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# Life Safety Code® Handbook

TWELFTH EDITION

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With the complete text of the 2012 edition of NFPA *101®*, *Life Safety Code®*

**National Fire Protection Association®, Quincy, Massachusetts**

# Contents

CHAPTER

# Industrial Occupancies

40

The industrial occupancy classification is broad in its scope and application. The following are examples of industrial occupancies:

1. Factories of all kinds
2. Pumping stations
3. Telephone exchanges
4. Gas plants
5. Laundries
6. Laboratories
7. Recycling plants
8. Refineries
9. Food processing plants
10. Drycleaning plants
11. Auto body and repair shops
12. Sawmills
13. Hangars (for servicing aircraft)
14. Power plants
15. Post office central sorting/maintenance facilities

The range of facilities that are classified as industrial occupancies is diverse. Industrial occupancies comprise a wide variety of building configurations, uses, and equipment types. Some industrial occupancies might be considered innocuous with respect to the threat of fire hazard, such as a factory that manufactures concrete blocks. An industrial occupancy subject to the threat of serious fire hazard might be a petroleum processing and refining plant, where the threat of explosion is always present. The subclassification system used in 40.1.2.1 is intended to assist the user in establishing the level of hazard to the occupants of an industrial occupancy.

The requirements of Chapter 40 were written to provide adequate life safety without unduly restricting the functional operations of a facility. For example, 40.2.2.10 and 40.2.2.11 permit fire escape ladders and slide escapes as part of an occupant protection package that balances the need for rapid escape from platforms and other industrial structures with the ability of the occupants to use such egress devices. By permitting the use of fire escape ladders and slide escapes, Chapter 40 recognizes that functional requirements necessitate occupant access to unusual spaces within the industrial facility and that efficient egress from these spaces is important.

A unique life safety consideration addressed in Chapter 40 involves egress for occupants of ancillary facilities. Paragraph 40.2.5.1 recognizes that some types of industrial processes and equipment cannot be immediately abandoned if the building fire alarm sounds. If workers do not remain in the building long enough to effect orderly equipment shutdown during a fire emergency, dangers greater than fire might result. The protection measures required by 40.2.5.1 provide for the safety of occupants who must remain while others leave the building.

Another unique feature that the *Code* addresses for industrial occupancies is the equipment access dimensional criteria of Table 40.2.5.2.1. These dimensional criteria, although more lenient than those of Chapter 7, provide adequate egress paths for the small number of occupants using any of those routes to reach major aisles that lead to exits.

The statistics provided by the national fire incident databases demonstrate that the potential loss of life from fire in an industrial occupancy is directly related to the hazard of the industrial operation or process. Most multiple-death industrial fires are the result of flash fires caused by highly combustible material or explosions involving combustible dusts, flammable liquids, or gases.

Until recently, industrial fire losses have constituted a high percentage of the annual property loss from fire; however, such fires have not, as a general rule, resulted in extensive loss of life. With most rules, however, there are exceptions. At least four major dust explosions have occurred in industrial occupancies in recent years, killing a total of 32 workers.

In the first incident, which occurred in May 2002, five workers were killed in an explosion at a rubber reclaiming plant located in Vicksburg, Mississippi. The fire, which originated in the rubber dryer system,

ignited the building's roof and spread to the bagging room, where rubber dust ignited and exploded. In the second incident, which occurred in January 2003, 6 workers were killed in a dust explosion at a pharmaceutical plant in Kinston, North Carolina. The accumulation of dust above a suspended ceiling led to the blast, which could be felt 25 miles (40 kilometers) away. In the third incident, which occurred in February 2003, 7 workers were killed when insulation particles inside an oven ignited and exploded at an automobile insulation manufacturing plant in Corbin, Kentucky. In the fourth incident, which occurred in February 2008, 14 workers died in a huge explosion fueled by the accumulation of sugar dust throughout the packaging building at a sugar processing plant in Port Wentworth, Georgia. Although it is not mandatorially referenced by the *Code*, NFPA 654, *Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids*,[1] should be applied where industrial processes involve combustible dusts to reduce the likelihood of such catastrophic fires and explosions.

In March 2005, an explosion at a Texas City, Texas, oil refinery — an example of a high hazard industrial occupancy — killed 15 workers and injured more than 170. The explosion occurred in the refinery's isomerization unit — the location of equipment used to boost the octane in gasoline — when the system was being restarted following maintenance a few days earlier. Although the *Code* does not directly address the hazards associated with handling flammable liquids, it does reference NFPA 30, *Flammable and Combustible Liquids Code*,[2] which provides requirements for such operations to minimize the probability of fires and explosions (see 8.7.3.1). Other industry standards, such as those published by the American Petroleum Institute (API), directly address the hazards associated with refineries.

Natural gas explosions resulted in the deaths of a total of 10 workers in two separate incidents in 2009 and 2010. In June 2009, an explosion occurred at a food processing plant in Garner, North Carolina, when newly installed natural gas lines were being purged. The explosion killed 4 workers and injured dozens of others. In February 2010, another natural gas explosion occurred at a power plant undergoing construction in Middletown, Connecticut, when workers were using natural gas under high pressure to remove debris from gas piping. This explosion resulted in the deaths of 6 workers. Although the industrial processes involved in these incidents are not directly regulated by the *Code*, they do reinforce the need to follow applicable codes (e.g., NFPA 54, *National Fuel Gas Code*[3]) and accepted industry practices when working with special hazards.

One of the major features to be considered in the design of an industrial occupancy's life safety system is the use of automatic sprinkler protection. Originally developed for industrial property protection, automatic sprinkler systems have also been largely responsible for an excellent life safety record in industrial occupancies. Limiting the size of a fire by means of sprinklers provides sufficient time for the safe evacuation of occupants. This record has been recognized by the fire protection community, as evidenced by the widespread use of automatic sprinkler systems in buildings with significant hazards to life. The contribution of the automatic sprinkler to safety to life can be fully appreciated only when the wide range of fire risks associated with the many processes used in an industrial facility are recognized.

Employees and other occupants of industrial buildings are generally ambulatory and capable of quick response to fires. They are also able to exit rapidly once properly alerted. To capitalize on this employee capability, many industrial facilities include life safety measures in their emergency preplanning. A well-conceived plan provides a valuable tool in preventing loss of life. Provisions that should be part of the emergency preplan include the following:

1. Measures for alerting employees
2. Identification and posting of exit access routes
3. Establishment of group assembly areas for occupants once they have evacuated the building
4. Procedures for determining that all employees have safely evacuated

Responsibilities are usually established and assigned in the preplan to ensure that the tasks necessary to facilitate safe evacuation of the building are performed. The preplan should routinely be evaluated through simulated fire exercises and drills. Only through the execution of such drills can flaws in the preplan be recognized and modified.

Although the life safety record in industrial occupancies has been good, the trend toward constructing large industrial plants that house hazardous operations might prove problematic. The introduction of combustible materials, such as extensive quantities of plastics, has increased the need for additional measures to help protect workers from fire. Compared with the industrial buildings of the early twentieth century, the modern industrial complex has placed a larger number of employees in a more complex and increasingly hazardous environment. This trend has increased the need for facility managers to concentrate

on life safety principles not only during the design stage but also during day-to-day plant operations.

As part of their employee training programs, most industrial firms include education in the use of first aid fire-fighting equipment, such as in-plant standpipes, hose, and portable fire extinguishers. Although first aid fire-fighting measures are primarily a property protection measure, they also provide a significant life safety benefit when utilized correctly by trained individuals. Industrial training of this type, where fully utilized, has resulted in a major reduction in loss of property and life.

## 40.1 General Requirements

### 40.1.1 Application.

**40.1.1.1** The requirements of this chapter shall apply to both new and existing industrial occupancies.

**40.1.1.2 Administration.** The provisions of Chapter 1, Administration, shall apply.

**40.1.1.3 General.** The provisions of Chapter 4, General, shall apply.

**40.1.1.4** Industrial occupancies shall include factories making products of all kinds and properties used for operations such as processing, assembling, mixing, packaging, finishing or decorating, repairing, and similar operations.

**40.1.1.5** Incidental high hazard operations protected in accordance with Section 8.7 and 40.3.2 in occupancies containing low or ordinary hazard contents shall not be the basis for high hazard industrial occupancy classification.

Unlike most occupancies addressed by the *Code*, both new and existing industrial occupancies are covered in one chapter. Where requirements vary, exemptions that apply to existing industrial occupancies are often provided, or additional requirements that are limited to new industrial occupancies are specified.

### 40.1.2 Classification of Occupancy.

Classification of occupancy shall be in accordance with 6.1.12.

**40.1.2.1 Subclassification of Occupancy.** Each industrial occupancy shall be subclassified according to its use as described in 40.1.2.1.1, 40.1.2.1.2, and 40.1.2.1.3.

**40.1.2.1.1 General Industrial Occupancy.** General industrial occupancies shall include all of the following:

(1) Industrial occupancies that conduct ordinary and low hazard industrial operations in buildings of conventional design that are usable for various types of industrial processes
(2) Industrial occupancies that include multistory buildings where floors are occupied by different tenants, or buildings that are usable for such occupancy and, therefore, are subject to possible use for types of industrial processes with a high density of employee population

**40.1.2.1.2 Special-Purpose Industrial Occupancy.** Special-purpose industrial occupancies shall include all of the following:

(1) Industrial occupancies that conduct ordinary and low hazard industrial operations in buildings designed for, and that are usable only for, particular types of operations
(2) Industrial occupancies that are characterized by a relatively low density of employee population, with much of the area occupied by machinery or equipment

It can be difficult to determine if a building qualifies as a special-purpose industrial occupancy. For example, a structure is often erected to protect a large machine or equipment from weather. Once constructed, authorities might try to impose means of egress requirements applicable to a general industrial occupancy, despite the fact that only a handful of personnel are expected to occupy the building. Steel mills, paper plants, power-generating plants, and other operations with large machines are examples of the types of industrial occupancies requiring massive structures for process control and weather protection. These structures often represent minimum hazards to life safety and are typically classified as special-purpose industrial occupancies. In many of the more modern operations, all process control is conducted from a control room by remote means, which further reduces the number of occupants likely to be exposed to a fire in the equipment areas.

The special-purpose industrial occupancy classification must not be applied to a building simply to reduce egress requirements. Economic considerations, or staffing limitations that result in occupancy by fewer employees than usual, should not be used as justification for reducing life safety features; the full number and arrangement of exits required for a general industrial occupancy must be maintained. Reductions in aisles, doors, stairways, and other components of the means of egress should not be permitted by the temporary classification of a building as a special-purpose industrial occupancy.

**40.1.2.1.3* High Hazard Industrial Occupancy.** High hazard industrial occupancies shall include all of the following:

(1) Industrial occupancies that conduct industrial operations that use high hazard materials or processes or house high hazard contents
(2) Industrial occupancies in which incidental high hazard operations in low or ordinary hazard occupancies that are protected in accordance with Section 8.7 and 40.3.2 are not required to be the basis for overall occupancy classification

**A.40.1.2.1.3** Additional information on the definition of high hazard industrial occupancy can be found in A.3.3.188.8.2.

A high hazard industrial occupancy classification is limited to those industrial buildings housing extremely hazardous operations with regard to potential for rapid fire development or explosion. Incidental use of restricted quantities of flammable liquids in a building does not necessarily constitute a high hazard, although some additional life safety precautions might be required during the limited period of use. NFPA 30, *Flammable and Combustible Liquids Code*, specifies requirements for safe handling of flammable liquids. Storage of flammable liquids, such as paint, in sealed containers also does not necessarily require a high hazard occupancy classification, unless the operation includes mixing or blending operations that require the containers to be opened. Mixing and blending of flammable liquids is permitted to be conducted in a separate room with a fire barrier between the storage and mixing areas. The mixing and blending room would be considered a high hazard industrial occupancy, while the adjacent, fire-separated storage area would be considered a general industrial occupancy or possibly a storage occupancy subject to the requirements of Chapter 42.

Combustible dusts released from an industrial or manufacturing process constitute a significant threat to life safety, as demonstrated by the incidents described in the commentary following the title of this chapter, and might justify a high hazard classification. Major loss of life has occurred in industrial occupancies that release extensive quantities of combustible dusts. Opportunity for the rapid escape of employees who work in operations that release combustible dust should be provided to prevent injury or loss of life if a dust explosion occurs. In high hazard occupancies that are subject to explosions, the provisions of 40.3.2 require special consideration of the techniques for explosion suppression or venting to ensure the life safety of occupants. Full use of fire protection engineering techniques should be employed in these occupancies to minimize the risk to life safety.

The industrial occupancies that clearly require classification as high hazard are those associated with the production of explosives or highly reactive chemicals. In some especially hazardous operations, additional exits will be necessary to ensure rapid egress to prevent loss of life in the event of an explosion or fire. Where the installation of the preventive or protective measures specified in 40.3.2 is not possible due to the nature of the industrial operation, consideration should be given to operating procedures that restrict access to a limited number of people during the hazardous portion of the operation. The operating procedures would limit the potential threat to those trained personnel who are fully aware of the extent of the hazard. Procedures should also include a record of personnel who have signed in or out. This procedure ensures prompt determination of the number of personnel exposed to a hazardous operation and, thus, the number who might require rescue.

**40.1.2.2 Change of Industrial Occupancy Subclassification.** A change from one subclassification of industrial occupancy to another shall comply with Chapter 43.

