Report of Committee on Chemicals and Explosives

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The Report of the Committee on Chemicals and Explosives is presented in 8 parts.


Part II has been submitted to letter ballot of the Technical Committee on Electrical Equipment in Chemical Atmospheres which consists of 15 voting members; of whom all 15 voted affirmatively.

Part I has also been submitted to letter ballot of the Correlating Committee on Chemicals and Explosives which consists of 7 voting members; of whom all 7 voted affirmatively.


Part II has been submitted to letter ballot of the Technical Committee on Electrical Equipment in Chemical Atmospheres which consists of 15 voting members; of whom 13 voted affirmatively, and 2 negatively (Mr. Cowley and Mr. Higgins).
Mr. Cawley's negative vote is based on his opinion that the entire document should be revised to reflect new test procedures.

Mr. Higgin's negative vote is based on his opinion that Proposals 1 and 2 should be accepted and on his opinion that silicon should be listed as a Group G dust.

Part II has also been submitted to letter ballot of the Correlating Committee on Chemicals and Explosives which consists of 7 voting members; of whom all 7 voted affirmatively.


Part III has been submitted to letter ballot of the Technical Committee on Hazardous Chemical Reactions which consists of 5 voting members; of whom all 5 voted affirmatively.

Part III has also been submitted to letter ballot of the Correlating Committee on Chemicals and Explosives which consists of 7 voting members; of whom all 7 voted affirmatively.


Part IV has been submitted to letter ballot of the Technical Committee on Storage, Handling and Transportation of Hazardous Chemicals which consists of 21 voting members; of whom 17 voted affirmatively, 1 abstained (Mr. Sammis) and 3 ballots were not returned (Mr. Lowery, Mr. McAnulty and Mr. Santos).

Part V has been submitted to letter ballot of the Correlating Committee on Chemicals and Explosives which consists of 7 voting members; of whom all 7 voted affirmatively.

Part V has also been submitted to letter ballot of the Correlating Committee on Chemicals and Explosives which consists of 7 voting members; of whom all 7 voted affirmatively.


Part VI has been submitted to letter ballot of the Technical Committee on Storage, Handling and Transportation of Hazardous Chemicals which consists of 21 voting members; of whom 16 voted affirmatively, 1 abstained (Mr. Sammis) and 4 ballots were not returned (Mr. Lowery, Mr. McAnulty, Mr. Santos and Mr. Lowery).

Part VI has also been submitted to letter ballot of the Correlating Committee on Chemicals and Explosives which consists of 7 voting members; of whom all 7 voted affirmatively.


Part VII has been submitted to letter ballot of the Technical Committee on Storage, Handling and Transportation of Hazardous Chemicals which consists of 17 voting members; of whom 15 voted affirmatively, 1 abstained (Mr. Sammis) and 1 ballot was not returned (Mr. Lowery).

Part VII has also been submitted to letter ballot of the Correlating Committee on Chemicals and Explosives which consists of 7 voting members; of whom all 7 voted affirmatively.


Part VIII has been submitted to letter ballot of the Technical Committee on Storage, Handling and Transportation of Hazardous Chemicals which consists of 21 voting members; of whom 16 voted affirmatively, 1 abstained (Mr. Sammis), 1 ballot was not returned (Mr. Lowery).

Part VIII has also been submitted to letter ballot of the Correlating Committee on Chemicals and Explosives which consists of 7 voting members; of whom all 7 voted affirmatively.
Chapter 2 Basic Considerations

2-1 National Electrical Code Criteria.

2-1.1 Article 500 of NFPA 70, NATIONAL ELECTRICAL CODE, designates as hazardous (classified) any location in which a combustible material is or may be present in the atmosphere in sufficient concentration to produce an ignitible mixture. Article 500 defines three major categories of hazardous location:

- Class I, in which the combustible material is a gas or vapor;
- Class II, in which the combustible material is a dust;
- Class III, in which the combustible material is a fiber or flying.

This recommended practice is limited to Class I hazardous (classified) locations.

2-1.2 The intent of Article 500 is that electrical equipment and systems in hazardous (classified) locations should not provide a means of ignition for an ignitible mixture that may be present.

2-1.3 This recommended practice does not apply to situations that may involve catastrophic failure of or catastrophic discharge from process vessels, pipelines, tanks, or systems.

2-1.4 This recommended practice does not apply to situations involving enriched oxygen atmospheres. It also does not apply to situations involving pyrophoric materials.

2-1.5 This recommended practice is not intended to supersede or conflict with applicable requirements of the following:

- NFPA 30, Flammable and Combustible Liquids Code;
- NFPA 33, Standard for Spray Application Using Flammable and Combustible Materials;
- NFPA 34, Standard for Dip Tanks Containing Flammable or Combustible Liquids;
- NFPA 35, Standard for Organic Coatings Manufacture;
- NFPA 36, Standard for Solvent Extraction Plants;
- NFPA 45, Standard on Fire Protection for Laboratories Using Chemicals;
- NFPA 50A, Standard for Gaseous Hydrogen Systems at Consumer Sites;
- NFPA 50B, Standard for Liquefied Hydrogen Systems at Consumer Sites;
- NFPA 58, Standard for the Storage and Handling of Liquefied Petroleum Gases; and
- NFPA 59A, Standard for the Production, Storage and Handling of Liquefied Natural Gas.

2-1 Purpose.

2-1.1 It is the intent of this recommended practice to provide the user with a basic understanding of the parameters which determine the degree and the extent of the hazardous (classified) location. This recommended practice also provides the user with examples of the application of these parameters.

2-1.2 This recommended practice is intended as a guide and should be applied with sound engineering judgment. When all factors are properly evaluated, a consistent area classification scheme can be developed.

1-3 National Electrical Code Criteria.

1-3.1 This recommended practice is based on the criteria established by Article 500 of NFPA 70, NATIONAL ELECTRICAL CODE, but is not intended to supersede or conflict with the requirements therein. Once an area is properly classified, the NATIONAL ELECTRICAL CODE specifies the type of equipment and the wiring methods that may be used.
2-1.3.2 Installations for Division 2 locations are designed and arranged so that normal operation of the electrical system does not provide a source of ignition. Protection against ignition during electrical breakdown is not provided. However, electrical breakdowns are sufficiently rare that the chances of one occurring simultaneously with incidental release of an ignitable mixture is extremely remote. Arcing and sparking devices are permitted only if suitable protective devices are provided or if the sparks are of insufficient energy to ignite the mixture.

2-1.4 Electrical installations for areas classified as hazardous may be designed in various manners. No single manner is best in all respects or for all types of equipment used in a chemical processing plant. Explosion-proof electrical equipment, Types X and Y, purged electrical equipment, and Intrinsically safe electrical equipment are applicable to both Division 1 and Division 2 locations. Nonsparking electrical equipment and other less restrictive equipment, as specified in NFPA 70, NATIONAL ELECTRICAL CODE, are permitted in Division 2 locations.

2-1.5 Factors such as corrosion, weather, maintenance, equipment standardization and interchangeability, and possible process changes or expansion frequently dictate the use of special enclosures or installations for electrical systems. However, such factors are outside the scope of this recommended practice, which is concerned entirely with the proper application of electrical equipment to avoid ignition of flammable mixtures.

2-1.6 Locations which do not need to be classified as Division 1 or Division 2 are "nonclassified."

2-2 Conditions Necessary for Ignition.

2-2.1 In a Class I location, three conditions must be satisfied for ignition to occur:

a. A combustible gas or vapor must be present.

b. The gas or vapor must be mixed with air in the proportions required to produce an ignitible mixture. Further, within the context of this recommended practice, a sufficient quantity of this mixture must be present in the atmosphere surrounding the electrical equipment.

c. There must be a release of energy intense enough to cause ignition of the mixture. Within the context of this recommended practice, the energy release is understood to originate within the electrical system.

2-2.2 In classifying a particular location, the first condition, presence of a combustible gas or vapor, is significant in determining the correct Division. As described in 2-1.3, the presence of an ignitable mixture during normal conditions of operation, repair, maintenance, or leakage of the process equipment either continuously or intermittently, calls for a Division 1 classification. In other words, combustible gas or vapor is assumed to be present at any time; all that is necessary for electrical ignition is failure of the electrical system. If combustible gas or vapor is only present as a result of abnormal operation or equipment failure, and the location is designated Division 2; ignition will only occur if there is simultaneous failure of the electrical system and the equipment.

2-2.3 The second condition, presence of an ignitable mixture, is important in determining the boundaries of the hazardous location, i.e., hazards that occur frequently enough to require the use of enclosures or installations for electrical systems. The quantity of material that may be released, its physical and chemical properties, and the natural tendency of gases and vapors to disperse all must be considered.

2-3 Behavior of Gases, Vapors, and Liquids.

2-3.1 Lighter-than-Air Gases. Gases whose densities are less than that of air will tend to dissipate rapidly once released to the atmosphere. They will not affect as great an area as heavier-than-air gases or vapors. Except in enclosed spaces, such gases seldom accumulate to form an ignitable mixture near grade level, where most electric installations are located.

2-3.2 Heavier-than-Air Gases. Gases whose densities at ambient temperature are greater than that of air tend to fall to grade level when released from a container. Under stagnant conditions, diffusion is slow and depends on the particular characteristics of the gas. The gas may remain for a significant period of time, unless disturbed by natural or forced ventilation, which will assist the dispersion process.

2-3.2.1 As the gas diffuses into the surrounding air, the density of the mixture approaches that of air, which also enhances dispersion.

2-3.2.2 The temperature of the gas, as it leaves its container, must be considered. A gas whose density at ambient temperature is greater than that of air will rise if it is heated to a temperature high enough to decrease its density below that of the surrounding atmosphere. Conversely, an increase in the diffusion rate and the gas mixes with the surrounding atmosphere more rapidly. On the other hand, gases which are lighter than air at ambient conditions will behave like heavier-than-air gases if they are very cold. The decreased temperature results in an increased density. If the density is greater than that of air, the gas sinks to grade level and the rate of diffusion is decreased.

2-3.3 Compressed Liquefied Gases. These gases are stored above their normal boiling point, but kept in the liquid state by pressure. When released from this pressure, the liquid immediately expands and vaporizes, creating large volumes of cold gas. The cold gases behave like heavier-than-air gas, until they warm, mix with air, and dissipate.

