FACILITIES AND SUPPORT SERVICES

Facilities and Support Services (FSS) provides a variety of administrative support services for the Environmental Protection Agency. FSS is part of the Office of Administration and Resources Management in EPA Headquarters in Washington, D.C. Many FSS programs operate on a nationwide basis, and this Manual provides uniform procedures throughout EPA.

FSS has four major components: the Office of the FSS Director, and the Communications, General Services, and Facilities Engineering and Real Estate Branches. The FSS Branches provide services related to communications, facilities engineering and safety, real estate, physical and document security, personal property and supplies, transportation, and emergency preparedness.

THE FSS MANUAL

The FSS Policy and Procedures Manual is a set of seven volumes; each volume gives policies and procedures that pertain to FSS functions.

The volumes are titled as follows:

- The Administrative Handbook and Guide for Updating the Manual, Volume 4810
- Communications, Volume 4820
- Personal Property Management, Volume 4830
- Facilities Management, Volume 4840
- Security, Volume 4850
- Emergency Preparedness, Volume 4860
- Facilities Safety, Volume 4870.

Each volume begins with an Introductory Materials section consisting of a title page, an introduction, a general organization of the volume, and a guide for the reader. The Introductory Materials are followed by the technical content of the volume.

A separately bound Master Table of Contents provides a detailed overview of all seven volumes of the manual. It contains a tables of contents, list of exhibits, and list of forms for each part.

The entire seven volumes of the FSS Manual were written with the assistance of JWK INTERNATIONAL CORPORATION of Annandale, Virginia, working under contract 42-83 with the Office of Personnel Management. The following section describes the organization and content of this particular volume.

FACILITIES SAFETY VOLUME

The Facilities Safety Volume (FS 1) provides safety criteria and guidelines for buildings occupied by EPA or buildings which are included in the EPA Real Property Inventory and occupied by other than EPA staff. Subject areas treated in the Volume include firesafety, construction, interior arrangement, and mechanical and electrical systems.

The facilities safety criteria contained within the volume apply to occupants of buildings owned or leased by EPA, and buildings assigned to EPA by GSA or other Government agencies. The organization section on the next page provides a general overview of the volume contents.

ORGANIZATION OF THE FACILITIES SAFETY VOLUME

PART 0: INTRODUCTORY MATERIALS

FS 0-01 INTRODUCTION TO THE FACILITIES SAFETY VOLUME
FS 0-02 ORGANIZATION OF THE FACILITIES SAFETY VOLUME
FS 0-03 GUIDE FOR THE READER

PART 1: FACILITIES SAFETY

FS 1-00 TABLE OF CONTENTS AND LIST OF EXHIBITS
FS 1-01 AUTHORITY, POLICY AND RESPONSIBILITY
FS 1-02 BASIC FIRESAFETY STANDARDS
FS 1-03 SPECIFIC SAFETY CRITERIA
FS 1-04 INTERIOR CONSTRUCTION AND ARRANGEMENT
FS 1-05 MECHANICAL SYSTEMS
FS 1-06 ELECTRICAL SYSTEMS AND EQUIPMENT
FS 1-07 MISCELLANEOUS OCCUPANCY FEATURES
FS 1-A APPENDIX: STANDARDS AND DEFINITIONS

OVERVIEW

The Guide for the Reader briefly describes the FSS Policies and Procedures Manual, including how the Manual is organized, how a page is read, how a change is initiated, and how a copy is kept up to date. The Manual is issued by the Director of the Facilities and Support Services (FSS), in EPA Headquarters, Washington, D.C.

HOW THE MANUAL IS ORGANIZED

The Manual is organized into seven volumes; each volume gives policies and procedures that pertain to particular FSS functions. Exhibit 1 lists the volumes, their authoring branches and sections, and the related EPA administrative contact.

Volume Structure

Each volume begins with an Introductory Materials section consisting of a title page, an introduction, a general organization of the volume, and this Guide. The Introductory materials are followed by the technical content of the volume.

Part Structure

The technical content of each volume is divided into parts and chapters. Each part begins with a detailed table of contents showing chapter titles and internal contents, appendixes to the part, and a list of exhibits used in the part.

Master Table of Contents

A separately bound Master Table of Contents provides a detailed overview of all seven volumes of the Manual. It contains the assembled part tables of contents and lists of exhibits. Following each part table of contents and list of exhibits will appear a list of forms drawn from the appendix(es) and exhibits of each part.

HOW TO READ A PAGE

Each page of the Manual has identifying information that is separated from the text by top and bottom horizontal lines. Text headings are blocked out vertically down the left side of the page.

Top of the Page

To locate yourself in the Manual, look above the horizontal line in the top left hand corner of the page to find the name of the volume. Directly under the volume name is the part name. To the right of the part name--on the same line--is the chapter name. Immediately above the chapter name appears the effective date of issuance of the material on that page. The initial base manual shows "Change 00" to the left of the original 7/16/84 issuing date. Future changes to each volume will be assigned new dates and change numbers. The volume number appears before the change number.

Bottom of the Page

In the bottom left hand corner is the name of the issuing branch of FSS. In the bottom center is the page number. Each chapter is numbered separately beginning with the Arabic numeral one ("1"). However, the Introductory Materials --in the beginning of each volume--are numbered continuously beginning with the lower case Roman nummeral one ("i"). In the bottom right hand corner is the Code Index.

The Code Index

The Code Index consists of two or three letters that stand for the name of the volume, the number of the part, a hyphen, and the number of the chapter. Thus COM 1-02 means "Communications Volume, Part 1, Chapter 02."

Text Headings

Arranged down the left side of the page are text headings. Primary headings are the major points in the outline and are all in capital letters and underlined. Secondary headings are minor points and are shown with initial capital letters and not underlined. (See "Text Headings" next to this paragraph.) Sometimes, detailed tertiary headings are used. These are underlined and start in the body of the text with initial capital letters as follows:

Tertiary heading. The text after a tertiary heading begins two spaces after the period.

Body of Text

The body of the text occupies the space to the right of the text headings between the horizontal lines. Exhibit 2 shows a list of acronyms used throughout the Manual. Cross references use the Code Index described in "Code Index" of this Guide.

HOW TO INITIATE A CHANGE

To initiate a change in the Manual, the reader shall prepare a memorandum describing the need for and impact of the proposed change. The memorandum should be submitted to the FSS Branch Chief responsible for the volume or part of the Manual affected by the proposed change.

The memorandum shall include either a copy of the original Manual page--marked up with the proposed change--or a draft of the proposed change along with a copy of the Manual pages being revised.

A description of the change review and approval process is given in the Guide for Updating the Manual, available from the Manual Coordinator in the Office of the Director, FSS.

HOW TO KEEP YOUR COPY UP TO DATE

Each individual who has custody of a copy of the Manual is responsible for ensuring that his or her copy is kept current by entering all approved changes.

When changes are placed in your copy of the Manual, entries should be made on EPA Form 1315-4, Checklist of EPA Transmittals. Be certain to give the transmittal number, the date of entry, and your initials. The instructions on the transmittal letter should be followed carefully, including removing old and inserting new pages of all tables of contents, lists of exhibits, and lists of forms in the individual volume(s) or the Master Table of Contents.

EXHIBIT 1
THE FSS MANUAL AND THE FSS ORGANIZATION

VOLUME NAME/CODE/NUMBER	RESPONSIBLE ORGANIZATION	CONTACT
ADMINISTRATIVE HANDBOOK (ADM) 4810 GUIDE FOR UPDATING THE MANUAL (ADM) 4810	OFFICE OF THE DIRECTOR	Director Manual Coordinator
COMMUNICATIONS (COM) 4820	COMMUNICATIONS BRANCH Telecommunications Management Section Printing and Distribution Section Mail Management Program	Branch Chief Section Chief Section Chief EPA Mail Mgr.
SECURITY (SCR) 4850 EMERGENCY PREPAREDNESS (EMR) 4860	GENERAL SERVICES BRANCH Security Section	Branch Chief
PERSONAL PROPERTY MANAGEMENT (PMR) 4830	Property, Supply and Transportation Section	Section Chief
FACILITIES MANAGEMENT (FM) 4840	HQ Building Operations Section FACILITIES ENGINEERING & REAL ESTATE BRANCH Real Estate Section Facilities Engineering Section	Branch Chief Branch Chief Section Chief Section Chief
FACILITIES SAFETY (FS) 4870		

EXHIBIT 2

ACRONYMS USED IN THE FSS MANUAL

B&F	Buildings & Facilities
C.F.R.	Code of Federal Regulations
CO	Contracting Officer
DOD	Department of Defense
E.O.	Executive Order
EPA	Environmental Protection Agency
EPPR	EPA Procurement Regulations
FAR	Federal Acquisition Regulations
FEMA	Federal Emergency Management Agency
FEREB	Facilities Engineering & Real Estate Branch
FPMR	Federal Property Management Regulations
FSS	Facilities & Support Services
GAO	General Accounting Office
GSA	General Services Administration
GSB	General Services Branch
GPO	Government Printing Office
JCP	Joint Committee on Printing
U.S.C.	United States Code
OARM	Office of the Asst. Administrator for Administration and Resources Management
OFA	Office of Federal Activities
OMB	Office of Management and Budget
OPM	Office of Personnel Management
POSS	Program Operations & Support Staff
PMR	(Personal) Property Management Regulations
RTP	Research Triangle Park (North Carolina)
SBA	Small Business Administration
S&E	Salaries & Expenses
SF	Standard Form
USPS	United States Postal Service
U.S.	United States

TABLE OF CONTENTS
PART 1: FACILITIES SAFETY

Page

FS 1-01 AUTHORITY, POLICY AND RESPONSIBILITY

PURPOSE..... 1
OVERVIEW..... 1
SCOPE..... 1
AUTHORITY..... 1
POLICY..... 1
OBJECTIVES..... 1
RESPONSIBLE OFFICERS..... 2
REFERENCES..... 2

FS 1-02 BASIC FIRESAFETY STANDARDS

PURPOSE..... 1
AUTHORITY..... 1
FIRE RESISTANCE RATINGS..... 1
TYPES OF CONSTRUCTION..... 1
FIRE WALLS AND FIRE PARTITIONS..... 1
VERTICAL OPENINGS AND SHAFTS..... 3
Atriums..... 3
Shafts..... 3
Monumental Stairs..... 3
Escalators..... 3
Penetrations..... 4
PANEL, CURTAIN AND SPANDREL WALLS..... 4
Panel and Curtain Walls..... 4
Windows..... 4
Spandrel Walls..... 4
Exception No. 1..... 4
Exception No. 2..... 4
CEILINGS..... 4
FIRE-STOPPING..... 4
FIRE DOORS..... 5
UTILITIES..... 5

FS 1-03 SPECIFIC SAFETY CRITERIA

PURPOSE..... 1
CLASSIFICATION OF OCCUPANCIES..... 1
Group I, Low Intensity-Low Severity..... 1
Group II, Full Intensity-Low Severity..... 2
Group III, Full Intensity-Medium Severity..... 2
Group IV, Full Intensity-High Severity..... 3

Page

FS 1-03 SPECIFIC SAFETY CRITERIA (Continued)

Occupancy Classification Considerations..... 3
Wood Furniture..... 4
AUTOMATIC SPRINKLER-PROTECTED OCCUPANCIES..... 4
OPEN PLAN OFFICE SPACE..... 4
TYPES OF CONSTRUCTION..... 4
Top Floor..... 4
Below Grade Floor..... 6
Multiple Occupancy Building..... 6
AREA LIMITATIONS..... 6
ATTACHMENTS AND ADDITIONS..... 6
FIRE EXPOSURE PROTECTION..... 6

FS 1-04 INTERIOR CONSTRUCTION AND ARRANGEMENT

PURPOSE..... 1
NATIONAL CODES AND TEST METHODS..... 1
INTERIOR FINISH..... 1
Sprinkler-Protected Buildings..... 1
Doors and Door Frames..... 1
Final Finishing Material..... 2
Airspace..... 2
Combustible Substances..... 2
Restrictions..... 3
Flooring Materials..... 3
Draperies and Curtains..... 3
FLOORING..... 3
PARTITIONS..... 3
Ceiling-High Partitions..... 3
Wood Stud Partitions..... 3
Less Than Ceiling-High Partitions..... 3
EXIT FACILITIES..... 3
Number of Exits..... 3
Emergency Egress..... 3
Exit Stairs..... 4
Exit Merging..... 4
Exit Stair Doors..... 4
Distance Between Exits..... 4
Latches..... 4
Continuous Corridors..... 5
Open Plan Office Space..... 5
Exit Corridors..... 5
Exit Discharge..... 5

Page

FS 1-04 INTERIOR CONSTRUCTION AND ARRANGEMENT (Continued)

Two-Doorway Discharge..... 7
Panic Hardware..... 7
Smokeproof Towers..... 7
Timed Exit Calculation..... 7
Fire Subdivisions..... 7
Fire Escape..... 8
HAZARD SEGREGATION..... 8
Garages..... 8
Assembly Areas..... 8
Blind Stands and Self-Service Stores..... 8

FS 1-05 MECHANICAL SYSTEMS

PURPOSE..... 1
NATIONAL CODES..... 1
WATER SUPPLIES..... 2
Fire Department Hose Streams..... 2
Standpipe Hose Stream..... 3
Automatic Sprinklers..... 3
AUTOMATIC SPRINKLER PROTECTION..... 4
HALON 1301 FIRE EXTINGUISHING SYSTEM..... 5
Applicability..... 5
Use With Solid Fuels..... 5
Flame-Inhibiting Atmosphere..... 5
Water Damage Prevention..... 5
General Requirements..... 6
Design Requirements..... 6
Discharge..... 6
Openings..... 7
Installation..... 7
Trouble Signal..... 7
Acceptance Tests..... 8
DRY CHEMICAL SYSTEMS..... 8
Design Requirements..... 8
Acceptance Tests..... 8
AIR-CONDITIONING SYSTEMS..... 8
Air Distribution..... 8
Ducts..... 8
Smoke Control Systems..... 9
Shaft Construction..... 9
Automatic Fire Doors and Dampers..... 9

Page

FS 1-05 MECHANICAL SYSTEMS (Continued)

Cooling Towers..... 9
Smoke Detectors..... 10
Fans..... 10
VENTILATION SYSTEMS..... 10
Paint Spraying and Finishing Booths..... 10
Cooking Equipment..... 10
HEATING EQUIPMENT..... 10
Authority..... 10
Fuel Storage..... 11
Shop Operations..... 11
Burners..... 11
Space Heaters..... 11
Gas Piping..... 11
Gas Meter Regulators..... 11
Valves..... 12
Piping Location..... 12
Gas Meter Rooms..... 12
Fire-Resistive Shafts or Conduit..... 12
INTERNAL COMBUSTION ENGINES..... 12
ELEVATORS..... 12

FS 1-06 ELECTRICAL SYSTEMS AND EQUIPMENT

PURPOSE..... 1
NATIONAL CODES..... 1
FUEL POTENTIAL OF ELECTRICAL SYSTEMS AND EQUIPMENT..... 1
ELECTRICAL INSTALLATION..... 1
PLENUMS, CEILINGS, VOIDS, AND SIMILAR SPACES..... 2
HIGH-ENERGY COMPONENTS..... 2
PUBLIC UTILITY TRANSFORMERS..... 2
INTERIOR TRANSFORMERS..... 2
OUTSIDE SUBSTATIONS AND TRANSFORMER INSTALLATIONS..... 3
DISTRIBUTION SYSTEMS..... 3
WIRE CLOSETS..... 3
FIRESAFETY REQUIREMENTS FOR LIGHTING..... 4
Mounting..... 4
Florescent Fixtures..... 4
Locations..... 4
Light Diffusers..... 4
EXIT MARKINGS..... 4
FIRE ALARM SYSTEMS..... 5
Basic Requirements..... 5

Page

FS 1-06 ELECTRICAL SYSTEMS AND EQUIPMENT (Continued)

