

RESOLUTION NO. 08-18

A RESOLUTION OF THE MAYOR AND CITY COUNCIL OF THE CITY OF MARICOPA, ARIZONA, DECLARING AS A PUBLIC RECORD THAT CERTAIN DOCUMENT FILED WITH THE CITY CLERK AND ENTITLED "CITY OF MARICOPA FIRE CODE," RELATING TO THE ESTABLISHMENT OF RULES AND REGULATIONS FOR THE SAFEGUARDING OF LIFE AND PROPERTY FROM FIRE AND EXPLOSION HAZARDS WITHIN THE CITY OF MARICOPA.

WHEREAS, the International Code Council has developed comprehensive rules and regulations relating to the establishment of procedures regulating the safeguarding of life and property from fire and explosion hazards; and

WHEREAS, the Maricopa Fire Department has provided some amendments to these rules and regulations to meet the needs of the citizens of the City of Maricopa; and

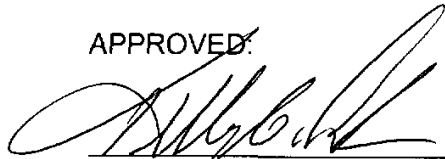
WHEREAS, the City Council believes that declaring such document a public record and adopting its provisions by reference will be in the City's best interests;

NOW THEREFORE, BE IT RESOLVED by the Mayor and City Council of the City of Maricopa, Arizona as follows:

That certain document known as CITY OF MARICOPA FIRE CODE relating to the establishment of procedures regulating the safeguarding of life and property from fire and explosion hazards within the City of Maricopa, is hereby declared to be a public record, and three (3) copies shall remain on file in the office of the City Clerk of the City of Maricopa for examination by the public.

PASSED AND ADOPTED by the City Council of the City of Maricopa, Arizona this 6th day of May, 2008.

APPROVED:



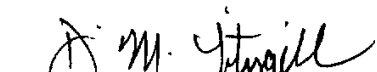
Kelly Anderson
Mayor

ATTEST:



Vanessa Bueras, CMC
City Clerk

APPROVED AS TO FORM:



Denis Fitzgibbons
City Attorney

City of Maricopa

Amendments to International Fire Code, 2006 Edition

Designated as a Public Record In:

City of Maricopa City Clerk's Office

Pursuant to City of Maricopa Resolution # _____

Effective: _____

SUBMITTAL

By:

City of Maricopa Fire Department
P.O. Box 610
Maricopa, Arizona 85239

Amendments to International Fire Code, 2006

1. That a certain document, three (3) copies of which are on file in the city Clerk's office of the City of Maricopa, being marked and designated as the International Fire Code, 2006 edition including Appendix B: Fire flow Requirements for Buildings, Appendix C: Fire Hydrant Locations and Distribution, Appendix D: Fire Apparatus Access Roads, Appendix E: Hazard Categories, Appendix F: Hazard Ranking and Appendix G: Cryogenic Fluids-Weight and Volume Equivalents as published by the International Code Council, be and is hereby adopted as the Fire Code of the City of Maricopa, in the State of Arizona regulating and governing the safeguarding of life and property from fire and explosion hazards arising from the storage, handling and use of hazardous substances, material, and devices and from conditions hazardous to life or property in the occupancy of buildings and premises herein provided; providing for the issuance of permits and collection of fees therefore; and each and all of the regulations, provisions, penalties, conditions and terms of said Fire code on file in the office of the and hereby referred to, adopted, and made a part hereof, as if fully set out in this resolution, with additions, insertions, deletions, and changes, if any, prescribed in # 2 of this resolution.

2. That the following sections are hereby revised:

Section 101.1 is hereby amended to read as follows:

Section 101.1 Title. These regulations shall be known as the *Fire Code of the City of Maricopa*, hereinafter referred to as "this code."

Section 101.2.1 is hereby amended to read as follows:

Section 101.2.1 Appendices. The following appendices are adopted as part of this code by the City of Maricopa: Appendices B,C,D,E,F & G. Other provisions in the appendices shall not apply.

Section 105.1.1 is hereby amended to read as follows:

Section 105.1.1 Permits required; fees. It shall be unlawful for any person, firm, or corporation to use a building or premises or engage in any activities for which a permit is determined to be required by the code official without having first obtained such permit. The fees for fire code permits shall be established by the City of Maricopa fire code fee schedule. Permit fees shall be paid prior to issuance of the permit. Issued permits shall be kept on the premises designated therein at all times and shall be readily available for inspection by the fire code official.

Section 105.1.1.1 is hereby added to read as follows:

Section 105.1.1.1 Work commencing before permit issuance; fees. Any person who commences any work on an item requiring a fire code permit before obtaining the

necessary permits shall be liable for the cost of the permit, along with an additional assessment equal to the normal assessed permit fees.

Section 105.7 is hereby amended to read as follows:

Section 105.7 Required construction permits. *The fire code official is authorized to issue construction permits for work as set forth in Sections 105.7.1 through 105.7.15.*

Section 105.7.14 is added as follows:

Section 105.7.14 Access-controlled egress doors. A construction permit is required to install or modify the connection to the fire alarm system for access-controlled egress doors in accordance with Section 1008.1.3.4.

Section 105.7.15 is hereby added as follows:

Section 105.7.15 Delayed egress locks. A construction permit is required to install to the fire alarm system for delayed egress locks in accordance with Section 1008.1.8.6.

Section 106.2.1 is hereby added as follows:

Section 106.2.1 Inspection requests. It shall be the duty of the holder of the permit or their duly authorized agent to notify the fire code official when work is ready for inspection. It shall be the duty of the permit holder to provide access to and means for inspections of such work that is required by this code.

Section 106.2.2 is hereby added as follows:

Section 106.2.2 Approval required. Work shall not be done beyond the point indicated in each successive inspection without first obtaining the approval of the fire code official. The fire code official, upon notification shall make the requested inspections and shall either indicate the portion of the construction that is satisfactory as completed, or notify the permit holder or the agent wherein the inspection fails to comply with this code. Any portions that do not comply shall be corrected and such portions shall not be covered or concealed until re-inspected and authorized by the fire code official.

Section 106.3 is hereby amended to read as follows:

Section 106.3 Concealed work. It shall be the duty of the permit applicant to cause the work to remain accessible and exposed for inspection purposes. Whenever any installation subject to inspection prior to use is covered or concealed without having first been inspected and approved, the fire code official shall have the authority to require that such work be exposed for inspection. Neither the fire code official nor the jurisdiction shall be liable for expense entailed in the removal or replacement of any material required to allow inspection and all expenses shall be incurred by the permit applicant.

Section 106.4 is hereby added to read as follows:

Section 106.4 On-site construction documents. One set of code official approved construction documents shall be on the job site for each inspection. Failure to have approved construction documents on site shall result in canceling the inspection and is subject to assessment of a fee in accordance with the adopted consolidated fee schedule of the City of Maricopa.

Section 109.3 is hereby amended to read as follows:

Section 109.3 Violation Penalties. Persons who violate a provision of this code or shall fail to comply with any of the requirements thereof or who shall erect, install, alter, repair, or do work in violation of the approved construction documents or directive of the fire code official, or of a permit or certificate used under provisions of this code, shall be guilty of a Class I misdemeanor punishable by a fine of not less than two hundred and fifty dollars (\$250.00) nor more than twenty five hundred dollars (\$2,500.00). Each day that a violation continues after due notice has been served shall be deemed a separate offense.

Section 111.4 is hereby amended to read as follows:

Section 111.4 Failure to Comply. Any person who shall continue any work after having been served with a stop work order, except such work as that person is directed to perform to remove a violation or unsafe condition shall be liable to a fine of not less than two hundred fifty dollars (\$250.00) or more than twenty five hundred dollars (\$2,500.00)

Section 202 is hereby amended to add the following definitions:

Section 202 STANDBY PERSONNEL. Qualified fire service personnel, whether City employees or otherwise as reasonably approved by the Fire Chief. When utilized, the

number required shall be as directed by the Fire Chief. Charges for utilization of city employees as standby personnel shall be as set forth in the City of Maricopa Fee Schedule or as customary.

Section 202 SPECIAL FIRE RISK AREA. Land which is covered with grass, grain, brush, refuse or forest, whether privately or publicly owned, which is so situated or is of such inaccessible location that a fire originating upon it would present an abnormally difficult job of suppression or would result in a great or unusual damage through fire or such areas designated by the code official.