Prior to the 2012 edition of the *Code*, changes in industrial occupancy subclassification were permitted only where the building complied with new construction requirements for the new subclassification. With the 2012 edition, changes in industrial occupancy subclassification are now permitted where they comply with Chapter 43, Building Rehabilitation, which makes provisions for changes in occupancy classification and requirements depend on the relative change in hazard category (see Section 43.7). In some cases, Chapter 43 permits a building to meet less restrictive requirements where there is a change in use or occupancy classification to promote the adaptive reuse of existing buildings. In cases where the relative hazard category increases, such as where a general industrial occupancy changes to a high hazard industrial occupancy, the building must meet the more restrictive new construction requirements. See Chapter 43 and associated commentary for additional details on building rehabilitation.

### 40.1.3 Multiple Occupancies.

All multiple occupancies shall be in accordance with 6.1.14.

Subsection 40.1.3 directs the user to the multiple occupancy provisions of 6.1.14, which permit protecting multiple occupancy buildings either as mixed or as separated. If a multiple occupancy building is protected via the provisions of 6.1.14.4 for separated uses, the required separation, in terms of fire resistance rating, is specified by Table 6.1.14.4.1(a) and Table 6.1.14.4.1(b).

### 40.1.4 Definitions.

Although no definitions are listed in 40.1.4, industrial occupancies are subclassified and defined in 40.1.2.1 under the labels *general industrial occupancy, special-purpose industrial occupancy,* and *high hazard industrial occupancy.* See also 3.3.188.8, 3.3.188.8.1, 3.3.188.8.2, and 3.3.188.8.3.

**40.1.4.1 General.** For definitions, see Chapter 3, Definitions.

**40.1.4.2 Special Definitions.** Special terms applicable to this chapter are defined in Chapter 3.

### 40.1.5 Classification of Hazard of Contents.

Classification of hazard of contents shall be in accordance with Section 6.2.

The method for determining the degree of hazard to life safety posed by an industrial occupancy is often a matter of personal judgment and not science. The authority having jurisdiction (AHJ) must use judgment based on past experience, review of reference materials and engineering analyses, and full discussion with third parties to evaluate the life safety measures in an industrial occupancy. The *Code* establishes broad categories of occupancy classification so that the relative risks to life safety posed by various types of buildings can be assessed.

A common error made when classifying industrial occupancies is the use of hazard categories for automatic sprinklers contained in NFPA 13, *Standard for the Installation of Sprinkler Systems,*[4] to determine the hazard to life safety. While the guidelines in NFPA 13 might not differ greatly from those of the *Life Safety Code* where classifying occupancies with high hazards, the remaining categories specified in NFPA 13 are usually not suitable for the general industrial occupancy classification of the *Code.* (The use of NFPA 13 is particularly inappropriate where classifying low hazard occupancies, which are classified as light hazard by NFPA 13.) The distinction is that the life safety industrial occupancy classification is concerned with determining the overall hazard to occupants in a manufacturing building for purposes of implementing an adequate means of egress system, while the NFPA 13 classification system is concerned with defining the hazard so that a sprinkler system can be designed to meet the challenge of the hazard.

To examine the conflicts between life safety occupancy classification and classifications in other fire codes, consider a metalworking plant using a flammable solvent in a dip tank coating operation. From a life safety standpoint, the normally ordinary hazard classification of the metalworking plant should not be changed to high hazard solely because of the presence of a dip tank coater. An adequate means of safe egress leading away from the coater is required to ensure the safety of the occupants. However, additional exits and a reduction in travel distance to an exit, as specified for a high hazard contents area, are not required. Nevertheless, if the coater is the principal piece of equipment in a separately enclosed area, that area might be considered as a high hazard industrial occupancy.

When determining the life safety hazard classification for an industrial occupancy, the AHJ should carefully analyze the nature of that industrial operation to ensure an accurate evaluation of the hazard to occupants. A number of resources are available for properly determining the degree of risk to life safety. One resource that should not be overlooked is the expertise of the industrial plant operator, who can provide a wealth of hazard information, although some such information might be treated as confidential to prevent competitors from learning the details of an industrial process. In such a case, the enforcing authority must handle that information with discretion; once an enforcing authority is known to be an outside source of data on industrial secrets, further cooperation will be difficult to obtain. Likewise, facility operators should be forthcoming with process information having an effect on emergency response operations.

Another resource is the engineering department of the company responsible for a facility's insurance coverage. In addition, discussions with officials who oversee jurisdictions where similar facilities exist and

a review of available literature, such as the NFPA *Fire Protection Handbook*[5]; the *Industrial Fire Protection Handbook*[6]; and *Industrial Fire Protection Engineering*,[7] will provide further information on a particular process and its associated hazards.

To assess the risk to life safety in an industrial occupancy, a number of factors should be considered. It should be determined if the manufacturing process includes the handling of flammable, reactive, or explosive materials in quantities that could directly expose occupants to a fire or explosion. If so, the occupancy is a strong candidate for a high hazard classification. See 40.1.2.1.3.

It should also be determined whether the manufacturing process requires a large number of people or whether it is basically a large collection of machines or equipment occasionally attended by operators. In some instances, operators might be clustered in one location, such as a control room. If a building predominantly houses machinery or equipment and is occupied by few employees, the building can be classified as a special-purpose industrial occupancy. See 40.1.2.1.2.

If an industrial building is used mostly for storage of materials (such as preparatory stock for assembly or finished goods), it might meet the requirements for classification as a storage occupancy. See Chapter 42.

Hazard classification is based on the burning and explosive characteristics of the materials contained in a building, not on the quantity of combustibles. For example, there is no reason to classify a building as high hazard simply because it is associated with a manufacturing process that requires extensive quantities of ordinary combustible materials to be distributed in such a manner that the process involves a high combustible fuel load.

The classification of an industrial occupancy, for life safety purposes, is not based on the type of structure housing the industrial process. The basic purpose of the hazard classification in Section 6.2 is to evaluate the risk posed to occupants by the burning characteristics of the building's contents. The classification is determined by an evaluation of the contents and other factors in a fire's development that affect the time available for safe evacuation of the occupants. Once employees are evacuated to a safe location, the extent of fire spread in the structure becomes a threat to property. As long as life safety measures are met, the threat of heavy fire damage to a building is beyond the scope of the *Life Safety Code*.

### 40.1.6 Minimum Construction Requirements.

(No requirements.)

Some occupancy chapters, such as Chapters 18 and 19, which address the life safety needs of nonambulatory health care occupants, specify minimum building construction type requirements to ensure structural integrity for the time needed for a lengthy evacuation or for safe refuge within the building. No minimum construction requirements are imposed by Chapter 40, because industrial occupancies characteristically have ambulatory occupants and do not provide sleeping accommodations. Occupants will likely have the ability to egress the building relatively quickly before the fire-resisting qualities of the building's structural components become an issue.

### 40.1.7* Occupant Load.

The occupant load, in number of persons for whom means of egress and other provisions are required, shall be determined on the basis of the occupant load factors of Table 7.3.1.2 that are characteristic of the use of the space, or shall be determined as the maximum probable population of the space under consideration, whichever is greater.

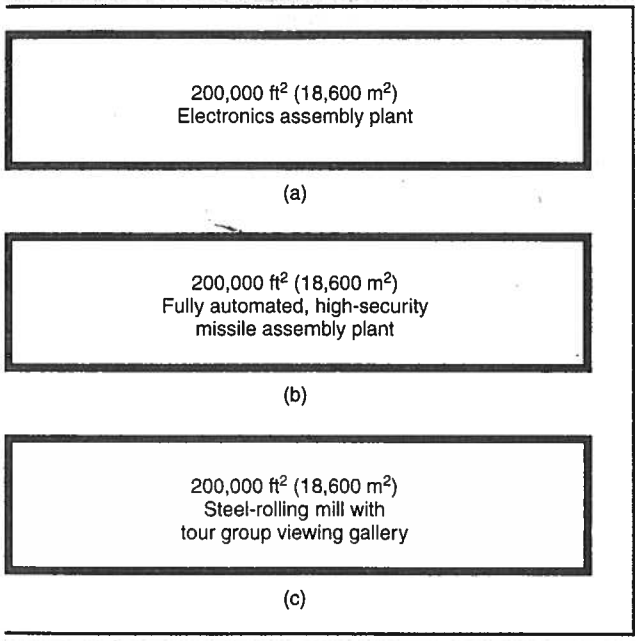
**A.40.1.7** In most cases, the requirements for maximum travel distance to exits will be the determining factor, rather than number of occupants, because exits provided to satisfy travel distance requirements will be sufficient to provide egress capacity for all occupants, except in cases of an unusual arrangement of buildings or the high occupant load of a general manufacturing occupancy.

The occupant load of an industrial occupancy is based on an average of 100 ft$^2$ (9.3 m$^2$) of gross floor area per occupant in accordance with Table 7.3.1.2. Some users of the *Code* confuse this concept with the actual number of employees who occupy the facility. The usual complaint is that the number of potential employees calculated for egress purposes in accordance with the 100 ft$^2$ (9.3 m$^2$) criterion far exceeds the anticipated or actual number of employees. Some industrial managers argue that using the larger number as a basis for egress design requires more exits, wider doors, and more passageways than are needed for emergency egress purposes, reducing productive work space and resulting in increased cost.

The concept of calculating occupant load by using an occupant load factor is useful, although it does not necessarily relate directly to the actual number of

ilding occupants. The occupant load factor is used a means of calculating the minimum egress require-ents, based on the needs of an average industrial cupancy. Although actual conditions might vary in individual location, the egress width determined by occupant load calculation will normally provide necessary, adequate, and required means of egress a typical industrial building with little or no pen-y to the building's owner/operator.

See Exhibit 40.1 for examples of occupant load termination using the occupant load factor for a neral industrial occupancy and using the probable mber of occupants for a special-purpose industrial cupancy.




*hibit 40.1 Determination of occupant load of industrial cupancies.*

In Exhibit 40.1, Part (a), the general industrial occupancy must provide a means of egress for at least 00 persons, based on an occupant load factor of 100 ft² 3 m²) per person.

In Exhibit 40.1, Part (b), a special-purpose industrial occupancy can size its means of egress for the aximum 20 persons (actual anticipated employee pulation) who are expected to occupy the facility ıder any probable condition.

In Exhibit 40.1, Part (c), the 200-person tour groups at visit this special-purpose industrial occupancy on e first Monday of each month must be added to the employees (actual employee population) who are normally present, for a total occupant load of 245 persons.

## 40.2 Means of Egress Requirements

### 40.2.1 General.

**40.2.1.1** Each required means of egress shall be in accordance with the applicable portions of Chapter 7.

**40.2.1.2*** Normally unoccupied utility chases that are secured from unauthorized access and are used exclusively for routing of electrical, mechanical, or plumbing equipment shall not be required to comply with the provisions of Chapter 7

**A.40.2.1.2** Horizontal and vertical utility chases in large industrial buildings used for routing of piping, ducts, and wiring must provide a reasonable level of access for occasional maintenance workers but do not warrant compliance with the comprehensive egress requirements of Chapter 7. Minimum access in these cases is governed by electrical and mechanical codes; 40.2.5.2, Industrial Equipment Access; and the Occupational Safety and Health Administration (OSHA) for facilities in the United States. Utility chases governed by 40.2.1.2 might involve tunnels or large open spaces located above or below occupied floors; however, such spaces differ from mechanical equipment rooms, boiler rooms, and furnace rooms, based on the anticipated frequency of use by maintenance workers. Portions of utility chases where the anticipated presence of maintenance workers is routine are not intended to be included by this paragraph.

### 40.2.2 Means of Egress Components.

**40.2.2.1 Components Permitted.** Components of means of egress shall be limited to the types described in 40.2.2.2 through 40.2.2.13.

**40.2.2.2 Doors.**

**40.2.2.2.1** Doors complying with 7.2.1 shall be permitted.

**40.2.2.2.2** Delayed-egress locks complying with 7.2.1.6.1 shall be permitted.

Use of the delayed-egress locking device covered by 7.2.1.6.1 is permitted on any door in recognition of the security needs of some industrial occupancies. In effect, the allowable 15-second or 30-second delay will be experienced only under non-fire conditions or very early in a fire's growth, because the door must be

usable immediately upon sprinkler operation, smoke or heat detection, or loss of power that controls the locking mechanism. The building must be protected throughout by an approved, supervised automatic sprinkler system or an approved, supervised automatic fire detection system to permit the use of delayed-egress locks per 7.2.1.6.1.

**40.2.2.2.3** Access-controlled egress doors complying with 7.2.1.6.2 shall be permitted.

Paragraph 40.2.2.2.3 permits the installation of access-controlled egress doors in industrial occupancies, provided that they meet the provisions of 7.2.1.6.2. Access-controlled egress doors are frequently confused with so-called "mag-lock" doors, whereby an occupant must swipe a card or enter a code on a keypad, for example, to unlock the door in the direction of egress travel. The *Code* prohibits such locking arrangements on required means of egress doors, even if they are provided with an emergency release button and are arranged to unlock upon activation of the fire alarm system. To comply with the *Code*, access-controlled egress doors must be provided with all of the features described in 7.2.1.6.2(1) through (7). The motion sensor arranged to detect approaching occupants and unlock the door described in 7.2.1.6.2(1) is perhaps the most frequently overlooked requirement.

**40.2.2.2.4** Approved existing horizontal-sliding fire doors shall be permitted in the means of egress where they comply with all of the following conditions:

(1) They are held open by fusible links.
(2) The fusible links are rated at not less than 165°F (74°C).
(3) The fusible links are located not more than 10 ft (3050 mm) above the floor.
(4) The fusible links are in immediate proximity to the door opening.
(5) The fusible links are not located above a ceiling.
(6) The door is not credited with providing any protection under this *Code*.