Manual Systems Input..... 6
Automatic Systems Input..... 6
Automatic Systems Output..... 8
Manual Systems Output..... 10
Systems Features..... 10
Reliability..... 12
EMERGENCY LIGHTING..... 12
EMERGENCY POWER..... 12
GROUND FAULT CIRCUIT INTERRUPTERS..... 12
Non-Aquatic Laboratories..... 14
Grounded System..... 14
Tripout..... 15

FS 1-07 MISCELLANEOUS OCCUPANCY FEATURES

PURPOSE..... 1
NATIONAL CODES..... 1
TRASH ROOMS..... 1
FLAMMABLE LIQUIDS..... 2
FLAMMABLE AND OXIDIZING GASES..... 2
GAS CYLINDERS..... 5
Size and Quantity in Use..... 5
Anchoring of Cylinders..... 5
Ventilation..... 5
ELECTRONIC EQUIPMENT..... 6
Housing..... 6
Separation..... 6
Construction..... 6
Occupancy..... 6
Wet Pipe Sprinkler Protection..... 6
Halon 1301..... 6
Smoke Detectors..... 6
Vital Records..... 6
Air-Conditioning System..... 7
Shutoff Switches..... 7
Emergency Lighting..... 7
Authority..... 7
COMMUNICATIONS EQUIPMENT..... 7
STAGES..... 7
LABORATORY FUME HOODS..... 8
Hood Function..... 8
Conditions Affecting Hood Performance..... 8

Page

FS 1-07 MISCELLANEOUS OCCUPANCY FEATURES (Continued)

Face Velocity..... 9
Operator Effect..... 9
Air Movement in the Laboratory..... 9
Hood Turbulence..... 9
Hood Location..... 10
Fume Hood Systems..... 10
Fume Hood Types..... 10
Constant Volume Bypass Type..... 10
Auxiliary Air Hoods..... 11
Radioactive Isotope Hoods..... 12
Perchloric Acid Hoods..... 12
Other Ventilated Enclosures..... 12
New Installations..... 14
Existing Installations..... 14
Face Velocities..... 15
Exhaust System..... 15
Effluent Cleaning..... 17
Fume Hood Operation..... 17
Hood Purchase and Installation..... 18
LABORATORIES..... 18
CONSUMER SAFETY OFFICERS..... 20
SPACE REQUIREMENTS..... 20

FS 1-A APPENDIX: STANDARDS AND DEFINITIONS

PURPOSE..... 1
NATIONAL REFERENCE STANDARDS..... 1
DEFINITIONS..... 2
TEST METHODS AND ACCEPTABILITY..... 3

LIST OF EXHIBITS
PART 1: FACILITIES SAFETY

Page

FS 1-02 BASIC FIRESAFETY STANDARDS

EXHIBIT 1: TYPES OF CONSTRUCTION..... 2

FS 1-03 SPECIFIC SAFETY CRITERIA

EXHIBIT 1: MAXIMUM HEIGHT OF BUILDINGS..... 5
EXHIBIT 2: AREA LIMITATION (SQUARE FEET)
GROUP CLASSIFICATION OF OCCUPANCY..... 7

FS 1-04 INTERIOR CONSTRUCTION AND ARRANGEMENT

EXHIBIT 1: FIRE HAZARD CLASSIFICATION OF ADJACENT SPACE..... 6

FS 1-06 ELECTRICAL SYSTEMS AND EQUIPMENT

EXHIBIT 1: STATUS CONDITION..... 11
EXHIBIT 2: EMERGENCY POWER REQUIREMENTS..... 13

FS 1-07 MISCELLANEOUS OCCUPANCY FEATURES

EXHIBIT 1: MAXIMUM QUANTITIES OF FLAMMABLE AND COMBUSTIBLE LIQUIDS IN LABORATORY UNITS OUTSIDE OF APPROVED FLAMMABLE LIQUID STORAGE ROOMS..... 3
EXHIBIT 2: CONSTRUCTION AND FIRE PROTECTION REQUIREMENTS FOR LABORATORY UNITS..... 4
EXHIBIT 3: ROOM CONDITION CLASSIFICATION CHART..... 16

PURPOSE

The purpose of this Chapter of the Facilities Safety Volume is to provide safety criteria for buildings occupied by EPA or which are included in EPA Real Property Inventory and occupied by other than EPA staff.

OVERVIEW

The safety criteria in this Chapter describe the full scope of the facilities safety features required in EPA buildings and may exceed building code criteria which generally describe minimum requirements necessary to protect against loss of life.

SCOPE

The facilities safety criteria apply to buildings owned or leased by EPA, and buildings assigned to EPA by GSA or other Government agencies. In this Volume, these buildings shall be referred to as, "EPA buildings." The criteria in this Volume are mandatory for new construction. Where it does not appear to be feasible to meet these criteria at existing facilities, consult FEREB for advice or a waiver.

AUTHORITY

Authority for the safety criteria is based on the following:

- Occupational Safety and Health Act, V of 1970
- 29 C.F.R. 1910, General Industry Standards
- National Fire Codes of the National Fire Protection Association
- Building Firesafety Criteria, General Services Administration
- State and local building codes (unspecified).

Publications referenced above and throughout this Volume are assumed to be the latest approved editions.

POLICY

The occupants of EPA buildings shall comply with the requirements provided by the National Fire Protection Association, the Occupational Safety and Health Administration, the General Services Administration, and State and local building codes.

OBJECTIVES

Safety criteria are provided for EPA buildings in order to establish these objectives:

- Provide reasonable safeguards against injury, illness, and loss of life
- Prevent fire exposure and public health hazards to the community that surrounds EPA buildings
- Prevent loss of Government real and personal property
- Prevent interruption of Government operations.

RESPONSIBLE OFFICERS

Evaluation of the degree of facility safety provided by EPA is a function of the Facilities Engineering and Real Estate Branch (FEREB), and the Occupational Health and Safety Staff. The Branch Chief of FEREB is responsible for the compliance of the safety criteria of EPA buildings with the building and firesafety codes described above.

REFERENCES

Topics discussed in this Volume were developed from the following sources:

- Building Safety Criteria, General Services Administration
- Occupational Safety and Health Act of 1970 29 C.F.R. 1910, General Industry Standards
- Consensus standards for the design and construction of buildings.

PURPOSE

The purpose of this Chapter is to provide the authority and basic structural firesafety criteria for fire walls, doors and partitions, shafts, ceilings, and utilities.

AUTHORITY

Unless otherwise specified herein, all building materials and structural components and assemblies shall conform to the applicable requirements of the following American Society for Testing and Materials (ASTM) Test Methods and the National Fire Protection Association (NFPA) Standards:

- Standard Methods of Fire Tests of Building Construction and Materials (ASTM E 119/NFPA Standard No. 251)
- Types of Building Construction (NFPA Standard No. 220)
- Installation of Sprinkler Systems (NFPA Standard No. 13)
- Fire Doors and Windows (NFPA Standard No. 80)
- Standard Methods of Fire Tests of Door Assemblies (ASTM E 152).

FIRE RESISTANCE RATINGS

The fire resistance hourly ratings shall be determined in accordance with ASTM E 119/NFPA Standard No. 251. However, for floor and ceiling assemblies, the ratings shall be determined in accordance with NFPA 251 and not ASTM E 119. The reasoning is that NFPA 251 does not permit restrictive floor loading which the ASTM E 119 does allow. The hourly ratings for various materials and designs shall be obtained either by actual fire testing or by conformance to designs listed by Underwriters Laboratories, Inc., or Factory Mutual. (See Appendix A.)

TYPES OF CONSTRUCTION

The various types of construction are defined in NFPA Standard No. 220 with exceptions noted in Exhibit 1.

FIRE WALLS AND FIRE PARTITIONS

Every fire wall shall be of noncombustible material having a fire resistance rating of not less than 4 hours and sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall. The use is limited to Group IV occupancies.

EXHIBIT 1

TYPES OF CONSTRUCTION

	TYPES OF CONSTRUCTION						
Structural Components	Fire-Resistive Type A	Fire-Resistive Type B	Protected NC/LC	NC/LC	Heavy Timber	Ordinary	Wood Frame
Bearing Walls	4	2	2	2	2	N	N
Nonbearing Walls	NC	NC	NC	NC	NC	N	N
Supporting Members For More than 1 Floor	4	2	1	NC	1	N	N
Supporting Members For 1 Floor Only	3	2	1	NC	1	N	N
Vertical Openings and Shaft Enclosures	2	2	1	1	1	1	1
Floors	2	2	1	NC	1	N	N
Roofs	2	1	1	NC	1	N	N

NC-Noncombustible LC-Limited Combustible N-No Requirement

Fire partitions are fire-resistive walls not meeting one or more of the requirements for a fire wall. Fire partitions may be of any specified fire resistance depending upon the intended use and degree of fire potential involved. All fire partitions must extend from floor slab to floor slab or roof deck.

VERTICAL OPENINGS AND SHAFTS

Fire resistance ratings for enclosures of vertical openings and shafts shall conform to the requirements cited in Exhibit 1. Openings into vertical openings and shafts shall be protected by fire doors or fire dampers as outlined in Fire Doors of this Chapter and FS 1-05, Mechanical Systems.

Atriums

Atriums and other openings not protected by shafts shall be protected by self-closing or automatic fire doors which provide adequate fire resistance.

Offices, or other rooms normally used for human occupancy, shall not open into an atrium. In addition, exit routes shall not pass through an atrium.

Shafts

When telephone rooms, electrical closets, and similar spaces are located one above the other, the enclosure walls are considered to form a shaft, and protection shall be in accordance with the requirements contained in Exhibit 1. Shafts shall not be installed between a structural member and the fireproofing for the member.

Structural members passing through a shaft shall be fireproofed separately from the shaft enclosure. The fireproofing shall be of concrete, plaster, or other hard material that is resistant to mechanical damage and not subject to rusting or erosion.

Monumental Stairs

Monumental stairs, not involved in the building exit requirements, may extend one floor above and one floor below the main entrance lobby, provided that fire partitions and self-closing fire doors are installed at the upper and lower levels. (See Exhibit 1.)

Escalators

Escalators shall be enclosed in fire-resistive shafts or shall be treated in the same manner as monumental stairs. In lieu of this enclosure protection, curtain boards and sprinkler protection may be provided as detailed in NFPA Standard No. 13.

Penetrations — Openings around penetrations in vertical openings and shafts shall be fire-stopped as described in Fire-Stopping of this Chapter.

PANEL, CURTAIN AND SPANDREL WALLS — Openings between panel, curtain, and spandrel walls, and the building structure or floor slabs around them, shall be fire-stopped in accordance with the provisions outlined in Fire-stopping of this Chapter.

Panel and Curtain Walls — All panel and curtain walls shall conform to the requirements for nonbearing walls in the type of construction involved and shall be securely anchored to the building in a manner which will prevent failure of the anchors under fire conditions.

Windows — Wherever windows extend to within 36 inches from the floor and the space is at least 4 feet above grade, a suitable metal barrier shall be provided on the interior window opening approximately 42 inches above floor level. If the glass is of the type construction to withstand a horizontal force of 200 pounds or more, no barriers are required. (NOTE: Perimeter heating and cooling units may form this barrier.)

Spandrel Walls — Except as noted below, spandrel walls shall be provided at each floor and shall have a height of at least 3 feet and a fire resistance equivalent to the floor involved.

Exception No. 1. Spandrel walls are not necessary or, if provided, are not required to have any fire resistance if the rooms located directly inside the building and on the floor below contain Group I occupancies or occupancies which are sprinkler protected.

Exception No. 2. No spandrel walls are required at grade level.

(NOTE: The above requirements in no way reduce the requirements for protection of walls subject to an exterior fire exposure. See FS 1-03, Specific Safety Criteria.)

CEILINGS — Suspended ceilings shall not be considered part of a fire-resistive assembly.

FIRE-STOPPING — Fire-stopping with rigid, noncombustible materials shall be provided in all walls, partitions, openings between exterior walls and floor slabs, and openings in floors and

shaft enclosures to form an effective fire and smoke barrier between stories and between horizontal compartments.

FIRE DOORS

Fire doors shall be in accordance with the requirements contained in NFPA Standard No. 80. Doors, hardware, and frames shall bear the label of Underwriters Laboratories, Inc., Factory Mutual, or other appoved laboratory testing in accordance with ASTM E 152.

Fire doors involved in exits or means of egress shall also conform to the requirements contained in FS 1-04, Interior Construction and Arrangements. Fire doors involved in air-handling systems shall also conform to the requirements outlined in FS 1-05, Mechanical Systems.

UTILITIES

Pipes, wires, cables, ducts, or other utilities or services shall not be embedded in or between the required fireproofing and structural members unless the assembly has been tested and has achieved the required fire resistance.

One-inch or smaller steel conduit with wiring to clocks, receptacles, telephones, thermostats, or switches may be embedded in the fireproofing if the necessary thickness of fireproofing is not reduced. In such cases, electrical boxes shall be steel, limited to 4-inch nominal size, and securely anchored in place and be at least 2 feet apart or on opposite sides of the structural member.

PURPOSE

This Chapter describes specific safety criteria for various groups of occupancies, open plan office space and building attachments.

CLASSIFICATION OF OCCUPANCIES

The type of building construction and height and area limitations shall be based on the fuel load classifications of the occupancy normally expected in the building. See Appendix A for guidance pertaining to unusual occupancies. Typical occupancies are grouped as follows.

Group I, Low Intensity-Low Severity

Group I, Low Intensity-Low Severity occupancies are those occupancies containing a small amount of fuel and which do not present a flash fire or explosion potential. Such occupancies are limited to those where it is reasonable to expect that a fire involving only the occupancy will not develop to a sufficient degree to propagate from the room of origin. Listed below are examples of such occupancies:

- Offices using metal furnishings
- Offices using wooden furnishings where occupancy does not exceed one person per 200 square feet of floor area
- Open plan office space having a fuel load of 6 pounds per square foot or less (see Open Plan Office Space of this Chapter)
- File room or stock rooms, where material is contained in metal files, cabinets, or other closed metal containers
- Classrooms, meeting rooms, conference rooms, auditoriums, and similar assembly areas--in any instance where there is extensive use of plastic furniture, such as moulded auditorium chairs or foam cushions, the occupancy class is to be raised to Group II or higher
- Library reading rooms
- Restrooms and locker rooms where metal lockers are used

- Switchgear rooms with air-cooled equipment, uninterruptible power service (UPS) areas and battery rooms
- Computer rooms.

Group II, Full Intensity-Low Severity

Group II, Full Intensity-Low Severity occupancies are those occupancies containing potential for propagation from the room of origin but where the maximum expected fire severity does not exceed a standard 1-hour fire. Listed below are examples of such occupancies:

- Storage areas less than 500 square feet
- Open plan office space having fuel load in excess of 6 pounds per square foot (see Open Plan Office Space of this Chapter)
- Mechanical equipment rooms
- Mechanical, electrical, and similar shops
- Drafting rooms and map making rooms
- Offices using wooden furniture where occupancy exceeds one person per 200 square feet of floor area
- Cafeterias and kitchens
- Switchgear rooms and transformer vaults with combustible dielectrics
- Automobile parking garages.

Group III, Full Intensity-Medium Severity

Group III, Full Intensity-Medium Severity occupanices are those occupancies where the maximum expected fire severity approaches or equals that produced by a standard 2-hour fire. Listed below are examples of such occupancies:

- Storage areas, 500 square feet or larger
- Library areas, except open shelving higher than 9 feet
- Printing and reproduction operations

- Laboratories using chemicals, flammable liquids or explosive materials
- Flammable liquids operations
- Paint shops
- Woodworking shops
- Trash rooms without baling operations
- Automotive repair, servicing, or fuel facilities
- Magnetic tape libraries (tape in plastic cases or on plastic reels)
- Paper recycling storage
- Hazardous waste-staging areas where flammable or combustible waste is not retained in bulk quantities.