Section 311.2.2 is hereby amended to read as follows: (deleting Exceptions 1 & 2)

Section 311.2.2 Fire Protection. Fire alarm, sprinkler and standpipe systems shall be maintained in an operable condition at all times.

Section 508.3 is hereby amended to read as follows:

Section 508.3 Fire flow. Fire flow requirements for buildings or portions of buildings and facilities shall be determined by an approved method and in accordance with Appendix B. The fire code official shall require an approved independent third party individual or firm to conduct a fire flow test prior to issuance of a certificate of Occupancy.

Section 508.3.1 is hereby added to read as follows:

Section 508.3.1 Fire flow verification. The fire code official may require all new buildings or structures to provide fire flow verification according to the requirements in Appendix B. Verification shall be conducted by an approved separate third party certifying the fire flow data.

Section 508.5.2.1 is hereby added to read as follows:

Section 508.5.2.1 Water distribution system failure notification. Each water service provider serving areas within the city, whether municipal or private, shall notify the Fire Department of any failure in their water distribution system, hydrant repair main breaks, pump failures, or other interruptions of water supply that may affect water supply for fire control purposes as soon as possible. ~~in writing.~~

Section 508.2.2 is hereby added to read as follows:

Section 508.2.2 Out of service hydrants. Any hydrant that is out of service shall have an out of service ring located on the largest diameter discharge and shall remain in place until the hydrant is operational and verified by the Fire Department.

Section 903.2.1.1 is hereby amended to read as follows:

Section 903.2.1.1 Group A-1. An automatic sprinkler system shall be provided for Group A-1 occupancies.

Section 903.2.1.2 Group A-2. An automatic sprinkler system shall be provided for Group A-2 occupancies.

Section 903.2.1.3 is hereby amended to read as follows:

Section 903.2.1.3 Group A-3. An automatic sprinkler system shall be provided for Group A-3 occupancies.

Section 903.2.1.4 is hereby amended to read as follows:

Section 903.2.1.4 Group A-4. An automatic sprinkler system shall be provided for Group A-4 occupancies.

Section 903.2.2 is hereby amended to read as follows:

Section 903.2.2 Group E. An automatic sprinkler system shall be provided for Group E occupancies.

Section 903.2.3 is hereby amended to read as follows:

Section 903.2.3 Group F-1. An automatic sprinkler system shall be provided throughout all buildings containing Group F-1 occupancy.

Section 903.2.6 is hereby amended to read as follows:

Section 903.2.6 Group M. An automatic sprinkler system shall be provided throughout all buildings containing Group M occupancy.

Section 903.2.7 is hereby amended to read as follows:

Section 903.2.7 Group R. An automatic sprinkler system installed in accordance with Section 903.3 shall be provided throughout all buildings with a Group R fire area.

Exception #1. Automatic sprinkler systems shall not be required in R-3 occupancies of 5,000 square feet or less.

Exception #2. Congregate living facilities with 5 or fewer persons.

Section 903.2.8 is hereby amended to read as follows:

Section 903.2.8 Group S-1 & S-2. An automatic sprinkler system shall be provided throughout all buildings containing Group S-1.

Section 903.2.8.1 is hereby deleted:

Section 903.2.8.2 is hereby deleted:

Section 903.2.9 is hereby added:

Section 903.2.9 Group S-2. An automatic sprinkler system shall be provided throughout all buildings containing a Group S-2 occupancy.

Section 903.2.13.1 is hereby added to read as follows:

Section 903.2.13.1 Group B. An automatic sprinkler system shall be provided throughout buildings containing a Group B occupancy.

Exemption #1. Temporary modular sales offices for the intended use of residential sub-division home sales provided adequate fire flow is available according to Section 508 and Appendix B of the 2006 IFC as amended.

Exemption #2. Temporary modular construction offices for the intended use of specific residential sub-division or commercial development sites provided adequate fire flow is available according to Section 508 and Appendix B of the 2006 IFC as amended.

Section 903.2.13.2 is hereby added to read as follows:

Section 903.2.13.1 Group F-2. An automatic sprinkler system shall be provided throughout all buildings containing a Group F-2 occupancy.

Section 903.2.13.3 is hereby added to read as follows:

One and Two Family Dwellings as referenced in the *International Residential Code (Scope R101.2 provisions)*. An automatic sprinkler system shall be provided for all one and two family dwellings greater than 5,000 square feet as set forth under the provisions of the *International Residential Code Scope R101.2*.

Section 903.3.5 is hereby amended to read as follows:

Section 903.3.5 Water supplies. Water supplies for automatic sprinkler systems shall comply with this section and the standards referenced in Section 903.3.1. The potable water supply shall be protected against backflow in accordance with the requirements of this section and the International Plumbing Code. Automatic sprinkler systems water supply data for hydraulic calculations shall be based on a curve that is 90 percent of the available water supply curve as determined by flow test information.

Section 903.3.7 is hereby amended to read as follows:

Section 903.3.7 Fire Department connections. The fire department connection (FDC) shall be a separate approved line that connects to the sprinkler riser above the control valve. The location of fire department connections shall be approved by the fire code official and, unless shown to the fire code official to be adequate based on unique circumstances to the development, be located within 150 feet of a hydrant.

Section 903.7 is hereby added to read as follows:

Section 903.7 Protection and security of sprinkler systems. All fire sprinkler risers shall be secured and protected from the environment and being located inside the building or structure with a direct exterior access.

Section 904.11.6.6 is hereby added to read as follows:

Section 904.11.6.6 Additions, alterations or repairs. Existing automatic fire extinguishing systems shall be upgraded to an approved fire extinguishing system, installed throughout all portions of any commercial cooking system when there are additions, alterations or repairs made when an existing non-compliant system can no longer be serviced and maintained in a certified operational condition.

Section 907.10.3 is hereby added to read as follows:

Section 907.10.3 Interior Tenant Notification. Interior Tenant Notification shall be provided when monitoring of the fire sprinkler system is provided.

Shell Buildings: 1 (one) horn strobe shall be installed and operational within the interior space prior to final. When demising walls are present, 1 (one) horn-strobe shall be installed for each space. Multi-story buildings shall require a minimum of 1 (one) horn-strobe per level.

Tenant Improvements (Shell build-outs): 1 (one) horn-strobe shall be provided for each individual tenant. When a common area is provided serving multiple tenants, a minimum of 1 (one) horn-strobe in the common area shall be provided.

These requirements may be increased based on occupancy type or if reasonably necessary for adequate protection of life safety as determined by the fire code official.

Section 2701.5.1 is hereby amended to read as follows:

Section 2701.5.1 Hazardous Materials Management Plan. Where required by the fire code official, each application for a permit shall include an electronic Hazardous Materials Management Plan (HMMP) in a format acceptable to the fire code official. The HMMP shall include a facility site plan designating the following:

1. Storage and use areas.
2. Maximum amount of each material stored or used in each area.
3. Range of container sizes.
4. Locations of emergency isolation and mitigation valves and devices.
5. Product conveying piping containing liquids or gases, other than utility owned fuel gas lines and low-pressure fuel gas lines.
6. On and off positions of valves for valves that are of the self-indicating type.
7. Storage plan showing the intended storage arrangements, including the location and dimension of aisles.
8. The location and type of emergency equipment. The plans shall be legible and drawn approximately to scale. Separate distribution systems are allowed to be shown on separate pages.

Section 2701.5.2 is hereby amended to read as follows:

Section 2701.5.2 Hazardous Materials Inventory Statement (HMIS). Where required by the fire code official, an application for a permit shall include an electronic HMIS in a format acceptable to the fire code official. The HMIS shall include the following information:

1. Manufacturer's name.
2. Chemical name, trade names, hazardous ingredients.
3. Hazard classification.
4. MSDS
5. United Nations (UN), North America (NA) or the Chemical Abstract Service (CAS) identifications number.
6. Maximum quantity stored or used on-site at one time.
7. Storage conditions related to the storage type, temperature and pressure.

3. In addition to the requirements of the 2006 International Fire Code, an approved automatic sprinkler system shall be installed in all expanded, remodeled, and newly constructed buildings with a total floor area of greater than zero (0) square feet.

Exception 1.

- a) Group R-3 Occupancies
- b) Group U Occupancies

Exception 2.

