the code. Material and curbing requirements for glass skylights and sloped glazing are provided in Chapter 24. Fire-resistance requirements for plastic light-transmitting skylights are provided in Section 2610.

External fire-exposure classifications are defined in Sections 1505.2-1505.5:

“1505.2 Class A roof assemblies. Class A roof assemblies are those that are effective against severe fire test exposure. Class A roof assemblies and roof coverings shall be *listed* and identified as Class A by an *approved* testing agency. Class A roof assemblies shall be permitted for use in buildings or structures of all types of construction.

Exceptions:

1. Class A roof assemblies include those with coverings of brick, masonry or an exposed concrete roof deck.
2. Class A roof assemblies also include ferrous or copper shingles or sheets, metal sheets and shingles, clay or concrete roof tile or slate installed on noncombustible decks or ferrous, copper or metal sheets installed without a roof deck on noncombustible framing.

3. Class A roof assemblies include minimum 16 oz./sq. ft. (0.0416 kg/m²) copper sheets installed over combustible decks.

1505.3 Class B roof assemblies. Class B roof assemblies are those that are effective against moderate fire-test exposure. Class B roof assemblies and roof coverings shall be *listed* and identified as Class B by an *approved* testing agency.

1505.4 Class C roof assemblies. Class C roof assemblies are those that are effective against light fire-test exposure. Class C roof assemblies and roof coverings shall be *listed* and identified as Class C by an *approved* testing agency.

1505.5 Nonclassified roofing. Nonclassified roofing is *approved* material that is not *listed* as a Class A, B or C roof covering.”

Italicized use of the term “approved” in Sections 1505.2, 1505.3 and 1505.4 indicates the testing agency is acceptable to a building official. Italicized use of the term “approved” in Section 1505.5 indicates a building official has the authority to accept a specific assembly as complying with the code. Italicized use of the term “listed” refers to assemblies included in a list of tested and classified assemblies published by an evaluation organization acceptable to the building official, typically Underwriters Laboratories (UL) Inc. or FM Approvals for roof assemblies. A listing for a specific assembly indicates the external fire-resistance class.

Exceptions provided in Section 1505.2 waive the testing and listing requirements and assign Class A ratings to the specific roof assemblies referenced based on past performance. For instance, steel, copper or other metal panel roof systems installed over noncombustible purlins or joists are considered equivalent to Class A ratings without testing. Also, metal panel roof systems fabricated using minimum 16 oz./sq. ft. sheet copper installed over combustible decks are classified Class A and are not required to be tested. However, steel panel roof systems installed over combustible decks are not included among the exceptions and require fire-resistance testing to be performed to determine their fire-resistance classifications.

A roofing material that has not been listed as a part of a Class A, B or C roof assembly may be accepted by a

building official for constructions permitted to use non-classified roof assemblies (see Table 1505.1 note (b)).

Wood shakes and wood shingles are examples of nonclassified roof coverings, except for FRT wood shakes and shingles that meet the treatment process and labeling requirements of Section 1505.6 (see Section 3.7 and Section 3.8).

As may be easily inferred from a reference in Section 1505.1 to a UL test standard, listings of roof assemblies tested and certified to meet external fire-exposure classifications by UL commonly are used to substantiate code compliance to building officials. The burden of obtaining UL certifications typically rests with roofing manufacturers. A roof system designer may contact a roofing manufacturer to obtain verification of fire exposure classifications for specific assemblies.

UL maintains a certifications directory available online and in print. The UL Online Certifications Directory is found at www.ul.com/database. UL certifications are ordered according to a proprietary scheme of product categories. The UL product categories for external fire-exposure classifications of roof assemblies are:

- Prepared Roof-covering Materials (TFWZ)
- Prepared Roof-covering Materials, Formed or Molded Metal, Fiber-Cement, Plastic or Fire-retardant-treated Wood (TFXX)
- Prepared Roofing Accessories (TGDY)
- Roofing Systems (TGFU)
- Wood Structural Panels (TGGN)

A roof system designer may consult the UL Online Certifications Directory to verify fire-exposure classifications of specific assemblies. The four-letter product category designations aid in navigating UL's certifications directory.

Section 1505 addresses external fire-exposure classifications for rooftop PV systems in the following paragraph:

“1505.8 Photovoltaic systems. Rooftop installed photovoltaic systems that are adhered or attached to the roof covering or photovoltaic modules/shingles installed as roof coverings shall be labeled to identify their fire classification in accordance with the testing required in Section 1505.1.”

IBC 2012's Section 202—Definitions contains the following definition for “photovoltaic modules/shingles”:

“PHOTOVOLTAIC MODULES/SHINGLES.

A roof covering composed of flat-plate photovoltaic modules fabricated in sheets that resemble three-tab composite shingles.”

Section 1505.8 references Table 1505.1 Minimum Roof Covering Classification for Types of Construction for minimum fire-classification requirements. It is important to note the minimum fire classification for a rooftop-mounted PV system is determined according to type of construction as indicated in Table 1505.1 and not according to the fire-classification of the roof assembly serving as the platform for the PV system. In other words, Section 1505.8 specifically does not require the PV system to have the same fire classification as the underlying roof assembly. In many instances, roof assemblies are installed that have fire classifications greater (more restrictive) than the minimum classifications required by the code.

The use of the term “photovoltaic modules/shingles” indicates Section 1505.8 also addresses PV components that perform as roof coverings. These components commonly are referred to as roof-integrated PV components or building-integrated PV components. Therefore, PV components attached or adhered to roof systems, as well as building-integrated PV components, are required to be fire-tested according to ASTM E108 or UL 790, which are the test methods that develop Class A, Class B and Class C external fire-resistance ratings for roof assemblies with which roofing professionals are familiar.