Group IV, Full Intensity-High Severity

Group IV, Full Intensity-High Severity occupancies are those occupancies containing a large amount of fuel or presenting a flash fire or explosive potential. Listed below are examples of such occupancies:

- Trash rooms with baling operations
- General storage warehouse
- Library stack areas higher than 9 feet
- Record centers and archives with open file shelving
- Hazardous waste-staging areas where flammable or combustible waste is retained in bulk quantities.

Occupancy Classification Considerations

The above examples are based on typical operations and average distribution of combustibles. Professional judgment must be used and the classification of occupancy increased or decreased where the conditions are not typical. For example, mailrooms with low activity or drafting rooms using metal furniture are usually one group lower.

Conversely, if an office equipped with metal furniture habitually contains very large quantities of paper and similar combustibles which are not contained within file cabinets or other metal containers, that office would be one group higher.

Wood Furniture — The principal difference in the fire potential between wood and metal furniture is that wood furniture does not have the ability to prevent its contents from entering the fire. File cabinets normally contain the largest single concentration of papers. A limited amount of wood furniture in an office using steel file cabinets should not result in a higher group classification for that office. Conversely, the use of open shelf files in an office of basically metal furnishings will necessitate assigning such office a higher group reclassification.

AUTOMATIC SPRINKLER-PROTECTED OCCUPANCIES — Where the occupancy group under consideration is protected by automatic sprinkler systems installed in accordance with FS 1-05, Automatic Sprinkler Protection, the classification of the occupancy shall be one group lower than that indicated for occupancies under Classification of Occupancies of this Chapter. For example, a library stack area is classified as a Group III occupancy; when sprinkler-protected, the library stack area occupancy classification is reduced to Group II. No reductions shall be applied to Group IV occupancies.

OPEN PLAN OFFICE SPACE — The firesafety objective is to maintain this type of occupancy at a Group I classification level. This can be done by limiting the fuel load to 6 pounds per square foot or by providing complete automatic sprinkler protection where the fuel load exceeds 6 pounds per square foot.

TYPES OF CONSTRUCTION — Except as noted below, the type of construction shall be that determined to be the most suitable and economical for the group classification of occupancy and height limitation as shown in Exhibit 1.

Top Floor — If the top floor of the fire-resistive or protective noncombustible building is exclusively occupied by building machinery such as air-conditioning fans, which are basically noncombustible, the roof construction, walls, and columns of that floor may be of unprotected noncombustible construction, and the floor involved not counted in determining any height limitations.

EXHIBIT 1

MAXIMUM HEIGHT OF BUILDINGS

	Group I Occupancies (Low intensity-Low severity)	Group II Occupancies (Full intensity-Low severity)	Group III Occupancies (Full intensity-Medium severity)	Group IV Occupancies (Full intensity-High severity)
Fire-resistive Type A	AS-U NS-5	AS-U NS-5	AS-U NS-5	AS-U(*) NS-NP
Fire-resistive Type B	AS-U NS-5	AS-U NS-5	AS-U NS-1	AS-U(*) NS-NP
Protected NC/LC	AS-U NS-2	AS-U NS-1	AS-1 NS-1	AS-1 NS-NP
NC/LC	AS-1 NS-1	AS-1 NS-1	AS-1 NS-1	AS-1 NS-NP
Heavy Timber	AS-5 NS-NP	AS-2 NS-NP	AS-1 NS-NP	AS-1 NS-NP
Ordinary	AS-1 NS-NP	AS-1 NS-NP	AS-1 NS-NP	AS-1 NS-NP
Wood frame	AS-1 NS-NP	AS-1 NS-NP	AS-1 NS-NP	AS-1 NS-NP

AS - Automatic sprinkler protected
NS - Not sprinkler protected
NC - Noncombustible
U - Unlimited height
NP - Not permitted
LC - Limited combustible

1 - Maximum height, 1 story above highest grade
2 - Maximum height, 2 stories above highest grade
5 - Maximum height, 5 stories above highest grade

* Maximum height of 2 stories (Type A) or 1 story (Type B) if Group IV occupancy is not separated into 5,000 sq. ft. compartments by 4 hour fire-resistive enclosures.

Below Grade Floor — Where a floor is partially or wholly below grade, it and its supporting members shall have a minimum fire resistance of two hours.

Multiple Occupancy Building — In multiple occupancy buildings, the highest group occupancy shall determine the type of construction for the floor and all floors below. Where highest group occupancies are compartmented (see FS 1-04), protected by sprinklers (see FS 1-05), and do not exceed 5,000 square feet or 25 percent of the area of the floor, they shall not determine the type of construction. An example of a building having more than one group classification of occupancy would be an office building with a library stack area.

AREA LIMITATIONS — Area limitations include the area of any floor of a building, the area between fire walls, or the area enclosed by fire partitions and exterior walls shall not exceed the limits set in Exhibit 2. Fire walls and fire partitions shall conform to the requirements of FS 1-02. The rating of fire partitions shall be as required in FS 1-04. Where more than one group classification of occupancy is housed, the higher group classification shall govern for determining area limitations.

ATTACHMENTS AND ADDITIONS — Penthouses, cornices, marquees, skylights, monitors, and ventilations shall be of noncombustible construction. Attachments and additions for the purpose of providing additional space shall conform to the same construction height and area limitations as the base building.

FIRE EXPOSURE PROTECTION — A fire exposure is any building, structure, yard storage, industrial operation, or other collection or accumulation of combustible substance which, if involved in a fire, would present a danger to the building. Classification of exposure severity and determination of minimum separation distance shall be in accordance with National Fire Protection Association Standard No. 80A, Recommended Practices for Protection of Buildings from Exterior Fire Exposures.

EXHIBIT 2

AREA LIMITATION (SQUARE FEET)
GROUP CLASSIFICATION OF OCCUPANCY*

		Group I	Group II	Group III	Group IV
AT GRADE	AS	U	U	U	40,000
	NS	U	1,000	1,000	NP
ABOVE GRADE	AS	U	U	20,000	5,000
	NS	U	1,000	1,000	NP
BELOW GRADE	AS	U	U	20,000	5,000
	NS	NP	NP	NP	NP

AS - Automatic
NS - Not sprinkler protected
U - Unlimited
NP - Not permitted
* - The group classification of occupany is that obtained as a result of the reductions in classification outlined in FS 1-03.

PURPOSE

The purpose of this Chapter is to provide the authority and specifications for interior construction (e.g., interior finish, floors, partitions, and exits) as they relate to safety requirements.

NATIONAL CODES AND TEST METHODS

Unless otherwise specified herein, all interior construction and arrangements shall conform to the applicable requirements of the following National Fire Protection Association Standards (NFPA) and test methods:

- Fire Doors and Windows (NFPA Standard No. 80)
- Life Safety Code (NFPA Standard No. 101)
- Test for Critical Radiant Flux of Carpet Flooring Systems (Federal Test Method Standard No. 372)
- National Bureau of Standards Smoke Chamber Test (NBS Technical Note 708) - Identical test methods are NFPA Standard No. 258 and ANSI/ASTM E 662-79
- Standard Methods of Fire Tests for Flame-Resistant Textiles and Films (NFPA Standard No. 701).

INTERIOR FINISH

Interior finish shall be in accordance with the definitions contained in Chapter 6 of NFPA Standard No. 101. Unless otherwise stated below, the firesafety characteristics of interior finish shall include a flame spread rating not to exceed 25 and a smoke development rating not to exceed 50.

Sprinkler-Protected Buildings

In fully sprinkler-protected buildings, the interior finish in areas not involved in the normal means of egress of the building may be of materials having a flame spread rating of 200 or less and a smoke development rating of 200 or less. In sprinkler-protected exit accesses or passageways, interior finish may be composed of materials having a flame spread rating of 75 or less and a smoke development rating of 100 or less.

Doors and Door Frames

Doors and door frames not located in exit ways and not involved in fire cutoffs and trim materials such as moldings, window frames, chair rails, and baseboards may be of wood

	or any other material having fire characteristics no more severe than wood. The total area finished with this type of material in any room or space shall not exceed 10 percent of the aggregate wall and ceiling area involved.
Final Finishing Material	Wallpaper, paint, veneer, and other thin final finishing materials not over 0.035-inch thick are exempt from the firesafety requirements for interior finish, except that these materials shall not significantly increase the flame spread nor the smoke development ratings of the base material involved.
Airspace	Whenever an airspace is located behind combustible material exists, the space shall be blocked so that no void extends more than 10 feet in any direction. For example, paneling applied to wood furring strips will meet the requirement if the distance betweem the furring strips is no more than 10 feet in both the horizontal and vertical direction.
Combustible Substances	Materials composed of basically combustible substances, such as wood or fiberboard, which have been treated with fire-retardant chemicals by a pressure impregnation process or other method which provides treatment throughout the material (as opposed to a surface treatment) to produce acceptable firesafety characteristics, may be used as interior finish subject to the following conditions: The treated material shall be installed in full accordance with the manufacturer's instructions; the treated material shall not be installed in any location where conditions, such as high humidity, exist that may reduce the effectiveness of the fire-retardant treatment.
Restrictions	No material shall be used as an interior finish which will result in higher flame spread or smoke development ratings than those permitted herein.
Flooring Materials	Flooring materials used as wall sections or wall coverings shall comply with the firesafety characteristics described within the first three paragraphs under Interior Finish, of this Chapter.
Draperies and Curtains	All draperies, curtains, and similar hanging materials shall be of a noncombustible (see Appendix A) or flame-retardant fabric (chemically treated). "Flame-retardant" means that the fabric or films (e.g., thin plastic sheets or cellophane) are difficult to ignite, do not spread flame beyond the area which is exposed, and do not drop

flaming parts. Flame-retardant materials shall meet the performance described for the most appropriate test, small scale or large scale, NFPA Standard No. 701.

FLOORING — Finish floors and floor coverings may be of any material normal to the intended use. Materials may be either combustible or noncombustible, including wood, asphalt tile, carpet, rugs, linoleum, concrete, and terrazzo..

PARTITIONS — Partitions requiring fire-resistance ratings shall be constructed of noncombustible/limited combustible (NC/LC) materials and listed by UL; or approved by Factory Mutual Engineering and listed in their Approval Guide.

Ceiling-High Partitions — Except for ordinary and wood frame construction all ceiling-high partitions shall be constructed of NC/LC material. Interior finish or trim may be combustible to the extent permitted by Interior Finish of this Chapter. Combustible insulation on electrical installations may be used to the extent described in FS 1-06, Electrical Systems and Equipment.

Wood Stud Partitions — Wood stud partitions may be used in ordinary and wood frame construction. Wood studs shall not be installed as part of the initial construction, or part of a major alteration, or space adjustment in the other types of construction.

Less Than Ceiling-High Partitions — Bank type, acoustical screens, free standing space dividers, and other less than ceiling-high partitions, shall conform to the requirements for movable partitions, prescribed by Federal Property Management Regulations (FPMR) 101-20.109-9.

EXIT FACILITIES — Except as noted below or covered elsewhere in this handbook, the following provisions of NFPA Standard No. 101 shall be followed.

Number of Exits — Exits shall be arranged to ensure that at least two separate exits are available from every floor area. Exits shall be remote from each other and shall be arranged to minimize the possibility that both may be blocked by an emergency.

Emergency Egress — Emergency egress from the building shall be maintained at all times the building is occupied.

Exit Stairs All exit stairs in new construction, and all exit stairs added to existing buildings, shall conform to the requirements for Class A stairs, described in NFPA Standard No. 101 and shall have a minimum width of 44 inches.

Exit Merging In any instance where the arrangement of stairs is such that files of persons egressing down from upper floors may be required to merge with files of persons egressing up from lower floors through a common stair exit doorway, the total width of the doorway shall be at least equal to three-fourths of the width of stairs from above, plus three-fourths of the width of the stairs from below.

Exit Stair Doors All exit stair doors and all other doors opening onto exit routes, except those opening directly to the outside, shall be self-closing or shall be those whose operation is controlled by a smoke detector. Doors shall be located or recessed in a manner to ensure that they do not swing to impede pedestrian flow in corridors or other egress routes. Vision panels shall be provided in those doors where such panels are permitted (NFPA Standard No. 80) and where necessary to alleviate potential personnel traffic hazard.

Distance Between Exits The two most remote exits on each floor shall be separated by a distance equal to at least two-thirds the long rectangular dimension of the floor.

Latches Latches on stair doors shall be operable from both the stairs and the occupied space side of the stairs. For security reasons, ingress may be prohibited without impeding emergency egress as follows:

- Door may open directly to the exterior
- Door may open from a stair to an exit discharge route
- An individual stair door may be locked against ingress from the stair when fully justified in writing, and where no other reasonable means can be developed to provide necessary security.

In no instance shall doors at the top and the bottom stair levels be secured. Each secured door shall be clearly marked. Directions shall be posted showing the nearest

floors above and below where re-entrance can be made. In buildings which are equipped for relocation of personnel via a voice fire alarm system, the use of security doors and the mode of re-entry shall be coordinated.

Continuous Corridors — Except in open plan office space, continuous corridors shall be provided connecting to every exit.

Open Plan Office Space — The following conditions shall be met for emergency egress in open plan office space.

The space layout shall be planned to ensure maintenance of rational routes with well-marked secondary exits. Color dynamics and other innovative directional guidance may be needed in large installations. The height of dividers and acoustical partitions shall be limited to 5-1/2 feet so that occupants can quickly identify problems which may arise from fire in the area and routes available to reach exits. (Higher partitions should be limited to periphery.)

Free-standing space dividers shall resist a momentary overturning force of 25 pounds perpendicular to the face applied at a height of 60 inches above the floor and be arranged so as not to interfere with egress.

Exit Corridors — The minimum width of any corridor or passageway serving as a required exit or means of travel to or from a required exit shall not be less than 44 inches clear width and shall not be obstructed by partitions, columns, doors, or other projections.

Exit access corridors are not required to have any fire resistance rating where exposed to Group I occupancies. Refer to Exhibit 1 for fire-resistance ratings of exit corridors exposed to Group II, III, and IV occupancies.

Exit Discharge — Except as provided below, and as detailed in the NFPA Standard No. 101, every exit stair shall discharge directly to the outside or to a protected corridor leading directly to the outside. A protected corridor shall consist of a totally unoccupied passageway or other space, such as a lobby, separated from all occupied areas by partitions having 1-hour or greater fire resistance, with all doorways in these partitions protected by Class C or higher-classed fire doors that are either self-closing or automatic-closing, controlled by ionization smoke detectors located on the occupied side of a partition.

EXHIBIT 1

FIRE HAZARD CLASSIFICATION OF ADJACENT SPACE

Fire hazard classification of occupancy	Fire hazard classification of adjacent space								
	Nonsprinklered space					Sprinklered space			
	Group					Group			
	I	II	III	IV	Exit access corr.	I	II	IV	Exit access corr.
Nonsprinklered space									
Group I	NR	1/C/N	2/B/Y	3/A/Y	NC/T/N	NR	NR	3/A/Y	NC/T/N
Group II	1/C/N	1/C/N	2/B/Y	3/A/Y	NC/T/N	1/C/N	1/C/N	3/A/Y	NC/T/N
Group III	2/B/Y	2/B/Y	2/B/Y	3/A/Y	1/C/N	2/B/Y	2/B/Y	3/A/Y	1/C/N
Sprinklered space(*)									
Group I	NR	1/C/N	2/B/Y	3/A/Y	NC/T/N	NR	NR	2/B/Y	NC/T/N
Group II	NR	1/C/N	2/B/Y	3/A/Y	NC/T/N	NR	NR	2/B/Y	NC/T/N
Group IV	3/A/Y	3/A/Y	3/A/Y	3/A/Y	1/C/N	2/B/Y	2/B/Y	2/B/Y	1/C/N

(*) The fire hazard classification of occupancies in sprinklered space is that classification obtained as the result of those reductions in classification prescribed by ch 3

Partitions

NR - No requirement, partitions may be omitted if desired
NC - Noncombustible or limited combustible materials may be used for partitions.
1 - 1-hour fire resistive partition required.
2 - 2-hour fire resistive partition required
3 - 3-hour or higher fire resistive required, actual rating dependent on fuel load involved.