All additions to existing buildings or structures and all buildings or structures that are expanded by an addition(s) shall be provided with an automatic fire protection system complying with 903.3 with the following exception(s):

1. An existing non-sprinkled building or structure and addition(s) to such existing building, provided the occupancy of the existing building is not changed, the addition is the same occupancy, and the total area of all such additions to the building do not exceed one thousand (1,000) square feet.

"The above exception does not supersede other requirements of this chapter or the City of Maricopa Fire Code."

If a conflict occurs between the requirements of the building code or the fire code and this section, the most stringent requirement shall apply.

Section 3204.3.1.1 is hereby amended to read as follows:

3204.3.1.1 Location. Stationary containers shall be located in accordance with Section 3203.6. Containers of cryogenic fluid shall not be located within diked areas containing other hazardous materials.

Section 3404.2.9.5.1 is hereby amended to read as follows:

3404.2.9.5.1 Location where above ground tanks are prohibited. Storage of Class I and II liquids in above-ground tanks is prohibited within the limits established by City of Maricopa Zoning Code.

Section 3406.2.4.4 is hereby amended to read as follows:

3406.2.4.4 Locations where above ground tanks are prohibited. The Storage of Class I and II liquids in above-ground tanks is prohibited within the limits established by City of Maricopa Zoning Code.

Section 3804.2 is hereby amended to read as follows:

3804.2 Maximum capacity within established limits. Within the limits established by the City of Maricopa Zoning Code restricting the storage of liquefied petroleum gas for the protection of heavily populated or congested areas, the aggregate capacity of any one installation shall not exceed a water capacity of 2000 gallons (7570L)

5. That Resolution No. _____ of the City of Maricopa adopting the 1997 Uniform Fire Code and all other resolutions or parts of resolutions in conflict herewith are hereby repealed.

6. That if any section, subsection, sentence, clause or phrase of this resolution is, for any reason, held to be unconstitutional, such decision shall not affect that validity of the remaining portions of this resolution. The City of Maricopa hereby declares that it would have passed this resolution, and each section, subsection, clause or phrase thereof, irrespective of the facts that any one or more sections, subsections, sentences, clauses and phrases be declared unconstitutional.

7. That nothing in this resolution or in the Fire Code hereby adopted shall be construed to affect any suit or proceeding impending in any court, or any rights acquired, or liability incurred, or any causes of action acquired or existing, under any act or resolution hereby repealed as cited in # 4 of this resolution: nor shall any just or legal right or remedy of any character be lost, impaired, or affected by this resolution.

8. That the Fire Chief or senior fire official hereby ordered and directed to cause this resolution to be published in a newspaper or general circulation.

9. That this resolution and the rules, regulations, provisions, requirements, orders and matters established and adopted hereby shall take effect and be in full force and effect _____

Appendices

NO CHANGES MADE TO APPENDICES

Appendices

APPENDIX B

FIRE-FLOW REQUIREMENTS FOR BUILDINGS

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

SECTION B101 GENERAL

B101.1 Scope. The procedure for determining fire-flow requirements for buildings or portions of buildings hereafter constructed shall be in accordance with this appendix. This appendix does not apply to structures other than buildings.

SECTION B102 DEFINITIONS

B102.1 Definitions. For the purpose of this appendix, certain terms are defined as follows:

FIRE-FLOW. The flow rate of a water supply, measured at 20 pounds per square inch (psi) (138 kPa) residual pressure, that is available for fire fighting.

FIRE-FLOW CALCULATION AREA. The floor area, in square feet (m²), used to determine the required fire flow.

SECTION B103 MODIFICATIONS

B103.1 Decreases. The fire chief is authorized to reduce the fire-flow requirements for isolated buildings or a group of buildings in rural areas or small communities where the development of full fire-flow requirements is impractical.

B103.2 Increases. The fire chief is authorized to increase the fire-flow requirements where conditions indicate an unusual susceptibility to group fires or conflagrations. An increase shall not be more than twice that required for the building under consideration.

B103.3 Areas without water supply systems. For information regarding water supplies for fire-fighting purposes in rural and suburban areas in which adequate and reliable water supply systems do not exist, the fire code official is authorized to utilize NFPA 1142 or the *International Wildland-Urban Interface Code*.

SECTION B104 FIRE-FLOW CALCULATION AREA

B104.1 General. The fire-flow calculation area shall be the total floor area of all floor levels within the exterior walls, and under the horizontal projections of the roof of a building, except as modified in Section B104.3.

B104.2 Area separation. Portions of buildings which are separated by fire walls without openings, constructed in accordance with the *International Building Code*, are allowed to be considered as separate fire-flow calculation areas.

B104.3 Type IA and Type IB construction. The fire-flow calculation area of buildings constructed of Type IA and Type IB construction shall be the area of the three largest successive floors.

Exception: Fire-flow calculation area for open parking garages shall be determined by the area of the largest floor.

SECTION B105 FIRE-FLOW REQUIREMENTS FOR BUILDINGS

B105.1 One- and two-family dwellings. The minimum fire-flow requirements for one- and two-family dwellings having a fire-flow calculation area which does not exceed 3,600 square feet (344.5 m²) shall be 1,000 gallons per minute (3785.4 L/min). Fire-flow and flow duration for dwellings having a fire-flow calculation area in excess of 3,600 square feet (344.5 m²) shall not be less than that specified in Table B105.1.

Exception: A reduction in required fire flow of 50 percent, as approved, is allowed when the building is provided with an approved automatic sprinkler system.

B105.2 Buildings other than one- and two-family dwellings. The minimum fire-flow and flow duration for buildings other than one- and two-family dwellings shall be as specified in Table B105.1.

Exception: A reduction in required fire-flow of up to 75 percent, as approved, is allowed when the building is provided with an approved automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2. The resulting fire-flow shall not be less than 1,500 gallons per minute (5678 L/min) for the prescribed duration as specified in Table B105.1.

SECTION B106 REFERENCED STANDARDS

ICC	IBC	International Building Code	B104.2, Table B105.1
ICC	IWUIC	International Wildland-Urban Interface Code	B103.3
NFPA	1142	Standard on Water Supplies for Suburban and Rural Fire Fighting	B103.3

APPENDIX B

TABLE B105.1
MINIMUM REQUIRED FIRE-FLOW AND FLOW DURATION FOR BUILDINGS^a

FIRE-FLOW CALCULATION AREA (square feet)					FIRE-FLOW (gallons per minute) ^b	FLOW DURATION (hours)
Type IA and IB ^b	Type IIA and IIIA ^b	Type IV and V-A ^b	Type IIB and IIIB ^b	Type V-B ^b		
0-22,700	0-12,700	0-8,200	0-5,900	0-3,600	1,500	2
22,701-30,200	12,701-17,000	8,201-10,900	5,901-7,900	3,601-4,800	1,750	
30,201-38,700	17,001-21,800	10,901-12,900	7,901-9,800	4,801-6,200	2,000	
38,701-48,300	21,801-24,200	12,901-17,400	9,801-12,600	6,201-7,700	2,250	
48,301-59,000	24,201-33,200	17,401-21,300	12,601-15,400	7,701-9,400	2,500	
59,001-70,900	33,201-39,700	21,301-25,500	15,401-18,400	9,401-11,300	2,750	
70,901-83,700	39,701-47,100	25,501-30,100	18,401-21,800	11,301-13,400	3,000	3
83,701-97,700	47,101-54,900	30,101-35,200	21,801-25,900	13,401-15,600	3,250	
97,701-112,700	54,901-63,400	35,201-40,600	25,901-29,300	15,601-18,000	3,500	
112,701-128,700	63,401-72,400	40,601-46,400	29,301-33,500	18,001-20,600	3,750	
128,701-145,900	72,401-82,100	46,401-52,500	33,501-37,900	20,601-23,300	4,000	4
145,901-164,200	82,101-92,400	52,501-59,100	37,901-42,700	23,301-26,300	4,250	
164,201-183,400	92,401-103,100	59,101-66,000	42,701-47,700	26,301-29,300	4,500	
183,401-203,700	103,101-114,600	66,001-73,300	47,701-53,000	29,301-32,600	4,750	
203,701-225,200	114,601-126,700	73,301-81,100	53,001-58,600	32,601-36,000	5,000	
225,201-247,700	126,701-139,400	81,101-89,200	58,601-65,400	36,001-39,600	5,250	
247,701-271,200	139,401-152,600	89,201-97,700	65,401-70,600	39,601-43,400	5,500	
271,201-295,900	152,601-166,500	97,701-106,500	70,601-77,000	43,401-47,400	5,750	
295,901-Greater	166,501-Greater	106,501-115,800	77,001-83,700	47,401-51,500	6,000	
—	—	115,801-125,500	83,701-90,600	51,501-55,700	6,250	
—	—	125,501-135,500	90,601-97,900	55,701-60,200	6,500	
—	—	135,501-145,800	97,901-106,800	60,201-64,800	6,750	
—	—	145,801-156,700	106,801-113,200	64,801-69,600	7,000	
—	—	156,701-167,900	113,201-121,300	69,601-74,600	7,250	
—	—	167,901-179,400	121,301-129,600	74,601-79,800	7,500	
—	—	179,401-191,400	129,601-138,300	79,801-85,100	7,750	
—	—	191,401-Greater	138,301-Greater	85,101-Greater	8,000	

For SI: 1 square foot = 0.0929 m², 1 gallon per minute = 3.785 L/m, 1 pound per square inch = 6.895 kPa.

a. The minimum required fire flow shall be allowed to be reduced by 25 percent for Group R.

b. Types of construction are based on the *International Building Code*.

c. Measured at 20 psi.

