(ii) **Pump test.** Fire pumps shall be tested. If the pump performance characteristics when tested are more than 10 percent below the manufacturer's certified shop test characteristic curve or as specified on the pump housing, the pump shall be repaired and restored to its original condition. Caution should be taken when drawing residual pressure below 20 psi on public service mains during testing as it may cause damage to the mains. Pump supervisory devices shall be tested for proper functioning and to assure that the alarm is transmitting to the proper location.

(iii) **Outlets.** Flow water from each outlet in the system in a manner that will indicate the valves are fully operable and that there is water pressure at that outlet. Check each outlet for signs of corrosion and leakage. Check for the installation of an approved pressure-reducing device at outlets where the pressure will exceed 100 psi.

(iv) **Inlet connections.** Backflow inlet connections so the water will backflow out of the fire department connections.

(v) **Hose.** Examine each full length of hose section for mildew, cuts, abrasions and other deterioration. When required by the chief, the hose shall be replaced with listed lined hose. Check hose couplings, gaskets and nozzle for damage and obstructions.

Basement

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(d) **Detailed** steel, brass or b

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APPENDIX III-D
BASEMENT PIPE INLETS

Basement Pipe Inlets

Sec. 10.316. (a) General. All basement pipe inlets shall be installed in accordance with the requirements of this section.

(b) **Where Required.** Basement pipe inlets shall be installed in the first floor of every store, warehouse or factory having basements.

EXCEPTIONS: 1. Where the basement is equipped with an automatic fire-extinguishing system.

2. Where the basement is used for the storage of permanent archives or valuables such as safe deposit vaults or similar uses adversely affected by water.

(c) **Location.** The location of basement pipe inlets shall be as required by the fire department.

(d) **Detailed Requirements.** All basement pipe inlets shall be of cast iron, steel, brass or bronze with lids of cast brass or bronze.

The basement pipe inlet shall consist of a sleeve of not less than 8-inch inside diameter extending through the floor and terminating flush with or through the basement ceiling and shall have a top flange recessed with an inside shoulder to receive the lid. The top flange shall be installed flush with finish floor surface. The lid shall be a solid casting and have a lift recessed in the top. This lid shall be provided with a cast-in sign reading FIRE DEPARTMENT ONLY—DO NOT COVER. The lid shall be installed in such a manner as to permit its easy removal from the flange shoulder.

Division IV
FLAMMABLE FLOOR COVERINGS
APPENDIX IV-A
INTERIOR FLOOR FINISH

1. GENERAL

This appendix regulates exposed floor surfaces of buildings, including coverings which are applied over a previously finished floor.

EXCEPTION: Interior floor finish materials of a traditional type, such as wood, vinyl, linoleum, terrazzo and other resilient floor-covering materials.

Floor coverings judged by the chief to represent an unusual hazard shall meet the classification prescribed for the various occupancy groups listed in Table IV-A when tested in accordance with the requirements of Section 2.

2. TESTING AND CLASSIFICATION OF MATERIALS

(a) **Testing.** Critical radiant flux values of interior floor finishes shall be established by tests conducted in accordance with procedures specified within Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source, National Fire Protection Association Standard 253-1978 conducted by an approved testing agency.

(b) **Classification.** Interior floor finish materials which are judged by the chief to represent an unusual hazard which are to be installed in an exit enclosure, passageway or corridor shall be tested and classified on the basis of tests conducted in accordance with Subsection 2 as follows:

1. **Class 1 Interior Floor Finish.** Materials having a minimum critical radiant flux of 0.45 watt per square centimeter.

2. **Class 2 Interior Floor Finish.** Materials having a minimum critical radiant flux of 0.22 watt per square centimeter.

3. MAXIMUM ALLOWABLE CRITICAL RADIANT FLUX

(a) **General.** Interior floor finish materials judged by the chief to represent an unusual hazard shall meet the classification prescribed for the various occupancy groups listed in Table IV-A when tested in accordance with the requirements of Section 2.

EXCEPTION: When an approved automatic sprinkler system is installed, Class 2 materials may be used in any area where Class 1 materials are required and the materials need not be classified in areas where Class 2 materials are permitted.

(b) **Test Report Availability.** All interior floor finish materials required by this section to meet critical radiant flux limits in accordance with Section 2 shall be tested by an approved laboratory. A copy of the test report identifying and representing the style to be installed shall be provided to the chief upon request. The test report shall identify the interior floor finish by manufacturer (or supplier) and style name and shall be representative of the current construction of the material to be installed.

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Group A
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Group E
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Group R-1

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(c) **Identification.** The interior floor finish material shall be identified by a hang tag or other suitable method as to manufacturer (or supplier) and style and shall indicate the classification of the material based upon the limits specified within Section 2.

TABLE IV-A—INTERIOR FLOOR FINISH REQUIREMENTS

USE GROUPS	REQUIRED EXITS AND PASSAGEWAYS[1]	CORRIDORS PROVIDING EXIT ACCESS
Group A	2	2
Group B-2	2	2
Group E	2	2
Group I2	1	1
Group R-1	2	2

[1]Combustible floor finish not permitted for stairs in Types I and II construction nor other types of construction exceeding three stories in height.

[2]Combustible floor finish not permitted in rooms occupied by inmates or patients whose personal liberties are restrained.

Division V

STANDARDS

APPENDIX V-A

NATIONALLY RECOGNIZED STANDARDS OF GOOD PRACTICE

The following standards and publications are intended for use as a guide to attain a reasonable level of safety where specific requirements are not stated or specific standards are not adopted or referenced in the body of the code.

AMERICAN GAS ASSOCIATION LABORATORIES
8501 East Pleasant Road, Cleveland, OH 44131
1425 Grande Vista Avenue, Los Angeles, CA 90023
DIRECTORY OF CERTIFIED APPLIANCES AND ACCESSORIES

COMPRESSED GAS ASSOCIATION, INC.
1235 Jefferson Davis Highway, Arlington, VA 22202

CGA	PAMPHLETS
G-1	Acetylene.
G-2	Anhydrous Ammonia.
G-3	Sulphur Dioxide.
G-4	Oxygen.
G-5	Hydrogen.
P-1	Safe Handling of Compressed Gases.
P-2	Characteristics and Safe Handling of Medical Gases.
V-5	Diameter-Index Safety System.

FACTORY MUTUAL ENGINEERING AND RESEARCH
1151 Boston-Providence Turnpike, Norwood, MA 02062

INSTITUTE OF MAKERS OF EXPLOSIVES
1120 19th Street, N.W., Suite 310, Washington, DC 20036-3605
IME PAMPHLETS

No. 1 Construction Guide for Storage Magazines—Jan., 1983.
No. 20 Radio Frequency Radiation Hazard in Use of Electric Blasting Caps—Sept., 1981.

NATIONAL FIRE PROTECTION ASSOCIATION
Batterymarch Park, Quincy, MA 02269
NFPA NATIONAL FIRE CODES

UNDERWRITERS LABORATORIES INC.
333 Pfingsten Road, Northbrook, IL 60062
1655 Scott Blvd., Santa Clara, CA 95050

U.L. INC. DIRECTORIES

Automotive, Burglary Protection and Mechanical Equipment.
Building Materials.
Electrical Appliance and Utilization Equipment.
Electrical Construction Materials.
Fire Protection Equipment.
Fire Resistance.
Gas and Oil Equipment.
General Information from Electrical Construction Materials and Hazardous Location Equipment Directories.
Hazardous Location Equipment.
Marine Products.
Recognized Component.

UNITED STATES GOVERNMENT AGENCIES
Code of Federal Regulations, Titles 1-50, Superintendent of Documents
U.S. Government Printing Office, Washington, DC 20402

Division VI
INFORMATIONAL
APPENDIX VI-A
HAZARDOUS MATERIALS CLASSIFICATIONS

1. INTENT

This appendix provides information, explanations and examples to illustrate and clarify the hazard categories contained in Division II of Article 80. The hazard categories are based upon the Code of Federal Regulations, Title 29, (CFR-29). Where numerical classifications are included, they are in accordance with nationally recognized standards.