Door openings

A - Class A fire doors required on all openings
B - Class B fire doors required on all openings
C - Class C fire doors required on all openings.
T - Any type of door - no specific requirement

Duct penetrations

N - No fire rated damper required in steel ducts piercing required partition.
Y - Fire damper or fire door required in steel ducts piercing required partitions.

Note. See ch 3 for area limitations of occupancies

Two-Doorway Discharge	When a stair discharges through two separate doorways into two separate fire areas at grade, protected corridors may be omitted. Under these conditions, appropriate exit markings shall be provided within the stairwell to indicate termination of that exit and the availability of alternate exits. For example: the sign over an exit door might read "Exit to Main Street," and a clearly visible nearby sign would read "Exit to Market Street - Down One Floor."
Panic Hardware	Panic hardware may be used whenever desired, but it is required for all exterior exit doors and interior-latched exit doors from classrooms, theaters, and other places of assembly having a capacity in excess of 100.
Smokeproof Towers	Smokeproof towers conforming with the requirements of NFPA Standard No. 101 are acceptable, but not required. The venting of the vestibules required for smokeproof towers shall be directly to the outside from each floor. The required vestibules shall be located on the exterior of the building or in an interior court or shaft having a minimum horizontal dimension of one-half the height of the shaft or court or 40 feet, whichever is less. In no instances shall any vestibules leading to exit stairs be interconnected through ducts or shafts not meeting the requirements cited above.
Timed Exit Calculation	Egress from buildings or an area of refuge shall be in accordance with timed exit calculations. Personnel in the fire area can travel toward the fire no more than 15 seconds. They should be able to relocate from the fire area within 90 seconds. Unimpeded horizontal movement is calculated at 3.5 feet per second. It should take no longer than 8 minutes for individuals to exit downward to the outside of the building or a safe area of refuge.
Fire Subdivisions	Fire subdivisions may be developed to improve lifesafety conditions where complete correction of existing stair and exit deficiencies is not feasible. Fire subdivisions may be used to develop horizontal exits where large numbers of handicapped occupants must be provided with safe exit facilities. Fire subdivisions may be used in conjunction with a smoke control system. Unless greater fire resistance is required for other purposes, fire partitions installed to improve exit facilities or for smoke control shall be of 1-hour fire-resistive construction.

Fire Escape	Fire escape stairs, as defined in NFPA Standard No. 101, are not acceptable as a component in the means of egress.
HAZARD SEGREGATION	All rooms or areas containing Group I, II, III, and IV occupancies shall be cutoff from the remainder of the building by fire-resistive enclosures, as shown in Exhibit 1. In addition, any Group I, II, III, or IV occupancy exceeding the area limitations outlined in FS 1-03, Specific Safety Criteria, shall be subdivided into proper size areas by separations conforming to the requirements shown in Exhibit 1. Fire areas shall be limited to 40,000 square feet by appropriate fire-resistive construction. Refer to FS 1-08, Storage Occupancies for storage occupancies.
Garages	Parking garages located within buildings containing other occupancies shall be cut off from the remainder of the building by construction having a fire resistance of at least 2 hours. Entrances between garages and elevators shall be protected by a vestibule having 1-1/2-hour, Class B or higher-classed fire door. Doorways between garages and stairs, building corridors, or other nongarage areas shall be protected by 1-1/2-hour, Class B or higher-classed fire doors.
Assembly Areas	Because of the concentration of occupants in auditoriums, cafeterias, and other places of assembly, it is necessary to provide a greater number of exit passageways from these locations to the outside of the building. Whenever possible, such occupancies shall be located on the grade floor of the building or a floor close to grade.
Blind Stands and Self-Service Stores	Blind stands and self-service stores shall be cut off from the remainder of the building by 1-hour fire-rated enclosures and doors. If the entire floor is protected by automatic sprinklers, fire-rated enclosures are not needed.

PURPOSE

This Chapter establishes the authority for and safety requirements of mechanical systems in buildings such as water supply systems, automatic sprinkler systems, fire main systems, fire extinguishers, air-conditioning systems, heating equipment and elevators.

NATIONAL CODES

Unless otherwise specified herein, all mechanical system installations shall conform to the applicable requirements of the following National Fire Protection Association Standards (NFPA) and American National Standards Institute (ANSI) Safety Code:

- Halogenated Fire Extinguishing Agent Systems - Halon 1301 (NFPA Standard No. 12A)
- Sprinkler Systems (NFPA Standard No. 13)
- Standpipe and Hose Systems (NFPA Standard No. 14)
- Water Spray Fixed Systems (NFPA Standard No. 15)
- Dry Chemical Extinguishing Systems (NFPA Standard No. 17)
- Outside Protection (NFPA Standard No. 24)
- Oil Burning Equipment (NFPA Standard No. 31)
- Spray Application Using Flammable and Combustible Materials (NFPA Standard No. 33)
- Stationary Combustion Engines and Gas Turbines (NFPA Standard No. 37)
- National Fuel Gas Code (NFPA Standard No. 54)
- Liquefied Petroleum Gases (NFPA Standard No. 58)
- Liquefied Natural Gas (LNG) (NFPA Standard No. 59A)
- Protection of Electronic Computer/Data Processing Equipment (NFPA Standard No. 75)

- Air-Conditioning and Ventilating Systems (NFPA Standard No. 90A)
- Blower and Exhaust Systems (NFPA Standard No. 91)
- Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment (NFPA Standard No. 96)
- Water Cooling Towers (NFPA Standard No. 214)
- Elevators, Dumbwaiters, Escalators and Moving Walks (ANSI A17.1).

WATER SUPPLIES Except as noted below, every building, as a minimum, shall be provided with a water supply available for use by fire department mobile pumping apparatus. The water supply shall normally be provided by fire hydrants suitable for firefighting apparatus located within 5 feet of paved roadways. The hydrants shall be supplied from a dependable public or private water main system. Other water supplies shall be available to those buildings where fire protection needs require them.

The water supply system shall provide ample water to meet all water uses. Essentially, there are three types of fire protection water use: outside fire department hose streams from hydrants; small and large hose streams from inside building standpipe or hose connections; and automatic sprinkler systems. See FS 1-03 for intensity and severity designations to be used in determining the requirements for the various types of water supplies. The minimum requirements for each type of water use are determined as follows.

Fire Department Hose Streams The flow and pressure must be available from a public or private water main system (see below).

Occupancy Classification Intensity/Severity	Unsprinklered Building Minimum Flow & Pressure (gpm, @ 20 psi)	Sprinklered Building Minimum Flow & Pressure (gpm, @ 20 psi)
Low/Low	500	100
Full/Low	750	250
Full/Medium	1500	500
Full/High	1750	750

Standpipe Hose Stream

This section concerns standpipe hose streams for three or more stories of a building, one riser per stairwell. The flow must be available from a public or private water main system. The minimum pressure from a water main system shall be 20 psi. Pressure requirements will be provided by fire department mobile pumping apparatus by use of the siamese connection(s) (see below).

Number of Risers	Flow at 65 psi at Top Floor
1	250 gpm
2	500 gpm
3	750 gpm
4	1000 gpm
5 or more	1250 gpm

Automatic Sprinklers

The following flow and pressure requirements shall be used except where noted in other sections of this handbook.

Occupancy Classification With Respect to Severity Only	Minimum Flow at 15 psi at the Most Remote Sprinkler Head on the Top Floor
Low	150 gpm
Medium	450 gpm
High	See NFPA Standards or other Chapters of this Volume.

AUTOMATIC SPRINKLER PROTECTION

Automatic sprinkler protection shall be provided in the following situations:

- Throughout all floors of any building which is six floors or more in height above its lowest ground level (for six-story buildings where the sixth floor is occupied strictly for mechanical building service equipment, sprinkler protection is not required)
- Throughout occupancies exceeding the area or height limitations allowed in FS 1-03 for unsprinklered buildings of various types of construction
- In all areas below grade (50 percent or more below grade level)
- In all areas which contain a Group IV occupancy (see FS 1-03)
- In any area above grade of over 1,000 square feet in size which contains a Group II occupancy (see FS 1-03)
- Throughout windowless buildings or windowless floors of buildings or windowless subdivisions exceeding 1,000 square feet within buildings
- In cooling towers of combustible construction under the conditions described in Air-Conditioning Systems of this Chapter
- In any location where maximum fire potential of the occupancy exceeds the fire-resistance capabilities of exposed live load-bearing structural elements (for example: moving of flammable liquids operation into a former office area)
- Throughout open plan office space which has a fuel load in excess of 6 pounds per square foot (see FS 1-03)
- In all newly constructed laboratories and in major modifications to existing laboratories

that use chemicals, flammable liquids or explosive materials

- Throughout electronic equipment operation areas, including data storage areas. "On-off" type sprinkler heads and sprinkler guards should be used, however, to minimize water damage in these areas.

HALON 1301 FIRE EXTINGUISHING SYSTEM

Halon 1301 (CF_3BR, a halogenated hydrocarbon) in concentrations of less than 7 percent has been found to produce minimal, if any, effects on the central nervous system of humans; however, unnecessary exposure should be avoided. Systems using concentrations of more than 7 percent present much greater personnel hazards.

Applicability

The exact fire extinguishing mechanism of Halon 1301 is not known, nor for that matter, is the chemistry of ordinary flames completely understood. However, it is believed that Halon 1301 interferes with the flame chemistry and inhibits flame propagation. In most materials tested, flaming is stopped with about a 3.5 percent Halon 1301 concentration. In materials with surface-burning characteristics, such as flammable liquids and plastics which melt before burning, extinguishing the flames allows the heat to radiate away very quickly, and the fire is extinguished almost instantly.

Use With Solid Fuels

In the case of solid fuels, flaming is stopped just as easily, but smoldering can continue as long as the heat generated equals or exceeds the heat lost. Some materials, such as low-density cellulose fiberboard, will continue to smolder until totally consumed, even though the Halon 1301 concentration is maintained high enough to prevent flaming.

Flame-Inhibiting Atmosphere

Most solid materials fall between the two extremes cited, and a fire can be extinguished by maintaining a flame-inhibiting atmosphere for an extended period of time. In practice, in case of fire, it may be adequate to provide a flame-inhibiting atmosphere (about 5 percent concentration) and maintain it for as long as it takes for professional firefighting forces to arrive and complete the extinguishment.

Water Damage Prevention

Halon 1301 systems are most frequently proposed to avoid water damage. If the occupancy to be protected has an appreciable amount of ordinary combustibles (e.g., wood, paper, fiber), a fire suppressed by Halon 1301 may continue

to generate smoke, causing the fire department to apply hose streams, resulting in more water damage than sprinklers would have caused.

General Requirements

Halon 1301 has been proposed as an extinguishing agent to replace automatic sprinkler protection where water damage is unacceptable or where unacceptable fire damage can occur before sprinklers operate. Halon 1301 extinguishing systems shall not be used as a substitute for automatic sprinkler protection in EPA installations; however, EPA may elect to augment automatic sprinklers with Halon 1301 protection. On-off types of sprinkler heads may be used in the sprinkler system as an option. Sprinkler head guards may be utilized to minimize possible physical damage to the heads. Although sprinkler protection is strongly recommended, Halon 1301 may be used as the primary fire suppression system for Group I occupancies (see FS 1-07), if an automatic sprinkler system is also provided as a back-up. As described above, there are inherent limitations other than cost when evaluating the use of a Halon 1301 system. The organization responsible for the electronic or computer equipment shall justify the need for the Halon 1301 system, and should be fully informed of the cost, especially the cost of recharging the system, the applicability limitation of Halon 1301, and the various advantages and disadvantages involved in utilizing a Halon 1301 extinguishing system.

Design Requirements

The design concentration of Halon 1301 shall be a minimum of 5 percent and no more than 7 percent, both above and below the raised floor. This concentration shall be verified by an actual Halon 1301 or Halon 122 discharge at an acceptance test.

Discharge

Discharge of Halon 1301 shall be automatic, controlled by a system of ionization type smoke detectors arranged in cross-zoned or equivalent circuits. Actuation of a single detector must sound an alarm within the room and automatically notify the local fire department.

Activation of a detector on the second circuit must cause the Halon 1301 to discharge after a preset time delay has elapsed, area ventilation equipment to shut down, and the building fire alarm system to activate. The time delay must be sufficient to permit all occupants to evacuuate the area prior to Halon 1301 discharge. (The time delay shall be calculated by dividing the farthest travel distance inside the area to an exit door of the area by 3.5

and adding 15 for a safety factor. Therefore, in a room where the largest travel distance would be 50 feet, the time delay would be 50 ÷ 3.5 + 15 = 30 seconds.) Consideration shall be given to shutting down power to the computer after sending the computers a signal on the first alarm. Detection and activation circuits shall be supervised. Signs shall be provided to direct occupants to evacuate upon the sounding of the alarm within the room. Manual Halon 1301 release stations shall be provided at the exits from the room. The actuation of the manual release station must sound an alarm within the room, shut down area ventilation equipment, discharge Halon 1301, cause the building fire alarm system to activate, and cause the local fire department to be notified. Discharge of Halon 1301 shall occur only after the activation of at least two smoke detectors or a manual release station in the room. Abort switches may be provided to prevent the discharge of Halon 1301 from smoke detector operation, but shall not override the manual release stations. Abort switches shall return to the normal position unless manually held in an abort position. Area ventilation equipment need not be shut down upon detector or manual release actuation, if the ventilation system recirculates only volumes of space being protected by Halon 1301.

Openings — All openings in the walls, floors, or ceiling must be closed in order to maintain the Halon concentration for at least five minutes. All doors on the perimeter walls of the room shall be self-closing, and all other openings shall be equipped with electrically released dampers which close upon activation of the cross-zoned detectors or halon manual station. The air handling unit for the room must shut down upon Halon 1301 system operation, unless the air handler can be arranged to recycle the air within the room without introducing outside air.

Installation — The system shall be designed and installed by a contractor fully experienced in the installation of Halon 1301 systems, in accordance with NFPA Standard No. 12A, except where in conflict with the provisions of this Chapter.

Trouble Signal — Halon 1301 containers shall be supervised to sound a local trouble signal in the event of Halon 1301 leakage.

Acceptance Tests — After installation, all mechanical and electrical equipment shall be tested to ensure correct operation and function. When all necessary corrections have been made, a full discharge test should be conducted. Halon 122 may be substituted for the Halon 1301 for this test. The contractor shall be responsible for providing suitable test equipment to sample Halon 1301 concentrations continuously at three separate locations in the space being protected. The test shall indicate that 5 percent concentration is maintained for 3 minutes and a 3 percent concentration is maintained for 5 minutes. A 7 percent concentration limit shall not be exceeded.

DRY CHEMICAL SYSTEMS — Dry chemical systems utilize an interaction of flame and chemical that stop the chain reaction occurring in combustion. Dry chemical is difficult to remove from electrical contacts. Use is generally restricted to cafeteria exhaust hoods and plenums, deep fat fryers, and grills. Pre-engineered systems are satisfactory for this use.

Design Requirements — Systems shall be designed in accordance with NFPA Standard No. 17 and No. 96. Discharge of dry chemical shall actuate a pressure switch connected to initiate an alarm on the building fire alarm system (see FS 1-06).

Acceptance Tests — After installation, all mechanical and electrical equipment shall be tested to ensure correct operation and function. When all necessary corrections have been made, a full discharge test shall be conducted. Plastic or cotton bags shall be attached to each individual nozzle and the system activated. Cooking appliance nozzles must discharge at least 2 pounds and duct or plenum nozzles must discharge at least 5 pounds. Pre-engineered systems which fail to discharge these amounts will be considered unsatisfactory.

