Report of the Committee on

Flammable and Combustible Liquids

Correlating Committee

Edward Hildebrandt, *Chair*
Village of Morton Grove, IL

John A. Davenport, Industrial Risk Insurers, CT
John J. Hawley, Underwriters Laboratories Inc., IL
William R. Heitzig, The Dow Chemical Co., MI
Rep. Society of the Plastics Industry, Inc.
Donald L. Hierman, Rhone-Poulenc, Inc., NJ
Rep. Chemical Manufacturers Assn.
James D. Kieffer, Hiram Walker & Sons Ltd., Canada
Richard S. Kraus, Petroleum Safety Consultants, VA
Rep. American Petroleum Inst.
Douglas A. River, 3M Co., MN
Gerald J. Rosicky, General Motors Corp., MI
Rep. NFPA Industrial Fire Protection Section
Orville M. Slye, Jr., Loss Control Assoc., Inc., PA
Brooke B. Smith, Jr., Aspen Engr Inc., CO

Alternates

Richard D. Gottwald, Society of the Plastics Industry, DC
(Alt. to W. R. Heitzig)
Douglas L. Jeffries, Chevron Research and Technology Co., CA
(Alt. to R. Kraus)

Committee Scope: This Committee shall have primary responsibility for documents on safeguarding against the fire and explosion hazards associated with the storage, handling, and use of flammable and combustible liquids; safeguarding against the fire and explosion hazards associated with the transporting of flammable and combustible liquids in tank vehicles, in portable tanks, and in containers, except as this subject is addressed by the regulations of the U.S. Department of Transportation; and classifying flammable and combustible liquids.

Technical Committee on

Fundamentals (FLC-FUN)

C. Charles Snow, Jr., *Chair*
3M Co., MN

Robert P. Benedetti, *Secretary*
Nat'l Fire Protection Assn., MA
(Nonvoting)

David L. Blomquist, Blomquist Fire Protecting Engr, CA
Gerald A. Gordon, Sonoco Industrial, IL
John J. Hawley, Underwriters Laboratories Inc., IL
Duane L. Rehmeyer, Sun Company, Inc., PA
Rep. American Petroleum Inst.
Jack Woycheese, Gage-Babcock & Assoc., Inc., CA

Alternate

Richard S. Kraus, Petroleum Safety Consultants, VA
(Alt. to D. L. Rehmeyer)

Committee Scope: This committee shall have primary responsibility for documents or portions of documents on the fundamental requirements for safeguarding against the fire and explosion hazards associated with the storage and handling of flammable and combustible liquids, the classification of flammable and combustible liquids, and definitions related thereto.

Technical Committee on

Operations (FLC-OPS)

Jack Woycheese, *Chair*
Gage-Babcock & Assoc., Inc., CA

Byron L. Briese, HSB Professional Loss Control, Inc., TN
Gary R. Glowinski, Safety-Kleen Corp., IL
John P. Hartmann, Hartmann Mgmt Services Inc., IL
Donald L. Hierman, Rhone-Poulenc, Inc., NJ
Rep. Chemical Mfrs. Assn.
Richard J. Hild, Verian Fire Insurance Co., MD
Edward Hildebrandt, Village of Morton Grove, IL
Clark L. Holmberg, Citco Petroleum Corp., OK
Rep. Nat'l Petroleum Refiners Assn.
Douglas L. Jeffries, Chevron Research and Technology Co., CA
Rep. American Petroleum Inst.
Joshy Paul Kallungal, Ontario Fire Marshals Office, ON
James D. Kieffer, Hiram Walker & Sons Ltd., ON
Robert E. McClay, IN University of Pennsylvania, PA
Rep. American Society of Safety Engr
Richard F. Murphy, Exxon Research & Engr Co., NJ
Thaddeus A. Nosal, American Insurance Services Group, NY
Rep. American Insurance Services Group, Inc.
Anthony M. Ordile, Loss Control Assoc., Inc., PA
Lee Paige, IRM Insurance, NC
Susan Preske, Liberty Mutual Insurance Co., NY
Rep. The Alliance of American Insurers
Robert N. Renkes, Petroleum Equipment Inst., OK
Rep. Petroleum Equipment Inst.
Gerald J. Rosicky, General Motors Corp., MI
Rep. NFPA Industrial Fire Protection Section
Brooke B. Smith, Jr., Aspen Engr Inc., CO
C. Charles Snow, Jr., 3M Co., MN
Bryan L. Swinney, Pro Plus, Inc., TX
Thomas K. Terrebonne, Kemper Nat'l Insurance Cos., KS
William A. Thornberg, Industrial Risk Insurers, CT

Alternates

Jon V. Brannan, Underwriters Laboratories Inc., IL
(Vot. Alt. to UL Rep.)
John A. Davenport, Industrial Risk Insurers, CT
(Alt. to W. Thornberg)
John J. Foley, Gage-Babcock & Assoc., Inc., GA
(Alt. to J. Woycheese)
Robert D. Grausam, Kemper Nat'l Insurance Cos., NY
(Alt. to T. K. Terrebonne)
David C. Kirby, Union Carbide Corp., WV
(Alt. to D. L. Hierman)
Duane L. Rehmeyer, Sun Company, Inc., PA
(Alt. to D. L. Jeffries)
Douglas A. Rivers, 3M Co., MN
(Alt. to C. C. Snow)
Orville M. Slye, Jr., Loss Control Assoc., Inc., PA
(Alt. to A. M. Ordile)
Kevin F. Sykora, The Sherwin-Williams Co., OH
(Alt. to R. E. McClay)
Harold S. Wass, Jr., IRM Insurance, NC
(Alt. to L. Paige)

Nonvoting

Michael B. Moore, U.S. Occupational Safety & Health Admin., DC
Terence P. Smith, U.S. Dept. of Labor, DC
(Alt. to M. B. Moore)

Committee Scope: This Committee shall have primary responsibility for documents on operations that involve the handling or use of flammable and combustible liquids, either as a principle activity or as an incidental activity, and for the transportation of these liquids, except as this subject is addressed by the regulations of the U.S. Department of Transportation.

Technical Committee on

Storage and Warehousing of Containers and Portable Tanks (FLC-SWC)

William M. Carey, Underwriters Laboratories Inc., IL
Robert H. Christopher, DuPont Co., DE
Rep. Nat'l Paint & Coatings Assn.
Dennis W. Cralley, Quaker State Corp., PA
Rep. American Petroleum Inst.
John A. Davenport, Industrial Risk Insurers, CT
John J. Foley, Gage-Babcock & Assoc., Inc., GA
Gary R. Glowinski, Safety-Kleen Corp., IL
Gerald A. Gordon, Sonoco Industrial, IL
William R. Heitzig, The Dow Chemical Co., MI
Rep. Society of the Plastics Industry Inc.
John Heller, Brown Sprinkler Corp., KY
Rep. Nat'l Fire Sprinkler Assn.
Richard J. Hild, Verlan Fire Insurance Co., MD
Edward Hildebrandt, Village of Morton Grove, IL
Joshy Paul Kallungal, Ontario Fire Marshals Office, Canada

David C. Kirby, Union Carbide Corp. WV
Rep. Chemical Mfrs. Assn.
John A. LeBlanc, Factory Mutual Research Corp., MA
Robert E. Lister, American Insurance Services Group, NY
Rep. American Insurance Services Group, Inc.
Navin D. Mehta, Defense Logistic Agency (DLA-MMDI), VA
Charles L. Milles, Jr., AgrEvo USA Co., DE
Rep. American Crop Protection Assn.
Anthony M. Ordile, Loss Control Assoc., Inc., PA
Lee Paige, IRM Insurance, NC
Lee Rindfuss, M&M Protection Consultants, MA
Douglas A. Rivers, 3M Co., MN
Gerald J. Rosicky, General Motors Corp., MI
Rep. NFPA Industrial Fire Protection Section
Gregory D. Schneekloth, Snyder Industries, Inc., NE
Ronald J. Stephens, Automatic Sprinkler Corp. of America, CA
David C. Tabar, The Sherwin-Williams Co., OH
Thomas K. Terrebonne, Kemper Nat'l Insurance Cos., KS
William J. Tomes, Tomes, VanRickley & Assoc., CA
Rep. Home Depot
Paul T. Vavala, Haz-Stor Co., IL
William W. Woodfill, Wausau Insurance Cos., IL
Rep. The Alliance of American Insurers

Alternates

Jon V. Brannan, Underwriters Laboratories Inc., IL
(Alt. to W. M. Carey)
Richard D. Gottwald, Society of the Plastics Industry, DC
(Alt. to W. R. Heitzig)
Robert D. Grausam, Kemper Nat'l Insurance Cos., NY
(Alt. to T. K. Terrebonne)
Donald L. Hierman, Rhone-Poulenc, Inc., NJ
(Alt. to D. C. Kirby)
Richard S. Kraus, Petroleum Safety Consultants, VA
(Alt. to D. W. Crawlley)
Thaddeus A. Nosal, American Insurance Services Group, NY
(Alt. to R. E. Lister)
Susan Preske, Liberty Mutual Insurance Co., NY
(Alt. to W. W. Woodfill)
Leon C. Schaller, L-C Schaller Co., DE
(Alt. to R. H. Christopher)
Orville M. Slye, Jr., Loss Control Assoc., Inc., PA
(Alt. to A. M. Ordile)
C. Charles Snow, Jr., 3M Co., MN
(Alt. to D. A. Rivers)
David C. Swenson, The Sherwin-Williams Co., OH
(Alt. to D. C. Tabar)
William A. Thornberg, Industrial Risk Insurers, CT
(Alt. to J. A. Davenport)
James W. Tomes, Tomes, VanRickley & Assoc., CA
(Alt. to W. J. Tomes)
Harold S. Wass, Jr., IRM Insurance, NC
(Alt. to L. Paige)
Jack Woycheese, Gage-Babcock & Assoc., Inc., CA
(Alt. to J. J. Foley)

Committee Scope: This Committee shall have primary responsibility for documents on storage of liquids in containers and in portable tanks whose capacity does not exceed 2500 liters (660 gallons).

Technical Committee on

Tank Storage and Piping Systems (FLC-TAN)

David L. Blomquist, *Chair*
Blomquist Fire Protection Engr, CA

Gary T. Austerman, Burns & McDonnel Engr Co., MO
Thomas M. Bazzolo, Connecticut Fire Marshal's Office, CT
Rep. T/C Automotive/Marine Service Station
John V. Brannan, Underwriters Laboratories Inc., IL
Michael T. Castellano, Joseph E. Seagram & Sons Inc., NY
Rep. Distilled Spirits Council of the U.S.
John M. Cunningham, U.S. Environmental Protection Agency, DC
Sullivan D. Curran, Fiberglass Petroleum Tank & Pipe Inst., TX
Rep. Fiberglass Petroleum Tank & Pipe Inst.
Wayne Geyer, Steel Tank Inst., IL
Rep. Steel Tank Inst.
John P. Hartmann, Hartmann Mgmt Services, Inc., IL
Thomas Henning, Unocal, CA
Rep. Western States Petroleum Assn.
Donald L. Hierman, Rhone-Poulenc, Inc., NJ
Rep. Chemical Mfrs. Assn.
Michael D. Lattner, Morrison Bros., Co. IA
David G. Mahoney, M&M Protection Consultants, IL
Armin E. Mittermaier, Data Action, IN
Rep. Petroleum Marketers Assn. of America
Richard F. Murphy, Exxon Research & Engr Co., NJ
Joseph R. Natale, Mobile Research & Development, NJ
Rep. Nat'l Petroleum Refiners Assn.
Thaddeus A. Nosal, American Insurance Services Group, NY
Rep. American Insurance Services Group, Inc.
Albert S. Pela, Jr., Mobil Research & Development Corp., NJ
Rep. American Petroleum Inst.
Robert N. Renkes, Petroleum Equipment Inst., OK
Rep. Petroleum Equipment Inst.
Orville M. Slye, Jr., Loss Control Assoc., Inc., PA
Brooke B. Smith, Jr., Aspen Engr Inc., CO
William A. Thornberg, Industrial Risk Insurers, CT

Alternates

James W. Cragun, Phillips Petroleum Co., OK
(Alt. to A. Pela)
John A. Davenport, Industrial Risk Insurers, CT
(Alt. to W. A. Thornberg)
David C. Kirby, Union Carbide Corp., WV
(Alt. to D. L. Hierman)
Patrick A. McLaughlin, McLaughlin & Assoc., CA
(Alt. to S. D. Curran)
Arthur R. Nash, Michigan State Police, MI
(Vot. Alt. to FMANA Rep.)
Michael B. Nolan, Joseph E. Seagram & Sons, Inc., NY
(Alt. to M. T. Castellano)
Anthony M. Ordile, Loss Control Assoc., Inc., PA
(Alt. to O. M. Slye)
K. Tim Perkins, Unocal, CA
(Alt. to J. R. Natale)

Nonvoting

Donald M. Johnson, Walnut Creek, CA
(Member Emeritus)

Staff Liaison: **Robert P. Benedetti**

This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred.

Committee Scope: This Committee shall have primary responsibility for documents on the storage of liquids in fixed aboveground and underground tanks of any size and in portable tanks whose capacity exceeds 2500 liters (660 gallons) and for the installation of such tanks and portable tanks in buildings and in storage tank buildings.

The Report of the **Flammable and Combustible Liquids Code Committee** is presented for adoption in 3 parts.

The Flammable and Combustible Liquids Code Committee consists of the Technical Correlating Committee on Flammable and Combustible Liquids and the following four Technical Committees:

Technical Committee on Fundamentals (NFPA 30, Chapter 1; NFPA 321)

Technical Committee on Operations (NFPA 30, Chapter 5 and related Appendices)

Technical Committee on Storage and Warehousing of Containers and Portable Tanks (NFPA 30, Chapter 4 and related Appendices)

Technical Committee on Tank Storage and Piping Systems (NFPA 30, Chapters 2 and 3 and related Appendices; NFPA 395)

Part I of this Report was prepared by the **Flammable and Combustible Liquids Code Committee** and proposes for adoption amendments to NFPA 30-1993, **Flammable and Combustible Liquids Code.** NFPA 30-1993 is published in Volume 2 of the 1995 National Fire Codes and in separate pamphlet form.