2. HAZARD CATEGORIES

(a) **Physical Hazards**

1. **Explosives and Blasting Agents**

(i) **High explosives.** Can be detonated by means of blasting cap when unconfined. Examples: dynamite, TNT, nitroglycerine, C-3, C-4.

(ii) **Low explosives.** Can be deflagrated when confined. Examples: black powder, smokeless powder, propellant explosives, display fireworks. Generally corresponds with DOT Class B or C. Black powder is a DOT Class A explosive.

(iii) **Blasting agents.** Oxidizer/liquid fuel slurry mixtures. Examples: ammonium nitrate/fuel oil.

2. **Compressed Gases**

(i) **Flammable.** Examples: Acetylene, carbon monoxide, ethane, ethylene, hydrogen, methane. Ammonia will ignite and burn, although its flammable range is too narrow for it to fit the definition of flammable gas.

(ii) **Oxidizing.** Examples: oxygen, ozone, oxides of nitrogen, chlorine and fluorine. Chlorine and fluorine do not contain oxygen but reaction with flammables is similar to that of oxygen.

(iii) **Corrosive.** Examples: ammonia, hydrogen chloride and fluorine.

(iv) **Highly Toxic.** Examples: arsine, cyanogen, fluorine, germine, hydrogen cyanide, hydrogen selenide, nitric oxide, phosphine and stibene.

(v) **Toxic.** Examples: boron trichloride, boron trifluoride, chlorine, hydrogen flouride, hydrogen sulfide and silicon tetrafluoride.

(vi) **Inert (chemically unreactive).** Examples: argon, helium, krypton, neon, nitrogen and xenon.

(vii) **Pyrophoric.** Examples: diborane, dichloroborane, phosphine and silane.

(viii) **Unstable (reactive).** Examples: butadiene (unstabilized), ethylene oxide and vinyl chloride.

CODE ENFORCEMENT

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5. **Oxidizers**
(i) **Gases.** Ex
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CLASS 3 - An c
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3. **Flammable and Combustible liquids:**

(i) **Flammable liquids:**

CLASS I-A shall include those having flash points below 73°F. and having a boiling point below 100°F.

CLASS I-B shall include those having flash points below 73°F. and having a boiling point at or above 100°F.

CLASS I-C shall include those having flash points at or above 73°F. and below 100°F.

(ii) **Combustible liquids:**

CLASS II liquids shall include those having flash points at or above 100°F. and below 140°F.

CLASS III-A liquids shall include those having flash points at or above 140°F. and below 200°F.

CLASS III-B liquids shall include those liquids having flash points at or above 200°F.

4. **Flammable Solids**

(i) **Organic solids.** Examples: camphor, cellulose nitrate and napthalene.

(ii) **Inorganic solids.** Examples: decaborane, lithium amide, phosphorous heptasulfide, phosphorous sesquisulfide, potassium sulfide, anhydrous sodium sulfide and sulfur.

(iii) **Combustible metals (except dusts and powders).** Examples: cesium, magnesium and zirconium.

(iv) **Combustible dusts and powders (including metals).** Finely divided flammable solids which may be dispersed in air as a dust cloud. Examples: wood sawdust, plastics, coal, flour and powdered metals (few exceptions).

5. **Oxidizers**

(i) **Gases.** Examples: Oxygen, ozone, oxides of nitrogen fluorine and chlorine (reaction with flammables is similar to that of oxygen).

(ii) **Liquids.** Examples: bromine, hydrogen peroxide, nitric acid, perchloric acid and sulfuric acid.

(iii) **Solids.** Examples: chlorates, chromates, chromic acid, iodine, nitrates, nitrites, perchlorates and peroxides.

Classification of liquid and solid oxidizers according to hazard:

CLASS 4 - An oxidizing material that can undergo an explosive reaction when catalyzed or exposed to heat, shock or friction. Examples: ammonium perchlorate, ammonium permanganate, guanidine nitrate, hydrogen peroxide solutions more than 91 percent by weight, perchloric acid solutions more than 72.5 percent by weight and potassium superoxide.

CLASS 3 - An oxidizing material that will cause a severe increase in the burning rate of combustible material with which it comes in contact. Examples: ammoniun dichromate, bromine pentafluoride, bromine trifluoride, hydrogen peroxide 52 percent to not more than 91 percent concentration by weight, calcium hypochlorite over 50 percent by weight, potassium bromate, potassium chlorate, sodium chlorite over 40 percent by weight, mono (trichloro) tetra-(monopotassium dichloro) -penta-s-triazinetrione, perchloric acid solutions 60 percent to 72.5 percent by weight, potassium dichloro-s-triazinetrione (potassium dichloroisocyanurate), sodium chlorate, sodium chlorite over 40 percent by weight and sodium dichloro-s-triazinetrione (sodium dichloroisocyanurate).

CLASS 2 - An oxidizing material that will moderately increase the burning rate or which may cause spontaneous ignition of combustible material with which it comes in contact. Examples: calcium hypochlorite 50 percent or less by weight, chromium trioxide (chromic acid), halane (1, 3-dichloro-5, 5-dimethyl hydantion), hydrogen peroxide 27.5 percent to 52 concentration by weight, nitric acid more than 70 percent concentration, potassium perchlorate, potassium permanganate, sodium chlorite 40 percent or less, sodium permanganate and trichloro-s-triazinetrione (trichloroisocyanuric acid).

CLASS 1 - An oxidizing material whose primary hazard is that it may increase the burning rate of combustible material with which it comes in contact. Examples: aluminum nitrate, ammonium persulfate, barium chlorate, barium nitrate, barium perchlorate, barium permanganate, barium peroxide, beryllium nitrate, calcium chlorate, calcium chlorite, calcium citrate, calcium peroxide, cobalt nitrate, cupric nitrate, ferric nitrate, hydrogen peroxide solutions over 8 percent but not exceeding 27.5 concentration by weight, lead nitrate, lithium hypochlorite, lead peroxide, lithium peroxide, magnesium nitrate, magnesium perchlorate, magnesium peroxide, mercurous nitrate, nickel nitrate, nitric acid 70 percent concentration or less, perchloric acid solutions less than 60 percent by weight, potassium dichromate, potassium nitrate, potassium nitrite, potassium persulfate, silver nitrate, sodium carbonate peroxide, sodium dichloro-s-triazinetrione dihydrate, sodium dichromate, sodium nitrate, sodium nitrite, sodium perborate, sodium perborate tetrahydrate, sodium perchlorate monohydrate, sodium persulfate, strontium chlorate, strontium nitrate, strontium peroxide, thorium nitrate, uranium nitrate, zinc chlorate, zinc nitrate, zinc peroxide, zinc permanganate and zirconium nitrate.

Note: Examples are based upon NFPA Standard No. 43-A.

6. **Organic Peroxides**

Organic peroxides are flammable compounds which contain the double oxygen or peroxy (-o-o-) group and are subject to explosive decomposition. They are available as:

(i) Liquids.

(ii) Pastes.

(iii) Solids (usually finely divided powders).

Classification or organic peroxides according to hazard:

UNCLASSIFIED: Peroxides which are capable of detonation. These peroxides present an extremely high explosion hazard through rapid explosive decompo-

potassium bromate, potas-
y weight, mono (trichloro)
ione, perchloric acid solu-
m dichloro-s-triazinetrione
e, sodium chlorite over 40
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ely increase the burning rate
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less, sodium permanganate
: acid).

hazard is that it may increase
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. barium peroxide, beryllium
m citrate, calcium peroxide,
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gnesium nitrate, magnesium
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olutions less than 60 percent
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No. 43-A.

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sition and are regulated in accordance with the provisions of Article 77 for Class A explosives.