AIR-CONDITIONING SYSTEMS — Except as set forth herein, all air-conditioning and ventilating systems for the handling of air not contaminated with flammable or explosive vapors or dust shall conform to the requirements of NFPA Standard No. 90A.

Air Distribution — No vertical portion of the exit facilities or protected hallways leading from the vertical exit to the outside of the building shall be used for the normal distribution or return of air.

Ducts — Ducts shall conform to the requirements of NFPA Standard No. 90A. Any duct linings or coverings shall be of noncombustible construction and the total assembly of the duct

lining, including adhesive and any coatings or additives involved, shall have a fire hazard rating not exceeding 25 for flame spread nor 50 for fuel contribution or smoke development.

Smoke Control Systems Smoke control systems shall be provided in all facilities 12 stories or more in height.

Shaft Construction The construction of shafts containing or used as vertical ducts shall be installed in accordance with the requirements for vertical shafts contained in FS 1-02, Basic Firesafety Standards.

Automatic Fire Doors and Dampers Automatic fire doors and fire dampers shall be provided in the air distribution and air return and exhaust systems per the requirements of NFPA Standard No. 90A and FS 1-04, except where they are omitted in accordance with either a system analysis or application of smoke control concepts as stated above under Smoke Control Systems.

Cooling Towers The casing and fill of cooling towers shall be of noncombustible construction. Plastic fill shall not be used. Cooling towers over 3,000 cubic feet having a combustible fill shall be provided with an automatic sprinkler system designed in accordance with NFPA Standard No. 214 when any of the following conditions exist:

- The continued operation of the cooling tower is essential for the functioning of the operations contained in the area serviced by it.
- The building is totally sprinkler protected.
- A fire in the cooling tower could cause structural damage or other severe fire exposure to the building.
- The value of the cooling tower is 5 or more times the cost of installing the sprinkler protection. The cost of the sprinkler protection shall include all factors involved, such as the sprinkler piping distribution system, the heat-sensing system, the control valve, and any special water supplies or extension of water supplies required.

Smoke Detectors — Smoke detectors as required by FS 1-06 shall not be installed in ducts in air handling systems whenever automatic sprinkler protection is provided throughout the building. Smoke detectors shall not be provided in air handling systems scheduled to operate less than 12 hours during a typical work day.

Fans — If air handling systems supply multiple floors then the fans affecting airflow for the fire floor shall be automatically shut down upon actuation of the sprinkler system or manual fire alarm pull stations.

VENTILATION SYSTEMS — All processes, operations, or other situations which present the possibility of a hazardous accumulation of combustible or explosive vapors, dust, fumes, or other airborne substances shall be provided with ventilation facilities in accordance with NFPA Standard No. 91.

Paint Spraying and Finishing Booths — All paint spraying and finishing booths and rooms shall be provided with ventilation equipment in accordance with NFPA Standard No. 33.

Cooking Equipment — Cooking equipment used in processes producing smoke or grease shall be designed and protected in accordance with NFPA Standard No. 96. Any insulation shall be of noncombustible materials. If other utilities are included in a vertical shaft with the grease duct, they shall not be insulated or lined with combustible materials.

HEATING EQUIPMENT — Furnaces and boilers for central heating systems shall be located in a room having 2-hour fire-resistive walls, floors, and ceilings with openings protected by automatic or self-closing 1 1/2-hour fire doors. For small units consisting of a single furnace on a hot air system or a boiler not exceeding 15 psi pressure or a rating of 10 boiler horsepower, 1-hour fire-resistance is permissible.

Authority — Heating equipment will be provided in accordance with the following standards except as noted otherwise:

- Oil-fired - NFPA Standard No. 31
- Gas-fired - NFPA Standard No. 54
- Liquefied petroleum gas-fired - NFPA Standard No. 58

- Liquefied natural gas-fired - NFPA Standard No. 59A.

Fuel Storage — If coal in any quantity is stored within the building, it shall be in a 2-hour fire-resistive room with openings protected by automatic or self-closing 1 1/2-hour fire-doors. Where liquid fuel is used, ramps or curbs shall be provided at the openings. The height of the ramps or curbs shall be sufficient to contain all the fuel in case of tank rupture.

Shop Operations — Shop, storage, or other operations, either involving flammable or combustible materials or not directly related to the operations in the furnace or boiler rooms, shall not be located in these rooms, unless the room is sprinkler protected.

Burners — Regardless of size, burners on suspended oil-fired heaters shall be provided with flame supervision that will ensure shutdown in not more than 4 seconds if flame failure occurs or trial for ignition does not establish a flame.

Space Heaters — Space heaters shall be approved or listed by the American Gas Association, UL, or other nationally recognized testing authority and shall be installed in complete compliance with all of the requirements of the manufacturer and the laboratory involved. Each fuel-fired space heater shall be vented. The clearances specified by the manufacturer and laboratory shall be maintained between the space heater and combustible materials.

Gas Piping — Gas piping entry into the building shall be protected against the possibility of breakage due to settling or vibration. Where practical, piping shall be brought above grade and provided with a swing joint before entering the building. Where it is necessary for gas piping to enter a building below ground, a ventilated pit or vault shall be provided at the point of entry. Preferably, the location shall be outside of the building line. In any case, the physical arrangement and venting shall be such that a break in the gasline due to settling or other cause at or near the point of entry cannot result in the free flow of gas into the building.

Gas Meter Regulators — To avoid placing any strain on the gas piping, any meters, regulators, or similar attachments shall be adequately supported. Any vents or rupture discs on the equipment shall be vented to the outside of the building.

Valves	Earthquake-sensitive shutoff valves shall be provided for each gas entry, where applicable.
Piping Location	Gas piping shall not be run in any space between a structural member and its fireproofing.
Gas Meter Rooms	Gas meter rooms shall be ventilated in a manner which will ensure removal of any gas leak without moving it through the structure.
Fire-Resistive Shafts or Conduit	In the case of large capacity (over 3-inch diameter at 4-inches of water pressure head or any other size having equivalent or greater delivery capabilities) gas services within the building, the piping shall be enclosed in fire-resistive shafts and vented directly to the outside at top and bottom. Any horizontal runs of the gas pipe shall be enclosed in a conduit or chase also directly vented at each end to the exterior or to the vented vertical shaft. Automatic gas detection and automatic shutoff shall be provided.

INTERNAL COMBUSTION ENGINES

Stationary internal combustion engines, such as gasoline- or diesel-powered generation sets or fire pumps, shall conform to the requirements of NFPA Standard No. 37.

ELEVATORS

Elevators, dumbwaiters, escalators and moving walks shall be in accordance with ANSI A17.1. In addition to those requirements, the following features are required:

- Automatic elevators shall be recalled on activation of any fire alarm-initiating device such as elevator lobby smoke detectors, manual fire alarm stations, or sprinkler system waterflow switches.
- When a building is not sprinkler protected throughout, smoke detectors shall be provided for every elevator lobby including the main lobby. Elevator lobby smoke detectors are not required in buildings which are sprinkler protected throughout.
- An alternate capture floor shall be provided. Activation of an alarm-initiating device on the main capture floor shall return the elevators to the alternate capture floor.

- Elevator lobby smoke detectors shall not initiate the building fire alarm system but shall send an alarm to the fire department or central station service and capture the elevators.

- Elevator hoistways shall not be vented to the outside by unclosable openings. A remote means of opening hoistway vents shall be provided to vent elevator hoistways in an emergency.

- When elevators are captured, the hoistway doors shall close after a predetermined time delay after arriving at the recalled floor.

PURPOSE

The purpose of this Chapter is to establish the authority and provide specifications for the installation of electrical systems such as fire alarm systems and emergency lighting.

NATIONAL CODES

Unless otherwise specified herein, all electrical installations shall conform to the applicable requirements of the following current National Association Standards:

- National Electrical Code (NFPA Standard No. 70)
- Life Safety Code (NFPA Standard No. 101)
- Automatic Fire Detectors (NFPA Standard No. 72E)
- Air-Conditioning and Ventilating Systems (NFPA Standard No. 90A)
- Central Station Signaling Systems (NFPA Standard No. 71)
- Auxiliary Protective Signaling Systems (NFPA Standard No. 72B)
- Remote Station Signaling Systems (NFPA Standard No. 72C)
- Factory Mutual Engineering Loss Prevention Data Sheet 5-4, Transformers.

FUEL POTENTIAL OF ELECTRICAL SYSTEMS AND EQUIPMENT

The selection of materials and equipment should minimize the impact of such equipment on the total fuel condition of the building. Of particular concern is the use of combustible dielectric fluids and combustible or smoke-producing insulating materials. Where a choice is available, noncombustible, nonsmoking materials are to be selected. Fire and smoke potentials shall be considered in the development of the overall fire protection systems for the building.

ELECTRICAL INSTALLATION

The installation of electrical equipment shall be made in such a manner as to maintain the integrity of the fire-stopping, fire resistance, fire separation, smoke control, zoning, and other structurally oriented firesafety features. (NFPA 70, Article 300.)

PLENUMS, CEILINGS, VOIDS, AND SIMILAR SPACES

All wiring shall be in accordance with Article 300 of the National Electrical Code (NEC), except that communication (Article 800) and Class 2 and 3 (Article 725) circuits need not be run in conduit when conductors are of materials which are classified by UL as having adequate fire-resistant and low smoke producing characteristics.

Conductors in plenums, ceilings, voids, and similar spaces are not required to be protected against physical damage (Article 300-4).

When conductors of materials other than those noted above are used, the plenums, ceiling, void, or other similar spaces shall be provided with automatic sprinkler protection or the conductors installed in conduit. All fire alarm and emergency communication circuits shall be installed entirely in metal conduit.

HIGH-ENERGY COMPONENTS

Systems carrying 480 volts or greater shall be provided with ground fault protection. Necessary precautions shall, however, be taken to minimize the possibility of nuisance tripping. In addition, all buses or other conductors at motor control centers, switch gear, switchboards, and bus ducts shall be insulated or isolated.

PUBLIC UTILITY TRANSFORMERS

To the maximum extent possible, public utility transformers shall be located outside the actual building without any direct link to the EPA building. The openings necessary to bring conductors into buildings shall be grouted or otherwise fire-stopped (see FS 1-02). Any public utility transformers located within buildings or in a vault or location abutting the EPA building shall be installed in standard transformer vaults conforming to the requirements of the NEC. Such transformer vaults shall not be located adjacent to or directly beneath any exit. Whenever any public utility transformer or other equipment involving a combustible dielectric fluid is located within the EPA building, or in a position where the fire in the dielectric could expose the EPA building, automatic sprinkler protection shall be provided. (See FS 1-05.)

INTERIOR TRANSFORMERS

All Government-owned transformers located within a building shall be either dry type or high-fire point, liquid-insulated type in accordance with NEC.

OUTSIDE SUBSTATIONS AND TRANSFORMER INSTALLATIONS

Equipment which is either of the type filled with a high-fire point liquid as defined by the NEC, or of the dry, ventilated, fire-resistant type located against or near buildings, shall not be considered a fire exposure, regardless of the proximity of the building. Equipment which is filled with a flammable or combustible dielectric medium shall be considered a fire exposure to the building, and in the case of substations, from one piece of equipment in the substation to another. As noted in Article 450 NEC, there are recognized safeguards to limit fire exposure to nearby structures and prevent fire exposure damage from one transformer to another where there is more than one transformer situated.

These safeguards include masonry barriers or separation between the transformer and the structure ranging in distance from 25 feet for non-combustible construction to 100 feet for wood frame construction. Fixed automatic water spray protection for the transformers, in addition to separation distances or masonry barriers, is recommended for installations involving more than one transformer with an individual capacity over 10,000 KVA. The monetary value and importance of the transformer installation shall also be considered when determining fire protection needs. For protection guidelines see Factory Mutual Engineering Loss Prevention Data Sheet 5-4 on Transformers.

DISTRIBUTION SYSTEMS

Where electrical wiring is required to be physically protected by NEC, it shall be installed in metal conduit, electric metallic tubing, underfloor ducts, or cellular floors approved as raceways. Flexible metal conduit may be used as necessary in conformance with the requirements of NEC. Where underfloor ducts, cellular floors, or header ducts are installed in a fire-resistant floor assembly, the necessary structural adjustments shall be made to maintain the required degree of fire resistance. (See Appendix A.)

WIRE CLOSETS

Wire closets which leave passages between floors constitute shafts and shall be protected in accordance with FS 1-02 of this Manual. In any case where wire closet ventilation arrangements or other features cannot conform to the requirements for a shaft, all openings through the floor shall be fire-stopped (grouted), as described in FS 1-02. In any building where smoke control systems are likely to be involved, such additional fire-stopping or other methods to increase the smoke passage resistance of openings around

doors or through wire passes shall be provided as necessary to meet the needed level of efficiency for smoke control systems. (See FS 1-05.)

FIRESAFETY REQUIREMENTS FOR LIGHTING

No lighting fixtures shall be installed in a circuit with a higher voltage than that for which the fixture is rated. Lamps meant to identify a facility or location rather than to illuminate shall be rated at a voltage higher than the line voltage in order to provide a long, dependable life for the lamp.

Mounting

All lamps shall be mounted in a manner that prevents the possibility of direct contact between the lamp and any combustible material. Wherever accidental contact is remotely possible, the lamp shall be protected by a guard, globe, reflector, fixture, or other means. (NFPA No. 70, Article 410.)

Florescent Fixtures

All florescent fixtures rated as 35 watts or more shall be provided with ballasts equipped with self-resetting, automatic thermal overload protection. (NFPA No. 70, Article 410.)

Locations

Lighting in locations where dangerous gases, liquids, dusts, or fibers exist or may exist, shall meet the requirements of Article 500, NEC.

Light Diffusers

Light diffusers shall be of either noncombustible material or of a design or material which will drop from the fixture before ignition. Where combustible "drop-out" type fixtures are used, plastic material shall not constitute more than 30 percent of the total ceiling area. Where luminous or diffuser ceilings are used, these restrictions also apply.

EXIT MARKINGS

Exit signs shall be provided to clearly indicate the location of exits in conformance with the Life Safety Code (NFPA Standard No. 101).

Internally illuminated signs conforming to the Life Safety Code shall be provided in assembly areas and spaces with large floor areas such as open plan office space. In all other areas, self-luminous or externally illuminated signs may be substituted, provided the following conditions are met:

- Emergency lighting for the area conforms to the Life Safety Code and provides at least 5 foot-candles on the sign surface
- The word "EXIT" is centered on a background material with minimum dimensions of 8 inches by 12 1/2 inches
- Letters are 6 inches high and 2 3/4 inches wide (except for "I") with 1/2-inch spacing between letters and 3/4-inch strokes
- Reflected light measurements from the bright portions of each sign are at least 3 foot-lamberts
- Reflected light measurements from the dark portions of each sign, which may be either the letters or background, do not exceed 1 foot-lambert
- The maximum distance to a sign does not exceed 100 feet.

Exit signs are not required over lobby doors leading directly to the outside, unless there is a condition which may be considered unusual, confusing, or hazardous to the public or building occupants.

FIRE ALARM SYSTEMS

Building environmental monitoring systems and security systems may share common equipment with the fire alarm components required in this section; however, the performance of the fire alarm systems shall not be compromised and shall take precedence over any other system and shall meet all of the requirements in this section.

Basic Requirements

In any office, computer room, library, classroom, cafeteria, or similar business-type occupancy, fire alarm systems are required where such occupancies have these characteristics:

- Are in buildings three stories or higher
- Are subject to 100 or more occupants, above or below grade
- Are in buildings containing more than 50,000 square feet gross floor area

- Are in smaller or less occupied buildings than stated above, but where a human voice, gas-powered horn, or other similar nonelectric system cannot efficiently or reliably be utilized.

Storage occupancies having a 100,000 square foot gross floor area and larger shall have fire alarm systems.