APPENDIX C

FIRE HYDRANT LOCATIONS AND DISTRIBUTION

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

SECTION C101 GENERAL

C101.1 Scope. Fire hydrants shall be provided in accordance with this appendix for the protection of buildings, or portions of buildings, hereafter constructed.

SECTION C102 LOCATION

C102.1 Fire hydrant locations. Fire hydrants shall be provided along required fire apparatus access roads and adjacent public streets.

SECTION C103 NUMBER OF FIRE HYDRANTS

C103.1 Fire hydrants available. The minimum number of fire hydrants available to a building shall not be less than that listed in Table C105.1. The number of fire hydrants available to a complex or subdivision shall not be less than that determined by spacing requirements listed in Table C105.1 when applied to fire apparatus access roads and perimeter public streets from which fire operations could be conducted.

SECTION C104 CONSIDERATION OF EXISTING FIRE HYDRANTS

C104.1 Existing fire hydrants. Existing fire hydrants on public streets are allowed to be considered as available. Existing fire hydrants on adjacent properties shall not be considered available unless fire apparatus access roads extend between properties and easements are established to prevent obstruction of such roads.

SECTION C105 DISTRIBUTION OF FIRE HYDRANTS

C105.1 Hydrant spacing. The average spacing between fire hydrants shall not exceed that listed in Table C105.1.

Exception: The fire chief is authorized to accept a deficiency of up to 10 percent where existing fire hydrants provide all or a portion of the required fire hydrant service.

Regardless of the average spacing, fire hydrants shall be located such that all points on streets and access roads adjacent to a building are within the distances listed in Table C105.1.

**TABLE C105.1
NUMBER AND DISTRIBUTION OF FIRE HYDRANTS**

FIRE-FLOW REQUIREMENT (gpm)	MINIMUM NUMBER OF HYDRANTS	AVERAGE SPACING BETWEEN HYDRANTS ^{a, b, c} (feet)	MAXIMUM DISTANCE FROM ANY POINT ON STREET OR ROAD FRONTAGE TO A HYDRANT ^d
1,750 or less	1	500	250
2,000-2,250	2	450	225
2,500	3	450	225
3,000	3	400	225
3,500-4,000	4	350	210
4,500-5,000	5	300	180
5,500	6	300	180
6,000	6	250	150
6,500-7,000	7	250	150
7,500 or more	8 or more ^e	200	120

For SI: 1 foot = 304.8 mm, 1 gallon per minute = 3.785 L/min.

- a. Reduce by 100 feet for dead-end streets or roads.
- b. Where streets are provided with median dividers which can be crossed by fire fighters pulling hose lines, or where arterial streets are provided with four or more traffic lanes and have a traffic count of more than 30,000 vehicles per day, hydrant spacing shall average 500 feet on each side of the street and be arranged on an alternating basis up to a fire-flow requirement of 7,000 gallons per minute and 400 feet for higher fire-flow requirements.
- c. Where new water mains are extended along streets where hydrants are not needed for protection of structures or similar fire problems, fire hydrants shall be provided at spacing not to exceed 1,000 feet to provide for transportation hazards.
- d. Reduce by 50 feet for dead-end streets or roads.
- e. One hydrant for each 1,000 gallons per minute or fraction thereof.



APPENDIX D FIRE APPARATUS ACCESS ROADS

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

SECTION D101 GENERAL

D101.1 Scope. Fire apparatus access roads shall be in accordance with this appendix and all other applicable requirements of the *International Fire Code*.

SECTION D102 REQUIRED ACCESS

D102.1 Access and loading. Facilities, buildings or portions of buildings hereafter constructed shall be accessible to fire department apparatus by way of an approved fire apparatus access road with an asphalt, concrete or other approved driving surface capable of supporting the imposed load of fire apparatus weighing at least 75,000 pounds (34,050 kg).

SECTION D103 MINIMUM SPECIFICATIONS

D103.1 Access road width with a hydrant. Where a fire hydrant is located on a fire apparatus access road, the minimum road width shall be 26 feet (7925 mm). See Figure D103.1.

D103.2 Grade. Fire apparatus access roads shall not exceed 10 percent in grade.

Exception: Grades steeper than 10 percent as approved by the fire chief.

D103.3 Turning radius. The minimum turning radius shall be determined by the fire code official.

D103.4 Dead ends. Dead-end fire apparatus access roads in excess of 150 feet (45 720 mm) shall be provided with width and turnaround provisions in accordance with Table D103.4.

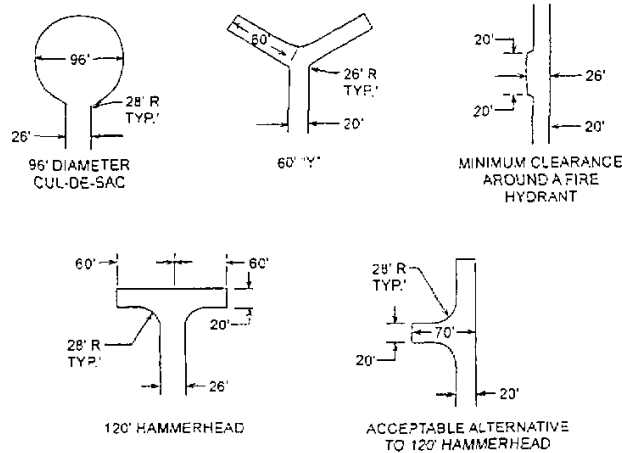
**TABLE D103.4
REQUIREMENTS FOR DEAD-END FIRE
APPARATUS ACCESS ROADS**

LENGTH (feet)	WIDTH (feet)	TURNAROUNDS REQUIRED
0-150	20	None required
151-500	20	120-foot Hammerhead, 60-foot "Y" or 96-foot-diameter cul-de-sac in accordance with Figure D103.1
501-750	26	120-foot Hammerhead, 60-foot "Y" or 96-foot-diameter cul-de-sac in accordance with Figure D103.1
Over 750	Special approval required	

For SI: 1 foot = 304.8 mm.

D103.5 Fire apparatus access road gates. Gates securing the fire apparatus access roads shall comply with all of the following criteria:

1. The minimum gate width shall be 20 feet (6096 mm).



For SI: 1 foot = 304.8 mm.

**FIGURE D103.1
DEAD-END FIRE APPARATUS ACCESS ROAD TURNAROUND**

APPENDIX D

2. Gates shall be of the swinging or sliding type.
3. Construction of gates shall be of materials that allow manual operation by one person.
4. Gate components shall be maintained in an operative condition at all times and replaced or repaired when defective.
5. Electric gates shall be equipped with a means of opening the gate by fire department personnel for emergency access. Emergency opening devices shall be approved by the fire code official.
6. *Manual opening* gates shall not be locked with a padlock or chain and padlock unless they are capable of being opened by means of forcible entry tools or when a key box containing the key(s) to the lock is installed at the gate location.
7. Locking device specifications shall be submitted for approval by the fire code official.

D103.6 Signs. Where required by the fire code official, fire apparatus access roads shall be marked with permanent NO PARKING—FIRE LANE signs complying with Figure D103.6. Signs shall have a minimum dimension of 12 inches (305 mm) wide by 18 inches (457 mm) high and have red letters on a white reflective background. Signs shall be posted on one or both sides of the fire apparatus road as required by Section D103.6.1 or D103.6.2.