CLASS I: Class I peroxides are capable of deflagration, but not detonation. These peroxides present a high explosion hazard through rapid decomposition. Examples: acetyl cyclohexane sulfonyl 60-65 percent concentration by weight, fulfonyl peroxide, benzoyl peroxide over 98 percent concentration, t-butyl hydroperoxide 90 percent, t-butyl peroxyacetate 75 percent, t-butyl peroxyisopropylcarbonate 92 percent, diisopropyl peroxydicarbonate 100 percent, di-n-propyl peroxydicarbonate 98 percent and di-n-propyl peroxydicarbonate 85 percent.

CLASS II: Class II peroxides burn very rapidly and present a severe reactivity hazard. Examples: Acetyl peroxide, 25 percent, t-butyl hydroperoxide 70 percent, t-butyl peroxybenzoate 98 percent, t-butyl peroxy-2-ethylhexanoate 97 percent, t-butyl peroxyisobutyrate 75 percent, t-butyl peroxyisopropylcarbonate 75 percent, t-butyl peroxypivalate 75 percent, dybenzoyl peroxydicarbonate 85 percent, di-sec-butyl peroxydicarbonate 98 percent, di-sec-butyl peroxydicarbonate 75 percent, 1,1-di- (t-butylperoxy)- 3,5,5-trimethyecyclohexane 95 percent, di-(2-ethythexyl) peroxydicarbonate 97 percent, 2,5-dymethyl-2-5 di (benzoylperoxy) hexane 92 percent and peroxyacetic acid 43 percent.

CLASS III: Class III peroxides burn rapidly and present a moderate reactivity hazard. Examples: acetyl cyclohexane sulfonal peroxide 29 percent, benzoyl peroxide 78 percent, benzoyl peroxide paste 55 percent, benzoyl peroxide paste 50 percent, cumene hydroperoxide 86 percent, di- (4-butylcyclohexyl) peroxydicarbonate 98 percent, t-butyl peroxy-2-ethytehexanoate 97 percent, t-butyl peroxyneodecanoate 75 percent, decanoyl peroxide 98.5 percent, di-t-butyl peroxide 99 percent, 1,1-di(t-butylperoxy)3,5,5-trimethylcyclohexane 75 percent, 2,4-dichlorobenzoyl peroxide 50 percent, diisopropyl peroxydicarbonate 30 percent, 2,5-dimethyl-2,5-di(2-ethylhexanolyperoxy)-hexane 90 percent, 2,5-dimethyl-2,5-di(t-butylperoxy) hexane 90 percent and methyl ethyl ketone peroxide 9 percent active oxygen.

CLASS IV: Class IV peroxides burn in the same manner as ordinary combustibles and present a minimum reactivity hazard. Examples: benzoyl peroxide 70 percent, benzoyl peroxide paste 50 percent, benzoyl peroxide slurry 40 percent, benzoyl peroxide powder 35 percent, t-butyl hydroperoxide 70 percent, t-butyl peroxy-2-ethylhexanoate 50 percent, decumyl peroxide 98 percent, di-(2-ethylhexal) peroxydicarbonate 40 percent, laurel peroxide 98 percent, p-methane hydroperoxide 52.5 percent, methyl ethyl ketone peroxide 5.5 percent active oxygen and methyl ethyl ketone peroxide 9 percent active oxygen.

CLASS V: Class V peroxides do not burn or present a decomposition hazard. Examples: benzoyl peroxide 35 percent, 1,1-di-t-butyl peroxy 3,5,5-trimethylcyclohexane 40 percent, 2,5-di-(t-butyl peroxy) hexane 47 percent and 2,4-pentanedione peroxide 4 percent active oxygen.

Note: Examples are based upon NFPA Standard No. 43-B.

7. **Pyrophoric Materials**

(i) **Gases.** Examples: diborane, phosphine and silane.

(ii) **Liquids.** Examples: diethyl aluminum chloride, diethyl beryllium, diethyl phosphine, diethyl zinc, dimethyl arsine, triethyl aluminum etherate, thriethyl bismuthine, thriethyl boron, trimethyl aluminum and trimethyl gallium.

(iii) **Solids.** Examples: cesium, hafnium, lithium, white or yellow phosphorus, plutonium, potassium, rubidium, sodium and thorium.

8. **Unstable (Reactive) Materials**

CLASS 4: Materials which in themselves are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures. This class should include materials which are sensitive to mechanical or localized thermal shock at normal temperatures and pressures. Acetyl peroxide, dibutyl peroxide, dinitrobenzene, ethyl nitrate, peroxyacetic acid and picric acid (dry) trinitrobenzene.

CLASS 3: Materials which in themselves are capable of detonation or of explosive decomposition or explosive reaction but which require a strong initiating source or which must be heated under confinement before initiation. This degree should include materials which are sensitive to thermal or mechanical shock at elevated temperatures and pressures. Examples: hydrogen peroxide (greater than 52 percent), hydroxylamine, nitromethane, paranitroaniline, perchloric acid and tetrafluoroethylene monomer.

CLASS 2: Materials which in themselves are normally unstable and readily undergo violent chemcial change but do not detonate. This degree should include materials which can undergo chemical change with rapid release of energy at normal temperatures and pressures and which can undergo violent chemical change at elevated temperatures and pressures. Examples: acrolein, acrylic acid, hydrazine, methacrylic acid, sodium perchlorate, styrene and vinyl acetate.

CLASS 1: Materials which in themselves are normally stable but which can become unstable at elevated temperatures and pressures. Examples: acetic acid, hydrogen peroxide 35 percent to 52 percent, paraldehyde and tetrahydrofuran.

Classification by degree of hazard shall be in accordance with U.F.C. Standard No. 79-3. Also see NFPA Standard No. 49.

9. **Water-reactive Materials**

CLASS 3: Materials which react explosively with water without requiring heat or confinement. Examples: aluminum alkyls such as triethylaluminum, isobutylaluminum and trimethylaluminum; bromine pentafluoride, bromine trifluoride, chlorodiethylaluminium and diethylzinc.

CLASS 2: Materials which may form potentially explosive mixtures with water. Examples: calcium carbide, calcium metal, cyanogen bromide, lithium hydride, methyldichlorosilane, potassium metal, potassium peroxide, sodium metal, sodium peroxide, sulfuric acid and trichlorosilane.

CLASS 1: Materials which may react with water with some release of energy but not violently. Examples: acetic anhydride, sodium hydroxide, sulfur monochloride and titanium tetrachloride.

Classification by degree of hazard shall be in accordance with U.F.C. Standard No. 79-3. Also see NFPA Standard No. 49.

10. **Cryogenic Fluids**

(i) **Flammable.** Examples: carbon monoxide, deuterium (heavy hydrogen), ethylene, hydrogen and methane.

(ii) **Oxidizing.** Examples: fluorine, nitric oxide and oxygen.

(iii) **Corrosive.** Examples: fluorine and nitric oxide.

(iv) **Inert (chemically unreactive).** Examples: argon, helium, krypton, neon, nitrogen and xenon.

(v) **Highly toxic.** Examples: fluorine and nitric oxide.

(vi) All of the cryogenics listed will exist as compressed gases when they are stored at ambient temperatures.

(b) **Health Hazards**

1. **Highly Toxic and Toxic Materials**

(i) Highly toxic materials, Class A as defined in Parts 100-177, Title 49, CFR. Examples:

Gases—arsine, cyanogen, fluorine, germane, hydrogen cyanide, hydrogen selenide, nitric oxide, nitrogen dioxide, phosgene (diphosgene), phosphine and stibene.

Liquids—bromacetone, hydrocyanic acid, nitrogen peroxide and nitrogen tetroxide.

(ii) Toxic materials (including pesticides, fumigants and all Class B poisons). Examples:

Gases—boron trifluoride, chlorine, chlorine dioxide, chlorine trifluoride, diborane, fluorine, hydrogen sulfide, methyl bromide, nitrogen trifluoride and ozone.

