CALCULATING EGRESS CAPACITY

Capacity of means of egress is covered in Section 5-3 and in the 2.3 subsection of each occupancy chapter of the Life Safety Code. If you haven't used the Life Safety Code before, you may have some trouble initially with calculating the capacity of means of egress. The follow guidelines should help you develop these calculations.

The first step in evaluating the capacity of means of egress is to determine the occupant load that must be served. Chapter 5 requires that the occupant load of a building, floor or space be based on the actual anticipated maximum occupant load but never less than that determined by using the appropriate occupant load factor. The occupant load factors are provided in the 1.7 subsection of each occupancy chapter and are summarized in A-5-3.1.2. A typical mistake at this stage is to try to restrict the occupant load to that number calculated using the occupant load factors. The Code does not intend to limit the occupant load to this number; rather, it intends to ensure that egress capacity and other life safety considerations are adequate for at least this number of people.

For example, if a building used for business occupancy is 120,000 sq ft in gross area (gross and net area are defined in Chapter 3 under "Floor Area, Gross" and "Floor Area, Net"), divide the square footage by the occupant load factor for business use, which is 1 person per 100 sq ft (gross) area.

120,000 / 100 = 1,200 people

Even if the owner insists that there will never be more than 500 people in the building, an occupant load of 1,200 people is used for determining the applicable code requirements. (There are exceptions for existing assembly occupancies and for Special Purpose Industrial Occupancies; also, Storage Occupancies have no occupant load factor.) However, the owner may want to have 1,500 people in the building, which is acceptable, provided that all the means of egress and other safety requirements for the higher occupant load are met. Assembly occupancies have restrictions on this ability to exceed the calculated number

Once the occupant load has been determined, it is necessary to find the width of each component in the individual egress systems. The components are doors, aisles, corridors, stairs, and so on. Subsection 5-3.2 discusses all such components except doors, which are discussed in 5-2.1.2.1. For the purposes of calculating egress capacity, the width of an egress component is measured "in the clear"--that is, in unobstructed space--except for projections not exceeding 3½ in. located at and below handrail height (maximum of 38 in. high). This exception resolves questions regarding handrails, stair stringers, door knobs and similar objects in the measured space.

Now that we know the width of each component, the next step is to calculate the capacity of each component. The capacities are provided in 5-3.3.1, but the 2.3 subsection of each

chapter should be checked to see if any modifications or additional minimums are provided for the occupancy in question. In general 0.3 in. per person is provided for stairs and 0.2 in. per person is provided for level components. For example, let's assume that we have a 32 in. (clear width) door leading to a 72 in.-wide corridor, and a 30 in. (clear width) door going to a 44 in. stair ending at a 32 in. (clear width) door to the outside.

32 in. clear door = 160 people
0.2 in. per person

72 in. corridor = 360 people
0.2 in. per person

30 in. corridor = 150 people
0.2 in. per person

44 in. wide stair = 146 people
0.3 in. per person

32 in. clear door = 160 people
0.2 in. per person

The door leading to the corridor can handle 160 people, the given portion of the corridor can handle 360 people, and, although the doors in and out of the stair can handle 150 and 160 people respectively, they are limited by the stair to 146 people. Unless the corridor leads to other stairs, the egress system can handle only 146 people since the system is limited to the component with the least capacity, in this case the stair itself. Note that the doors to the stair are considered level components, at 0.2 in. per person. That is why a 3 ft door (32 in. clear width), which is a very common door, is typically used on 44 in. stairs.

Door: 32 / 0.2 = 160 and stair: 44 / 0.3 = 146

A common mistake is to consider stair doors as having a 0.3 in. per person capacity factor.

The last step is to compare the occupant load to the egress capacity to assure that the egress capacity is always greater than or equal to the occupant load.

If you know the occupant load and want to determine the size of an egress component, the same unit capacity factor is used. However, multiply rather than divide. For example, if a room with 50 occupants has a single door, what must be its clear width?

50 people x 0.2 in. per person = 10 in.

However, to assure that such small numbers are not used, minimum widths are provided in 5-3.4 for all components except doors, which are covered by 5-2.1.3. In new construction, this door is required to be at least 32 in. in clear width. If it were an existing door, it would be required to be at least 28 in. in leaf width.

Since a minimum width door in new construction handles at least 160 people (32 in. / 0.2 = 160) and 140 people in existing construction (28 in. leaf width approx. 26 in. clear width, 28 in. / 0.2 = 140), and a minimum width stair handles 146 people (44 in. / 0.3 = 146), detailed calculations of egress capacity are rarely done when dealing with small occupant loads.

When dealing with egress components that serve more than one floor, such as a stair, the occupant load of each floor individually is considered separately, that is, you do not add floors together. There are exceptions to this rule, such as for "mini-atriums" in 6-2.4.5(f), for converging stairs (see 5-3.1.5), for mezzanines (see 5-3.1.6), and in some occupancies (see 26-2.3.3).

FIRE TESTING

ROLE

Each test referenced by the Code is intended to evaluate a specific intended behavior, and only that intended behavior; no other may be inferred from the test. For example, as the NFPA 255 test evaluates a material's relative rate of flame spread, one should not use 255 results to determine fire resistance.

Generally, fire testing provides a relative measure of assembly, material, or device performance. Fire tests provide results which can be used to assess fire performance but they do not replicate all scenarios and exposure severities. For example, an assembly tested for fire resistance (NFPA 251) against a standard predetermined exposure severity might receive a 2-hour fire resistance rating. A high challenge fire, such as one involving a flammable liquid spill, may compromise a 2-hour assembly in less than two hours. Although the potential for variation from tested performance exists, fire testing is still valuable to the Code in that it provides a measure of performance.

Material, assembly, and device performance can only be trusted to behave as expected if they are applied or installed as tested.

TEST TYPES

Building Materials

Fire Barriers

Fire barriers are tested to determine fire endurance expressed as fire resistance. NFPA 251, Standard Methods of Fire Tests of Building Construction and Materials is referenced by the Code for establishing the fire resistance rating of fire barriers. ASTM E-119 and U.L. 263 are equivalent to the NFPA 251 test method.

The actual test involves mounting a test specimen to a furnace and exposing a minimum 100-square-foot area of the specimen to a Standard Time-Temperature exposure. At least nine thermocouples as well as cotton waste are placed on the unexposed surface of the specimen.

Acceptance criteria for desired/anticipated time period include:

- Cotton waste on unexposed surface shall not ignite.
- Unexposed side's surface temperature limited to a 325°F single point rise and a 250°F average rise.
- Hose Stream Test for Assemblies rated for one hour or greater (evaluating impact, erosion, and cooling effects).
- Load-bearing assemblies must sustain their anticipated maximum load.

Structural Frame Elements (Beams and Columns)

- Tested in accordance with NFPA 251 (ASTM E-119, U.L. 263)
- Specimen must sustain applied loading
- Limitation on temperature rise

Doors

Fire doors are required to protect the integrity of fire barriers. The performance requirements for fire doors vary from the requirements for fire barriers, as such the ratings for doors are referred to as "fire protection ratings" rather than "fire resistance ratings". Fire doors are tested in accordance with NFPA 252, Standard Methods of Fire Tests of Door Assemblies. ASTM E-152 and U.L. 10B are equivalent to NFPA 252.

