



AMERICAN UNIVERSITY OF BEIRUT
FIRE PROTECTION MANUAL

ENVIRONMENTAL HEALTH, SAFETY & RISK MANAGEMENT
FIRE PROTECTION DIVISION
JULY 2003

Forward.

The American university of Beirut (Campus, Medical Center, & AREC) is committed to providing its patients, students, employees and visitors with an environmental health, safety and risk management services that support the university's mission of rendering education, research, patient care and public services.

The Fire Protection Division of the Environmental Health, Safety & Risk Management (EHS&RM) is responsible for implementing the University's Policy on Environmental Health, Safety and Risk Management by ensuring that campus operations comply with Lebanese and/or US National Safety and environmental regulations, building code requirements and standards.

The purpose of this manual is to prescribe minimum requirements necessary to establish a reasonable level of fire safety and property protection from the hazards created by fire and explosion. The manual partially comprised of limited text references extracted from NFPA codes and applicable standards in an effort to bring together information useful to the AUB community.

Moreover, the Fire Protection Division of EHS&RM offers AUB staff and students life safety and fire fighting training sessions that are related to the nature of their work or building occupancy use. This document and other pertinent Fire protection and fighting training information and training materials may be obtained from the Environmental Health, Safety & Risk Management Office.

Important Phone Numbers.

Environmental Health, Safety & Risk Management:	2360
Fire Protection Engineer:	2360/2368
Hospital Safety Officer:	2360/6019
Protection Office:	2400
Fire:	5555
Beirut Fire Brigade:	175
Civil Defense:	125
Red Cross:	140

TABLE OF CONTENTS

Chapter	Page
1. Administration and Enforcement	1
1.1 Authority.	1
1.2 The Emergency Response Team.	1
1.3 Plans Review.	1
1.4 Code Review.	2
1.5 Independent Review.	2
1.6 Permits and Approvals.	2
1.7 Certificates of Fitness.	2
1.8 Application.	2
1.9 Occupancy.	3
1.10 Changes of Occupancy.	3
1.11 Maintenance and Testing.	3
1.12 Records and Reports.	3
1.13 Fire Reporting and False Alarms.	3
1.14 Tampering With Fire Safety Equipment.	4
2. General Provisions	5
2.1 Fundamental Requirements.	5
2.2 Building Evacuation.	5
2.3 Fire Drills.	5
2.4 Smoking.	5
2.5 Public Roads Accessible to Fire Apparatus.	5
2.6 Fire Protection Markings.	5
2.7 Stairway Marking.	5
2.8 Combustible Vegetation.	6
2.9 Special Outdoor Events, Carnivals, and Fairs.	6
3. Means of Egress	7
3.1 Application.	7
3.2 Doors.	7
3.3 Number of Means of Egress.	7
3.4 Arrangement of Means of Egress.	8
3.5 Occupant Load.	8
3.6 Illumination of Means of Egress and Emergency Lighting.	8
3.7 Marking of Means of Egress.	9
3.8 Means of Egress Reliability.	9
3.9 Furnishings and Decorations in Means of Egress.	9
4. Features of Fire Protection	10
5. Building Services	11
5.1 Electrical Fire Safety.	11
5.2 Heating, Ventilation, and Air Conditioning.	11
5.3 Elevators.	11

5.4 Utilities.	11
5.5 Heating Appliances.	11
5.6 Portable Electric Heater.	11
5.7 Chimneys.	11
5.8 Emergency and Standby Power.	11
5.9 Smoke Control.	12
6. Fire Protection Systems	13
6.1 General.	13
6.2 Standpipe Systems.	13
6.3 Automatic Sprinklers.	13
6.4 Fire Pumps.	14
6.5 Water Supply.	15
6.6 Portable Extinguishers.	15
6.7 Detection, Alarm, and Communication Systems.	16
6.8 Other Fire Protection Systems.	18
7. Combustible Waste and Refuse	19
7.1 Combustible Waste and Refuse.	19
7.2 Sources of Ignition.	19
8. Commercial Cooking Equipment	20
9. Fireworks	22
10. Flammable and Combustible Liquids	23
10.1 General.	23
10.2 Storage, Handling and Use.	23
11. Hot Work Operations	25
11.1 General.	25
11.2 Fire Prevention Precautions.	25
11.3 Hot Work Permit.	25
11.4 Fire Watch.	26
11.5 Oxygen-Fuel Gas Systems.	26
12. Laboratories Using Chemicals	27
13. Liquefied Petroleum Gases and Liquefied Natural Gases	28
13.1 General.	28
13.2 Containers.	28
13.3 Piping (Including Hose), Fittings, and Valves.	29
13.4 Installation of LP-Gas Systems.	29
13.5 LP-Gas Systems in Buildings or on Building Roofs or Exterior Balconies.	33
13.6 Buildings Under Construction or Undergoing Major Renovation.	33
13.7 Buildings Housing Industrial Occupancies.	33
13.8 Buildings Housing Educational and Laboratory Occupancies.	33
13.9 Cylinders on Roofs or Exterior Balconies.	33
13.10 Fire Protection.	34
13.11 Storage of Portable Containers Awaiting Use.	34
13.12 Storage within Buildings.	34

14. Parking Garages	36
15. Safeguards During Building Construction, Alteration, and Demolition Operations	37
15.1 General.	37
15.2 Scaffolding, Shoring, and Forms.	37
15.3 Flammable and Combustible Liquids.	37
15.4 Alteration of Buildings.	38
16. Grandstands and Bleachers, Folding Seating, Tents, and Membrane Structures	39
16.1 General.	39
16.2 Guards and Railings.	39

1. Administration and Enforcement

1.1 Authority.

The AUB Environmental Health, Safety & Risk Management (EHS&RM) department is the authority having jurisdiction on the interpretation and implementation of the minimum requirements set forth in this manual.

The AUB Protection Office shall have authority to render necessary assistance when requested to do so by EHS&RM.

The EHS&RM shall be authorized to inspect, at all reasonable times, any building or premises for dangerous or hazardous conditions or materials as set forth in this manual. The EHS&RM shall have authority to order any person(s) to remove or remedy such dangerous or hazardous condition or material. Any person(s) failing to comply with such order shall be in violation of the requirements in this manual.

The EHS&RM shall be authorized to enter and examine any building, structure, construction site, or premises for the purpose of making fire safety inspections.

The EHS&RM shall have the authority to investigate the cause, origin, and circumstances of any fire, explosion, or other hazardous condition.

The EHS&RM shall have the authority to require plans and specifications to ensure compliance with applicable codes and standards.

Whenever any installation subject to inspection prior to use is covered or concealed without having first been inspected, the EHS&RM shall have the authority to require that such work be exposed for inspection. The EHS&RM shall be notified when the installation is ready for inspection and shall conduct the inspection within a reasonable period of time.

When any construction or installation work is being performed in violation of the plans and specifications as approved by the EHS&RM, the EHS&RM may stop work on that portion of the work that is in violation.

The EHS&RM shall have the authority to order the immediate evacuation of any occupied building deemed unsafe when such building has hazardous conditions that present imminent danger to building occupants.

1.2 The Emergency Response Team.

The American University of Beirut is an institution of higher education and is subject to several natural and man-made hazards and risks. These include but are not limited to: Earthquakes, fires, hazardous materials spills or releases, lightning, terrorist acts, bomb threats etc ... It is important to note that preventive and security measures cannot assure elimination of all risks. Therefore, it is inevitable that the University will find itself facing emergency situations of various kinds. Because of this, the University has founded the Emergency Response Team (ERT) and devised an [Emergency Response Plan](#) to deal effectively with most anticipated kinds of emergency situations.

Established in the summer of 2000, the ERT is composed of twenty-five people, from different AUB hospital and campus departments, and is headed by President John Waterbury and Vice President George Tomey. The Environmental Health, Safety and Risk Management (EHS&RM) department supervises the team and works closely with the AUB Protection Office as well as the Physical plant. The ERT provides first and basic response to fires, releases of hazardous and toxic materials and can perform limited rescue services.

1.3 Plans Review.

As required by the Policy on Environmental Health, Safety & Risk Management issued April 15, 1999, by president John Waterbury, all new construction, modification, or rehabilitation, construction documents and shop drawings shall be submitted to and reviewed by EHS&RM as the established authority having jurisdiction for approvals.

It shall be the responsibility of the applicant to ensure that the following conditions are met:

- (1) The construction documents include all of the fire protection requirements.
- (2) The shop drawings are correct and in compliance with the applicable codes and standards.

When required by the EHS&RM, revised construction documents or shop drawings shall be prepared and submitted for review and approval to illustrate corrections or modifications necessitated by field conditions or other revisions to approved plans.

1.4 Code Review.

The EHS&RM determines violations of the minimum requirements set forth in this manual and other applicable codes and standards for existing occupancies on campus and the medical center. Violations of the minimum requirements of NFPA 101 *Life Safety Code* will be conveyed to the concerned jurisdictions.

1.5 Independent Review.

The EHS&RM is permitted to require a review by a mutually acceptable independent third party with expertise in the matter to be reviewed at the submitter's expense. The independent reviewer shall provide an evaluation and recommend necessary changes of the proposed design, operation, process to the EHS&RM.

1.6 Permits and Approvals.

The EHS&RM shall be authorized to establish and issue permits, certificates, notices, and approvals, or orders pertaining to fire control and fire hazards pursuant to this section.

The EHS&RM shall be permitted to revoke a permit or approval issued if any violation of the minimum requirements set forth in this manual is found upon inspection or in case there have been any false statements or misrepresentations submitted in the application or plans on which the permit or approval was based.

Any attempt to defraud or otherwise deliberately or knowingly design, install, service, maintain, operate, falsify records, reports, or applications, or other related activity in violation of the requirements prescribed by this manual shall be a violation of the provisions of this manual. Such violations shall be cause for immediate suspension or revocation of any related licenses, certificates, or permits issued by this jurisdiction.

The EHS&RM has the authority to require an inspection prior to the issuance of a permit.

Applications for permits shall be made to the EHS&RM on forms provided by the jurisdiction and shall include the applicant's answers in full to inquiries set forth on such forms. Applications for permits shall be accompanied by such data as required by the EHS&RM and fees as required by the jurisdiction.

A copy of the permit shall be posted or otherwise readily accessible at each place of operation or carried by the permit holder as specified by the EHS&RM.

1.7 Certificates of Fitness.

The authority having jurisdiction shall have the authority to require certificates of fitness for individuals or companies performing activities related to fire safety and construction within the jurisdiction.

1.8 Application.

The minimum requirements of this manual shall apply to both new and existing conditions.

Buildings in existence or permitted for construction prior to the adoption of the minimum requirements set forth in this manual shall comply with the provisions stated herein or referenced for existing buildings.

Existing buildings or installations that do not comply with the provisions of this manual shall be permitted to be continued in use unless EHS&RM determines that the lack of conformity with these codes and standards presents an imminent danger.

Additions, alterations, or repairs to any building shall conform to that required of a new building without requiring the existing building to comply with all the requirements of this manual. Additions, alterations, or repairs shall not cause an existing building to become unsafe or adversely affect the performance of the building as determined by EHS&RM.

Where two or more classes of occupancy occur in the same building or structure and are so intermingled that separate safeguards are impracticable, means of egress facilities, construction, protection, and other safeguards shall comply with the most restrictive fire safety requirements of the occupancies involved.