The amendments to Chapter 1 have been submitted to letter ballot of the **Technical Committee on Fundamentals** which consists of 6 voting members; of whom 6 voted affirmatively.

The amendments to Chapter 1 have also been submitted to letter ballot of the **Technical Correlating Committee on Flammable and Combustible Liquids** which consists of 11 voting members; of whom 11 voted affirmatively.

The amendments to Chapters 2 and 3 and related appendices have been submitted to letter ballot of the **Technical Committee on Tank Storage and Piping Systems** which consists of 23 voting members; of whom 21 voted affirmatively and 2 ballots were not returned (Messrs. Cunningham and Henning).

The amendments to Chapters 2 and 3 and related appendices have also been submitted to letter ballot of the **Technical Correlating Committee on Flammable and Combustible Liquids** which consists of 11 voting members; of whom 10 voted affirmatively and 1 member abstained (Mr. Heitzig).

Mr. Heitzig abstained from voting due to his impending retirement.

The amendments to Chapter 4 and related appendices have been submitted to letter ballot of the **Technical Committee on Storage and Warehousing of Containers and Portable Tanks** and **Technical Correlating Committee on Flammable and Combustible Liquids** in three segments.

Segment No. 1, consisting of Proposal 30-90 (Log #66), has been submitted to letter ballot of the **Technical Committee on Storage and Warehousing of Containers and Portable Tanks**, which consists of 29 voting members; of whom 25 voted affirmatively, 2 negatively (Messrs. Heitzig and Kirby), and 2 abstained (Messrs. Foley and Glowinski).

Mr. Heitzig voted negatively stating: "The proposal adequately covers manufacturing areas where greater emphasis is placed on fire protection."

Mr. Kirby voted negatively stating: "Accepting this proposal would force the authority having jurisdiction to use some common sense judgement. Rejecting it will involve generating long prescriptive standards with difficult and sometimes ridiculous outcomes."

Mr. Foley abstained stating: "Although some refineries, chemical plants, and distilleries are provided with sufficient fire protection and are prepared to handle emergency situations, many are not. Not all facilities are located in isolated areas. Numerous ones exist in urban areas where separation of building structures within the facility is limited. If the warehouse used to store the flammable liquids is exempt from the requirements of NFPA 30, the possibility of a fire spreading to the adjacent refinery or chemical plant facilities is far greater. For this reason, I do not believe either the existing or the modified exception is acceptable. I therefore am abstaining from voting."

Mr. Glowinski abstained stating: "I believe the exemption for chemical plants, refineries, etc. should be eliminated. I do not agree with replacing it with other verbiage to provide the same exclusion."

Segment No. 1 has also been submitted to letter ballot of the **Technical Correlating Committee on Flammable and Combustible Liquids** which consists of 11 voting members; of whom 10 voted affirmatively and 1 ballot was not returned (Mr. Gottwald).

Segment No. 2, consisting of Proposals 30-105 through 30-108 and 30-111 (Logs Nos. 102 through 106), has been submitted to letter ballot of the **Technical Committee on Storage and Warehousing of Containers and Portable Tanks** which consists of 29 voting members; of whom 22 voted affirmatively, 3 negatively (Messrs. Hild, LeBlanc, and Rivers), 1 abstained (Mr. Gordon), and 3 ballots were not returned (Messrs. Lister, Mehta, and Terrebonne).

Mr. Hild voted negatively stating: "The existing wording in Chapter 4 is adequate."

Mr. LeBlanc voted negatively stating the following reason:
"Drainage plays a key role in providing adequate fire protection for the storage of flammable or combustible liquids in containers larger than five gallons in size. A possible fire scenario for this type of storage consists of a liquid release that becomes ignited and forms a pool fire. A properly designed automatic sprinkler system can effectively cool a metal 55 gallon drum that is exposed to a pool fire, but it cannot extinguish or control the pool fire. Flammable liquids that are lighter than water will float on the sprinkler discharge and spread out away from the initial point of release. As the burning liquid spreads, additional sprinklers open. The final sprinkler operating area can easily exceed the current designs leading to overtaxing of the water supply. Loss of adequate sprinkler discharge would quickly lead to failure of additional storage containers. A properly arranged drainage system would quickly remove the burning liquid leading to quick control of the fire. A possible alternative to drainage may be a special protection system that is able to extinguish pool fires.
There are flammable and combustible liquids that form pool fires that can be controlled by sprinkler discharge due to the physical characteristics of the liquid (i.e., water miscible liquid, high flash point liquid - greater than 200°F, liquids that are heavier than water, and high viscosity liquids). Drainage is not needed for these liquids, however, containment is still needed to prevent the spread of burning liquid before it is extinguished.
This proposal does not accomplish the above intent. As the proposal is currently written and illustrated in the flow chart, drainage and/or containment is not required for the storage of large containers of flammable and combustible liquids in protected warehouses or inside rooms."

Mr. Rivers voted negatively stating: "The performance language currently in the code adequately covers these issues. The flow chart does not correctly represent the current code and creates excessive requirements for non-sprinklered facilities."

Mr. Gordon abstained because he felt he did not have the required technical expertise to vote on the issue.

Segment No. 2 has also been submitted to letter ballot of the **Technical Correlating Committee on Flammable and Combustible Liquids** which consists of 11 voting members; of whom 9 voted affirmatively and 2 negatively (Messrs. Rivers and Smith).

Mr. Rivers voted negatively stating: "The language currently in the code adequately covers these issues. The flow chart does not correctly represent the current code and creates excessive requirements for non-sprinklered facilities."

Mr. Smith voted negatively stating: "Figure 4-4.2.6 is confusing relative to containment and drainage requirements for inside rooms. These provisions have been part of NFPA 30 for many editions and no substantiation was given for changing them."

Segment No. 3, consisting of all remaining Proposals to amend Chapter 4, has been submitted to letter ballot of the **Technical Committee on Storage and Warehousing of Containers and Portable Tanks**, which consists of 29 voting members; of whom 26 voted affirmatively, 1 negatively (Mr. Cralley), and 2 ballots were not returned (Messrs. Lister and Mehta).

Mr. Cralley voted negatively stating the following reason:
"After a thorough review of the amendments to Chapter 4, my negative vote is due solely to the new proposed Tables 4-8.1 through 4-8.6, found in Proposal 30-123 (Log #114).
My objection to these tables is that they are confusing when applied to mixed storage of the various classes of flammable and combustible liquids. Each line on each table represents "protection" as applicable to one class of liquid, one type of container, one storage array, and even a specific ceiling height. (Paragraph) 4-8.1.1 states 'Where different liquid classes and container types are stored in the same occupancy, protection shall conform to the requirements for the most severe hazard class.' Based on the tables, protection for the most severe hazard class may not protect a less severe hazard class without taking into account many other variables, including those mentioned above.
Given the quantity and the complexity of recent fire testing, the compilation of this data is very important and these tables can be a useful tool for designing functional sprinkler protection systems. They should not, however, be used as the sole criteria to determine whether storage is considered 'protected' or 'unprotected' by the authority having jurisdiction. Although I applaud the efforts of the task force, these tables do not belong in Section 4-8, but in the appendix of the document."

Segment No. 3 has also been submitted to letter ballot of the **Technical Correlating Committee on Flammable and Combustible Liquids** which consists of 11 voting members; of whom 9 voted affirmatively, 1 negatively (Mr. Kraus), and 1 ballot was not returned (Mr. Heitzig).

Mr. Kraus voted negatively fstating the following reasons:
"My negative ballot is based on Proposals 30-109 (Log #113) and 30-123 (Log #114).
The Log 113 recommendation is to delete existing Tables 4-4.4(b) and 4-4.4(c). I have voted negative as these Tables must remain in the code based on my negative ballot on Log 114 below, which negates new proposed replacement tables. Log 114 recommendation is to replace section 4-8 with the new proposed Section 4-8, Fire Protection and Control. This proposed section includes new protection tables which replace the tables deleted by Log 113.
I am very concerned that the new recommended Section 4-8 protection tables are open to challenge for the following reasons: while the tables are based on actual tests, the recommended protection schemes depend on numerous extrapolations and engineering judgements. As a committee member, I cannot support, defend, or justify these extrapolations and judgements.
As an example, I have analyzed one part of Table 4-8.2, which covers water protection for non-relieving style metal containers in bulk or palletized storage. Lines 2 through 7 of this Table are based on a number of different tests of relieving style containers. Non-relieving containers have BLEVEd or otherwise released product in numerous tests.
The primary test used to develop Line 2 protection was Test S-5. Test S-5 was a foam-water sprinkler test of relieving style containers. This was a 'fluke' test in which water flowed for some time due to a foam system malfunction. The fire was not suppressed until the foam activated. (See attached UL summary of Test S-5.) In addition to Test S-5, Tests S-16 and S-17 were used to develop protection criteria in Lines 3, 5, 6, and 7 of this Table. The containers which passed in these tests had relieving spouts or inserts. Some tests used as criteria had 10-gallon starter fires. An analysis of test data clearly indicates that sprinkler activation in these tests started in less than one minute, whereas sprinkler activation in tests using 2-gallon starter fires took approximately two minutes. This leads me to believe that the systems worked because the activation occurred before the commodity was fully involved.
I believe that the Tables proposed in this recommendation should not appear in the body of the code, but belong in the appendix to Chapter 4, to be used as engineering considerations for designing protection systems. These tables are basically applicable to storage of a single commodity, in a designated container, under very specific storage arrangements and conditions. They are more confusing than the present tables when applied to mixed commodities, in various containers, in mixed storage in different occupancies."

The amendments to Chapter 5 and related appendices have been submitted to letter ballot of the **Technical Committee on Operations** which consists of 25 voting members; of whom 21 voted affirmatively, 2 negatively (Messrs. Jeffries and Swinney), 1 abstained (Mr. Hartmann), and 1 ballot was not returned (Mr. Hierman).

Mr. Jeffries voted negatively stating: "Various sections in proposed Section 5-6 need to be revised, specifically 5-6.4.1 through 5-6.4.4 and the proposed prohibition against switch loading. Since the entire chapter is one proposed change, I am voting negative to initiate action on these revisions."

Mr. Swinney voted negatively stating: "Test data developed through the American Petroleum Institute by Gulf Oil Corp. on or about 1968 and recent test data presented in API document 855-22301 (April 29, 1994) indicate that reduced loading rates for fuels possessing high electrical resistance (jet fuels, kerosenes, diesel fuels, etc.) actually concentrate the electrical charge in the receiving tank truck or rail car, produce higher electrical voltages, and, therefore, higher potential for explosions, when filtering the fuel during the loading process. The reduced loading rates recommended in Paragraphs 5-6.4.5 and 5-6.5.3 produce conditions which increase the potential for explosions. I have personally witnessed electrical charge voltage drop from (a range of) 10,000 to 30,000 volts down to (a range of) 1,000 to 5,000 volts by simply increasing the flow rate from 300 gpm to 600 gpm. Also, this data indicates the necessity for revising NFPA 77."

Mr. Hartmann abstained because he was not able to attend all of the Technical Committee meetings due to conflicts with meetings of the Technical Committee on Tank Storage and Piping Systems, on which he also serves, and therefore lacked sufficient information to vote.

The amendments to Chapter 5 and related appendices have also been submitted to letter ballot of the **Technical Correlating Committee on Flammable and Combustible Liquids** which consists of 11 voting members; of whom 10 voted affirmatively and 1 negatively (Mr. Kraus).

Mr. Kraus voted negatively stating the following reasons:
"New section 5-6.4.2 prohibits switch loading. This new section will cause a negative economic impact upon petroleum operations nationwide and will create unnecessary hazardous waste. Switch loading has been successfully conducted for over 100 years following guidelines established in API 2003 and NFPA 30. There is no need to prohibit this activity.
New Section 5-6.4.3 needs clarification. Bonding is achieved through loading hoses when bottom loading and by contacting the fill pipe against the rim of the tank opening when top loading. Grounding is required when loading with top or bottom and is achieved by a ground wire connecting the tank truck to the loading rack and the loading rack to ground.
New Section 5-6.4.9 and 5-6.5.4 need modification to indicate reduced flow rate is only necessary until the fill pipe is submerged."

Part II of this Report was prepared by the **Technical Committee on Fundamentals** and proposes for adoption the withdrawal of NFPA 321-1991, **Standard on Basic Classification of Flammable and Combustible Liquids.** NFPA 321-1991 is published in Volume 6 of the 1995 National Fire Codes and in separate pamphlet form.

Part II of this Report has been submitted to letter ballot of the **Technical Committee on Fundamentals** which consists of 6 voting members; of whom 6 voted affirmatively.

Part II of this Report has also been submitted to letter ballot of the **Technical Correlating Committee on Flammable and Combustible Liquids** which consists of 11 voting members; of whom 11 voted affirmatively.

Part III of this Report was prepared by the **Technical Committee on Tank Storage and Piping Systems** and proposes for adoption the withdrawal of NFPA 395-1993, **Standard for the Storage of Flammable and Combustible Liquids at Farms and Isolated Sites.** NFPA 395-1993 is published in Volume 6 of the 1995 National Fire Codes and in separate pamphlet form.

Part III of this Report has been submitted to letter ballot of the **Technical Committee on Tank Storage and Piping Systems** which consists of 23 voting members; of whom 21 voted affirmatively and 2 ballots were not returned (Messrs. Cunningham and Henning.)

Part III of this Report has also been submitted to letter ballot of the **Technical Correlating Committee on Flammable and Combustible Liquids** which consists of 11 voting members; of whom 11 voted affirmatively.