NFPA 252 requires a specimen be mounted to a masonry wall and exposed to the Standard Time Temperature fire exposure.

Acceptance criteria for a desired/anticipated time period include:

- Door must withstand fire exposure without developing openings through the assembly.
- No flaming on unexposed surface for first 30 minutes of test and limited flaming after 30 minutes.
- Must withstand effects of a hosestream test.
- Some warping permitted as long as flaming limitation is satisfied.

Note: No limitation on unexposed surface temperature.

Windows

Windows are tested in accordance with NFPA 257, Standard for Fire Tests of Window Assemblies. ASTM E-163 and U.L. 9 are equivalent to NFPA 257.

NFPA 257 evaluates the ability of a window or other glazing material to remain in an opening for 45 minutes when exposed to a standard time-temperature exposure.

Assembly must withstand fire exposure and hose stream application permitting only a limited amount of openings.

Interior Finish Items

Wall and Ceiling Finish Items

Definition of Flame Spread Rating. The flame spread index (FSI) of a material is a dimensionless number, calculated from the results of a test, which indicates the relative rate

at which flame will spread over the surface of a material as compared with flame spread on asbestos cement board, with an FSI of 0, and red oak, with an FSI of 100. This index is not the speed at which the flame actually spreads across the surface nor is it an indication of the material's fire resistance.

Methods of Test. The test used to obtain results from which an index is calculated is NFPA 255, Method of Test of Surface Burning Characteristics of Building Materials (ASTM E-84 & U.L. No. 723). It is commonly referred to as the Steiner Tunnel Test or the Tunnel Test.

Derivation of Flame Spread Rating. A sample of material to be evaluated (20 inches wide by 24 feet long) is mounted to the ceiling of the tunnel apparatus. A gas flame is applied at one end and a regulated draft is directed through the tunnel from the flame end. The progress of the flame front along the sample is monitored through the side windows. The observations are plotted on coordinate paper to create a time-distance chart of the material being tested. The area under the time distance curve is used to determine the FSI.

There is no relationship between flame spread and fire resistance rating. Fire resistance rating which is a measure of an assembly's fire endurance in hours is determined by an entirely different test, NFPA 251, Standard Method of Fire Tests of Building Construction and Materials (ASTM E-119 or U.L. No. 263). The surface of an assembly with a fire resistance rating determined by NFPA 251 could have a relatively high flame spread index; and conversely, the surface of an assembly possessing very little fire resistance could have a very low flame spread index. There is no correlation between the two ratings.

Smoke Development Index (SDI). Another material characteristic derived from the Tunnel Test and contemplated by the Code is the Smoke Developed Index. SDI represents the relative degree to which a material can obscure the means of egress (i.e. smoke density). The degree of obscuration is measured by a photoelectric cell mounted in the tunnel vent pipe opposite a light source. Reduction in light due to passing smoke, and particulate read by the photoelectric cell is recorded and used to calculate the SDI.

Application of Flame Spread Ratings. Relative values on how fast fire will spread across the surface of a material allow fire protection professionals to deal with problems involving possibilities of 1) people being trapped within a building before orderly evacuation can be accomplished, and 2) rapid spread of fire through an entire building or area of a building before the usual fire protection measures can be put into effect to control or extinguish the fire.

For the purpose of applying flame spread limits to interior finish materials, NFPA 101, Life Safety Code groups flame spread indices into three classes as follows:

Class A	FSI 0-25
Class B	FSI 26-75
Class C	FSI 76-200

Also, to qualify for one of the acceptable classes, newly installed interior finish materials must have an SDI that doesn't exceed 450. A material with an SDI greater than 450 receives no classification regardless of FSI.

The Class ABC designations used by the Life Safety Code correlate with the ABC designations used by the Standard Building Code and Class I, II, and III designations used by the National and Uniform Building Codes.

The Code specifies the class of interior finish materials to be used in certain areas within buildings, depending on the occupancy and use of the space within the building. Since the Code addresses Safety to Life, these flame spread limits are aimed at controlling the threat to people.

Textile Wall Coverings

Of critical importance to the Code's intention of regulating interior finish items is the presumption that materials will be used in their intended orientation. For example, carpeting tested in accordance with the flooring radiant panel test is acceptable only for use on a floor. In the recent past, there has been a proliferation in the use of carpet and carpet- like materials as wall and ceiling finish items. Correspondingly, there is a growing case history of fire incidents in which the application of floor finish items on walls and ceilings has been detrimental to the incident.

The Code addresses this concern by prohibiting carpet-like materials (napped, tufted, lopped, woven, non-woven, or similar surfaces) from being applied to walls or ceilings, unless:

- such materials are Class A rated and installed in automatic sprinkler protected spaces, or
- such materials have been previously installed and possess a Class A rating, or
- such materials have a Class A rating and are applied to fixed or movable partitions $\leq$ ¾ floor-to-ceiling height and $\leq$ 8 ft, or
- < 4 ft high on ceiling-height walls, or
- such materials have been tested in accordance with NFPA 265, Standard Method of Fire Test for Evaluating Room Fire Growth Contributions of Textile Coverings.

NFPA 265, commonly referred to as a room corner test is used to evaluate the flammability characteristics of textile wall coverings, where such materials constitute the exposed interior surfaces of buildings. This test provides:

- extent or room fire growth
- upper level gas temperature
- rate of heat release
- heat flux, incident to floor

- time to flashover, if occurs
- rate of CO production

but does not provide:

- complete toxicity information of combustion gases
- fire resistance of floor ceiling systems

This test method allows for the use of one of two testing protocols. Protocol A provides for specimens to be mounted on two walls of the test compartment. Protocol B requires the test compartment to have three fully-lined walls. Materials are mounted using substrates, backings, insulations and air gaps which resemble the intended use. For each protocol, a gas burner located in a corner of the compartment provides a diffusion flame exposure for a 15 minute period.

The test is conducted with natural ventilation through the test compartment doorway. Combustion products are collected into a hood.

Textile wall coverings should be considered as demonstrating satisfactory performance if:

- flashover does not occur
- flame should not spread to the ceiling during the initial gas burner exposure period
- during the later period of the gas burner exposure, flames should not spread to the outer extremities of the test sample
- peak heat release should be limited

See A-6-5.2.3 for a discussion on textile wall coverings.

Floor Coverings

Tested in accordance with NFPA 253, Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source. ASTM E-648 is equivalent to NFPA 253.

NFPA 253 evaluates a floor covering's ability to withstand fire exposure and subsequent resistance to flame propagation across its surface. A specimen is mounted to the floor of a Flooring Radiant Panel test apparatus. A gas-fired, inclined radiant heat source exposes the specimen. The distance the sample is burned is converted to a Critical Radiant Flux (CRF) value. The higher the CRF, the better the floor covering.

See A-6-5.4.1 for a further discussion on floor coverings.

Furnishings and Contents

Upholstered Furnishings and Mattresses

Cigarette Ignition Resistance:

- NFPA 260, Standard Method of Tests and Classification System for Cigarette Ignition Resistance of Components of Upholstered Furniture. NFPA 260 is the same as the Upholstered Furniture Action Council (UFAC) Standard Test.
- NFPA 261, Standard Method of Test for Determining Resistance of Mock-Up Upholstered Furniture Assemblies to Ignition by Smoldering Cigarettes.

