CHAPTER 6

FIRE SAFETY

SECTION 601

SOURCES OF FIRE IGNITION

The purpose of this section is to reduce the potential of permanently installed building equipment, appliances, and services to cause a fire because of their installation. All types of permanently installed equipment, appliances, and services represent potential ignition hazards and need to be installed in a fashion that minimizes or prevents these hazards from occurring. Fuel-burning equipment, including gas, oil, and solid fuel-fired types can, by their nature, transfer heat to building materials when located too close to such materials. Electrical equipment also produces heat and potential sparks, thus requiring clearances to combustible materials and hazards such as areas where flammable vapors are likely. Additionally, should a spark or flame escape the equipment or appliance enclosure, ignition of building materials or contents can occur. These provisions were developed with the potential hazards of this equipment in mind.

601.1 Objective

This section prevents the ignition of building materials caused by permanently installed equipment, appliances, or services. This is in contrast to portable equipment or appliances, which are connected by cord and plug and are usually not regulated by construction code provisions. Hazards such as welding and cutting operations, hazardous materials processes, and smoking are covered by Part III, Chapter 16. There is a difference in approach because of the traditional scope of fire codes versus building codes. Therefore, it is important that both sections be reviewed.

601.2 Functional statements

Each functional statement indicates that either fuel-fired or electrical equipment, appliances, or services must be installed in a manner that reduces the potential for the installation to be a source of ignition. Fuel burning appliances and electrical equipment are generally intended for installation in accordance with the manufacturer's installation instructions. These instructions should be provided as part of the design submittal to determine if the equipment is being installed in accordance with the manufacturer's recommendations. If the equipment has not been listed or independently evaluated for safety, it is up to the designer and code official to verify that the equipment installation provides an acceptable level of safety.

To avoid the equipment becoming a potential source of ignition, several factors need to be considered. Appliances must not generate temperatures or operate under conditions that could ignite nearby combustible materials. Electrical conductors and components must not create a condition in which they will overheat and ignite combustibles either in or near the appliance, or in the branch circuit wiring supplying the product. Additionally, the equipment must provide an acceptable level of performance under normal operating conditions and any other conditions that may be encountered during the life of the product.

Standards for safety have been developed for most fuel-burning and electrical appliances and equipment by organizations such as UL and ASTM. These standards provide a comprehensive set of safety criteria with which to evaluate the ability of the equipment to not produce an undesired source of fire ignition. These standards are customized to address safety conditions that are unique to the specific appliance or equipment.

Equipment that has been listed by an approved testing and certification laboratory has undergone an independent safety investigation. As part of the listing, the certification agency evaluates the equipment and certifies that it complies with appropriate safety standards when installed in accordance with the manufacturer's installation instructions. Equipment installed within the limitations of its listings and in accordance with the manufacturer's installation instructions can generally be considered to not serve as a source of fire ignition.

It is also necessary to periodically test and maintain appliances and equipment in accordance with the manufacturer's instructions and in accordance with any referenced installation and use standards to ensure that the appliances and equipment do not create a potential source of fire ignition during the life of the product.

601.3 Performance requirements

Each performance requirement specifies the intent of the code regarding performance of equipment, appliances, and services.

601.3.1 Uncontrolled combustion and explosion

This section requires fuel-burning equipment, appliances, and services to be designed and installed in a manner that precludes uncontrolled combustion, which can cause overheating or explosion of an appliance. The prescriptive requirements dealing with this particular objective are found within the *International Fuel Gas Code*.

601.3.2 Fuel-burning appliances and services as sources of ignition

This section requires fuel-burning appliances to be installed with adequate clearance to combustibles to prevent ignition of building materials.

601.3.3 Sparks and arcing

This section requires electrical equipment, appliances, and services to contain arcs and sparking within their enclosures so as to prevent ignition of building materials or contents. The *National Electrical Code* provides prescriptive guidance on this hazard.

601.3.4 Electrical equipment, appliances and services

This section requires electrical equipment, appliances, and services to be installed with adequate clearances so that normal operation or overheating will not cause ignition of building materials.

601.3.5 Flammable, combustible and explosive atmospheres

In occupancies such as those known for dust explosions, ignition sources should be located appropriately, or special protection should be provided for the equipment.

SECTION 602

LIMITING FIRE IMPACT

In the event that a fire does occur, this section contains provisions to either contain the fire or limit the spread of a fire in a manner that allows safe egress of the occupants; limit the damage to the building in which the fire originated, to adjacent buildings, and to contents and amenities as appropriate; allow fire fighters to perform their duties on the fire scene; and provide detection systems that allow appropriate and timely response to a fire. Although it is very difficult to control the amount of combustibles that constitute the fire load of a building (i.e., normally exposed items that are placed in a structure once construction has been completed), the code does seek to limit the amount of combustibles. Resistance to other mechanisms of fire-spread within a building from floor-to-floor, compartment-to-compartment, or within building cavities is also an important design consideration.

There is a need to interface systems used in buildings such as fire suppression, smoke control, heating, ventilating, and air conditioning. Further, to reduce the possibility of a fire in one building engaging an adjacent structure, certain precautions must be taken, such as the use of fire-resistive construction of exterior walls and opening protectives. Also, consideration must be given to the protection of buildings from exposure to wildfires or fires involving other external elements such as aboveground fuel storage tanks. These more challenging scenarios will alter the necessary design features based on the possible severity of the event. Additionally, very specific attention must be given to the effect of the use of combustibles within or on the elements of a building that must be entered by fire-fighting personnel for the purpose of evacuating occupants or the protection of property. In developing this section of the performance code, several chapters of the *International Building Code* were taken into consideration. These include but are not limited to: Chapter 3, Use and Occupancy; Chapter 4, Special Use and Occupancy; Chapter 5, General Building Heights and Areas; Chapter 6, Types of Construction; Chapter 7, Fire Resistant Materials and Construction; Chapter 8, Interior Finishes; Chapter 9, Fire Protection; and Chapter 10, Means of Egress.