Liquids—acetelyene tetrabromide, acetone cyanhydrin, acrolein, acrylonitrile, allyl alcohol, allyl chloride, aniline, o-anisidine, arsenic compounds, benzaldehyde, benzyl chloride, beryllium compounds, carbolic acid (phenol), carbon disulfide, carbon tetrachloride, chlorinated diphenyl oxide, chloroacetaldehyde, chloroform, o-chlorophenyl, chloropicrin, chromic acid, cresol, crotonaldehyde, cyanide compounds, dichloroethyl ether, diethylaminoethanol, diethyl sulfate, dimethyl sulfate, dimethylaniline, dinitrobenzol, 1,4 dioxane, epichlorhydrin, ethelyne chlorohydrin, ethylene dibromide, ethyleneimine, formic acid, furfural, furfural alcohol, hexaethyl tetraphosphate, hydrazine, isophorone, mercury, mercury compounds, methyl isocyanate, methyl parathion, nickle carbonyl, nicotine, nitric acid, nitrobenzene, nitrochlorobenzene, nitroglycerin, parathion, perchloric acid, phosphorus oxychloride, phosphorus trichloride, propylene amine, sulfur chloride, sulfuryl chloride, tetrachloroethane, tetrachloroethylene, tetraethyl ditho pyrophosphate, tetraethyl lead, tetranitromethane, thionyl chloride, thiophosgene, 2,4 diisocyanate, o-toluidine and xylidine.

Solids—acrylamide, aldrin, antimony compounds, arsenic compounds, barium compounds, barium cyanide, benzidine, benzoyl peroxide, beryllium compounds, brucine, cadmium compounds, calcium oxide, carbolic acid (phenol), chloroacetic acid, a-chloroacetophenone, copper acetoarenite, cyanide salts, cyanogen bromide, DDT, decarborane, 1,2 dinitrobenzene, 2,4 dinitrotoluene, diphenyl, ferric arsenate, fluoride salts, hexachloronapthalene, p-hydroquinine, iodine, lead compounds, lithium hydride, mercury compounds, methyl parathion, methylene biphenyl isocyanate, nicotine, osmium tetroxide, oxalic acid, parathion, pentachlorophenol, phenol, p-phenylene, diamine, phenylhydrazine, phosphorus (yellow), phosphorus pentachloride, phosphorus pentasulfide, picric acid, quinone, selenium compounds, silver nitrate, sodium, sodium azide, sodium borohydride, sodium fluosilicate, sodium hydroxide, sodium hypochlorite, strychnine, thallium salts and zinc arsenate.

2. **Radioactive Materials**

(i) **Common radiation source materials.** More than 100 radioisotopes are in common usage in various medical and industrial test and measuring situations. Most emit Beta and Gamma radiation. Some emit Alpha radiation also. Some emit Beta or Gamma radiation exclusively. Examples of Alpha, Beta, Gamma emitters: Americium-241, Bismuth-210, Polonium-210, Radium-226, Uranium-238. These are the heavier isotopes as indicated by high numbers.

Examples of Beta emitters: calcium-45, carbon-14, hydrogen-3, nickel-63, sulfur-35, tungsten-185 and zinc-65.

Examples of Gamma emitters: beryllium-7, germanium-71, iron-55, palladium-13, praseodymium-143, promethium-147 and tin-113.

(ii) **Fissile materials.** Fissile materials are materials which may undergo a fission reaction, and are usually found only at reactor sites, or as part of a nuclear weapon. Fissile materials may emit Alpha, Beta, Gamma and neutron radiation. Examples: plutonium-238, plutonium-239, plutonium-241, uranium-233 and uranium-235.

Note: Uranium (and certain other radioactive metals) are combustible in solid and finely divided form, as well as chemically toxic. When radioactive materials burn, the products of combustion (other than heat) will be radioactive as well.

3. **Corrosives**

(i) **Acids.** Examples: chromic, formic, hydrochloric (muriatic greater than 15 percent), hydrofluoric, nitric (greater than 6 percent), perchloric and sulfuric (4 percent or more).

(ii) **Bases (alk**
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(iii) **Other cor**
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Note: Corrosive
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4. **Other Health H**

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Pulmonary dar
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Eye hazards (che
solvents and acid

(iii) Irritants—Substance
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Examples: dipheny
tophene.

(iv) Sensitizer—Substanc
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(ii) **Bases (alkalis).** Examples: hydroxides—ammonium (greater than 10 percent), calcium, potassium (greater than 1 percent), sodium (greater than 1 percent) and certain carbonates—potassium.

(iii) **Other corrosives.** Examples: bromine, chlorine, fluorine, iodine and ammonia.

Note: Corrosives which are oxidizers, e.g., nitric acid, chlorine, fluorine; or are compressed gases, e.g., ammonia, chlorine, fluorine; or are water-reactive, e.g., concentrated sulfuric acid, sodium hydroxide, are physical hazards in addition to being health hazards.

4. **Other Health Hazards**

(i) Carcinogens or suspect carcinogens—Substances which produce or are suspected of producing or inciting cancer (see definitions, Article 9). Examples: asbestos, benzene, beryllium, carbon tetrachloride, chloroform, diazomethane, P-dioxane, ethylene dichloride, polychlorinated biphenyls (PCBs) and vinyl chloride.

(ii) Target organ toxins—Substances which cause damage to particular organs or systems (see definition, Article 9). Examples:

Hepatoxins (chemicals which produce liver damage): carbon tetrachloride and nitrosamines.

Nephrotoxins (chemicals which produce kidney damage): halogenated hydrocarbons and uranium.

Neurotoxins (chemicals which produce their primary toxic effects on the nervous system): mercury and carbon disulfide.

Blood or hematopoistic system toxins (chemicals which decrease hemoglobin function, deprive the body tissues of oxygen): carbon monoxide and cyanides.

Pulmonary damage agents (chemicals which irritate or damage the lungs): silica and asbestos.

Reproductive toxins [chemicals which affect the reproductive capabilities, including chromosomal damage (mutations) and effects on fetuses (tersiogenesis)]: lead and DBCP.

Cutaneous hazards [chemicals which affect the dermal layer (skin)]: ketones and chlorinated compounds.

Eye hazards (chemicals which affect the eye or visual capacity): organic solvents and acids.

(iii) Irritants—Substances other than corrosives which cause a reversible inflammatory effect on living tissue by chemical action at the site of contact. Examples: diphenylaminechloroarsine, xylyl bromide and chloracetophene.

(iv) Sensitizer—Substances which cause an allergic reaction in normal tissue after repeated exposure.

3. EVALUATION OF HAZARDS

(a) **Degree of Hazard.** The degree of hazard present depends upon many variables which should be considered individually and in combination. Some of the variables are:

1. **Chemical properties of the material.** Chemical properties of the material determine self-reactions and reactions which may occur with other materials. Generally, materials within subdivisions of hazard categories will exhibit similar chemical properties. However, materials with similar chemical properties may present very different hazards. Each individual material should be researched to determine its hazardous properties and then considered in relation to other materials that it might contact and the surrounding environment.
2. **Physical properties of the material.** Physical properties, such as whether a material is a solid, liquid or gas at ordinary temperatures and pressures, considered along with chemical properties will determine requirements for containment of the material. Specific gravity (weight of a liquid compared to water) and vapor density (weight of a gas compared to air) are both physical properties which are important in evaluating the hazards of a material.
3. **Amount and concentration of the material.** The amount of material present and its concentration must be considered along with physical and chemical properties to determine the magnitude of the hazard. Hydrogen peroxide for example, is used as an antiseptic and a hair bleach in low concentrations (approximately 8 percent in water solution). Over 8 percent, hydrogen peroxide is classed as an oxidizer and is toxic. Above 90 percent it is a Class 4 oxidizer "that can undergo an explosive reaction when catalyzed or exposed to heat, shock or friction," a definition which incidentally also places hydrogen peroxide over 90 percent concentration in the unstable (reactive) category. Small amounts at high concentrations may present a greater hazard than large amounts at low concentrations.
4. **Actual use, activity or process involving the material.** The definition of handling, storage and use in closed systems refer to materials in packages or containers. Dispensing and use in open containers or systems describe situations where a material is exposed to ambient conditions or vapors are liberated to the atmosphere. Dispensing and use in open systems then, are generally more hazardous situations than handling, storage or use in closed systems. The actual use or process may include heating, electric or other sparks, catalytic or reactive materials and many other factors which could affect the hazard and must therefore be thoroughly analyzed.
5. **Surrounding conditions.** Conditions such as other materials or processes in the area, type of construction of the structure, fire-protection features (e.g., fire walls, sprinkler systems, alarms, etc.), occupancy (use) of adjoining areas, normal temperatures, exposure to weather, etc., must be taken into account in evaluating the hazard.