PART I

(Log #1)
Committee: FLC-FUN

30- 1 - (1-1.8.1 (New)): Accept in Principle

Note: This proposal appeared as comment 30-1 which was held for further study from the Annual 93 TCD, which was on proposal 30-1.

SUBMITTER: Christopher T. Lummus, Fire Prevention & Engineering Bureau of Texas

RECOMMENDATION: Add new text as follows:

1-1.8.1 Installations protected by water-based fire protection systems shall conform to the applicable requirements of NFPA 25, Inspection, Testing and Maintenance of Water-Based Fire Protection Systems.

SUBSTANTIATION: Installed protection is not necessarily reliable protection if systems are not properly inspected, tested and maintained. The new NFPA 25 provides details of proper maintenance of such systems. Inspection, testing and maintenance per NFPA 25 should be specified at all points in NFPA standards where protection by water-based fire extinguishing systems is specified. This will also correlate water-based protection requirements in NFPA 30 with water-based protection requirements of other NFPA standards.

COMMITTEE ACTION: Accept in Principle.

Refer this proposal to the Technical Committees on Operations, Storage and Warehousing of Containers and Portable Tanks, and Tank Storage and Piping Systems for incorporation into appropriate sections of Chapters 2, 3, 4, and 5 of NFPA 30.

COMMITTEE STATEMENT: The Technical Committee on Fundamentals agrees with the thrust of this proposal, but feels that reference to NFPA 25 should be made in the individual chapters where fire protection systems are addressed.

(Log #7)
Committee: FLC-FUN

30- 2 - (1-6 Hazardous Substance (New)): Reject

SUBMITTER: Dennis Kirson, US Dept of Energy

RECOMMENDATION: Replace the definition for Hazardous Material or Hazardous Chemical in 1-2 with the following:

Hazardous Substance*. Any hazardous material, chemical, or waste that—if released into the environment in a specific volume or concentration—should have an adverse impact on either the environment or human health.

A-1-6 The terms "hazardous materials," "hazardous chemicals," and "hazardous wastes" are often used interchangeably, and in most context, it is properly understood that they have the same meaning. In the United States, however, these terms actually have quite different definitions under the US Code of Federal Regulations (CFR):

(a) Hazardous materials are raw materials in transit to the user and are governed by the US Department of Transportation (DOT) under Title 49 CFR, Transportation.

(b) By definition, a hazardous material becomes a hazardous chemical once it arrives at a plant and is used in the work place, at which time its use is governed by the Occupational Safety and Health Administration (OSHA) under Title 29 CFR, Labor.

(c) Waste is generated by a process. A chemical becomes waste once it completes its useful life in-plant, and disposal is required. If the waste contains any ingredient which is classified as ignitable, corrosive, reactive, or toxic, it is considered hazardous waste, and it is regulated by the Environmental Protection Agency (EPA) under Title 40 CFR, Protection of the Environment.

While ignitable wastes are of particular interest to the NFPA, all hazardous waste must be protected to avoid adverse impact to the environment.

SUBSTANTIATION: The terms "hazardous materials," "hazardous chemicals," and "hazardous wastes" are often used interchangeably, as currently in NFPA 30, Article 1-2, and in most context, it is properly understood that they have the same meaning. In the United States, however, these terms actually have quite different definitions under the US Code of Federal Regulations (CFR):

(a) Hazardous materials are raw materials in transit to the user and are governed by the US Department of Transportation (DOT) under Title 49 CFR, Transportation.

(b) By definition, a hazardous material becomes a hazardous chemical once it arrives at a plant and is used i the work place, at which time its use is governed by the Occupational Safety and Health Administration (OSHA) under Title 29 CFR, Labor.

(c) Waste is generated by a process. A chemical becomes waste once it completes its useful life in-plant, and disposal is required. If the waste contains any ingredient which is classified as ignitable, corrosive, reactive, or toxic, it is considered hazardous waste, and it is regulated by the Environmental Protection Agency (EPA) under Title 40 CFR, Protection of the Environment.

COMMITTEE ACTION: Reject.

COMMITTEE STATEMENT: The Technical Committee on Fundamentals feels that the proposed definition does not offer significant improvement over the existing definitions. Also, the Technical Committee feels that incorporation of the term "hazardous material" in NFPA 30 will result in confusion and conflict with existing U.S. Environmental Protection Agency regulations that also use this term.

(Log #12)
Committee: FLC-FUN

30- 3 - (1-6 Liquid and Flammable Liquid): Reject

SUBMITTER: D. L. Hierman, Rhone-Poulenc

RECOMMENDATION: 1. Definition of Liquid: Eliminate first sentence and substitute:

Liquid. For the purpose of this Code, any material that has a boiling point at or above 50°F (10°C) and a freezing point at or below 70°F (21°C).

2. Definition of Flammable Liquid: Change first sentence to read: "Flammable Liquid. A liquid with a flash point below 100°F (37.8°C) shall be known as a Class I liquid."

SUBSTANTIATION: Revision will clarify scope of the code because boiling point and freezing point are readily available, whereas fluidity compared to 300 penetration asphalt and vapor pressure at 100°F are not readily available.

COMMITTEE ACTION: Reject.

COMMITTEE STATEMENT: The Technical Committee on Fundamentals disagrees with this proposal because there is no way to address liquids that do not have a clearly defined transition from liquid to solid. Also, the Technical Committee points out that there is no substantiation given for the particular numbers chosen. For example, dimethyl ether would not come under this definition, yet is clearly intended to be addressed by NFPA 30.

(Log #41)
Committee: FLC-FUN

30- 4 - (1-6 IBC's, Metal IBC, Rigid Plastics IBC, Composite IBC): Accept in Principle

SUBMITTER: Gerald A. Gordon, Rigid Intermediate Bulk Container Assn.

RECOMMENDATION: Revise text. Additions are underlined, deletions are in [brackets].

Chapter 1 General Provisions

1-6 Definitions.

IBC's. IBC's (Intermediate Bulk Containers) intended for use with liquids are rigid portable packagings that have a capacity not more than 793 gal (3000 L), are designed for mechanical handling, and are resistant to the stresses produced in handling and transport.

Metal IBC. Metal body with appropriate service (filling, emptying, pressure relief, etc.) and structural equipment, UN code 31A (steel, 31B (aluminum) or 31N (other metal). (Metal IBC's are essentially identical to Metal Portable Tanks having capacities not exceeding 793 gal (3000 L), except for marking.)

Rigid Plastics IBC. Plastics Body. UN Code 31H1 (with structural equipment designed to withstand stacking), or 31H2 (freestanding).

Composite IBC. Structural equipment in the form of a rigid outer packaging enclosing a plastics inner receptacle together with any service or other structural equipment. It is so constructed that the inner receptacle and the outer packaging form an integral packaging and are filled, stored, transported or emptied as a unit. UN Code 31HZ1, where Z is to be replaced by a letter indicating the nature of the material used for the outer casing (A for steel, B for aluminum, H for plastic).

SUBSTANTIATION: Intermediate Bulk Containers (IBC's) have been approved for the shipment of flammable and combustible liquids by the US Department of Transportation (DOT) and by regulatory bodies in most of the other countries in the world (as indicated by provisions for their use in the UN "Recommendations on the Transport of Dangerous Goods"). Their use is rapidly growing both in the United States and worldwide. The basic types allowed for use in the packaging of flammable and combustible liquids, as defined in the regulations (and in the proposed amendment to NFPA 30), are Metal IBC's, Rigid Plastics IBC's, and Composite IBC's, but only Metal Portable Tanks (of which Metal IBC's compose a subset) are recognized in NFPA 30 for the storage of Liquids. The results of fire tests sponsored by the Rigid IBC Association (RIBCA) on Rigid Plastics and Composite IBC's are

shown in the accompanying videotape and report. These results indicate that appropriate levels of sprinkler protection can prevent loss of lading from such IBC's even when engulfed in an intense pool fire.

IBC's containing flammable and combustible liquids will be showing up in warehouses in increasing numbers. NFPA 30 should recognize that fact and be pro-active in setting guidelines for their storage.

COMMITTEE ACTION: Accept in Principle.

Add to the current definition of "Portable Tanks":

"This includes intermediate bulk containers (IBCs) as defined and regulated by the U.S. Dept. of Transportation."

COMMITTEE STATEMENT: This more simply and more clearly meets the intent of the submitter.

(Log #46)
Committee: FLC-FUN

30- 5 - (1-6 Emergency Relief Venting, Fixed Tank, Important Building, Secondary Containment Tank, Vapor (New)): Accept in Part

SUBMITTER: Jon V. Brannan, Underwriters Laboratories, Inc.

RECOMMENDATION: Add new definitions:

Emergency Relief Venting. An opening, construction method or device that will automatically relieve excessive internal pressure within any enclosed volume of a tank caused by over pressurization, such as exposure fire.

Fixed Tank. A tank that is permanently installed and not intended to be relocated after installation.

Important Building. A building that is considered not sacrificial in an exposure fire, such as a building with occupants, a control building, a building storing other flammable and combustible liquids, a building that if involved could cause the spread of the fire.

Secondary Containment Tank. A primary tank for storing flammable and combustible liquids within a secondary containment tank, forming an interstitial space between the tanks and such space is capable of being monitored for leakage of either the primary or secondary tank walls.

Vapor. Flammable and/or combustible liquids in the gaseous state. May be mixed with air.

SUBSTANTIATION: Definitions needed to clarify document.

COMMITTEE ACTION: Accept in Part.

1. Change the definition of Emergency Relief Venting to read:

"An opening, construction method, or device that will automatically relieve excessive internal pressure due to an exposure fire from an enclosed volume.

2. Change the definition of Important Building to read:

"A building that is considered not expendable in an exposure fire. Examples include, but are not limited to, occupied buildings, control buildings, or buildings that contain high value contents or critical equipment or supplies."

COMMITTEE STATEMENT: The changes made clarify the definitions.

"Fixed Tank" and "Secondary Containment Tank" are already defined.

The dictionary definition of "Vapor" is adequate.

(Log #62)
Committee: FLC-FUN

30- 6 - (1-6 Boiling Point): Accept

SUBMITTER: Kenneth H. Turnbull, Texaco, Inc.

RECOMMENDATION: Revise the definition of "Boiling Point" to read:

Boiling Point. The temperature at which a liquid exerts a vapor pressure of 14.7 psia (760 mm Hg). ~~Where an accurate boiling point is unavailable for the material in question, or~~ For mixtures that do not have a constant boiling point, for purposes of this code the ~~10~~ 20 percent evaporated point of a distillation performed in accordance with ASTM D ~~86~~82 93, Standard Test for Distillation of Petroleum Products, shall be used as the boiling point of the liquid.

SUBSTANTIATION: 1. The reference to "Where an accurate boiling point is unavailable for the material in question" at the beginning of the second sentence has no pertinence to the remainder of the sentence. An accurate boiling point can be determined for any material with a constant boiling point. This sentence should refer only to mixtures which do not have a constant boiling point.

2. The last version of ASTM Standard D86 was in 1993, thus 82 should changed to 93.

3. The concern with the present definition is that it incorrectly classifies some winter grade gasolines as Class IA flammable liquids. This definition is used to determine if a flammable liquid mixture is Class IA or Class IB. As the Flammable and Combustible Liquids Code Handbook points out; "Some liquids are mixtures of components having both high and low boiling points." Gasoline is the most common flammable liquid mixture. Its components can range in boiling points from -100°F to 1300°F. A typical 10 percent evaporated temperature is 120°F. However, 10 percent points can range from 80°F to 158°F depending upon the grade of fuel and seasonal adjustments for drivability. Generally the values will be above 100°F, but some winter fuels will have 10 percent points of less than 100°F. Lowering the distillation of winter grade gasoline does not generally raise the risk of vaporizing the gasoline because it is stored at lower temperature during those months. In short, the fire hazards of gasoline remain the same because the gasolines are produced to meet standard specifications and most all fire professionals are familiar with the hazards of gasoline (as are the public, but to a much less extent). The Class IA rating should be reserved for those liquids that rapidly vaporize and because of that rapid vaporization present a special risk to fire fighters. A tank labeled Flammability Rating of 4 (essentially a Class IA flammable liquid) should send a message to fire fighters that it is extremely important to keep that tank cool and if you can't it is important to prepare for a rapid build up of flammable vapors in the area. Changing the definition of boiling point for a flammable mixture as suggested will insure gasoline remains a Class IB flammable and should not affect the classification of any other flammable mixtures we are aware of.

COMMITTEE ACTION: Accept.

(Log #67)
Committee: FLC-FUN

30- 7 - (1-1.7.5): Accept in Principle

SUBMITTER: Rick Thornberry, ConVault

RECOMMENDATION: Revise text to read as follows:

1-1.7.5 Storage of flammable and combustible liquids on farms, in rural areas, and at isolated construction sites and isolated earth-moving projects including gravel pits, quarries and borrow pits, when such facilities are permitted by the authority having jurisdiction to comply with ~~These requirements are covered separately in~~ NFPA 395, Standard for the Storage of Flammable and Combustible Liquids at Farms and Isolated Sites.

SUBSTANTIATION: NFPA 30 does not properly correlate with the scope of NFPA 395-1993, Standard for the Storage of Flammable and Combustible Liquids at Farms and Isolated Sites. Although it appears that the intent is to refer the user of the standard to NFPA 395 in those cases where NFPA 395 is intended to apply, that is not clear in the way Section 1-1.7.5 is presently written. This proposed revision to the scope of NFPA 30 will clarify the intent of this section and provide a direct cross reference to NFPA 395 for those applications included within the scope Section 1-1.1 of NFPA 395 in order to properly correlate the two standards. This will also help to eliminate the potential for conflict or overlap between the two standards.

COMMITTEE ACTION: Accept in Principle.

Delete 1-1.7.5.