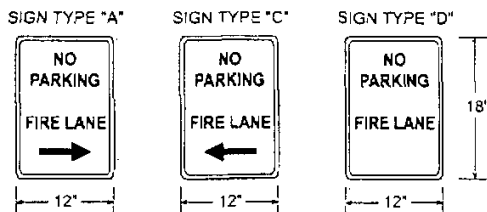


FIGURE D103.6
FIRE LANE SIGNS

D103.6.1 Roads 20 to 26 feet in width. Fire apparatus access roads 20 to 26 feet wide (6096 to 7925 mm) shall be posted on both sides as a fire lane.

D103.6.2 Roads more than 26 feet in width. Fire apparatus access roads more than 26 feet wide (7925 mm) to 32 feet wide (9754 mm) shall be posted on one side of the road as a fire lane.

SECTION D104

COMMERCIAL AND INDUSTRIAL DEVELOPMENTS

D104.1 Buildings exceeding three stories or 30 feet in height. Buildings or facilities exceeding 30 feet (9144 mm) or three stories in height shall have at least three means of fire apparatus access for each structure.

D104.2 Buildings exceeding 62,000 square feet in area. Buildings or facilities having a gross building area of more than 62,000 square feet (5760 m²) shall be provided with two separate and approved fire apparatus access roads.

Exception: Projects having a gross building area of up to 124,000 square feet (11,520 m²) that have a single approved fire apparatus access road when all buildings are equipped throughout with approved automatic sprinkler systems.

D104.3 Remoteness. Where two access roads are required, they shall be placed a distance apart equal to not less than one half of the length of the maximum overall diagonal dimension of the property or area to be served, measured in a straight line between accesses.

SECTION D105

AERIAL FIRE APPARATUS ACCESS ROADS

D105.1 Where required. Buildings or portions of buildings or facilities exceeding 30 feet (9144 mm) in height above the lowest level of fire department vehicle access shall be provided with approved fire apparatus access roads capable of accommodating fire department aerial apparatus. Overhead utility and power lines shall not be located within the aerial fire apparatus access roadway.

D105.2 Width. Fire apparatus access roads shall have a minimum unobstructed width of 26 feet (7925 mm) in the immediate vicinity of any building or portion of building more than 30 feet (9144 mm) in height.

D105.3 Proximity to building. At least one of the required access routes meeting this condition shall be located within a minimum of 15 feet (4572 mm) and a maximum of 30 feet (9144 mm) from the building, and shall be positioned parallel to one entire side of the building.

SECTION D106

MULTIPLE-FAMILY RESIDENTIAL DEVELOPMENTS

D106.1 Projects having more than 100 dwelling units. Multiple-family residential projects having more than 100 dwelling units shall be equipped throughout with two separate and approved fire apparatus access roads.

Exception: Projects having up to 200 dwelling units may have a single approved fire apparatus access road when all buildings, including nonresidential occupancies, are equipped throughout with approved automatic sprinkler systems installed in accordance with Section 903.3.1.1 or 903.3.1.2.

D106.2 Projects having more than 200 dwelling units. Multiple-family residential projects having more than 200 dwelling units shall be provided with two separate and approved fire apparatus access roads regardless of whether they are equipped with an approved automatic sprinkler system.

**SECTION D107
ONE- OR TWO-FAMILY RESIDENTIAL
DEVELOPMENTS**

D107.1 One- or two-family dwelling residential developments. Developments of one- or two-family dwellings where the number of dwelling units exceeds 30 shall be provided with separate and approved fire apparatus access roads and shall meet the requirements of Section D104.3.

Exceptions:

1. Where there are more than 30 dwelling units on a single public or private fire apparatus access road and all dwelling units are equipped throughout with an approved automatic sprinkler system in accordance with Section 903.3.1.1, 903.3.1.2 or 903.3.1.3.3, access from two directions shall not be required.
2. The number of dwelling units on a single fire apparatus access road shall not be increased unless fire apparatus access roads will connect with future development, as determined by the fire code official.



APPENDIX E

HAZARD CATEGORIES

This appendix is for information purposes and is not intended for adoption.

SECTION E101 GENERAL

E101.1 Scope. This appendix provides information, explanations and examples to illustrate and clarify the hazard categories contained in Chapter 27 of the *International Fire Code*. The hazard categories are based upon the DOL 29 CFR. Where numerical classifications are included, they are in accordance with nationally recognized standards.

This appendix should not be used as the sole means of hazardous materials classification.

SECTION E102 HAZARD CATEGORIES

E102.1 Physical hazards. Materials classified in this section pose a physical hazard.

E102.1.1 Explosives and blasting agents. The current UN/DOT classification system recognized by international authorities, the Department of Defense and others classifies all explosives as Class 1 materials. They are then divided into six separate divisions to indicate their relative hazard. There is not a direct correlation between the designations used by the old DOT system and those used by the current system nor is there correlation with the system (high and low) established by the Bureau of Alcohol, Tobacco and Firearms (BATF). Table 3304.3 provides some guidance with regard to the current categories and their relationship to the old categories. Some items may appear in more than one division, depending on factors such as the degree of confinement or separation, by type of packaging, storage configuration or state of assembly.

In order to determine the level of hazard presented by explosive materials, testing to establish quantitatively their explosive nature is required. There are numerous test methods that have been used to establish the character of an explosive material. Standardized tests, required for finished goods containing explosives or explosive materials in a packaged form suitable for shipment or storage, have been established by UN/DOT and BATF. However, these tests do not consider key elements that should be examined in a manufacturing situation. In manufacturing operations, the condition and/or the state of a material may vary within the process. The in-process material classification and classification requirements for materials used in the manufacturing process may be different from the classification of the same material when found in finished goods depending on the stage of the process in which the material is found. A classification methodology must be used that recognizes the hazards commensurate with the application to the variable physical conditions as well as potential variations of physical character and type of explosive under consideration.

Test methods or guidelines for hazard classification of energetic materials used for in-process operations shall be approved by the fire code official. Test methods used shall be DOD, BATF, UN/DOT or other approved criteria. The results of such testing shall become a portion of the files of the jurisdiction and be included as an independent section of any Hazardous Materials Management Plan (HMMP) required by Section 3305.2.1. Also see Section 104.7.2.

Examples of materials in various Divisions are as follows:

1. Division 1.1 (High Explosives). Consists of explosives that have a mass explosion hazard. A mass explosion is one which affects almost the entire pile of material instantaneously. Includes substances that, when tested in accordance with approved methods, can be caused to detonate by means of a blasting cap when unconfined or will transition from deflagration to a detonation when confined or unconfined. Examples: dynamite, TNT, nitroglycerine, C-3, HMX, RDX, encased explosives, military ammunition.
2. Division 1.2 (Low Explosives). Consists of explosives that have a projection hazard, but not a mass explosion hazard. Examples: nondetonating encased explosives, military ammunition and the like.
3. Division 1.3 (Low Explosives). Consists of explosives that have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard. The major hazard is radiant heat or violent burning, or both. Can be deflagrated when confined. Examples: smokeless powder, propellant explosives, display fireworks.
4. Division 1.4. Consists of explosives that pose a minor explosion hazard. The explosive effects are largely confined to the package and no projection of fragments of appreciable size or range is expected. An internal fire must not cause virtually instantaneous explosion of almost the entire contents of the package. Examples: squibs (nondetonating igniters), explosive actuators, explosive trains (low level detonating cord).
5. Division 1.5 (Blasting Agents). Consists of very insensitive explosives. This division is comprised of substances which have a mass explosion hazard, but are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal conditions of transport. Materials are not cup sensitive; however, they are mass detonating when provided with sufficient input. Examples: oxidizer and liquid fuel slurry mixtures and gels, ammonium nitrate combined with fuel oil.

6. Division 1.6. Consists of extremely insensitive articles which do not have a mass explosive hazard. This division is comprised of articles which contain only extremely insensitive detonating substances and which demonstrate a negligible probability of accidental initiation or propagation. Although this category of materials has been defined, the primary application is currently limited to military uses. Examples: Low vulnerability military weapons.

Explosives in each division are assigned a compatibility group letter by the Associate Administrator for Hazardous Materials Safety (DOT) based on criteria specified by DOT's 49CFR. Compatibility group letters are used to specify the controls for the transportation and storage related to various materials to prevent an increase in hazard that might result if certain types of explosives were stored or transported together. Altogether, there are 35 possible classification codes for explosives, e.g., 1.1A, 1.3C, 1.4S, etc.