602.1 Objective

This section is intended to reduce the likelihood of death or injury to an acceptable level to those persons involved in a fire within the building or facility. It also prevents or reduces damage or loss of property because of the spread of fire within a structure or to an adjacent structure. "Persons involved" include building occupants, emergency responders, and people in the vicinity of the building or facility. Consideration is also given to the impact a fire may have on the use of the building, including any process that may be conducted within the building. The objective statement is a continuation of the basic principle of building codes from the beginning of

code development. The difference is that this format provides the opportunity for the reader to understand the overall performance of a particular building or facility in a fire event and how different subsystems interact to achieve the desired objective.

602.2 Functional statement

To provide for the safety of people and property involved in a building fire and to provide the facilities for fire fighting and rescue operations, it is imperative that the design community place elements into the structure that will mitigate the growth potential of fire. This section indicates the need for the building to have safeguards designed into it to achieve the objectives related to the protection of people and property. Specifically, the code states that a person not directly adjacent to or involved in the ignition of a fire must not suffer serious injury or death. It goes on to state that property loss has an upper limit based on the performance group assignment from Chapter 3. This section therefore establishes a single performance level with regard to occupant and public safety and an upper limit on the levels of damage with regard to property protection dependent on the performance group.

This particular functional statement was originally linked to Chapter 3 for guidance on the levels of performance. Subsequently, it was decided that because fire is an event whose magnitude is dependent on many factors related to the use, construction, configuration, size, and contents of a building or facility, evaluating fire based on a simplistic relationship between magnitude of event and level of damage was not only inappropriate but extremely difficult. The general relationship between magnitude of event and level of damage presented in Chapter 3 is not completely invalid for fire, but the many interdependencies related to fire events must be specifically accounted for and understood. The simplistic relationship between event magnitude and level of damage is more easily applied to seismic events because a building or facility will have no effect on the size (magnitude) of an earthquake.

In addition to the concern with dependant factors, there was a concern that the levels of impact that were generically provided for all events, specifically life-safety, were not necessarily appropriate for events such as fire. Society has a very low tolerance for death or serious injury caused by fires, especially of large numbers in a single incident. In addressing this low tolerance, this section in effect establishes a single performance level with regard to life safety in buildings, which basically equates to a mild impact for all fire events.

This single performance level recognizes that it is very difficult to protect someone who is intimately involved with the fire or in the immediate vicinity of the ignition point or source. Society does, however, have a higher tolerance for property loss, taking into account the importance of the building, which is why the upper limit of damage to be tolerated is based on the performance group classification of the building. Clearly the approach has been to separate property protection from life-safety, which are two distinct objectives of building and fire codes. The performance level chosen is ultimately a public policy decision that reflects the expectations of society. Such expectations fluctuate in light of certain events, such as hurricanes, earthquakes, and terrorist attacks such as those on the World Trade Center. In particular, the World Trade Center tower collapses resulting from the suicide attack on September 11, 2001 have sparked considerable discussion and debate over the expectations of society for building construction. Although it is not clear at this point how our lawmakers and policy makers will react to this event, it is almost certain that the designers of future high rises in a major metropolitan area or of some significant structure will seriously consider the possibility of attack.

As noted numerous times within this user's guide, it is very difficult to understand the specific level of performance provided by the prescriptive code because the prescriptive code focuses on one or a limited number of solutions. The ICC *Performance Code for Buildings and Facilities* has attempted to capture the intent of the prescriptive code, but in order to more clearly describe the level of performance provided, an analysis of the prescriptive documents is necessary. It is hoped that such an analysis will show how the performance and the prescriptive documents link. This may lead to adjustments in both documents and a better understanding of how buildings and facilities perform when designed to comply with the codes and how that actual performance relates to societal expectations.

The general functional statement is the same as that found in Chapter 17. The subsections, however, vary because of the differences in how building and fire codes operate. A building code is generally more focused on the initial design and construction of a building, whereas fire codes have traditionally placed an emphasis on the long-term maintenance of a building or facility, with a much stronger interest in the contents, processes, operations, and use. This code utilizes the terms "building" and "facility" almost interchangeably, insofar as the term "facilities" includes buildings in its definition.

602.3 Performance requirements

The performance requirements have been relocated to Chapter 17 (specifically Section 1703). This was done in an effort to correlate Parts II and III of this code. Both Section 602 and Chapter 17 deal with the management and limitation of fire events within or to exposed buildings and facilities. There were concerns that if these overlaps in subject matter were not properly addressed, they would create confusion. There was also a concern that eventually future code revisions could create conflicts within the document. Because the code is designed to be either adopted in full or adopted with only Parts I and III, it was determined that Chapter 17 was the appropriate location for the more specific performance requirements. The objective and functional statements were left within Chapter 6 so as to direct the user to Chapter 17.

ACCEPTABLE METHODS

Sources of ignition. As noted previously, the prescriptive code documents may include the *International Mechanical Code*, the *International Fuel Gas Code*, and the *National Electrical Code*. The listing requirements and manufacturer's instructions provide an additional set of prescriptive guidance documents to achieve the objectives.

Management of fire impact. As discussed earlier, the *International Building Code* deals with the management of fire impact in many areas including, but not limited to, Chapters 5, 6, 7, 8, 9, 14, and 26. This is an area where much work needs to be done in terms of performance-based design.