1.9 Occupancy.

No new construction or existing building shall be occupied in whole or in part except as permitted by EHS&RM.

Buildings or portions of buildings shall not be occupied during construction, repair, or alteration without the approval of EHS&RM if required means of egress are impaired or required fire protection systems are out of service.

1.10 Changes of Occupancy.

In any building or structure, whether or not a physical alteration is needed, a change from one occupancy classification to another shall be permitted only where such a structure, building, or portion thereof conforms with the requirements of NFPA 101, *Life Safety Code*, that apply to new construction for the proposed new use, or NFPA 101, *Life Safety Code*, existing construction features shall be permitted to be continued in use in conversions.

1.11 Maintenance and Testing.

Whenever or wherever any device, equipment, system, condition, arrangement, level of protection, or any other feature is required for compliance with the provisions of NFPA 101, *Life Safety Code*, such device, equipment, system, condition, arrangement, level of protection, or other feature shall thereafter be continuously maintained in accordance with applicable NFPA requirements or as directed by EHS&RM.

Maintenance and testing shall be under the supervision of a responsible person from Physical Plant who shall ensure that testing and maintenance are made at specified intervals in accordance with applicable NFPA standards or as directed by EHS&RM.

1.12 Records and Reports.

A record of examinations, approvals, and variances granted shall be maintained by the Physical Plant and shall be available for public inspection.

The EHS&RM shall be notified to witness and be provided with all records of all fire prevention inspections.

1.13 Fire Reporting and False Alarms.

The person discovering any unwanted fire, regardless of magnitude, shall take the following actions:

1. **Remain calm** - do not shout "Fire".
2. **Rescue:** Rescue personnel who are in immediate danger. This step is usually performed simultaneously with step 3, **Alarm**.
3. **Alarm:** Give the alarm - dial 5555, give your name and inform operator of exact location of fire and pull the nearest fire alarm.
4. **Contain:** Close doors and windows to isolate fire and smoke from the rest of the building.
5. **Evacuate:** Evacuate immediately. Do not use elevators for evacuation.

-
6. **Extinguish:** You may fight the fire if you have been trained to do so, your exit is assured and the alarm has been given.
 7. Do not re-enter the building until the alarm is silenced and you are told by the Emergency Response Team that it is safe to do so.
 8. Once the Beirut Fire Brigade arrives, they will be in charge until they declare the area is safe and leave the scene.

No person shall deliberately or maliciously turn in an alarm of fire when in fact that person knows that no fire exists.

1.14 Tampering With Fire Safety Equipment.

No person shall render any portable or fixed fire-extinguishing system or device or any fire warning system inoperative or inaccessible.

No person, except a person authorized by the EHS&RM, shall remove, unlock, destroy, or tamper with, in any manner, any locked gate, door, or barricade; chain; enclosure; sign; tag; or seal that has been required by the EHS&RM pursuant to life safety.

2. General Provisions

2.1 Fundamental Requirements.

Every new and existing building or structure shall be constructed, arranged, equipped, maintained, and operated in accordance with the minimum requirements set forth by this manual so as to provide a reasonable level of life safety, property protection, and public welfare from the actual and potential hazards created by fire, explosion, and other hazardous conditions.

Every new and existing building shall comply with NFPA 101, *Life Safety Code*.

2.2 Building Evacuation.

No person shall fail to leave a building when notified to do so or when directed to leave by the EHS&RM as a result of a known or perceived emergency.

No person shall fail to leave any overcrowded premises when told to do so by the management of the premises or the EHS&RM. Premises are deemed to be overcrowded when the occupant load exceeds the exit capacity or a posted occupant load.

2.3 Fire Drills.

Where required, emergency egress and relocation drills will be conducted as specified by the EHS&RM.

Drills will be held with sufficient frequency to familiarize occupants with the drill procedure and to establish conduct of the drill as a matter of routine. Drills will include suitable procedures to ensure that all persons subject to the drill participate.

Drill participants shall relocate to a predetermined assembly area and remain at such location until a recall or dismissal signal is given.

2.4 Smoking.

The American University of Beirut has issued a smoking policy (ref.179910 038) that is posted on the Web.

Removal or destruction of any required "No Smoking" sign shall be prohibited.

2.5 Public Roads Accessible to Fire Apparatus.

Public roads on Campus shall have not less than 6 m of unobstructed width, able to withstand live loads of fire apparatus, and have a minimum of 4.1 m of vertical clearance. An approved turnaround for fire apparatus shall be provided where an access road is a dead end and is in excess of 46 m in length. The turnaround shall have a minimum centerline radius of 15 m.

Public roads around fire hydrants shall be maintained free of all obstructions at all times.

2.6 Fire Protection Markings.

New and existing buildings shall have approved address numbers or names placed in a position to be plainly legible and visible from the street or road fronting the property. These numbers shall contrast with their background.

2.7 Stairway Marking.

Stairs serving five or more stories shall be provided with signage within the enclosure at each floor landing. The signage shall indicate the story, the terminus of the top and bottom of the stair enclosure, and the identification of the stair enclosure. The signage also shall state the story of, and the direction to, exit discharge. The signage shall

be inside the enclosure located approximately 1.5 m above the floor landing in a position that is readily visible when the door is in the open or closed position.

Wherever an enclosed stair requires travel in an upward direction to reach the level of exit discharge, signs with directional indicators indicating the direction to the level of exit discharge shall be provided at each floor level landing from which upward direction of travel is required. Such signage shall be readily visible when the door is in the open or closed position.

2.8 Combustible Vegetation.

Combustible vegetation and natural cut Christmas trees shall not be permitted in all occupancies except living vegetation.

Artificial combustible vegetation and Christmas trees shall be labeled or otherwise identified or certified by the manufacturer as being flame retardant or flame resistive.

No combustible vegetation and Christmas trees shall be allowed to obstruct corridors, exit ways, or other means of egress.

Only listed electrical lights and wiring shall be used on combustible vegetation, Christmas trees, and similar decorations.

Open flames such as from candles, lanterns, kerosene heaters, and gas-fired heaters shall not be located on or near combustible vegetation, Christmas trees, or other similar combustible materials.

Combustible vegetation and natural cut Christmas trees shall not be located near heating vents or other fixed or portable heating devices that could cause it to dry out prematurely or to be ignited.

2.9 Special Outdoor Events, Carnivals, and Fairs.

The EHS&RM shall approve and regulate all outdoor events such as carnivals and fairs as it pertains to access for emergency vehicles; access to fire protection equipment; placement of stands, concession booths, and exhibits; and the control of hazardous conditions dangerous to life and property.

The EHS&RM shall be permitted to require standby fire personnel when potentially hazardous conditions exist, due to the type of performance, display, exhibit, or activity, or the number of persons present.

Electrical equipment and installations of these events shall comply with NFPA 70, *The national Electric Code*.

3. Means of Egress

3.1 Application.

Means of egress in new and existing buildings shall comply with NFPA 101, *Life Safety Code*.

All inside stairs serving as an exit or exit component shall be enclosed.

Exit enclosures shall not be used for any purpose that has the potential to interfere with its use as an exit.

There shall be no enclosed, usable space within an exit enclosure, including under stairs, nor shall any open space within the enclosure be used for any purpose that has the potential to interfere with egress.

3.2 Doors.

Any device or alarm installed to restrict the improper use of a means of egress shall be designed and installed so that it cannot, even in case of failure, impede or prevent emergency use of such means of egress.

Swinging doors shall swing in the direction of egress travel where serving a room or area with an occupant load of 50 or more or serving a high hazard contents, unless it is a door from an individual living unit that opens directly into an exit enclosure.

Swinging doors shall swing in the direction of egress travel and provided with panic hardware where serving a room or area with an occupant load of 100 or more. Devices shall not be installed in connection with any door on which panic hardware or fire exit hardware is required where such device prevents or is intended to prevent the free use of the door for purposes of egress.

Doors shall be arranged to be opened readily from the egress side whenever the building is occupied. Locks, if provided, shall not require the use of a key, a tool, or special knowledge or effort for operation from the egress side.

Every door in a stair enclosure serving more than four stories shall allow re-entry from the stair enclosure to the interior of the building, or an automatic release shall be provided to unlock all stair enclosure doors to allow re-entry. Such automatic release shall be actuated with the initiation of the building fire alarm system.

Delayed-egress locks shall be permitted to be installed on doors serving low and ordinary hazard contents in buildings protected throughout by an approved, supervised automatic fire detection system, or an approved, supervised automatic sprinkler system, where permitted by the occupancy classification, and as approved by EHS&RM. The doors shall unlock upon actuation of the alarm or the sprinkler system, loss of power controlling the lock, or an irreversible process of a force to the release device continuously applied as required by EHS&RM.

The minimum width of egress doors in existing buildings shall not be less than 71 cm.

The minimum width of egress doors in existing buildings shall not be less than 91 cm.

The minimum width of egress doors in the medical center shall not be less than 112 cm.

3.3 Number of Means of Egress.

The number of means of egress from any balcony, mezzanine, story, or portion thereof shall be not less than two.

Occupant load more than 500 but not more than 1000 — not less than 3

Occupant load more than 1000 — not less than 4

The occupant load of each story considered individually shall be required to be used in computing the number of means of egress at each story, provided that the required number of means of egress is not decreased in the direction of egress travel.

3.4 Arrangement of Means of Egress.

Exits shall be located and exit access shall be arranged so that exits are readily accessible at all times.

Where more than one exit is required from a building or portion thereof, such exits shall be remotely located from each other and shall be arranged and constructed to minimize the possibility that more than one has the potential to be blocked by any one fire or other emergency condition.

Exit access shall be arranged so that there are no dead ends in corridors, unless permitted by and limited to the length specified in NFPA 101, *Life Safety Code* for the specific occupancy and condition.

3.5 Occupant Load.

The occupant load in any building or portion thereof shall be not less than the number of persons determined by dividing the floor area assigned to that use by the occupant load factor for that use as specified in **Table 3.5**.

Table 3.5 Occupant Load Factor

Use	m ² (net per person)
Assembly Use	
Concentrated use, without fixed seating	0.65
Less concentrated use, without fixed seating	1.4
Bench-type seating	1 person/45.7 linear cm
Fixed seating	number of fixed seats
Kitchens	9.3
Library stack areas	9.3
Library reading rooms	4.6
Swimming pools	4.6 — of water surface
Swimming pool decks	2.8
Exercise rooms with equipment	4.6
Exercise rooms without equipment	1.4
Stages	1.4
Lighting and access catwalks, galleries, gridirons	9.3
Educational Use	
Classrooms	1.9
Shops, laboratories, vocational rooms	4.6
Health Care Use	
Inpatient treatment departments	22.3
Sleeping departments	11.1
Residential Use	
Dormitories	18.6
Apartment buildings	18.6
Industrial Use	
General and high hazard industrial	9.3
Business Use	
	9.3

Where exits serve more than one story, only the occupant load of each story considered individually shall be used in computing the required capacity of the exits at that story, provided that the required egress capacity of the exit is not decreased in the direction of egress travel.

3.6 Illumination of Means of Egress and Emergency Lighting.

Illumination of means of egress shall be provided for every building and structure.

