



People Helping People Build a Safer World™



CODE CORNER

ABOUT CODE CORNER

CCFS would like to remind you to check with your local "Authority Having Jurisdiction (AHJ)" for questions and opinions concerning your local Fire and Building Codes. The information contained in this article is supplied as a courtesy by the International Code Council (ICC) and is based on the International Fire and Building Codes and their respective commentaries. Your local codes or ordinances may vary.

CHAPTER 24 TENTS, CANOPIES AND OTHER MEMBRANE STRUCTURES

General Comments

Though they do not happen often, fires occurring in tents and air-supported structures have historically caused significant loss of life. Perhaps the most notable of these tragedies occurred on July 6, 1944, in Hartford, Connecticut, where a Ringling Brothers, Barnum and Bailey circus tent caught fire during a matinee performance, killing 167 people and injuring 487. Since then, protection of tents and air-supported structures has focused on construction methods and materials, as well as limiting use and occupancy.

Construction Methods and Materials

Tents and air-supported structures are constructed of diverse materials, usually fabrics, textiles and films. Section 3102 of the *International Building Code*® (IBC®) requires these membrane materials to be either noncombustible as defined in Section 703.4 of the IBC or fire resistant as defined by NFPA 701. The use of lightweight high-tensile-strength membrane coverings is perhaps the most significant similarity between tents and air-supported structures. Beyond this similarity, an increasingly wide variety of structural configurations is becoming common. Tents include all struc-

tures using rigid structural frames or supports for lateral and compressive stability. In the case of air-supported structures, a positive pressure differential between the inside and the outside of the structure, coupled with the favorable tensile properties of the membrane, yields these structural properties.

In every case, anchors and cables are used for either additional structural stability or to act as fail-safe devices against extreme wind, rain or snow loading. The more commonplace membrane coverings include cotton and plastic canvas fabrics. Exotic new materials, such as high-tensile-strength plastic films, have spawned a new generation of air-supported structures, including the spectacularly covered and domed stadiums built in recent years in many large metropolitan areas. Protecting the structure from collapse and fire remains the most significant fire and life safety concern.

Occupancy

Fire poses a dual threat to a tent or air-supported structure. First, the fire presents a danger to the occupants by exposing them to heat, smoke and toxic combustion products. Just as important, the fire represents an imminent threat to the structure. Even the best flame-resistant fabrics may ignite or fail under extreme conditions posed by

a fire, and the fire's demand for air may compromise the structural support of the air inside the building, if not the integrity of the membrane in the case of an air-supported structure. Full or partial collapse of the membrane covering of a tent or air-supported structure may occur earlier and with less warning than in any other structural type.

Egress may become difficult, if not nearly impossible, if a collapse occurs; therefore, this chapter limits the storage or handling of combustible materials inside tents and air-supported structures because of their contribution to fuel loading. Similarly, heat energy sources that may ignite the membrane fabric or other combustibles are prohibited or restricted. Even spot lighting must be used with caution to prevent heat energy from igniting the covering. Portable fire extinguishers must be readily available for incipient fire fighting as an additional safeguard against fire.

Purpose

The requirements in this chapter are intended to protect tents, canopies and air-supported structures from fire by requiring regular inspections, certifying continued compliance with fire safety regulations, as well as the requirements of the IBC regulating their use and occupancy.

SECTION 2401

GENERAL

2401.1 Scope. Tents, canopies and membrane structures shall comply with this chapter. The provisions of Section 2403 are applicable only to temporary membrane structures. The provisions of Section 2404 are applicable to temporary and permanent membrane structures.

∫ This section defines the kinds of structures covered by this chapter and designates which sections apply to temporary structures and which apply to permanent structures. Structures can range from 10-foot by 10-foot (3048mm by 3048 mm) canvas shelters to major indoor sports arenas. The common feature of all types of tents, whether they are air-supported, air-inflated or tensioned membrane structures, is the nature of the structural skin. In all cases, a textile material is used to create an indoor or protected space by separating the area under the covering from wind, precipitation and temperature extremes. Although most

membrane structures are intended for temporary or seasonal use, elegant all-weather permanent structures are becoming increasingly common.