Horizontal-sliding fire doors exist in many industrial occupancies for property protection purposes. Although the *Code* normally does not recognize these doors within the required means of egress, 40.2.2.2.4 makes a special exemption for existing horizontal-sliding fire doors. By requiring the fusible link to be positioned in immediate proximity to the door opening, rated 165°F (74°C) or higher, and located not more than 10 ft (3050 mm) above the floor, the *Code* helps to ensure that the door will remain open until rising temperatures make it unsafe to pass through the door opening. Because the door will not close early in the fire development, the door cannot be credited as a fire door for life safety purposes. However, the door might serve as a means of property protection. See Exhibit 40.2.

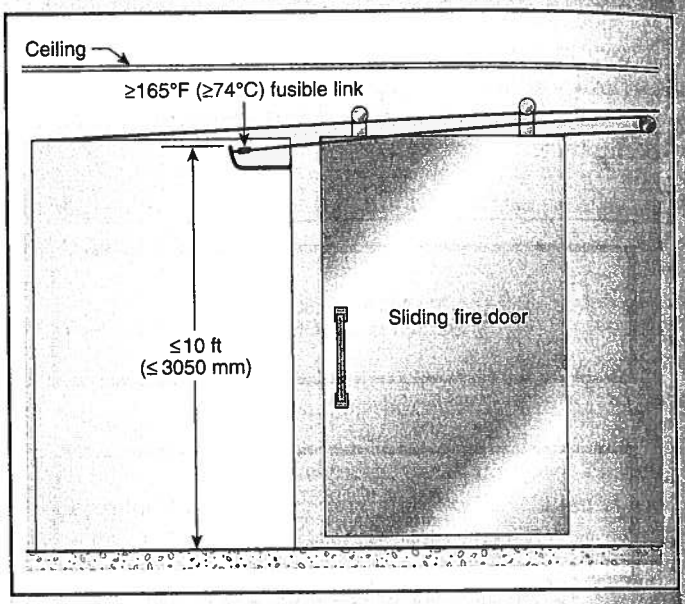



***Exhibit 40.2*** *Existing horizontal-sliding fire door in accordance with 40.2.2.2.4.*

**40.2.2.3 Stairs.**

**40.2.2.3.1** Stairs shall comply with 7.2.2 and shall be permitted to be modified by any of the following:

(1) Noncombustible grated stair treads and noncombustible grated landing floors shall be permitted.
(2) Industrial equipment access stairs in accordance with 40.2.5.2 shall be permitted.

**40.2.2.3.2** Spiral stairs complying with 7.2.2.2.3 shall be permitted.

**40.2.2.3.3** Existing winders complying with 7.2.2.2.4 shall be permitted.

Paragraph 40.2.2.3.1(1) exempts stair treads and landings in industrial occupancies from the provisions of 7.2.2.3.3.1, which would otherwise require that all stair treads and stair landing floors be solid. Although the requirement for solid treads and landing floors is intended to prevent occupants from avoiding the use of

the stairs because they become afraid when they are able to see through the openings to the floor or ground below, occupants of industrial occupancies are usually more familiar, and thus more comfortable, with grated or expanded metal treads and landings. There is also a high degree of certainty that occupants will be wearing shoes appropriate for the environment, and not high heels that could get stuck in the grate openings. The grated walking surfaces provide slip resistance in what are sometimes greasy and slippery surroundings. For consistency, 7.2.2.3.3.4(3) alerts the user that industrial occupancies, in accordance with Chapter 40, are exempt from the solid tread and landing provisions.

Paragraph 40.2.2.3.1(2) directs the user to 40.2.5.2, which has special provisions for industrial equipment access stairs that differ from the requirements of Chapter 7. See the commentary following 40.2.5.2.2.

**40.2.2.4 Smokeproof Enclosures.** Smokeproof enclosures complying with 7.2.3 shall be permitted.

Paragraph 40.2.2.4 does not mandate the use of smokeproof enclosures. It does, however, recognize such an enclosure as part of the means of egress system in an industrial occupancy only if that enclosure meets the requirements of 7.2.3. For an example of an occupancy requiring a smokeproof enclosure, see 31.2.11.1, which specifies that existing nonsprinklered or partially sprinklered high-rise apartment buildings are required to be provided with smokeproof enclosures in accordance with 7.2.3.

**40.2.2.5 Horizontal Exits.**

**40.2.2.5.1** Horizontal exits complying with 7.2.4 shall be permitted.

**40.2.2.5.2*** In horizontal exits where the opening is protected by a fire door assembly on each side of the wall in which it is located, one fire door shall be of the swinging type, as provided in 7.2.4.3.7, and the other shall be permitted to be an automatic-sliding fire door that shall be kept open whenever the building is occupied.

**A.40.2.2.5.2** The customary building code requirement for fire doors on both sides of an opening in a fire wall is permitted to be met by having an automatic-sliding fire door on one side and a self-closing fire door swinging out from the other side of the wall. This arrangement qualifies only as a horizontal exit from the sliding door side. For further information, see A.7.2.4.3.10.

Paragraph 40.2.2.5.1 does not mandate the use of horizontal exits. It does, however, recognize a horizontal exit as part of the means of egress system in an industrial occupancy if that exit meets the requirements of 7.2.4, as modified by 40.2.2.5.2.

Paragraphs 40.2.2.5.2 and A.40.2.2.5.2 recognize the common practice of combining a horizontal exit that is used for life safety with a fire barrier having a significant fire resistance rating that is used for property protection. Opening protectives for such a fire barrier can require the use of a set of doors to achieve the required fire protection rating. It is impractical for both doors to swing in the same direction without interfering with each other; yet, operation of two doors that swing in opposite directions is cumbersome for daily or frequent use. The use of a combination of swinging and sliding doors, as shown in Exhibit 40.3, provides an acceptable arrangement for day-to-day functioning of the building. The normally open sliding door does not compromise life safety, because, by the time its fusible link mechanism releases the door and allows it to close, temperatures in the vicinity of the door opening render use of the door impractical. See also the commentary following 40.2.2.2.4(6). The provisions of 40.2.2.2.4 also permit an existing horizontal-sliding door (as depicted in Exhibit 40.2) to serve within the means of egress.

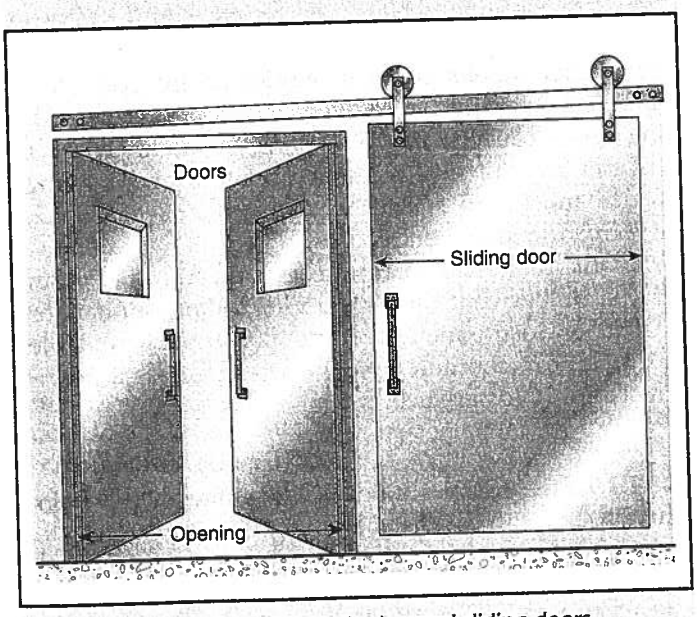



***Exhibit 40.3*** *Combination swinging and sliding doors permitted by 40.2.2.5.2.*

**40.2.2.6 Ramps.** Ramps shall comply with 7.2.5, except that industrial equipment access ramps shall be permitted to be in accordance with 40.2.5.2.

Paragraph 40.2.2.6 does not mandate the use of ramps in industrial occupancies. It does, however, recognize a ramp as part of the means of egress system if that ramp meets the requirements of 7.2.5. Paragraph 40.2.2.6 also serves to remind the user that 40.2.5.2 has special provisions for industrial equipment access ramps that differ from the requirements of Chapter 7. See the commentary following 40.2.5.2.2.

**40.2.2.7 Exit Passageways.** Exit passageways complying with 7.2.6 shall be permitted.

Paragraph 40.2.2.7 does not mandate the use of exit passageways in industrial occupancies. It does, however, recognize an exit passageway as part of the means of egress system if that exit passageway meets the requirements of 7.2.6.

**40.2.2.8 Escalators and Moving Walks.** Existing previously approved escalators and moving walks complying with 7.2.7 and located within the required means of egress shall be permitted.

Note that 7.2.7 permits existing escalators and moving walks to continue to be recognized as required means of egress components if permitted by the applicable occupancy chapter. In earlier editions of the *Code*, escalators and moving walks were recognized as providing egress capacity for 75 persons. To qualify as exits (as opposed to exit access), escalators and moving walks must also meet the requirements of 7.1.3.2, which address exit enclosures.

Note that escalators protected in accordance with the sprinkler-vent, spray nozzle, rolling shutter, or partial enclosure method do not constitute acceptable exits but can continue to serve as exit access if previously approved as such.

**40.2.2.9 Fire Escape Stairs.** Existing fire escape stairs complying with 7.2.8 shall be permitted.

**40.2.2.10 Fire Escape Ladders.**

**40.2.2.10.1** Fire escape ladders complying with 7.2.9 shall be permitted.

**40.2.2.10.2** Fixed industrial stairs in accordance with the minimum requirements for fixed stairs in ANSI A1264.1, *Safety Requirements for Workplace Floor and Wall Openings, Stairs and Railing Systems*, shall be permitted where fire escape ladders are permitted in accordance with 7.2.9.1.

The geometry associated with the incline angle and the size and shape of surfaces intended for foot placement on fire escape ladders falls within the range permitted for fixed industrial stairs. However, most fixed industrial stairs meet criteria that result in a safer arrangement than that provided by the fire escape ladder detailed in 7.2.9. Therefore, 40.2.2.10.2 recognizes fixed industrial stairs as a substitute for fire escape ladders.

**40.2.2.11 Slide Escapes.**

**40.2.2.11.1** Approved slide escapes complying with 7.2.10 shall be permitted as components in 100 percent of the required means of egress for both new and existing high hazard industrial occupancies.

**40.2.2.11.2** Slide escapes permitted by 40.2.2.11.1 shall be counted as means of egress only where regularly used in emergency egress drills to ensure that occupants are familiar with their use through practice.

The intent of 40.2.2.11 is to permit the use of slide escapes, which are commonly used components for means of egress from areas that house explosives or other highly hazardous materials in chemical industry buildings. This provision allows consideration of slide escapes as part of the required means of egress from both new and existing high hazard industrial occupancies. In many high hazard industrial occupancies, slide escapes are the only practical means of ensuring safe egress prior to an explosion or flash fire. As required by 40.2.2.11.2, occupants must be drilled in the use of the slide escapes to help ensure sufficient familiarity for quick egress under emergency conditions.

**40.2.2.12 Alternating Tread Devices.** Alternating tread devices complying with 7.2.11 shall be permitted.

The provisions of 7.2.11, in effect, limit the use of alternating tread devices to those locations where the *Code* recognizes the use of fire escape ladders (and fixed industrial stairs). See 40.2.2.10.1, 40.2.2.10.2, 7.2.9, and 7.2.11.

**40.2.2.13 Areas of Refuge.** Areas of refuge complying with 7.2.12 shall be permitted.

### 40.2.3 Capacity of Means of Egress.

Capacity of means of egress shall comply with either 40.2.3.1 or 40.2.3.2.

**).2.3.1** The capacity of means of egress shall be in accor-.nce with Section 7.3.

**).2.3.2** In industrial occupancies, means of egress shall be zed to accommodate the occupant load as determined in cordance with 40.1.7; spaces not subject to human occu-ıncy because of the presence of machinery or equipment all not be included in the computation.

:ior to the 1991 edition, the *Code* required a minimum ł in. (1120 mm) width for corridors and passageways ithin the required means of egress of industrial oc-ıpancies. A corridor or passageway of that minimum idth would have provided egress capacity for 220 ersons [i.e., 44 in./0.2 in. per person (approximately 20 mm/5 mm per person) in accordance with Table 3.3.1 for level egress components]. That minimum quirement resulted in unnecessarily large egress sys-ms, relative to the occupant load, in many industrial :cupancies. Therefore, the requirement was elimi-ıted, and the minimum 36 in. (915 mm) width re-ıirement of 7.3.4.1(2), which addresses the minimum idth of any exit access, was made applicable to in-ıstrial occupancies. Exit access is required to be ider than 36 in. (915 mm) only if a corridor or pas-ıgeway in an industrial occupancy is to provide ca-ıcity for more than 180 persons [i.e., 36 in./0.2 in. per erson (approximately 915 mm/5 mm per person)]. :e the commentary following A.40.1.7 for details on ıe determination of occupant load in an industrial :cupancy.

Paragraph 40.2.3.2 imposes practical limits on the ıumber of required means of egress and on the ar-ıngement of the means of egress in industrial occu-ancies. No life safety purpose is served by providing cits from the center of a large machine or equipment ıstallation that is unoccupied under normal operat-ıg conditions. A number of industries provide eather shelter for large processes and equipment. ypical examples include steel-rolling mills, paper ex-uders, and metalworking machines, all of which oc-ıpy a majority of the floor space in the sheltered ıilding. In many of the more sophisticated opera-ons, full process control is conducted from a remotely ıcated control room. Personnel normally occupy the uilding only for maintenance and adjustment pur-oses, and then only on a limited basis. The provision f exits from these special-purpose industrial occupan-es serves no useful purpose and could unjustly im-ose an economic penalty in the name of safety.

The large areas normally enclosed by special-urpose structures would require excessive egress idth if the occupant load were calculated on the basis of the 100 ft² (9.3 m²) per person specified for general industrial occupancies. Such arrangements might actually require exits from the interior of machinery and equipment installations, which would be incompatible with the equipment's design. In many cases, these exits would originate from locations that, even under normal operating conditions, would be considered dangerous for humans. Poorly conceived exit facilities serve no life safety purpose and detract from an otherwise well-designed egress system.