2-3.4 Cryogenic Liquids and Other Cold Liquefied Flammable Gases. Cryogenic liquids are generally handled below -10°F (-12°C). Those which are combustible, such as hydrogen, carbon monoxide, and natural gas, behave like flammable liquids when they are spilled. Small spills will immediately vaporize; but larger spills will remain in the liquid state, spreading horizontally and freezing the ground beneath, thus inhibiting heat transfer. As the liquid absorbs heat, it vaporizes and rises. This results in a vertical cylinder of gas in the ignitable range which diffuses as it rises.

Some liquefied flammable gases are stored at low temperatures (above -10°F [-12°C]) and pressures close to atmospheric. These materials will behave as described above. Examples of such gases are anhydrous ammonia, propane, ethane, ethylene, and propylene.

2-3.5 Flammable and Combustible Liquids. Flammable and combustible liquids are categorized by NFPA 30, Flammable and Combustible Liquids Code, as follows:

- Class I: those having flash points below 100°F (37.8°C);
- Class II: those having flash points at or above 100°F (37.8°C) and below 140°F (60°C);
- Class III: those having flash points at or above 140°F (60°C).

2-3.5.1 When released in appreciable quantity, a Class I liquid will begin to evaporate at a rate that depends on its volatility: the lower the flash point, the greater the volatility; hence, the faster the evaporation. The vapors of Class I liquids form ignitable mixtures with air at ambient temperatures more or less readily. Even when evolved rapidly, the vapors tend to disperse rapidly, becoming diluted to a concentration below the lower flammable limit. Until this dispersion takes place, however, these vapors will behave like heavier-than-air gases. Class I liquids normally will produce ignitable mixtures unless they travel some finite distance from the point of origin; thus, they will normally require area classification for proper electrical system design.

2-3.5.2 With Class II liquids, the degree of hazard is lower because the vapor release is low at the normal handling and storage temperatures. In general, these liquids will not form ignitable mixtures with air at ambient temperatures unless heated above their flash points. Also, the vapors will not travel far because they tend to condense as they are cooled by ambient air. Class II liquids should be considered capable of producing an ignitable mixture near the point of release when handled, processed, or stored under conditions where the liquid may exceed its flash point.

2-3.5.3 Class III liquids are subdivided into two classes: IIIA and IIIB. Class IIIA liquids have flash points at or above 140°F (60°C), but below 200°F (93.4°C). These liquids do not form ignitable mixtures with air at ambient temperatures unless heated above their flash points. Furthermore, the vapors can exist in air and disperse rapidly, and the area requiring electrical classification will be very small or nonexistent.

Class IIIB liquids have flash points at or above 200°F (93.4°C). These liquids seldom evolve enough vapors to form ignitable mixtures even when heated and are seldom ignited by properly installed and maintained general purpose electrical equipment.

2-3.5.4 The density of air saturated with combustible vapor at ambient temperature is generally less than 1.5 times the density of the gas. However, when the vapor is diluted with enough air to form an ignitable mixture, the density of the mixture approaches that of air.
2-4 Division 1 Classified Locations.

2-4.1 The decision to classify a location as hazardous is based upon the possibility that a flammable mixture may be present.

Having decided that a location should be classified, the next step is to determine the degree of hazard: Is the location Division 1 or Division 2?

2-4.2 As stated in 2-1.3, a condition for Division 1 is whether the location is likely to have an ignitable mixture present under normal conditions. For instance, the presence of flammable vapors in the vicinity of open-dome loading of flammable liquid tank trucks is normal and requires a Division 1 classification.

2-4.3 Normal does not necessarily mean the situation that prevails when everything is working properly. For instance, there may be cases where a frequent maintenance and repair work is necessary. These are viewed as normal and, if quantities of flammable liquid, gas or vapor are released as a result of the maintenance, the location is Division 1. However, if repairs are not usually required between turnarounds, the need for repair work is considered abnormal. In any event, the classification of the location, as related to equipment maintenance is influenced by the maintenance procedures and frequencies.

2-5 Division 2 Classified Locations.

2-5.1 The criterion for a Division 2 location is whether the location is likely to have ignitable mixtures present only under abnormal conditions. The term "abnormal" is used here in a limited sense and does not include a major catastrophe.

2-5.2 As an example, consider a vessel containing liquid hydrocarbons (the source) which releases flammable material only under abnormal conditions. In this case, there is no Division 1 location because the vessel is normally tight. To release vapor, the vessel would have to leak, and that would not be normal. Thus, the vessel is surrounded by a Division 2 location.

2-5.3 Process equipment does not fail often. Furthermore, the electrical installation requirements of NFPA 70, NATIONAL ELECTRICAL CODE, for Division 2 locations are such that an ignition-capable spark will occur only in the event of a breakdown of the electrical system. Otherwise, any spark will be contained within a suitable enclosure. On a realistic basis, the possibility of simultaneous failure of operating equipment and electrical equipment is very remote; this justifies the recognition and acceptance of the Division 2 concept.

2-5.4 The Division 2 classification is equally applicable to conditions not involving equipment failure. For example, consider a location classified as Division 1 because of the normal presence of an ignitable mixture. Obviously, one side of the Division 1 boundary cannot be normally hazardous and the opposite side never hazardous. Therefore, a surrounding Division 2 location separates the Division 1 location from the nonhazardous location. Another example would be a point emission source which releases combustible vapors during normal operation. This source is surrounded by a Division 1 location which, in turn, is surrounded by a larger, concentric Division 2 location. Division 2 is the transition zone and the area outside the Division 2 location is not classified.

2-5.5 In cases in which an unplugged barrier, such as a blank wall, completely prevents the escape of gas or vapor, area classification does not extend beyond the barrier.

2-6 Nonclassified Locations.

2-6.1 Experience has shown that the release of ignitable mixtures from some operations and apparatus is so infrequent that area classification is not necessary. For example, it is not usually necessary to classify the following locations where combustible materials are processed, stored, or handled:

- Locations that are adequately ventilated, where combustible materials are contained within suitable, well-maintained, closed piping systems.
- Locations that are not adequately ventilated but where piping systems are without valves, fittings, flanges, and similar accessories that may be prone to leaks.
- Locations where combustible materials are stored in suitable containers.

2-6.2 "Adequate ventilation" is defined by NFPA 30, Flammable and Combustible Liquids Code, as that which is sufficient to prevent accumulation of significant quantities of vapor-air mixtures in concentrations over 25 percent of the lower flammable limit.

2-6.3 An "adequately ventilated location" is one of the following:

(a) An outside location.

(b) A building, room, or space which is substantially open and free from obstruction to the natural passage of air, either vertically or horizontally. Such locations may be roofed over with no walls, may be roofed over and closed on one side, or may be provided with suitably designed windbreaks.

(c) An enclosed or partly enclosed space provided with mechanical ventilation equivalent to natural ventilation. The mechanical ventilation system must have adequate safeguards against failure.

2-6.4 Open flames and hot surfaces associated with the operation of certain equipment, such as boilers and fired heaters, provide inherent thermal ignition sources. Electrical classification is not appropriate in the immediate vicinity of these facilities. Consideration should be given, however, to potential leak sources in pumps, valves, etc. or in waste product and other fuel feed lines to flame- or heat-producing equipment to avoid installing electrical devices which could then become primary ignition sources for such leaks.

2-7 Extent of Classified Location.

2-7.1 The extent of a Division 1 or Division 2 location requires careful consideration of the following factors:

- the flammable or combustible material;
- the vapor density of the material;
- the temperature of the material;
- the process or storage pressure;
- size of release;
- ventilation.

2-7.2 The first step is to identify the materials being handled and their vapor densities. Hydrocarbon vapors and gases are generally heavier than air, while hydrogen and methane are lighter than air. The following guidelines apply:

- in the absence of walls, enclosures, or other barriers, and in the absence of air currents or similar disturbing forces, the gas or vapor will disperse. Heavier-than-air vapors will travel primarily downward and outward; lighter-than-air vapors will travel upward and outward. If the source of the vapors is a single point, the horizontal radius will be about 1 yard.

- For heavier-than-air vapors released at or near grade level, ignitable mixtures are most likely to be found below grade level; next most likely at grade level; with decreasing likelihood of presence at height above grade increases. In the open, away from the immediate point of release, freely drifting gases or vapors from a source near grade have seldom reached ignition sources at elevations more than 6 or 8 ft (1.8 to 2.4 m) above grade. For lighter-than-air gases, the opposite is true: there is little or no hazard at and below grade, but greater hazard above grade.

- In cases where the source of vapor is above grade or below grade or in cases where the gas or vapor is released under pressure, the limits of the classified location is a function of substance and weather. A light breeze may extend these limits. However, a stronger breeze may accelerate dispersion of gases or vapors so that the extent of the classified location is greatly reduced. The dimensional limits recommended for Division 1 or Division 2 zones must be based on experience, rather than relying solely on the theoretical diffusion of vapors.

2-7.3 The degree to which air movement and material volatility combine to effect the extent of the classified location can be illustrated by two experiences monitored by combustible gas detectors. Gasoline spilled in a sizeable open manifold pit gave no indication of ignitable mixtures beyond 3 or 4 ft (0.9 to 1.2 m) from the pit when the breeze was 8 to 10 (13 to 16 km/hr) mph. A slightly smaller pool of a more volatile material, blocked on one side, was monitored during a moderate, 12 mph breeze. Although the vapor could be detected for approximately 100 ft (30 m) downwind; however, at 18 in. (46 cm) above grade there was no indication of vapor as close as 30 ft (9 m) from the pool.

These examples show the great variability that may be present in situations of this type and points out again that careful consideration must be given to the large number of factors when classifying areas.

2-7.4 The size of a building and its design may influence considerably the classification of the enclosed volume. In the case of a small industrial ventilated building or testing room, it may be appropriate to classify the entire internal volume as Division 1.
2-7.5 When classifying buildings, careful evaluation of prior experience with the same or similar installations should be made. It is not enough to merely identify a potential source of vapor within the building and proceed immediately to defining the extent of a Division 1 or Division 2 location. An assessment of divisional experience with the same or similar installations should be made. Furthermore, it is conceivable that a location might be reclassified from Division 1 to Division 2, or from Division 2 to nonhazardous, based on experience.

2-7.6 Correctly evaluated, an installation will be found to be a multiplicity of Division 1 locations of very limited extent. Probably the most numerous of offenders are packing glands. A packing gland leaking a quart per minute (360 gals per day) (0.95 liter per minute) would certainly not be commonplace. Yet, if a quart bottle was emptied each minute outdoors, the homemade hazardous would be difficult to locate with a combustible gas detector.

2-7.7 The volume of liquid or vapor released is of extreme importance in determining the extent of a hazardous location and is the consideration which necessitates the greatest application of sound engineering judgment. However, one cannot lose sight of the purpose of this judgment: the location is classified solely for the installation of electrical equipment.