Internal Fire Resistance

In Section 1508—Roof Insulation, there are the following requirements for fire resistance of internal roof assembly components:

“1508.1 General. The use of above-deck thermal insulation shall be permitted provided such insulation is covered with an *approved* roof covering and passes the tests of FM 4450 or UL 1256 when tested as an assembly.

Exceptions:

1. Foam plastic roof insulation shall conform to

the material and installation requirements of Chapter 26.

2. Where a concrete roof deck is used and the above-deck thermal insulation is covered with an *approved* roof covering.

1508.1.1 Cellulosic fiberboard. Cellulosic fiberboard roof insulation shall conform to the material and installation requirements of Chapter 23.”

The use of above deck insulation is subject to two requirements. First, the use of a roof covering acceptable to the building official is required. Second, the above deck insulation has to meet defined criteria for its potential contribution to the spread of fire originating under the roof deck. The code separately addresses several scenarios for compliance with the second requirement:

- Meeting the passing criteria of FM 4450 or UL 1256 testing provides compliance for roof assemblies with cellular glass, fiberglass, mineral fiber and perlite insulations installed above steel decks.
- Exception 1 references Chapter 26 provisions for foam plastic insulation such as polyisocyanurate, extruded polystyrene and expanded polystyrene board insulations.
- Exception 2 addresses assemblies constructed with insulations other than foam plastic installed above a concrete roof deck. In such scenarios, a concrete roof deck provides protection for the above deck insulation, and the testing requirement is waived.
- Meeting the passing criteria of FM 4450 or UL 1256 and Chapter 23 provisions for wood fiberboard roof insulation provides compliance for roof assemblies with wood fiberboard insulation installed above steel decks.

FM 4450, “Approval Standard for Class 1 Insulated Steel Deck Roofs,” provides FM Approvals requirements for the approval of Class 1 insulated steel roof decks. A Class 1 insulated steel roof deck is one that meets the criteria of this standard for fire, wind uplift, live load resistance, corrosion of metal parts and fatigue of plastic parts. The standard is referenced in this section as part of an exception to the required use of a thermal barrier.

UL 1256, “Standard for Fire Test of Roof Deck Constructions,” covers fire-test methods to evaluate the performance of metallic and nonmetallic roof deck constructions subjected to internal (under deck) fire exposures for the purpose of determining the contribution of the roof covering material, insulation and other components of the roof assembly to the spread of fire within a building.

Foam Plastic Insulation: In Section 2603—Foam Plastic Insulation, there are additional requirements for fire resistance of internal roof assembly components:

“**2603.6 Roofing.** Foam plastic insulation meeting the requirements of Sections 2603.2, 2603.3 and 2603.4 shall be permitted as part of a roof-covering assembly, provided the assembly with the foam plastic insulation is a Class A, B or C roofing assembly where tested in accordance with ASTM E108 or UL 790.”

The sections referenced in the code text follow:

“**2603.2 Labeling and identification.** Packages and containers of foam plastic insulation and foam plastic insulation components delivered to the job site shall bear the *label* of an *approved agency* showing the manufacturer’s name, product listing, product identification and information sufficient to determine that the end use will comply with the code requirements.

2603.3 Surface-burning characteristics. Unless otherwise indicated in this section, foam plastic insulation and foam plastic cores of manufactured assemblies shall have a flame spread index of not more than 75 and a smoke-developed index of not more than 450 where tested in the maximum thickness intended for use in accordance with ASTM E84 or UL723. Loose fill-type foam plastic insulation shall be tested as board stock for the flame spread and smoke-developed indexes.

Exceptions:

1. Smoke-developed index for interior *trim* as provided for in Section 2604.2.
2. In cold storage buildings, ice plants, food plants, food processing rooms and similar areas, foam plastic insulation where tested in a thickness of 4 inches (102 mm) shall be permitted in a thickness up to 10

inches (254 mm) where the building is equipped throughout with an *automatic fire sprinkler system* in accordance with Section 903.3.1.1. The approved automatic sprinkler system shall be provided in both the room and that part of the building in which the room is located.

3. Foam plastic insulation that is a part of a Class A, B or C roof-covering assembly provided the assembly with the foam plastic insulation satisfactorily passes FM 4450 or UL 1256. The smoke-developed index shall not be limited for roof applications.
4. Foam plastic insulation greater than 4 inches (102 mm) in thickness shall have a maximum flame spread index of 75 and a smoke-developed index of 450 where tested at a minimum thickness of 4 inches (102 mm), provided the end use is approved in accordance with Section 2603.10 using the thickness and density intended for use.
5. Flame spread and smoke-developed indexes for foam plastic interior signs in *covered and open mall buildings* provided the signs comply with Section 402.6.4.

2603.4 Thermal barrier. Except as provided for in Sections 2603.4.1 and 2603.10, foam plastic shall be separated from the interior of a building by an approved thermal barrier of ½-inch (12.7 mm) gypsum wallboard or a material that is tested in accordance with and meets the acceptance criteria of both the Temperature Transmission Fire Test and the Integrity Fire Test of NFPA 275. Combustible concealed spaces shall comply with Section 718.”

ASTM E84, “Standard Test Method for Surface Burning Characteristics of Building Materials,” is a test conducted with the specimen in the ceiling position with the surface to be evaluated exposed face down to the ignition source. The purpose of this test method is to determine the specimen’s flame spread and smoke developed index. The standard is referenced in this section because flame spread and smoke developed index values are used to establish