### 40.2.4 Number of Means of Egress.

See also Section 7.4.

**40.2.4.1** The number of means of egress shall comply with either 40.2.4.1.1 or 40.2.4.1.2.

**40.2.4.1.1** Not less than two means of egress shall be provided from every story or section, and not less than one exit shall be reached without traversing another story.

**40.2.4.1.2** A single means of egress shall be permitted from any story or section in low and ordinary hazard industrial occupancies, provided that the exit can be reached within the distance permitted as a common path of travel.

**40.2.4.2** In new buildings, floors or portions thereof with an occupant load of more than 500 shall have the minimum number of separate and remote means of egress specified by 7.4.1.2.

**40.2.4.3** Areas with high hazard contents shall comply with Section 7.11.

The provisions of 40.2.4.1.1, which apply to the minimum required number of means of egress for industrial occupancies, clarify that, in addition to providing every story or section with access to at least two means of egress, one of the exits must be located on each floor, so that the entrance to that exit (e.g., a door that opens into an enclosed exit stair) can be reached without traveling to another floor.

Paragraph 40.2.4.1.2 recognizes that there are small floors or areas in low and ordinary hazard industrial occupancies that, if provided with access to only a single exit, are no less safe than larger areas of a building that have access to two exits where an occupant must first travel through the maximum allowable common path. Where a single exit is provided, the occupant travels the 50 ft (15 m) [or 100 ft (30 m) in sprinklered buildings] of common path allowed by Table 40.2.5, enters the exit, and is judged to have reached a point of safety (see Exhibit 40.4). In larger buildings and larger build-

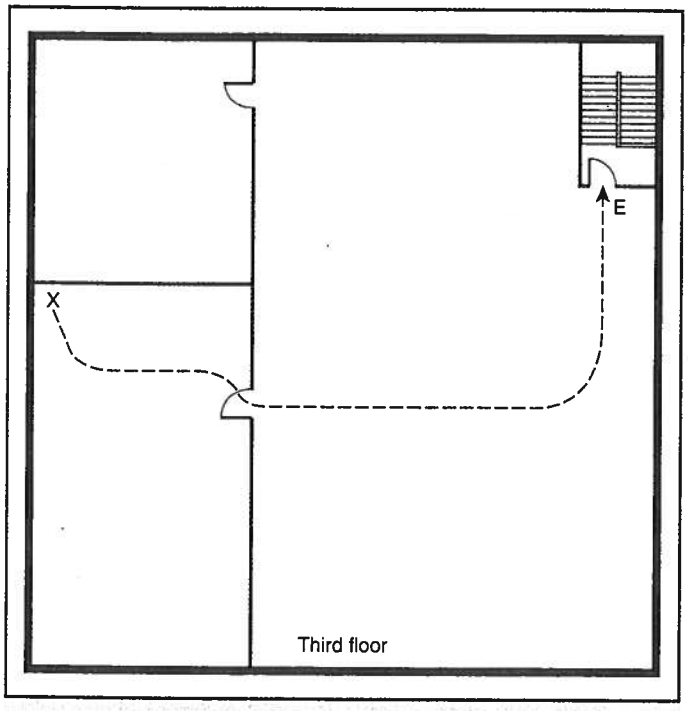



***Exhibit 40.4*** *Single means of egress from story of low or ordinary hazard industrial occupancy.*

ing areas that do not meet the limited travel distance for a single exit, a minimum of two exits must be provided. By traveling to the nearer of the two exits, the occupant is permitted to travel the same 50 ft (15 m) [or 100 ft (30 m) in sprinklered buildings] of common path that the occupant of the single-exit building traveled to reach the one exit before reaching the point where travel to the two exits in different directions is possible. Although the occupant of the single-exit building has reached an exit by this point, the occupant of the multiple-exit building is then allowed an additional 150 ft (46 m) [200 ft (61 m) if the building is sprinklered] of exit access travel before the safety of an exit must be reached. Therefore, the single-exit exemption provides a level of life safety that is at least equivalent to that of the multiple-exit building.

In older editions, the *Code* required more than two exits based on occupant load for assembly occupancies only. Third, fourth, and subsequent exits were provided in industrial occupancies to meet travel distance requirements or as a convenience for day-to-day use. Paragraph 7.4.1.2 expands the concept of requiring three or four exits based on occupant load to apply to all occupancies. Paragraph 40.2.4.2, in compliance with the option offered by 7.4.1.2, exempts existing buildings from the requirement for third and fourth exits to avoid unnecessarily forcing existing, previously approved means of egress systems into noncompliance.

Section 7.11 includes an adequate set of means of egress provisions for high hazard areas and is referenced by 40.2.4.3 to provide commensurate protection to industrial occupancies that contain high hazard areas. The provisions of Section 7.11 are vital to life safety in high hazard occupancies. The requirement for two means of egress for all high hazard occupancies recognizes the possibility that a fire or explosion might block or destroy one of the two exits. Two separate and equal means of egress from high hazard areas provide a necessary redundancy to ensure the evacuation of occupants under fire or explosion conditions and to minimize the potential for injury or loss of life. Subsection 7.11.4 recognizes that it is not necessary to require two means of egress from very small high hazard areas [maximum 200 ft$^2$ (18.6 m$^2$)] with limited occupant load (maximum three persons) if the room door can be reached within 25 ft (7620 mm) of travel.

### 40.2.5 Arrangement of Means of Egress.

Means of egress, arranged in accordance with Section 7.5, shall not exceed that provided by Table 40.2.5.

See the discussion of dead-end corridor pockets and common path of travel in A.7.5.1.5 and its associated commentary.

#### 40.2.5.1 Ancillary Facilities.

**40.2.5.1.1*** New ancillary facilities shall be arranged to allow travel in independent directions after leaving the ancillary facility so that both means of egress paths do not become compromised by the same fire or similar emergency.

**A.40.2.5.1.1** Ancillary facilities located within industrial occupancies might include administrative office, laboratory, control, and employee service facilities that are incidental to the predominant industrial function and are of such size that separate occupancy classification is not warranted.

**40.2.5.1.2*** New ancillary facilities in special-purpose industrial occupancies where delayed evacuation is anticipated shall have not less than a 2-hour fire resistance–rated separation from the predominant industrial occupancy, and shall have one means of egress that is separated from the predominant industrial occupancy by 2-hour fire resistance–rated construction.

**A.40.2.5.1.2** Occupants of ancillary facilities located within special-purpose industrial occupancies might be required by

*Table 40.2.5 Arrangement of Means of Egress*

| Level of Protection | General Industrial Occupancy ft | General Industrial Occupancy m | Special-Purpose Industrial Occupancy ft | Special-Purpose Industrial Occupancy m | High Hazard Industrial Occupancy |
|---|---|---|---|---|---|
| **Dead-End Corridor** | | | | | |
| Protected throughout by an approved, supervised automatic sprinkler system in accordance with 9.7.1.1(1) | 50 | 15 | 50 | 15 | Prohibited, except as permitted by 7.11.4 |
| Not protected throughout by an approved, supervised automatic sprinkler system in accordance with 9.7.1.1(1) | 50 | 15 | 50 | 15 | Prohibited, except as permitted by 7.11.4 |
| **Common Path of Travel** | | | | | |
| Protected throughout by an approved, supervised automatic sprinkler system in accordance with 9.7.1.1(1) | 100 | 30 | 100 | 30 | Prohibited, except as permitted by 7.11.4 |
| Not protected throughout by an approved, supervised automatic sprinkler system in accordance with 9.7.1.1(1) | 50 | 15 | 50 | 15 | Prohibited, except as permitted by 7.11.4 |

administrative controls to remain in the facility when a fire occurs in the predominant industrial area, so that they can perform an orderly shutdown of process equipment to control the spread of the fire and minimize damage to important equipment.

The presence of ancillary facilities within an industrial occupancy can create challenges to life safety. For example, the means of egress for factory office workers, who might have little knowledge of the industrial processes and operations and their respective hazards, might require leaving the safety of an office area and traveling across the factory production floor.

In other cases, safe egress is not ensured for employees assigned to a control room who might have to perform orderly shutdown of certain processes to control the spread of fire before evacuating a building. The requirements of 40.2.5.1.1 and 40.2.5.1.2 are illustrated in Exhibit 40.5.

In Exhibit 40.5, an occupant of control room 1, which is elevated and has a single means of egress via a stair leading down to the main production floor, is forced to travel in one direction only into the open manufacturing area. This arrangement does not meet the requirement of 40.2.5.1.1, which mandates that egress be arranged to allow travel in independent directions after leaving the ancillary facility, so that both means of egress paths are not compromised by the same fire or similar emergency. Control room 1 requires a second exit access door and stair remotely located from the first.

Control room 2 in Exhibit 40.5 meets the requirements of both 40.2.5.1.1 and 40.2.5.1.2. Control room 2 permits egress travel in independent directions, so that both means of egress paths are not compromised by the same fire or similar emergency. Further, it provides one of the two means of egress via an exit passageway–like arrangement separated from the predominant industrial occupancy by 2-hour fire resistance–rated construction. Also, control room 2 is surrounded by 2-hour fire resistance–rated construction. This protection allows occupants charged with special emergency duties to delay their egress and still be afforded adequate life safety.

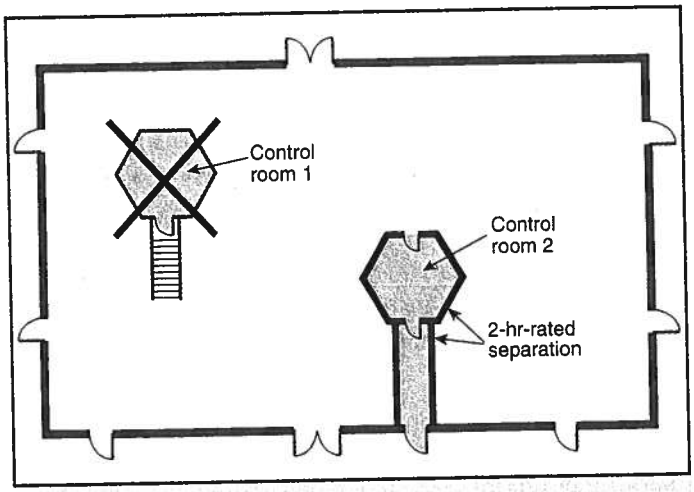



***Exhibit 40.5*** *Ancillary facilities.*

The requirements of 40.2.5.1, which first appeared in the 1997 edition of the *Code*, apply only to new ancillary facilities and are not required to be applied retroactively to existing facilities.

### 40.2.5.2 Industrial Equipment Access.

**40.2.5.2.1** Industrial equipment access doors, walkways, platforms, ramps, and stairs that serve as a component of the means of egress from the involved equipment shall be permitted in accordance with the applicable provisions of Chapter 7, as modified by Table 40.2.5.2.1.

*Table 40.2.5.2.1 Industrial Equipment Access Dimensional Criteria*

| Feature | Dimensional Criteria |
|---|---|
| Minimum horizontal dimension of any walkway, landing, or platform | 22 in. (560 mm) clear |
| Minimum stair or ramp width | 22 in. (560 mm) clear between rails |
| Minimum tread width | 22 in. (560 mm) clear |
| Minimum tread depth | 10 in. (255 mm) |
| Maximum riser height | 9 in. (230 mm) |
| Handrails are permitted to terminate, at the required height, at a point directly above the top and bottom risers. | |
| Maximum height between landings | 12 ft (3660 mm) |
| Minimum headroom | 6 ft 8 in. (2030 mm) |
| Minimum width of door openings | 22 in. (560 mm) clear |

**40.2.5.2.2** Any means of egress component permitted by 40.2.5.2.1 shall serve not more than 20 people.

Paragraph 40.2.5.2 permits industrial equipment access walkways, platforms, ramps, stairs, and doors serving not more than 20 persons to deviate from some of the usual dimensional criteria specified by Chapter 7. The dimensional criteria detailed in Table 40.2.5.2.1 are illustrated in Exhibit 40.6.

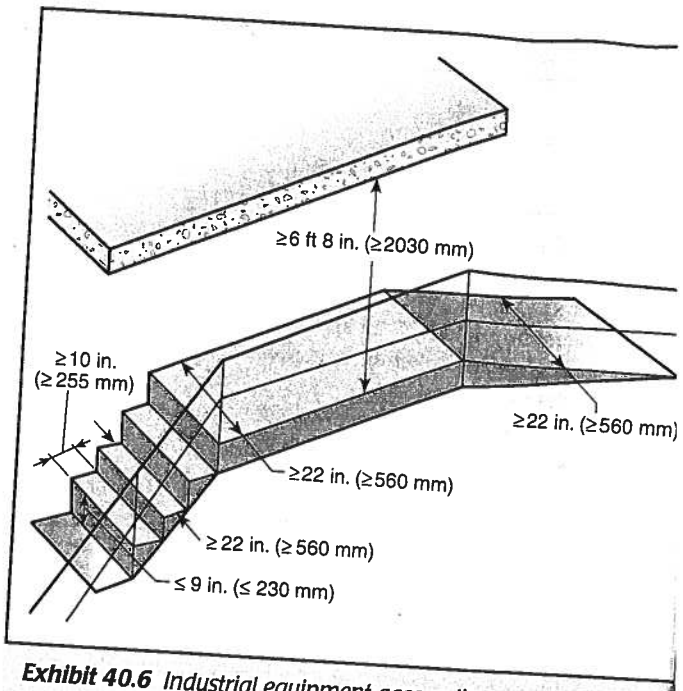



***Exhibit 40.6*** *Industrial equipment access dimensional criteria.*

### 40.2.6 Travel Distance to Exits.

Travel distance, measured in accordance with Section 7.6, shall not exceed that provided by Table 40.2.6.