COMMITTEE STATEMENT: With the withdrawal of NFPA 395, as proposed by the Technical Committee on Tank Storage and Piping Systems, and the incorporation of the text of NFPA 395 into NFPA 30 as a stand-alone chapter, there is no need for 1-1.7.5.

(Log #68)
Committee: FLC-FUN

30- 8 - (1-6 Enclosed Secondary Containment, Protected Aboveground Tank (New)): Reject

SUBMITTER: Rick Thornberry, ConVault

RECOMMENDATION: Add the following new definitions:

Enclosed Secondary Containment. A liquid-tight enclosure designed to provide supplementary containment of the contents of an aboveground storage tank by completely enclosing the tank so as to create an interstitial space capable of being monitored for a leak in the tank; which is not open to the atmosphere except for normally closed openings provided for emergency venting, inspection and leak detection.

Protected Aboveground Tank. A storage tank assembly consisting of an aboveground storage tank encased by construction providing fire-resistive protection to the tank and its contents from a high-intensity liquid pool fire and protection of the tank from physical damage. (See NFPA 30A, Automotive and Marine Service Station Code.)

SUBSTANTIATION: The proposed definition for "Enclosed Secondary Containment" is necessary in order to allow the use of enclosed secondary containment within the standard as it relates to separation distances for protected aboveground tanks which are in a companion proposal to revise Section 2-2.6. This definition describes the attributes believed necessary to indicate what enclosed secondary containment is. It has also been submitted as a proposal to NFPA 30A.

The definition for "Protected Aboveground Tank" is based on a similar definition contained in Appendix II-F of the 1994 Uniform Fire Code. This definition is being provided so that protected aboveground tanks can be recognized in NFPA 30 and appropriate criteria established for their use. Companion proposals have been submitted to revise various sections of NFPA 30A to recognize and regulate protected aboveground tanks. This same definition has also been submitted as a proposal to NFPA 30A.

Protected aboveground tanks achieve a higher level of fire safety and overall protection compared to that for fire resistant tanks presently specified in NFPA 30A. The major differences area as follows. The temperature limits on the primary tank are much lower for protected aboveground tanks in order to prevent the auto-ignition of the tank contents. The protected aboveground tank is also subjected to a hose stream test at the end of the fire test. Additional criteria are provided for vehicle impact protection and ballistic impact protection which are not a part of the listing for fire resistant tanks. A protected aboveground tank provides the highest level of fire safety for the category of aboveground tanks used in accordance with NFPA 30A.

COMMITTEE ACTION: Reject.

COMMITTEE STATEMENT: This term is already defined. Also, Committee Action on Proposal 30-32 (Log #70) recognizes UL 2085 which also defines these types of tanks. Finally, the proposed amendments to Section 2-2.6 were rejected. Therefore, there is no need for these definitions.

(Log #71)
Committee: FLC-FUN

30- 9 - (1-6 Special Enclosure (New)): Reject

SUBMITTER: Thaddeus A. Nosal, American Insurance Services Group, Inc.

RECOMMENDATION: Add new text to read:

1-6 Special Enclosure. A fixed, secondary enclosure within which a storage tank is placed that meets the requirements of Section 2-6.

SUBSTANTIATION: NFPA 30 does not cover tanks in vaults or other types of special fire resistant enclosures. These alternative tank designs are becoming more common. This proposal would provide wording similar to that used in the Uniform Fire Code and NFPA 30A.

COMMITTEE ACTION: Reject.

COMMITTEE STATEMENT: The proposed new Section 2-6 was not adopted, therefore the definition is not needed.

(Log #72)
Committee: FLC-FUN

30- 10 - (1-6 Fire Point (New)): Accept in Part

SUBMITTER: David C. Tabar, The Sherwin-Williams Company

RECOMMENDATION: Add a new definition to read:

Fire Point. The lowest temperature at which a liquid will ignite and achieve sustained burning for at least 5 sec when the test specimen is exposed to a test flame in accordance with ASTM D92, Standard Test Method for Fire Point by Cleveland Open Cup.

SUBSTANTIATION: "Fire Point" is referenced in Section 4-1.2 of NFPA 30 (1993).

COMMITTEE ACTION: Accept in Part.

Use this proposed definition, but delete the phrases "for at least 5 sec." and "the test specimen."

COMMITTEE STATEMENT: The criteria of duration of sustained burning should be within the scope of the test method.

(Log #73)
Committee: FLC-FUN

30- 11 - (1-6 Flammability Hazard Rating (New)): Reject

SUBMITTER: David C. Tabar, The Sherwin-Williams Company

RECOMMENDATION: Add a new definition to read:

Flammability Hazard Rating. materials that will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air, and which will burn readily. This degree usually includes:

Flammable gases;

Flammable cryogenic materials;

Any liquid or gaseous material that is liquid while under pressure and has a flash point below 73°F (22.8°C) and a boiling point below 100°F (37.8°C) (i.e., Class IA flammable liquids);

Materials that ignite spontaneously when exposed to air.

Liquids and solids that can be ignited under almost all ambient temperature conditions. Materials in this degree produce hazardous atmospheres with air under almost all ambient temperatures or, though unaffected by ambient temperatures, are readily ignited under almost all conditions. This degree usually includes:

Liquids having a flash point below 73°F (33.8°C) and having a boiling at or above 100°F (37.8°C) and those liquids having a flash point at or above 73°F (22.8°C) and below 100°F (37.8°C) (i.e., Class IB and Class IC flammable liquids);

Materials that on account of their physical form or environmental conditions can form explosive mixtures with air and that are readily dispersed in air, such as dusts of combustible solids and mists of flammable or combustible liquid droplets;

Materials that burn with extreme rapidly, usually by reason of self-contained oxygen (e.g., dry nitrocellulose and many organic peroxides).

Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur. Materials in this degree would not under normal conditions form hazardous atmospheres with air, but under high ambient temperatures or under moderate heating may release vapor in sufficient quantities to produce hazardous atmospheres with air. This degree usually includes:

Liquids having a flash point above 100°F (37.8°C) but not exceeding 200°F (93.4°C) (i.e., Class II and Class IIIA combustible liquids);

Solid materials in the form of coarse dusts that may burn rapidly but that generally do not form explosive atmospheres with air;

Solid materials in a fibrous or shredded form that may burn rapidly and create flash fire hazards, such as cotton, sisal, and hemp;

Solids and semisolids that readily give off flammable vapors.

Materials that must be preheated before ignition can occur. Materials in this degree require considerable preheating, under all ambient temperature conditions, before ignition and combustion can occur. This degree usually includes:

Materials that will burn in air when exposed to a temperature of 1500°F (815.5°C) for a period of 5 min or less;

Liquids, solids, and semisolids having a flash point above 200°F (93.4°C) (i.e., Class IIIB combustible liquids);

Most ordinary combustible materials.

Materials that will not burn. This degree usually includes any material that will not burn in air when exposed to a temperature of 1500°F (815.5°C) for a period of 5 min.

Note: IF the Committee considers the definition to be too lengthy, the first sentence from each rating could be used, with further reference to NFPA 704.

SUBSTANTIATION: Flammability Hazard Ratings are covered by NFPA 704, Standard System for the Identification of Fire Hazards of Materials (1990). The system is widely in use for the recognition of the severity of the fire hazard for materials including flammable, combustible, and non-combustible liquids. NFPA 325, Fire Hazard Properties of Flammable Gases, and Volatile Solids (1994) provides additional guidance regarding Flammability Hazard Rating determinations for materials. The proposed definition is necessary to provide clarification for a related proposal to Section 4-1.2.

COMMITTEE ACTION: Reject.

COMMITTEE STATEMENT: This definition is not necessary. The subject matter is not within the scope of NFPA 30.

(Log #107)
Committee: FLC-FUN

30- 12 - (1-6 Fire Point (New)): Accept in Principle

SUBMITTER: John Davenport, Industrial Risk Insurers

RECOMMENDATION: Add a new definition to read:

Fire Point. The minimum temperature at which flammable or combustible liquids produce an ignitable vapor concentration that can result in sustained combustion when exposed to a spark of flame ignition source when measured by ASTM D92, Cleveland Open Cup Test Method.

SUBSTANTIATION: "Fire Point" is used Section 4-1.2, but is not defined in the Code.

COMMITTEE ACTION: Accept in Principle.

Refer to Committee Action on Proposal 30-10 (Log #72).

COMMITTEE STATEMENT: See Committee Statement on Proposal 30-10 (Log #72).

(Log #108)
Committee: FLC-FUN

30-13 - (1-6 Relieving-Style Container (New)): Reject
SUBMITTER: John Davenport, Industrial Risk Insurers
RECOMMENDATION: Add a new definition to read:
Relieving-Style Container. A metallic container or portable tank equipped with at least one relieving mechanism on top of the container sized to permit venting of internal pressures generated during fire exposure prevent container rupture.
SUBSTANTIATION: Term is used in the new protection tables to be inserted into Section 4-8.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: This definition is too specific and might rule out use of containers that are not constructed of metal. Also, NFPA 30 does not now define specific types of containers. If more specific definitions are needed, they can be added to Chapter 4. (For example, F-style containers are described in Footnote to Table D-2.2.)

(Log #109)
Committee: FLC-FUN

30-14 - (1-6 Viscous Liquid (New)): Reject
SUBMITTER: John Davenport, Industrial Risk Insurers
RECOMMENDATION: Add a new definition to read:
Viscous Liquid. Liquid materials that have minimal amounts of flammable or combustible liquids combined with inerts. This combination may have a flash point, however, the material will not flow if released, will not reduce in viscosity when heated and the minimal amount of flammable or combustible liquid will not burn off quickly in a fire. The fire hazard created by the material is not consistent with the flash point.
SUBSTANTIATION: "Viscous Liquid" is used in Section 4-8, but is not defined in the Code.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: This definition is not adequate in that it defines a "viscous liquid" not in terms of the property of viscosity, but on fire behavior.

(Log #117)
Committee: FLC-FUN

30-15 - (1-6 Secondary Containment Tank): Reject
SUBMITTER: Eugene S. Schmitt, Michigan State Police Fire Marshals Division
RECOMMENDATION: Add the following language to the definition of Secondary Containment Tank:
"For aboveground secondary containment tank see Section 2-3.4.1 Exception No. 2."
SUBSTANTIATION: Confusion has occurred on the requirements for aboveground secondary containment tanks, especially emergency venting.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: This reference would imply a different definition of aboveground secondary containment tank is located in 2-3.4.1. This is not the case.

(Log #CP33)
Committee: FLC-FUN

30-16 - (Chapter 1): Accept
SUBMITTER: Technical Committee on Fundamentals
RECOMMENDATION: Completely revise Chapter 1 to read as follows:

1-1 Scope.

1-1.1 This code shall apply to the storage, handling, and use of flammable and combustible liquids, including waste liquids, as herein defined and classified.

1-1.2 This code shall not apply to the following:

(a) Any liquid that has a melting point equal to or greater than 100°F (37.8°C) or that does not meet the criteria for fluidity given in the definition for "Liquid" in Section 1-6 of this Code.

(b) Any liquefied gas or cryogenic liquid as defined in Section 1-6 of this Code.

(c)* Any liquid that does not have a flash point, which can be flammable under some conditions, such as certain halogenated hydrocarbons and mixtures containing halogenated hydrocarbons.

(d) Any aerosol product. (See NFPA 30B, Code for the Manufacture and Storage of Aerosol Products.)

(e) Any mist, spray, or foam.

1-1.3 This Code shall also not apply to the following:

(a) Transportation of flammable and combustible liquids, as governed by the U. S. Department of Transportation. (Requirements for transportation of flammable and combustible liquids are found in NFPA 385, Standard for Tank Vehicles for Flammable and Combustible Liquids, and in Title 49, Code of Federal Regulations, Parts 100 through 199.

(b) Storage, handling, and use of fuel oil tanks and containers connected with oil burning equipment. (See NFPA 31, Standard for the Installation of Oil-Burning Equipment.)

1-2* Purpose. The purpose of this Code is to provide reasonable requirements for the safe storage and handling of flammable and combustible liquids.

1-3 Applicability. Chapters 2 and 3 apply to bulk storage of liquids in tanks and similar vessels. Chapter 4 applies to storage of liquids in containers and portable tanks in inside storage areas and in warehouses. Chapter 5 applies to handling of liquids in manufacturing and related operations and processes. Chapter 6 applies to storage of flammable and combustible liquids in certain containers and in certain tanks on farms and isolated construction projects.

1-4 Equivalency.

1-4.1 Nothing in this Code is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, or safety over those prescribed by this Code, provided that technical documentation is submitted to the authority having jurisdiction to demonstrate equivalency and the system, method, or device is approved for the intended purpose.

1-4.2 The provisions of this Code shall be permitted to be altered at the discretion of the authority having jurisdiction after consideration of special situations, such as topographical conditions of the site; presence or absence of protective features (barricades, walls, etc.); adequacy of building exits; the nature of the occupancy; proximity to buildings or adjoining property and the construction of such buildings; capacity and construction of proposed storage tanks and the nature of the liquids to be stored; the nature of the process; the degree to which private fire protection is provided; and the capabilities of the local fire department. Such alternate arrangements shall provide protection at least equivalent to that required by this Code.

1-4.3 The provisions of this Code shall also be permitted to be altered at the discretion of the authority having jurisdiction in cases where other regulations, such as for environmental protection, impose requirements that are not anticipated by this Code. Such alternate arrangements shall provide protection at least equivalent to that required by this Code.

1-4.4 Installations made in accordance with the applicable requirements of the following standards, shall be deemed to be in compliance with this Code:

NFPA 30A, Automotive and Marine Service Station Code; NFPA 32, Standard for Drycleaning Plants; NFPA 33, Standard for Spray Application Using Flammable and Combustible Materials; NFPA 34, Standard for Dipping and Coating Processes Using Flammable or Combustible Liquids; NFPA 35, Standard for the Manufacture of Organic Coatings; NFPA 36, Standard for Solvent Extraction Plants; NFPA 37, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines; NFPA 45, Standard on Fire Protection for Laboratories Using Chemicals; and Chapter 10 of NFPA 99, Standard for Health Care Facilities.