E102.1.2 Compressed gases. Examples include:

1. Flammable: 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.
2. Oxidizing: 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.
3. Corrosive: ammonia, hydrogen chloride, fluorine.
4. Highly toxic: arsine, cyanogen, fluorine, germane, hydrogen cyanide, nitric oxide, phosphine, hydrogen selenide, stibine.
5. Toxic: chlorine, hydrogen fluoride, hydrogen sulfide, phosgene, silicon tetrafluoride.
6. Inert (chemically unreactive): argon, helium, krypton, neon, nitrogen, xenon.
7. Pyrophoric: diborane, dichloroborane, phosphine, silane.
8. Unstable (reactive): butadiene (unstabilized), ethylene oxide, vinyl chloride.

E102.1.3 Flammable and combustible liquids. Examples include:

1. Flammable liquids.

Class 1A liquids shall include those having flash points below 73°F (23°C) and having a boiling point at or below 100°F (38°C).

Class 1B liquids shall include those having flash points below 73°F (23°C) and having a boiling point at or above 100°F (38°C).

Class 1C liquids shall include those having flash points at or above 73°F (23°C) and below 100°F (38°C).

2. Combustible liquids.

Class II liquids shall include those having flash points at or above 100°F (38°C) and below 140°F (60°C).

Class IIIA liquids shall include those having flash points at or above 140°F (60°C) and below 200°F (93°C).

Class IIIB liquids shall include those liquids having flash points at or above 200°F (93°C).

E102.1.4 Flammable solids. Examples include:

1. Organic solids: camphor, cellulose nitrate, naphthalene.
2. Inorganic solids: decaborane, lithium amide, phosphorous heptasulfide, phosphorous sesquisulfide, potassium sulfide, anhydrous sodium sulfide, sulfur.
3. Combustible metals (except dusts and powders): cesium, magnesium, zirconium.

E102.1.5 Combustible dusts and powders. Finely divided solids which may be dispersed in air as a dust cloud: wood sawdust, plastics, coal, flour, powdered metals (few exceptions).

E102.1.6 Combustible fibers. See Section 2902.1.

E102.1.7 Oxidizers. Examples include:

1. Gases: oxygen, ozone, oxides of nitrogen, fluorine and chlorine (reaction with flammables is similar to that of oxygen).
2. Liquids: bromine, hydrogen peroxide, nitric acid, perchloric acid, sulfuric acid.
3. Solids: chlorates, chromates, chromic acid, iodine, nitrates, nitrites, perchlorates, peroxides.

E102.1.7.1 Examples of liquid and solid oxidizers according to hazard.

Class 4: ammonium perchlorate (particle size greater than 15 microns), ammonium permanganate, guanidine nitrate, hydrogen peroxide solutions more than 91 percent by weight, perchloric acid solutions more than 72.5 percent by weight, potassium superoxide, tetranitromethane.

Class 3: ammonium dichromate, calcium hypochlorite (over 50 percent by weight), chloric acid (10 percent maximum concentration), hydrogen peroxide solutions (greater than 52 percent up to 91 percent), mono-(trichloro)-tetra-(monopotassium dichloro)-penta-s-triazinetriene, nitric acid, (fuming—more than 86 percent concentration), perchloric acid solutions (60 percent to 72 percent by weight), potassium bromate, potassium chlorate, potassium dichloro-s-triazinetriene (potassium dichloro-isocyanurate), sodium bromate, sodium chlorate, sodium chlorite (over 40 percent by weight) and

sodium dichloro-s-triazinetriene (sodium dichloroisocyanurate).

Class 2: barium bromate, barium chlorate, barium hypochlorite, barium perchlorate, barium permanganate, 1-bromo-3-chloro-5,5-dimethylhydantoin, calcium chlorate, calcium chlorite, calcium hypochlorite (50 percent or less by weight), calcium perchlorate, calcium permanganate, chromium trioxide (chromic acid), copper chlorate, halane (1,3-dichloro-5,5-dimethylhydantoin), hydrogen peroxide (greater than 27.5 percent up to 52 percent), lead perchlorate, lithium chlorate, lithium hypochlorite (more than 39 percent available chlorine), lithium perchlorate, magnesium bromate, magnesium chlorate, magnesium perchlorate, mercurous chlorate, nitric acid (more than 40 percent but less than 86 percent), perchloric acid solutions (more than 50 percent but less than 60 percent), potassium perchlorate, potassium permanganate, potassium peroxide, potassium superoxide, silver peroxide, sodium chlorite (40 percent or less by weight), sodium perchlorate, sodium perchlorate monohydrate, sodium permanganate, sodium peroxide, strontium chlorate, strontium perchlorate, thallium chlorate, trichloro-s-triazinetriene (trichloroisocyanuric acid), urea hydrogen peroxide, zinc bromate, zinc chlorate and zinc permanganate.

Class 1: all inorganic nitrates (unless otherwise classified), all inorganic nitrites (unless otherwise classified), ammonium persulfate, barium peroxide, calcium peroxide, hydrogen peroxide solutions (greater than 8 percent up to 27.5 percent), lead dioxide, lithium hypochlorite (39 percent or less available chlorine), lithium peroxide, magnesium peroxide, manganese dioxide, nitric acid (40 percent concentration or less), perchloric acid solutions (less than 50 percent by weight), potassium dichromate, potassium percarbonate, potassium persulfate, sodium carbonate peroxide, sodium dichloro-s-triazinetriene dihydrate, sodium dichromate, sodium perborate (anhydrous), sodium perborate monohydrate, sodium perborate tetrahydrate, sodium percarbonate, sodium persulfate, strontium peroxide and zinc peroxide.

E102.1.8 Organic peroxides. Organic peroxides contain the double oxygen or peroxy (-o-o) group. Some are flammable compounds and subject to explosive decomposition. They are available as:

1. Liquids.
2. Pastes.
3. Solids (usually finely divided powers).

E102.1.8.1 Classification of organic peroxides according to hazard.

Unclassified: Unclassified organic peroxides are capable of detonation and are regulated in accordance with Chapter 33.

Class I: 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: acetyl peroxide 25 percent, t-butyl hydroperoxide 70 percent (with DTBP and t-BuOH diluents), t-butyl peroxybenzoate 98 percent, t-butyl peroxy-2-ethylhexanoate 97 percent, t-butyl peroxyisobutyrate 75 percent, t-butyl peroxyisopropyl-carbonate 75 percent, t-butyl peroxypropylate 75 percent, dibenzoyl peroxydicarbonate 85 percent, di-sec-butyl peroxydicarbonate 98 percent, di-sec-butyl peroxydicarbonate 75 percent, 1,1-di-(t-butylperoxy)-3,5,5-trimethylcyclohexane 95 percent, di-(2-ethylhexyl) peroxydicarbonate 97 percent, 2,5-dimethyl-2,5-di-(benzoylperoxy) hexane 92 percent, and peroxyacetic acid 43 percent.

Class III: acetyl cyclohexane sulfonal peroxide 29 percent, benzoyl peroxide 78 percent, benzoyl peroxide paste 55 percent, benzoyl peroxide paste 50 percent peroxide/50 percent butylbenzylphthalate diluent, cumene hydroperoxide 86 percent, di-(4-butylcyclohexyl) peroxydicarbonate 98 percent, t-butyl peroxy-2-ethylhexanoate 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 diluted in dimethyl phthalate.

Class IV: benzoyl peroxide 70 percent, benzoyl peroxide paste 50 percent peroxide/15 percent water/35 percent butylphthalate diluent, benzoyl peroxide slurry 40 percent, benzoyl peroxide powder 35 percent, t-butyl hydroperoxide 70 percent, (with water diluent), 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 diluted in water and glycols.

Class V: 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.

E102.1.9 Pyrophoric materials. Examples include:

1. Gases: diborane, phosphine, silane.
2. Liquids: diethylaluminum chloride, diethylberyllium, diethylphosphine, diethylzinc, dimethylarsine, triethylaluminum etherate, triethylbismuthine, triethylboron, trimethylaluminum, trimethylgallium.

3. Solids: cesium, hafnium, lithium, white or yellow phosphorous, plutonium, potassium, rubidium, sodium, thorium.

E102.1.10 Unstable (reactive) materials. Examples include:

Class 4: acetyl peroxide, dibutyl peroxide, dinitrobenzene, ethyl nitrate, peroxyacetic acid and picric acid (dry) trinitrobenzene.