The travel distance exemption permitted by the footnote to Table 40.2.6 is meant to provide flexibility in determining the layout of the means of egress system in a single-story industrial building with a large floor area that houses a low- or ordinary-hazard general industrial occupancy. The exemption is limited to use in one-story buildings. Any stairs or other impediments to the rapid movement of occupants would result in slower evacuation of the building and increase

*Table 40.2.6 Maximum Travel Distance to Exits*

| Level of Protection | General Industrial Occupancy | | Special-Purpose Industrial Occupancy | | High Hazard Industrial Occupancy | |
|---|---|---|---|---|---|---|
| | ft | m | ft | m | ft | m |
| Protected throughout by an approved, supervised automatic sprinkler system in accordance with 9.7.1.1(1) | 250† | 76† | 400 | 122 | 75 | 23 |
| Not protected throughout by an approved, supervised automatic sprinkler system in accordance with 9.7.1.1(1) | 200 | 61 | 300 | 91 | NP | NP |

NP: Not permitted.

†In one-story buildings, a travel distance of 400 ft (122 m) is permitted, provided that a performance-based analysis demonstrates that safe egress can be accomplished.

the probability of exposure to smoke or fire. The exemption requires a performance-based analysis to demonstrate that safe egress can be accomplished. NFPA 204, *Standard for Smoke and Heat Venting*,[8] might be of assistance. In addition, NFPA 92, *Standard for Smoke Control Systems*,[9] can be consulted. Also see Chapter 5 for details on performance-based designs.

The construction of tunnels and elevated means of egress that originate from the center of an industrial building with an extensive floor area is rarely attempted. Only a handful of buildings have ever been provided with such egress facilities, and most were World War II era airframe manufacturing buildings of massive size. In most industrial buildings, it is not practicable or economical to construct exit tunnels or overhead passageways. These special types of means of egress are not easily altered if modifications are necessary to adjust to changes in the layout of the facility. In addition, the construction costs for tunnels and elevated passageways are high due to the special design features required to ensure their safety, including fire resistance–rated supports for the elevated passageways, waterproofing, and other features necessary to maintain the integrity of underground tunnels. Another negative factor in such construction is the confining nature of a tunnel or an elevated passage, which tends to discourage the use of these means of egress.

The use of horizontal exits that pass through fire walls is common in many industrial occupancies. The provisions in Chapter 7 are required to be fully considered to ensure the safe use of horizontal exits. A common violation of the provisions of Chapter 7 is the failure to provide the proper type of fire door in a horizontal exit fire barrier. A horizontal-sliding fire door is not an acceptable life safety feature. Such a door is permitted in existing installations in accordance with 40.2.2.2.4, but, even then, the door is not credited with protecting the opening for the purposes of this *Code*. If the horizontal exit is to be used from both sides of a fire wall, careful consideration of the direction of door swing is necessary to ensure that the *Code* will recognize such use. In many instances, two doors swinging in opposite directions will be required, so that the exit is permitted to be used as a means of egress from both sides of the fire wall. See 7.2.1.4, 7.2.4.3.6, and 40.2.2.5.

Low hazard and ordinary hazard special-purpose industrial occupancies, which are characterized by large, specialized equipment and low occupant load, are permitted an increase in travel distance beyond that allowed for low hazard and ordinary hazard general industrial occupancies. Table 40.2.6 permits an increase to 300 ft (91 m) if the building is not sprinklered, and an increase to 400 ft (122 m) if the building is protected throughout by an approved, supervised automatic sprinkler system.

### 40.2.7 Discharge from Exits.

Discharge from exits shall be in accordance with Section 7.7.

### 40.2.8 Illumination of Means of Egress.

Means of egress shall be illuminated in accordance with Section 7.8 or with natural lighting that provides the required level of illumination in structures occupied only during daylight hours.

### 40.2.9* Emergency Lighting.

**A.40.2.9** The authority having jurisdiction should review the facility and designate the stairs, aisles, corridors, ramps, and passageways that should be required to be provided with emergency lighting. In large locker rooms or laboratories using hazardous chemicals, for example, the authority having jurisdiction should determine that emergency lighting is needed in the major aisles leading through those spaces.

**40.2.9.1** Emergency lighting shall be provided in accordance with Section 7.9, except as otherwise exempted by 40.2.9.2.

**40.2.9.2** Emergency lighting shall not be required for any of the following:

(1) Special-purpose industrial occupancies without routine human habitation
(2) Structures occupied only during daylight hours, with skylights or windows arranged to provide the required level of illumination on all portions of the means of egress during such hours

The intent of 40.2.8 is not to require the installation of extensive and unneeded illumination systems in industrial occupancies. Illumination is required for the exit access, which is limited to designated aisles, corridors, and passageways that lead to an exit. No requirement is specified for the provision of illumination throughout the building, which in many industrial occupancies would involve lighting an extensive floor area. The purpose of the lighting system is to ensure that occupants are able to see the means of egress, not to illuminate the operation of production facilities.

In addition, the *Code* does not require illumination of the means of egress if the building is occupied during daylight hours only and the building, including stairways, has sufficient windows and skylights to ensure natural illumination. The authority having jurisdiction should make certain that the building is not occupied after daylight hours.

The exemptions of 40.2.9.2 for emergency lighting are included for the same reasons that illumination of the means of egress is not required (see 40.2.8). Paragraph 40.2.9.2(1) addresses special-purpose industrial occupancies that are not routinely occupied. There is no need to install an extensive and costly emergency lighting system in a normally unoccupied building.

### 40.2.10 Marking of Means of Egress.

Means of egress shall have signs in accordance with Section 7.10.

### 40.2.11 Special Means of Egress Features.

**40.2.11.1 Reserved.**

**40.2.11.2 Lockups.**

**40.2.11.2.1** Lockups in new industrial occupancies shall comply with the requirements of 22.4.5.

**40.2.11.2.2** Lockups in existing industrial occupancies, other than approved existing lockups, shall comply with the requirements of 23.4.5.

Where an industrial occupancy is provided with a lockup for security purposes, it must meet the provisions of 22/23.4.5, as specified in 40.2.11.2. The lockup criteria require the application of some of the concepts of detention and correctional occupancies to other occupancies where persons might be detained for security purposes, without classifying the lockup as a detention and correctional occupancy. See 22/23.4.5 and related commentary for details on the lockup provisions.

## 40.3 Protection

### 40.3.1 Protection of Vertical Openings.

Any vertical opening shall be protected in accordance with Section 8.6, unless otherwise permitted by one of the following:

(1) In special-purpose industrial and high hazard industrial occupancies where unprotected vertical openings exist and are necessary to manufacturing operations, such openings shall be permitted beyond the specified limits, provided that every floor level has direct access to one or more enclosed stairs or other exits protected against obstruction by any fire or smoke in the open areas connected by the unprotected vertical openings.

(2) Approved existing open stairs, existing open ramps, and existing escalators shall be permitted where connecting only two floor levels.

(3) Approved, existing, unprotected vertical openings in buildings with low or ordinary hazard contents that are protected throughout by an approved automatic sprinkler system in accordance with 9.7.1.1(1) shall be permitted, provided that the following conditions exist:

   (a) The vertical opening does not serve as a required exit.

   (b) All required exits consist of outside stairs in accordance with 7.2.2, smokeproof enclosures in accordance with 7.2.3, or horizontal exits in accordance with 7.2.4.

(4) Vertical openings in accordance with 8.6.9.1 shall be permitted.

Paragraph 40.3.1(1) strictly limits the use of unprotected vertical openings in high hazard and special-purpose industrial occupancies. Direct access to one or more enclosed stairways or to other exits is required from any areas connected by unprotected vertical openings. This provision recognizes that many high hazard and special-purpose industrial occupancies require openings between floor levels to accommodate piping, conveyors, and other devices and equipment essential to the orderly operation of the facility. In most of these situations, full enclosure is not practical or feasible. In high hazard occupancies, the provision of two means of egress will, in most situations, be sufficient to comply with this exemption. In special-purpose industrial occupancies, additional exits or other special arrangements will normally be required for compliance with the provision that stairways and exits be protected against obstruction from fire and smoke in open areas connected by unprotected vertical openings.

Paragraph 40.3.1(2) limits the use of existing open stairways, existing open ramps, and existing escalators that are unenclosed or unprotected by permitting them to connect only two floors. An existing open stairway connecting three floors would have to be enclosed, protected, or permitted by another of the exemptions to 40.3.1.

Paragraph 40.3.1(3) recognizes that an existing industrial occupancy might contain unprotected vertical openings and still provide a reasonable level of safety

to life if the building houses only low or ordinary hazard contents and is protected by a complete automatic sprinkler system. Smokeproof enclosures and outside stairways (the only types of vertical exits permitted by this exemption) must be fully enclosed or protected against vertical fire spread and must meet the requirements of Chapter 7. The unenclosed vertical openings are not permitted to serve as part of the means of egress, although they can remain as convenience openings and stairways to be used for normal operations.

### 40.3.2* Protection from Hazards.

**A.40.3.2** Emergency lighting should be considered where operations require lighting to perform orderly manual emergency operation or shutdown, maintain critical services, or provide safe start-up after a power failure.

**40.3.2.1** All high hazard industrial occupancies, operations, or processes shall have approved, supervised automatic extinguishing systems in accordance with Section 9.7 or other protection appropriate to the particular hazard, such as explosion venting or suppression.

**40.3.2.2** Protection in accordance with 40.3.2.1 shall be provided for any area subject to an explosion hazard in order to minimize danger to occupants in case of fire or other emergency before they have time to use exits to escape.

**40.3.2.3** Activation of the fire-extinguishing or suppression system required by 40.3.2.1 shall initiate the required building fire alarm system in accordance with 40.3.4.3.4.

**40.3.2.4** Hazardous areas in industrial occupancies protected by approved automatic extinguishing systems in accordance with Section 9.7 shall be exempt from the smoke-resisting enclosure requirement of 8.7.1.2.

The intent of 40.3.2 is to provide for the life safety of the occupants of industrial buildings by controlling the risk associated with hazardous operations. The alternatives offered in 40.3.2 are not all-inclusive, and a proper fire protection engineering solution might not incorporate the listed provisions. The *Code* intends to allow for engineering judgment in a wide range of potentially hazardous situations, including some where protection might be limited. The intent of 40.3.2 is also broad in application, because, in many highly hazardous operations, an explosion might be immediately preceded by a fire or other emergency, such as an overheated reactor vessel, an exothermic reaction, or increased pressure. Because such conditions might initiate an explosion, depending on the process and arrangement of the equipment, immediate egress from the facility might be necessary. If fire or other emergencies are likely to develop rapidly into an explosion, adequate precautions are necessary for life safety. Where a sprinkler system is used to provide the protection required by 40.3.2.1, it must be electrically supervised.

In many modern facilities, provisions that prove adequate for the life safety of occupants might already be included for process control and property protection, and any additional measures will not increase the life safety of operators to an appreciable degree.

The NFPA *Fire Protection Handbook* discusses the basic principles of explosion prevention, venting, and suppression. The applicable chapters also contain an extensive bibliography on the subject. Requirements for the design and use of vents to limit pressures developed by explosions are specified in NFPA 68, *Standard on Explosion Protection by Deflagration Venting*.[10] Standards for explosion prevention systems are found in NFPA 69, *Standard on Explosion Prevention Systems*.[11]

Paragraph 8.7.1.2 requires that, where a hazardous area is protected by automatic sprinklers, the hazardous area must be enclosed by smoke partitions rather than with fire barriers with a 1-hour fire resistance rating and doors with a 45-minute fire protection rating. Paragraph 40.3.2.4 exempts hazardous areas in industrial occupancies from the requirement for smoke partitions if those areas are protected by automatic sprinklers. For consistency, similar wording appears in 8.7.1.2(2).

### 40.3.3 Interior Finish.

**40.3.3.1 General.** Interior finish shall be in accordance with Section 10.2.

**40.3.3.2 Interior Wall and Ceiling Finish.** Interior wall and ceiling finish materials complying with Section 10.2 shall be Class A, Class B, or Class C in operating areas and shall be as required by 7.1.4 in exit enclosures.

**40.3.3.3 Interior Floor Finish.**

**40.3.3.3.1** Interior floor finish in exit enclosures and in exit access corridors shall be not less than Class II.

**40.3.3.3.2** Interior floor finish in areas other than those specified in 40.3.3.3.1 shall not be required to comply with Section 10.2.

### 40.3.4 Detection, Alarm, and Communications Systems.

**40.3.4.1 General.** A fire alarm system shall be required in accordance with Section 9.6 for industrial occupancies,

unless the total occupant load of the building is under 100 persons and unless, of these, fewer than 25 persons are above or below the level of exit discharge.

**40.3.4.2 Initiation.** Initiation of the required fire alarm system shall be by any of the following means:

(1) Manual means in accordance with 9.6.2.1(1)
(2) Approved automatic fire detection system in accordance with 9.6.2.1(2) throughout the building, plus a minimum of one manual fire alarm box in accordance with 9.6.2.6
(3) Approved, supervised automatic sprinkler system in accordance with 9.6.2.1(3) throughout the building, plus a minimum of one manual fire alarm box in accordance with 9.6.2.6

**40.3.4.3 Notification.**

**40.3.4.3.1** The required fire alarm system shall meet one of the following criteria:

(1) It shall provide occupant notification in accordance with 9.6.3.
(2) It shall sound an audible and visible signal in a constantly attended location for the purposes of initiating emergency action.