Rate of Heat Release:

- ASTM E-1537 Standard Method of Fire Testing of Real Scale Upholstered Furniture Items

Draperies and Curtains
Tested in accordance with NFPA 701, Standard Method of Fire Tests for Textiles and Flames.

- Large Scale Test
- Small Scale Test
- Match Flame Field Test (Only used by AHJs as a confirmatory tool, not a substitute for large and small scale tests, therefore not to be relied upon to assess LSC compliance.)

NFPA 101 requires that specimens pass both large and small scale tests.

TEST DOCUMENTATION

Following is a partial listing of documents available that provide test documentation:

U.L. Fire Resistance Directory
U.L. Building Materials Directory
FM Approval Guide
Warnock Hersey and ETL Certification Listings by Intertek Testing Services

FIRE ALARM AND FIRE DETECTION

FIRE PROTECTIVE SIGNALING SYSTEMS

Functions

Fire protective systems involve several functions:

Initiation

A fire alarm system must receive input to start its operation. This initiation may take one of several forms, the most common method being manual pull stations. Pull stations should be located in accordance with NFPA 72 and should be unobstructed, accessible, and within a natural path of travel. There should be at least one pull station at each required exit, with additional stations so located that total travel distance to a pull station does not exceed 200 feet. Other forms of initiating devices include automatic fire detectors (heat or smoke detectors), sprinkler water flow switches, and pressure switches.

Notification

Occupant warning is the primary reason the Code requires fire protective signaling systems. Generally, the Code makes reference to one or more installation standards to accomplish this "Local Alarm" notification. While Chapter 7 typically requires general audible and visible notification appliances throughout the entire building without delay, it permits (given occupancy chapter allowance) the incorporation of a "Pre-Signal Feature."

The Pre-Signal concept introduces a human element into the sequence of events. An initiation signal must be received by a person, then acted upon (i.e., transmitting general audible alarm).

There are two other instances when the general evacuation alarm signal need not automatically operate throughout the building:

- Staff Notification - Where occupants are deemed incapable of self-preservation, as in health care and detention and correction occupancies, the Code permits the use of a signal to provide staff notification. The signal should be familiar to staff, and indicate affected area of building (e.g., 'Dr. Blaze, report to Ward 2 South," or "Code Red, Emergency Room").

- Selective Notification - When building configuration or size does not permit total evacuation, the Code permits selective notification to facilitate an orderly evacuation. Those floors or areas of the building most affected by the fire are first notified, followed by the next most seriously affected portions of the building.

In addition to warning building occupants, the fire protective signaling system may be called upon to provide for automatic fire department notification, building control functions, or supervisory service.

Building Control Functions
Elevator recall, fan shutdown, door closure, and smoke control activities may all interface and be managed by the fire alarm system.

Supervision
A fire protective signaling system may be designed to monitor the overall integrity of the fire protection system, incorporating:

- Integrity of the fire protective signaling system itself (trouble signal)
- Sprinkler system water flow
- Valve tamper
- Tank water level
- Tank water temperature
- Pump running
- Power supply

Types of Fire Alarm Systems

Local Protective Signaling System
Such systems are intended to provide notification to occupants within the protected building and are not required to provide automatic fire department notification. NFPA 72 is the appropriate reference standard (previously NFPA 72A).

Auxiliary Protective Signaling System
The protected building's alarm initiating devices are connected to a municipal fire alarm system. The alarm signal terminates at the fire communications center and transmits the same signal as the street box. NFPA 72 is the appropriate reference standard (previously NFPA 72B).

Remote Station Protective Signaling System
The alarm signal is received at a constantly attended location remote from the protected building. The remote receiving facility does not have to be a fire service

communications center. Leased telephone lines or Digital Alarm Communicators transmit the signal from the protected building to the remote receiving facility which, although not required, may be a police or fire station (not an auxiliary system). NFPA 72 is the appropriate reference standard (previously NFPA 72C).

Proprietary Protective Signaling System

A proprietary system involves one or more buildings under single ownership connected to a central alarm receiving facility under the same ownership. Signal is received at a constantly attended receiving facility. NFPA 72 is the appropriate reference standard (previously NFPA 72D).

Central Station Protective Signaling System

The building fire protective signaling system is connected to a privately owned, constantly attended location. When an alarm signal is received by central station staff, action must be taken to notify the fire department. NFPA 72 (previously NFPA 71) is the appropriate reference standard.

Equipment/Technology

Multiplex

Multiplexing refers to the transmitting and receiving of multiple signals (simultaneously or sequentially) over a single circuit. Generally, modern fire alarm systems implementing multiplexing technology employ either microprocessors or computers to interface with fire alarm components. The state of initiating devices or initiating device circuits (e.g., smoke detectors) can be actively monitored, and the condition of each device or circuit can be individually identified at a central panel.

Addressable Detectors

Addressability permits the detector to individually communicate with the control panel. Typically, the control panel constantly polls individual devices on a circuit as to their current status (normal, alarm, or trouble).

Wireless Transmission

Although used for many years in central station applications, the use of Radio-Frequency signal transmission (RF) may now be used in local alarm applications. RF transmission reduces the need for "hardwire" signal transmission cabling. Although the technology is similar, application requirements vary for central station, remote, proprietary, and local alarm systems.

CODES AND STANDARDS

Codes identify the conditions which mandate the installation of a fire protective signaling system and automatic detection. NFPA 101 generally requires a fire protective signaling system for occupant notification when a building reaches such size that a reliable means of alerting occupants to evacuate is essential for life safety. The various occupancy chapters contain requirements for such systems typically based upon the number of stories or the occupant load. In addition, some occupancies are required to be protected with a fire protective signaling system to alert staff or employees to initiate the fire emergency plan.

Automatic detection is typically required in the residential occupancies so as to alert sleeping occupants. NFPA 101 also requires automatic detection in other instances such as enclosed, non-occupied spaces; areas open to the means of egress; door release service; and as an alternative to manual pull stations. These requirements are occupancy dependent.

When a fire protective signaling system or automatic detection system is required by NFPA 101 or installed as alternative protection, installation shall be in accordance with Section 7-6. In addition to specific criteria, Section 7-6 also mandates compliance with the following reference standards, where applicable:

- NFPA 70 - National Electrical Code
- NFPA 72 - Installation, Maintenance and Use of Protective Signaling Systems (Formerly NFPA 71, 72A, 72B, 72C, 72D, 72F and NFPA 74)
- NFPA 1221 - Installation, Maintenance and Use of Public Fire Service Communication Systems

It should be noted that NFPA 101 and the reference standards require that the devices and equipment installed in fire protective signaling systems be listed. In addition to manufacturer's literature, the following two publications are widely used to verify the listing of such devices and equipment:

UL Fire Protection Equipment Directory
FM Approval Guide

AUTOMATIC FIRE DETECTION

Fire detectors are designed to discover fire by recognizing one of several fire signatures: heat (thermal), smoke (aerosol), flame (IR and UV), and fire gases. After sensing the fire, a detector or system of detectors may be responsible for alarm initiation, fire suppression actuation, or triggering building control activities (e.g., door closure, fan shutdown or elevator recall).