Illumination of means of egress shall be continuous during the time that the conditions of occupancy require that the means of egress be available for use. Artificial lighting shall be employed at such locations and for such periods of time as required to maintain the illumination to the minimum a minimum criteria.

A functional test shall be conducted by the Physical Plant on every required emergency lighting system at 30-day

intervals for not less than 30 seconds. An annual test shall be conducted on every required battery-powered emergency lighting system for not less than 1½ hours. Equipment shall be fully operational for the duration of the test. Written records of visual inspections and tests shall be kept by the Physical Plant and made available upon request for review by the EHS&RM.

3.7 Marking of Means of Egress.

Exits shall be marked by an approved sign readily visible from any direction of exit access.

Access to exits shall be marked by approved, readily visible signs in all cases where the exit or way to reach the exit is not readily apparent to the occupants. Sign placement shall be such that no point in an exit access corridor is in excess of 30 m from the nearest externally illuminated sign and is not in excess of the marked rating for internally illuminated signs.

Every sign shall be suitably and continuously illuminated by a reliable light source.

A sign with a directional indicator showing the direction of travel shall be placed in every location where the direction of travel to reach the nearest exit is not apparent.

3.8 Means of Egress Reliability.

Means of egress shall be continuously maintained free of all obstructions or impediments to full instant use in the case of fire or other emergency.

3.9 Furnishings and Decorations in Means of Egress.

No furnishings, decorations, or other objects shall obstruct exits, access thereto, egress therefrom, or visibility thereof.

4. Features of Fire Protection

This chapter shall apply to new, existing, permanent, and temporary buildings.

Types of building construction shall comply with NFPA 220, *Standard on Types of Building Construction*.

The design and construction of fire walls and fire barrier walls that are required to separate buildings or subdivide a building to prevent the spread of fire shall comply with NFPA 221, *Standard for Fire Walls and Fire Barrier Walls*.

The installation and maintenance of assemblies and devices used to protect openings in walls, floors, and ceilings against the spread of fire and smoke within, into, or out of buildings shall comply with NFPA 80, *Standard for Fire Doors and Fire Windows*.

Interior finish, Furnishings, contents, decorations, and treated finishes in buildings and structures shall meet the requirements of NFPA 101, *Life Safety Code*.

Where required by the specific occupancy classification as per NFPA 101, smoke partitions shall be provided to limit the transfer of smoke.

Smoke partitions shall extend from the floor to the underside of the floor or roof deck above, through any concealed spaces, such as those above suspended ceilings, and through interstitial structural and mechanical spaces.

Doors in smoke partitions shall comply with the relevant sections of NFPA 101, *Life Safety Code*.

Pipes, conduits, bus ducts, cables, wires, air ducts, pneumatic tubes and ducts, and similar building service equipment that pass through smoke partitions shall be protected with material that is capable of limiting the transfer of smoke through the smoke partition.

Air transfer openings in smoke or fire partitions shall be provided with approved dampers designed to limit the transfer of smoke or fire.

5. Building Services

5.1 Electrical Fire Safety.

This section shall apply to new, existing, permanent, or temporary electrical appliances, equipment, fixtures, or wiring.

All electrical appliances, fixtures, equipment, or wiring shall be installed and maintained in accordance with NFPA 70, *National Electrical Code*[®].

Extension cords shall not be used as a substitute for permanent wiring.

5.2 Heating, Ventilation, and Air Conditioning.

Air-conditioning, heating, and ventilating ductwork and related equipment shall be installed in accordance with NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, or NFPA 90B, *Standard for the Installation of Warm Air Heating and Air-Conditioning Systems*, as applicable.

Ventilating systems in laboratories using chemicals shall be installed in accordance with NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*, or NFPA 99, *Standard for Health Care Facilities*, as appropriate.

5.3 Elevators.

All elevators shall conform to the requirements of ASME/ANSI A17.1, *Safety Code for Elevators and Escalators* or ASME/ANSI A17.3, *Safety Code for Existing Elevators and Escalators*.

5.4 Utilities.

Equipment using fuel gas and related gas piping shall be installed in accordance with NFPA 54, *National Fuel Gas Code*, or NFPA 58, *Liquefied Petroleum Gas Code*. Existing installations shall be permitted to be continued in service, subject to approval by the EHS&RM.

5.5 Heating Appliances.

The installation of gas-fired heating appliances shall comply with NFPA 54, *National Fuel Gas Code*.

Electrical wiring and equipment used in connection with oil-burning equipment shall be installed in accordance with NFPA 70, *National Electrical Code*.

5.6 Portable Electric Heater.

The EHS&RM shall be permitted to prohibit use of portable electric heaters in occupancies or situations where such use or operation would present an undue danger to life or property.

5.7 Chimneys.

All chimneys, smokestacks, or similar devices for conveying smoke or hot gases to the outer air and the stoves, furnaces, incinerators, boilers, or any other heat-producing devices or appliances shall be installed and maintained in accordance with NFPA 54, *National Fuel Gas Code*, and NFPA 211, *Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances*.

5.8 Emergency and Standby Power.

Emergency generators, where required for compliance with this Code, shall be tested and maintained in accordance with NFPA 110, *Standard for Emergency and Standby Power Systems*.

Stored electrical energy systems shall be maintained in accordance with NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*.

5.9 Smoke Control.

Smoke control systems, where required, shall have an approved maintenance and testing program to ensure operational integrity. The purpose of such smoke control systems shall be to confine smoke to the general area of fire origin and maintain use of the means of egress system.

6. Fire Protection Systems

6.1 General.

The AUB requires that shop drawings for all fire protection systems be submitted for review and approval by the EHS&RM and a “permit” be issued for installation, rehabilitation, or modification. Further, the EHS&RM shall have the authority to require that full acceptance tests of the systems shall be performed in the EHS&RM’s presence prior to final system certification.

The Physical Plant shall be responsible for the proper testing and maintenance of the equipment and systems.

Detailed records documenting all systems and equipment testing and maintenance shall be kept by the Physical Plant. These records shall be made available upon request for review by the EHS&RM.

6.2 Standpipe Systems.

The design and installation of standpipe systems shall be in accordance with NFPA 14, *Standard for the Installation of Standpipe, Private Hydrant, and Hose Systems*.

New buildings more than three stories in height or new buildings over 15 m in height above grade and containing intermediate stories or balconies shall be equipped with a standpipe system installed in accordance with the provisions of this section and NFPA 14, *Standard for the Installation of Standpipe, Private Hydrant, and Hose Systems*.

A standpipe system shall be properly maintained to provide at least the same level of performance and protection as designed. The Physical Plant shall be responsible for maintaining the system and keeping it in good working condition.

A standpipe system installed in accordance with this Code shall be inspected, tested, and maintained in accordance with NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*.

6.3 Automatic Sprinklers.

Automatic sprinklers shall be installed and maintained in full operating condition, as specified for the occupancy involved in the codes or standards. Installations shall be in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*; NFPA 13R, *Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height*; or NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes*, as appropriate.

Basement areas of new occupancies exceeding 232.3 m² shall be protected throughout by an approved automatic sprinkler system.

New Buildings containing assembly occupancies with occupant loads of more than 300 shall be protected by an approved, supervised automatic sprinkler system in accordance with Section 9.7 of NFPA 101.

Any existing assembly occupancy used or capable of being used for exhibition or display purposes shall be protected throughout by an approved automatic sprinkler system in accordance with Section 9.7 of NFPA 101 where the exhibition or display area exceeds 1400 m².

Every portion of educational buildings below the level of exit discharge shall be protected throughout by an approved, supervised automatic sprinkler system in accordance with Section 9.7 of NFPA 101.

Wherever student occupancy exists below the level of exit discharge, every portion of such floor shall be protected throughout by an approved automatic sprinkler system in accordance with Section 9.7 of NFPA 101. Where student occupancy does not exist on floors below the level of exit discharge, such floors shall be separated from the rest of the building by 1-hour fire resistance-rated construction or shall be protected throughout by an approved automatic sprinkler system in accordance with Section 9.7 of NFPA 101.

Buildings with unprotected openings in accordance with NFPA 101 shall be protected throughout by an approved, supervised automatic sprinkler system in accordance with Section 9.7 of NFPA 101.

Health care facilities shall be protected throughout by an approved, supervised automatic sprinkler system in accordance with Section 9.7 of NFPA 101. Listed quick-response or listed residential sprinklers shall be used throughout smoke compartments containing patient sleeping rooms. Sprinklers in areas where cubicle curtains are installed shall be in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*.

All dormitories shall be protected throughout by an approved, supervised automatic sprinkler system in accordance with Section 9.7 of NFPA 101.

All apartment buildings shall be protected throughout by an approved, supervised automatic sprinkler system in accordance with Section 9.7 of NFPA 101.

All new residential occupancies, one & two family dwellings up to and including four stories in height shall be protected throughout by an approved automatic sprinkler system in accordance with Section 9.7 of NFPA 101.

Where windowless or underground structures have an occupant load of more than 50 persons in the windowless or underground portions of the structure, the windowless or underground portions and all areas and floor levels traversed in traveling to the exit discharge shall be protected by an approved, supervised automatic sprinkler system in accordance with Section 9.7 of NFPA 101.

High-rise buildings (23 m or more in height from accessible street level) shall be protected throughout by an approved, automatic sprinkler system in accordance with Section 9.7 of NFPA 101. The sprinkler system installed in accordance with this Code shall be properly maintained to provide at least the same level of performance and protection as designed. The Physical Plant shall be responsible for maintaining the system and keeping it in good working condition. The sprinkler system installed in accordance with this Code shall be inspected, tested, and maintained in accordance with NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*.

All automatic sprinkler systems shall be continuously maintained in a reliable operating condition at all times, and such periodic inspections and tests shall be made as necessary to ensure proper maintenance. When an automatic sprinkler system is out of service for more than four hours within a 24-hour period, the building shall be evacuated, or an approved fire watch shall be provided for all portions left unprotected by the sprinkler system shutdown until the sprinkler system has been returned to service.

6.4 Fire Pumps.

Fire pumps shall be installed in accordance with this section and NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*.

The fire pump, driver, and controller shall be protected against possible interruption of service through damage caused by explosion, fire, flood, earthquake, rodents, insects, windstorm, vandalism, and other adverse conditions.

Centrifugal pumps shall not be used where a static suction lift is required.

Where provided, the suction valve, discharge valve, bypass valves, and isolation valves on the backflow prevention device or assembly shall be supervised open by a method approved by EHS&RM.

At least one entrance 61 cm wide and 2 m high shall be provided to give access to the work space around electrical equipment. There shall be a minimum of 76.2 cm work space in front of the electrical equipment requiring examination, adjustment, servicing, or maintenance. Working space shall not be used for storage. Illumination shall be provided for all working spaces around electrical equipment requiring servicing, examination, or adjustment. Provision shall be made for ventilation of a pump room or pump house. Floors shall be pitched for adequate drainage of escaping water away from critical equipment such as the pump, driver, controller, and so forth. The pump room or pump house shall be provided with a floor drain that will discharge to a frost-free location.

Controllers shall be located as close as is practical to the engines they control and shall be within sight of the engines. They shall be so located or so protected that they will not be injured by water escaping from pumps or pump connections. Current-carrying parts of controllers shall not be less than 305 mm above the floor level.