**40.3.4.3.2** Positive alarm sequence in accordance with 9.6.3.4 shall be permitted.

**40.3.4.3.3** Existing presignal systems in accordance with 9.6.3.3 shall be permitted.

**40.3.4.3.4** In high hazard industrial occupancies, as described in 40.1.2.1.3, the required fire alarm system shall automatically initiate an occupant evacuation alarm signal in accordance with 9.6.3.

The requirements of 40.3.4.3.1 and 40.3.4.3.4 specify two separate and distinct provisions for audible alarms activated by the fire alarm system required by 40.3.4.1. In low and ordinary hazard industrial occupancies, the system is permitted to activate an evacuation alarm or to sound an alarm at a constantly attended location for the purpose of initiating emergency action (see 40.3.4.3.1). This provision permits an interface between the alarm system and the plant's emergency organization. The alarm system is permitted to be controlled from a central security console or a similar location. The key feature is that the location from which the alarm sounds must be constantly staffed. This requirement is not intended to mandate the installation of supervisory service, such as that connected to a central station, but the location must be fully attended at all times when the building is occupied.

In high hazard occupancies, the alarm must be arranged to automatically provide evacuation signals (see 40.3.4.3.4), because the safety of the occupants of these areas depends on their immediate notification of a fire.

Note that 40.3.4.3.3 recognizes existing presignal systems but not new presignal systems. If an automatic form of delay is desired for an existing alarm system that does not already have a presignal feature, or for a new alarm system, the more reliable system feature known as *positive alarm sequence* is permitted by 40.3.4.3.2. The positive alarm sequence option might be applied to the high hazard industrial occupancies addressed in 40.3.4.3.4 for which an automatic form of occupant notification is needed. Also, positive alarm sequence might be used in industrial occupancies, other than those that are high hazard, where the provisions of 40.3.4.3.1(1) are used instead of those of 40.3.4.3.1(2).

### 40.3.5 Extinguishment Requirements.

(No requirements.)

### 40.3.6 Corridors.

The provisions of 7.1.3.1 shall not apply.

Without the exemption to the requirements of 7.1.3.1 provided by 40.3.6, all new industrial occupancy corridors serving more than 30 persons would be required to have a 1-hour fire resistance rating, with openings protected by 20-minute fire protection–rated door assemblies. The exemption to 7.1.3.1 is provided because of the ambulatory nature of occupants of industrial occupancies and the operational need for openings, even where corridors are provided.

## 40.4 Special Provisions — High-Rise Buildings

New high-rise industrial occupancies shall comply with Section 11.8.

**40.4.1** The provisions of 11.8.5.2.4(2) for jockey pumps and 11.8.5.2.4(3) for air compressors serving dry-pipe and pre-action systems shall not apply to special-purpose industrial occupancies.

New high-rise industrial occupancy buildings are required to comply with Section 11.8. This reference to

the entire Section 11.8 "high-rise package" is new to the 2012 edition of the *Code*. In prior editions, new high-rise industrial occupancy buildings were required to comply only with the sprinkler system requirements of Section 11.8. Note that 40.4.1 exempts special-purpose industrial occupancies from the standby power requirement for automatic sprinkler system pressure maintenance (jockey) pumps and air compressors.

## 40.5 Building Services

### 40.5.1 Utilities.

Utilities shall comply with the provisions of Section 9.1.

### 40.5.2 Heating, Ventilating, and Air-Conditioning.

Heating, ventilating, and air-conditioning equipment shall comply with the provisions of Section 9.2.

### 40.5.3 Elevators, Escalators, and Conveyors.

Elevators, escalators, and conveyors shall comply with the provisions of Section 9.4.

### 40.5.4 Rubbish Chutes, Incinerators, and Laundry Chutes.

Rubbish chutes, incinerators, and laundry chutes shall comply with the provisions of Section 9.5.

## 40.6* Special Provisions for Aircraft Servicing Hangars

**A.40.6** For further information on aircraft hangars, see NFPA 409, *Standard on Aircraft Hangars*.

**40.6.1** The requirements of Sections 40.1 through 40.5 shall be met, except as modified by 40.6.1.1 through 40.6.1.4.

**40.6.1.1** There shall be not less than two means of egress from each aircraft servicing area.

**40.6.1.2** Exits from aircraft servicing areas shall be provided at intervals not exceeding 150 ft (46 m) on all exterior walls.

**40.6.1.3** Where horizontal exits are provided, doors shall be provided in the horizontal exit fire barrier at intervals not exceeding 100 ft (30 m).

**40.6.1.4** Where dwarf, or "smash," doors are provided in doors that accommodate aircraft, such doors shall be permitted for compliance with 40.6.1.1 through 40.6.1.3.

**40.6.2** Means of egress from mezzanine floors in aircraft servicing areas shall be arranged so that the travel distance to the nearest exit from any point on the mezzanine does not exceed 75 ft (23 m), and such means of egress shall lead directly to a properly enclosed stair discharging directly to the exterior, to a suitable cutoff area, or to outside stairs.

**40.6.3** Dead ends shall not exceed 50 ft (15 m) for other than high hazard contents areas and shall not be permitted for high hazard contents areas.

Section 40.6, which addresses aircraft servicing hangars, is nearly identical to Section 42.6, which addresses aircraft storage hangars. Because aircraft hangars are used for both storage and repair, corresponding requirements can be found in both Chapters 40 and 42.

## 40.7 Operating Features

### 40.7.1 Upholstered Furniture and Mattresses.

The provisions of 10.3.2 shall not apply to upholstered furniture and mattresses.

### 40.7.2 Soiled Linen and Trash Receptacles.

The requirements of 10.3.9 for containers for rubbish, waste, or linen with a capacity of 20 gal (75.7 L) or more shall not apply.

### References Cited in Commentary


1. NFPA 654, *Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids*, 2006 edition, National Fire Protection Association, Quincy, MA.
2. NFPA 30, *Flammable and Combustible Liquids Code*, 2012 edition, National Fire Protection Association, Quincy, MA.
3. NFPA 54, *National Fuel Gas Code*, 2012 edition, National Fire Protection Association, Quincy, MA.
4. NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2010 edition, National Fire Protection Association, Quincy, MA.
5. NFPA *Fire Protection Handbook*, 20th edition, National Fire Protection Association, Quincy, MA, 2008.
6. Schroll, R. C., *Industrial Fire Protection Handbook*, 2nd edition, CRC Press, Boca Raton, FL, 2002.

7. Zalosh, R. G., *Industrial Fire Protection Engineering*, John Wiley and Sons, Hoboken, NJ, 2003.
8. NFPA 204, *Standard for Smoke and Heat Venting*, 2012 edition, National Fire Protection Association, Quincy, MA.
9. NFPA 92, *Standard for Smoke Control Systems*, 2012 edition, National Fire Protection Association, Quincy, MA.
10. NFPA 68, *Standard on Explosion Protection by Deflagration Venting*, 2007 edition, National Fire Protection Association, Quincy, MA.
11. NFPA 69, *Standard on Explosion Prevention Systems*, 2008 edition, National Fire Protection Association, Quincy, MA.

CHAPTER

# Storage Occupancies

42

Storage occupancies include all buildings or structures used primarily for the storage or sheltering of goods, merchandise, products, or vehicles. The following are examples of storage occupancies:

1. Barns
2. Hangars (for aircraft storage only)
3. Freight terminals
4. Bulk oil storage
5. Truck and marine terminals
6. Parking garages
7. Cold storage
8. Grain elevators
9. Warehouses

Chapter 42 covers a range of facilities used for storage of a wide variety of commodities. While the same life safety philosophy that prevails in the other occupancy chapters applies to storage occupancies, the protection scheme is less complicated, given the relatively small number of people who characteristically occupy a storage occupancy. Although some warehouse facilities are substantially larger than buildings housing other occupancies, few people typically occupy them.

Once the basic characteristics of a given storage occupancy are determined, the general protection measures of Sections 42.2 and 42.3 can be applied. In addition to these measures, the supplementary provisions that are specific to a particular type of storage occupancy can be applied. These provisions include those for aircraft storage hangars (Section 42.6), grain and other bulk storage elevators (Section 42.7), and parking structures (Section 42.8).

## 42.1 General Requirements

### 42.1.1 Application.

**42.1.1.1** The requirements of this chapter shall apply to both new and existing storage occupancies.

Note that Chapter 42 applies to both new and existing storage occupancies. Where the requirements vary, exemptions that apply to existing storage occupancies are often provided, or additional requirements that are limited to new storage occupancies are specified.

Minor storage that is incidental to another occupancy is treated as part of the other occupancy. See 6.1.14.1.3.

**42.1.1.2 Administration.** The provisions of Chapter 1, Administration, shall apply.

**42.1.1.3 General.** The provisions of Chapter 4, General, shall apply.

**42.1.1.4** Storage occupancies shall include all buildings or structures used primarily for the storage or sheltering of goods, merchandise, products, or vehicles.

Life safety provisions for storage locations are not extensive, because the number of occupants is generally low, and many of those who occupy such a structure are present for only short periods of time. Furthermore, employees of storage occupancies normally do not remain in one location; instead, their assignments require that they move about and perform activities of a short-term nature.

Due to the special characteristics of storage occupancies, a number of provisions are included in the *Code* to modify, as required, those provisions that normally apply to occupancies with larger populations.

### 42.1.2 Classification of Occupancy.

**42.1.2.1** Storage occupancies shall include all buildings and structures or parts thereof with occupancy as defined in 6.1.13.

**42.1.2.2** Incidental storage in another occupancy shall not be the basis for overall occupancy classification.

**42.1.2.3** Storage occupancies or areas of storage occupancies that are used for the purpose of packaging, labeling, sorting, special handling, or other operations requiring an occupant load greater than that normally contemplated for storage shall be classified as industrial occupancies. *(See Chapter 40.)*

The purpose of 42.1.2.3 is to provide suitable egress facilities for storage occupancies, or portions of storage occupancies, with a population greater than normally expected. It is common practice to employ large numbers of people in a storage building for industrial types of operations, such as labeling, sorting, or packaging. Such operations require additional egress in accordance with the provisions of Chapter 40 for industrial occupancies.

### 42.1.3 Multiple Occupancies.

All multiple occupancies shall be in accordance with 6.1.14.

Subsection 42.1.3 directs the user to the multiple occupancy provisions of 6.1.14, which permit protecting the multiple occupancies either as mixed or as separated. If the multiple occupancy building is protected via the provisions of 6.1.14.4 for separated uses, the required separation, in terms of fire barrier rating, is specified by Table 6.1.14.4.1(a) and Table 6.1.14.4.1(b).

### 42.1.4 Definitions.

**42.1.4.1 General.** For definitions, see Chapter 3, Definitions.

**42.1.4.2 Special Definitions.** Special terms applicable to this chapter are defined in Chapter 3.

### 42.1.5 Classification of Hazard of Contents.

Contents of storage occupancies shall be classified as low hazard, ordinary hazard, or high hazard in accordance with Section 6.2, depending on the character of the materials stored, their packaging, and other factors.

No basis for comparison exists between the hazard categories for storage facilities in NFPA 13, *Standard for the Installation of Sprinkler Systems*,[1] and those of the *Life Safety Code*. The hazard categories for storage facilities contained in NFPA 13 are established for the design of automatic sprinkler systems.

There is a strong inclination to use the potential for rapid fire growth associated with high-piled or racked storage as justification for establishing strict life safety provisions. However, the arrangement of buildings typical for this type of storage is adequate to allow safe and rapid egress at the first notification or discovery of fire. If a building is not protected by automatic sprinklers, the *Code* provides adequate provisions — such as those for travel distance to an exit — to help ensure the safety of the occupants.

### 42.1.6 Minimum Construction Requirements.

(No requirements.)

Some occupancy chapters, such as Chapters 18 and 19, which address the life safety needs of nonambulatory health care occupants, specify minimum building construction type requirements to ensure structural integrity for the time needed for a lengthy evacuation or for safe refuge within the building. No minimum construction requirements are imposed by Chapter 42, because, characteristically, storage occupancies have few occupants, and those few occupants are ambulatory.

### 42.1.7* Occupant Load.

The occupant load, in number of persons for whom means of egress and other provisions are required, shall be determined on the basis of the maximum probable population of the space under consideration.

**A.42.1.7** There is no occupant load factor specified for storage occupancies. Rather, the probable maximum number of persons present needs to be considered in determining the occupant load.

Although 42.1.7 and Table 7.3.1.2 do not provide an occupant load factor for calculating a minimum occupant load to size means of egress systems in a storage occupancy, it is necessary to establish an occupant load. The occupant load is determined on the basis of the maximum number of persons expected to occupy the storage occupancy under any anticipated facility operation. Due to the low occupant load characteristic of storage occupancies, compliance with other *Code* provisions — such as minimum widths for doors, corridors, or passageways; minimum number of exits; and travel distance allowances — generally yields means of egress systems capable of handling the actual occupant load, without specifically considering the occupant load when the means of egress is designed. Considering a door with a clear width of 32 in. (810 mm) has an egress capacity of 160 persons [based

on 0.2 in. (5 mm) per person], egress capacity for nearly all storage occupancies is moot due to the anticipated low occupant load.

## 42.2 Means of Egress Requirements

### 42.2.1 General.

**42.2.1.1** Each required means of egress shall be in accordance with the applicable portions of Chapter 7.

**42.2.1.2*** Normally unoccupied utility chases that are secured from unauthorized access and are used exclusively for routing of electrical, mechanical, or plumbing equipment shall not be required to comply with the provisions of Chapter 7.