Chapter 3 Determining the Degree and Extent of Hazardous (Classified) Locations

3-1 Diagrams and Recommendations.

3-1.1 This chapter contains a series of diagrams which illustrate the recommended extent of classified locations around typical sources of flammable gases or vapors. These locations may be assumed to contain an ignitable atmospheric mixture under the conditions described. Some of the diagrams are for single-point sources, others apply to a multiple source or an operating area. The bases for the diagrams are explained in Section 3-2.

3-1.2 The intended use of the diagrams is to aid in developing electrical classification maps of operating units, process plants, or buildings. Derivations or section views may be required where different classifications apply at different levels.

3-1.3 An operating unit will have many interconnected sources of combustible material, including pumps, compressors, vessels, tanks, and heat exchangers. These will, in turn, present sources of leaks such as flanged and screwed connections, fittings, valves, meters, etc. Thus, considerable judgment will be required to establish the boundaries of the Division 1 and Division 2 locations.

3-1.4 In some cases, individual classification of a multitude of point sources within an operating unit is neither feasible nor economical. In such cases, the entire unit may be classified as a single source entity. However, this should be considered only after a thorough evaluation of the extent and interaction of the various sources both within the unit and adjacent to it.

3-1.5 In developing these diagrams, vapor density is generally assumed to be greater than that of air. Lighter-than-air gases, such as hydrogen and methane, will quite readily disperse and the diagrams for lighter-than-air gases should be used. However, if such gases are being evolved from the cryogenic state (i.e., liquefied hydrogen or LNG), caution must be exercised because, for some finite period of time, these gases will be heavier than air due to their low temperature when first released.

3-2 Bases for Recommendations.

3-2.1 The practices of the petroleum refining industry are published in the American Petroleum Institute's RP 500A, Recommended Practice for Classification of Locations for Electrical Installations in Petroleum Refineries. These practices are based on a survey and an analysis of the practices of a large segment of the industry, experimental data, and careful weighing of pertinent factors. Refinery operations are characterized by the handling, processing, and storage of large quantities of materials, often at elevated temperatures. The recommended limits of classified locations for refinery installations may therefore be stricter than are warranted for more traditional chemical processing facilities that handle smaller quantities.

3-2.2 Various codes, standards, and recommended practices of the National Fire Protection Association include recommendations for classifying hazardous locations. These recommendations are based on many years of study and are included in the Code for the Storage and Handling of Liquefied Petroleum Gases, NFPA 59, Standard for the Storage and Handling of Liquefied Petroleum Gases, NFPA 193, Recommended Practice for Classification of Locations for Multiplicity of Division 1 Locations of Very Limited Extent, NFPA 30, Flammable and Combustible Liquids Code, and NFPA 58, Standard for Storage and Handling of Liquefied Petroleum Gases, are two of these documents.

3-2.3 Continuous process plants and large batch chemical plants may be almost as large as refineries and should, therefore, follow the practices of the refining industry. The volume of leakage from pump and agitator shaft packing glands, piping flanges, and valves increases proportionally with process equipment size and flow rate, as does the travel distance and area of dispersion from the discharge source. Similarly, the volume of the leakage, the travel distance, and the area of dispersion all increase at operating pressure increases.

3-2.4 In deciding whether to use an overall plant classification scheme or individual equipment classification, process equipment size, flow rate, and pressure should be taken into consideration. Generally speaking, for small or batch chemical plants, point source classification diagrams can be used; for large, high pressure plants, the API recommendations are more suitable. Table 3-2, gives ranges of process equipment size, pressure, and flow rate for equipment and piping handling flammable or combustible liquids or gases.

3-2.5 The great majority of chemical plants fall in the moderate range of size, pressure, and flow rate for equipment and piping handling flammable or combustible liquids or gases. However, since all cases are not the same, sound engineering judgment is required.

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<tr>
<th>Relative Magnitudes of Process Equipment and Piping</th>
<th>Handling Flammable Liquids or Gases</th>
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<tr>
<td><strong>Units</strong></td>
<td><strong>Small/Low</strong></td>
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<td><strong>Process Equipment Size</strong></td>
<td><strong>gal</strong></td>
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<td><strong>Flow Rate</strong></td>
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3-3 Procedure for Classifying Locations. The following procedure should be used for each room, section, or area being classified.

3-3.1 Step One -- Need for Classification. The area should be classified if the answer to either of the following questions is "Yes":

(a) Are flammable liquids or flammable gases likely to be present?

(b) Are combustible liquids likely to be handled, processed, or stored at temperatures above their flash points?

3-3.2 Step Two -- Assignment of Division Classification. Assuming an affirmative answer to Step One, the following questions should be answered to determine the correct Division classification.

3-3.2.1 Division 1 locations are distinguished by a "Yes" answer to any one of the following questions:

(a) Is an ignitable atmospheric mixture likely to exist under normal operating conditions?

(b) Is an ignitable atmospheric mixture likely to occur frequently because of leakage due to maintenance and repairs?

(c) Would failure of process equipment, storage vessels, or piping systems be likely to cause a failure of the electrical system simultaneous with the release of the combustible material?

3-3.2.2 Division 2 locations are distinguished by a "Yes" answer to any of the following questions:

(a) Is a process equipment system containing a combustible material in an inadequately ventilated space, but the piping system is not likely to leak?

(b) Is a piping system containing a combustible material in an inadequately ventilated space and the material can only escape during abnormal situations, such as failure of a gasket or packing?

(c) Is the location adjacent and open to a Division 1 location or can gas or vapor be transmitted from a Division 1 location to the location in question by trenches, pipes, or ducts?

3-3.3 Step Three -- Extent of Classified Location. The extent of the classified location may be determined by applying, with sound engineering judgment, the distances recommended in the diagrams contained in this chapter.
3-4 Index of Classification Diagrams. This section contains descriptions of the classification diagrams which follow. Most of the diagrams include a table of "suggested applicability," corresponding to Table 3-2. The check marks show the ranges of process equipment size, pressure, and flowrate where each diagram most appropriately applies. Unless otherwise stated, these diagrams assume that the material being handled is a flammable liquid.

Figure 3-4.1 shows a source of leakage located outdoors, at grade. The material being handled is a flammable liquid.

Figure 3-4.2 shows a source of leakage located outdoors, above grade. The material being handled is a flammable liquid.

Figure 3-4.3 shows a source of leakage located indoors, at floor level. Adequate ventilation is provided. The material being handled is a flammable liquid.

Figure 3-4.4 shows a source of leakage located indoors, above floor level. Adequate ventilation is provided. The material being handled is a flammable liquid.

Figure 3-4.5 shows a source of leakage located indoors, at floor level, adjacent to an opening in an exterior wall. Adequate ventilation is provided. The material being handled is a flammable liquid.

Figure 3-4.6 shows a source of leakage located indoors, at floor level, adjacent to an opening in an exterior wall. Ventilation is not adequate. The material being handled is a flammable liquid.

Figure 3-4.7 shows a source of leakage located outdoors, at grade. The material being handled may be a flammable liquid or a liquefied or compressed flammable gas, or a cryogenic liquid.

Figure 3-4.8 shows a source of leakage located outdoors, above grade. The material being handled may be a flammable liquid or a liquefied or compressed flammable gas, or a cryogenic liquid.

Figure 3-4.9 shows a source of leakage located outdoors, at grade. The material being handled is a flammable liquid. (From API RP500A.)

Figure 3-4.10 shows a source of leakage located outdoors, above grade. The material being handled is a flammable liquid. (From API RP500A.)

Figure 3-4.11 shows a source of leakage located indoors, adjacent to an opening in an exterior wall. Ventilation is not adequate. The material being handled is a flammable liquid.

Figure 3-4.12 shows a source of leakage located indoors, adjacent to an opening in an exterior wall. Adequate ventilation is provided. The material being handled is a flammable liquid.

Figure 3-4.13 shows multiple sources of leakage, located both at grade and above grade, in an outdoor process area. The material being handled is a flammable liquid.

Figure 3-4.14 shows multiple sources of leakage, located both at grade and above grade, in an outdoor process area. The material being handled is a flammable liquid.

Figure 3-4.15 shows multiple sources of leakage, located both at and above floor level, in an adequately ventilated building. The material being handled is a flammable liquid.

Figure 3-4.16 shows multiple sources of leakage, located both at and above floor level, in an adequately ventilated building. The material being handled is a flammable liquid.

Figure 3-4.17 shows a product-dryer located in an adequately ventilated building. The product dryer system is totally enclosed. The material being handled is a solid wet with a flammable liquid.

Figure 3-4.18 shows a plate and frame filter press. Adequate ventilation is provided. The material being handled is a solid wet with a flammable liquid.

Figure 3-4.19 shows a product storage tank located outdoors, at grade. The material being stored is a flammable liquid. (From API RP500A.)

Figure 3-4.20 shows tank car (or tank truck) loading and unloading via a closed transfer system. Material is transferred only through the dome. The material being transferred may be a liquefied or compressed flammable gas or a cryogenic liquid.

Figure 3-4.21 shows tank car (or tank truck) loading and unloading via a closed transfer system. Material is transferred only through the dome. The material being transferred may be a liquefied or compressed flammable gas or a cryogenic liquid.

Figure 3-4.22 shows tank car (or tank truck) loading and unloading via an open transfer system. Material is transferred either through the dome or the bottom fittings. The material being transferred is a flammable liquid.

Figure 3-4.23 shows tank car (or tank truck) loading and unloading via a closed transfer system. Material is transferred only through the dome. The material being transferred may be a liquefied or compressed flammable gas or a cryogenic liquid.

Figure 3-4.24 shows a drum filling station located either outdoors or indoors in an adequately ventilated building. The material being handled is a flammable liquid.

Figure 3-4.25 shows an emergency impounding basin for oil/water separator and an emergency or temporary drainage ditch for oil/water separator. The material being handled is a flammable liquid.

Figure 3-4.26 shows a liquid hydrogen storage facility located outdoors or indoors in an adequately ventilated building. This diagram applies to liquid hydrogen only.

Figure 3-4.27 shows a gaseous hydrogen storage facility located outdoors or indoors in an adequately ventilated building. This diagram applies to gaseous hydrogen only.

Figure 3-4.28 shows an adequately ventilated compressor shelter. The material being handled is a lighter-than-air gas. (From API RP500A.)

Figure 3-4.29 shows an inadequately ventilated compressor shelter. The material being handled is a lighter-than-air gas. (From API RP500A.)