Where the pump room is not constantly attended, audible or visible alarms powered by a source other than the engine starting batteries and not exceeding 125 V shall be provided at a point of constant attendance. These alarms shall indicate the following:

- (1) The engine is running (separate signal).
- (2) The controller main switch has been turned to the off or manual position (separate signal).
- (3) Trouble on the controller or engine (separate or common signals).

Field acceptance tests shall be conducted in accordance with NFPA 20, *Standard for the Installation of Centrifugal Fire Pumps*. The pump, engine, controller, and transfer switch supplier shall be present for the field acceptance test. All electric wiring to the fire pump motor(s), including control (multiple pumps) interwiring, emergency power supply, and jockey pump, shall be completed and checked by the electrical contractor prior to the initial startup and acceptance test. The EHS&RM shall be notified as to time and place of the field acceptance test. A copy of the manufacturer's certified pump test characteristic curve shall be available for comparison of results of field acceptance test. The fire pump as installed shall equal the performance as indicated on the manufacturer's certified shop test characteristic curve within the accuracy limits of the test equipment. The fire pump shall perform at minimum, rated, and peak loads without objectionable overheating of any component. Vibrations of the fire pump assembly shall not be of a magnitude to warrant potential damage to any fire pump component.

A fire pump shall be properly maintained to provide at least the same level of performance and protection as designed. The Physical Plant shall be responsible for maintaining the system and keeping it in good working condition. A fire pump shall be inspected, tested, and maintained in accordance with NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*.

6.5 Water Supply.

Private fire service mains shall be installed in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems* and NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*.

The installation of devices to protect the public water supply from contamination shall comply with the provisions of NFPA 13, *Standard for the Installation of Sprinkler Systems*, or NFPA 24, *Standard for the Installation of Private Fire Service Mains and their Appurtenances*, and the plumbing code of the jurisdiction. Backflow prevention devices shall be inspected, tested, and maintained in accordance with the requirements of NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*.

Private fire service main installed in accordance with this Code shall be properly maintained to provide at least the same level of performance and protection as designed. The owner shall be responsible for maintaining the system and keeping it in good working condition.

A private fire service main installed in accordance with this Code shall be inspected, tested, and maintained in accordance with NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*.

6.6 Portable Extinguishers.

The installation, maintenance, selection, and distribution of portable fire extinguishers shall be in accordance with NFPA 10, *Standard for Portable Fire Extinguishers*.

Fire extinguishers shall be provided in all occupancies on Campus and Medical Center.

Fire extinguishers shall be conspicuously located where they will be readily accessible and immediately available in the event of fire. Preferably they shall be located along normal paths of travel, including exits from areas. Cabinets housing fire extinguishers shall not be locked. Fire extinguishers shall not be obstructed or obscured from view.

The selection of fire extinguishers for a given situation shall be determined by the character of the fires anticipated, the construction and occupancy of the individual property, the vehicle or hazard to be protected, ambient-temperature conditions, and other factors.

Fires are grouped into three basic categories called classes: Class A, Class B, and Class C

Class A fires involve ordinary combustibles such as rubber, plastic, linen, wool, paper, trash, wood, etc....

Class B fires involve flammable liquids such as gasoline, diesel fuel, alcohol, etc...

Class C fires involve energized electrical equipment

There are three types of fire extinguishers available throughout AUB. These types are:

1. Pressurized Water extinguishers (stainless steel finish): suitable for Class A fires only.
Never use on electrical equipment and flammable liquid fires
2. CO₂ type extinguishers (red Extinguisher with horn and without pressure gauge): suitable for Class B & Class C fires
3. Multipurpose ABC dry powder type extinguishers (red Extinguisher with pressure gauge): suitable for Class A, Class B, and Class C fires

NOTE: Whenever in doubt, you can always use an ABC extinguisher on any type of fire. If dry powder ABC extinguishers are used, there will be a need to clean up the powder afterwards. If these powders are mixed with water, they will result in corrosive solutions that will require special precautions.

Fire extinguishers shall be inspected by the Physical Plant when initially placed in service and thereafter at approximately 30-day intervals.

Fire extinguishers shall be subjected to maintenance at intervals of not more than 1 year, at the time of hydrostatic test, or when specifically indicated by an inspection.

6.7 Detection, Alarm, and Communication Systems.

Where building fire alarm systems or automatic fire detectors are required, they shall be provided in accordance with NFPA 72, *National Fire Alarm Code*[®].

Protected premises fire alarm systems shall include one or more of the following features:

- (1) Manual alarm signal initiation
- (2) Automatic alarm signal initiation
- (3) Monitoring of abnormal conditions in fire suppression systems
- (4) Activation of fire suppression systems
- (5) Activation of fire safety functions
- (6) Activation of alarm notification appliances
- (7) Emergency voice/alarm communications
- (8) Activation of off-premises signals
- (9) Combination systems
- (10) Integrated systems

Fire alarm systems serving two or more zones shall identify the zone of origin of the alarm initiation by annunciation or coded signal.

Equipment constructed and installed in conformity with NFPA 72 requirements shall be listed for the purpose for

which it is used.

All fire detection devices that receive their power from the initiating device circuit or signaling line circuit of a fire alarm control unit shall be listed for use with the control unit.

Table 6.7-a Guidelines for spacing and installation of fire detection & alarm devices.

Device/ Requirement	Spacing	Installation	
Smoke Detectors	9 m between devices. 4.5 m between devices and adjacent walls. 6.3 m between devices and remote corners.		
Heat Detector (Spot Type)	9 m between devices. 4.5 m between devices and adjacent walls. 6.3 m between devices and remote corners.	Open Ceiling:	Not less than 10 cm from the sidewall or On the sidewall between 10 cm and 30 cm from the ceiling.
		Solid Open Joist Construction:	At the bottom of the joists.
		Beam Construction:	At the bottom of the beams where beams are less than 30 cm. in depth and less than 2.4m apart , center to center.
Manual Call Points	Horizontal travel distance to a manual call point shall not exceed 61 m.	The Operable Part of The Device:	1.1m to 1.5 m above finished floor. Within 1.5 m of exit door.
Audio Alarm (Bells & Horns)		Top of Appliance:	Not less than 2.3 m above finished floor. Not less than 15 cm below finished ceiling.
Audio Visual Alarm (Strobe/Horn)		Bottom of Appliance:	2.03 m to 2.43 m above finished floor.
Fire Detection & Alarm Panel		Top of Panel:	1.8 m from finished floor Installed @ the Building Main Entrance.

Table 6.7-b Labeling of Fire Detection & Alarm Devices

Device or Plan /Requirement	Labeling Method
Panel LCD Display	Loop No. – Floor No. – Device No.: Location
Riser Diagram	Loop No. – Floor No. – Device No.: Location
As-built Drawing	Loop No. – Floor No. – Device No.
Example:	L1 – B5 – 001: Room # B530 L2 – GF – 010: Room # 110 L3 – F9 – 150: Room # 920

Assembly occupancies with occupant loads of more than 300 and all theaters with more than one audience-viewing room shall be provided with an approved fire alarm system in accordance with 9.6 of NFPA 101.

Educational occupancies shall be provided with a fire alarm system in accordance with Section 9.6 of NFPA 101.

Health care occupancies shall be provided with a fire alarm system in accordance with Section 9.6 of NFPA 101.

Dormitory occupancies shall be provided with a fire alarm system in accordance with Section 9.6 of NFPA 101. An approved single-station smoke alarm shall be installed in every guest room and every living area and sleeping room within a guest suite.

Apartment buildings with more than three stories or with more than 11 dwelling units shall be provided with a fire alarm system in accordance with Section 9.6 of NFPA 101. Approved single-station smoke alarms shall be installed in accordance with 9.6 of NFPA 101 outside every sleeping area in the immediate vicinity of the bedrooms and on all levels of the dwelling unit, including basements.

Approved, single-station smoke alarms shall be installed in accordance with 9.6 of NFPA 101 in the following locations of one and two family dwellings:

- (1) Outside of each separate sleeping area, in the immediate vicinity of the sleeping rooms
- (2) On each level of the dwelling unit, including basements

Business occupancies shall be provided a fire alarm system in accordance with Section 9.6 of NFPA 101, where any one of the following conditions exists:

- (1) The building is two or more stories in height above the level of exit discharge.
- (2) The occupancy is subject to 50 or more occupants above or below the level of exit discharge.
- (3) The occupancy is subject to 300 or more total occupants.

Industrial occupancies shall be provided with a fire alarm system in accordance with Section 9.6 of NFPA 101.

Ambulatory health care facilities shall be provided with fire alarm systems in accordance with Section 9.6 of NFPA 101.

High rise buildings shall be provided with a fire alarm system using an approved, emergency voice/alarm communication system in accordance with Section 9.6 of NFPA 101 or as approved by EHS&RM.

Inspection, testing, and maintenance shall be performed by the Physical Plant in accordance with of NFPA 72 or more often if required by the EHS&RM. A record of the inspection, testing, and maintenance shall be maintained by the Physical Plant, copies of which shall be submitted to EHS&RM

6.8 Other Fire Protection Systems.

Where other fire protection systems are required to be installed by the provisions of this Manual, or are installed with the approval of the EHS&RM as an alternative or equivalency, the design and installation of the system shall comply with the appropriate standards listed in **Table 6.8**.

Table 6.8 Other Required Fire Protection Systems

Type of System	NFPA Standard
Carbon dioxide systems	NFPA 12, <i>Standard on Carbon Dioxide Extinguishing Systems</i>
Sprinklers in one- and two-family dwellings and manufactured homes	NFPA 13D, <i>Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes</i>
Sprinklers in residential occupancies up to and including four stories in height	NFPA 13R, <i>Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height</i>
Dry chemical extinguishing systems	NFPA 17, <i>Standard for Dry Chemical Extinguishing Systems</i>
Wet chemical extinguishing systems	NFPA 17A, <i>Standard for Wet Chemical Extinguishing Systems</i>
Clean agent fire extinguishing systems	NFPA 2001, <i>Standard on Clean Agent Fire Extinguishing Systems</i>

7. Combustible Waste and Refuse

7.1 Combustible Waste and Refuse.

No person owning or having control of any property shall allow any combustible waste material to accumulate in any area or in any manner that creates a fire hazard to life or property.

Combustible waste or refuse shall be properly stored or disposed of to prevent unsafe conditions.

Fire extinguishing capabilities approved by the authority having jurisdiction shall be provided at waste disposal sites including, but not limited to, fire extinguishers, water supply and hose, and earth-moving equipment.

Burning debris shall not be dumped at a waste disposal site except at a remote location on the site where fire extinguishment can be accomplished before compacting, covering, or other disposal activity is carried out.

Vehicles or conveyances used to transport combustible waste or refuse over public thoroughfares shall have all cargo space covered and maintained tight enough to ensure against ignition from external fire sources and scattering burning and combustible debris that can come in contact with ignition sources. Transporting burning waste or refuse shall be prohibited.

7.2 Sources of Ignition.

Trucks or automobiles, other than mechanical handling equipment and approved industrial trucks shall not enter any fiber storage room or building but shall be permitted to be used at loading platforms.