**A.42.2.1.2** Horizontal and vertical utility chases in large industrial buildings used for routing of piping, ducts, and wiring must provide a reasonable level of access for occasional maintenance workers but do not warrant compliance with the comprehensive egress requirements of Chapter 7. Minimum access in these cases is governed by the electrical and mechanical code; 40.2.5.2, Industrial Equipment Access; and the Occupational Safety and Health Administration (OSHA) for facilities in the United States. Utility chases governed by 42.2.1.2 might involve tunnels or large open spaces located above or below occupied floors; however, such spaces differ from mechanical equipment rooms, boiler rooms, and furnace rooms, based on the anticipated frequency of use by maintenance workers. Portions of utility chases where the anticipated presence of maintenance workers is routine are not intended to be included by this paragraph.

### 42.2.2 Means of Egress Components.

**42.2.2.1 Components Permitted.** Components of means of egress shall be limited to the types described in 42.2.2.2 through 42.2.2.12.

**42.2.2.2 Doors.**

**42.2.2.2.1** Doors complying with 7.2.1 shall be permitted.

**42.2.2.2.2** Delayed-egress locks complying with 7.2.1.6.1 shall be permitted.

**42.2.2.2.3** Access-controlled egress doors complying with 7.2.1.6.2 shall be permitted.

**42.2.2.2.4** Approved existing horizontal-sliding fire doors shall be permitted in the means of egress where they comply with all of the following conditions:

(1) They are held open by fusible links.
(2) The fusible links are rated at not less than 165°F (74°C).
(3) The fusible links are located not more than 10 ft (3050 mm) above the floor.
(4) The fusible links are in immediate proximity to the door opening.
(5) The fusible links are not located above a ceiling.
(6) The door is not credited with providing any protection under this *Code*.

Use of delayed-egress locking systems in accordance with the requirements of 7.2.1.6.1 is permitted on any door in recognition of the security needs of some storage occupancies. In effect, the allowable 15-second or 30-second delay will be experienced only under non-fire conditions or very early in a fire's growth, because the door must be usable immediately upon sprinkler operation, smoke or heat detection, and loss of power that controls the locking mechanism. The building must be protected throughout by an approved, supervised automatic sprinkler system or an approved, supervised automatic fire detection system.

Paragraph 42.2.2.2.3 recognizes the use of access-controlled egress doors in storage occupancies as a security measure that does not compromise the use of the means of egress.

Horizontal-sliding doors exist in many storage occupancies for property protection purposes. Although the *Code* normally does not recognize these doors within the required means of egress, 42.2.2.2.4 makes an exemption for existing horizontal-sliding fire doors. See Exhibit 42.1. By requiring the fusible link to be positioned in immediate proximity to the door open-

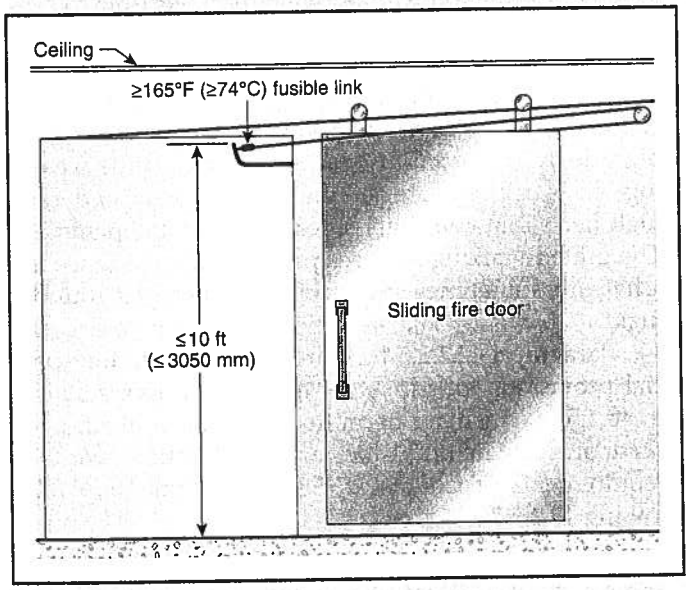



***Exhibit 42.1*** *Existing horizontal-sliding fire door in accordance with 42.2.2.2.4.*

### 42.2.3 Capacity of Means of Egress.

The capacity of means of egress shall be in accordance with Section 7.3.

Prior to the 1991 edition, the *Code* required a minimum 44 in. (1120 mm) width for corridors and passageways within the required means of egress of storage occupancies. A corridor or passageway of that minimum width would have provided egress capacity for 220 persons [i.e., 44 in./0.2 in. per person (approximately 1120 mm/5 mm per person) in accordance with Table 7.3.3.1 for level egress components]. That requirement resulted in excessively large egress systems, relative to the occupant load, in many storage occupancies. The requirement was eliminated, and the minimum 36 in. (915 mm) width requirement of 7.3.4.1(2), which addresses the minimum width of any exit access, was made applicable to storage occupancies. Exit access is required to be wider than 36 in. (915 mm) only if a corridor or passageway in a storage occupancy is to provide capacity for more than 180 persons [i.e., 36 in./0.2 in. per person (approximately 915 mm/5 mm per person)].

See the commentary following A.42.1.7 for details on the determination of occupant load in a storage occupancy.

### 42.2.4 Number of Means of Egress.

See also Section 7.4.

**42.2.4.1** The number of means of egress shall comply with any of the following:

(1) In low hazard storage occupancies, a single means of egress shall be permitted from any story or section.
(2) In ordinary hazard storage occupancies, a single means of egress shall be permitted from any story or section, provided that the exit can be reached within the distance permitted as a common path of travel.
(3) All buildings or structures not complying with 42.2.4.1(1) or (2) and used for storage, and every section thereof considered separately, shall have not less than two separate means of egress as remotely located from each other as practicable.

**42.2.4.2** In new buildings, floors or portions thereof with an occupant load of more than 500 persons shall have the minimum number of separate and remote means of egress specified by 7.4.1.2.

**42.2.4.3** Areas with high hazard contents shall comply with Section 7.11.

Paragraphs 42.2.4.1(1) and (2) modify the requirement for two, separate, remotely located means of egress, due, in part, to the small number of employees typically found in a storage occupancy and the exemplary life safety fire record of such facilities. Paragraph 42.2.4.1(1) recognizes that a low hazard storage occupancy is not subject to a self-propagating fire and, therefore, considers a single means of egress to be safe. Paragraph 42.2.4.1(2) permits a single means of egress in an ordinary hazard storage occupancy if the total travel distance to the single exit does not exceed the 50 ft (15 m) or 100 ft (30 m) common path of travel allowance for nonsprinklered and sprinklered buildings, respectively (see Table 42.2.5). This allowance is made because such a single-exit arrangement is equivalent or superior to a two-exit arrangement that applies the maximum common path of travel allowance and subsequently requires additional travel distance to reach an exit.

In Exhibit 42.3, a single exit is depicted in Part (a). It is located within the distance permitted for common path of travel (see Table 42.2.5), as addressed by 42.2.4.1(2) for ordinary hazard storage occupancies, and creates a situation no more dangerous than the common path of travel shown as X1 to C1 in the two-exit building depicted in Part (b) of Exhibit 42.3.

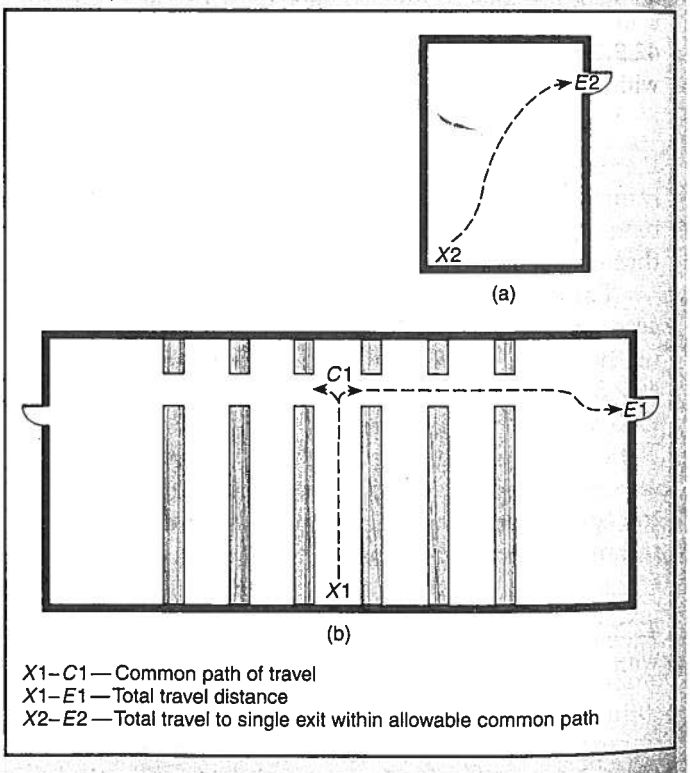



***Exhibit 42.3*** *Common path of travel in single exit building compared to that in two-exit building.*

### 42.2.5 Arrangement of Means of Egress.

Means of egress, arranged in accordance with Section 7.5, shall not exceed that provided by Table 42.2.5.

By definition, no self-propagating fire can occur in low hazard contents. If a fire will not spread or continue to burn, building occupants will not be subject to an emergent need to egress the building by means of paths that avoid the fire. Therefore, the *Code* establishes no maximum dead-end corridor and no maximum common path of travel for storage occupancies with low hazard contents. See Section 6.2.

An ordinary hazard storage occupancy, despite its characteristically low occupant load, is not permitted to provide a common path of travel that forces an occupant to travel in only one direction for more than 50 ft (15 m) [100 ft (30 m) in a sprinklered building] without providing a route to a second, remotely located exit.

By definition, the potential for an extremely rapid-developing fire or an explosion is a characteristic of high hazard contents. If a fire spreads with extreme rapidity, building occupants will have an emergent need to egress the building by means of paths that avoid the fire. Therefore, the *Code* permits no dead-end corridors and no common path of travel for storage occupancies with high hazard contents, except as permitted by 7.11.4. See Section 6.2 and 7.11.4.

### 42.2.6* Travel Distance to Exits.

Travel distance, measured in accordance with Section 7.6, shall not exceed that provided by Table 42.2.6.

*Table 42.2.5 Arrangements of Means of Egress*

| Level of Protection | Low Hazard Storage Occupancy | Ordinary Hazard Storage Occupancy | | High Hazard Storage Occupancy |
|---|---|---|---|---|
| | | ft | m | |
| **Dead-End Corridor** | | | | |
| Protected throughout by an approved, supervised automatic sprinkler system in accordance with 9.7.1.1(1) | NL | 100 | 30 | Prohibited, except as permitted by 7.11.4 |
| Not protected throughout by an approved, supervised automatic sprinkler system in accordance with 9.7.1.1(1) | NL | 50 | 15 | Prohibited, except as permitted by 7.11.4 |
| **Common Path of Travel** | | | | |
| Protected throughout by an approved, supervised automatic sprinkler system in accordance with 9.7.1.1(1) | NL | 100 | 30 | Prohibited, except as permitted by 7.11.4 |
| Not protected throughout by an approved, supervised automatic sprinkler system in accordance with 9.7.1.1(1) | NL | 50 | 15 | Prohibited, except as permitted by 7.11.4 |

NL: Not limited.

*Table 42.2.6 Maximum Travel Distance to Exits*

| Level of Protection | Low Hazard Storage Occupancy | Ordinary Hazard Storage Occupancy | | High Hazard Storage Occupancy | |
|---|---|---|---|---|---|
| | | ft | m | ft | m |
| Protected throughout by an approved, supervised automatic sprinkler system in accordance with 9.7.1.1(1) | NL | 400 | 122 | 100 | 30 |
| Not protected throughout by an approved, supervised automatic sprinkler system in accordance with 9.7.1.1(1) | NL | 200 | 61 | 75 | 23 |
| Flammable and combustible liquid products stored and protected in accordance with NFPA 30, *Flammable and Combustible Liquids Code* | NA | NA | NA | 150 | 46 |

NL: Not limited. NA: Not applicable.

**A.42.2.6** The travel distance to exits specified recognizes a low population density. Consideration should be given to locating areas that have a relatively high population, such as lunchrooms, meeting rooms, packaging areas, and offices, near the outside wall of the building to keep the travel distance to a minimum.

Subsection 42.2.6 establishes limitations on travel distance for storage occupancies. Note that the provisions create a direct relationship between the level of hazard of contents housed within a building and its life safety requirements. Therefore, in low hazard storage occupancies, no limitation is imposed on travel distance.

The absence of travel distance restrictions for low hazard storage occupancies is reasonable, because the small fire risk posed by low hazard materials, coupled with the low number of occupants, provides a minimal risk to life safety. The imposition of restrictive provisions would not be consistent with good fire protection and reasonable life safety requirements, because the probability of fire is relatively low, and occupants are not expected to experience difficulty in evacuating the building. See Section 6.2 for guidelines on the classification of low hazard contents.

As the level of hazard of contents increases, travel distance limitations are imposed. Storage buildings housing ordinary hazards and lacking sprinkler protection are limited to 200 ft (61 m) of travel distance to the nearest exit. A distance of 400 ft (122 m) is permitted if complete automatic sprinkler protection is provided. In high hazard storage occupancies, travel distance is restricted to a maximum of 75 ft (23 m) in nonsprinklered buildings and 100 ft (30 m) if the building is equipped with a complete automatic sprinkler system.

The last entry in Table 42.2.6 addresses an increase in travel distance for storage occupancies where flammable and combustible liquid products are stored and protected in accordance with NFPA 30, *Flammable and Combustible Liquids Code*.[2] Since the 1996 edition, NFPA 30 has provided adequate safeguards to permit increasing the travel distance allowance from 75 ft (23 m) to 150 ft (46 m). Flammable and combustible liquids storage facilities not in compliance with the 1996, 2000, 2003, 2008, or 2012 edition of NFPA 30 should not make use of the travel distance increase.

### 42.2.7 Discharge from Exits.

Discharge from exits shall be in accordance with Section 7.7.