Figure 3-4.30 shows storage tanks for the storage of cryogenic and other cold liquefied flammable gases. (From NFPA 59A, Standard for the Production, Storage and Handling of Liquefied Natural Gas.)

Figure 3-4.31 shows a source of leakage from equipment handling liquefied natural gas or other cold liquefied flammable gas, and located outdoors, at or above grade. (From NFPA 59A, Standard for the Production, Storage and Handling of Liquefied Natural Gas.)

Figure 3-4.32 shows a source of leakage from equipment handling liquefied natural gas or other cold liquefied flammable gas and located indoors in an adequately ventilated building. (From NFPA 59A, Standard for the Production, Storage and Handling of Liquefied Natural Gas.)

Figure 3-4.33 shows the classified zones around liquefied natural gas operating bleeds, drips, vents and drains both outdoors, at or above grade, and indoors in an adequately ventilated building. This diagram also applies to other cold liquefied flammable gases. (From NFPA 59A, Standard for the Production, Storage and Handling of Liquefied Natural Gas.)

Figure 3-4.34 shows tank car (or tank truck) loading and unloading via a closed transfer system. Material is transferred only through the dome. The material being transferred may be a liquefied or compressed flammable gas or a cryogenic liquid.

Figure 3-4.35 shows a product-dryer located in an adequately ventilated building. The product dryer system is totally enclosed. The material being handled is a solid wet with a flammable liquid.

Figure 3-4.36 shows a plate and frame filter press. Adequate ventilation is provided. The material being handled is a solid wet with a flammable liquid.

Figure 3-4.37 shows a product storage tank located outdoors, at grade. The material being stored is a flammable liquid. (From API RP500A.)

Figure 3-4.38 shows tank car (or tank truck) loading and unloading via a closed transfer system. Material is transferred only through the dome. The material being transferred is a flammable liquid.

Figure 3-4.39 shows tank car (or tank truck) loading and unloading via an open transfer system. Material is transferred either through the dome or the bottom fittings. The material being transferred is a flammable liquid.

Figure 3-4.40 shows tank car (or tank truck) loading and unloading via a closed transfer system. Material is transferred only through the dome. The material being transferred may be a liquefied or compressed flammable gas or a cryogenic liquid.

Figure 3-4.41 shows a product-dryer located in an adequately ventilated building. The product dryer system is totally enclosed. The material being handled is a solid wet with a flammable liquid.

Figure 3-4.42 shows a plate and frame filter press. Adequate ventilation is provided. The material being handled is a solid wet with a flammable liquid.

Figure 3-4.43 shows a product storage tank located outdoors, at grade. The material being stored is a flammable liquid. (From API RP500A.)

Figure 3-4.44 shows tank car (or tank truck) loading and unloading via a closed transfer system. Material is transferred only through the dome. The material being transferred is a flammable liquid.

Figure 3-4.45 shows tank car (or tank truck) loading and unloading via an open transfer system. Material is transferred either through the dome or the bottom fittings. The material being transferred is a flammable liquid.

Figure 3-4.46 shows tank car (or tank truck) loading and unloading via a closed transfer system. Material is transferred only through the dome. The material being transferred may be a liquefied or compressed flammable gas or a cryogenic liquid.

Figure 3-4.47 shows a product-dryer located in an adequately ventilated building. The product dryer system is totally enclosed. The material being handled is a solid wet with a flammable liquid.

Figure 3-4.48 shows a plate and frame filter press. Adequate ventilation is provided. The material being handled is a solid wet with a flammable liquid.

Figure 3-4.49 shows a product storage tank located outdoors, at grade. The material being stored is a flammable liquid. (From API RP500A.)

Figure 3-4.50 shows tank car (or tank truck) loading and unloading via a closed transfer system. Material is transferred only through the dome. The material being transferred is a flammable liquid.
Figure 3-4.1 Leakage Source Located Indoors, Above Floor Level. Adequate Ventilation is Provided.

Figure 3-4.2 Leakage Source Located Outdoors, Above Grade.

Figure 3-4.3 Leakage Source Located Indoors, at Floor Level. Adequate Ventilation is Provided.

Figure 3-4.4 Leakage Source Located Indoors, Above Floor Level. Adequate Ventilation is Provided.

Figure 3-4.5 Leakage Source Located Indoors, at Floor Level, Adjacent to Opening in Exterior Wall. Adequate Ventilation is Provided.
Figure 3-4.6 Leakage Source Located Indoors, at Floor Level, Adjacent to Opening in Exterior Wall. Adequate Ventilation Is Not Provided

NOTE: If building is small compared to size of equipment and leakage can fill the building, the entire building interior is classified Division 1.

Figure 3-4.7 Leakage Source Located Outdoors, at Grade

Figure 3-4.8 Leakage Source Located Outdoors, Above Grade

Figure 3-4.9 Leakage Source Located Outdoors, at Grade
Figure 3-4.10 Leakage Source Located Outdoors, Above Grade. (From API Recommended Practice 500A)

Figure 3-4.11 Leakage Source Located Indoors, Adjacent to Opening in Exterior Wall. Adequate Ventilation Is Not Provided. (From API Recommended Practice 500A)

Figure 3-4.12 Leakage Source Located Indoors, Adjacent to Opening in Exterior Wall. Adequate Ventilation Is Provided.

Figure 3-4.13 Multiple Leakage Sources, Both At and Above Grade in Outdoor Process Area
Figure 3-4.14 Multiple Leakage Sources, Both At and Above Grade, In Outdoor Process Area

Figure 3-4.15 Multiple Leakage Sources, Both At and Above Grade, In Outdoor Process Area

Figure 3-4.16 Multiple Leakage Sources, Both At and Above Floor Level, Located Indoors. Adequate Ventilation Is Provided

Figure 3-4.17 Totally Enclosed Product Dryer Located in Adequately Ventilated Building
Figure 3-4.18 Plate and Frame Filter Press Provided with Adequate Ventilation

Figure 3-4.19 Storage Tanks, Outdoors at Grade. (From API Recommended Practice 500A)

Figure 3-4.20 Tank Car/Tank Truck Loading and Unloading via Closed System. Transfer through Dome Only.

Figure 3-4.21 Tank Car/Tank Truck Loading and Unloading via Closed System. Bottom Product Transfer Only.
Below grade location such as sump

Division 1  Division 2
MATERIAL: Flammable Liquid

Figure 3-4.22 Tank Car/Tank Truck Loading and Unloading Via Open System. Top or Bottom Product Transfer.

Vapor return line

Liquid transfer pipe

15' Radius

5' Radius

Division 1  Division 2
MATERIAL: Liquefied Gas
Compressed Gas
Cryogenic Liquid

Figure 3-4.23 Tank Car/Tank Truck Loading and Unloading Via Closed System. Transfer Through Dome Only.

Fill pipe

Vent

3' Radius

10' Radius

Division 1  Division 2
MATERIAL: Flammable Liquid

Figure 3-4.24 Drum Filling Station, Outdoors or Indoors with Adequate Ventilation

Figure 3-4.25 Emergency Impounding basin or Oil Water Separator (Top) and Emergency or Temporary Drainage Ditch Oil/Water Separator (bottom).

NOTE: This diagram does not apply to open pits or open vessels, such as dip tanks or open mixing tanks, that normally contain flammable liquids.
Figure 3-4.26 Liquid Hydrogen Storage System Located Outdoors or in an Adequately Ventilated Building

Figure 3-4.27 Gaseous Hydrogen Storage System, Located Outdoors or Indoors in an Adequately Ventilated Building.

Figure 3-4.28 Adequately Ventilated Compressor Shelter (API Recommended Practice 500A)

Figure 3-4.29 Inadequately Ventilated Compressor Shelter (API Recommended Practice 500A)

Figure 3-4.30 Storage Tanks for Cryogenic Liquids. (From NFPA 59A, Standard for the Production, Storage and Handling of Liquefied Natural Gas)
Figure 3-4.31 Leakage Source from Equipment Handling Liquefied Natural Gas. Source Is Located At or Above Grade.

Figure 3-4.32 Leakage Source from Equipment Handling Liquefied Natural Gas in an Adequately Ventilated Building.

Figure 3-4.33 Operating Bleeds, Drips, Vents from Liquefied Natural Gas Equipment

Chapter 4 Referenced Publications

4-1 The following documents or portions thereof are referenced within this recommended practice and should be considered part of the recommendations of this document. The edition indicated for each reference is current as of the date of the NFPA issuance of this document. These references are listed separately to facilitate updating to the latest edition by the user.

4-1.1 NFPA Publications. National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

NFPA 30-1984, Flammable and Combustible Liquids Code
NFPA 58-1983, Standard for the Storage and Handling of Liquefied Petroleum Gas
NFPA 59A-1985, Standard for the Production, Storage and Handling of Liquefied Natural Gas (LNG)
NFPA 70-1984, NATIONAL ELECTRICAL CODE.

4-1.2 API Publication. The following publication is available from the American Petroleum Institute, 2101 L Street, NW, Washington, DC 20037.


Appendix A Referenced Publications

A-1 The following documents or portions thereof are referenced within this recommended practice for informational purposes only, and thus shall not be considered part of the recommendations of this document. The edition indicated for each reference is current as of the date of the NFPA issuance of this document. These references are listed separately to facilitate updating to the latest edition by the user.


NFPA 33-1985, Standard for Spray Application Using Flammable and Combustible Materials
NFPA 34-1982, Standard for Dip Tanks Containing Flammable or Combustible Liquids
NFPA 35-1982, Standard for Organic Coatings Manufacture
NFPA 36-1985, Standard for Solvent Extraction Plants
NFPA 50A-1984, Standard for Gaseous Hydrogen Systems at Consumer Sites
PART II

497M-1 - (1-3): Reject
SUBMITTER: D. B. Wechsler, Union Carbide Corp.
RECOMMENDATION: Add new definition as follow:
COMMITTEE ACTION: Accept.

letes: Technical Committee on Electrical Equipment in Chemical Atmospheres
RECOMMENDATION: Move the entries for isopropyl alcohol from Table 2-3
SUBMITTER: Technical Committee on Electrical Equipment in Chemical Atmospheres
RECOMMENDATION: Move the entry for isopropyl alcohol from Table 2-3
SUBMITTER: Technical Committee on Electrical Equipment in Chemical Atmospheres
RECOMMENDATION: Move the entry for isopropyl alcohol from Table 2-3

497M-2 - (Table 3-5, Note 2): Reject
SUBMITTER: D. B. Wechsler, Union Carbide Corp.
SUBSTANTIATION: The title of Table 3-5 informs the user that the items listed are "selected, nonconductive dusts, classified as Group G." Thus while it may be possible for the referenced carbonaceous dust materials to be conductive and hence be different from the listed variety, differences may also exist for other dusts listed in this table depending on the real world applications. Further using the classic Frank-Kamenetski thermal theory, it can be demonstrated that as the conductivity of a dust increases, so will the ignition temperature. The notation thus provides misinformation to the user regarding the conductive type of carbonaceous dusts, because it does not give ignition temperature values for the different variety of carbonaceous dusts.
COMMITTEE ACTION: Reject.
COMMITTEE COMMENT: The Committee is reluctant to eliminate the footnote because it warns the user of a particular problem with those particular dusts.