Electrical wiring and equipment in any combustible fiber storage room or building shall be installed in accordance with the requirements of NFPA 70, *National Electrical Code*, for Class III hazardous locations. The EHS&RM shall be responsible for designating the areas requiring hazardous location electrical classifications and shall classify the area in accordance with the classification system set forth in NFPA 70.

No smoking or open flame shall be permitted in any area where combustible fibers are handled or stored. “No Smoking” signs shall be posted.

Portable fire extinguishers shall be installed as required for extra-hazard occupancy protection as applicable in NFPA 10, *Standard for Portable Fire Extinguishers*.

8. Commercial Cooking Equipment

Cooking equipment used in processes producing smoke or grease-laden vapors shall be equipped with an exhaust system that complies with all the equipment and performance requirements of NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations*, and all such equipment and performance shall be maintained per NFPA 96 during all periods of operation of the cooking equipment. Specifically, the following equipment shall be kept in good working condition:

- (1) Cooking equipment
- (2) Hoods
- (3) Ducts (if applicable)
- (4) Fans
- (5) Fire suppression systems
- (6) Special effluent or energy control equipment

All airflows shall be maintained. Maintenance and repairs shall be performed on all components at intervals necessary to maintain these conditions.

Except where enclosures are required, hoods, grease removal devices, exhaust fans, and ducts shall have a clearance of at least 457.2 mm to combustible material, 76.2 mm to limited-combustible material, and 0 mm to noncombustible material.

Hoods, grease removal devices, fans, ducts, and other appurtenances shall be cleaned to bare metal at frequent intervals prior to surfaces becoming heavily contaminated with grease or oily sludge. After the exhaust system is cleaned to bare metal, it shall not be coated with powder or other substance. The entire exhaust system shall be inspected by properly trained and qualified Physical Plant personnel on a monthly basis.

Components of the fire suppression system shall not be rendered inoperable during the cleaning process. Care shall be taken not to apply cleaning chemicals on fusible links or other detection devices of the automatic extinguishing system.

Portable fire extinguishers shall be installed in kitchen cooking areas in accordance with NFPA 10, *Standard for Portable Fire Extinguishers*. Such extinguishers shall use agents that saponify upon contact with hot grease such as sodium bicarbonate and potassium bicarbonate dry chemical and potassium carbonate solutions. Class B gas-type portables such as CO₂ and halon shall not be permitted in kitchen cooking areas. Fire extinguishers provided for the protection of cooking appliances that use combustible cooking media (vegetable or animal oils and fats) shall be listed and labeled for Class K fires.

The design, installation, protection, and maintenance of exhaust system components including hoods, grease removal devices, exhaust ducts, dampers, air-moving devices, auxiliary equipment, and fire-extinguishing equipment for the exhaust system and the cooking equipment in commercial, industrial, institutional, and similar cooking applications shall be in accordance with this section and NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations*.

Fire-extinguishing systems equipment shall include both automatic fire-extinguishing systems as primary protection and portable fire extinguishers as secondary backup.

Automatic fire-extinguishing systems shall comply with standard UL 300, *Fire Testing of Fire Extinguishing Systems for Protection of Restaurant Cooking Areas*, or other equivalent standards and shall be installed in accordance with their listing.

Automatic fire-extinguishing systems shall be installed in accordance with the terms of their listing, the manufacturer's instructions, and the following standards where applicable:

-
- (1) NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*
 - (2) NFPA 13, *Standard for the Installation of Sprinkler Systems*
 - (3) NFPA 17, *Standard for Dry Chemical Extinguishing Systems*
 - (4) NFPA 17A, *Standard for Wet Chemical Extinguishing Systems*

Upon activation of any fire-extinguishing system for a cooking operation, all sources of fuel and electric power that produce heat to all equipment requiring protection by that system shall automatically shut off.

A readily accessible means for manual activation shall be located between 1067 mm and 1524 mm above the floor, located in a path of exit or egress and clearly identify the hazard protected. The automatic and manual means of system activation external to the control head or releasing device shall be separate and independent of each other so that failure of one will not impair the operation of the other.

The means for manual actuator(s) shall be mechanical and shall not rely on electrical power for actuation.

Upon activation of an automatic fire-extinguishing system, an audible alarm or visual indicator shall be provided to show that the system has activated.

An inspection and servicing of the fire extinguishing system and listed exhaust hoods containing a constant or fire-actuated water system shall be made at least every 6 months by properly trained and qualified persons.

All actuation components, including remote manual pull stations, mechanical or electrical devices, detectors, actuators, fire-actuated dampers, etc., shall be checked for proper operation during the inspection in accordance with the manufacturer's listed procedures. In addition to these requirements, the specific inspection requirements of the applicable NFPA standard shall also be followed.

Fusible links (including fusible links on fire-actuated damper assemblies) and automatic sprinkler heads shall be replaced at least annually, or more frequently if necessary, to ensure proper operation of the system. Other detection devices shall be serviced or replaced in accordance with the manufacturer's recommendations.

If required, certificates of inspection and maintenance shall be forwarded to the EHS&RM.

9. Fireworks

The construction, handling, and use of fireworks intended solely for outdoor display as well as the general conduct and operation of the display shall comply with the requirements of NFPA 1123, *Code for Fireworks Display*.

The use of pyrotechnic special effects in the performing arts in conjunction with theatrical, musical, or any similar productions before a proximate audience, performers, or support personnel shall comply with NFPA 1126, *Standard for the Use of Pyrotechnics before a Proximate Audience*. Any indoor display of pyrotechnic special effects; any outdoor use of pyrotechnic special effects at distances less than those required by NFPA 1123, *Code for Fireworks Display*, the use of pyrotechnic special effects during any videotaping, audiotaping, or filming of any television, radio, or movie production if such production is before a proximate audience; or the rehearsal of any production in which pyrotechnic special effects are used shall also comply with NFPA 1126.

10. Flammable and Combustible Liquids

10.1 General.

This chapter shall apply to the storage, handling, and use of flammable and combustible liquids, including spray applications, dipping and coating operations, and solvent extraction.

10.2 Storage, Handling and Use.

The storage, handling, and use of flammable and combustible liquids, including waste liquids, shall comply with this section and NFPA 30, *Flammable and Combustible Liquids Code*.

The following are four rules for indoor storage of flammable and combustible liquids in Educational and Institutional Occupancies have been established by the National Fire Protection Association (NFPA):

- No more than 1 gallon of Class I liquids in a fire area.
- No more than 10 gallons of Class I and Class II combined in a single fire area.
- No more than 25 gallons of Class I and Class II combined in a single fire area, in safety cans.
- No more than 60 gallons of Class IIIA liquids.

Table 10.1 Flammability classifications for commonly used chemicals:

Class IA	Class IB	Class IC
Dimethyl Sulfide	Acetone	Ethylene Glycol Diethyl Ether
Ethylene Oxide	Acrylonitrile	Ethylene Glycol Isopropyl Ether
Ethyl Mercaptan	Ethyl Acetate	Hydrazine
Hydrogen Cyanide	Ethyl Alcohol (Ethanol)	High Flash V.M.&P. Naphtha
Pentane	Ethylene Dichloride	Paraldehyde
Petroleum Ether*	Ethyl Ether	Styrene
Propylene Oxide	Heptane	Xylenes
Vinyl Chloride	Hexane	Butyl Alcohol
Acetaldehyde	Isopropanol	Butyl Aceylate
2-Butyne	(Methyl Alcohol) Methanol	M-Xylene
2-Chloropropane	Methyl Ethyl Ketone	O-Xylene
Dichlorosilane	Methyl Isobutyl Ketone	P-Xylene
Methyl Ethel Ether	Methyl Methacrylate	Amyl Alacohol
Methyl Formate	Petroleum Ether*	Amyl Bromide
Methyl Mercaptan	V.M.&P Naphtha	Butyl Nitrate
Cimethyl Sulfide	Pyridine	Chlorobenzene
Ethyl Amine	Tetrahydrofuran	Cumene
Ethyl Chloride	Toluene	Cyclohexanone
Ethyl Nitrite	p-Dioxane	Dibutyl Ether
Furan	Ethyl Nitrate	Hexylamine
Hydrocyanic Acid	Methyl Isobutyl Ketone	Isoamyl Acetate
Isoprene	Methyl Methacrylate	Isobutyl Alcohol
1, 3 Pentadiene	Octane	Nitromethane
Trichlorosilane	Triethylamine	Turpentine

*May fall into Class IA or IB, depending on the Boiling Point of the mixture

Source: Fire Protection Guide to Hazardous Materials, 10th edition, NFPA, 1991.

Each petroleum product (oil, antifreeze, WD40, etc.) should be categorized and kept under these limits. Some simpler rules of thumb may be easier to remember and follow:

- Class I liquids shall not be handled or used in basements
- No flammable liquid storage in mechanical rooms.
- No more than one drum of combustible liquids in one room (one drum of oil or one drum of antifreeze).
- Minimize the amount and time that paint is stored in mechanical rooms, unless stored in flammable storage cabinets.

Flammable and Combustible Liquids

For the purpose of this code, any material that has a fluidity greater than that of 300 penetration asphalt when tested in accordance with ASTM D 5 Test for Penetration for Bituminous Materials. When not otherwise identified, the term liquid shall mean both flammable and combustible liquids.

Flammable liquid. A liquid having a flash point below 100 degrees F (37.8 degrees C) and having a vapor pressure not exceeding 40 psia (2,068 mm Hg) at 100 degrees F (37.8 degrees C) shall be known as a Class I liquid.

Class I liquids shall be subdivided as follows:

- **Class IA** shall include those having flash points below 73 degrees F (22.8 degrees C) and having a boiling point below 100 degrees F (37.8 degrees C).
- **Class IB** shall include those having flash points below 73 degrees F (22.8 degrees C) and having a boiling point at or above 100 degrees F (37.8 degrees C).
- **Class IC** shall include those having flash points at or above 73 degrees F (22.8 degrees C) and below 100 degrees F (37.8 degrees C).

Combustible liquid. A liquid having a flash point at or above 100 degrees F. (37.8 degrees C).

Combustible liquids shall be subdivided as follows:

- **Class II** liquids shall include those having flash points at or above 100 degrees F (37.8 degrees C) and below 140 degrees F (60 degrees C).
- **Class IIIA** liquids shall include those having flash points at or above 140 degrees F (60 degrees C) and below 200 degrees F (93 degrees C).
- **Class IIIB** liquids shall include those having flash points at or above 200 degrees F (93 degrees C).

11. Hot Work Operations

11.1 General.

Welding, cutting, and use of torches shall comply with this chapter and NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*.

The design and installation of oxygen-fuel gas systems for welding, cutting, and allied processes shall comply with this section and NFPA 51, *Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes*.

11.2 Fire Prevention Precautions.

Hot work shall be allowed only in areas that are or have been made fire safe. Hot work shall be performed in either designated areas or permit-required areas.

A designated area shall be a specific area designed or approved for such work, such as a maintenance shop or a detached outside location that is of noncombustible or fire-resistive construction, essentially free of combustible and flammable contents, and suitably segregated from adjacent areas.

A permit-required area shall be an area that is made fire safe by removing or protecting combustibles from ignition sources and authorized by EHS&RM.

11.3 Hot Work Permit.

Before hot work operations begin in a nondesignated location, a written [hot work permit form](#) shall be completed and a copy forwarded to EHS&RM for records.