1-5 Retroactivity. The provisions of this Code are considered necessary to provide a reasonable level of protection from loss of life and property from fire and explosion. They reflect situations and the state-of-the-art prevalent at the time the Code was issued. Unless otherwise noted, it is not intended that the provisions of this Code be applied to facilities, equipment, structures, or installations that were existing or approved for construction or installation prior to the effective date of this Code, except in those cases where it is determined by the authority having jurisdiction that the existing situation involves a distinct hazard to life or adjacent property.

1-6 Definitions. For the purpose of this Code, the following terms shall be defined as follows:

Apartment House. A building or that portion of a building containing more than two dwelling units.

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.

Assembly Occupancy. All buildings or portions of buildings used for gathering 50 or more persons for such purposes as deliberation, worship, entertainment, dining, amusement, or awaiting transportation.

Atmospheric Tank. A storage tank that has been designed to operate at pressures from atmospheric through 0.5 psig (760 mm Hg through 786 mm Hg) measured at the top of the tank.

Authority Having Jurisdiction. The "authority having jurisdiction" is the organization, office or individual responsible for "approving" equipment, an installation or a procedure.

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 public safety is primary, 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 department, 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."

Barrel. A volume of 42 U.S. gal (158.9 L).

Basement. A story of a building or structure having 1/2 or more of its height below ground level and to which access for fire fighting purposes is unduly restricted.

Boiling Point. See Subsection 1-7.2.

Boil-Over. An event in the burning of certain oils in an open top tank when, after a long period of quiescent burning, there is a sudden increase in fire intensity associated with expulsion of burning oil from the tank. Boil-over occurs when the residues from surface burning become more dense than the unburned oil and sink below the surface to form a hot layer, which progresses downward much faster than the regression of the liquid surface. When this hot layer, called a "heat wave," reaches water or water-in-oil emulsion in the bottom of the tank, the water is first superheated and then boils almost explosively, overflowing the tank. Oils subject to boil-over consist of components having a wide range of boiling points, including both light ends and viscous residues. These characteristics are present in most crude oils and can be produced in synthetic mixtures.

NOTE: A boil-over is an entirely different phenomenon from a slop-over or froth-over. Slop-over involves a minor frothing that occurs when water is sprayed onto the hot surface of a burning oil. Froth-over is not associated with a fire but results when water is present or enters a tank containing hot viscous oil. Upon mixing, the sudden conversion of water to steam causes a portion of the tank contents to overflow.

Bulk Plant or Terminal. That portion of a property where liquids are received by tank vessel, pipelines, tank car, or tank vehicle and are stored or blended in bulk for the purpose of distributing such liquids by tank vessel, pipeline, tank car, tank vehicle, portable tank, or container.

Chemical Plant. A large integrated plant or that portion of such a plant, other than a refinery or distillery, where liquids are produced by chemical reactions or used in chemical reactions.

Closed Container. A container as herein defined, so sealed by means of a lid or other device that neither liquid nor vapor will escape from it at ordinary temperatures.

Container. Any vessel of 60 U.S. gal (227 L) or less capacity used for transporting or storing liquids.

Crude Petroleum. Hydrocarbon mixtures that have a flash point below 150°F (65.6°C) and that have not been processed in a refinery.

Cryogenic Liquid. A refrigerated liquid gas having a boiling point below -130°F (-90°C) at atmospheric pressure.

Distillery. A plant or that portion of a plant where liquids produced by fermentation are concentrated and where the concentrated products are also be mixed, stored, or packaged.

Dwelling. A building that is occupied exclusively for residence purposes and has not more than two dwelling units. Also, a building that is used as a boarding or rooming house and which serves not more than 15 persons with meals or sleeping accommodations or both.

Dwelling Unit. One or more rooms arranged for the use of one or more individuals living together as a single housekeeping unit, with cooking, living, sanitary, and sleeping facilities.

Educational Occupancy. A building or structure or any portion thereof used for the purpose of learning or of receiving educational instruction.

Fire Area. An area of a building separated from the remainder of the building by construction having a fire resistance of at least 1 hr and having all communicating openings properly protected by an assembly having a fire resistance rating of at least 1 hr.

Flash Point. See Subsection 1-7.2.

Fugitive Emissions. Releases of flammable vapor that continuously or intermittently occur from process equipment during normal operations. These include leaks from pump seals, valve packing, flange gaskets, compressor seals, process drains, etc.

Hazardous Material or Hazardous Chemical. Material presenting dangers beyond the fire problems relating to flash point and boiling point. These dangers can arise from but are not limited to toxicity, reactivity, instability, or corrosivity.

Hazardous Materials Storage Locker. A movable prefabricated structure, manufactured primarily at a site other than the final location of the structure and transported completely assembled or in a ready-to-assemble package to the final location. It is intended to meet local, state, and federal requirements for outside storage of hazardous materials.

Hazardous Reaction or Hazardous Chemical Reaction. Reactions that result in dangers beyond the fire problems relating to flash point and boiling point of either the reactants or of the products. These dangers might include, but are not limited to, toxic effects, reaction speed (including detonation), exothermic reaction, or production of unstable or reactive materials.

Hotel. Buildings or groups of buildings under the same management in which there are sleeping accommodations for hire, primarily used by transients who are lodged with or without meals, including, but not limited to, inns, clubs, motels, and apartment hotels.

Incidental Liquid Use or Storage. Use or storage as a subordinate activity to that which establishes the occupancy or area classification.

Inside Liquid Storage Area. A room or building used for the storage of liquids in containers or portable tanks, separated from other types of occupancies. Such areas include:

Inside Room. A room totally enclosed within a building and having no exterior walls.

Cut-Off Room. A room within a building and having at least one exterior wall.

Attached Building. A building having only one common wall with another building having other types of occupancies.

Liquid Warehouse. A separate, detached building or attached building used for warehousing-type operations for liquids.

Institutional Occupancy. A building or structure or any portion thereof used by persons who are harbored or detained to receive medical, charitable, or other care or treatment or by persons involuntarily detained.

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.

Liquefied Gas. A gas that, under its charged pressure, is partially liquid at 70°F (21°C).

Liquid. See Subsection 1-7.2.

Listed. Equipment or materials included in a list published by 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 whose listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

NOTE: The means for identifying listed equipment may vary for each 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.

Low-Pressure Tank. A storage tank designed to withstand an internal pressure above 0.5 psig (3.5 kPa) but not more than 15 psig (103.4 kPa) measured at the top of the tank.

Mercantile Occupancy. A building or structure or any portion thereof used for the wholesale or retail displaying, selling, or buying of goods, wares, or merchandise.

Occupancy Classification. The system of defining the predominant operating characteristic of a portion of a building or plant for purposes of applying relevant sections of this code. This may include but is not limited to distillation, oxidation, cracking, and polymerization.

Office Occupancy. A building or structure or any portion thereof used for the transaction of business or the rendering or receiving of professional services.

Operating Unit (Vessel) or Process Unit (Vessel). The equipment in which a unit operation or unit process is conducted. (See also definition of Unit Operation or Unit Process.)

Operations. A general term that includes, but is not limited to, the use, transfer, storage, and processing of liquids.

Outdoor Occupancy Classification. Similar to occupancy classification, except that it applies to outdoor operations not enclosed in a building or shelter.

Portable Tank. Any closed vessel having a liquid capacity over 60 U.S. gallons (227 L) and not intended for fixed installation.

Pressure Vessel. Any fired or unfired vessel within the scope of the applicable section of the ASME Boiler and Pressure Vessel Code.

Process or Processing. An integrated sequence of operations. The sequence can be inclusive of both physical and chemical operations, unless the term is modified to restrict it to one or the other. The sequence can involve, but is not limited to, preparation, separation, purification, or change in state, energy content, or composition.

Protection for Exposures. Fire protection for structures on property adjacent to liquid storage. Fire protection for such structures shall be acceptable when located either within the jurisdiction of any public fire department or adjacent to plants having private fire brigades capable of providing cooling water streams on structures on property adjacent to liquid storage.

Refinery. A plant in which flammable or combustible liquids are produced on a commercial scale from crude petroleum, natural gasoline, or other hydrocarbon sources.

Safety Can. An approved container, of not more than 5 gal (18.9 L) capacity, having a spring-closing lid and spout cover and so designed that it will safely relieve internal pressure when subjected to fire exposure.

Secondary Containment Tank. A tank having an inner and an outer wall with an interstitial space (annulus) between the walls and having means for monitoring the interstitial space for a leak. Underground secondary containment tanks are of either Type I or Type II construction.

Type I. A primary tank wrapped by an exterior shell that is in direct contact with it. The exterior shell might or might not wrap the full 360 degree circumference of the primary tank.

Type II. A primary tank wrapped by an exterior shell that is physically separated from it by stand-offs and wraps the full 360 degree circumference of the primary tank.

Stable Liquid. Any liquid not defined as unstable.

Storage Tank. Any vessel having a liquid capacity that exceeds 60 gal (227 L), is intended for fixed installation and is not used for processing.

Storage Tank Building. A roofed structure that contains storage tanks and that limits the dissipation of heat or the dispersion of flammable vapors or restricts fire fighting access and control and that is installed in accordance with the requirements of Section 2-5.

Unit Operation or Unit Process. A segment of a physical or chemical process that might or might not be integrated with other segments to constitute the manufacturing sequence.

Unstable Liquid. A liquid that, in the pure state or as commercially produced or transported, will vigorously polymerize, decompose, undergo condensation reaction, or become self-reactive under conditions of shock, pressure, or temperature.

Vapor Pressure. See Subsection 1-7.2.

Vapor Processing Equipment. Those components of a vapor processing system designed to process vapors or liquids captured during transfer operations.

Vapor Processing System. A system designed to capture and process vapors displaced during transfer operations by use of mechanical or chemical means. Examples are systems using blower-assist for capturing vapors and refrigeration, absorption, and combustion systems for processing vapors.

Vapor Recovery System. A system designed to capture and retain, without processing, vapors displaced during transfer operations. Examples are balanced-pressure vapor displacement systems and vacuum assist systems without vapor processing.

Ventilation. As specified in this code, movement of air that is provided for the prevention of fire and explosion. It is considered adequate if it is sufficient to prevent accumulation of significant quantities of vapor-air mixtures in concentrations over one-fourth of the lower flammable limit.

Warehouses.

General-Purpose Warehouse. A separate, detached building or portion of a building used only for warehousing-type operations.

Liquid Warehouse. (See definition under Inside Storage Area.)

NOTE: Warehousing operations referred to in these definitions are those operations not accessible to the public and include general purpose, merchandise, distribution, and industrial warehouse-type operations.

Wharf. Any dock, pier, bulkhead, or other structure over or contiguous to navigable water with direct physical access from land, the primary function of which is the transfer of liquid cargo in bulk between shore installations and any tank vessel, such as a ship, barge, lighter boat, or other mobile floating craft.

1-7 Definition and Classification of Liquids. [RESERVED]

1-8 Use of Other Units. If a value for measurement given in this standard is followed by an equivalent value in other units, the first stated shall be regarded as the requirement. The given equivalent value shall be considered to be approximate.

1-9 General Requirements.

1-9.1 Storage. Liquids shall be stored in tanks in accordance with Chapter 2 of this Code or in containers, portable tanks, and intermediate bulk containers in accordance with Chapter 4 of this Code.

1-9.2 Pressure Vessels. All new pressure vessels that contain flammable or combustible liquids shall meet the following:

(a) Fired pressure vessels shall be designed and constructed in accordance with Section I (Power Boilers), or Section VIII, Division 1 or Division 2 (Pressure Vessels), as applicable, of the ASME Boiler and Pressure Vessel Code.

(b) Unfired pressure vessels shall be designed and constructed in accordance with Section VIII, Division 1 or Division 2, of the ASME Boiler and Pressure Vessel Code.

(c) Pressure vessels that do not meet the requirements of (a) or (b) shall be permitted to be used provided approval has been obtained from the state or other governmental jurisdiction in which they are to be used. (Such pressure vessels are generally referred to as "State Special.")

1-9.3 Exits. Egress from buildings and areas covered by this code shall meet the requirements of NFPA 101, Life Safety Code.

Appendix A

A-1-1.2(c) Certain mixtures of flammable or combustible liquids and halogenated hydrocarbons either do not exhibit a flash point using the standard closed-cup test methods or will exhibit elevated flash points. However, if the halogenated hydrocarbon is the more volatile component, preferential evaporation of this component can result in a liquid that does have a flash point or has a flash point that is lower than the original mixture. In order to evaluate the fire hazard of such mixtures, flash point tests should be conducted after fractional evaporation of 10, 20, 40, 60, or even 90 percent of the original sample or other fractions representative of the conditions of use. For systems such as open process tanks or spills in open air, an open-cup test method might be more appropriate for estimating the fire hazard.

A-1-2 Requirements for the safe storage and use of the great variety of flammable and combustible liquids commonly available depend primarily on their fire characteristics, particularly the flash point, which is the basis for the classification system given in Section 1-7. It should be noted that a liquid's classification can be changed by contamination. For example, placing a Class II liquid into a tank that last contained a Class I liquid can change the flash point of the former so that it falls into the range of a Class I liquid. The same situation can exist where a Class II liquid is exposed to the vapors of a Class I liquid via an interconnecting vapor line. (See 2-3.7.4 and 2-4.5.6.) Care must be exercised in such cases to apply the requirements appropriate to the actual classification. Refer to NFPA 49, Hazardous Chemicals Data, and NFPA 325M, Fire Hazard Properties of Flammable Liquids, Gases, for flash point and other fire hazard data.