Editorial Corrections
The Committee has identified the following editorial corrections to NFPA 497M.

1-1 Revise first sentence to read: "...classification into the groups established by the National Electrical Code for proper selection of electrical equipment in hazardous (classified) locations."
Definition of Class I, Division 2: Insert comma after the word "processed" in line two. Insert comma after the word "vapors" in line three.
2-2 In last sentence, change "those" to "these."
2-2 In last sentence, change "cruled" to "selected."
2-3 In first sentence, delete comma.
2-4 In first sentence, delete comma.
2-5 In first sentence, delete comma.

PART III

497M-1 - (Entire Document): Accept
SUBMITTER: Technical Committee on Hazardous Chemical Reactions
SUBSTANTIATION: NFPA 491M is still suitable for current use.
COMMITTEE ACTION: Accept.
COMMITTEE COMMENT:
1-1 Scope.

1-1.1 This code shall apply only to commercially available organic peroxide formulations in approved packages, as defined in Section 1-5.

1-1.2 This code shall not apply to the storage of such formulations in process areas where they are manufactured or used.

1-1.3 This code does not apply to organic peroxide formulations that are capable of detonation in their normal shipping containers under conditions of fire exposure. Such formulations shall be handled and stored as Class A explosives in accordance with NFPA 495, Code for the Manufacture, Transportation, Storage and Use of Explosive Materials.

1-2 Purpose. The purpose of this code is to provide reasonable requirements for the safe storage of commercially available formulations containing organic peroxides.

1-3 Applicability of Other Documents. The requirements of NFPA 30, Flammable and Combustible Liquids Code, and NFPA 231, Standard on General Storage, shall apply where applicable and where they are more restrictive than this code.

1-4 Equivalency. Nothing in this standard is intended to prevent the use of systems, methods, or devices which provide equivalent protection from fire and explosion, provided that suitable data is available to demonstrate equivalency.

1-5 Definitions. For the purpose of this code, the following terms shall have the meanings given below.

Approved. Acceptable to the "authority having jurisdiction."

NOTE: The National Fire Protection Association does not approve, inspect or certify any installations, procedures, equipment, or materials nor does it approve or evaluate testing laboratories. In determining the acceptability of installations or procedures, equipment or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization concerned with product evaluations which is in a position to determine compliance with appropriate standards for the current production of listed items.

[Further text not visible]
NOTE: The phrase "authority having jurisdiction" is used in NFPA documents in a broad manner since jurisdictions and "approval" agencies vary as do their responsibilities. Where particular authority is involved, the "authority having jurisdiction" may be a federal, state, local or other regional department or individual such as a fire chief, fire marshal, chief of a fire prevention bureau, labor department, health department, building official, electrical inspector, or others having statutory authority. For insurance purposes, an insurance inspection rating bureau or other insurance company representative may be the "authority having jurisdiction." In many circumstances the property owner or his designated agent assumes the role of the "authority having jurisdiction" at government installations, the commanding officer or departmental official may be the "authority having jurisdiction."  

Deflagration. Propagation of a combustion zone at a velocity which is less than the speed of sound in the unreacted medium.  

Detonation. Propagation of a combustion zone at a velocity which is at or above the speed of sound in the unreacted medium.  

Explosive Decomposition. Rapid chemical reaction resulting in a large, almost instantaneous, release of energy. The term includes both deflagration and detonation.  

Incompatible Materials. Materials which can initiate, catalyze or accelerate the decomposition of organic peroxide formulations or which can cause hazardous reactions when in contact with such formulations.  

Listed. Equipment or materials to which has been attached a label, symbol or other identifying mark of an organization acceptable to the "authority having jurisdiction" and concerned with product evaluation, that maintains periodic inspection of production of listed equipment or materials and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.  

Labeled. Equipment or materials to which has been attached a label, symbol or other identifying mark of an organization acceptable to the "authority having jurisdiction" and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.  

NOTE: The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The "authority having jurisdiction" should utilize the system employed by the listing organization to identify a listed product.  

Organic Peroxide. Any organic compound having a double oxygen or "peroxy" (-O-O-) group in its chemical structure.  

Organic Peroxide Formulation.* A pure organic peroxide or a mixture of one or more organic peroxides with one or more other materials in various combinations and concentrations.  

Organic Peroxide Storage Area. An area used for the storage of organic peroxide formulations.  

Shall. Indicates a mandatory requirement.  

Should. Indicates a recommendation or that which is advised but not required.  

1-6* Classification of Organic Peroxide Formulations. For the purpose of this code, organic peroxide formulations shall be classified according to the system described in this section. The system is based on the behavior of certain specific formulations in their U.S. Department of Transportation approved shipping containers and under conditions of fire exposure. (See Appendix B for classification of Typical Organic Peroxide Formulations.)  

1-6.1 "Class I" shall describe those formulations which are capable of deflagration, but not detonation.  

1-6.2 "Class II" shall describe those formulations which burn very rapidly and which present a severe reactivity hazard.  

1-6.3 "Class III" shall describe those formulations which burn rapidly and which present a moderate reactivity hazard.  

1-6.4 "Class IV" shall describe those formulations which burn in the same manner as ordinary combustibles and which present a minimal reactivity hazard.  

1-6.5 "Class V" shall describe those formulations which do not sustain combustion and which present no reactive hazard.  

1-7 Classification of Storage Facilities.  

1-7.1 Segregated storage refers to storage in the same room or inside area, but physically separated by distance from incompatible materials. Sills, curbs, intervening storage of nonhazardous compatible materials, and aisles may be used as aids in maintaining spacing. (See Chapter 3.)  

1-7.2 Cut-off storage refers to storage in the same building or inside area, but physically separated by distance from incompatible materials by partitions or walls. (See Chapter 4.)  

1-7.3 Detached storage refers to storage in a separate building or in an outside area located away from all other structures. (See Chapter 5.)  

Chapter 2 Basic Requirements  

2-1 Identification of Materials in Storage. All storage areas containing organic peroxide formulations shall be conspicuously identified by the words "Organic Peroxides" and by the class, as defined in Section 1-6.  

2-1.1* When organic peroxide formulations having different classifications as defined by Section 1-6 are stored in the same area, the area shall be marked for the most severe class present.  

2-1.2 Packages containing organic peroxide formulations shall be individually marked with the chemical name of the organic peroxide or with other information suitable and adequate to allow proper area classification as required by this section.  

2-1.3 Packages containing organic peroxide formulations that require temperature control shall be marked with the recommended storage temperature range.  

2-2 Employee Instruction. Personnel involved in operations in organic peroxide storage areas shall be instructed in proper and safe handling of such materials, proper use of personal protective equipment, proper and safe disposal of spilled material, and proper emergency procedures. Manufacturers' instructions shall be consulted for each specific formulation.  

2-3 Building Construction. Any construction materials that may come in contact with organic peroxide formulations shall be compatible with the materials stored.  

2-4 Heating and Cooling.  

2-4.1 Storage areas shall be maintained within the recommended storage temperature range for the materials stored.  

2-4.2 When the required storage temperature range extends beyond normal ambient temperatures, high or low temperature limit switches, as applicable, shall be provided in addition to the normal temperature controls. These limit switches shall actuate an alarm arranged to ensure prompt response.  

2-4.3 Heating systems shall use hot water, low pressure (less than 15 psig [103.4 kPa-gage]) steam, or indirectly heated water. Air conditioning systems shall not utilize direct expansion of a flammable gas.  

2-4.4 Heating coils, radiators, air diffusers, cooling coils, piping and ducts shall be installed so as to prevent direct contact with containers and to prevent overheating or overcooling of the materials stored.  

2-5 Electrical Installations.  

2-5.1 Electrical installations shall meet all applicable requirements of NFPA 70, NATIONAL ELECTRICAL CODE.  

2-5.2 The interior of any refrigerator or freezer cabinet used for the storage of Class I, II, or III organic peroxide formulations shall be considered a Class I, Group D, Division 1 location as defined in Article 500 of NFPA 70; NATIONAL ELECTRICAL CODE. Any electrical equipment installed in the interior of such cabinets shall be approved for such use and shall be installed according to the requirements of Article 501 of NFPA 70, NATIONAL ELECTRICAL CODE.  

2-5.3* Any area used for the storage of any organic peroxide formulation that is considered to be a flammable liquid according to NFPA 321, Basic Classification of Flammable and Combustible Liquids, or which evolves flammable gases when heated to 308°C shall be considered a Class I, Group D, Division 2 location as defined by Article 500 of NFPA 70, NATIONAL ELECTRICAL CODE. Any electrical equipment installed in such areas shall be approved for such use and shall be installed according to the requirements of Article 501 of NFPA 70, NATIONAL ELECTRICAL CODE.  

2-6 Ventilation. Mechanical exhaust ventilation, with suction pick-ups at floor level, shall be provided for the storage areas described in 2-5.3. Installations shall meet the requirements of 4-4.1.16 of NFPA 30, Flammable and Combustible Liquids Code.

41
2-7 Smoking. Smoking shall be prohibited in all organic peroxide storage areas. "No Smoking" signs shall be placed conspicuously within and at all entrances to storage areas.

2-8 Maintenance Operations.

2-8.1 Maintenance operations in organic peroxide storage areas shall be subject to prior review by and approval of supervisory personnel.

2-8.2 Cutting and welding operations in organic peroxide storage areas shall not be conducted until all organic peroxide formulations have been removed. Cutting and welding operations shall be conducted according to the requirements of NFPA 51B, Standard for Fire Prevention in Use of Cutting and Welding Processes.

2-9 Fire Protection.

2-9.1 Manual fire fighting equipment shall be provided and maintained according to the requirements of NFPA 10, Standard for Portable Fire Extinguishers, and NFPA 14, Standard for the Installation of Standpipe and Hose Systems.