Hot work in AUB shall comply with the following conditions:

- (1) Hot work equipment to be used shall be in satisfactory operating condition and in good repair.
- (2) Where combustible materials, such as paper clippings, wood shavings, or textile fibers, are on the floor, the floor shall be swept clean for a radius of 10.7 m. Combustible floors (except wood on concrete) shall be kept wet, be covered with damp sand, or be protected by noncombustible or fire-retardant shields. Where floors have been wet down, personnel operating arc welding or cutting equipment shall be protected from possible shock.
- (3) All combustibles shall be relocated at least 10.7 m horizontally from the work site. If relocation is impractical, combustibles shall be protected with fire-retardant covers or otherwise shielded with metal or fire-retardant guards or curtains. Edges of covers at the floor shall be tight to prevent sparks from going under them, including where several covers overlap when protecting a large pile.
- (4) Openings or cracks in walls, floors, or ducts within 10.7 m of the site shall be tightly covered with fire-retardant or noncombustible material to prevent the passage of sparks to adjacent areas.
- (5) If hot work is done near walls, partitions, ceilings, or roofs of combustible construction, fire-retardant shields or guards shall be provided to prevent ignition.
- (6) If hot work is to be done on a wall, partition, ceiling, or roof, precautions shall be taken to prevent ignition of combustibles on the other side by relocating combustibles. If it is impractical to relocate combustibles, a fire watch on the opposite side from the work shall be provided.
- (7) Hot work shall not be attempted on a partition, wall, ceiling, or roof that has a combustible covering or insulation, or on walls or partitions of combustible sandwich-type panel construction.
- (8) Hot work that is performed on pipes or other metal that is in contact with combustible walls, partitions, ceilings, roofs, or other combustibles shall not be undertaken if the work is close enough to cause

ignition by conduction.

- (9) Fully charged and operable fire extinguishers that are appropriate for the type of possible fire shall be available immediately at the work area. If existing hose lines are located within the hot work area defined by the permit, they shall be connected and ready for service, but shall not be required to be unrolled or charged.
- (10) If hot work is done in close proximity to a sprinkler head, a wet rag shall be laid over the head and then removed at the conclusion of the welding or cutting operation. During hot work, special precautions shall be taken to avoid accidental operation of automatic fire detection or suppression systems (for example, special extinguishing systems or sprinklers).
- (11) Nearby personnel shall be suitably protected against heat, sparks, slag, and so on.

11.4 Fire Watch.

When hot work is performed in a location where other than a minor fire might develop, a fire watch shall be present.

11.5 Oxygen-Fuel Gas Systems.

Cylinders permitted inside of buildings shall be stored at least 6 m from flammable and combustible liquids and easily ignited forms of materials such as wood, paper, oil, and grease, and where they will not be exposed to excessive rise in temperature, physical damage, or tampering by unauthorized persons.

Separate rooms or buildings used for gas cylinder storage shall be provided with natural or mechanical ventilation designed to provide a minimum of 1 cfm per sq ft (0.3 m³/m²) of floor area. Ventilation systems shall discharge a minimum of 50 ft (15 m) from intakes of air handling systems, air conditioning equipment, and air compressors.

Cylinders shall be secured in a manner so as to not be easily overturned.

Any person using a torch or other flame-producing device for removing paint, sweating pipe joints, or similar use in or around any building or structure or combustibles shall be responsible for the prevention of fire and shall comply with the following:

- (1) Provide, in a ready state, within 4.6 m travel distance of the work being done, either an approved fire extinguisher having a minimum 2A rating or a water hose connected to a reliable water supply. If a water hose is used as the approved extinguisher, it shall be charged and equipped with a suitable nozzle.
- (2) Provide shielding, wetting, or other approved means to protect combustible material in close proximity of the flame. Approved, stored pressure water fire extinguishers shall not be used to wet combustible material.
- (3) In all cases, the person operating the torch or a designee shall remain in the immediate vicinity for a minimum of 30 minutes or a period of time sufficient to ensure that no fire results from the work that was completed. This person's responsibilities shall include detecting and reporting any fire.

12. Laboratories Using Chemicals

The handling or storing of chemicals in laboratory buildings, laboratory units, and laboratory work areas whether located above or below grade shall comply with NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals* and the EHS&RM [Lab Safety Manual](#).

This chapter shall apply to substances with one or more of the following hazard ratings as defined in NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*:

Health — 2, 3, or 4

Flammability — 2, 3, or 4

Reactivity — 2, 3, or 4

Any building, space, room, or group of rooms in a health care facility intended to serve activities involving procedures for investigation, diagnosis, or treatment in which flammable, combustible, or oxidizing materials are to be used shall comply with NFPA 99, *Standard for Health Care Facilities*.

These requirements shall not apply to isolated frozen section laboratories; areas in which oxygen is administered; blood donor rooms in which flammable, combustible, or otherwise hazardous materials normally used in laboratory procedures are not present; and clinical service areas not using hazardous materials.

13. Liquefied Petroleum Gases and Liquefied Natural Gases

13.1 General.

The storage and handling of liquefied petroleum gases (LP-Gas) shall be in accordance with this manual and NFPA 58, *Liquefied Petroleum Gas Code*.

Plans for stationary installations and all rooftop installations shall be submitted to the EHS&RM before the installation is started.

13.2 Containers.

Containers that show serious denting, bulging, gouging, or excessive corrosion shall be removed from service.

Repair or alteration of containers shall comply with the regulations, rules, or code under which the container was fabricated. Other welding shall be permitted only on saddle plates, lugs, or brackets attached to the container by the container manufacturer.

Cylinders of 1000 lb (454 kg) water capacity [nominal 420 lb (191 kg) LP-Gas capacity] or less shall incorporate protection against physical damage to cylinder appurtenances and immediate connections to these when in transit, when in storage, when being moved into position for use, and when in use, except in residential and commercial installations, by the following:

- (1) A ventilated cap or collar designed to permit pressure relief valve discharge and capable of withstanding a blow from any direction equivalent to that of a 30-lb (14-kg) weight dropped 1.2 m. Construction shall be such that the force of the blow will not be transmitted to the valve.
- (2) Collars shall be designed so that they do not interfere with the free operation of the cylinder valve.

Horizontal ASME containers of 2000 gal (7.6 m³) water capacity or less designed for permanent installation in stationary service shall be permitted to be equipped with non-fireproofed structural steel supports and designed to allow mounting on firm foundations in accordance with the following:

- (1) For installation on concrete foundations raised above the ground level by more than 300 mm, the structural steel supports shall be designed so that the bottoms of the horizontal members are not less than 51 mm nor more than 300 mm below the outside bottom of the container shell.
- (2) For installation on paved surfaces or concrete pads within 102 mm of ground level, the structural steel supports shall be permitted to be designed so that the bottoms of the structural members are not more than 610 mm below the outside bottom of the container shell.

Where LP-Gas and one or more other compressed gases are to be stored or used in the same area, the cylinders shall be marked "Flammable" and either "LP-Gas," "LP-GAS," "Propane," or "Butane."

Cylinders shall be marked with the following information:

- (1) The water capacity of the cylinder in pounds or cubic meters.
- (2) The tare weight of the cylinder in pounds or in kg, fitted for service. The tare weight is the cylinder weight plus the weight of all permanently attached valves and other fittings but does not include the weight of protecting devices that are removed in order to load the cylinder.

ASME containers shall be marked in accordance with the following:

- (1) The marking specified shall be on a stainless steel metal nameplate attached to the container, located to remain visible after the container is installed. The nameplate shall be attached in such a way as to minimize corrosion of the nameplate or its fastening means and not contribute to corrosion of the container.

- (2) Service for which the container is designed (for example, underground, aboveground, or both)
- (3) Name and address of container supplier or trade name of container
- (4) Water capacity of container in pounds or U.S. gallons
- (5) Design pressure in pounds per square inch
- (6) The wording "This container shall not contain a product that has a vapor pressure in excess of psi at 100°F" (*See NFPA 58.*)
- (7) Outside surface area in square feet
- (8) Year of manufacture
- (9) Shell thickness and head thickness
- (10) OL, OD, HD
- (11) Manufacturer's serial number
- (12) ASME Code symbol

Container appurtenances shall be fabricated of materials that are suitable for LP-Gas service and, shall be resistant to the action of LP-Gas under service conditions, and shall comply with NFPA 58, *Liquefied Petroleum Gas Code*.

13.3 Piping (Including Hose), Fittings, and Valves.

Piping (including hose), fittings, and valves shall comply with NFPA 58.

Emergency shutoff valves shall be approved and shall incorporate all of the following means of closing:

- (1) Automatic shutoff through thermal (fire) actuation. Where fusible elements are used, they shall have a melting point not exceeding 250°F (121°C).
- (2) Manual shutoff from a remote location.
- (3) Manual shutoff at the installed location.

Hose, hose connections, and flexible connectors shall be fabricated of materials that are resistant to the action of LP-Gas both as liquid and vapor. If wire braid is used for reinforcement, it shall be of corrosion-resistant material such as stainless steel.

Hydrostatic relief valves designed to relieve the hydrostatic pressure that might develop in sections of liquid piping between closed shutoff valves shall have pressure settings not less than 400 psi (2.8 MPa) or more than 500 psi (3.5 MPa) unless installed in systems designed to operate above 350 psi (2.4 MPa). Hydrostatic relief valves for use in systems designed to operate above 350 psi (2.4 MPa) shall have settings not less than 110 percent or more than 125 percent of the system design pressure.

13.4 Installation of LP-Gas Systems.

Containers installed outside of buildings, whether of the portable type replaced on a cylinder exchange basis or permanently installed and refilled at the installation, shall be located with respect to the nearest container, important building, group of buildings, or line of adjoining property that can be built upon, in accordance with the following and **Table 13.4-a**, and **Table 13.4-c**.

- (1) At a consumer site, if the aggregate water capacity of a multicontainer installation comprised of individual containers having a water capacity of less than 125 gal (0.5 m³) is 501 gal (1.9 m³) or more, the minimum distance shall comply with the appropriate portion of Table 21-3.1.1.1, applying the aggregate capacity rather than the capacity per container. If more than one such installation is made, each installation shall be separated from any other installation by at least 7.6 m. The minimum distances between containers shall not be applied to such installations.

Table 13.4-a

Water Capacity per Container gallons (m ³)	Minimum Distances m		
	Mounded or Underground Containers	Aboveground Containers	Between Containers
Less than 125 (0.5)	3	None	None
125 to 250 (0.5 to 1.0)	3	3	None
251 to 500 (1.0+ to 1.9)	3	3	1
501 to 2,000 (1.9+ to 7.6)	3	7.6	1
2,001 to 30,000 (7.6+ to 114)	15	15	1.5
30,001 to 70,000 (114+ to 265)	15	23	*
70,001 to 90,000 (265+ to 341)	15	30	*
90,001 to 120,000 (341+ to 454)	15	38	*
120,001 to 200,000 (454 to 757)	15	61	*
200,001 to 1,000,000 (757 to 3,785)	15	91	*
Over 1,000,000 (3,785)	15	122	*

*One-quarter of the sum of the diameters of adjacent containers.