All other occupancies shall follow the requirements in NFPA Standard No. 101.

Manual Systems Input

Each system shall provide manual input from manual fire alarm stations which shall be located in exit or public corridors adjacent to each stairway and each exit discharge from the building. Additional locations may be provided at any location where there is a special risk. The general principle in locating stations shall be that the station is located in a position where a person using it will be between the fire and the exit.

When an emergency telephone system is required, telephone stations shall be provided in the same location as indicated for manual fire alarm stations. In addition, stations shall be provided at each elevator lobby at the ground and alternate elevator capture floors.

Automatic Systems Input

Automatic fire detection or other fire-indicating input shall be provided on the following basis:

- A waterflow switch(es) shall be provided for each floor or fire area protected by wet pipe sprinkler systems. Other type sprinkler systems will be activated by a pressure switch at the dry or deluge valve only.

- Automatic heat or smoke detection shall not be installed in lieu of automatic sprinkler protection. Detection shall be provided where a pre-action or deluge sprinkler system is requested and funded by tenants. Automatic sprinkler protection requirements are described in FS 1-05.

- Smoke detectors shall be provided for essential electronic equipment (see FS 1-07), air handling systems (see FS 1-05), and elevator lobbies (see FS 1-05). Smoke detectors are not required in elevator lobbies and in air handling systems in fully sprinklered buildings. All smoke detectors shall be of the ionization type or equal, as approved by FEREB. Smoke detectors require periodic maintenance, and arrangements for same should be made at time of installation to ensure proper operation and to guard against false alarm or unintended discharge.

- Detection in air handling systems shall comply with NFPA Standard No. 90A, except that detectors shall not be provided in systems scheduled to operate only 2 hours longer than the typical 8-10 hour work day. Where provided, detectors shall be located in the main supply duct downstream of a fan filter and in the return air ducts for each individual floor or fire area. Detectors shall not be provided in buildings that are fully sprinkler protected.

- Heat and smoke detectors shall be designed and installed in accordance with NFPA Standard No. 72E.

- Special hazard protection systems shall initiate an alarm. These special systems include, but are not limited to, those systems such as Halon 1301 or dry chemical extinguishing systems (see FS 1-05).

- Supervisory signals shall be transmitted under the following conditions:
  - Operation of generator
  - Operation of fire pump
  - Loss of primary power to a fire alarm system, fire pump or extinguishing system
  - Loss of air pressure for dry pipe sprinkler system
  - Loss of a central processing unit or CPU peripheral equipment in a multiplex system
  - Low water level in pressure tanks, elevated tanks or reservoirs.

- By tamper switches when control valves in the supply or distribution lines of automatic sprinkler systems, fire pumps, standpipe systems or interior building fire main systems are closed either a maximum of two complete turns of a valve wheel or 10 percent closure of the valve, whichever is less.

Automatic Systems Output

In all buildings, the primary alarms to the occupants, the fire department, and other critical signals or emergency equipment operation shall be initiated automatically. In no case shall these actions be made dependent upon the action of a human being. Various outputs include those listed below:

- Smoke detector actuation shall sound an alarm at the fire alarm panel, recall elevators and notify the fire department, but shall not initiate an audible alarm signal to building occupants or start any smoke control system. The smoke detector alarm signal shall be received at a privately operated central station, or some other location which is constantly attended and will ensure an investigative response to the alarm.

- All alarm signals or messages shall be continuous. Coded alarm signals are unacceptable.

- The output of special systems, such as those provided for smoke detectors in computer rooms, shall include the actuation of the building fire alarm system.

- Where evacuation of an entire building can be accomplished within 5 minutes (see FS 1-04), the fire alarm shall sound either throughout the building or on a selective floor or floors. Where selective evacuation is used, features such as smoke control and automatic sprinklers shall be provided as necessary to ensure the safety of occupants remaining in the building.

- For voice communications systems, only the occupants on the fire floor and one floor above are expected to relocate or evacuate. They are to automatically receive that message; however, all occupants shall be notified of the fire alarm emergency condition. Where automatic prerecorded voices are used, message arrangement and content shall be designed to fit the needs of the individual building (bilingual where appropriate).

- The use of visual signals to supplement the audible fire alarm system is not required because all facilities are required to have an occupant emergency organization.

- Every alarm reported on a building fire alarm system shall automatically actuate one of the following:
  - An Underwriters Laboratories, Inc. approved transmitter connected to a privately operated, central station, protective signaling system conforming to NFPA No. 71; the central station facility shall be listed by Underwriters Laboratories, Inc.; automatic telephone dialers shall not be used
  - An auxiliary tripping device connected into a municipal fire alarm box to notify the local fire department in accordance with NFPA No. 72B
  - A direct supervised circuit between a building and the local fire alarm headquarters or constantly manned fire station in accordance with NFPA No. 72C
  - As a last resort, an alternate method approved by the Director, Occupational Health and Safety Staff.

- Notification of the fire department shall not exceed 90 seconds after the initiation of an alarm. The specific location of an alarm condition can be determined by the fire department after they arrive.

- A supervisory condition shall transmit a separate signal to a central station, different from an alarm signal. No more than one

supervisory signal shall be provided for an entire building. See Automatic Input (tamper switches) of this Chapter.

- Additional automatic actions shall also be performed (smoke control, elevator capture and door closings). Smoke control and elevator capture shall be coordinated with the evacuation plan for a building. (A summary of systems actions is shown in Exhibit 1.)

Manual Systems Output

Also, any action which can be done automatically must be able to be initiated manually from the control center or fire alarm system control panel. A smoke control panel shall be provided when smoke control systems are required. The control center, or fire alarm system control panel, shall have the capability of canceling and restoring any action which has been initiated automatically or manually.

Systems Features

All systems shall include the following:

- Indication of normal or abnormal conditions
- Annunciation of alarm, supervisory, or trouble conditions by zone
- Graphic annunciation of alarm conditions by zone
- Ringback feature when a silence switch for audible trouble signal is provided.

For buildings twelve stories or higher, the systems shall also include the following:

- Permanent record of alarm, supervisory, or trouble conditions via a printer
- Initiation of voice messages via recordings on tape player(s)
- Recording of emergency telephone messages and voice messages via a console microphone on tape recorder.

EXHIBIT 1

STATUS CONDITION

Output Function / Input Device	Manual Fire Alarm Station	Smoke Detectors (other than duct)	Duct Smoke Detectors	Waterflow Detectors & Automatic Extinguishing Systems	Supervisory Device	Emer. Telephone	Console Microphone
Transmit signal to fire department	X	X	X	X	X		
Indicate location of device on control panel and annunciator	X	X	X	X	X	X	
Cause audible signal at control panel	X	X	X	X	X	X	
Initiate emergency operation of elevators	X	X		X			
Initiate smoke control sequence	X			X			
Result in a record on system printer	X	X	X	X	X		
Initiate operation of the tape recorder						X	X
Cause audible alarm signal throughout building (voice or non-voice)	X			X			

All power supply equipment and wiring shall be installed in conformity with requirements of the NEC.

Reliability — The maximum amount of time from actuation of a system input device until initiation of all system functions shall be ten (10) seconds. Any system alarm input device, other than smoke detectors, shall be capable of initiating an alarm during a single break or a single ground fault condition on any system alarm-initiating circuit (Class A feature). In addition, any signaling line circuit of a multiplex system (other than combination multiplex-point wired systems) shall also perform its intended service during a wire-to-wire short or a combination of a single break and a single ground of a circuit (Class A feature).

EMERGENCY LIGHTING — An emergency lighting system shall be provided and so arranged to provide a minimum of 1 foot-candle illumination throughout the entire path of egress including exit access routes, exit stairways, or other routes such as exit passageways to the outside of the building. In general, the work places shall not be provided with emergency lighting, however, laboratories, large open areas such as cafeterias, assembly areas, and open plan office spaces where exit access is normally through the major portion of these areas, shall be provided with emergency lighting. The type of system used shall be such that it will operate in the event of any failure of a public utility or internal disruption of the normal power distribution system in a building, except that in buildings seven stories or below the system may be powered from connections to two separate substations from a reliable public utility. Automatic transfer switching shall be provided for the emergency power supply.

EMERGENCY POWER — Exhibit 2 outlines the requirements for emergency power based on building height and particular firesafety systems. Generators are not required as part of this criteria unless an economic analysis of the cost of installation and maintenance of acceptable emergency power sources shows a generator to be the most cost effective. Automatic switching schemes shall be provided for all emergency power sources.

GROUND FAULT CIRCUIT INTERRUPTERS — As a minimum requirement, Ground Fault Circuit Interrupter (GFI) protection shall be provided for all receptacles in aquatic laboratories that are rated 120 volts, single phase, for personnel protection against potential shock hazards. GFI protection shall also be required under these circumstances:

EXHIBIT 2
EMERGENCY POWER REQUIREMENTS

Emergency System	Acceptable Sources of Emergency Power*** Building Height* 75 Feet or Less	Over 75 Feet
Emergency Lighting (1-1/2 Hours)	1, 2, 3	1, 3
Exit Lighting (1-1/2 Hours)	1, 2, 3	1, 3
Fire Alarm	1, 3	1, 3
Fire Pump	N. R.	1, 2
Jockey Pump	N. R.	1, 2
Elevator	N. R.	1, 2**
Smoke Control	--	N. R.
Sprinkler System Air Compressor	N. R.	N. R.
Special Extinguishing System Power Supply (Halon, CO_2, etc.)	N. R.	N. R.

***1 - Generator

***2 - Connection to either two separate primary sources or to a utility network system.

***3 - Battery with charger.

***N.R. - Not Required.

*The building height for application of the criteria shall be determined by measurement of the distance from grade level of the lowest accessible floor to ceiling height of the highest occupied floor in the building. Mechanical rooms and penthouses are not considered occupied floors in this case.

**Power source must be capable of providing power to one elevator on a selective basis when the building contains 6 or fewer elevators. Otherwise, two elevators must be supplied on a selective basis.

- In any other location where the laboratory personnel are operating electrical equipment in direct contact with water or other liquids
- For all outside receptacles
- If such electrical equipment is prescribed for GFI protection by the manufacturer
- If previous experience indicates a need for GFI protection.

It shall be the responsibility of the facility director to install these devices as required.

This protection shall be provided in new and existing construction by means of interrupter devices incorporated in receptacles. These GFI receptacles may be the terminating type, the feedthrough type, or whichever will satisfy the need. GFI receptacles shall be color-coded to identify location for usability.

In the event that GFI protection is installed in existing receptacle circuits in existing laboratories, these circuits should remain in place, requiring no retrofit. Replacement of existing GFI devices should take place only where persistent problems are encountered, or when changes in purpose of aquatic laboratory areas or renovations of office space to laboratory area occur.

In addition, ground fault protection shall be installed on incoming services feeders rated 1000 amperes or more in accordance with Articles 230-95 of the NEC.

Non-Aquatic Laboratories

For non-aquatic laboratories and associated areas, GFI protection shall not be required in receptacle circuits.

Grounded System

The electrical ground system shall be checked or verified upon completion of the initial installation for continuity to the conduit system, the equipment housing, and the final connection to the receptacle grounding stud. For aquatic laboratories and other required areas, the receptacles shall be connected to the grounded system in addition to the installation of the GFI protective device in the receptacle.

Tripout

GFI devices shall be rated to trip out instantaneously on ground currents in excess of 5 milliamperes over a temperature range of -35° C to +65° C with a maximum humidity of 100 percent and as approved by Underwriters Laboratories or other nationally recognized testing laboratories. Furthermore, these GFI devices shall be specified to withstand high transmitting frequencies of 480 megahertz without tripout, line noise or transient currents in the system or those induced by motors or other inductive equipment without tripout.

PURPOSE

This Chapter establishes the authority for fire protection features of miscellaneous occupancies such as trash rooms, gas cylinders, electronic equipment, communications equipment, stages, laboratory fume hoods, shelters, laboratories, garages, and consumer safety offices.

NATIONAL CODES

Unless otherwise specified herein, the fire protection features of these miscellaneous special occupancies shall conform to the applicable requirements of the following National Fire Protection Association (NFPA) Standards:

- Installation of Sprinkler Systems (NFPA Standard No. 13)
- Flammable and Combustible Liquids Code (NFPA Standard No. 30)
- Fire Protection for Laboratories Using Chemicals (NFPA Standard No. 45)
- National Fuel Gas Code (NFPA Standard No. 54)
- Storage and Handling of Liquefied Petroleum Gases (NFPA Standard No. 58)
- Storage and Handling of Liquefied Natural Gas (NFPA Standard No. 59A)
- Protection of Electronic Computer/Data Processing Equipment (NFPA Standard No. 75)
- Life Safety Code (NFPA Standard No. 101).

TRASH ROOMS

In any building where it can be expected that combustible trash will be accumulated in a centralized location, a properly protected trash room shall be provided.

Trash rooms shall be enclosed and cut off from the remainder of the building by fire-resistive construction which complies with the requirements contained in FS 1-04. The door to the trash room shall be a self-closing type. Trash rooms and any areas used as a staging area for trash collection shall be sprinkler protected. The water supply for the sprinklers in trash rooms or staging area which are less than 250 square feet in size may be the domestic water system.

FLAMMABLE LIQUIDS

Facilities conforming to the requirements contained in NFPA Standard No. 30 shall be provided for the use and storage of flammable liquids which are necessary for the operation of the building and the business conducted in it. Whenever the site arrangements permit the storage of large quantities of flammable liquids, such as those required to support chemical laboratory operations, these liquids shall be in detached buildings rather than in the principal structure.

Chemical laboratory requirements for flammable liquids are outlined in NFPA Standard No. 45 and summarized in Exhibits 1 and 2.

Laboratory cabinets used for flammable liquids storage must be vented using a mechanical exhaust system providing the following features:

- The ventilation rate must be at least 5 to 20 CFM
- Air should be supplied at the top of a cabinet, exhausted from the bottom, and swept across all the shelves by arranging the shelves as baffles or constructing the shelves of perforated metal
- The inlet fitting should incorporate a flame arrestor
- The exhaust fan must be roof-mounted and should be weatherproof.

The requirement for mechanical ventilation of chemical cabinets is waived where prohibited by local jurisdictions.

FLAMMABLE AND OXIDIZING GASES

NFPA Standards shall be used as a basis for determining requirements. Depending on the type of installation, Standards 51, 54, 58 and 59A shall be used. Requirements for chemical laboratories are outlined in NFPA Standard No. 45.

In situations not covered by NFPA Standards, Compressed Gas Association, Inc., publications shall be used as guidelines.