2-9.2 Where required by other provisions of this code, automatic sprinklers and water spray systems shall be designed and installed according to the requirements of NFPA 13, Standard for the Installation of Sprinkler Systems, and NFPA 15, Standard for Water Spray Fixed Systems for Fire Protection, and shall provide the following discharge densities:

<table>
<thead>
<tr>
<th>Class</th>
<th>Discharge Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>0.40 gpm/sq. 12</td>
</tr>
<tr>
<td>II</td>
<td>0.35 gpm/sq. 12</td>
</tr>
<tr>
<td>III</td>
<td>0.30 gpm/sq. 12</td>
</tr>
<tr>
<td>IV</td>
<td>0.25 gpm/sq. 10</td>
</tr>
</tbody>
</table>

2-9.2.1 The system shall be designed to provide the required discharge density over a 3000 sq ft (279 m²) area or over the entire area of any building of less than 3000 sq ft (279 m²).

2-9.3 Where required water supplies for automatic sprinklers, fire hydrants, etc. shall be provided in accordance with NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances, and shall be capable of supplying the anticipated demand for at least 90 min.

2-10 Housekeeping and Waste Disposal.

2-10.1 Any accumulation of combustible waste in organic peroxide storage areas shall be prohibited.

2-10.2* Spilled material and leaking or damaged containers and packages shall immediately be removed to a safe location for disposal.

2-10.3 Specific disposal procedures shall be established for all organic peroxide storage areas. Disposal procedures shall conform to all applicable federal, state and local regulations and with the manufacturers' recommendations.

2-11 Storage Limitations.

2-11.1 Storage of organic peroxide formulations shall be limited to those areas within the scope of this code. The maximum allowable quantities of organic peroxide formulations that can be stored in a single area or building shall depend on the classification of the formulations and the classification of the storage facility, as set forth in Table 2-11.

<table>
<thead>
<tr>
<th>Class</th>
<th>Storage</th>
<th>Segregated Cut-Off</th>
<th>Detached Storage-Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>NS</td>
<td>0</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>AS</td>
<td>2000*</td>
<td>2000</td>
</tr>
<tr>
<td>II</td>
<td>NS</td>
<td>0</td>
<td>2000</td>
</tr>
<tr>
<td></td>
<td>AS</td>
<td>4000</td>
<td>1000</td>
</tr>
<tr>
<td>III</td>
<td>NS</td>
<td>1,500</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>AS</td>
<td>50,000</td>
<td>1000</td>
</tr>
<tr>
<td>IV</td>
<td>NS</td>
<td>100,000</td>
<td>2000</td>
</tr>
<tr>
<td></td>
<td>AS</td>
<td>200,000</td>
<td>2000</td>
</tr>
<tr>
<td>V</td>
<td>NS/AS</td>
<td>UNL</td>
<td>UNL</td>
</tr>
<tr>
<td></td>
<td>UNL</td>
<td>UNL</td>
<td>UNL</td>
</tr>
</tbody>
</table>

2-11.2* When two or more different classes of organic peroxide formulations are stored in the same area, the maximum quantity permitted shall be limited to the sum of the proportional amounts that each class bears to the maximum permitted for that class. The total of the proportional amounts shall not exceed 100 percent.

2-11.4 The quantities of organic peroxide formulations in storage may deviate from the requirements of this section and other sections of this code when the storage area is protected by a specially engineered fire protection system acceptable to the authority having jurisdiction. The adequacy of any such system shall be supported by appropriate technical documentation.

2-11.5 Organic peroxide formulations shall not be stored where they may be exposed to explosive materials.

2-12 Storage Arrangements.

2-12.1 Storage shall be arranged to facilitate manual access and handling, to maintain pile stability, to minimize breakage and spillage, and to promote good housekeeping.

2-12.2 A clear space of at least 2 ft (.6 m) shall be maintained between organic peroxide storage and uninsulated metal walls.

2-12.3 Incompatible materials shall not be stored in the same storage area with organic peroxide formulations.

Exception: As permitted in accordance with 3-4.2.

2-12.4 Only closed containers and packages shall be permitted in storage areas.

2-12.5 Bulk storage in bins or piles shall not be permitted.

2-12.6 Storage of Class V organic peroxide formulations need only meet the requirements of NFPA 231, Standard for General Storage, or NFPA 231C, Standard for Rack Storage of Materials, as applicable.

2-12.7 Storage of Class IV organic peroxide formulations shall meet the following requirements:

(a) Bags, drums, and other containers and packages shall not be stored more than 10 ft (.3 m) high. Pile width shall not exceed 16 ft (.5 m).

(b) At least one main aisle, at least 4 ft (.12 m) wide, shall be provided to divide the storage area. All other aisles shall be not less than 3 ft wide (.9 m).

2-12.8 Storage of Class III and Class II formulations shall meet the following requirements:

(a) Bags and other containers and packages shall not be stored more than 8 ft (.24 m) high. Pile width shall not exceed 8 ft.

(b) 55 gal. (208 L) drums shall be stored one high only.

(c) At least one main aisle, at least 6 ft (.18 m) wide, shall be provided to divide the storage area. All other aisles shall be not less than 4 ft (.12 m) wide.

2-12.9* Storage of Class I formulations shall meet the following requirements:

(a) Bags, drums, and other containers and packages shall not be stored more than 6 ft (.18 m) high. Pile width shall not exceed 4 ft (.12 m).

(b) At least one main aisle, at least 8 ft (.24 m) wide, shall be provided to divide the storage area. All other aisles shall be not less than 4 ft (.12 m) wide.

Chapter 3 Segregated Storage

3-1 Scope. This chapter shall apply to the storage of organic peroxide formulations when stored under segregated conditions as defined in Section 1-7 of this code and in quantities not exceeding those shown in Table 2-11.

3-2 Basic Requirements. The basic requirements set forth in Chapter 2 shall apply to the segregated storage of organic peroxide formulations.

3-3 Building Construction. If there are any floors or open spaces located below the organic peroxide storage area, the floor area of the storage area shall be made watertight and shall be provided with drainage that leads to a safe location. Every means shall be taken to ensure that spilled material cannot run down into areas below the organic peroxide storage area.

I lb = 0.454 Kg; ft = 0.305 m.
3-4 Storage Arrangement.

3-4.1 A minimum 8 ft (2.4 m) clear space shall be maintained between organic peroxide storage and any other storage.

3-4.2 Flammable liquids or incompatible materials shall not be stored within 25 ft (7.6 m) of the organic peroxide storage area unless separated by a wall having a fire resistance rating of at least one hour, as measured by the procedure described in NFPA 251, Standard Methods of Fire Tests of Building Construction and Materials, and sealed or curbed where necessary.

3-4.3 Segregated storage areas shall meet all applicable requirements of NFPA 231, Standard for General Storage, or NFPA 231C, Standard for Rack Storage of Materials, as applicable.

3-4.4 A clear space of at least 4 ft (1.2 m) shall be maintained between organic peroxide storage and any walls of combustible or limited-combustible construction. (See NFPA 220, Construction and Materials.

3-5 Fire Protection. Automatic sprinkler protection shall be provided for segregated storage areas, in accordance with subsections 2-9.2 and 2-9.1, under the following conditions:

(a) Wherever storage of Class IV formulations exceeds 100,000 lb (45,400 kg).

(b) Wherever storage of Class III formulations exceeds 1,500 lb (681 kg).

(c) Wherever Class II formulations are stored, regardless of floor area or quantity.

Chapter 4 Cut-off Storage

4-1 Scope. This chapter shall apply to the storage of organic peroxide formulations when stored under cut-off conditions as defined in Section 1-7 of this code and in quantities not exceeding those shown in Table 2-11.

4-2 Basic Requirements. The basic requirements set forth in Chapter 2 shall apply to cut-off storage of organic peroxide formulations.

4-3 Building Construction.

4-3.1 Cut-off storage areas shall be single story, without basements or crawl spaces.

4-3.2 Where Class I organic peroxide formulations are stored, internal walls shall be capable of withstanding internal pressure of 3 psig (20.7 kPa-gage).

4-3.3 Where any Class I, Class II or any refrigerated organic peroxides are stored, any wall, roof, or ceiling which exposes another occupied building shall be capable of withstanding an internal pressure of 125 psf (6 kPa) without failure.

4-3.3.1 For Class I, Class II, or any refrigerated Class III organic peroxide formulation, the storage area shall be provided with deflagration vents at a ratio of not less than one square foot of flat area to 30 cu ft (1 m²/9 m³) of building or room volume. (See NFPA 43B, Guide for Deflagration Venting, for information on vent design.)

4-3.4 Any walls common with another building shall have a fire resistance of at least two hours, as measured by the procedure described in NFPA 251, Standard Methods of Fire Tests of Building Construction and Materials.

4-3.4.1 Any door or window openings in such walls shall be protected by approved fire doors and fire windows suitable for the opening and installed according to NFPA 80, Standard for Fire Doors and Windows.

4-3.5 The storage area shall be provided with vents to discharge decomposition gases. Roof vents, eave vents, louvers, etc., are acceptable. The vent ratio for decomposition vents shall be not less than 1 sq ft of free vent area to 100 sq ft (1 m²/100 m²) of floor area.

Exception: This requirement does not apply to buildings where temperature control is maintained in accordance with Section 2-4.

4-4 Storage Arrangement. A clear space of at least 4 ft shall be maintained between organic peroxide storage and any walls of combustible or limited-combustible construction. (See NFPA 220, Standard on Types of Building Construction.

4-5 Fire Protection.

4-5.1 Automatic sprinkler protection in accordance with 2-9.2 and 2-9.3 shall be provided for all storage areas of combustible construction, regardless of the Class of formulation stored, and for all storage areas of noncombustible construction where any quantity of Class I organic peroxide formulations are stored. Automatic sprinkler protection shall also be provided for all storage areas of noncombustible construction when quantities exceed:

- 2000 lb (908 Kg) for Class I;
- 3000 lb (1362 Kg) for Class II;
- 200,000 lb (90,800 Kg) for Class IV.

Chapter 5 Detached Storage

5-1 Scope. This chapter shall apply to the storage of organic peroxide formulations when stored under detached conditions as defined in Section 1-7 in quantities not exceeding those shown in Table 2-11.

5-2 Basic Requirements. The basic requirements set forth in Chapter 2 shall apply to detached storage of organic peroxide formulations.

5-3 Building Location. Detached storage buildings shall be separated from normally occupied buildings and from property lines by the distances specified in Table 2-11.

5-3.1 Detached storage buildings shall be separated from normally occupied buildings by the distances specified in Table 2-11.

5-3.2 For Classes II, III, and IV organic peroxide formulations, detached storage buildings shall be separated from each other by at least 50 ft (15.3 m) if the total quantity stored exceeds the maximum quantity allowed in Table 2-11.