SECTION 2402

DEFINITIONS

2402.1 Definitions. The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

∫ Definitions of terms can help in the understanding and application of the code requirements. The purpose for including these definitions that are associated with the subject matter of this chapter is to provide more convenient access to them without having to refer back to Chapter 2. It is important to emphasize that these terms are not exclusively related to this chapter but are applicable everywhere the term is used in the code. For convenience, these terms are also listed in Chapter 2 with a cross reference to this section. The use and application of all defined terms, including those defined in this section, and are set forth in Section 201. Although "air-inflated structure" is not a defined term in this section, it is defined in Section 3102.2 of the IBC and is used in Sections 2403.5, 2403.7, 2403.10 and 2403.10.2 of the code. This type of structure is generally much smaller than an air-supported structure and differs in that it depends for support on the inflation of balloon-like sections over, under or around the occupants. The occupants normally are found within a surrounding structure consisting of these inflated sections. Note that the occupants of the structure are not subjected to the pressurized areas, as they are in air-supported membrane structures. Possibly the most common example of this kind of structure is the "Moon Walk" children's entertainment structure, which has an inflated floor structure for children to play on and also inflated columns that support an overhead canopy and plastic mesh walls. Figure 2402.1(2) illustrates an air-inflated structure.

AIR-SUPPORTED STRUCTURE. A structure wherein the shape of the structure is attained by air pressure, and occupants of the structure are within the elevated pressure area.

∫ The term air-supported structure identifies those membrane structures that are completely pressurized for the purposes of supporting the membrane covering. Most domed sports arenas use air pressure within the

structure to support the membrane covering. The membrane covering can consist of one layer or multiple layers.

CANOPY. A structure, enclosure or shelter constructed of fabric or pliable materials supported by any manner, except by air or the contents it protects, and is open without sidewalls or drops on 75 percent or more of the perimeter.

☞ *A canopy is a structure comprised of a rigid structure over which a membrane covering is typically attached, providing overhead weather protection, a means of identity or decoration. Note that the definition requires that the canopy be overhead only, except for a drop on one side or 25 percent of the perimeter. Structures with more than 25 percent of their perimeter enclosed by drops fall under the definition of a "Tent." Note also that this definition is different from the same term defined in the IBC.*

MEMBRANESTRUCTURE. An air-inflated, air-supported, cable or frame-covered structure as defined by the *International Building Code* and not otherwise defined as a tent or canopy. See Chapter 31 of the *International Building Code*.

☞ *This definition is broadly inclusive of all types of membrane structures, regardless of the supporting mechanism or structure, and intends to include the structures defined in Section 3102 of the IBC.*

TENT. A structure, enclosure or shelter constructed of fabric or pliable material supported by any manner except by air or the contents that it protects.

☞ *Tents can be temporary or permanent structures. When permanent, they are regulated by Section 2404. When erected as temporary enclosures, they are regulated by Sections 2403 and 2304 (see also Chapter 31 of the IBC).*

SECTION 2403

TEMPORARY TENTS, CANOPIES AND MEMBRANE STRUCTURES

2403.1 General. All temporary tents, canopies and membrane structures shall comply with this section.

☞ *This section addresses tents, canopies and mem-*

brane structures that are considered temporary in terms of the duration of their erection and use (see Section 2403.5 for the definition of "Temporary" as it applies to membrane structures). The intent of this section is that if a canopy or awning is used, it should be soundly designed so as not to present a hazard to its users, emergency responders or the public during the time it is in place.

2403.2 Approval required. Tents and membrane structures having an area in excess of 200 square feet (19 m²) and canopies in excess of 400 square feet (37 m²) shall not be erected, operated or maintained for any purpose without first obtaining a permit and approval from the fire code official.

Exceptions:

1. Tents used exclusively for recreational camping purposes.
2. Fabric canopies open on all sides which comply with all of the following:
 - 2.1 Individual canopies having a maximum size of 700 square feet (65 m²).
 - 2.2 The aggregate area of multiple canopies placed side by side without a fire break clearance of 12 feet (3658 mm), not exceeding 700 square feet (65 m²) total.
 - 2.3 A minimum clearance of 12 feet (3658 mm) to all structures and other tents.

☞ *Use of membrane structures results in great flexibility and a large volume of weather-protected space; however, these benefits are balanced by the sensitivity of these structures to strict maintenance requirements. The approval process allows the fire code official to exercise strict control, assuring compliance with the requirements of this chapter. This section sets the minimum size structure that requires approval. Exception 1 covers tents that are normally used by families or very small groups for short periods under widely varying conditions that would be difficult or impossible for a fire code official to police.*

2403.3 Place of assembly. For the purposes of this chapter, a place of assembly shall include a circus, carnival, tent show, theater, skating rink, dance hall or other place of assembly in or under which persons

gather for any purpose.

2403.4 Permits. Permits shall be required as set forth in Sections 105.6 and 105.7.

2403.5 Use period. Temporary tents, air-supported, air-inflated or tensioned membrane structures and canopies shall not be erected for a period of more than 180 days within a 12-month period on a single premises.