EXHIBIT 1

MAXIMUM QUANTITIES OF FLAMMABLE AND COMBUSTIBLE LIQUIDS IN LABORATORY UNITS OUTSIDE OF APPROVED FLAMMABLE LIQUID STORAGE ROOMS

		Excluding Quantities in Storage Cabinets and Safety Cans			*Including* Quantities in Storage Cabinets and Safety Cans		
Laboratory Unit Class	Flammable or Combustible Liquid Class	Maximum Quantity[3] Per 100 Square Feet of Laboratory Unit	Maximum Quantity[4] per Laboratory Unit		Maximum Quantity[3] Per 100 Square Feet of Laboratory Unit	Maximum Quantity[4] per Laboratory Unit	
			Unsprinklered	Sprinklered[6]		Unsprinklered	Sprinklered[6]
A[1] (High Hazard)	I	10 gallons	300 gallons	600 gallons	20 gallons	600 gallons	1200 gallons
	I, II and IIIA[5]	20 gallons	400 gallons	800 gallons	40 gallons	800 gallons	1600 gallons
B[2] (Intermediate Hazard)	I	5 gallons	150 gallons	300 gallons	10 gallons	300 gallons	600 gallons
	I, II and IIIA[5]	10 gallons	200 gallons	400 gallons	20 gallons	400 gallons	800 gallons
C[2] (Low Hazard)	I	2 gallons	75 gallons	150 gallons	4 gallons	150 gallons	300 gallons
	I, II and IIIA[5]	4 gallons	100 gallons	200 gallons	8 gallons	200 gallons	400 gallons

1 *Class A laboratory units shall not be used as instructional laboratory units*
2 *Maximum quantities of flammable and combustible liquids in Class B and Class C instructional laboratory units shall be 50% of those listed in the table.*
3 *For maximum container sizes*
4 *Regardless of the maximum allowable quantity, the maximum amount in a laboratory unit shall never exceed an amount calculated by using the maximum quantity per 100 sq. ft of laboratory unit. The area of offices, lavatories, and other contiguous areas of a laboratory unit are to be included when making this calculation.*
5 *The maximum quantities of Class I liquids shall not exceed the quantities specified for Class I liquids alone*
6 *Where water may create a serious fire or personnel hazard, a nonwater extinguishing system may be used instead of sprinklers*

EXHIBIT 2

CONSTRUCTION AND FIRE PROTECTION REQUIREMENTS FOR LABORATORY UNITS

		Nonsprinklered Laboratory Units				Sprinklered Laboratory Units[2]	
		Construction Types I and II		Construction Types III, IV and V		Any Construction Type[3]	
Unit Fire Hazard Class	Area of Laboratory Unit Square Feet	Separation from Non-laboratory Areas	Separation from Lab Units of Equal or Lower Hazard Classification	Separation from Non-laboratory Areas	Separation from Lab Units of Equal of Lower Hazard Classification	Separation from Non-laboratory Areas	Separation from Laboratory Units of Equal or Lower Hazard Classification
A	Under 1000	1 hour	1 hour	2 hours	1 hour	1 hour	NC/LC[3] [4]
	1001-2000	1 hour	1 hour	N/A[4]	N/A	1 hour	NC/LC
	2001-5000	2 hours	1 hour	N/A	N/A	1 hour	NC/LC
	5001-10,000	N/A[4]	N/A	N/A	N/A	1 hour	NC/LC
	10,001 or more	N/A	N/A	N/A	N/A	N/A	N/A
B	Under 20,000	1 hour	NC/LC[3] [4]	1 hour	1 hour	NC/LC[5] [7]	NC/LC
	20,000 or more	N/A	N/A	N/A	N/A	N/A	N/A
C	Under 10,000	1 hour	NC/LC	1 hour	NC/LC	NC/LC[5] [7]	NC/LC[5] [8]
	100,000 or more	1 hour	NC/LC	1 hour	1 hour	NC/LC[5] [7]	NC/LC

1 *Where a laboratory work area or unit contains an explosion hazard, appropriate protection shall be provided for adjoining laboratory units and nonlaboratory areas, as specified in Chapter 5*

2 *In laboratory units where water may create a serious fire or personnel hazard, a nonwater extinguishing system may be substituted for sprinklers.*

3 *See Appendix B-4.*

4 *N/A = Not allowed; NC/LC = Noncombustible/Limited-Combustible Construction (see Appendix B-4).*

5 *May be ½-hour fire-rated combustible construction*

6 *Existing combustible construction is acceptable.*

7 *Laboratory units in educational occupancies shall be separated from nonlaboratory areas by 1-hour construction*

For SI Units: 1 sq ft = 0.0929m²

Flammable gases or liquids shall be separated from oxidizing gases, such as oxygen, compressed air, and chlorine, and from combustible or flammable materials. All containers shall be rigidly mounted in a vertical position and protected against physical damage.

Flammable gas containers shall be stored outside the building whenever possible with the gas piped to the work space as detailed in NFPA criteria. Whenever ground space is not available, the gas containers shall be located on a roof. As a last resort, gas containers shall be located inside the building in a ventilated, fire-resistive room conforming to NFPA Standards.

GAS CYLINDERS

All cylinders shall be constructed, charged, shipped and maintained in accordance with applicable DOT specifications and regulations published in 49 C.F.R., Chapters 100-177.

Size and Quantity in Use

Cylinder size and number permitted within a facility will depend upon system size, room size, construction, room ventilation, cylinder contents and availability of fire suppression. A gaseous system includes all regulators, relief devices, manifolds, piping and controls leading from the cylinder(s) to the point of actual use.

No single flammable gas or oxygen cylinder shall exceed 220 cubic feet (approximately 10 inches by 50 inches). The total number of flammable gas and oxygen cylinders in a laboratory shall not exceed the amount specified in Table 8-2 of NFPA Standard No. 45.

Anchoring of Cylinders

When in place at the point of use, cylinders shall be securely supported in an upright position by using a chain, nylon strap or metal channel assembly attached to a countertop, wall, column or substantial pipe. Cylinders shall not be secured to tables or desks which are not attached to the structure. Cylinder stands attached to or near the base of gas cylinders shall not be used.

Restraining points should be above the center of gravity but not so high as to permit the cylinder to slide out. Cylinders must be secured individually. "Gang" chaining shall not be permitted in the laboratory, although this is a permissible practice in a storage facility.

Ventilation

Ventilation rates in any room using flammable gas cylinders shall be sufficient to prevent the achievement of the lower explosive limit resulting from the leakage of one cylinder.

ELECTRONIC EQUIPMENT	Except as noted below--or covered elsewhere in this Volume--the provisions of NFPA Standard No. 75 shall be followed.
Housing	All operations shall be housed in a building of fire-resistant or noncombustible construction.
Separation	All operations shall be separated from other occupancies within the building by 1-hour fire rated construction.
Construction	All materials used in construction shall have a flame spread rating of 25 or less and smoke development rating of 50 or less. Raised floors shall be of noncombustible construction as defined in Appendix A of this Volume.
Occupancy	Except for small supervisory offices or Group I occupancies directly related to the electronic equipment operations, no other activity shall be located within the fire rated enclosure.
Wet Pipe Sprinkler Protection	Automatic wet pipe sprinkler protection shall be provided throughout all electronic equipment operations areas, including data storage areas (see FS 1-05). Systems shall be designed to provide 0.10 gpm per square foot for 1500 square feet for electronic equipment areas and 0.15 gpm per square foot for 3000 square feet for tape libraries and storage areas where storage heights do not exceed 9 feet. For storage heights of 9 feet or more, systems shall be designed to provide 0.18 gpm per square foot for 3000 square feet. The sprinkler piping may be valved separately, but valves shall be provided with tamper switches connected to the building fire alarm system. On-off type sprinkler heads and sprinkler guards are recommended to reduce water damage.
Halon 1301	Halon 1301 protection shall only be provided under the conditions stated in FS 1-05.
Smoke Detectors	Ionization type smoke detectors shall be provided at ceilings and in raised floors and for data storage areas, in accordance with NFPA Standard No. 72E. Detectors may be omitted for the ceilings of areas occupied 24 hours a day, every day of the year.
Vital Records	Important and vital records that have not been duplicated and stored at a different location shall be stored in a room with 2-hour fire rated enclosure. Automatic sprinkler

protection shall be provided for data storage areas. Class 150 data storage equipment shall be provided only for vital data which has not been duplicated and which is being stored within the electronic equipment operations area.

Air-Conditioning System — A separate air conditioning system should be provided for the electronic equipment operation area. If a system serves other areas, dampers to protect against both smoke and fire shall be provided for the duct work at every penetration of the electronic equipment area fire cutoff. No other ducts shall pass through the electronic equipment area.

Shutoff Switches — Emergency shutoff switches shall be provided at all exits from the electronic equipment area which will allow for the disconnection of all power to the electronic equipment and air conditioning systems. The same shutoff switch shall be connected to a sprinkler waterflow device so that the power to the computer room, including the air handlers, will be shut off automatically when the sprinkler system operates. The waterflow device used to disconnect power to the equipment shall be equipped with a supervised bypass switch so that maintenance testing can be conducted without disconnecting power to the computer room equipment.

Emergency Lighting — Emergency lighting shall be provided.

Authority — Fire prevention practices shall conform to NFPA's August, 1978, issuance of RP-1, "Standard Practice for the Fire Protection of Essential Electronic Equipment Operations."

COMMUNICATIONS EQUIPMENT — Communications equipment constitutes a Group I occupancy. Where this equipment utilizes paper, such as teletypes, the grouping of the equipment may form a Group II occupancy.

Where equipment is essential to the continuity of operation of the building or is otherwise essential, the communications room shall be protected by fire rated enclosures conforming to the requirements contained in FS 1-04.

STAGES — All stages, platforms in auditoriums, or similar arrangements, shall conform to the requirements for interior finish contained in FS 1-04. All curtains and draperies for stages and platforms shall be of a noncombustible material, such as fiberglass, or shall be of material impregnated to be flame resistant for the life of the fabric (25 washings).

Stages arranged or intended for theatrical, operatic, or similar use involving movable scenery, rigging loft, and the like shall conform to the following:

- Stages shall be separated from all other parts of the building by the fire partitions having at least a 2-hour fire-resistive rating. The proscenium walls shall also have at least a 2-hour fire-resistive rating.
- The entire stage and all dressing rooms, storage rooms, prop rooms, and other backstage areas shall be protected by automatic sprinklers.
- The rooms over the stage shall have at least 1-hour fire-resistive construction and shall be provided with emergency venting of not less than 1/8 of the area of the stage.
- The proscenium opening shall be protected by a standard fire-resistive proscenium curtain arranged for automatic closing without the use of applied power.
- All interior construction for rigging and lighting shall be noncombustible.

LABORATORY FUME HOODS

The laboratory fume hood is the primary hazard control device that laboratory workers depend upon for their protection while working with toxic or other hazardous materials. If designed, installed, operated and maintained properly, the laboratory fume hood will provide personnel with a high degree of protection and allow the user to work with a wide range of potentially hazardous materials.

Hood Function

The purpose of a laboratory fume hood is to prevent or minimize the escape of contaminants from the hood into the laboratory. This is accomplished by drawing air past the operator, into the hood, through the zone of contaminant generation, and out the stack.

Conditions Affecting Hood Performance

The ability of a laboratory hood to control contaminant generated in the hood will depend on these conditions:

- The control velocity at the hood face
- Air movement in the room

- Turbulence within the hood working space
- Hood location.

It is the proper selection and control of the above factors as an interacting group that determine the performance of the hood from the standpoint of hazard control.

Face Velocity. Air flow rates, to provide protection from operations performed in the hood, must provide positive control of air movement against competing influences. This is why face velocity requirements are affected by room conditions.

Operator Effect. The operator standing in front of the hood affects air flow patterns. The "eddies" generated can carry contaminants from the hood to the operator's breathing zone. Proper use of make-up air at the hood face, with emphasis on filling the void or minimizing the low pressure areas in front of the operator, can enhance hood performance.

Air Movement in the Laboratory. Air movement within the laboratory affects the performance of hoods and is influenced by hood location and air supply systems. Hood locations must be away from doors, operable windows and pedestrian traffic. Air from these sources can attain velocities several times greater than the hood face velocity, creating a potential for drag out or displacement of contaminated air from the hood.

Ceiling and wall diffusers for distribution of make-up air are also serious potential sources of interference. Air from such outlets should either be controlled to assist in the performance of the hood or directed so that the kinetic energy is lost before entering the zone of influence. Experience indicates that air from make-up systems should not exceed 25 FPM in the hood face area (measured with hood exhaust "off"). Air drawn from adjacent areas (by the hood exhaust system) must enter the hood in a manner that does not create excessive turbulence.

Hood Turbulence. Upon entering the hood, the air is drawn past equipment and sources of contamination toward the exhaust slots. Much of the air within the hood is in a turbulent state. Turbulence will result at airflows greater than needed to provide a good vector and contain the contaminant. The turbulence can be excessive and cause

a "rolling effect" in the hood chamber. Under these circumstances, the potential for greater mixing of contaminated air and room air at the hood face is increased. Often, a combination of poor hood arrangement and interior turbulence will result in loss of contaminated air to the room.

Hood Location. Location of a hood at the end of a room or bay, where the operator is essentially the only one who enters the zone of influence, is the most desirable. In any arrangement, pedestrian traffic past fume hoods should be minimized.

Fume Hood Systems

The laboratory fume hood is part of an overall system involving the laboratory, a duct system, a blower, and sometimes, effluent cleaning devices. The user has the right to assume that, if used properly, the hood and system will provide him or her with the means to work with hazardous materials without exposure to contaminants generated in the hood. It is essential, therefore, that each portion of the system be chosen carefully. The laboratory hood manufacturers should provide proof that the unit in and of itself performs satisfactorily under the conditions required.

Materials should meet corrosion resistance standards, blowers should be AMCA-rated (or equivalent), and plumbing fixtures and electrical outlets should meet existing codes. EPA specification and testing procedures for checking performance of fume hoods have been developed and are available from the Facilities Engineering and Real Property Branch.

Fume Hood Types

Selected fume hood types are listed and described below.

Constant Volume Bypass Type. The laboratory hood is often an integral part of the building exhaust system. The volume of air exhausted should be constant, which can be achieved by having an airflow bypass above the sash through which room air can pass as the sash is lowered. The bypass sizing and design must be such that the following conditions are met:

- The total air flow volume is essentially the same at all sash positions.
- As a sash is lowered, the face velocity increases to at least double, but no more than

triple, the design velocity for full open sash position.

- The bypass provides a "sight-tight" (a worker cannot see through the bypass louvers from where he is standing) barrier between the hood work space and the room when the sash is lowered. A "sight-tight" barrier will deflect flying particles from an operator in the event of an accident.

- The bypass opening is dependent only on the operation of the sash.

A horizontal bottom airfoil must be specified and used on all hoods. Also, vertical foils on the sides, which result in a slight airflow improvement by minimizing the eddies caused as air enters the hood, should be specified.

The work surface should be of the recessed type so that spills can be effectively contained. The front raised edge should extend into the hood sufficiently so it is beyond the airfoil but not wide enough to be used as a shelf enabling a worker to move equipment out to the face opening.

Horizontal sliding sashes have been promoted as air-saving devices as well as a means to increase face velocities. Use of horizontal sliding sashes is discouraged because they produce eddy currents (owing to their sharp edges), their use as a safety shield tends to be exaggerated, and they further complicate the difficult task of air balancing bypass hoods.

Auxiliary Air Hoods. Auxiliary air hoods are those provided with a source of air which is supplemental to that taken from the room. It is essential that all air be supplied from outside the hood face. Any model that introduces air behind the sash must not be used because it reduces the control velocity at the face, and it could actually pressurize the work chamber should the exhaust flow be reduced (e.g., foreign matter in fan, broken belt, normal wear and maintenance). Features described for the constant volume bypass-type hood are applicable to the auxiliary hood, including the bypass arrangement. The main advantages of an auxiliary air hood are conservation of energy during the cooling season, and an orderly supply of hood air to a room that otherwise would not get the quantity of air required by a hood(s). Also an auxiliary air

fume hood can be used to achieve improved performance over other hoods by controlling the air flow patterns around an operator.

Radioactive Isotope Hoods. In addition to the features described for constant volume bypass and auxiliary air-type hoods, radioactive isotope hoods should have panels at the sides, back, top, and plenum enclosure of 18-gage type 302 stainless steel with structural members, reinforcements, and brackets of 16-gage type 302 stainless steel. The work surface should be 14-gage type 302 stainless steel. Joints should be fully sealed by fine-line solder. The base structure should have a heavy angle frame reinforced to support 1-ton of lead brick shielding.

Perchloric Acid Hoods. In addition to the features described for constant volume bypass and auxiliary air-type hoods, perchloric acid hoods must use materials which are non-reactive, acid-resistant, and relatively impervious. Type 316 stainless steel with welded joint should be specified, although certain other materials may be acceptable. Corners should be rounded to facilitate cleaning. Work surfaces should be water tight with an integral trough at the rear for collection of washdown water.

A washdown system must be provided which has spray nozzles to adequately wash the entire assembly including the blower, all ductwork, and the interior of the hood, with an easily accessible strainer to filter particulates in the water supply that might clog the nozzles. The washdown system should be activated immediately after a hood has been in use. Ductwork should be installed with minimal horizontal runs, no sharp turns, and must not be shared with any other hood.