Types of Detectors

Heat Detectors Typically the slowest form of detection, heat detectors are ideally suited to detecting rapidly developing fires in small spaces and are less prone to unwanted alarms than smoke detectors. Generally less expensive than smoke detectors, heat detectors are a good alternative in areas where conditions would not permit use of other detection forms or where speed is not the primary concern. Heat detectors employ one or more of several operating mechanisms :

- Fixed temperature - Detectors are designed to alarm when the operating element reaches a predetermined temperature.
- Rate of rise - Detectors alarm when the rate of rise of the surrounding air temperature exceeds a predetermined value (regardless of ambient temperature) and are preferable to fixed temperature for fast developing fires.
- Combination - Incorporates fixed-temperature and rate-of-rise mechanisms into one detector.

Smoke Detectors Generally, smoke detectors respond more rapidly than heat detectors, especially for slower developing or smoldering fires. Smoke detectors are more sensitive to certain ambient/environmental conditions than heat detectors. Dust, humidity, temperature, and vehicle exhaust cause problems for smoke detectors. There are two basic operating principles for smoke detectors:

- Photoelectric - The presence of smoke particles affect the presence of light beam in one of two ways: either light obscuration (beam detector) or light scattering, in which smoke particles change the direction of light beams in a chamber.
- Ionization - The presence of a small amount of radioactive material ionizes the air within a sensing chamber, causing a current flow in the air between two electrodes. When smoke particles enter the chamber, the flow of current is affected, causing an alarm.

Flame Detectors Sensitive to light energy emitted by fires, flame detectors can only respond to causes within their line of sight. Flame detectors can sense either ultraviolet or infrared energy.

Gas Sensing Fire Detectors Detect gases produced as a result of the combustion process.

Selection

The following factors impact detector type selection:

- Anticipated fire
- Ambient conditions
- Space configuration
- Ventilation
- Detection goals (i.e., life safety or property protection)
- Cost

Location and Spacing

The location and spacing of automatic detectors should be based on the applicable code requirements including the appropriate reference standard, NFPA 72, (previously NFPA 72E). In addition to the listing criteria, specific fire tests and manufacturer's literature must be referred to for spacing criteria.

FIRE ALARM & DETECTOR TESTING

Many problems encountered with fire protective signaling systems are the result of conditions at the time the system was accepted. Therefore, prior to accepting a system, a complete test of the system, including all devices and functions, should be performed. At the completion of all tests, the contractor should be required to certify that the system is properly installed. The following should be consulted for testing requirements and protocol:

- NFPA 72
- NFPA 70
- Manufacturer's Literature

FIRE ALARM AND DETECTOR MAINTENANCE

Similar to acceptance testing, system and device maintenance, and periodic testing are essential to the reliability of the system. NFPA 101 requires an approved maintenance and testing program (7-6.1.7). Such programs should consider the requirements in NFPA 72, NFPA 70, and the recommendations of the manufacturer.

AUTOMATIC SPRINKLER PROTECTION

GENERAL

An automatic sprinkler system consists of a number of thermally sensitive, heat-actuated automatic sprinklers attached to a network of piping which is connected to a reliable water supply.

OBJECTIVE

The objective of sprinkler protection is to control a developing fire (prevent flashover) and to limit the spread of the fire and its effects. Residential sprinkler systems are intended to control fire growth and spread and to permit safe egress for building occupants.

SYSTEM COMPONENTS

Water Sources

Sprinkler systems derive water supplies from one or more possible sources:

- Public water distribution system
- Fire pumps
- Water storage tanks (suction, gravity, and pressure)
- Natural water sources (e.g., ponds or wells)

Types of Systems

Wet Pipe
A system of automatic sprinklers attached to a piping network filled with water at all times and connected to a water supply. When a sprinkler opens due to a fire, water immediately discharges from the system. Only those sprinklers opened by the fire discharge water.

Dry Pipe
A system of automatic sprinklers attached to a piping network which is filled with either air or nitrogen under pressure. Upon sprinkler actuation, the air or nitrogen is released, reducing pressure in the piping and allowing water supply pressure to open a dry-pipe valve, permitting water flow through the piping and from the open sprinklers. Dry-pipe systems are used in lieu of wet-pipe systems in areas subject to freezing.

Pre-Action
A system of automatic sprinklers attached to a piping network filled with air that may or may not be under pressure. A fire actuates an associated fire detecting device (e.g., heat detector) which opens a system water control valve permitting water to enter the piping network. When a sprinkler subsequently opens, the system performs like a wet-pipe system allowing immediate water discharge. Typically used in areas judged to be water sensitive (e.g., electrical equipment rooms, computer rooms).

Deluge
A system of open sprinklers connected to a network of piping. A fire detector sensing a fire opens a system water control valve (deluge valve) allowing water to flow through the piping and discharge from all the sprinklers.

Piping and Fittings

Pipe, fittings, and pipe joining methods should comply with the requirements of NFPA 13, 13R, or 13D as appropriate. Currently, two non-metallic pipe materials are U.L.-listed for use in sprinkler systems. Polybutylene and chlorinated polyvinyl chloride (CPVC) have wide approval for residential and light hazard applications. To be used, each must be installed in adherence with its listing limitations and manufacturer's instructions.

AUTOMATIC SPRINKLERS

Automatic sprinklers incorporate heat-sensitive devices designed to respond at a predetermined temperature. Sprinklers are tested and rated to respond at a specific temperature. Once the predetermined temperature is reached, an operating element (e.g., fusible link, glass bulb) releases a valve cap that allows water to flow through the sprinkler orifice (standard orifice is 1/2 inch in diameter).

Water flowing from the orifice strikes a deflector to produce a specific spray pattern to cover a certain area. Sprinklers can be installed either in the upright or pendant positions. It is important that the correct sprinkler be chosen for the desired orientation. Standard spray upright sprinklers (SSU) and standard spray pendant (SSP) sprinklers are available. Although deflector shape typically indicates intended orientation, the letters SSU or SSP should be stamped on the deflector for easy identification.

Also available are sidewall sprinklers, designed so that the deflector discharges water in a horizontal plane; these are often used in residential and retrofit applications. Some sprinklers are designed and listed to be installed concealed, recessed, or flush with the ceiling. Also available are sprinklers coated with a corrosion resistant substance, such as wax, which will melt and permit normal sprinkler operations.

Fast Response Sprinklers

Fast response sprinklers is a relatively new general category that includes Early Suppression Fast Response (ESFR), Quick Response (QR), Quick Response Extended Coverage (QREC), Quick Response Early Suppression (QRES), and residential sprinklers. The fast response characteristics enable the specific sprinkler to provide increased life safety or suppress high challenge fire hazards. In the case of the QRES, the sprinkler is listed for its capability to provide fire suppression of specific fire hazards.

The response characteristics for sprinklers can be quantified in terms of a Response Time Index (R.T.I.). Sprinklers with an R.T.I. of 50 (metric) or 90 (English) are generally considered fast response.