5-3.3 For Class I organic peroxide formulations, detached storage buildings shall be separated from each other in accordance with Table 5-3-3.

Table 5-3-3 Separation of Individual Storage Buildings

<table>
<thead>
<tr>
<th>NS</th>
<th>AS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity, lbs</td>
<td>1,000</td>
</tr>
<tr>
<td>Distance, ft</td>
<td>20</td>
</tr>
</tbody>
</table>

For SI units: 1 lb = 0.454 kg; 1 ft = 0.305 m.

5-4 Building Construction and Utilities.

5-4.1 Detached storage buildings shall be single story, without basement or crawl space.

5-4.2 Nonsprinklered buildings for storing more than 5000 lb (2270 Kg) of organic peroxide formulations shall meet the following requirements:

(a) Construction materials shall be noncombustible.

(b) Roofs shall be of light-weight construction, suitably insulated.

5-4.3 The storage building shall be provided with vents to discharge decomposition gases. Roof vents, eave vents, louvers, etc., are acceptable. The vent ratio for decomposition vents shall be not less than 1 sq ft of free vent area to 100 sq ft (1 m²/100 m²) of floor area.

Exception: This requirement does not apply to buildings where temperature control is maintained in accordance with Section 2-4.

5-4.4 For storage of Class I and II organic peroxide formulations, the storage building shall be provided with deflagration vents at a ratio of not less than 1 sq ft of free vent area to 30 cu ft of building volume (1 m²/9 m³). (See NFPA 68, Guide for Deflagration Venting, for information on vent design.)

5-4.5 Sun shields such as those illustrated in Figure A-5-4.5 may be used for detached storage buildings in those areas where the temperature inside the storage building may approach or exceed the maximum recommended storage temperature.

5-5 Storage Arrangement.

5-5.1 No incompatible materials shall be stored in the same detached storage building with organic peroxide formulations.

5-5.1.1 When flammable or combustible liquids are stored with organic peroxide formulations, the requirements of NFPA 30, Flammable and Combustible Liquids Code, shall apply when they are more restrictive than this code.
A-2-11.3 For example, a sprinklered building, detached by 50 ft may contain up to 500 lb of Class I formulations, 50,000 lb of Class II, and 50,000 lb of Class III, according to the following ratios:

$$
\begin{align*}
&500 \text{ lb} \times 100 = 25\% \\
&2000 \text{ lb (max)}
\end{align*}
$$

and

$$
\begin{align*}
&50,000 \text{ lb} \times 100 = 50\% \\
&100,000 \text{ lb (max)}
\end{align*}
$$

In no case does the quantity in storage exceed the maximum for its class, nor does the sum of the percentages exceed 100 percent.

A-2-12.9 Since no commercially available Class I organic peroxide formulations are supplied in 55-gal drums, there is no requirement for such storage.

A-5-4.5 The following diagram is an example of a suitable building for detailed storage of up to 5000 lbs of organic peroxide formulations.

Figure A-5-4.5

Appendix A Typical Organic Peroxide Formulations

This Appendix is not a part of the requirements of this NFPA document, but is included for information purposes only.

8-1 Class I Formulations.

B-1.1 Fire Hazard Characteristics. Class I formulations present a deflagration hazard through easily initiated, rapid explosive decomposition. Class I includes some formulations that are relatively safe only under closely controlled temperatures. Either excessively high or low temperatures may increase the potential for severe explosive decomposition.

B-1.2 Fire Fighting Information. The immediate area should be evacuated and the fire should be fought from a remote location. Some damage to structures from overpressure can be expected, should a deflagration occur.

B-1.3 Typical Class I Formulations.

<table>
<thead>
<tr>
<th>Peroxide</th>
<th>Concentration, Weight Percent</th>
<th>Maximum Individual Container Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetyl Cyclohexane</td>
<td>60-85</td>
<td>Water 1 lb R</td>
</tr>
<tr>
<td>Benzyol Peroxide</td>
<td>98+</td>
<td>-</td>
</tr>
<tr>
<td>t-Butyl Hydperoxide</td>
<td>90</td>
<td>Water &amp; t-BuOH 5 gal</td>
</tr>
<tr>
<td>t-Butyl Peroxyacetate</td>
<td>75</td>
<td>OMS 5 gal</td>
</tr>
<tr>
<td>t-Butyl Peroxyisopropyl-carbonate</td>
<td>92</td>
<td>OMS 5 gal</td>
</tr>
<tr>
<td>Dilsopropy1 Peroxydicarbonate</td>
<td>&lt;100</td>
<td>- 10 lb R</td>
</tr>
<tr>
<td>Di-n-propyl Peroxydicarbonate</td>
<td>98</td>
<td>OMS 1 gal R</td>
</tr>
<tr>
<td>R</td>
<td>Refrigeration Required</td>
<td>OMS - Odorless Mineral Spirits</td>
</tr>
<tr>
<td>t-BuOH</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>R</td>
<td>Refrigeration Required</td>
<td>t-BuOH tertiary Butanol</td>
</tr>
</tbody>
</table>
NFPA 43B
B-2 Class II Formulations.

B-2.1 Fire Hazard Characteristics. Class II formulations present a severe fire hazard similar to Class I flammable liquids. The decomposition is not as rapid, violent, or complete as that produced by Class I formulations. As with Class I formulations, this class includes some formulations that are relatively safe when under controlled temperatures or when diluted.

B-2.2 Fire Fighting Information. Fires should be fought from a safe distance, since a hazard exists from rupturing containers.

B-2.3 Typical Class II Formulations.

<table>
<thead>
<tr>
<th>Peroxide</th>
<th>Concentration, Weight Percent</th>
<th>Container Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetyl Peroxide</td>
<td>25</td>
<td>DMP 5 gal</td>
</tr>
<tr>
<td>t-Butyl Hydroperoxide</td>
<td>70</td>
<td>DTBP 55 gal</td>
</tr>
<tr>
<td>t-Butyl Peroxybenzoate</td>
<td>98</td>
<td>- 55 gal</td>
</tr>
<tr>
<td>t-Butyl Peroxy-2-ethylhexanoate</td>
<td>97</td>
<td>OMS 5 gal R</td>
</tr>
<tr>
<td>t-Butyl Peroxyisobutyrate</td>
<td>75</td>
<td>OMS 5 gal R</td>
</tr>
<tr>
<td>t-Butyl Peroxyisopropylcarbonate</td>
<td>75</td>
<td>OMS 5 gal R</td>
</tr>
<tr>
<td>t-Butyl Peroxyisopropyl carbonate</td>
<td>75</td>
<td>OMS 5 gal R</td>
</tr>
<tr>
<td>Dibenzoyl Peroxycarbonate</td>
<td>85</td>
<td>Water 14 lb R</td>
</tr>
<tr>
<td>Di-sec-butyl Peroxydicarbonate</td>
<td>98</td>
<td>- 5 gal R</td>
</tr>
<tr>
<td>Di-sec-butyl Peroxydicarbonate</td>
<td>75</td>
<td>OMS 1 gal</td>
</tr>
<tr>
<td>1,1-Di-(t-butyl peroxy)-3,5,5- trimethylcyclohexane</td>
<td>95</td>
<td>5 gal</td>
</tr>
<tr>
<td>2,5-Dimethyl-2,5 di-(benzoylperoxy)hexane</td>
<td>92</td>
<td>50 x 1 lb, 4 x 5 lb</td>
</tr>
<tr>
<td>Peroxyacetic Acid</td>
<td>43</td>
<td>H2O 30 gal</td>
</tr>
</tbody>
</table>

R - Refrigeration Required
DMP - Dimethyl Phthalate
OMS - Odorless Mineral Spirits
H2O2 - Hydrogen Peroxide
t-BUOH - tertiary Butanol

B-3 Class II Formulations.

B-3.1 Fire Hazard Characteristics. Class III formulations present a fire hazard similar to Class II combustible liquids. They are characterized by rapid burning and high heat liberation, due to decomposition.

B-3.2 Fire Fighting Information. Caution should be observed due to possible unexpected increases in fire intensity.

B-4 Class III Formulations.

B-4.1 Fire Hazard Characteristics. Class IV Formulations present fire hazards that are easily controlled. Reactivity has little effect on fire intensity.

B-4.2 Fire Fighting Information. Normal fire fighting procedures may be used.
### Table 1: Peroxide Concentrations

| Peroxide                     | Concentration, Weight Percent | Maximum Individual Container Size
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzoyl Peroxide</td>
<td>70</td>
<td>Water 25 lb</td>
</tr>
<tr>
<td>Benzoyl Peroxide paste</td>
<td>50</td>
<td>BBP &amp; Water 300 lb</td>
</tr>
<tr>
<td>Benzoyl Peroxide slurry</td>
<td>40</td>
<td>Water &amp; Plasticizer 300 lb</td>
</tr>
<tr>
<td>Benzoyl Peroxide powder</td>
<td>35</td>
<td>Starch 100 lb</td>
</tr>
<tr>
<td>t-Butyl Hydroperoxide</td>
<td>70</td>
<td>Water 55 gal</td>
</tr>
<tr>
<td>t-Butyl Peroxy-2-ethyl hexamone</td>
<td>50</td>
<td>DOP 55 gal</td>
</tr>
<tr>
<td>Dicumyl Peroxide</td>
<td>98</td>
<td>-</td>
</tr>
<tr>
<td>Di-(2-ethylhexyl)peroxy dicarbonate</td>
<td>40</td>
<td>OMS 5 gal</td>
</tr>
<tr>
<td>Lauroyl Peroxide</td>
<td>98</td>
<td>-</td>
</tr>
<tr>
<td>p-Methylene Hydroperoxide</td>
<td>52.5</td>
<td>Alcohols &amp; Ketones 55 gal</td>
</tr>
<tr>
<td>Methyl Ethyl Ketone Peroxide</td>
<td>5.5% AO</td>
<td>DMP 5 gal</td>
</tr>
<tr>
<td>Methyl Ethyl Ketone Peroxide</td>
<td>9.0% AO</td>
<td>Water &amp; Glycols 5 gal</td>
</tr>
</tbody>
</table>

### Section B-5: Class V Formulations

#### B-5.1 Fire Hazard Characteristics

Class V formulations do not themselves burn and do not present a decomposition hazard.

#### B-5.2 Fire Fighting Information

Fire fighting procedures need only consider the combustibility of containers.