The volatility of a liquid is increased by heating. Where Class II or Class III liquids are exposed to storage conditions, use conditions, or process operations where they are naturally or artificially heated to or above their flash points, additional fire safety features might be necessary. These include ventilation, exposure to ignition sources, diking, and electrical area classification.

Additional fire safety considerations might also be necessary for the safe storage and use of liquids that have unusual burning characteristics, that are subject to self-ignition when exposed to air, that are highly reactive with other substances, that are subject to explosive decomposition, or that have other special properties that dictate safeguards over and above those specified for a normal liquid of similar flash point classification.

SUBSTANTIATION: This complete rewrite of Chapter 1 of NFPA 30 is being done to comply with the NFPA Manual of Style; to incorporate the text of NFPA 321 as a new section on definition and classification of liquids; and to simplify the text.

COMMITTEE ACTION: Accept.

(Log #CP34)
Committee: FLC-FUN

30-17 - (1-1.1): Accept
SUBMITTER: Technical Committee on Fundamentals
RECOMMENDATION: In the proposed new version of Chapter 1 of NFPA 30, as printed in Committee Proposal 30-16 (Log #CP33), add the following appendix item to Subsection 1-1.1:
A-1-1.1 Liquids that are solid at 100°F or above, but are handled, used, or stored at temperatures above their flashpoints should be reviewed against pertinent sections of this code.
SUBSTANTIATION: Although these materials are exempt from NFPA 30 by means of 1-1.1, if they are stored handled or used in a manner that might cause a fire hazard, then some of the requirements of NFPA 30 might be applicable.
COMMITTEE ACTION: Accept.

(Log #CP35)
Committee: FLC-FUN

30-18 - (1-6 Atmospheric Tank): Accept
SUBMITTER: Technical Committee on Fundamentals
RECOMMENDATION: Revise the definition of "atmospheric tank" to read:
Atmospheric Tank.* A storage tank that has been designed to operate at pressures from atmospheric through 1.0 psig (760 mm Hg through 812 mm Hg), measured at the top of the tank.
A-1-6, Atmospheric Tank. Older style flat roof tanks were designed to operate at pressures from atmospheric through 0.5 psig (760 mm Hg through 786 mm Hg), measured at the top of the tank. This limitation was established to avoid continuous stress on the roof plates of the tank.
SUBSTANTIATION: This changes the upper pressure limit from 0.5 psig to 1.0 psig. This change recognizes the current design specifications of typical atmospheric storage tanks.
COMMITTEE ACTION: Accept.

(Log #CP36)
Committee: FLC-FUN

30-19 - (1-6 Building (New)): Accept
SUBMITTER: Technical Committee on Fundamentals
RECOMMENDATION: Add a new definition for "building" to read:
Building. A three-dimensional space that is enclosed by a roof and a wall that covers more than one-half of the possible area of the sides of the space, is of sufficient size to allow entry by personnel, will likely limit the dissipation of heat or dispersion of vapors, and restricts access for fire fighting.
SUBSTANTIATION: This definition is necessary to distinguish between true buildings and weather shelters that do not need to be treated as buildings.
COMMITTEE ACTION: Accept.

(Log #CP37)
Committee: FLC-FUN

30-20 - (1-7): Accept
SUBMITTER: Technical Committee on Fundamentals
RECOMMENDATION: Add a new Section 1-7, Definition and Classification of Liquids as follows:
1-7 Definition and Classification of Liquids.
1-7.1 Scope. This section shall establish a uniform system of defining and classifying flammable and combustible liquids for the purpose of proper application of this Code. This section shall apply to any liquid within the scope of and subject to the requirements of this Code.
1-7.1.1 This section shall not apply to mists, sprays, or foams.
1-7.1.2 This section shall not apply to liquids that do not have flash points, but are capable of burning under certain conditions, such as certain halogenated hydrocarbons and certain mixtures of flammable or combustible liquids and halogenated hydrocarbons. [See A-1-1.2(c)]
1-7.2 Definitions. For the purpose of this section, the following terms shall have the definitions given.
Boiling Point.* The temperature at which the vapor pressure of a liquid equals the surrounding atmospheric pressure. For purposes of defining the boiling point, atmospheric pressure shall be considered to be 14.7 psia (760 mm Hg). Where an accurate boiling point is unavailable for a particular liquid or for mixtures that do not have a constant boiling point, the 20 percent point of a distillation performed in accordance with ASTM D86, Standard Method of Test for Distillation of Petroleum Products, shall be considered to be the boiling point.
Flash Point.* The minimum temperature of a liquid at which sufficient vapor is given off to form an ignitible mixture with air, near the surface of the liquid or within the vessel used, as determined by the appropriate test procedure and apparatus specified in 1-7.4.
Liquid. Any material that has a fluidity greater than that of 300 penetration asphalt when tested in accordance with ASTM D5, Test for Penetration for Bituminous Materials.
Vapor Pressure.* The pressure, measured in pounds per square inch, absolute (psia), exerted by a liquid, as determined by ASTM D323, Standard Method of Test for Vapor Pressure of Petroleum Products (Reid Method).
1-7.3* Classification and Definition of Liquids. Any liquid within the scope of this Code and subject to the requirements of this Code shall be known generally as either a flammable liquid or a combustible liquid and shall be defined and classified in accordance with this subsection.
1-7.3.1 Flammable Liquid. Any liquid that has a closed-cup flash point below 100°F (37.8°C), as determined by the test procedures and apparatus set forth in Subsection 1-7.4. Flammable liquids shall be classified as Class I as follows:
Class I Liquid. Any liquid that has a closed cup flash point below 100°F (37.8°C) and a Reid vapor pressure not exceeding 40 psia (2068.6 mm Hg) at 100°F (37.8°C), as determined by ASTM D 323, Standard Method of Test for Vapor Pressure of Petroleum Products (Reid Method). Class I liquids shall be further classified as follows:
Class IA liquids shall include those liquids that have flash points below 73°F (22.8°C) and boiling points below 100°F (37.8°C).
Class IB liquids shall include those liquids that have flash points below 73°F (22.8°C) and boiling points at or above 100°F (37.8°C).
Class IC liquids shall include those liquids that have flash points at or above 73°F (22.8°C), but below 100°F (37.8°C).
1-7.3.2 Combustible Liquids. A combustible liquid shall be defined as any liquid that has a closed-cup flash point at or above 100°F (37.8°C), as determined by the test procedures and apparatus set forth in Subsection 1-7.4. Combustible liquids shall be classified as Class II or Class III as follows:
Class II liquid. Any liquid that has a flash point at or above 100°F (37.8°C) and below 140°F (60°C).
Class IIIA. Any liquid that has a flash point at or above 140°F (60°C), but below 200°F (93°C).
Class IIIB. Any liquid that has a flash point at or above 200°F (93°C).
1-7.4 Determination of Flash Point. The flash point of a liquid shall be determined according to the methods specified in this subsection.
1-7.4.1 The flash point of a liquid having a viscosity below 5.5 centiStokes at 104°F (40°C) or below 9.5 centiStokes at 77°F (25°C) shall be determined in accordance with ASTM D56, Standard Method of Test for Flash Point by the Tag Closed Tester.
Exception: Cut-back asphalts, liquids that tend to form a surface film, and liquids that contain suspended solids shall not be tested in accordance with ASTM D 56, even if they otherwise meet the viscosity criteria.
1-7.4.2 The flash point of a liquid having a viscosity of 5.5 centiStokes or more at 104°F (40°C) or 9.5 centiStokes or more at 77°F (25°C) or a flash point of 200°F (93.4°C) or higher shall be determined in accordance with ASTM D93, Standard Test Method for Flash Point by the Pensky-Martens Closed Tester.
1-7.4.3 As an alternative, ASTM D3278, Standard Method of Tests for Flash Point of Liquids by Setaflash Closed Tester, shall be permitted to be used for paints, enamels, lacquers, varnishes, and related products and their components that have flash points between 32°F (0°C) and 230°F (110°C) and viscosities below 150 Stokes at 77°F (25°C).
1-7.4.4 As an alternative, ASTM D3828, Standard Test Methods for Flash Point of Liquids by Setaflash Closed Tester, shall be permitted to be used for materials other than those for which ASTM D 3278 is specifically required.
Appendix A
This Appendix is not a part of the requirements of this NFPA document, but is included for information purposes only.
A-1-7.2 Boiling Point. At the boiling point, the surrounding atmospheric pressure can no longer hold the liquid in the liquid state and the liquid boils. A low boiling point is indicative of a high vapor pressure and a high rate of evaporation.
A-1-7.2 Flash Point. Flash point is a direct measure of a liquid's volatility, its tendency to vaporize. The lower the flash point, the greater the volatility and the greater the risk of fire. Flash point is determined using one of several different test procedures and apparatus that are specified in 1-7.4.

A liquid that has a flash point at or below ambient temperature is easy to ignite and will burn quickly. On ignition, the spread of flame over the surface of such a liquid will be rapid, because it is not necessary for the fire to expend energy heating the liquid to generate more vapor. Gasoline is a familiar example. A liquid with a flash point above ambient temperature presents less risk because it must be heated to generate enough vapor to become ignitible; it is more difficult to ignite and presents less potential for the generation and spread of vapor. A common example is home heating oil (Fuel Oil No. 2). Home heating oil must be atomized to a fine mist in order for it to be easily ignited.

Certain solutions of liquids in water exhibit a flash point using the standard closed-cup test procedures but will not burn and might even extinguish a fire. To assist identifying such solutions, the following standards are helpful: ASTM D4207, Standard Test Method for Sustained Burning of Low Viscosity Liquid Mixtures by the Wick Test, and ASTM 4206, Standard Test Method for Sustained Burning of Liquid Mixtures by the Setaflash Tester (Open Cup). Liquid mixtures that do not sustain combustion for a specified time at a specified temperature are considered to be noncombustible. These tests provide additional data for determining proper storage and handling of such mixtures. In a confined space, such mixtures might still create an ignitible vapor-air mixture, depending on the amount of flammable liquid in the mixture and the quantity of the spill.

Related to the flash point is the "fire point". The fire point of a liquid is the temperature at which ignition of vapors will result in continued burning. As the term "flash point" suggests, the vapors generated at that temperature will flash, but will not necessarily continue to burn. While the difference between flash point and fire point has some significance when conducting flash point tests, it is ignored in practice and the flash point is used to classify the liquid and characterize its hazard.

For more information, see ASTM E502, Standard Test Method for Selection and Use of ASTM Standards for the Determination of Flash Point of Chemicals by Closed Cup Methods and the ASTM Manual on Flash Point Standards and Their Use.

A-1-7.2, Vapor Pressure. Vapor pressure is a measure of the pressure that the liquid exerts against the atmosphere above it. Just as the atmosphere exerts pressure on the surface of the liquid, the liquid pushes back. Vapor pressure is normally less than atmospheric pressure and is a measure of the liquid's tendency to evaporate, to move from the liquid to the gaseous state. This tendency is also referred to as volatility, thus the use of the term "volatile" to describe liquids that evaporate very easily. The higher the vapor pressure, the greater the rate of evaporation and the lower the boiling point. Simply put, this means more vapors and increased fire risk.

A-1-7.3 The classification of liquids is based on flash points that have been corrected to sea level, in accordance with the relevant ASTM test procedures. At high altitudes, the actual flash points will be significantly lower than those either observed at sea level or corrected to atmospheric pressure at sea level. Allowances might be necessary for this difference in order to appropriately assess the risk.

Table A-1-7.3 presents a comparison of the definitions and classification of flammable and combustible liquids, as set forth in section 1-7 of this Code, with similar definitions and classification systems used by other regulatory bodies.

NOTE: The Hazardous Materials Regulations of the U. S. Department of Transportation (DOT), as set forth in the Code of Federal Regulations, Title 49, Parts 173.120(b)(2) and 173.150(f), provide an exception whereby a flammable liquid that has a flash point between 100°F (37.8°C) and 141°F (60.5°C) and does not also meet the definition of any other DOT hazard class can be reclassified as a combustible liquid (i.e., one having a flash point above 141°F (60.5°C) for shipment by road or rail within the United States.

SUBSTANTIATION: This incorporates text of NFPA 321 into NFPA 30.

COMMITTEE ACTION: Accept.

(Log #40)
Committee: FLC-TAN

30- 22 - (2-1): Accept in Principle

SUBMITTER: Peter R. Marshall, Charlotte, NC

RECOMMENDATION: This chapter shall apply to aboveground, underground, and inside storage of liquids in fixed tanks; and, in portable tanks whose capacity exceeds 660 gal (2498 L).

(Added separation of the two independent requirements [; and ,]!)

SUBSTANTIATION: As presently written the application of this chapter is unclear. The 1991 edition of the Flammable and Combustible Liquids Code Handbook provided no explanatory commentary regarding the scope of Chapter 2 while the 1993 edition has included a lengthy commentary beginning with "It is sometimes assumed... This is not correct." Clearly the committee has come to the realization that this paragraph is up for misinterpretation. As a matter of fact, as written it does NOT state what the explanatory commentary states. However, the explanatory commentary is quite clear as to what the scope of Chapter 2 is and is conveyed more accurately in the proposal above.

COMMITTEE ACTION: Accept in Principle.

Revise 2-1 to read:

2-1 Scope. This chapter shall apply to:

(a) the storage of flammable and combustible liquids in fixed aboveground and underground tanks;

(b) the storage of flammable and combustible liquids in fixed aboveground tanks in buildings;

(c) the storage of flammable and combustible liquids in portable tanks whose capacity exceeds 660 gal (2500 L); and

(d) the installation of such tanks and portable tanks.

COMMITTEE STATEMENT: This revision of the Scope of Chapter 2 should eliminate any confusion.