- (2) Cylinders installed alongside of buildings shall be located and installed so that the discharge from the cylinder pressure relief device is at least 1 m horizontally away from any building opening that is below the level of such discharge. Cylinders shall not be located and installed underneath any building unless the space is not enclosed for more than 50 percent of its perimeter. The discharge from container pressure relief devices shall be located not less than 1.5 m in any direction away from any exterior source of ignition, openings into direct-vent (sealed combustion system) appliances, or mechanical ventilation air intakes.
- (3) The distance measured horizontally from the point of discharge of a container pressure relief valve to any building opening below the level of such discharge shall be in accordance with **Table 13.4-b**.
- (4) The distance measured in any direction from the point of discharge of a container pressure relief valve, the vent of a fixed maximum liquid level gauge on a container, or the installed location of the filling connection of a container to any exterior source of ignition, openings into direct-vent (sealed combustion system) appliances, or mechanical ventilation air intakes shall be in accordance with **Table 13.4-b**.
- (5) The 7.6 m distance from aboveground containers of 501 gal to 2000 gal (1.9 m³ to 7.6 m³) capacity to buildings, group of buildings, or line of adjoining property that can be built upon shall be permitted to be reduced to not less than 3 m for a single container of 1200 gal (4.5 m³) water capacity or less provided such container is at least 7.6 m from any other LP-Gas container of more than 125 gal (0.5 m³) water capacity.

Table 13.4-b

Container Type	Exchange or Filled on Site	Distance Horizontally from Relief Valve Discharge to Opening Below Discharge	Discharge from Relief Valve, Vent Discharge, and Filling Connection to Exterior Source of Ignition, Openings into Direct-Vent Appliances, Mechanical Ventilation Air Intakes
		m	m
Cylinder	Exchange	1	1.5
Cylinder	Filled on site	1	3
ASME	Filled on site	1.5	3

- (6) Minimum distances for underground or mounded ASME containers of 2001 gal through 30,000 gal (7.6 m³ through 114 m³) water capacity incorporating all the provisions of NFPA 58 shall be permitted to be reduced to 3 m. Distances for all underground and mounded ASME containers shall be measured from

the relief valve and the filling connection. No part of an underground ASME container shall be less than 3 m from a building or line of adjoining property that can be built upon, and no part of a mounded ASME container that is installed above grade shall be less than 1.5 m from a building or line of adjoining property that can be built upon.

- (7) Where underground multicontainer installations are made of individual containers having a water capacity of 125 gal (0.5 m³) or more, such containers shall be installed so as to permit access at their ends or sides to facilitate working with cranes or hoists.
- (8) In applying the distance between buildings and ASME containers of 125 gal (0.5 m³) or more water capacity, a minimum of 50 percent of this horizontal distance shall also apply to all portions of the building that project more than 1.5 m from the building wall and that are higher than the relief valve discharge outlet. This horizontal distance shall be measured from a point determined by projecting the outside edge of such overhanging structure vertically downward to grade or other level upon which the container is installed. Under no condition shall the distances to the building wall be less than those specified except when the provisions of NFPA 58 are met. These distances shall be permitted to be reduced by one-half for ASME containers of 2001 gal through 30,000 gal (7.6 m³ through 114 m³) water capacity used in systems complying with Section of NFPA 58.

Underground or mounded containers shall be located outside of any buildings. Buildings shall not be constructed over any underground or mounded containers. Sides of adjacent containers shall be separated in accordance with **Table 13.4-a** but not less than 1 m.

Where containers are installed parallel with ends in line, any number of containers shall be permitted to be in one group. Where more than one row is installed, the adjacent ends of the tanks in each row shall be separated by not less than 3 m.

The following provisions shall also apply:

- (1) Containers shall not be stacked one above the other.
- (2) Loose or piled combustible material and weeds and long dry grass shall not be permitted within 3.0 m of any container.
- (3) Means shall be used to prevent the accumulation or flow of liquids having flash points below 93.4°C under adjacent LP-Gas containers such as by dikes, diversion curbs, or grading.
- (4) LP-Gas containers shall be located at least 3.0 m from the centerline of the wall of diked areas containing flammable or combustible liquids.
- (5) The minimum horizontal separation between aboveground LP-Gas containers and aboveground tanks containing liquids having flash points below 93.4°C shall be 6 m. No horizontal separation shall be required between aboveground LP-Gas containers and underground tanks containing flammable or combustible liquids installed in accordance with NFPA 30, *Flammable and Combustible Liquids Code*.
- (6) The minimum separation between LP-Gas containers and oxygen or gaseous hydrogen containers shall be in accordance with **Table 13.4-c** of this document.
- (7) The minimum separation between LP-Gas containers and liquefied hydrogen containers shall be in accordance with NFPA 50B, *Standard for Liquefied Hydrogen Systems at Consumer Sites*.
- (8) Where LP-Gas containers are to be stored or used in the same area with other compressed gases, the containers shall be marked to identify their content in accordance with ANSI/CGA C-4, *Method of Marking Portable Compressed Gas Containers to Identify the Material Contained*.
- (9) No part of an aboveground LP-Gas container shall be located in the area 1.8 m horizontally from a vertical plane beneath overhead electric power lines that are over 600 volts, nominal.

Table 13.4-c

LP-Gas Containers Aggregate Water Capacity gal (m ³)	Separation from Oxygen Containers Aggregate Capacity			Separation from Gaseous Hydrogen Containers Aggregate Capacity		
	11 m ³ * or less	More than 11 m ³ * to 566 m ³ * including unconnected reserves (m)	More than 566 m ³ * including unconnected reserves (m)	Less than 11 m ³ *	11 m ³ * to 85 m ³ * (m)	More than 85 m ³ * (m)
1200 (4.5) or less	None	6	7.6	—	—	—
Over 1200 (4.5)	None	6	15	—	—	—
500 (1.9) or less	—	—	—	None	3	7.6
Over 500 (1.9)	—	—	—	None	7.6	15

*m³ measured at 21°C and atmospheric pressure.

Structures such as fire walls, fences, earth or concrete barriers, and other similar structures, shall be avoided around or over installed nonrefrigerated containers.

Containers shall be installed in accordance with the following:

- (1) Cylinders shall be installed only aboveground, and shall be set upon a firm foundation or be otherwise firmly secured. Flexibility shall be provided in the connecting piping.
- (2) All containers shall be positioned so that the pressure relief valve is in direct communication with the vapor space of the container.
- (3) Where physical damage to LP-Gas containers, or systems of which they are a part, from vehicles is a possibility, precautions shall be taken against such damage.
- (4) The installation position of ASME containers shall make all container appurtenances accessible for their normally intended use.
- (5) Field welding on containers shall be limited to attachments to nonpressure parts, such as saddle plates, wear plates, or brackets applied by the container manufacturer.
- (6) Aboveground containers shall be kept properly painted.

Provision shall be made in piping including interconnecting of permanently installed containers, to compensate for expansion, contraction, jarring and vibration, and for settling. Where necessary, flexible connectors complying with NFPA 58 shall be permitted to be used. The use of nonmetallic pipe, tubing, or hose for permanently interconnecting such containers shall be prohibited.

Underground metallic piping shall be protected against corrosion as warranted by soil conditions.

LP-Gas piping shall not be used as a grounding electrode.

Hose shall be permitted to be used on the low-pressure side of regulators to connect to other than domestic and commercial appliances as follows:

- (1) The appliance connected shall be of a portable type.
- (2) For use inside buildings, the hose shall be of a minimum length, not exceeding 1.8 m, and shall not extend from one room to another nor pass through any partitions, walls, ceilings, or floors. It shall not be concealed from view or used in concealed locations. For use outside buildings, hose length shall be permitted to exceed 1.8 m but shall be kept as short as practical.
- (3) Hose shall be securely connected to the appliance.
- (4) A shutoff valve shall be provided in the piping immediately upstream of the inlet connection of the hose. Where more than one such appliance shutoff is located near another, precautions shall be taken to prevent operation of the wrong valve.

-
- (5) Hose used for connecting appliances to wall or other outlets shall be protected against physical damage.

13.5 LP-Gas Systems in Buildings or on Building Roofs or Exterior Balconies.

Cylinders, regulating equipment, manifolds, pipe, tubing, and hose shall be located to minimize exposure to abnormally high temperatures (such as might result from exposure to convection and radiation from heating equipment or installation in confined spaces), physical damage, or tampering by unauthorized persons.

Heat-producing equipment shall be located and used to minimize the possibility of the ignition of combustibles.

Where cylinders are located on a floor, roof, or balcony, provisions shall be made to minimize the possibility of cylinders falling over the edge.

13.6 Buildings Under Construction or Undergoing Major Renovation.

Cylinders shall be permitted to be used and transported in buildings or structures under construction or undergoing major renovation where such buildings are not occupied by the public or, if partially occupied by the public, cylinders shall be permitted to be used and transported in the unoccupied portions with the prior approval of the EHS&RM. Such use shall be in accordance with NFPA 58.

For temporary heating, such as curing concrete, drying plaster, and similar applications, heaters shall be located at least 1.8 m from any cylinder.

13.7 Buildings Housing Industrial Occupancies.

Cylinders shall be permitted to be used in buildings housing industrial occupancies for processing, research, or experimental purposes as follows:

- (1) Cylinders, equipment, and piping used shall comply with NFPA 58.
- (2) If cylinders are manifolded together, the total water capacity of the connected cylinders shall be not more than 333 kg [nominal 136 kg LP-Gas capacity]. If there is more than one such manifold in a room, it shall be separated from any other by at least 6.1 m.
- (3) The amount of LP-Gas in cylinders for research and experimental use in the building shall be limited to the smallest practical quantity.

Cylinders shall be permitted to be used to supply fuel for temporary heating in buildings housing industrial occupancies with essentially noncombustible contents, if portable equipment for space heating is essential and a permanent heating installation is not practical, provided cylinders and heaters comply with and are used in accordance with NFPA 58.

13.8 Buildings Housing Educational and Laboratory Occupancies.

Cylinders shall be permitted to be used in buildings housing educational and laboratory occupancies for research and experimental purposes, but not in classrooms, as follows:

- (1) The maximum water capacity of individual cylinders used shall be 23 kg [nominal 9.1 kg LP-Gas capacity] if used in educational occupancies and 5.4 kg [nominal 2 kg LP-Gas capacity] if used in institutional occupancies.
- (2) If more than one such cylinder is located in the same room, the cylinders shall be separated by at least 6.1 m.
- (3) Cylinders not connected for use shall not be stored in a laboratory room.

13.9 Cylinders on Roofs or Exterior Balconies.

Cylinders shall be permitted to be permanently installed on roofs of buildings of fire-resistive construction, or noncombustible construction having essentially noncombustible contents, or of other construction or contents

that are protected with automatic sprinklers (see NFPA 220, *Standard on Types of Building Construction*) in accordance with NFPA 58 and the following:

- 1) The total water capacity of cylinders connected to any one manifold shall be not greater than 445 kg [nominal 181 kg LP-Gas capacity]. If more than one manifold is located on the roof, it shall be separated from any other by at least 15 m.
- 2) Cylinders shall be located in areas where there is free air circulation, at least 3.0 m from building openings (such as windows and doors), and at least 6.1 m from air intakes of air conditioning and ventilating systems.
- 3) Cylinders shall not be located on roofs that are entirely enclosed by parapets more than 457 mm high unless the parapets are breached with low-level ventilation openings no more than 6.1 m apart or all openings communicating with the interior of the building are at or above the top of the parapets.
- 4) Piping shall be in accordance with NFPA 58. Hose shall not be used for connection to cylinders.
- 5) The fire department shall be advised of each such installation.