### 42.2.8 Illumination of Means of Egress.

**42.2.8.1** Means of egress shall be illuminated in accordance with Section 7.8.

**42.2.8.2** In structures occupied only during daylight hours, means of egress shall be permitted to be illuminated with windows arranged to provide the required level of illumination on all portions of the means of egress during such hours, when approved by the authority having jurisdiction.

The intent of 42.2.8 is not to require the installation of extensive and unneeded illumination systems in storage occupancies. Illumination is required for exits and exit access, which is limited to designated aisles, corridors, and passageways that lead to an exit. Limiting the extent of the lighting system to egress areas eliminates the necessity for installing specialized lighting systems throughout storage areas, a practice that might be extremely costly while providing little or no return in safety to life.

Paragraph 42.2.8.2 exempts the requirement for illumination systems if a building, including the stairways, is sufficiently lit during periods of occupancy by means of natural lighting. The term *windows*, as used in the text of the exemption, should not be interpreted literally. The term is meant to include skylights, open wall sections, and similar means of illumination by natural sources. The provisions are based on the fact that there is no need for a lighting system if the building is unoccupied during nondaylight hours.

### 42.2.9 Emergency Lighting.

Emergency lighting shall be provided in normally occupied storage occupancies in accordance with Section 7.9, except for spaces occupied only during daylight hours with natural illumination in accordance with 42.2.8.2.

The requirement for emergency lighting is exempted in storage occupancies that are naturally illuminated when occupied for the reasons stated in the commentary following 42.2.8.2. The exemption permits circuit arrangements that disconnect power from emergency lighting systems when the building is unoccupied. In many warehouses, power is turned off during periods when the building is unoccupied. This power disconnection serves fire prevention, energy conservation, and security purposes.

### 42.2.10 Marking of Means of Egress.

Means of egress shall have signs in accordance with Section 7.10.

### 42.2.11 Special Means of Egress Features.

**42.2.11.1 Reserved.**

**42.2.11.2 Lockups.**

**42.2.11.2.1** Lockups in new storage occupancies shall comply with the requirements of 22.4.5.

**42.2.11.2.2** Lockups in existing storage occupancies, other than approved existing lockups, shall comply with the requirements of 23.4.5.

If a storage occupancy is provided with a lockup for security purposes, it must meet the provisions of 22/23.4.5, as specified in 42.2.11.2. The lockup criteria require the application of some of the concepts of detention and correctional occupancies to other occupancies where persons might be detained for security purposes, without classifying the lockup as a detention and correctional occupancy. See 22/23.4.5 and related commentary for details on the lockup provisions.

## 42.3 Protection

### 42.3.1 Protection of Vertical Openings.

Any vertical opening shall be protected in accordance with Section 8.6, unless otherwise permitted by one of the following:

(1) Existing open stairs, existing open ramps, and existing open escalators shall be permitted where connecting only two floor levels.
(2) Existing unprotected vertical openings in buildings with low or ordinary hazard contents, and protected throughout by an approved automatic sprinkler system in accordance with 9.7.1.1(1), shall be permitted where they do not serve as required exits, and where all required exits consist of outside stairs in accordance with 7.2.2, smokeproof enclosures in accordance with 7.2.3, or horizontal exits in accordance with 7.2.4.

Paragraph 42.3.1(2) recognizes that an existing storage occupancy might contain unprotected vertical openings and still provide a reasonable level of safety to life if the building houses only low or ordinary hazard contents and is protected by a complete automatic sprinkler system. Smokeproof enclosures and outside stairs (the only types of vertical exits permitted by this exemption) must be fully enclosed or protected against vertical fire spread and must meet the requirements of Chapter 7. The unenclosed vertical openings are not permitted to serve as part of the means of egress, although they can remain as convenience openings and stairways to be used for normal operations.

### 42.3.2 Protection from Hazards.

(No requirements.) *(See also Section 8.7.)*

### 42.3.3 Interior Finish.

**42.3.3.1 General.** Interior finish shall be in accordance with Section 10.2.

**42.3.3.2 Interior Wall and Ceiling Finish.** Interior wall and ceiling finish materials complying with Section 10.2 shall be Class A, Class B, or Class C in storage areas and shall be as required by 7.1.4 in exit enclosures.

**42.3.3.3 Interior Floor Finish.**

**42.3.3.3.1** Interior floor finish in exit enclosures shall be not less than Class II.

**42.3.3.3.2** Interior floor finish in areas other than those specified in 42.3.3.3.1 shall not be required to comply with Section 10.2.

### 42.3.4 Detection, Alarm, and Communications Systems.

**42.3.4.1 General.** A fire alarm system shall be required in accordance with Section 9.6 for storage occupancies, except as modified by 42.3.4.1.1, 42.3.4.1.2, and 42.3.4.1.3.

**42.3.4.1.1** Storage occupancies limited to low hazard contents shall not be required to have a fire alarm system.

**42.3.4.1.2** Storage occupancies with ordinary or high hazard contents not exceeding an aggregate floor area of 100,000 ft$^2$ (9300 m$^2$) shall not be required to have a fire alarm system.

**42.3.4.1.3** Storage occupancies protected throughout by an approved automatic sprinkler system in accordance with Section 9.7 shall not be required to have a fire alarm system.

**42.3.4.2 Initiation.** Initiation of the required fire alarm system shall be by any of the following means:

(1) Manual means in accordance with 9.6.2.1(1)
(2) Approved automatic fire detection system in accordance with 9.6.2.1(2) throughout the building, plus a minimum of one manual fire alarm box in accordance with 9.6.2.6
(3) Approved, supervised automatic sprinkler system in accordance with 9.6.2.1(3) throughout the building, plus a minimum of one manual fire alarm box in accordance with 9.6.2.6

**42.3.4.3 Notification.**

**42.3.4.3.1** The required fire alarm system shall meet one of the following criteria:

(1) It shall provide occupant notification in accordance with 9.6.3.

(2) It shall sound an audible and visible signal in a constantly attended location for the purposes of initiating emergency action.

**42.3.4.3.2** Positive alarm sequence in accordance with 9.6.3.4 shall be permitted.

**42.3.4.3.3** Existing presignal systems in accordance with 9.6.3.3 shall be permitted.

**42.3.4.3.4** In high hazard storage occupancies, the required fire alarm system shall automatically initiate an occupant evacuation alarm signal in accordance with 9.6.3.

Subsection 42.3.4 requires the installation of a fire alarm system in nonsprinklered storage occupancies with an aggregate floor area of over 100,000 ft$^2$ (9300 m$^2$). An alarm system is also not required in storage occupancies limited to housing low hazard contents, regardless of size, nor is one required in sprinklered storage occupancies, regardless of size. Storage placement limits visibility in buildings with large floor areas. As a result, personnel who work in storage areas might be unaware of the occurrence of fire for a long period. If fire spreads, which is highly possible in an unprotected storage building, means of egress could be blocked. An alarm system provides a means of alerting all occupants to the presence of fire and allows for timely egress.

The requirements of 42.3.4.3.1 and 42.3.4.3.4 specify two separate and distinct provisions for audible alarms activated by the fire alarm system required by 42.3.4.1. In low and ordinary hazard storage occupancies (see 42.3.4.3.1), the system is permitted to activate an evacuation alarm or sound an alarm at a constantly attended location for the purpose of initiating emergency action. This provision permits an interface between the alarm system and the building's emergency organization. The alarm system is permitted to be controlled from a central security console or a similar location. The key feature is that the location from which the alarm sounds must be constantly staffed. This requirement is not intended to mandate the installation of supervisory service, such as connection to a central station, but the location must be fully attended at all times when the building is occupied.

In high hazard storage occupancies (see 42.3.4.3.4), the alarm must be arranged to automatically provide evacuation signals, because the safety of the occupants of these areas depends on their immediate notification of a fire.

Note that 42.3.4.3.3 permits existing presignal systems but not new presignal systems. If an automatic form of delay is desired for an existing alarm system that is not already equipped with a presignal feature, or for a new alarm system, the more reliable system feature known as positive alarm sequence is permitted. The positive alarm sequence option permitted by 42.3.4.3.2 might be applied to the high hazard storage occupancies addressed in 42.3.4.3.4 for which an automatic form of occupant notification is needed. Also, positive alarm sequence might be used in storage occupancies, other than those that are high hazard, where the provisions of 42.3.4.3.1(1) are used instead of those of 42.3.4.3.1(2).

The *Code* does not mandate an alarm system as a property protection requirement, although the probability of property loss is reduced in any occupancy where an alarm system is installed.

### 42.3.5 Extinguishment Requirements.

(No requirements.)

### 42.3.6 Corridors.

The provisions of 7.1.3.1 shall not apply.

Without the exemption to the requirements of 7.1.3.1 provided by 42.3.6, all new storage occupancy corridors serving more than 30 persons would be required to have a 1-hour fire resistance rating, with openings protected by 20-minute fire protection–rated door assemblies. The exemption to 7.1.3.1 is provided because of the ambulatory nature of occupants of storage occupancies; the operational need for openings, even where corridors are provided; and the functional need served by open floor areas.

## 42.4 Special Provisions — High-Rise Buildings

New high-rise storage occupancies shall comply with Section 11.8.

New high-rise, storage occupancy buildings are required to comply with Section 11.8. This reference to the entire Section 11.8 "high-rise package" is new to the 2012 edition of the *Code*. In prior editions, new high-rise industrial occupancy buildings were required to comply only with the sprinkler system requirements of Section 11.8.

## 42.5 Building Services

### 42.5.1 Utilities.

Utilities shall comply with the provisions of Section 9.1.

### 42.5.2 Heating, Ventilating, and Air-Conditioning.

Heating, ventilating, and air-conditioning equipment shall comply with the provisions of Section 9.2.

### 42.5.3 Elevators, Escalators, and Conveyors.

Elevators, escalators, and conveyors shall comply with the provisions of Section 9.4.

### 42.5.4 Rubbish Chutes, Incinerators, and Laundry Chutes.

Rubbish chutes, incinerators, and laundry chutes shall comply with the provisions of Section 9.5.

## 42.6* Special Provisions for Aircraft Storage Hangars

**A.42.6** For further information on aircraft hangars, see NFPA 409, *Standard on Aircraft Hangars*.

**42.6.1** The requirements of Sections 42.1 through 42.5 shall be met, except as modified by 42.6.1.1 through 42.6.3.

**42.6.1.1** There shall be not less than two means of egress from each aircraft storage area.

**42.6.1.2** Exits from aircraft storage areas shall be provided at intervals not exceeding 150 ft (46 m) on all exterior walls.

**42.6.1.3** Where horizontal exits are provided, doors shall be provided in the horizontal exit fire barrier at intervals not exceeding 100 ft (30 m).

**42.6.1.4** Where dwarf, or "smash," doors are provided in doors that accommodate aircraft, such doors shall be permitted for compliance with 42.6.1.1, 42.6.1.2, and 42.6.1.3.

**42.6.2** Means of egress from mezzanine floors in aircraft storage areas shall be arranged so that the travel distance to the nearest exit from any point on the mezzanine does not exceed 75 ft (23 m), and such means of egress shall lead directly to a properly enclosed stair discharging directly to the exterior, to a suitable cutoff area, or to outside stairs.

**42.6.3** Dead ends shall not exceed 50 ft (15 m) for other than high hazard contents areas and shall not be permitted for high hazard contents areas.

For provisions that apply to aircraft servicing hangars, see Section 40.6.

Section 42.6 specifies two alternate methods of providing egress from aircraft storage hangars. Where egress is possible through the outside wall, a distance of 150 ft (46 m) between exit doors is adequate. In larger hangars, the storage bay might have offices and other rooms located along one or more sides, with the walls constructed of fire resistance–rated materials. In those cases where the wall has a fire resistance rating so as to qualify as a horizontal exit, exit spacing of up to 100 ft (30 m) is specified. If the wall is nonrated, access to the outside is required. During inclement weather, large hangar doors are typically closed, so it is common procedure to provide small access doors for personnel in the larger aircraft hangar door. The small door can be considered a normal means of egress from an aircraft hangar. If possible, the door should swing in the direction of egress; however, this might not be possible due to the design of the aircraft door. For further information on aircraft hangars, see NFPA 409, *Standard on Aircraft Hangars*.[3] A typical aircraft storage hangar is depicted in Exhibit 42.4.

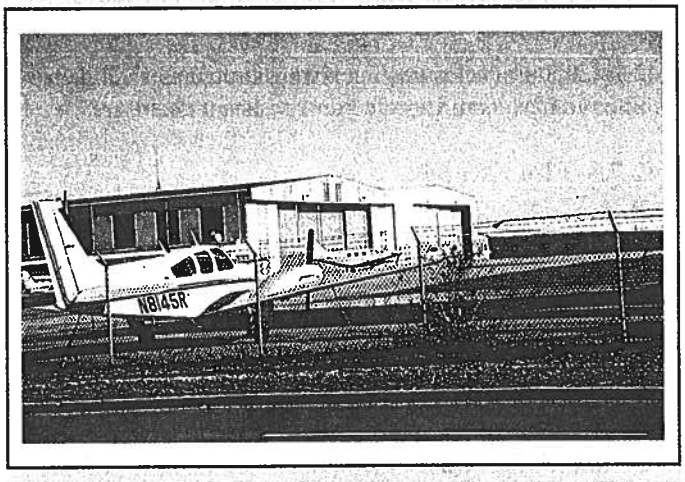



***Exhibit 42.4*** *Typical aircraft storage hangar.*

## 42.7* Special Provisions for Grain Handling, Processing, Milling, or Other Bulk Storage Facilities

**A.42.7** For further information, see NFPA 61, *Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities*. The egress requirements for storage elevators are based on the possibility of fire and are not based on the possibility of grain dust explosions.