A-1-7.3 Comparative Classification of Liquids

Agency	Agency Classification	Agency Flash Point	NFPA Definition	NFPA Classification	NFPA Flash Point
ANSI/CMA Z129.1-1994	Flammable	< 141°F	Flammable Combustible	Class I and Class II Class IIIA	< 100°F ≥100°F to <140°F ≥140°F to <200°F
	Combustible	≥141°F to <200°F	Combustible	Class IIIA	≥140°F to <200°F
DOT	Flammable	<141°F	Flammable Combustible	Class I Class II Class IIIA	<100°F ≥100°F to <140°F ≥140°F to <200°F
	Combustible	≥141°F to <200°F	Combustible	Class IIIA	≥140°F to <200°F
DOT HM-1891 Domestic Exception [(a)]	Flammable	<100°F	Flammable	Class I	<100°F
	Combustible	≥100°F to <200°F	Combustible	Class II Class IIIA	≥100°F to <140°F ≥140°F to <200°F
UN	Flammable	<141°F	Flammable Combustible	Class I Class II Class IIIA	<100°F ≥100°F to <140°F ≥140°F to <200°F
	Combustible	≥141°F to <200°F	Combustible	Class II Class IIIA	≥100°F to <140°F ≥140°F to <200°F

(a) See "Note" in A-1-7.3.

(Log #69)
Committee: FLC-TAN

30- 23 - (Table 2-1): Reject
SUBMITTER: Rick Thornberry, ConVault
RECOMMENDATION: Revise table to read as follows:
SUBSTANTIATION: The purpose of this proposal is to recognize the new aboveground tank technology known as protected aboveground tanks which are similar to fire resistant tanks presently regulated in NFPA 30A-1993. Protected aboveground tanks, however, achieve a greater fire resistive protection than fire resistant tanks and also provide protection against vehicle impact and ballistic impact. A companion proposal to NFPA 30A establishes the performance criteria for protected aboveground tanks and also specifies that such tanks be provided with enclosed secondary containment to provide an additional level of fire safety. Another companion code change to NFPA 30 proposes a new Section 2-2.6 which specifies the requirements for protected aboveground tanks based on NFPA 30A and limits their individual capacity to 12,000 gal.

Protected aboveground tanks provide a significant level of fire safety which is at least equivalent to horizontal or vertical tanks with emergency relief venting provided with an approved inerting system or an approved foam system. In accordance with Table 2-1, these tanks are allowed a reduction of 50 percent in the minimum distances shown in Table 2-6. Since protected aboveground tanks provide passive fire resistive protection and are of substantial construction and contain enclosed secondary containment, they pose a very minimal fire hazard to any surrounding buildings, public ways, or adjacent properties. Therefore, it appears reasonable to allow a further reduction in the minimum separation distances specified in Tables 2-1 and 2-6 as indicated in this proposal. The proposed distances appear reasonable given the protection provided by protected aboveground tanks relative to the other separation distances specified in Table 2-1 for "unprotected" tanks provided with active fire protection systems.

COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: The Technical Committee does not believe this proposal presents adequate justification for this change.

(Log #CP22)
Committee: FLC-TAN

30- 24 - (2-1 Exception (New)): Accept
SUBMITTER: Technical Committee on Tank Storage and Piping Systems
RECOMMENDATION: Add an exception to 2-1 to read:
"Exception: Tanks that do not exceed 1,100 gal and located at farms and isolated sites, as covered in Chapter 6."
SUBSTANTIATION: This exception will eliminate any potential conflict between the requirements of Chapter 2 and the new Chapter 6, which addresses farms and isolated sites.
COMMITTEE ACTION: Accept.

Table 2-1 Stable Liquids [Operating Pressure 2.5 psig (17.2 kPa) or Less]

Type of Tank	Protection	Minimum Distance in Ft from Property Line that Is or Can Be Built Upon, Including the Opposite Side of a Public Way ~~and Shall Be Not Less than 5 Ft~~	Minimum Distance in Ft from Nearest Side of Any Public Way or from Nearest Important Building on the Same Property ~~and Shall Be Not Less than 5 Ft~~
Floating Roof 4 [See 2-3.2.1(a)]	Protection for exposures* 1	1/2 times diameter of tank	1/6 times diameter of tank
	None	Diameter of tank but need not exceed 175 ft	1/6 times diameter of tank
Vertical with Weak Roof-to-Shell Seam 4 (See 2-3.2.2)	Approved foam or inerting system** 2 on tanks not exceeding 150 ft in diameter*** 3	1/2 times diameter of tank	1/6 times diameter of tank
	Protection for exposures* 1	Diameter of tank	1/3 times diameter of tank
	None	2 times diameter of tank but need not exceed 350 ft	1/3 times diameter of tank
Horizontal and Vertical with Emergency Relief Venting to Limit Pressures to 2.5 psig 4	Approved inerting system** 2 on the tank or approved foam system on vertical tanks	1/2 times Table 2-6	1/2 times Table 2-6
	Protection for exposures* 1	Table 2-6	Table 2-6
	None	2 times Table 2-6	Table 2-6
Protected Aboveground Tank (See 2-2.6)	Protection for exposures 1	2-1/2	0
	None	5	2-1/2

SI Units: 1 ft = 0.3m.

1 *See definition of "Protection for Exposures."
2 **See NFPA 69, *Standard on Explosion Prevention Systems* .
3 ***For tanks over 150 ft in diameter, use "Protection for Exposures" or "None," as applicable.
4 In no case shall the minimum distance be less than 5 ft.

(Log #36)
Committee: FLC-TAN

30- 25 - (2-2.3 (New)): Reject
SUBMITTER: Mike Psalidas, Aviation Equipment Repair Services
RECOMMENDATION: Above ground atmospheric tanks, including those incorporating secondary containment, whose purpose shall be for storing flammable or combustible liquids, and whose capacity does not exceed 50,000 USG shall be labeled or listed with one of the following standards:
(a) Underwriters Laboratories Inc., UL-142, Standard for Steel Aboveground Tanks for Flammable & Combustible Liquids; UL-80, Standard for Steel Inside Tanks for OIL Burner Fuel.
(b) American Petroleum Institute Standard No. 650, Welded Steel Tanks for Oil Storage.
(c) American Petroleum Institute Specifications 12D, Field Welded Tanks for Storage of Production Liquids; 12F, Shop Welded Tanks for Storage of Production Liquids.
SUBSTANTIATION: There has been a dramatic increase in the placement of aboveground flammable or combustible product tanks in the 50,000 USG or less category, with a larger increase expected. This requirement, since these size tanks are predominantly placed in service stations, truck stops, airports, etc. would assure both consumer and regulatory authorities that construction standards, calculations, and safety issues and equipment for these types of tanks have been met, and are periodically reviewed. Since it's conceivable these types of tanks can and/or will end up in neighborhood facilities, the need for quality assurance and independent review of all phases of their construction and design seems most imperative.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: The existing requirements are adequate for safe installation. NFPA 30's requirements are intended to provide a reasonable degree of fire safety, yet maintain some flexibility. The authority having jurisdiction is empowered to impose additional restrictions where conditions warrant. The submitter is further advised that aboveground tanks at service stations are governed by the more restrictive requirements of NFPA 30A.

(Log #CP24)
Committee: FLC-TAN

30- 26 - (2-2.3.1): Accept
SUBMITTER: Technical Committee on Tank Storage and Piping Systems
RECOMMENDATION: Revise 2-2.3.1 by adding the following text:
"Tanks designed and constructed to API 650 shall be permitted to operate at pressures from atmospheric to 1.0 psig, measured at the top of the tank. An engineering analysis shall be required for any other tank that is intended for use at pressures above the 0.5 psig permitted for atmospheric tanks. In no case shall an atmospheric tank be permitted to be operated above 1.0 psig."
SUBSTANTIATION: This proposed addition recognizes the ability of API 650 tanks to operate at pressures beyond the 0.5 psig upper limit set by NFPA 30 for atmospheric tanks. It also directs the user to conduct an engineering analysis of any other atmospheric tank that might serve at operating pressures between 0.5 psig and 1.0 psig. Finally, this addition sets an absolute limit to the operating pressure of tanks designed for atmospheric service.
COMMITTEE ACTION: Accept.

(Log #22)
Committee: FLC-TAN

30- 27 - (2-2.3.1 (New)): Accept in Principle
SUBMITTER: Jon V. Brannan, Underwriters Laboratories, Inc.
RECOMMENDATION: Add new text as follows:
(f) Underwriters Laboratories, Inc., Standard for External Corrosion Protection Systems for Steel Underground Storage Tanks, UL1746.
SUBSTANTIATION: Underground storage tanks are listed to this UL Standard and therefore should be referenced as UL58, UL142, and UL1316 are currently referenced.
COMMITTEE ACTION: Accept in Principle.
Refer to Committee Action on Proposals 30-47 (Log #26) and 30-48 (Log #27).
COMMITTEE STATEMENT: UL 1746 is already appropriately referenced in Subsections 2-4.3(a)6 and 2-4.3(b).

(Log #47)
Committee: FLC-TAN

30- 28 - (2-2.4.3): Accept
SUBMITTER: Jon V. Brannan, Underwriters Laboratories, Inc.
RECOMMENDATION: Revise text:
Horizontal Cylindrical and Rectangular tanks built according to Underwriters Laboratories Inc. requirements in 2-2.3.1 shall be permitted to be used for operating pressures not exceeding 1 psig (6.9 kPa) and shall be limited to 2.5 psig (17.2 kPa) under emergency venting conditions. Vertical Tanks built according to Underwriters Laboratories Inc., requirements in 2-2.3.1 require an Engineering evaluation if operated above 0.5 psig.
SUBSTANTIATION: Clarifies that UL Listed Vertical Atmospheric Tanks when operated above 0.5 psig require an evaluation to determine their suitability for the specific application.
COMMITTEE ACTION: Accept.

(Log #10)
Committee: FLC-TAN

30- 29 - (2-2.5.1): Reject
SUBMITTER: Lanny R. Berke, 3M
RECOMMENDATION: Revise text as follows:
"The pressure of the vessel shall never exceed the design pressure of the vessel."
SUBSTANTIATION: 1. "Normal" and "abnormal" are not defined.
2. Is it the intent that abnormal operating pressure of the vessel be allowed to exceed the design pressure of the vessel?
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: The Technical Committee on Tank Storage and Piping Systems points out that, under abnormal conditions, the tank is allowed to exceed its design pressure by the American Society of Mechanical Engineers Boiler and Pressure Vessel Code. The submitter is referred to this Code for criteria on "normal operating pressure."

(Log #43)
Committee: FLC-TAN

30- 30 - (2-2.6): Reject
SUBMITTER: Charles E. Kaempen, KCL Projects Ltd.
RECOMMENDATION: Revise text:
2-2.6 Provisions for Internal Corrosion. Atmospheric underground storage tanks, including those incorporating secondary containment, shall be built so that internal corrosion of the primary container can not occur during a thirty year design life of the tank.
SUBSTANTIATION: The wording as well as the intent of paragraph 2-2.6 in the 1993 edition of NFPA Document No. 30 is not clear. For example, it should be made clear that the intent of paragraph 2-2.6 is to provide environmental protection by preventing the unauthorized and uncontrolled release of flammable and combustible liquids from steel underground storage tanks. External corrosion of steel tanks can be inhibited by properly installed cathodic protection (sacrificial zinc or magnesium anodes) or by fiberglass coatings (such as described in UL 1746 Standard for External Corrosion Protection Systems for Steel Underground Storage Tanks). But neither cathodic protection or nonmetallic coatings prevent corrosion of the bottom of a steel tank used as the primary container for flammable and combustible liquids. It is well known that the bottom every fuel tank is covered by a measurable quantity of low pH water. If the tank bottom is unprotected steel, it will experience internal corrosion that will eventually produce leakage of the tank's liquid contents resulting in damage to the environment and possible pollution of underground water supplies.
The wording should be an unambiguous statement that, regardless of the sponsor of tank design, internal corrosion of the primary container, should be prevented for a period of at least 30 years. This is not an unreasonable requirement since 30 years is the recommended minimum tanks design life established by the Steel Tank Institute and by manufacturers of nonmetallic underground storage tanks that comply with the requirements established by Underwriters Laboratories Inc., under Subject 1746 and Subject UL 1316.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: See Proposal 30-31 (Log #60).

(Log #60)
Committee: FLC-TAN

30- 31 - (2-2.6): Reject
SUBMITTER: Charles E. Kaempen, KCL Projects Ltd.
RECOMMENDATION: Revise text to read as follows:
2-2.6 Provisions for Internal Corrosion. Atmospheric underground storage tanks, including those incorporating secondary containment, shall be built so that internal corrosion of the primary container can not occur during a thirty year design life of the tank.
SUBSTANTIATION: The wording as well as the intent of paragraph 2-2.6 in the 1993 edition of NFPA Document No. 30 is not clear. For example, it should be made clear that the intent of paragraph 2-2.6 is to provide environmental protection by preventing the unauthorized and uncontrolled release of flammable and combustible liquids from steel underground storage tanks. External corrosion of steel tanks can be inhibited by properly installed cathodic protection (sacrificial zinc or magnesium anodes) or by fiberglass coatings (such as described in UL 1746 Standard for External Corrosion Protection Systems for Steel Underground Storage Tanks). But neither cathodic protection or nonmetallic coatings prevent corrosion of the bottom of a steel tank used as the primary container for flammable and combustible liquids. It is well known that the bottom of every fuel tank is covered by a measurable quantity of low pH water. If the tank bottom is unprotected steel, it will experience internal corrosion that will eventually produce leakage of the tank's liquid contents resulting in damage to the environment and possible pollution of underground water supplies.
The wording should be an unambiguous statement that, regardless of the sponsor of tank design, internal corrosion of the primary container, should be prevented for a period of at least 30 years. This is not an unreasonable requirement since 30 years is the recommended minimum tank design life established by the Steel Tank Institute and by manufacturers of nonmetallic underground storage tanks that comply with the requirements established by Underwriters Laboratories, Inc. under Subject 1746 and Subject UL 1316.
NOTE: Supporting material is available for review at NFPA Headquarters.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: This is adequately covered by existing performance based requirements. It is not reasonable to expect short-term use tanks to meet a 30-year life cycle.