13.10 Fire Protection.

The wide range in size, arrangement, and location of LP-Gas installations covered by NFPA 58 precludes the inclusion of detailed fire protection provisions completely applicable to all installations.

Suitable roadways or other means of access for emergency equipment, such as fire department apparatus, shall be provided.

Emergency controls shall be conspicuously marked, and the controls shall be located so as to be readily accessible in emergencies.

13.11 Storage of Portable Containers Awaiting Use.

Cylinders in storage shall be located to minimize exposure to excessive temperature rise, physical damage, or tampering.

Cylinders stored in buildings shall not be located near exits, stairways, or in areas normally used, or intended to be used, for the safe egress of occupants.

If empty cylinders that have been in LP-Gas service are stored indoors, they shall be considered as full cylinders for the purposes of determining the maximum quantities of LP-Gas permitted.

Cylinders that are not connected for use shall not be stored on roofs.

Screw-on type caps or collars shall be securely in place on all cylinders stored, regardless of whether they are full, partially full, or empty, and cylinder outlet valves shall be closed and plugged or capped.

13.12 Storage within Buildings.

Cylinders with a maximum water capacity of 1.1 kg [nominal 0.45 kg] LP-Gas capacity used with completely self-contained hand torches and similar applications, shall be permitted to be stored or displayed in a building frequented by the public. The quantity of LP-Gas shall not exceed 91 kg. Storage in restaurants and at food service locations of 283-g butane nonrefillable containers shall be limited to no more than 24 containers. An additional twenty-four 283-g butane nonrefillable containers shall be permitted to be stored in another location within the building provided that the storage area is constructed with at least a 2-hour fire wall protection.

The maximum quantity allowed in one industrial storage location shall not exceed 334 kg water capacity [nominal 136 kg LP-Gas]. If additional storage locations are required on the same floor within the same building, they shall be separated by a minimum of 91.4 m. Storage beyond these limitations shall comply with the rules of storage within special buildings or rooms.

The maximum quantity of LP-Gas stored in special buildings or rooms shall be 4540 kg. Special buildings or

rooms for storing LP-Gas cylinders shall not be located adjoining the line of property occupied by schools, churches, hospitals, athletic fields, or other points of public gathering.

The construction of all such special buildings, and rooms within, or attached to, other buildings, shall comply with Chapter 7 of NFPA 58 and the following:

- (1) Adequate vents, to the outside only, shall be provided at both top and bottom and shall be located at least 1.5 m from any building opening.
- (2) The entire area shall be classified for purposes of ignition source control in accordance with NFPA 58.

Storage of cylinders within a residential building, including the basement or any storage area in a common basement storage area in multiple family buildings and attached garages, shall be limited to two cylinders each with a maximum water capacity of 1.2 kg and shall not exceed 2.4 kg total water capacity for smaller cylinders per each living space unit. Each cylinder shall meet DOT specifications.

Storage outside of buildings for cylinders shall be located at least 6.1 m from any doorway or opening in a building frequented by the public; 6.1 m from any automotive service station fuel dispenser; and in accordance with **Table 13.12** with respect to:

- (1) Nearest important building or group of buildings
- (2) Line of adjoining property that can be built upon
- (3) Busy thoroughfares or sidewalks
- (4) Line of adjoining property occupied by schools, churches, hospitals, athletic fields, or other points of public gathering
- (5) Dispensing station

Table 13.12

Quantity of LP-Gas Stored (kg)	Horizontal Distance in (m) to		
	(1) and (2)	(3) and (4)	(5)
227 or less	0	0	1.5
227+ to 1134	0	3	3
1134+ to 2721	3	3	3
2721+ to 4540	6.1	6.1	6.1
Over 4540	7.6	7.6	7.6

Cylinders at a location open to the public shall be protected by either:

- (1) An enclosure in accordance with 3.3.6(a) of NFPA 58, or
- (2) A lockable ventilated metal locker or rack that prevents tampering with valves and pilferage of the cylinder.

Protection against vehicle impact shall be provided in accordance with good engineering practice where vehicle traffic normally is expected at the location.

Storage locations, shall be provided with at least one approved portable fire extinguisher having a minimum capacity of 18 lb (8.2 kg) dry chemical with a B:C rating. (Also see NFPA 10, *Standard for Portable Fire Extinguishers*.)

14. Parking Garages

The construction and protection of new and existing parking garages as well as the control of hazards in open parking structures, enclosed parking structures, and basement and underground parking structures shall comply with NFPA 88A, *Standard for Parking Structures*.

15. Safeguards During Building Construction, Alteration, and Demolition Operations

15.1 General.

Buildings undergoing construction, alteration, or demolition operations shall comply with NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*.

A fire protection plan shall be established where required by EHS&RM.

In buildings under construction, adequate escape facilities shall be maintained at all times for the use of construction workers. Escape facilities shall consist of doors, walkways, stairs, ramps, fire escapes, ladders, or other approved means or devices arranged in accordance with the general principles of NFPA 101, *Life Safety Code*, insofar as they can reasonably be applied to buildings under construction.

Temporary wiring shall comply with the provisions of NFPA 70, *National Electrical Code*.

Cutting and welding shall comply with Chapter 11 of this manual.

In buildings required to be provided with a standpipe system, not less than one standpipe shall be provided and kept in service during construction. The standpipes shall be provided with conspicuously marked and readily accessible fire department connections on the outside of the building at the street level and shall have at least one standard hose outlet at each floor level.

The suitability, distribution, and maintenance of extinguishers shall be in accordance with NFPA 10, *Standard for Portable Fire Extinguishers*.

Smoking shall not be permitted in buildings, as per AUB's [Smoking Policy](#).

Accumulations of combustible waste material, dust, and debris shall be removed from the structure and its immediate vicinity at the end of each work shift or more frequently as necessary for safe operations.

Materials susceptible to spontaneous ignition, such as oily rags, shall be stored in a listed disposal container.

15.2 Scaffolding, Shoring, and Forms.

Accumulations of unnecessary combustible forms or form lumber shall be prohibited. Combustible forms or form lumber shall be brought into the structure only when needed. Combustible forms or form lumber shall be removed from the structure as soon as stripping is complete. Those portions of the structure where combustible forms are present shall not be used for the storage of other combustible building materials.

During forming and stripping operations, portable fire extinguishers or charged hose lines shall be provided to protect the additional combustible loading adequately.

15.3 Flammable and Combustible Liquids.

Storage of flammable and combustible liquids shall be in accordance with NFPA 30, *Flammable and Combustible Liquids Code*, except that storage of Class I and II liquids shall not exceed 227 L within 15 m of the structure.

Storage areas shall be kept free of weeds, debris, and combustible materials not necessary to the storage.

Open flames and smoking shall not be permitted in flammable and combustible liquids storage areas. Such storage areas shall be appropriately posted as "no smoking" areas.

Class I and Class II liquids shall be kept in approved safety containers.

Class I liquids shall be dispensed only where there are no open flames or other sources of ignition within the possible path of vapor travel.

15.4 Alteration of Buildings.

Where the building is protected by fire protection systems, such systems shall be maintained operational at all times during alteration. Where alteration requires modification of a portion of the fire protection system, the remainder of the system shall be kept in service. When it is necessary to shut down the system, the EHS&RM shall have the authority to require alternate measures of protection until the system is returned to service.

Fire-resistive assemblies and construction shall be maintained.

Where in the opinion of the EHS&RM the demolition site is of a hazardous nature, qualified personnel shall serve as an on-site fire watch and EHS&RM be consulted on the proper demolition procedures.

Torch-applied roofing systems and tar kettles applications shall be performed in compliance with NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations* and chapter 11 of this manual.

Fuel containers shall be constructed and approved for the use for which they were designed.

LP-Gas containers, hose, regulators, and burners shall conform to the specifications in NFPA 58, *Liquefied Petroleum Gas Code*.

LP-Gas cylinders shall be secured to prevent accidental tipover.

Regulators shall be required on any cylinders.

Where, in the opinion of the EHS&RM, there is danger of physical damage to the container, protection shall be provided to prevent such physical damage.

Roofing kettles and all integral working parts shall be in good working condition and shall be maintained free of excessive residue.

The materials and methods of construction of roofing kettles shall be acceptable to the EHS&RM. The following are minimum requirements:

- (1) These requirements section shall apply to all roofing kettles or tar pots in excess of 3.8 L capacity.
- (2) No roofing kettle shall have a capacity in excess of five barrels.
- (3) The chassis shall be substantially constructed and capable of carrying the load imposed upon it whether standing still or being transported.
- (4) Fuel containers, burners, and related appurtenances of roofing kettles in which liquefied petroleum gas is used for heating shall comply with all the requirements of NFPA 58, *Liquefied Petroleum Gas Code*.
- (5) All fuel containers shall be maintained in accordance with applicable NFPA codes and standards or shall be at least 10 ft (3 m) from the burner flame or at least 2 ft (0.6 m) therefrom when properly insulated from heat or flame.

16. Grandstands and Bleachers, Folding Seating, Tents, and Membrane Structures

16.1 General.

The construction, location, protection and maintenance of grandstands and bleachers, folding and telescopic seating, tents and membrane structures shall meet the requirements of this chapter. Seating facilities located in the open air or within enclosed or semi-enclosed structures such as tents membrane structures and stadium complexes shall also meet the requirements of this chapter.

Grandstands shall comply with the provisions of Chapter 12 of NFPA 101, *Life Safety Code*.

Where grandstand seating without backs is used indoors, rows of seats shall be spaced not less than 55.9 cm back-to-back.

The depth of footboards and seat boards in grandstands shall be not less than 22.9 cm. Where the same level is not used for both seat foundations and footrests, footrests independent of seats shall be provided.

Seats and footrests of grandstands shall be supported securely and fastened in such a manner that they cannot be displaced inadvertently.

Spaces underneath a grandstand shall be kept free of flammable or combustible materials, unless protected by an approved, supervised automatic sprinkler system in accordance with NFPA 101.

16.2 Guards and Railings.

Railings or guards not less than 107 cm above the aisle surface or footrest or not less than 91 cm vertically above the center of the seat or seat board surface, whichever is adjacent, shall be provided along those portions of the backs and ends of all grandstands where the seats are more than 1.2 m above the floor or ground.

Where the front footrest of any grandstand is more than 0.6 m above the floor, railings or guards not less than 84 cm above such footrests shall be provided.

Cross aisles located within the seating area shall be provided with rails not less than 66 cm high along the front edge of the cross aisle.

Vertical openings between guardrails and footboards or seat boards shall be provided with intermediate construction so that a 10.2-cm diameter sphere cannot pass through the opening.

An opening between the seat board and footboard located more than 76 cm above grade shall be provided with intermediate construction so that a 10.2-cm diameter sphere cannot pass through the opening.

The Physical Plant shall provide for not less than annual inspection and required maintenance of each outdoor grandstand to ensure safe conditions. At least biennially, the inspection shall be performed by a professional engineer, registered architect, or individual certified by the manufacturer. Where required by EHS&RM, the owner shall provide certification that such inspection has been performed.