Class 3: hydrogen peroxide (greater than 52 percent), hydroxylamine, nitromethane, paranitroaniline, perchloric acid and tetrafluoroethylene monomer.

Class 2: acrolein, acrylic acid, hydrazine, methacrylic acid, sodium perchlorate, styrene and vinyl acetate.

Class 1: acetic acid, hydrogen peroxide 35 percent to 52 percent, paraldehyde and tetrahydrofuran.

E102.1.11 Water-reactive materials. Examples include:

Class 3: aluminum alkyls such as triethylaluminum, isobutylaluminum and trimethylaluminum; bromine pentafluoride, bromine trifluoride, chlorodiethylaluminum and diethylzinc.

Class 2: calcium carbide, calcium metal, cyanogen bromide, lithium hydride, methylchlorosilane, potassium metal, potassium peroxide, sodium metal, sodium peroxide, sulfuric acid and trichlorosilane.

Class 1: acetic anhydride, sodium hydroxide, sulfur monochloride and titanium tetrachloride.

E102.1.12 Cryogenic fluids. The cryogenics listed will exist as compressed gases when they are stored at ambient temperatures.

1. Flammable: carbon monoxide, deuterium (heavy hydrogen), ethylene, hydrogen, methane.
2. Oxidizing: fluorine, nitric oxide, oxygen.
3. Corrosive: fluorine, nitric oxide.
4. Inert (chemically unreactive): argon, helium, krypton, neon, nitrogen, xenon.
5. Highly toxic: fluorine, nitric oxide.

E102.2 Health hazards. Materials classified in this section pose a health hazard.

E102.2.1 Highly toxic materials. Examples include:

1. Gases: arsine, cyanogen, diborane, fluorine, germane, hydrogen cyanide, nitric oxide, nitrogen dioxide, ozone, phosphine, hydrogen selenide, stibine.
2. Liquids: acrolein, acrylic acid, 2-chloroethanol (ethylene chlorohydrin), hydrazine, hydrocyanic acid, 2-methylaziridine (propylenimine), 2-methylacetonitrile (acetone cyanohydrin), methyl ester isocyanic acid (methyl isocyanate), nicotine, tetranitromethane and tetraethylstannane (tetraethyltin).
3. Solids: (aceto) phenylmercury (phenyl mercuric acetate), 4-aminopyridine, arsenic pentoxide, arsenic trioxide, calcium cyanide, 2-chloroacetophenone, aflatoxin B, decaborane(14), mercury (II) bromide

(mercuric bromide), mercury (II) chloride (corrosive mercury chloride), pentachlorophenol, methyl parathion, phosphorus (white) and sodium azide.

E102.2.2 Toxic materials. Examples include:

1. Gases: boron trichloride, boron trifluoride, chlorine, chlorine trifluoride, hydrogen fluoride, hydrogen sulfide, phosgene, silicon tetrafluoride.
2. Liquids: acrylonitrile, allyl alcohol, alpha-chlorotoluene, aniline, 1-chloro-2,3-epoxypropane, chloroformic acid (allyl ester), 3-chloropropene (allyl chloride), o-cresol, crotonaldehyde, dibromomethane, diisopropylamine, diethyl ester sulfuric acid, dimethyl ester sulfuric acid, 2-furaldehyde (furfural), furfural alcohol, phosphorus chloride, phosphoryl chloride (phosphorus oxychloride) and thionyl chloride.
3. Solids: acrylamide, barium chloride, barium (II) nitrate, benzidine, p-benzoquinone, beryllium chloride, cadmium chloride, cadmium oxide, chloroacetic acid, chlorophenylmercury (phenyl mercuric chloride), chromium (VI) oxide (chromic acid; solid), 2,4-dinitrotoluene, hydroquinone, mercury chloride (calomel), mercury (II) sulfate (mercuric sulfate), osmium tetroxide, oxalic acid, phenol, P-phenylenediamine, phenylhydrazine, 4-phenylmorpholine, phosphorus sulfide, potassium fluoride, potassium hydroxide, selenium (IV) disulfide and sodium fluoride.

E102.2.3 Corrosives. Examples include:

1. Acids: Examples: chromic, formic, hydrochloric (muriatic) greater than 15 percent, hydrofluoric, nitric (greater than 6 percent, perchloric, sulfuric (4 percent or more).
2. Bases (alkalis): hydroxides—ammonium (greater than 10 percent), calcium, potassium (greater than 1 percent), sodium (greater than 1 percent); certain carbonates—potassium.
3. Other corrosives: bromine, chlorine, fluorine, iodine, ammonia.

Note: Corrosives that 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.

SECTION E103 EVALUATION OF HAZARDS

E103.1 Degree of hazard. The degree of hazard present depends on many variables which should be considered individually and in combination. Some of these variables are as shown in Sections E103.1.1 through E103.1.5.

E103.1.1 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 pose 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.

E103.1.2 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.

E103.1.3 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.

E103.1.3.1 Mixtures. Gases—toxic and highly toxic gases include those gases which have an LC_{50} of 2,000 parts per million (ppm) or less when rats are exposed for a period of 1 hour or less. To maintain consistency with the definitions for these materials, exposure data for periods other than 1 hour must be normalized to 1 hour. To classify mixtures of compressed gases that contain one or more toxic or highly toxic components, the LC_{50} of the mixture must be determined. Mixtures that contain only two components are binary mixtures. Those that contain more than two components are multi-component mixtures. When two or more hazardous substances (components) having an LC_{50} below 2,000 ppm are present in a mixture, their combined effect, rather than that of the individual substances (components), must be considered. In the absence of information to the contrary, the effects of the hazards present must be considered as additive. Exceptions to the above rule may be made when there is a good reason to believe that the principal effects of the different harmful substances (components) are not additive.

For binary mixtures where the hazardous component is diluted with a nontoxic gas such as an inert gas, the LC_{50} of the mixture is estimated by use of the following formula:

$$LC_{50m} = \frac{1}{[C_1 / LC_{501}]} \quad (\text{Equation E-1})$$

For multi-component mixtures where more than one component has a listed LC_{50} , the LC_{50} of the mixture is estimated by use of the following formula:

$$C_{50m} = \frac{1}{(C_a / LC_{50a}) + (C_{i2} / LC_{50i2}) + (C_{in} / LC_{50i})} \quad (\text{Equation E-2})$$

where:

LC_{50m} = LC_{50} of the mixture in parts per million (ppm).

C_i = concentration of component (i) in decimal percent. The concentration of the individual components in a mixture of gases is to be expressed in terms of percent by volume.

LC_{50i} = LC_{50} of component (i). The LC_{50} of the component is based on a 1-hour exposure. LC_{50} data which are for other than 1-hour exposures shall be normalized to 1-hour by multiplying the LC_{50} for the time determined by the factor indicated in Table E103.1.3.1. The preferred mammalian species for LC_{50} data is the rat, as specified in the definitions of toxic and highly toxic in Chapter 2 of the *International Fire Code*. If data for rats are unavailable, and in the absence of information to the contrary, data for other species may be utilized. The data shall be taken in the following order of preference: rat, mouse, rabbit, guinea pig, cat, dog, monkey.

i_n = component 1, component 2 and so on to the nth component.

Examples:

- a. What is the LC_{50} of a mixture of 15-percent chlorine, 85-percent nitrogen?

The 1-hour (rat) LC_{50} of pure chlorine is 293 ppm.

$LC_{50m} = 1 / (0.15 / 293)$ or 1,953 ppm. Therefore, the mixture is toxic.

- b. What is the LC_{50} of a mixture of 15-percent chlorine, 15-percent fluorine and 70-percent nitrogen? The 1-hour (rat) LC_{50} of chlorine is 293 ppm. The 1-hour (rat) LC_{50} of fluorine is 185 ppm.

$LC_{50m} = 1 / (0.15 / 293) + (0.15 / 185)$ or 755 ppm. Therefore the mixture is toxic.

- c. Is the mixture of 1 percent phosphine in argon toxic or highly toxic? The 1-hour (rat) LC_{50} is 11 ppm.

$LC_{50m} = 1 / [0.01 / (11 / 2)]$ or 2,200 ppm. Therefore the mixture is neither toxic nor highly toxic. Note that the 4-hour LC_{50} of 11 ppm was normalized to 1-hour by use of Section E103.1.3.1.