⚡ *This section defines the term “temporary” for the purpose of applying this chapter. Any membrane structure erected for more than 180 days in any 12-month period at a single location must be considered permanent and would be subject to all requirements for permanent structures as set forth in Section 2404 and the IBC.*

2403.6 Construction documents. A detailed site and floor plan for tents, canopies or membrane structures with an occupant load of 50 or more shall be provided with each application for approval. The tent, canopy or membrane structure floor plan shall indicate details of the means of egress facilities, seating capacity, arrangement of the seating and location and type of heating and electrical equipment.

2403.7 Inspections. The entire tent, air-supported, air-inflated or tensioned membrane structure system shall be inspected at regular intervals, but not less than two times per permit use period, by the permittee, owner or agent to determine that the installation is maintained in accordance with this chapter.

Exception: Permit use periods of less than 30 days.

2403.7.1 Inspection report. When required by the fire code official, an inspection report shall be provided and shall consist of maintenance, anchors and fabric inspections.

2403.12 Means of egress. Means of egress for temporary tents, canopies and membrane structures shall be in accordance with Sections 2403.12.1 through 2403.12.8.

2403.12.1 Distribution. Exits shall be spaced at approximately equal intervals around the perimeter of the tent, canopy or membrane structure, and shall be

located such that all points are 100 feet (30 480 mm) or less from an exit.

2403.12.2 Number. Tents, canopies or membrane structures or a usable portion thereof shall have at least one exit and not less than the number of exits required by Table 2403.12.2. The total width of means of egress in inches (mm) shall not be less than the total occupant load served by a means of egress multiplied by 0.2 inches (5 mm) per person.

⚡ *This section specifies the use of the exit requirements contained in Table 2403.12.2 to determine the number and size of exits for all membrane structures. The formula given in the last sentence of the section allows calculation of total exit requirements for any given number of occupants.*

2403.12.5 Aisle. The width of aisles without fixed seating shall be in accordance with the following:

1. In areas serving employees only, the minimum aisle width shall be 24 inches (610 mm) but not less than the width required by the number of employees served.
2. In public areas, smooth-surfaced, unobstructed aisles having a minimum width of not less than 44 inches (1118 mm) shall be provided from seating areas, and aisles shall be progressively increased in width to provide, at all points, not less than 1 foot (305 mm) of aisle width for each 50 persons served by such aisle at that point.

2403.12.6 Exit signs. Exits shall be clearly marked. Exit signs shall be installed at required exit doorways and where otherwise necessary to indicate clearly the direction of egress when the exit serves an occupant load of 50 or more.

⚡ *This charging statement establishes the requirement for exit signs. See the commentary to Section 1011.2 for further discussion of exit sign requirements.*

2403.12.6.1 Exit sign illumination. Exit signs shall be of an approved self-luminous type or shall be internally or externally illuminated by luminaires supplied in the following manner:

1. Two separate circuits, one of which shall be separate from all other circuits, for occupant loads of 300 or

less; or

2. Two separate sources of power, one of which shall be an approved emergency system, shall be provided when the occupant load exceeds 300. Emergency systems shall be supplied from storage batteries or from the on-site generator set, and the system shall be installed in accordance with the ICC *Electrical Code*.

2403.12.8 Maintenance of means of egress. The required width of exits, aisles and passageways shall be maintained at all times to a public way. Guy wires, guy ropes and other support members shall not cross a means of egress at a height of less than 8 feet (2438 mm). The surface of means of egress shall be maintained in an approved manner.

2404.6 Smoking. Smoking shall not be permitted in tents, canopies or membrane structures. Approved “No Smoking” signs shall be conspicuously posted in accordance with Section 310.

2404.8 Fireworks. Fireworks shall not be used within 100 feet (30 480 mm) of tents, canopies or membrane structures.

2404.12 Portable fire extinguishers. Portable fire extinguishers shall be provided as required by Section 906.

⚡ *Section 906 states that portable extinguishers are required in Group A occupancies and in special-hazards areas as designated by the fire code official. This section also refers to NFPA 10 for guidance on selection and placement of the extinguishers. Employees and staff who will be manning the membrane structure must be trained to use the extinguishers because they are likely to become the first line of emergency response in case of a fire.*

2404.15 Heating and cooking equipment. Heating and cooking equipment shall be in accordance with Sections 2404.15.1 through 2404.15.7.

2404.15.3 Location. Cooking and heating equipment shall not be located within 10 feet (3048 mm) of exits or combustible materials.

2404.15.6 Outdoor cooking. Outdoor cooking that produces sparks or grease-laden vapors shall not be performed within 20 feet (6096 mm) of a tent, canopy or membrane structure.



Looking for
CAMPUS FIRE
SAFETY RESOURCES?
 Visit our website and choose
 “RESOURCES”
www.campusfiresafety.org