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temperature, sh
10. What effects of
from?
11. How can protect
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b. Separation by
c. Enclosure in c
d. Spill control, d
e. Control system
extinguishment
and excess flow
f. Administrative
trol, security, pe
and emergency p

Evaluation of the hazard
charged with this responsib
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and standards.

It may be necessary to ca
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particular material or process

4. REFERENCE PUBLICA

(a) **General.** See Appendix
Practices."

CODE ENFORCEMENT

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may occur with other materi-
ıs of hazard categories will
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etc.), occupancy (use) of
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(b) **Evaluation Questions:**

1. What is the material? Correct identification is important; exact spelling is vital. Check labels, MSDS, ask responsible persons, etc.
2. What are the concentration and strength?
3. What is the physical form of the material? Liquids, gases and finely divided solids have differing requirements for spill/leak control, containment.
4. How much material is present? Consider in relation to permit amounts, exempt amounts (from Group H Occupancy requirements), amounts which require detached storage and overall magnitude of the hazard.
5. What other materials (including furniture, equipment and building components) are close enough to interact with the material?
6. What are the likely reactions?
7. What is the activity involving the material?
8. How does the activity impact the hazardous characteristics of the material? Consider vapors released or hazards otherwise exposed.
9. What must the material be protected from? Consider other materials, temperature, shock, pressure, etc.
10. What effects of the material must people and the environment be protected from?
11. How can protection be accomplished? Consider:
    a. Proper containers and equipment
    b. Separation by distance or construction
    c. Enclosure in cabinets or rooms
    d. Spill control, drainage and containment
    e. Control systems—ventilation, special electrical, detection and alarm, extinguishment, explosion venting, limit controls, exhaust scrubbers and excess flow control
    f. Administrative (operational) controls—signage, ignition source control, security, personnel training, established procedures, storage plans and emergency plans.

Evaluation of the hazard is a strongly subjective process; therefore, the person charged with this responsibility must gather as much relevant data as possible so that the decision will be objective and within the limits prescribed in laws, policies and standards.

It may be necessary to cause the responsible persons in charge to have tests made by qualified persons and/or testing laboratories to support contentions that a particular material or process is or is not hazardous. See Section 2.301.

4. REFERENCE PUBLICATIONS

(a) **General.** See Appendix V-A "Nationally Recognized Standards of Good Practices."

(b) **Specific**

(i) AMERICAN INSURANCE ASSOCIATION
Engineering and Safety Service
85 John Street
New York, NY 10038

Special Interest Bulletins

No.	Date	Title
4	1/71	Liquified Petroleum Gas
7	5/78	Fire and Explosion Hazards of Liquified Flammable Gas Tanks
20	5/50	Bottled Gas Systems and the Need of Safeguarding Their Inherent Hazards
49	1/71	Cellulose Nitrate
85	4/55	Hydrogen
133	7/63	Polystyrene—Expandable Beads and Foamed Products
143	11/59	Liquified Petroleum Gas Fire Control
145	7/60	Nitroparaffins
161	10/78	Physical and Chemical Properties of Flammable Liquids and Gases
164	1/53	Sodium Nitrate Storage
166	6/52	Fire Department Operations—Hydrogen Explosions From the Decompositions of Water Under Fire Conditions
178	9/56	Magnesium
199	1/64	Plastics
203	1/57	Organic Peroxides
208	9/56	Sodium
209	9/57	Sodium Hydride Descaling
214	2/74	Calcium Hypochlorite—Swimming Pool Sanitation
247	7/56	Asphalt Protected Metal Roofing and Siding
264	2/52	Fire Hazard of Flammable Fabrics
283	9/50	Film, Motion Picture Cellulose Acetate
289	9/50	Fire Department Operations—Radioactive Materials
293	7/66	Insecticidal Fogging Hazards
295	12/52	Film, Aerial Mapping-Safety and Nitrate Types
303	11/55	Fire Department Operations—Protection of Firemen From Insecticidal Chemicals During a Fire
305	1/59	Fire Department Operations—Atomic Weapons Accidents
306	9/59	Fire Department Operations—Radioactive Material Incidents
311	7/66	Ammonium Nitrate—Fire-Explosion—Health Hazards

(ii) COMPRES
1235 Jeffer
Arlington, '

CGA Pamphlets

G-1	Acety
G-2	Anhy
G-3	Sulph
G-4	Oxyge
G-5	Hydro
P-1	Safe H
P-2	Charac

(iii) FACTORY M
1151 Boston-P
Norwood, MA

Data Sheets

5-1	Electrical
5-8	Static Ele
7-7	Semicond
7-13S/12-61S	Ammonia
7-14	Protection Equipment
7-19N	Fire Hazar (NFPA)
7-19S	Fire Hazard
7-22	Hydrazine a
7-23N	Hazardous C
7-28	Explosive M
7-28N	Explosive M
7-29	Flammable L
7-34	Electrolytic C
7-43	Loss Preventi
7-44	Spacing of Fa
7-45	Chemical Proc
7-45S	Process Contr
7-46/17-11	Chemical Reac
7-47	Physical Opera
7-49/12-65	Emergency Ve
7-50	Compressed Ga
7-51/17-12	Acetylene
7-52/17-13	Oxygen
7-53	Liquified Natur

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Title

ards of Liquified Flammable

ıd the Need of Safeguarding

ɔle Beads and Foamed Prod-

s Fire Control

Properties of Flammable Liq-

ıtions—Hydrogen Explosions
ns of Water Under Fire Condi-

ling
–Swimming Pool Sanitation
l Roofing and Siding
ble Fabrics
ellulose Acetate
tions—Radioactive Materials
ızards
Safety and Nitrate Types
tions—Protection of Firemen
ıicals During a Fire
ions—Atomic Weapons Acci-

ɔns—Radioactive Material

:-Explosion—Health Haz-

(ii) COMPRESSED GAS ASSOCIATION, INC. (CGA)
1235 Jefferson Davis Highway
Arlington, VA 22202

CGA Pamphlets

G-1	Acetylene
G-2	Anhydrous Ammonia
G-3	Sulphur Dioxide
G-4	Oxygen
G-5	Hydrogen
P-1	Safe Handling of Compressed Gases
P-2	Characteristics and Safe Handling of Medical Gases

(iii) FACTORY MUTUAL ENGINEERING AND RESEARCH
1151 Boston-Providence Turnpike
Norwood, MA 02062

Data Sheets

	ELECTRICAL
5-1	Electrical Equipment in Hazardous Locations
5-8	Static Electricity
	HAZARDS
7-7	Semiconductor Plants
7-13S/12-61S	Ammonia Refrigeration Systems
7-14	Protection for Flammable Liquid/Flammable Gas-processing Equipment
7-19N	Fire Hazard Properties of Flammable Liquids, Gases, Solids (NFPA)
7-19S	Fire Hazard Properties of Flammable Liquids, Gases, Solids
7-22	Hydrazine and its Derivatives
7-23N	Hazardous Chemicals Data (NFPA)
7-28	Explosive Materials (NFPA)
7-28N	Explosive Materials (NFPA)
7-29	Flammable Liquids in Drums and Small Containers
7-34	Electrolytic Chlorine Process
7-43	Loss Prevention in Chemical Plants
7-44	Spacing of Facilities in Outdoor Chemical Plants
7-45	Chemical Process Control and Control Rooms
7-45S	Process Control Houses Subject to External Explosion
7-46/17-11	Chemical Reactors and Reactions
7-47	Physical Operations in Chemical Plants
7-49/12-65	Emergency Venting of Vessels
7-50	Compressed Gases in Cylinders
7-51/17-12	Acetylene
7-52/17-13	Oxygen
7-53	Liquified Natural Gas (LNG)