### Section B-5.3 Typical Class V Formulations

<table>
<thead>
<tr>
<th>Peroxide</th>
<th>Concentration, Weight Percent</th>
<th>Maximum Individual Container Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzoyl peroxide</td>
<td>35</td>
<td>Dicalcium Phosphate 100 lb</td>
</tr>
<tr>
<td>1,1-Di-t-butyl peroxide</td>
<td>40</td>
<td>Calcium Carbonate 100 lb</td>
</tr>
<tr>
<td>1,1,5,5-tetramethylcyclohexane</td>
<td>47</td>
<td>Inert Solid 100 lb</td>
</tr>
<tr>
<td>2,4-Pentanedione Peroxide</td>
<td>4% AO</td>
<td>Water &amp; solvent 5 gal</td>
</tr>
</tbody>
</table>

#### AO - Active Oxygen

### Appendix C: Referenced Publications

- NFPA 43B
- NFPA 43C-1 - (Entire Document): Accept
- NFPA 43C-2 - (1-2.1): Accept
- NFPA 43C-3 - (1-2.5): Accept
- NFPA 43C-4 - (2-1.1): Accept
- NFPA 43C-5 - (Chapter 4 (New) and Appendix D): Accept

### Additional Notes

- The following documents or portions thereof are referenced within this code for informational purposes only and thus should not be considered part of the requirements of this document.
- The edition indicated for each reference is current as of the date of the NFPA issuance of this document.
- These references are listed separately to facilitate updating to the latest edition by the user.
- NFPA 60-1978, Guide for DeFlagration Venting
- NFPA 220-1979, Standard on Types of Building Construction
PART VII

43D- 1 - (Entire Document): Accept
SUBMITTER: Technical Committee on Storage, Handling and Transportation of Hazardous Chemicals
RECOMMENDATION: Reread NFPA 43D as suitable for continued use.
SUBSTANTIATION: No proposals to amend NFPA 43D were received from the public or from the Technical Committee as a result of the call for proposals, other than the following Technical Committee proposals for editorial changes.
COMMITTEE ACTION: Accept.

43D- 2 - (1-1.2): Accept
SUBMITTER: Technical Committee on Storage, Handling and Transportation of Hazardous Chemicals
RECOMMENDATION: Revise to read: "This standard shall not apply to noncommercial storage in households and garages of pesticides registered for use in the home by the U.S. Environmental Protection Agency under the Federal Insecticide, Fungicide and Rodenticide Act of 1945 (FIFRA) as amended by the Federal Economic Poison Control Act of 1972 (FEPCA)."
Delete footnote.
SUBSTANTIATION: Editorial Change.
COMMITTEE ACTION: Accept.

43D- 3 - (Chapter 2, Title): Accept
SUBMITTER: Technical Committee on Storage, Handling and Transportation of Hazardous Chemicals
RECOMMENDATION: Relocate footnote to Appendix B. Add to first paragraph of Appendix B. Editorial Change.
COMMITTEE ACTION: Accept.

43D- 4 - (2-3, 2-6.1 and 2-10): Accept
SUBMITTER: Technical Committee on Storage, Handling and Transportation of Hazardous Chemicals
RECOMMENDATION: Relocate the footnotes to these subsections from the bottom of the page to parentheticals at the end of each subsection.
SUBSTANTIATION: Editorial change.
COMMITTEE ACTION: Accept.

43D- 5 - (2-6.2): Accept
SUBMITTER: Technical Committee on Storage, Handling and Transportation of Hazardous Chemicals
RECOMMENDATION: Delete footnote.
Add the following: "Local regulations requiring locked storage shall be complied with."
SUBSTANTIATION: Editorial Change.
COMMITTEE ACTION: Accept.

43D- 6 - (3-1.2.1): Accept
SUBMITTER: Technical Committee on Storage, Handling and Transportation of Hazardous Chemicals
RECOMMENDATION: Revise to read: "General fire protection shall comply with applicable NFPA standards, including the following:"
NFPA 10, Standard for Portable Fire Extinguishers;
NFPA 13, Standard for the Installation of Sprinkler Systems;
NFPA 14, Standard for the Installation of Standpipe and Hose Systems;
NFPA 20, Standard for the Installation of Centrifugal Fire Pumps.
Delete footnote.
SUBSTANTIATION: Editorial change.
COMMITTEE ACTION: Accept.

43D- 7 - (3-1.2.2, 3-1.3.1 and 3-3.1.1): Accept
SUBMITTER: Technical Committee on Storage, Handling and Transportation of Hazardous Chemicals
RECOMMENDATION: Relocate footnotes to parentheticals at end of respective subsections.
SUBSTANTIATION: Editorial change.
COMMITTEE ACTION: Accept.

43D- 8 - (Appendix B, Appendix C): Accept
SUBMITTER: Technical Committee on Storage, Handling and Transportation of Hazardous Chemicals
RECOMMENDATION: Delete footnote to Appendix B.
Move Footnote to Appendix C to text in Subsection C-3.4.
SUBSTANTIATION: Editorial change.
COMMITTEE ACTION: Accept.

43D- 9 - (Chapter 4 (New) and Appendix D): Accept
SUBMITTER: Technical Committee on Storage, Handling and Transportation of Hazardous Chemicals
RECOMMENDATION: Add new Chapter 4 as follows and delete existing Appendix D.
Chapter 4: Referenced Publications
4-1 The following documents or portions thereof are referenced within this code and shall be considered part of the requirements, of this document. The edition indicated for each reference is current as of the date of the NFPA issuance of this document.
These references are listed separately to facilitate updating to the latest edition by the user.
4-1.1 NFPA Publications. National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.
NFPA 10-1981, Standard for Portable Fire Extinguishers
NFPA 13-1985, Standard for the Installation of Sprinkler Systems
NFPA 14-1983, Standard for the Installation of Standpipe and Hose Systems
NFPA 20-1983, Standard for the Installation of Centrifugal Fire Pumps
NFPA 30-1994, Flammable and Combustible Liquids Code
NFPA 231-1995, Standard for Indoor General Storage
NFPA 395-1980, Standard for the Storage of Flammable and Combustible Liquids on Farms and Isolated Construction Projects
NFPA 490-1986, Code for the Storage of Ammonium Nitrate
4-2 U.S. Government Publications.
These references are listed separately to facilitate updating to the latest edition by the user.
Environmental Protection Agency, Recognition and Management of Pesticide Poisonings, Washington, DC
Wisconsin, W. J., Jr., Editor, Pesticide Index, College Park, MD
Entomological Society of America, 1976, 5th Ed.
SUBSTANTIATION: Comply with Standards Council directive to separate mandatory references from advisory references.
COMMITTEE ACTION: Accept.
490-1 - (Entire Document): Accept
SUBMITTER: Technical Committee on Storage, Handling and Transportation of Hazardous Chemicals
RECOMMENDATION: Reconfirm NFPA 490 as suitable for continued use.
SUBSTANTIATION: No proposals to amend NFPA 490 were received from the public or the Technical Committee as a result of the call for proposals, other than the following Technical Committee proposals for editorial changes.
COMMITTEE ACTION: Accept.

490-2 - (1-1.1): Accept
SUBMITTER: Technical Committee on Storage, Handling and Transportation of Hazardous Chemicals
RECOMMENDATION: Revise 1-1.1 to read:

"This Code shall not apply to ammonium nitrate-based blasting agents. (See NFPA 495, Code for the Manufacture, Transportation, Storage and Use of Explosive Materials.)"

Delete footnotes.
SUBSTANTIATION: Editorial relocation for 1-1.1.
COMMITTEE ACTION: Accept.

490-3 - (1-1.4 (New)): Accept
SUBMITTER: Technical Committee on Storage, Handling and Transportation of Hazardous Chemicals
RECOMMENDATION: Add new 1-1.4 to read:

"This Code shall not apply to ammonium nitrate-based blasting agents. (See NFPA 495, Code for the Manufacture, Transportation, Storage and Use of Explosive Materials.)"

Renumber following subsections.
SUBSTANTIATION: Editorial relocation for 1-1.1.
COMMITTEE ACTION: Accept.

490-4 - (2-2.4, 4-2.2, 4-3.2 and 6-6.1): Accept
SUBMITTER: Technical Committee on Storage, Handling and Transportation of Hazardous Chemicals
RECOMMENDATION: Add asterisk to number.

"This Code shall apply to the storage of ammonium nitrate in the form of crystals, flakes, grains, or prills including fertilizer grade (as defined by Definition and Test Procedures for Ammonium Nitrate Fertilizer), dynamite grade, nitrous oxide grade (as defined by Standards for Ammonium Nitrate-Nitrous Oxide Grade), technical grade, and other mixture containing 60 percent or more by weight of ammonium nitrate."

Delete footnotes.
SUBSTANTIATION: Editorial relocation for 1-1.4.
COMMITTEE ACTION: Accept.

490-5 - (5.2.2.1): Accept
SUBMITTER: Technical Committee on Storage, Handling and Transportation of Hazardous Chemicals
RECOMMENDATION: Delete footnote and add the following:

"This Table may be found in NFPA 495, Code for the Manufacture, Transportation, Storage and Use of Explosive Materials."

SUBSTANTIATION: Editorial Change.
COMMITTEE ACTION: Accept.

490-6 - (Chapter 8 (New) and Appendix C): Accept
SUBMITTER: Technical Committee on Storage, Handling and Transportation of Hazardous Chemicals
RECOMMENDATION: Add new Chapter 8 as follows and delete current Appendix C.

Chapter 8 Referenced Publications

The following documents or portions thereof are referenced within this code for informational purposes only and thus should not be considered part of the requirements of this document. The edition indicated for each reference is current as of the date of the NFPA issuance of this document. These references are listed separately to facilitate updating to the latest edition by the user.


- NFPA 10-1981, Standard for Portable Fire Extinguishers
- NFPA 13-1985, Standard for the Installation of Sprinkler Systems
- NFPA 14-1981, Standard for the Installation of Standpipe and Hose Systems
- NFPA 24-1984, Standard for Outside Protection
- NFPA 30-1984, Flammable and Combustible Liquids Code
- NFPA 58-1983, Standard for the Storage and Handling of Liquefied Petroleum Gases
- NFPA 70-1984, National Electrical Code
- NFPA 203M-1980, Manual on Roof Coverings
- NFPA 220-1985, Standard on Types of Building Construction
- NFPA 505-1982, Fire Safety Standard for Powered Industrial Trucks
- Other Publications.


- Standard for Ammonium Nitrate (Nitrous Oxide Grade), New York, NY, Compressed Gas Assn.

SUBSTANTIATION: Comply with Standards Council directive to move mandatory references in body of standard.
COMMITTEE ACTION: Accept.