TABLE E103.1.3.1
NORMALIZATION FACTOR

TIME (hours)	MULTIPLY BY
0.5	0.7
1.0	1.0
1.5	1.2
2.0	1.4
3.0	1.7
4.0	2.0
5.0	2.2
6.0	2.4
7.0	2.6
8.0	2.8

E103.1.4 Actual use, activity or process involving the material. The definition of handling, storage and use in closed systems refers to materials in packages or containers. Dispensing and use in open containers or systems describes 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.

E103.1.5 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.

E103.2 Evaluation questions. The following are sample 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 and leak control and containment.
4. How much material is present? Consider in relation to permit amounts, maximum allowable quantity per control area (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:
 - 11.1. Proper containers and equipment.
 - 11.2. Separation by distance or construction.
 - 11.3. Enclosure in cabinets or rooms.
 - 11.4. Spill control, drainage and containment.
 - 11.5. Control systems — ventilation, special electrical, detection and alarm, extinguishment, explosion venting, limit controls, exhaust scrubbers and excess flow control.
 - 11.6. Administrative (operational) controls—signs, 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 or testing laboratories to support contentions that a particular material or process is or is not hazardous. See Section 104.7.2 of the *International Fire Code*.

APPENDIX F HAZARD RANKING

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

SECTION F101 GENERAL

F101.1 Scope. Assignment of levels of hazards to be applied to specific hazard classes as required by NFPA 704 shall be in accordance with this appendix. The appendix is based on application of the degrees of hazard as defined in NFPA 704 arranged by hazard class as for specific categories defined in Chapter 2 of the *International Fire Code* and used throughout.

F101.2 General. The hazard rankings shown in Table F101.2 have been established by using guidelines found within NFPA 704. As noted in Section 4.2 of NFPA 704, there could be specific reasons to alter the degree of hazard assigned to a specific material; for example, ignition temperature, flammable range or susceptibility of a container to rupture by an internal combustion explosion or to metal failure while under pressure or because of heat from external fire. As a result, the degree of hazard assigned for the same material can vary when assessed by different people of equal competence.

The hazard rankings assigned to each class represent reasonable minimum hazard levels for a given class based on the use of criteria established by NFPA 704. Specific cases of use or storage may dictate the use of *higher degrees of hazard* in certain cases.

SECTION F102 REFERENCED STANDARDS

ICC	IFC	International Fire Code	F101.1
NFPA	704	Identification of the Hazards of Materials for Emergency Response	F101.1, F101.2

APPENDIX F

TABLE F101.2
FIRE FIGHTER WARNING PLACARD DESIGNATIONS BASED ON HAZARD CLASSIFICATION CATEGORIES

HAZARD CATEGORY	DESIGNATION
Combustible liquid II	F2
Combustible liquid IIIA	F3
Combustible liquid IIIB	F1
Combustible dust	F4
Combustible fiber	F3
Cryogenic flammable	F4, H3
Cryogenic oxidizing	OX, H3
Explosive	R4
Flammable solid	F2
Flammable gas (gaseous)	F4
Flammable gas (liquefied)	F4
Flammable liquid IA	F4
Flammable liquid IB	F3
Flammable liquid IC	F3
Organic peroxide, UD	R4
Organic peroxide I	F4, R3
Organic peroxide II	F3, R3
Organic peroxide III	F2, R2
Organic peroxide IV	F1, R1
Organic peroxide V	Nonhazard
Oxidizing gas (gaseous)	OX
Oxidizing gas (liquefied)	OX
Oxidizer 4	OX
Oxidizer 3	OX
Oxidizer 2	OX
Pyrophoric gases	F4
Pyrophoric solids, liquids	F3
Unstable reactive 4D	R4
Unstable reactive 3D	R4
Unstable reactive 3N	R3
Unstable reactive 2	R2
Water reactive 3	W, R3
Water reactive 2	W, R2
Corrosive	H3, COR
Toxic	H3
Highly toxic	H4

F—Flammable category.
R—Reactive category.
H—Health category.
W—Special hazard: water reactive.
OX—Special hazard: oxidizing properties.

COR—Corrosive.
UD—Unclassified detonable material.
4D—Class 4 detonable material.
3D—Class 3 detonable material.
3N—Class 3 nondetonable material.

APPENDIX G

CRYOGENIC FLUIDS—WEIGHT AND VOLUME EQUIVALENTS

This appendix is for information purposes and is not intended for adoption.

SECTION G101 GENERAL

G101.1 Scope. This appendix is used to convert from liquid to gas for cryogenic fluids.

G101.2 Conversion. Table G101.2 shall be used to determine the equivalent amounts of cryogenic fluids in either the liquid or gas phase.

G101.2.1 Use of the table. To use Table G101.2, read horizontally across the line of interest. For example, to determine the number of cubic feet of gas contained in 1.0 gallon (3.785 L) of liquid argon, find 1.000 in the column entitled "Volume of Liquid at Normal Boiling Point." Reading across the line under the column entitled "Volume of Gas at 70°F and 1 atmosphere (4.7 psia)," the value of 112.45 cubic feet (3.184 m³) is found.

G101.2.2 Other quantities. If other quantities are of interest, the numbers obtained can be multiplied or divided to obtain the quantity of interest. For example, to determine the number of cubic feet of argon gas contained in a volume of 1,000 gallons (3785 L) of liquid argon at its normal boiling point, multiply 112.45 by 1,000 to obtain 112,450 cubic feet (3184 m³).

TABLE G101.2
WEIGHT AND VOLUME EQUIVALENTS FOR COMMON CRYOGENIC FLUIDS

CRYOGENIC FLUID	WEIGHT OF LIQUID OR GAS		VOLUME OF LIQUID AT NORMAL BOILING POINT		VOLUME OF GAS AT NTP	
	Pounds	Kilograms	Liters	Gallons	Cubic feet	Cubic meters
Argon	1.000	0.454	0.326	0.086	9.67	0.274
	2.205	1.000	0.718	0.190	21.32	0.604
	3.072	1.393	1.000	0.264	29.71	0.841
	11.628	5.274	3.785	1.000	112.45	3.184
	10.340	4.690	3.366	0.889	100.00	2.832
	3.652	1.656	1.189	0.314	35.31	1.000
Helium	1.000	0.454	3.631	0.959	96.72	2.739
	2.205	1.000	8.006	2.115	213.23	6.038
	0.275	0.125	1.000	0.264	26.63	0.754
	1.042	0.473	3.785	1.000	100.82	2.855
	1.034	0.469	3.754	0.992	100.00	2.832
	0.365	0.166	1.326	0.350	35.31	1.000
Hydrogen	1.000	0.454	6.409	1.693	191.96	5.436
	2.205	1.000	14.130	3.733	423.20	11.984
	0.156	0.071	1.000	0.264	29.95	0.848
	0.591	0.268	3.785	1.000	113.37	3.210
	0.521	0.236	3.339	0.882	100.00	2.832
	0.184	0.083	1.179	0.311	35.31	1.000
Oxygen	1.000	0.454	0.397	0.105	12.00	0.342
	2.205	1.000	0.876	0.231	26.62	0.754
	2.517	1.142	1.000	0.264	30.39	0.861
	9.527	4.321	3.785	1.000	115.05	3.250
	8.281	3.756	3.290	0.869	100.00	2.832
	2.924	1.327	1.162	0.307	35.31	1.000
Nitrogen	1.000	0.454	0.561	0.148	13.80	0.391
	2.205	1.000	1.237	0.327	30.43	0.862
	1.782	0.808	1.000	0.264	24.60	0.697
	6.746	3.060	3.785	1.000	93.11	2.637
	7.245	3.286	4.065	1.074	100.00	2.832
	2.558	1.160	1.436	0.379	35.31	1.000
LNG ^a	1.000	0.454	1.052	0.278	22.968	0.650
	2.205	1.000	2.320	0.613	50.546	1.434
	0.951	0.431	1.000	0.264	21.812	0.618
	3.600	1.633	3.785	1.000	82.62	2.340
	4.356	1.976	4.580	1.210	100.00	2.832
	11.501	5.217	1.616	0.427	35.31	1.000

For SI: 1 pound = 0.454 kg, 1 gallon = 3.785 L, 1 cubic foot = 0.02832 m³, °C = [(°F)-32]/1.8, 1 pound per square inch atmosphere = 6.895 kPa.
 a. The values listed for liquefied natural gas (LNG) are "typical" values. LNG is a mixture of hydrocarbon gases, and no two LNG streams have exactly the same composition.