HAZARDS

7-54	Natural Gas and Gas Piping
7-55/12-28	Liquified Petroleum Gas
7-56	MAPP Industrial Gas
7-58	Chlorine Dioxide
7-60/16-1	Fundamentals of Atomic Energy
7-61/16-2	Radioactive Materials
7-70	Fumigation
7-72/12-10	Catalytic Steam/Hydrocarbon Reformers
7-75	Grain Storage and Milling
7-76	Combustible Dusts
7-80	Organic Peroxides
7-81	Organic Peroxides—Hazard Classification
7-82N	Storage of Liquid/Solid Oxidizing Materials (NFPA)
7-83	Drainage for Flammable Liquids
7-84/12-48	Hydrogen Peroxide
7-86	Cellulose Nitrate
7-88	Storage Tanks for Flammable Liquids
7-89	Ammonium Nitrate
7-91	Hydrogen
7-92	Ethylene Oxide
7-94/12-22	Ammonia Synthesis Units

STORAGE

8-OS	Commodity Classification
8-9	Storage of Plastics and Elastomers
8-10	Coal and Charcoal Storage

BOILERS AND PRESSURE VESSELS

12-22/7-94	Ammonia Synthesis Units
12-23	Aqueous Nitrogen in Fertilizer Plants
12-27	Liquid Chlorine Storage Tanks and Systems
12-28/7-55	Liquified Petroleum Gas
12-48/7-84	Hydrogen Peroxide

NUCLEAR

16-6	Reactor Fuel Elements

(iv) NATIONAL FIRE PROTECTION ASSOCIATION
Batterymarch Park
Quincy, MA 02269

Fire Protection Handbook
Industrial Fire Hazards Handbook
National Fire Codes, specifically the following codes and standards:

No. 35	Manufacture of Organic Coatings
No. 40	Cellulose Nitrate Motion Picture Film
No. 43A	Storage of Liquid and Solid Oxidizing Materials
No. 43B	Storage of Organic Peroxide Formulations
No. 43C	Storage of Gaseous Oxidizing Materials

No. 45	Laboratories Using Chemicals
No. 48	Storage, Handling and Processing Magnesium
No. 49	Hazardous Chemicals Data
No. 56A	Use of Inhalation Anesthetics
No. 56C	Laboratories in Health-Related Institutions
No. 58	Storage and Handling of Liquified Petroleum Gases
No. 61B	Prevention of Fires and Explosions in Grain Elevators and Facilities Handling Bulk Raw Agricultural Commodities
No. 61C	Prevention of Fire and Dust Explosions in Feed Mills
No. 321	Basic Classification of Flammable and Combustible Liquids
No. 325M	Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids
No. 481	Production, Processing, Handling and Storage of Titanium
No. 482	Production, Processing, Handling and Storage of Zirconium
No. 490	Storage of Ammonium Nitrate
No. 491M	Manual of Hazardous Chemical Reactions
No. 495	Manufacture, Transportation, Storage and Use of Explosive Materials
No. 651	Manufacture of Aluminum and Magnesium Powder
No. 654	Prevention of Fire and Dust Explosions in the Chemical, Dye, Pharmaceutical and Plastics Industries
No. 655	Prevention of Sulfur Fires and Explosions
No. 704	Recommended System for the Identification of the Fire Hazards of Materials
No. 801	Recommended Fire Protection Practice for Facilities Handling Radioactive Materials

(v) NATIONAL TECHNICAL INFORMATION SERVICE
Springfield, VA 22161

A Method for Determining the Compatibility of Hazardous Wastes, EPA-600/2-80-076

(vi) UNITED STATES GOVERNMENT AGENCIES
U.S. Government Printing Office
Washington, DC 20402
Code of Federal Regulation, Title 29
Code of Federal Regulation, Title 49

APPENDIX VI-B

EMERGENCY RELIEF VENTING FOR FIRE EXPOSURE FOR ABOVEGROUND TANKS

The requirements for emergency venting given in Table No. 79.509-A and the modification factors in Section 79.509 (b) 4 are derived from a consideration of:

1. Probable maximum rate of heat transfer per unit area;
2. Size of tank and the percentage of total area likely to be exposed;
3. Time required to bring tank contents to boil;
4. Time required to heat unwet portions of the tank shell or roof to a temperature where the metal will lose strength;
5. Effect of drainage, insulation and the application of water in reducing fire exposure and heat transfer.

Table No. 79.509-A is based on a composite curve which is considered to be composed of three straight lines when plotted on log-log paper. The curve may be defined in the following manner:

The first straight line is drawn on log-log paper between the point 400,000 Btu/h, at 20 square feet exposed surface area and the point 4,000,000 Btu/h at 200 square feet exposed surface area. The equation for this portion of the curve is $Q = 20{,}000A$.

The second straight line is drawn on log-log graph paper between the points 4,000,000 Btu/h at 200 square feet exposed surface area and 9,950,000 Btu/h at 1,000 square feet exposed surface area. The equation for this portion of the curve is $Q = 199{,}300A^{.566}$.

The third straight line is plotted on log-log graph paper between the points 9,950,000 Btu/h at 1,000 square feet exposed surface area and 14,090,000 Btu/h, at 2,800 square feet exposed surface area. The equation for this portion of the curve is $Q = 963{,}400A^{.338}$.

$Q = 20{,}000A$		$Q = 199{,}300A^{.566}$		$Q = 963{,}400A^{.338}$	
A	Q	A	Q	A	Q
20	400,000	200	4,000,000	1,000	10,000,000
30	600,000	250	4,539,000	1,200	10,593,000
40	800,000	300	5,032,000	1,400	11,122,000
50	1,000,000	350	5,491,000	1,600	11,601,000
60	1,200,000	400	5,922,000	1,800	12,040,000
70	1,400,000	500	6,719,000	2,000	12,449,000
80	1,600,000	600	7,450,000	2,400	13,188,000
90	1,800,000	700	8,129,000	2,800 and over	14,000,000
100	2,000,000	800	8,768,000		
120	2,400,000	900	9,372,000		
140	2,800,000	1,000	10,000,000		
160	3,200,000				
180	3,600,000				
200	4,000,000				

FIRE EXPOSURE
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$Q = 963{,}400A^{.338}$	
A	Q
1,000	10,000,000
1,200	10,593,000
1,400	11,122,000
1,600	11,601,000
1,800	12,040,000
2,000	12,449,000
2,400	13,188,000
2,800	14,000,000
nd over	

For areas exceeding 2,800 square feet it has been concluded that complete fire involvement is unlikely, and loss of metal strength from overheating will cause failure in the vapor space before development of maximum possible vapor evolution rate. Therefore, additional venting capacity beyond the vapor equivalent of 14,090,000 Btu/h will not be effective or required.