Blowers must be of an acid resistant, nonsparking (AMCA Standard Type A) construction. Lubrication should be with a fluorocarbon grease only. Gaskets should be made of a tetrafluoroethylene polymer. Perchloric acid must never be used in hoods not specifically designed for its use. Organic materials, strong dehydrating or desiccating agents, and oxidizing or reducing materials must not be used in a hood used with perchloric acid.

Other Ventilated Enclosures

Other ventilated enclosures are often required by laboratory personnel to ensure containment of chemical or biological air-borne contaminants produced during their work. Except for the standard laboratory fume hood, the merits

and limitations associated with the various types of such devices are not readily available to assist users in making a proper selection. The more popular types include the following: a total exhaust ventilated cabinet (Type I); combination recirculation and exhaust cabinet (Type II); total exhaust clean air cabinets; and total containment units such as Type III cabinets and glove boxes. Types I, II, and III refer to standards for biological safety cabinets (NSF Standard No. 49). See also NIH Guidelines for Research Involving Recombinant DNA Molecules.

Containment tests indicate these results:

- All models can provide a significant safety factor when operated under optimum conditions.
- Recirculation types are subject to varying degrees of control as the exhaust and recirculation rates are varied.
- Outside interferences and cabinet location must be considered if control is to be ensured.
- Total exhaust type operation of such enclosures as the Class I bio-containment; the NCI cabinet with recirculation "off,"; and total exhaust clean air cabinets provide excellent worker protection when located and operated properly. These cabinets are considered safe from an aerodynamic standpoint for any work that can be performed in an open-face enclosure. Also, because of the reduced size of the face opening, less air is required than for normal laboratory hood use, and, therefore, a considerable amount of energy savings is possible.
- When product protection is also a factor, Class II B and the new total exhaust clean air cabinets can also provide very good worker protection for operations suitable for an open face cabinet.
- All high-toxicity applications should be performed in either a Class III total enclosure or a glovebox.

- All ventilated enclosures should be exhausted to the outside environment. The ventilation is also of major assistance when decontamination of such enclosures is required.

- Flammable solvents can be used safely if the quantities are controlled. However, storage or use of any highly flammable material in a Type III device should be severely restricted.

- All such devices, and particularly those with recirculation or two-fan systems, require maintenance and operational surveillance on a regular basis.

New Installations

The laboratory process requiring ventilation should be reviewed, the best location determined, and the hood or cabinet then selected based on its performance capabilities. If the review indicates that a bio-cabinet would suffice, which is operated with a sash height of 10 inches and an average face velocity of 100 FPM, then it should be used rather than a standard fume hood. The energy savings are significant when the preceding stipulations are met.

If it is determined that a fume hood is required, the conditions in the laboratory affecting hood performance should be studied (see above). In selecting constant volume bypass or auxiliary air type hoods, also consider the economics of the required heating and air conditioning equipment and the projected operating costs. A good laboratory hood when selected, installed, and used as described, allows the worker to handle a wide range of materials including those for which extremely low exposures are hazardous. For materials suspected or known to be extremely toxic and for which special precautions and equipment are required, consult with the EPA Occupational Health and Safety Staff before containment equipment is selected.

Existing Installations

When the performance of existing hoods is unsatisfactory, attention should first be directed to external factors such as hood location and room ventilation. When the best environment is achieved for the hood, then such features as airfoils, air volume moved, and control of the pattern of air in the zone of the operator should be considered. In some cases, a new fume hood system may be required.

Face Velocities

The use of a ventilated enclosure to contain and exhaust a contaminant depends upon providing an airflow which is sufficient, but not excessive and providing this airflow in a manner which dominates operator effects and other exterior influences which may compromise the proper aerodynamic performance of the hood. Control velocities required at the face of the hood range from 80 FPM for "ideal" laboratory situations to 100 FPM for "good" laboratory arrangements. (Refer to Exhibit 3, Room Condition Classification Chart.)

The recommended flow rates will provide the worker protection desired for any operations that should be performed in this type of equipment. Flows lower than those proposed do not ensure the protection factors desired for normal conditions such as operator movement. Higher flows than those proposed are not required for a good laboratory arrangement and will not improve hood performance if the arrangement is poor to begin with. If the arrangement is unsatisfactory, it should be improved rather than increasing hood face velocity. Increased turbulence within the hood and around the operator results when higher velocities are used. Hood systems which introduce and control air in front of the operator are generally considered safer than conventional (non-auxiliary air-type) exhaust hoods.

Exhaust System

Individual exhaust systems should be provided for each fume hood. Combining exhaust systems for fume hoods located in the same laboratory room where each user can see and be aware of other fume hood operations may be considered. Additional combination of systems beyond that stated is prohibited.

Further combination of systems increases the potential for additional problems such as difficult air balancing, loss of control at many sites in case of fan failure, corrosive action, interference with the work of many operators during servicing, or performing minor system repairs, reduced potential for addition of effluent cleaning devices, and undesirable interaction of effluents. Blowers should be AMCA-rated or equivalent and installed at the end of each duct system so that all ducts within a building are maintained under negative pressure.

Hood exhaust discharges should be designed in accordance with the recommendations in Industrial Ventilation published by the American Conference of Governmental Industrial Hygienists and should extend to at least seven feet

EXHIBIT 3

ROOM CONDITION CLASSIFICATION CHART

Factor	Ideal Condition	Good Condition
Hood location	End of room or bay--no door or window problems.	Not on a main aisle--no door or window problems.
Traffic	Essentially none (other than operator).	Minimal (other than operator).
Lab air supply	All required lab hood makeup air drawn or induced so as to enhance overall hood performance.* No other grills or diffuser that produce air at measurable velocities in the hood area.	Velocity from lab supply grills or diffuser does not exceed 25 FPM in vicinity of hood (measured with the hood fan off).

* Such as properly designed and located perforated duct or ceiling section or well-designed auxiliary air-type hood plenum

above roof level. Fresh air inlets for the building's supply systems should be as far as possible from exhaust discharges.

Effluent Cleaning

When air cleaning devices are required, the type is determined by the contaminant and degree of cleaning necessary, and can vary from a simple scrubber and filters to incinerators or specially designed units. The typical EPA laboratory fume hood exhaust cleaning system consists of a pre-filter, followed by a solvent resistant HEPA filter, followed by an activated charcoal filter. High-efficiency particulate air filters (HEPA) offer considerable resistance to airflow, especially when loaded with contaminants. This feature must be considered during the design of a system with HEPA filters. To maintain building air balance, keep laboratories under negative pressure relative to surrounding areas and maintain proper hood control. It is recommended that a compensating damper be installed with an HEPA filter so the airflow will remain constant over the life of the filter.

It is good practice to install a roughing filter ahead of an HEPA filter to prolong the life of the HEPA, and in some situations use bag-in/bag-out filter housings to minimize the spread of contaminants when the HEPA or roughing filter is changed. The pressure drop across HEPA and roughing filters should be monitored so the filters may be changed when loaded. The filter plenum should be located on the inlet side of the fan so the fan is serviceable from the clean side of a filter. It is good practice to allow a straight run of duct prior to the fan in order to obtain good fan performance as well as to allow for future installation of other air cleaning equipment.

Fume Hood Operation

The hood blower shall remain in operation at all times when hoods are in use and for a sufficient time thereafter to clean the hoods of airborne hazardous substances. Operation of the hood blower shall be confirmed by various devices. First, a pilot light may be provided to show that the blower is energized, although this generally does not give a sure indication of airflow; also, a static pressure sensor or impact (velocity) pressure sensor may be arranged to provide an audible or visual signal in case of exhaust system malfunction or as a continuous indication of proper hood operation.

A simple plastic, cloth or paper strip suspended from the sash frame can also provide an effective visual indication of hood blower operation for those installations where lower risk operations are carried out. Any two of these hood monitoring systems are required on all hoods, but higher risk situations require at least an airflow alarm with audible and visual indicators.

Hood Purchase and Installation

All fume hood purchases and installations must be approved by the Facilities Engineering and Real Estate Branch of Facilities and Support Services prior to processing procurement documents.

LABORATORIES

Firesafety, safety, and health problems in laboratories pose a need for careful design and construction, to assure personnel and property protection and efficient operations. It is desirable to consolidate laboratory space into separate buildings exclusive of other occupancies. Laboratories that handle or store hazardous chemicals, flammable gases, flammable liquids or explosives, and biological laboratories should not be incorporated into plans for EPA office buildings or into buildings which are being considered for EPA-leased office space. Laboratories shall not be established or expanded in existing EPA office buildings. Until existing laboratories in EPA office space can be phased out of their present locations into separate buildings, laboraatories in office buildings are permitted, provided all of the following features are met, which are also required for new laboratory construction:

- The laboratories meet NFPA Standard No. 45.
- Laboratories are sprinklered regardless of size. Sprinkler protection shall be hydraulically calculated to provide a density of 0.15 gpm per square feet over a 3,000 square foot area.
- Laboratory doors swing in the direction of egress.
- Adjacent occupancies of lesser hazard are separated from sprinklered laboratory spaces by 1-hour rated construction, including Class C rated fire doors.

- The laboratories are provided with a one-pass air system.
- Laboratories have at least eight air changes per hour.
- Laboratories are maintained at negative air pressure compared to the corridors and adjacent non-laboratory spaces.
- A manual fire alarm system is installed in all laboratory buildings and in any building housing laboratories.
- Backflow preventers of the reduced pressure zone type are installed in parallel on all water lines serving buildings of a chemical or biological laboratory nature.
- All laboratories have a sufficient number of fume hoods, which all meet the EPA ventilation requirements for hoods.

Laboratories which conduct experimental research and laboratories which possess, use, handle or store the following substances are prohibited in buildings containing office space, unless adequate engineering and management provisions are incorporated to control the inherent hazards ranging from entry into the building to ultimate disposal and removal from the building:

- Class 3 or 4 etiological agents (as classified in the Department of Health, Education, and Welfare Public Health Service Booklet entitled "Classification of Etiologic Agents on the Basis of Hazard")
- Explosive materials (as defined by NFPA Standard No. 45)
- Radioactive materials requiring a specific license
- Other extremely toxic substances such as known human carcinogens
- Concentrated (undiluted) pesticides.

CONSUMER SAFETY OFFICERS

A Consumer Safety Officer (previously known as a Pesticide Inspector) will, in his normal operational routine, take samples at the producer establishment, distribution and retail establishment, or at the user level and officially seal it in such a manner as to maintain its continuity and integrity. He is to ship the sample within seven working days from the date of collection. There should, therefore, be no reason for deliberate exposure to pesticides in the offices of the inspector. Any exposure would be through accidental means.

SPACE REQUIREMENTS

With the above mode of operation by the Consumer Safety Officer, the space occupied shall require the following features:

- Access to the space must result in minimal exposure of personnel to pesticide samples along the access route.
- A sink with an eye wash attachment shall be provided for cleaning.
- An approved fire rated storage cabinet with piped mechanical exhaust shall be provided.
- If the aggregate quantity of flammables does not exceed the equivalent of 1 gallon at any one time, the space shall be separated from non-laboratory areas by a 1-hour partition. If the room is sprinklered, the partitions are only required to be of noncombustible materials.
- If the aggregate quantity of flammables exceeds the equivalent of 1 gallon, the space must be sprinklered and separated from non-laboratory areas by a 2-hour partition.
- A canopy hood shall be provided over the table or bench used by the Inspector for packing samples for shipment. This canopy hood is provided to remove nuisance odors and NOT for personnel protection from toxic fumes. This hood should be exhausted directly to the outside, with a blower having a capacity of 100 cfm per square foot of horizontal hood area or at least equal to the quantity of air supplied to the room,

whichever is greater. The bottom of the hood should be no less than 36 inches and no more than 48 inches above the work surface. A minimum 10 inch duct should be provided (long duct runs may require a larger diameter). The exhaust blower and motor sizes are dependent upon the duct length and diameter.

APPENDIX: STANDARDS AND DEFINITIONS

APPENDIX: STANDARDS AND DEFINITIONS

PURPOSE

This appendix defines terms used in this Volume. It also outlines the various test methods used to establish the fire resistance ratings of building assemblies, members, and materials noted throughout this Volume. Some special conditions are also noted to add clarity to items listed in various Chapters of this Volume.

NATIONAL REFERENCE STANDARDS

Unless otherwise specified herein, all fire resistance ratings shall conform to the applicable requirements of the following National Fire Protection Association (NFPA) Standards and other references, as follows:

- Standard Methods for Fire Tests of Building Construction and Materials (NFPA Standard No. 251)
- Types of Building Construction (NFPA Standard No. 220)
- Method of Test of Surface Burning Characteristics of Building Materials (NFPA Standard No. 225/ASTM E-84)
- Standard Method of Test for Noncombustibility of Elementary Materials (ASTM E-136)
- Standard Method of Fire Tests of Building Construction and Materials (ASTM E-119)
- Building Code Requirements for Reinforced Concrete (ACI 318)
- Standard Methods of Fire Tests of Door Assemblies (NFPA Standard No. 252)
- Standard for Fire Tests of Window Assemblies (NFPA Standard No. 257)
- Standard Methods of Fire Tests of Roof Coverings (NFPA Standard No. 256).

DEFINITIONS

Combustible	"Combustible" means an item, fixture, or material capable of undergoing combustion.
Fire Load	"Fire Load" means the amount of combustibles present in a given situation. This statistic is usually expressed in terms of weight of combustible material per square foot.
Fire Resistance Rating	"Fire Resistance Rating" means the time in minutes or hours that materials or assemblies have withstood a fire exposure as established in accordance with the test procedures of NFPA Standard No. 251, "Standard Methods of Fire Tests of Building Construction and Materials;" NFPA Standard No. 252, "Standard Methods of Fire Tests of Door Assemblies;" and NFPA Standard No. 257, "Standard for Fire Tests of Window Assemblies."
Fire-Resistive Construction	"Fire-Resistive Construction" is that type of construction in which structural members, including walls, partitions, columns, floors, and roofs, are of noncombustible or limited combustible materials and have fire resistance ratings complying with the requirements in NFPA Standard No. 220, "Types of Building Construction."
Fire Retardant	"Fire Retardant" signifies a material which has been treated with chemicals, coatings, paints, or other materials to reduce its degree of combustibility to some extent.
Flame Spread	"Flame Spread" is the flaming combustion along a surface.
Flame Spread Rating	"Flame Spread Rating" is the numbers or classifications obtained according to the "Method of Test of Surface Burning Characteristics of Building Materials, NFPA Standard No. 225/ASTM E-84.
Listed	"Listed" means the assemblies, equipment, or materials included in a list published by a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of the production of listed equipment or materials and whose listings state either that the equipment or material meets nationally recognized standards, or has been tested and found suitable for use in a specified manner.

NOTE: The means for identifying listed equipment may vary for each testing laboratory, inspection agency or other organization concerned with product evaluation, some of which do not recognize equipment as "listed" unless it is also labeled.

Noncombustible

"Noncombustible" means a material in a form which when used, and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat. Materials reported as noncombustible, when tested in accordance with the "Standard Method of Test for Noncombustibility of Elementary Materials," ASTM E-136, shall be considered noncombustible materials.

TEST METHODS AND ACCEPTABILITY

All building materials, assemblies, and members noted throughout this Volume are required to meet certain fire resistance ratings which shall be derived from standard fire testing methods. The fire resistance ratings shall be contained in either laboratory report forms or in listings provided by nationally recognized testing laboratories. The fire tests include but are not restricted to the following:

- ASTM E-119, Standard Method of Fire Tests of Building Construction and Materials
- ASTM E-136, Noncombustibility of Elementary Materials
- ASTM E-84, Method of Test of Surface Burning Characteristics of Building Materials.

☆ U S GOVERNMENT PRINTING OFFICE 1984 452-383