DESIGN REQUIREMENTS

- In accordance with appropriate standard

- Hydraulic design based on:

    - Hazard Classification
    - Design Density
    - Computer aided methods

- Pipe schedule systems limited in application

- Spacing

    - Area of coverage limits
    - Avoid cold soldering
    - Avoid obstructions
    - Complete coverage

- Hangars and Bracing

- Supervision

INSPECTION, TEST, AND MAINTENANCE

- NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water Based Extinguishing Systems

CODES AND STANDARDS

Life Safety Code:

- Mandates Installation
- Code Specified Alternative
- Equivalency Option (101:1-6)

Installation References:

- NFPA 13 - Standard for the Installation of Sprinkler Systems
- NFPA 13R - Standard for the Installation of Sprinkler Systems in Residential Occupancies up to Four Stories in Height
- NFPA 13D - Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings

Additional Sprinkler Installation Guidance:

- NFPA 15 - Water Spray Fixed Systems for Fire Protection
- NFPA 16 - Deluge Foam-Water Spray Systems
- NFPA 20 - Centrifugal Fire Pumps
- NFPA 22 - Water Tanks for Private Fire Protection
- NFPA 24 - Private Fire Service Mains and Their Appurtenances
- NFPA 30 - Flammable and Combustible Liquids Code
- NFPA 231 - Standard for General Storage
- NFPA 231C - Standard for Rack Storage of Materials
- U.L. Fire Protection Equipment Directory
- F.M. Approval Guide

APPENDIX E

HEALTH CARE OCCUPANCY CLASSIFIER

HEALTH CARE OCCUPANCY CLASSIFIER

1) Does the space provide sleeping accommodations for four (4) or more patients who are incapable of self-preservation?

☐ **YES:** STOP **STOP:** This space must be evaluated as a Health Care occupancy.

☐ **NO:** ☞ **GO TO** Question 2.

2) Is the space occupied at any time by four (4) or more patients who are incapable of self-preservation?

☐ **YES:** ☞ **GO TO** Question 3

☐ **NO:** ☞ **GO TO** Question 7.

3) Is the space contiguous to a Health Care building?

☐ **YES:** ☞ **GO TO** Question 4.

☐ **NO:** STOP **STOP** - This space is Ambulatory Health Care

4) Is the space intended primarily for out-patient or non-patient use?

☐ **YES:** ☞ **GO TO** Question 5.

☐ **NO:** STOP **STOP** - This space must be evaluated as Health Care since it is not primarily intended for out-patient and non-patient use.

5) Is the space separated from the Health Care portions of the building by at least 2-hour fire resistance-rated construction?

☐ **YES:** ☞ **GO TO** Question 6.

☐ **NO:** STOP **STOP** - This space must be evaluated as Health Care since it is not properly separated from the Health Care occupancy.

6) Is the space used at any time by four (4) or more inpatients from the Health Care facility who are incapable of self-preservation (i.e., they are litter-borne)?

☐ **YES:** STOP **STOP** - This space must be evaluated as Health Care since it is used by four (4) or more inpatients who are incapable of self-preservation.

☐ **NO:** STOP **STOP** - This space can be evaluated as Ambulatory Health Care.

7) Is the space contiguous to a Health Care building?

☐ **YES:** ☞ **GO TO** Question 8.

☐ **NO:** STOP **STOP** - This space is an occupancy other than Health Care.

8) Is the space separated from the Health Care portions of the building by at least 2-hour fire resistance-rated construction?

☐ **YES/NA:** ☞ **GO TO** Question 9.

☐ **NO:** STOP **STOP** - This space must be evaluated as Health Care since it is not properly separated from the Health Care occupancy.

9) Is the space separated from any Ambulatory Health Care areas of the building by at least 1 hour fire resistance-rated construction?

☐ **YES/NA:** STOP **STOP** - This space can be evaluated as an occupancy other than Health Care.

☐ **NO:** STOP **STOP** - This space must be evaluated as Ambulatory Health Care since it is not properly separated from the Ambulatory Health Care occupancy.

User's Guide to the **Health Care Occupancy Classifier**

Health care facilities are commonly comprised of many different "use" areas that form one health care complex. Since the *Life Safety Code*, NFPA *101*, requirements are based on the occupancy classification, it is critical to be able to accurately classify an area within a health care facility by its proper occupancy. This is also required when completing *Statement of Conditions* forms for JCAHO accreditation since the SOC forms are based on the occupancy classification of the space or building being evaluated. Though the *Code* typically classifies an entire health care building as "Health Care" or mixed occupancy, there are provisions to classify areas within the building as an other occupancy. Commonly, these are "Ambulatory Health Care" and "Business" though several other NFPA *101* occupancy classification can be found in many health care complexes.

One of the most common, and troubling, problems encountered when evaluating health care facilities is the determination of a space or building being Health Care, Ambulatory Health Care or some other occupancy type (e.g., Business). Although this may appear to be an easy task, to perform this exercise properly can be more complex than initially thought.

The accompanying ***Health Care Occupancy Classifier***, and this "User's Guide" were developed to assist in accurately and effectively completing this task. It is intended that the *Classifier* be used as a tool to assist the user in applying the requirements of NFPA *101*. It should not be used in place of the *Code* as all requirements cannot be include in such a tool, nor in the brief User's Guide. Also, this tool does not further classify Health Care occupancies according to their use as a hospital, limited-care facility or nursing home, since such use is typically apparent. To properly use the ***Health Care Occupancy Classifier***, you must always pass through the questions until you reach a "STOP."

1) Does the space provide sleeping accommodations for four (4) or more patients who are incapable of self-preservation? Any space providing sleeping accommodations for four (4) or more patients who are incapable of self-preservation is considered Health Care or mixed occupancy per the *Code*. "Patients" are those occupants who are present for the purpose of receiving medical or related treatment. A patient is considered "incapable of self-preservation" if they need assistance from others in the event of an emergency. The use of a cane or wheelchair does not constitute "incapable of self-preservation." The key is SELF-preservation. It should be understood that the patient count should be based on the number of patients which can be realistically anticipated; it is not based on an average or a typical patient census. However, the patient count would not include the fact that the facility's disaster plan may use the area for such patients. See NFPA *101*, 4-1.4 and 12/13-1 for complete details.

2) Is the space occupied at any time by four (4) or more patients who are incapable of self-preservation? In this question we are not concerned with sleeping accommodations - only the number and capabilities of the patients present. The reason for this is that Ambulatory Health Care facilities cannot provide sleeping

accommodations (24 hour care) for its patients; note this does not prohibit limited post-operative recovery in a bed. Again, the patient count should be based on the number of patients which can be realistically anticipated as discussed in Question 1. See NFPA *101* 12/13-1.3 for more information.

3) Is the space contiguous to a Health Care building? In many cases, what may otherwise be an Ambulatory Health Care facility, Business office, or other occupancy group, will actually have to be evaluated as Health Care or mixed occupancy due to a lack of fire-separation or its use by certain inpatients when connected to a Health Care facility. See NFPA *101* 12/13-1.2.2 for more information.

4) Is the space intended primarily for out-patient or non-patient use? An Ambulatory Health Care facility that is contiguous with a health care building must be primarily used for out-patient services. If a facility is used extensively by in-patients, the facility must be evaluated as Health Care (not Ambulatory Health Care).

5) Is the space separated from the Health Care portions of the building by at least 2-hour fire resistance-rated construction? Any space that is to be classified as another use (not Health Care) must be separated from Health Care areas by 2-hour fire resistance-rated construction complying with NFPA *101* 12/13-1.2 and 12/13-1.1.4. These paragraphs should be consulted for complete separation requirements.