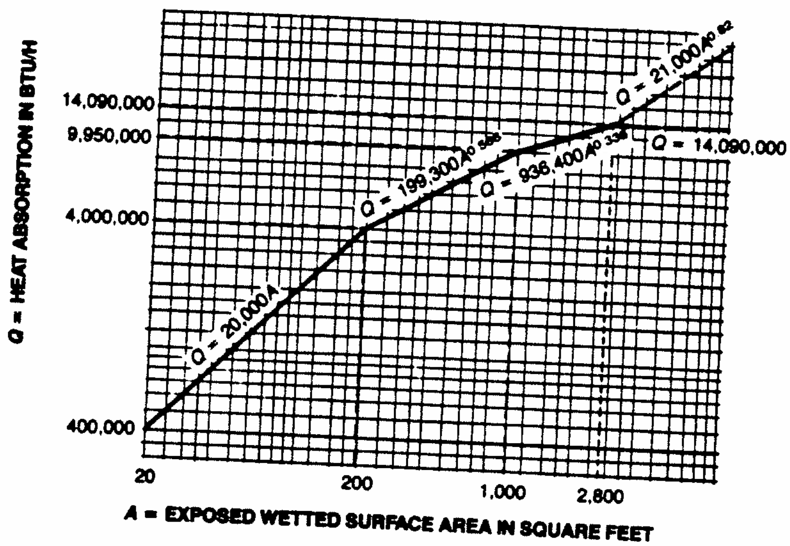
For tanks and storage vessels designed for pressures over 1 psig, additional venting for exposed surfaces beyond 2,800 square feet is believed to be desirable because, under these storage conditions, liquids are stored close to their boiling points. Therefore, the time to bring the container contents to boiling conditions may not be significant. For these situations a heat input value should be determined on the basis of

$$Q = 21{,}000A^{0.82}$$

The flow capacities are based on the assumption that the stored liquid will have the characteristics of hexane, and the vapor liberated has been transposed to equivalent free at at 60°F. and 14.7 psia by using appropriate factors in:

$$CFH = \frac{70.5Q}{L\sqrt{M}}$$

where 70.5 is the factor for converting pounds of gas to cubic feet of air; Q = the total heat input per hour expressed in Btu; L = latent heat of vaporization; and M = molecular weight.



CURVE FOR DETERMINING REQUIREMENTS FOR EMERGENCY VENTING DURING FIRE EXPOSURE

No consideration has been given to possible expansion from the heating of the vapor above the boiling point of the liquid, its specific heat, or the difference in density between the discharge temperature and 60°F., since some of these changes are compensating.

Since tank vent valves are ordinarily rated in *CFH* standard air, the figures derived from Table No. 79.509-A may be used with the appropriate tank pressure as a basis for valve selection.

The table below gives for a variety of chemicals the constants which can be used to compute the vapor generated and equivalent free air for liquids other than hexane, where greater exactness is desired. Inspections of the table will show that the use of hexane in deriving Table No. 79.509-A provides results which are within an acceptable degree of accuracy for the listed liquids.

CHEMICAL	$L\sqrt{M}$	MOLECULAR WEIGHT	HEAT OF VAPORIZATION BTU PER LB. AT BOILING POINT
Acetaldehyde	1673	44.05	252
Acetic acid	1350	60.05	174
Acetic anhydride	1792	102.09	177
Acetone	1708	58.08	224
Acetonitrile	2000	41.05	312
Acrylonitrile	1930	53.05	265
n-Amyl alcohol	2025	88.15	216
Aniline	1795	93.12	186
Benzene	1493	78.11	169
n-Butyl acetate	1432	116.16	133
n-Butyl alcohol	2185	74.12	254
Carbon disulfide	1310	76.13	150
Chlorobenzene	1422	112.56	134
Cyclohexane	1414	84.16	154
Cyclohexanol	1953	100.16	195
Cyclohexanone	1625	98.14	164
o-Dichlorobenzene	1455	147.01	120
cis-Dichloroethylene	1350	96.95	137
Diethyl amine	1403	73.14	164
Dimethyl acetamide	1997	87.12	214
Dimethyl amine	1676	45.08	250
Dimethyl formamide	2120	73.09	248
Dioxane (diethylene ether)	1665	88.10	177
Ethyl acetate	1477	88.10	157
Ethyl alcohol	2500	46.07	368
Ethyl chloride	1340	64.52	167
Ethylene dichloride	1363	98.97	137
Ethyl ether	1310	74.12	152
Furan	1362	68.07	165
Furfural	1962	96.08	200

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ULAR HT	HEAT OF VAPORIZATION BTU PER LB. AT BOILING POINT
.05	252
.05	174
.09	177
.08	224
.05	312
.05	265
.15	216
.12	186
.11	169
.16	133
.12	254
.13	150
.56	134
.16	154
.16	195
.14	164
.01	120
.95	137
.14	164
.12	214
.08	250
.09	248
.10	177
.10	157
.07	368
.52	167
.07	137
	152
	165
	200

(Continued)

CHEMICAL	$L\sqrt{M}$	MOLECULAR WEIGHT	HEAT OF VAPORIZATION BTU PER LB. AT BOILING POINT
Gasoline	1370-1470	96.0	140-150
n-Heptane	1383	100.20	138
n-Hexane	1337	86.17	144
Hydrogen cyanide	2290	27.03	430
Isoamyl alcohol	1990	88.15	212
Isobutyl alcohol	2135	74.12	248
Isopropyl alcohol	2225	60.09	287
Methyl alcohol	2680	32.04	474
Methyl ethyl ketone	1623	72.10	191
Methyl methacrylate	1432	100.14	143
n-Octane	1412	114.22	132
n-Pentane	1300	72.15	153
n-Propyl acetate	1468	102.13	145
n-Propyl alcohol	2295	60.09	296
Tetrahydro furan	1428	72.10	168
Toluene	1500	92.13	156
Vinyl acetate	1532	86.09	165
o-Xylene	1538	106.16	149

Note: For data on other chemicals, see chemistry handbook.

APPROXIMATE WETTED AREAS FOR HORIZONTAL TANKS
(Wetted Area Equals 75 Percent Total Area)

Tank Diameter, Feet	3	4	5	6	7	8	9	10	11	12
Tank Length, Feet	APPROXIMATE WETTED AREA OF TANKS WITH FLAT HEADS									
3	32									
4	39	55								
5	46	65	88							
6	53	74	100	128						
7	60	84	112	142	173					
8	67	93	124	156	190	226				
9	74	102	136	170	206	245	286			
10	81	112	147	184	223	264	308	353		
11	88	121	159	198	239	283	329	377	428	
12	95	131	171	213	256	301	350	400	454	509
13	102	140	183	227	272	320	371	424	480	537
14	109	150	194	241	289	339	393	447	506	565
15	116	159	206	255	305	358	414	471	532	594
16	123	169	218	269	322	377	435	495	558	622
17	130	178	230	283	338	395	456	518	584	650
18	137	188	242	298	355	414	477	542	610	678
19		197	253	312	371	433	499	565	636	707
20		206	265	326	388	452	520	589	662	735
21		216	277	340	404	471	541	612	688	763
22		225	289	354	421	490	562	636	714	792
23		235	300	368	437	508	584	659	740	820

(Continued)

CODE ENFORCEMENT

(Continued)

Tank Diameter, Feet → / Tank Length, Feet ↓	3	4	5	6	7	8	9	10	11	12
	APPROXIMATE WETTED AREA OF TANKS WITH FLAT HEADS									
24		244	312	383	454	527	605	683	765	848
25			324	397	470	546	626	706	791	876
26			336	411	487	565	647	730	817	905
27			347	425	503	584	668	754	843	933
28			359	440	520	603	690	777	869	961
29			371	454	536	621	711	801	895	989
30			383	468	553	640	732	824	921	1018
31			395	482	569	659	753	848	947	1046
32				496	586	678	775	871	973	1074
33				510	602	697	796	895	999	1103
34				524	619	715	817	918	1025	1131
35				539	635	734	838	942	1051	1159
36				553	652	753	860	966	1077	1187
37				567	668	772	881	989	1103	1216
38					685	791	902	1013	1129	1244
39					701	810	923	1036	1155	1272
40					718	828	944	1060	1181	1301
41					734	847	966	1083	1207	1329
42					751	866	987	1107	1233	1357
43					767	885	1008	1130	1259	1385
44						904	1029	1154	1284	1414
45						923	1051	1178	1310	1442
46						941	1072	1201	1336	1470
47						960	1093	1225	1362	1498
48						979	1114	1248	1388	1527
49						998	1135	1272	1414	1555
50							1157	1295	1440	1583
51							1178	1319	1466	1612
52							1199	1342	1492	1640
53							1220	1366	1518	1668
54							1246	1389	1544	1696
55							1263	1413	1570	1725
56								1437	1593	1753
57								1460	1622	1781
58								1484	1648	1809
59								1507	1674	1839
60								1531	1700	1866
61									1726	1894
62									1752	1923
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753	848	947	1046
775	871	973	1074
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APPENDIX VI-C
MODEL CITATION PROGRAM
Part I
SCOPE

Many agencies charged with the responsibility of enforcing the Uniform Fire Code have determined that the issuance of citations is necessary for gaining compliance in some circumstances. Therefore, the following outline and examples have been drawn up to assist jurisdictions in the formulation of a citation program.