6) Is the space used at any time by four (4) or more inpatients from the Health Care facility who are incapable of self-preservation? If any space is used by four of more in-patients who are incapable of self-preservation, NFPA *101* 12/13-1.2.1 and 12/13-1.2.2 requires that the space be evaluated as Health Care or mixed occupancy. Refer to Question 1 for a discussion on assessing patient counts.

7) Is the space contiguous to a Health Care building? See the discussion under Question 3 above.

8) Is the space separated from the Health Care portions of the building by at least 2-hour fire resistance-rated construction? See the discussion under Question 5 above.

9) Is the space separated from any Ambulatory Health Care areas of the building by at least 1-hour fire resistance-rated construction? Any space (other than Health Care) that is to be classified as a use other than Ambulatory Health Care must be separated from Ambulatory Health Care areas by 1-hour fire resistance-rated construction. See NFPA *101* 12/13-6.3.7 for more information. Also remember that a 2-hour separation is required between Health Care and all other occupancies, including Ambulatory Health Care (see Question 8).

TO: LT Heffern

Inspection, Testing, and Maintenance for Fire Protection Systems at Medical Treatment Facilities: JCAHO versus Navy/DoD Compliance

***Question*: Why has the Navy decided to perform inspection, testing, and maintenance (ITM) for several components of fire protection systems *less frequently* than the intervals specified by NFPA and JCAHO?**

***Answer*:** On 1 January 2001, DoD adopted a Unified Facilities Criteria (UFC) document, UFC Number 3-600-02, titled "Maintenance and Operation: Inspection, Testing and Maintenance for Fire Protection Systems, applicable to all Navy, Air Force, and Army facilities. This document requires less frequent inspection, testing, and maintenance (ITM) for several components of fire protection systems. To review this document go to: http://criteria.navfac.navy.mil/criteria/documents/unified_facilities_criteria.htm and then click on the applicable UFC Number (3-600-02). It states in section 1-1 (Background) "It is based on recognized reliability-centered maintenance concepts and reliability-centered risk management. It was prepared using model building maintenance codes, National Fire Codes, industrial standards, and other recognized standards to the maximum extent feasible. Personnel safety and continuity of mission were primary considerations." In section 1-2 (Purpose and Scope) it states "This UFC provides requirements for *ITM* of engineered fire protection features in Department of Defense (DoD) facilities. Do not deviate from these criteria without prior approval of the component office of responsibility: U.S. Navy, NAVFACENGCOM HQ-CHENG."

***Question*: Is BUMED pursuing a resolution to this issue?**

***Answer*:** Yes. BUMED has contacted the Naval Facilities Engineering Command (NAVFACENGCOM) to discuss the issue of UFC Number 3-600-02 conflicting with JCAHO and NFPA compliance for ITM of fire protection systems. The NAVFACENGCOM Chief Fire Protection Engineer stated, "The NFPA documents state that their purpose *is to provide requirements that ensure a reasonable degree of protection for life and property from fire through minimum inspection, testing, and maintenance...* They also state that they *are not intended to prevent the use of alternative test methods or testing devices.* UFC 3-600-02 is based on a 99% overall system reliability, which I believe equates to or is better than NFPA's statement of *reasonable degree of protection*. As far as the hospitals go, it appears it would be in our best interest to have a meeting with BUMED (and possible the Army & Air Force Medical Commands) and a representative of JCAHO to ensure that they understand how UFC 3-600-02 was developed and that they concur with the UFC and will still provide accreditation for the medical facilities. If they disagree and want to follow NFPA requirements, then we can modify the UFC accordingly." The meeting to discuss this issue is currently in the coordination stage. The results of the meeting will be communicated to BUMED medical treatment facilities.

***Question*: What should I do in the interim, pending a resolution to this issue?**

***Answer*:** Discuss it with your facilities officer/manager and brief it to your CO. Your command should contact the host Public Works Center (or other responsible entity) and the local fire department and/or "Authority Having Jurisdiction" for your facility(ies) to ensure they are aware of the conflict between UFC 3-600-02 and JCAHO Environment of Care (EC) Standard EC.2.10.2. Decide on what appropriate action to take based on the circumstances for ITM of fire protection systems at your activity, pending final resolution of the matter. Discuss the issue at your Safety Policy Council meeting (or equivalent) and document it in the minutes

***Question*: What are some examples of less frequent requirements for *ITM* of fire protection systems components established by UFC 3-600-02 versus JCAHO EC.2.10.2?**

***Answer*:** Here are some of the ITM frequency requirement differences:

Initiating devices/supervisory signal devices (except valve tamper switches) tested: JCAHO EC.2.10.2a.1/quarterly, UFC 3-600-02/two years.

Initiating devices/valve tamper switches and water flow devices tested: JCAHO EC.2.10.2a.2/semiannually, UFC 3-600-02/annually.

Initiating devices/heat detectors, smoke detectors, and manual fire alarm boxes tested: JCAHO EC.2.10.2a.3/annually, UFC 3-600-02/two years.

Water-based automatic fire extinguishing system/fire pumps tested *under no flow condition*: JCAHO EC.2.10.2d.1/weekly, UFC 3-600-02/monthly.

Water-based automatic fire extinguishing system/fire pumps tested *under flow*: JCAHO EC.2.10.2d.2/annually, UFC 3-600-02/five years.

Water-based automatic fire extinguishing system/all fire department connections inspected: JCAHO EC.2.10.2d.6/quarterly, UFC 3-600-02/annually.

U.S. Army Center for Health Promotion and Preventive Medicine

Just the Facts

56-32-0396

Flammable and Combustible Liquid Indoor Storage Rooms

General Design Guidelines

- Storage
- Ventilation
- Flashpoint

BACKGROUND

Indoor storage rooms containing flammable and combustible liquids must comply with the guidelines set by both the Flammable and Combustible Liquids Code, NFPA 30, and the Standard Method of Fire Tests of Building Construction and Materials, NFPA 251. This material is of particular importance in health care facilities, where the proper design and maintenance of storage areas are essential to the safety of everyone in the facility.

TERMINOLOGY

◆ Flammable Liquid - A liquid having a closed cup flash point below 100°F and having a vapor pressure ≤ 40 psia at 100°F.

1. Class IA: Flashpoint < 73°F and Boiling Point < 100°F
2. Class IB: Flashpoint < 73°F and Boiling Point ≥ 100°F
3. Class IC: Flashpoint ≥ 73°F and Flashpoint < 100°F

◆ Combustible Liquid - A liquid having a closed cup flash point at or above 100°F.

1. Class II liquids: Flashpoint ≥ 100° and Flashpoint < 140°
2. Class IIIA liquids: Flashpoint ≥ 140° and Flashpoint < 200°
3. Class IIIB liquids: Flashpoint ≥ 200°

GENERAL ROOM REQUIREMENTS

◆ Class I (Flammable Liquids) may not be stored in the basement of an establishment. Class II and III liquids (Combustible Liquids) may be stored in a room located in the basement only if that room is protected by an approved automatic sprinkler system (NFPA 30, 4-4.3.5).