(a) **Initiating Correspondence.** (See Part II, Example No. 1.) The first step in establishing a citation program is to write a letter to the appropriate legal officer of the jurisdiction stating the need, legal basis and intent to establish a program of this type. This letter should prompt a reply from the legal officer advising the enforcing agency of the action necessary to implement the program.

(b) **Citation Ordinance.** (See Part II, Example No. 2 when required.) In a few jurisdictions the legal officer has advised the enforcing agency that a municipal ordinance must be passed to allow for the issuance of citations. In such cases, a model ordinance is provided as an example.

(c) **Citation Program.** In the majority of cases, the legal officer has required the enforcing agency to submit the complete program to his or her office for review and approval.

(d) **Components.** The necessary components of a complete citation program include the following:

(i) **Operating procedure and policy.** (See Part III.)

(ii) **Sample forms.** (See Part IV; Pre-citation Letter, Sample No. 1; the Citation, Sample No. 2.)

(iii) **Bail schedule.** (See Sample No. 3.)

Part II
EXAMPLES
Example No. 1
Model Citation Initiation Correspondence

Address correspondence to the appropriate legal officer in the municipality or district (i.e., city attorney or district attorney).

Dear Sir:

The ________ Fire Department is proposing to initiate a citation program. This department has determined that there is a need for this type of action and, in some applications, would appropriately serve the legal process. To date, where we have been unable to gain compliance through routine inspection, notifications, reinspections, granting of time, explanations and extensions, we have had to file

CODE ENFORCEMENT

formal complaints. This process has consistently resulted in extended delays, continuing violations and added work for legal departments. Also, in special situations where immediate action must be taken, citations could be issued to individuals violating the law.

This department is currently required by law to enforce law pertaining to fire and life safety. Section 2.105 of the Uniform Fire Code reads as follows:

Sec. 2.105. Authority of Fire Personnel to Exercise Powers of Police Officers. The chief and members of the fire prevention bureau shall have the powers of a police officer in performing their duties under this code.

This provision of the Uniform Fire Code makes it clear that firemen have the powers of police officers as it pertains to this code.

It would be our intent to continue to follow the normal notice procedure presently being used and to issue citations only in those situations where it is deemed applicable. Citations would not be issued at the time of first contact except in unusual circumstances.

The proposed program would eliminate the clerical and legal work of many cases which currently must go through the complaint process.

Please review the program as submitted and contact ________ for your response to the proposed program.

Example No. 2
Model Citation Ordinance

ORDINANCE NO. ____

AN ORDINANCE OF THE CITY OF ______ ADDING SECTION ________ TO THE ________ MUNICIPAL CODE, PROVIDING FOR CITY COUNCIL DESIGNATION OF EMPLOYEES AND OFFICERS AUTHORIZED TO ISSUE ARREST CITATIONS.

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THE CITY COUNCIL OF THE CITY OF ________ DOES ORDAIN AS FOLLOWS:

SECTION 1. Chapter ______ of the ________ Municipal Code is hereby amended by the addition thereto of a new section, to be numbered ________ and reading as follows:

______ **Issuance of Citations by Designated Officers and Employees.** Officers and employees of the city who have the discretionary duty to enforce a statute or ordinance may, pursuant to Section ______ of (*state law*) and subject to the provisions hereof, arrest a person without a warrant whenever any such officer or employee has reasonable cause to believe that the person to be arrested has committed a misdemeanor in the officer's or employee's presence which he or she has the discretionary duty to enforce, and to issue a notice to appear and to release such person on his or her

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written promise to appear in court, pursuant to Section ______ of the (*state law*). No officer or employee shall be allowed by his or her superior to exercise the arrest and citation authority herein conferred, unless such officer or employee is within a classification of city officers and employees designated by resolution of the city council to exercise such arrest and citation authority as to specified misdemeanor violations. The city manager shall establish and cause to be administered a special enforcement training program designed to instruct each officer or employee who will exercise such arrest and citation authority, regarding the provisions of the statutes and ordinances to be enforced, the evidentiary prerequisites to proper prosecution for violations thereof, the appropriate procedures for making arrests or otherwise prudently exercising such arrest and citation authority, and the legal and practical ramifications and limitations attendant thereto. Any such officers or employees shall be appropriately instructed to deposit executed citations or notices within the (*appropriate agency*) for filing with the court after review for legal sufficiency.

SECTION 2. Effective Date. This ordinance shall be in full force and effect thirty (30) days after passage.

SECTION 3. Publication. The city clerk is hereby ordered and directed to certify to the passage of this ordinance and to cause same to be published once in ______, a daily newspaper of general circulation, printed, published and circulated in the City of ________, ________.

ADOPTED this ______ day of __________ 19____.

Part III
OPERATING PROCEDURE
CITATION PROGRAM

Department Policy

The fire prevention bureau shall be responsible for the enforcement of laws and regulations for the safeguarding, to a reasonable degree, of life and property from the hazards of fire and explosion and from conditions hazardous to life and property in the use or occupancy of buildings or premises and their contents.

It is the intent of the department to achieve compliance by traditional means of inspection, notification, granting of reasonable time to comply and reinspection. The citation shall be used only after all reasonable means to gain compliance have failed or, with proper justification, at the discretion of the fire chief.

By department policy, only those members of the fire department specifically designated by the fire chief may issue citations.

The adoption of the Uniform Fire Code is contained in the ______ Ordinance, Division ______, Article ______, Section ______, and establishes the procedures for handling violations of said code and applicable city ordinances.

Purpose

1. To gain compliance with the state and local codes, ordinances and regulations, when all reasonable efforts have been unsuccessful.
2. A course of action to be taken when a condition exists that causes an immediate and/or extreme threat to life or property from fire and explosion.

Authority

1. ______ Ordinance, Section ______, grants authority to use citations for violations of "any ordinance of the ______."
2. Uniform Fire Code Sections 2.204 (a) and 2.205 state that the "chief or his duly authorized representative shall issue such orders or notices as may be necessary for the enforcement of the fire prevention laws and ordinances."
3. Pursuant to state law (*section*), citations for misdemeanors, any local or state code applicable to fire and life safety may be cited.

Penalty

______ Ordinances: Not more than $500.00 fine; imprisonment not more than 6 months; or both. A misdemeanor. Each day is a separate offense.

Materials Helpful in Writing a Citation

1. Uniform Fire Code.
2. List of court holidays
3. List of common codes and sections violated.

Officer's Demeanor

The manner in which the officer conducts his relationship with the violator is of paramount importance. It has an effect on the violator's attitude throughout the duration of the citing period and a strong bearing on public opinion concerning this department. A courteous and businesslike demeanor must be displayed, and at NO TIME should the officer enter into an argument. Remember, most violators blame the officer, not themselves. An alert, confident manner and a reasonable attitude may affect the violator, creating a more favorable atmosphere for the issuance of the citation.

Salutation or Introduction

It is very important for the officer to adequately introduce himself, establish his identity and the purpose of his presence to the person in charge of the premises.

Reason to Issue Citation

Citations will not normally be issued on the first visit. When routine violations of the applicable fire code are encountered, citations will generally be issued following the third visit or second reinspection.

If code compliance has not been obtained on the second visit or the first reinspection, the inspector should mention the possibility of a citation and the need to issue one. In all cases, adequate time shall be provided between inspections. This will vary with the seriousness of the violation and the complexity of the work to be done.