◆ Storage rooms for flammable and combustible liquids must comply with the space requirements in the following table:

Is the room sprinkled?	Walls - Fire Resistance Rating (FRR)	(X) - Size of Storage Room (sq. ft.)	Storage Allowed (gals/sq. ft.)
Yes	2 hours	150 < X ≤ 500	10
No	2 hours	150 < X ≤ 500	5
Yes	1 hour	0 < X ≤ 150	4
No	1 hour	0 < X ≤ 150	2

Medical Safety and Health Program
U.S. Army Center for Health Promotion and Preventive Medicine
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OPENINGS

◆ Openings must be provided with approved self-closing fire doors. These doors must have positive latching. A 45- minute fire door must be provided for a 1-hour enclosure and a 1½-hour door for a 2-hour enclosure (NFPA 30, Table 4-4.2.2).

◆ Doors are allowed to remain open during any handling of the storage room supply only if the doors can close automatically in the event of an emergency (i.e., with the use of a self-closer) (NFPA 30, 4-4.2.2).

◆ Either curbs or open-grated trenches must be provided to prevent spills from entering other areas (NFPA 30, 4-4.2.7).

STORAGE ORGANIZATION

◆ Most importantly, the storage of any liquid must not obstruct any means of egress (NFPA 30, 4-4.3.1).

◆ In every storage room, one clear aisle must be maintained at least 3 feet wide (OSHA 29 CFR 1910.106). However if the room contains any storage racks, a 4 foot aisle must be present between racks (NFPA 30, 4-4.3.3).

◆ Wood may be used for shelving only if the wood is at least 1 inch in thickness. It may also be used for racks, scuff boards, and floor overlay (NFPA 30, 4-4.3.2).

◆ Containers over 30 gallons must not be stacked one upon the other (OSHA 29 CFR 1926.152).

◆ The quantity of liquid that may be located outside a storage room in any fire zone shall not exceed: 25 gallons of Class IA liquids in containers, 120 gallons of Class IB, IC, II, or III liquids in containers, and 660 gallons of Class IB, IC, II, or III liquids in a single tank (OSHA 29 CFR 1910.106).

◆ One portable fire extinguisher must be located no more than 10 feet from any indoor storage area (NFPA 30, 4-8.4.1).

VENTILATION

◆ Ventilation exhaust systems for flammable/combustible storage areas can either be mechanical or gravitational (OSHA 29 CFR 1910.106).

◆ Mechanical Ventilation Systems

1. Minimum 6 ACH required.
2. If ventilation can be directly turned off into the storage room, a switch must be located on the exterior of the room.
3. This switch should be in series with any room lighting fixtures to ensure adequate ventilation when the room is occupied.
4. Pilot lights are required to be installed next to the breaker switch if Class I liquids are to be stored.
5. Room air intake and exhaust outlets must be located on the exterior of the building. Exhaust outlets should also be located away from the air intake to prevent contamination of the fresh supply.

◆ Gravitational Ventilation Systems

1. Minimum 6 ACH required.
2. Room air intake and exhaust outlets must be located on the exterior of the building. Exhaust outlets should also be located away from the air intake to prevent contamination of the fresh supply.

ELECTRICAL SYSTEMS

◆ Electrical wiring and components in indoor storage rooms with Flammable liquids should be suitable for Class I, Division 2 hazardous locations. Electrical wiring and components to be used within indoor storage rooms of Combustible liquids should be suitable for general purposes only (NFPA 30, 4-4.2.9).

FIRE PLAN AND FIRE RESPONSE MANUAL

THE AIM OF A FIRE PLAN IS:

- **to reduce the risk to persons in the premises by the prevention of fire or the control of a fire, if one should occur,**
- **the maintenance of fire protection, fire detection and fire warning systems designed to protect the occupants and the building, and finally,**
- **to ensure the safe evacuation of all the occupants.**

A fire plan must be tailored to the specific needs of the premises and its occupants and should identify:

- **A management structure to ensure the correct implementation of the Fire Plan**
- **The appropriate action to be taken by the various occupants in the event of fire**
- **Appropriate staff training arrangements including induction training**
- **Fire prevention procedures, including the maintenance, testing and recording procedures for each element of fire safety protection systems and procedures**

THE FIRE PLAN WILL INCLUDE:

- **Individual floor plans showing all the Fixed Installation, and the buildings main service controls including the sprinkler shut-off valve**
- **Fire Detection Points and Fire Alarm actuation points**
- **The Means of Escape and their maintenance, inclusive of all doors, stairways, gangways and other routes to identify ways that they can always be used in an emergency**
- **Staff Training programs and the actions to take in the event of fire**
- **Staff emergency procedures inclusive of all special risk areas, (e.g. kitchens, boiler rooms, laundries etc.)**
- **A Management Structure to ensure implementation of the plan.**
- **Maintenance and Test records for equipment, installations and staff**

- **New Staff Induction Program**

A Health and Safety Guideline for Your Workplace

Fire Protection

Introduction

Fire protection is an organized approach designed to prevent fires. In the event of a fire, a fire protection program will help prevent or minimize personal injuries, and losses.

This guideline is designed to help you develop a fire protection program, or to identify areas in your existing program that may need improvement.

The elements of a fire protection program are discussed below.

Workplace Assessment

Your first step is to do a workplace assessment. You will be evaluating your workplace for:

- fire hazards,
- effectiveness of controls;
- emergency preparedness.

Collect as much information as possible on each of the areas shown in Appendix 1. This should include hazard and control information as well as relevant legal standards and requirements. An inventory of hazardous materials used in your workplace will prove useful.

Follow this up with a walk-through assessment of your workplace. Using the information you have collected, develop a basic floor plan and an assessment checklist for this purpose. Use the checklist to record your observations.

The results of your workplace assessment will help you determine the need to improve or implement:

- fire prevention and control procedures;
- an emergency plan.

Fire Prevention and Control

The best way to protect your employees and property is to prevent a fire from happening. The most effective way to do this is to eliminate or minimize all fire hazards.

If a fire does occur, however, immediate steps should be taken to control it, and prevent it from spreading.

Fire prevention and control are achieved by combining engineering, work practice and administrative controls. Appendix 2 provides some examples of each of these controls.

Emergency Plan

A fire emergency plan outlines a sequence of steps to be taken when fire strikes. Its purpose is to ensure the safety and health of employees, and to minimize the damage to property

Your plan should provide for "worst case" scenarios. Guidelines are provided in Appendix 3 to help you in preparing your plan.

Fire Inspections

Establish a regular schedule of fire inspections. These will help detect any deviations from, or shortcomings in, your control standards and emergency procedures. Take corrective action as soon as possible.

Appendix 4 is a sample checklist you can use to monitor your fire protection program. You will, of course, need to expand on the points provided under each general heading. The information collected during your workplace assessment, and subsequent action taken, will help you to come up with your own detailed checklist.

Carry out a complete assessment whenever you make changes in your workplace, such as a change in process., work activity or materials used.

Related Legislation

Ontario Regulations for Industrial Establishments:

- Sections 121 & 124 specify that certain requirements of the Building Code and Fire Code apply to industrial establishments.

These Regulations also contain provisions with respect to:

- storage of flammable liquids (s.26);
- portable containers for dispensing flammable liquids (s.27).

Ontario Fire Code:

- Part 2: Building and Occupant Fire Safety contains provisions for:
  - fire separations (s.2.2);
  - fire hazards (s.2.4);
  - fire department access to buildings (s.2.5);

- service equipment (s.2.6);
- safety to life (s.2.7);
- emergency planning (s.2.8).

- Part 3: Property Protection for Industrial and Commercial Occupancies.
- Part 4: Flammable and Combustible Liquids (Reserved)*.
- Part 5: Hazardous Materials, Processes and Operations.
- Part 6: Fire Protection Equipment.
- Part 7: Inspection, Testing and Maintenance of Fire Emergency Systems in High Buildings.
- Part 9: Retrofit.

*In the meantime, consult the *National Fire Code of Canada 1990, Part 4.*

Ontario Building Code:

- Part 3: Use and Occupancy - specifies requirements for:
  - fire alarms and detection systems (s.s.3.2.4);
  - fire fighting (s.s.3.2.5);
  - lighting and emergency power systems (s.s.3.2.7);
  - standpipe and hose systems (s.s.3.2.9);
  - requirements for exits (s.3.4).

Ontario Hydro Electrical Safety Code

- Section 18: Hazardous Locations.

For Further Information

To help you design your fire protection program and particularly in carrying out your workplace assessment, consult the following:

- Fire Protection Handbook, 15th edition
- Industrial Fire Hazards Handbook, 1st edition
- Suppliers' Materials Safety Data Sheets for the hazardous materials used in your workplace
- IAPA's Chemical Control Program Guide (G01211).

The first two publications are available from the National Fire Protection Association, Batterymarch Park, Quincey, Massachusetts, USA 02269.

Appendix 1
Assessing Your Workplace

Areas to be Assessed	Comments
Work Processes/Activities • Potential fire hazards (sources of ignition, and their location) • high risk areas (e.g., piping or tanks) • appliances, mechanical electrical equipment used • hazardous materials used, amounts, and characteristics (flammable, explosive, reactive, toxic, corrosive, oxidizing, compressed gases)	

• hazardous by-products (e.g., explosive dusts)		
Building • floor layout (stairs, exits, assess to exits) • building materials (fire-resistance ratings) • storage areas • emergency lighting • fire detectors and suppressors smoke detectors, automatic sprinklers)		
People (employees, visitors, community) • number that may be affected • characteristics (consider any disabilities that would affect their ability to evacuate) • location: - inside building (control rooms, offices) - outside building (storage yards) - neighbourhood (homes, schools)		
Controls • engineering controls • work practices • administrative controls • fire containment (extinguishers) • flammable spills containment (e.g., dykes, containment ponds, or isolation valves)		

Appendix 2
Example of Fire Controls

Engineering

- **Process alteration**
- **Substitution with less hazardous process materials**
  (the Chemical Referral Centre of the Canadian Chemical Producers' Association may be able to help in this regard; their toll free number is 1-800-267-6666).
- **Workplace design**
  - proper storage facilities (properly marked);
  - proper ventilation;
  - fire proofing of buildings;
  - installation of fire/heat/smoke detectors;
  - proper fire doors, and sprinkler systems;
  - control of explosive atmospheres e.g., dusts);

- adequate spill containment.

- **Elimination of Ignition sources**
  - static electricity;
  - electrical equipment (should be intrinsically safe and must be certified by the Canadian Standards Association or the Ontario Hydro Electrical Inspection department);
  - machinery (proper maintenance);
  - friction.
- **Consult a fire protection engineering consultant, if necessary.**

Work Practices

- **Housekeeping**
  - adequate waste disposal;
  - exit/fire escape access;
  - unobstructed aisles;
  - control of flammable dusts.
- **Proper storage of flammables and combustibles**
- **Company policies**
  - no smoking;
  - hot work permits.
- **Use of approved portable safety containers for the dispensing of flammable liquids**
- **Bonding/grounding**
- **Proper use and maintenance of electrical equipment**
- **Proper selection and use of fire extinguishers**

Administrative

- **Fire Safety Plan**
  (You may be required to have your plan approved by your local Fire Chief. See Section 2.8 of the Ontario Fire Code).
- **Fire Inspections**
  - establish schedule (daily, weekly, monthly);
  - by whom (internal: fire brigade members; external: fire department, insurance company);
  - by work area or department;
  - record keeping and follow-up.
- **Review**
  - new construction;
  - change in process design;
  - similar industry experiences;
  - changes to legislation (fire/building codes);
  - smoking policy;
  - hot work permit procedures;
  - plant security.
- **Employee training (including induction training and retraining) in:**
  - preventive measures;
  - inspection techniques;
  - fire extinguisher use;
  -hazard reporting;
  - emergency procedures.
- **Test**
  - employee knowledge of fire prevention procedures, and application of knowledge.

Appendix 3

Guidelines for an Emergency Fire Plan

Assign responsibilities at all levels for each of the following areas.

Communications

Install a communications system, and establish procedures to:

- **Alert occupants**
  - alarm systems.
- **Mobilize fire fighters**
  - municipal fire department;
  - ant fire brigade.
- **Meet fire department on arrival, and advise them on:**
  - location of fire;
  - contents in and near the location;
  - trapped people.
- **Make contact with:**
  - neighbouring industries that could be at risk;
  - police;
  - hospital;
  - workplace security.
- **Test communications system regularly**
- **Mark all exits clearly**

Fire Extinguishment

Organize a fire brigade, and provide training in:

- **Proper procedures**
  - take into account the volume of flammable materials, and areas at high risk of destruction;
- **Shutdown of processes;**
- **Use of equipment**
  - hoses
  - personal protection
  - etc.
- **Use of emergency lighting and power sources;**
- **Emergency plant access for fire trucks and ambulances.**

Safety of People

To ensure the safety of all persons in your workplace

- **Make sure exits and fire escapes are adequate**
  - properly marked;
  - accessible
- **Plan and drill for evacuation**
  - removal of all persons (including the handicapped, and those in special areas, e.g., washroo ıs);
  - ensuring that all persons (including visitors) are accounted for; this includes prompt access t daily attendance record;
  - use of alternative exits;
  - escape from toxic gases that may be generated during the fire.
- **Provide temporary refuge for those unable to evacuate**
- **Plan and drill for rescue operations**
  - availability of equipment;

- first aid.

Appendix 4
Fire Protection Checklist

Inspection Date_____ **Conducted by**_____

Department_____

Assessed Areas	Comments & Observations
Workplace Assessment **Work Processes** - all possible sources of ignition identified? - etc. • **Building Construction** - all wiring properly installed and of approved construction without extensions or temporary wiring? - etc. • **Building Contents**	
Controls • **Engineering** - ventilation systems implemented and working properly? - etc. • **Work Practices** - rubbish removed daily or more frequently? - aisles and floors free of oil and other flammable spills? - etc. • **Administrative Controls**	
Emergency Plan • **Communications** - emergency phone numbers readily accessible? - etc. • **Safety of People** - all employees trained and tested in evacuation procedures? - etc. • **Fire Extinguishment** - fire extinguishers tested? - etc.	

Fire Protection is one in a series of guidelines to help you make your workplace safer and healthier. Other

guidelines in this series on **Fire Safety** are:

- Fire Extinguishers (LPAA701)
- Industrial Fire Brigades (S00882)
- Static Electricity (LPAA712).

To order copies of these guidelines or other IAPA publications, contact Inquiries Service at one of the numbers below.

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