(Log #70)
Committee: FLC-TAN

30- 32 - (2-2.6 (New)): Accept in Principle
SUBMITTER: Rick Thornberry, ConVault
RECOMMENDATION: Add a new Section 2-2.6 to read as indicated in the following and renumber present Section 2-2.6 as 2-2.7:
2-2.6 Protected Aboveground Tanks.
2-2.6.1 Protected aboveground tanks shall comply with NFPA 30A, Automotive and Marine Service Station Code.
2-2.6.2 The individual capacity of a protected aboveground tank shall not exceed 12,000 gal (45,420 L).
2-2.6.3 Protected aboveground tanks provided with enclosed secondary containment shall not be required to comply with Section 2-3.4.
2-2.6.4 A protected aboveground tank provided with enclosed secondary containment which is completely encased by the fire resistive protection integral to the protected aboveground tank shall not be required to comply with Table 2-1.
SUBSTANTIATION: This is a companion proposal to a proposed revision to Table 2-1 which incorporates minimum separation distances for protected aboveground tanks. This proposal prescribes the requirements for protected aboveground tanks which are presently not regulated by NFPA 30A. However, there is a companion proposal to NFPA 30A which will specify performance criteria for protected aboveground tanks that provide greater fire resistive protection to the tank and its contents than fire resistant tanks presently specified in NFPA 30A. In addition to the increased fire resistive protection, protected aboveground tanks also must resist a hose stream test at the end of the fire test and are designed to be resistant to vehicle impact and ballistic impact.
The individual capacity of protected aboveground tanks it to be limited to 12,000 gal which is the maximum allowed in NFPA 30A and the maximum practical limit for factory manufactured tanks of this design.
Protected aboveground tanks provided with enclosed secondary containment as specified in a companion proposal to NFPA 30A are not required to comply with the provisions for diking or spillage control per Section 2-3.4. Protected aboveground tanks of this design are very similar to Exception No. 2 to Section 2-3.4.1 and, as such, when provided with enclosed secondary containment should not have to be provided with separate dikes or a drainage control system.
Protected aboveground tanks with enclosed secondary containment that is also encased within the fire resistive protection provided for the protected aboveground tank to meet the performance criteria specified in NFPA 30A provide a significantly greater level of fire safety which is intended to be recognized by eliminating the need for required separation distances as specified in Table 2-1. For these types of tanks the potential for an accidental fire involving a spill at the tank or the tank and its contents is virtually nonexistent due to the enhanced level of protection and containment provided by such designs. Because of the significant level of safety provided by such tanks, it appears reasonable not to specify minimum separation distances since the hazard is mitigated by the tank design itself.
COMMITTEE ACTION: Accept in Principle.
Add to 2-2.3.1(a) a referenced to UL 2085, Insulated Aboveground Tanks for Flammable Liquids.
COMMITTEE STATEMENT: The Technical Committee feels that these tanks are an acceptable design and the test requirements of UL 2085 are adequate. The Technical Committee points out that these tanks must still meet all other requirements of NFPA 30. With specific referenced to this proposal, 2-2.6.1 refers to an installation, not a design code. This is not appropriate. Proposed 2-2.6.2 conflicts with NFPA 30 and NFPA 30A, as both allow these tanks up to 12,000 gal. 2-2.6.3 is already addressed by an Exception to 2-3.4.1. Finally, the Technical Committee sees no justification for eliminating the need to comply with the separation distances of NFPA 30.

(Log #5)
Committee: FLC-TAN

30- 33 - (2-3.1 (New)): Reject
SUBMITTER: Jeffrey F. Moller, Assoc. of American Railroads
RECOMMENDATION: Add new text as follows:

Separation Distance for New Facilities
Loaded tank Cars and Storage Tanks from Mainline Class II Track or Better

Activity	Combustible Liquid, Corrosive Material and ORM's	PIH (Hazard Zone A or B), Flammable Liquid, Flammable Gas, Non Flammable Gas and All Other Hazard Classes
Loading and Unloading	50 ft	100 ft
Storage of Loaded Tank Cars	25 ft	50 ft
Storage in Tanks	50 ft	100 ft

"With regard to existing facilities, maximum reasonable effort should be made to conform to this standard taking into consideration cost, physical and legal constraints.
The proposals apply to storage on railroad property and on chemical company property located close to railroad mainline."
SUBSTANTIATION: Establishment of standardized setbacks for hazardous materials storage and handling will increase safety.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: The Technical Committee on Tank Storage and Piping Systems feels that the incident history provided by the submitter does not justify the implementation of the separation distances recommended in the proposal. Few such incidents have occurred. In reviewing those that have occurred, it cannot be determined whether there was or was not a dike or other barrier that might have prevented impact of the tank by the railcar. Also, it is noted that one of the incidents involved breach of a liquefied petroleum gas railcar. The distances stated would have had no effect on the outcome of this incident.
The Technical Committee points out that the traffic density and average speed on the rail line would presumably be a risk factor, yet does not appear to be addressed. The Technical Committee also points out that it would be impossible to retroactively apply the proposed requirement, as indicated by the proposed language.

(Log #11)
Committee: FLC-TAN

30- 34 - (2-3.3.3(g)1): Reject
SUBMITTER: D. L. Hierman, Rhone-Poulenc
RECOMMENDATION: In the first sentence between words "seam" and "or" insert:
", low pressure tanks, pressure vessels"
SUBSTANTIATION: Requirement for intermediate dikes is more restrictive for low pressure tanks and pressure vessels than for floating roof or weak roof-to-shell seam tanks. Construction of a tank's roof has not relevance for the possibility or severity of a spill from a tank or its associated piping.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: The Technical Committee on Tank Storage and Piping Systems points out that this proposal would change the intent of NFPA 30's requirements for atmospheric storage tanks and the subdivision requirements in 2-3.3.3(g)2. The Technical Committee also points out that acceptance of this proposal would increase overall fire hazard because pressurized tanks would be directly exposed to a spill in the storage area.

(Log #CP25)
Committee: FLC-TAN

30- 35 - (2-3.4.1 Exception No. 2 (i) (New)): Accept
SUBMITTER: Technical Committee on Tank Storage and Piping Systems
RECOMMENDATION: Add a new subparagraph (i) to read:
"Means shall be provided to establish the integrity of the secondary containment. For testing of secondary containment-type tanks. see 2-8.3.1."
SUBSTANTIATION: Some aboveground secondary containment-type tanks are not furnished with means to verify the tightness of the secondary containment. Some systems involve components that cannot be visually inspected. The exception to the spill control provisions assumes that the tank owner/operator and the authority having jurisdiction can be assured that the containment is functional throughout the operation of the system.
COMMITTEE ACTION: Accept.

(Log #24)
Committee: FLC-TAN

30- 36 - (2-3.4.1(h)): Accept in Principle
SUBMITTER: Jon V. Brannan, Underwriters Laboratories, Inc.
RECOMMENDATION: Revise text as follows:
(h) Where the interstitial space is enclosed, it shall be provided with emergency venting in accordance with 2-3.6 or shall be covered by the Listing.
SUBSTANTIATION: Emergency venting of the interstice of tight wrap aboveground storage tanks and fire resistant (insulated) tanks is an area under review by industry and UL. The current wording of paragraph 2-3.4.1(h) would not allow consideration for reduced venting of the interstice in a listing investigation.
COMMITTEE ACTION: Accept in Principle.
Add the following second sentence to Subsection 2-3.6.1:
"This requirement shall also apply to each compartment of a compartmented tank, the interstitial space (annulus) of a secondary containment-type tank, and the enclosed space of tanks of closed-top dike construction. Spaces or enclosed volumes, such as those intended for insulation, membranes, or weather shields, that can contain liquid because of a leak from the primary vessel and can inhibit venting during fire exposure shall also comply with this subsection. The insulation, membrane or weather shield shall not interfere with emergency venting."
COMMITTEE STATEMENT: The Technical Committee's version is clearer.

(Log #78)
Committee: FLC-TAN

30- 37 - (2-3.4.3(b)): Reject
SUBMITTER: Gary Austerman, Burns & McDonnell Engineering Company
RECOMMENDATION: Add to paragraph (b):
"The volume shall include sufficient freeboard to allow for precipitation volumes."
SUBSTANTIATION: The volumetric capacity now only addresses the tank volume without regard to precipitation or fire protection water volumes.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: NFPA 30 establishes a minimum level of protection for fire protection purposes. This requirement goes beyond that.

(Log #77)
Committee: FLC-TAN

30- 38 - (2-3.4.3(d)): Reject
SUBMITTER: Gary Austerman, Burns & McDonnell Engineering Company
RECOMMENDATION: Delete the last sentence in paragraph (d) and add:
"The entire diked area should be sufficiently impervious to contain spills and prevent soil or groundwater contamination."
SUBSTANTIATION: Paragraph now addresses only extremely porous soils but should cover any soils to prevent contamination.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: It is not the intent of NFPA 30 to govern environmental matters that are properly in the jurisdiction of U.S. EPA.

(Log #9)
Committee: FLC-TAN

30- 39 - (2-3.5.4): Accept in Principle
SUBMITTER: James McDairmant, Maryland Waste Management, Oil Control Program
RECOMMENDATION: Add after sentence 4:
"Tanks storing Class I liquids that require venting devices that are normally closed, except when venting to pressure or vacuum conditions, shall be equipped with an emergency relief device that vents at a pressure in excess of the normal venting device but less than 2.5 psig (17.2 kPa)."
SUBSTANTIATION: It has been observed that gasoline storage tanks, equipped with pressure/vacuum vent devices and manways with loose fitting bolts, vent from the manway instead of the normal vent. The manway in most instances is located less than 12 ft above the ground. Venting gasoline vapors from the manway places potentially explosive mixtures close to the ground and in the vicinity of sources of ignition. Leaking manway covers will also compromise environmental considerations of restricting the release of gasoline vapors to the atmosphere.
COMMITTEE ACTION: Accept in Principle.
Revise the fourth sentence of 2-3.6.4 to read:
"Such devices shall be vaportight and shall be permitted to be..."
COMMITTEE STATEMENT: The Technical Committee on Tank Storage and Piping Systems agrees with the reasons for this proposal, but notes that emergency vent devices can be safely used on manways. The Technical Committees' proposed amendment to 2-3.6.4 meets the submitter's intent, while still allowing such devices to be used.

(Log #21)
Committee: FLC-TAN

30- 40 - (2-3.5.6): Reject
SUBMITTER: Dennis P. Nolan, Occidental International Exp. & Prod. Co.
RECOMMENDATION: Revise section to state tanks to be provided with "listed" flame arrestors. Flame arrestors provided to pressure vessels or used "in line" to vapor disposal systems shall meet the intent of 33 CFR Part 154, SubPart E).
SUBSTANTIATION: U.L. or FM do not test flame arrestors for in line detonations from/to pressure vessels, only storage tanks. 33 CFR Part 154, SubPart E, Test Flame Arrestors for in-line high pressure detonations.
References:
(1) UL 525.
(2) British Standards 7244: 1990
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: The Technical Committee on Tank Storage and Piping Systems disagrees with this proposal for the following reasons:
1. Flame arresters are already required to be listed.
2. Flame arresters are not required for pressure vessels, indeed would serve no purpose on the relief vent of a pressure vessel.
The Technical Committee points out that vapor disposal/processing systems are covered in Chapter 5 of NFPA 30.

(Log #2)
Committee: FLC-TAN

30- 41 - (2-3.5.7 Exception): Accept in Principle
Note: This proposal appeared as comment 30-6 which was held for further study from the Annual 93 TCD, which was on proposal 30-10.
SUBMITTER: Russell J. Kerlin, Dow Corning Corp.
RECOMMENDATION: Delete the phrase "water miscible" in the first sentence of the exception.
SUBSTANTIATION: The test data presented in the substantiation does not support the need for liquids to be water miscible in order to qualify for the specified 50 percent reduction. While sprinklers installed both above and below the tank (test no. 2) did result in further heat reduction as compared with the API model, the free-burn test without sprinklers (test No. 1) resulted in a 56 percent reduction in heat. Test no. 3 with 286 F sprinklers at 30 ft also resulted in a 56 percent reduction (presumably as a result of the sprinklers failing to operate), and test no. 4 even resulted in an *increase* in heat. This data therefore suggests that water-miscibility is *not* an essential parameter in this respect. In any case, this exception could be applied to relief valves on storage tanks without sprinkler protection (e.g., on tanks with drainage or insulation only). Consequently, water-miscibility would not be important.
Elimination of the stipulation for liquids to be water miscible would allow the 50 percent factor to be applied to tanks storing flammable and combustible liquids which are *not* water miscible and which have heats of combustion less than ethanol. There are at least several such liquids which are in relatively wide commercial use, e.g. chlorosilanes, some silicone fluids, etc.
COMMITTEE ACTION: Accept in Principle.
Add a new exception to 2-3.6.7 to read:
Exception: Where liquids that are not water-miscible and whose heats of combustion and rates of burning are equal to or less than those of ethyl alcohol (ethanol) are stored, processed, or handled and where there is no potential fire exposure from liquids other than these liquids, the above factors for insulation alone and drainage alone shall be permitted to be reduced by 50 percent. No further reduction shall be allowed for protection by means of water spray. Drainage shall not be required to obtain this reduction. In no case shall the above factors be reduced to less than 0.15.
COMMITTEE STATEMENT: The Technical Committee on Tank Storage and Piping Systems recognizes that the original tests were done using water-miscible liquids, but agrees that there is no logical reason to distinguish between miscible and non-miscible liquids. However, the reduction factors for protection schemes involving water spray can receive no additional reduction because the water spray will not be able to dilute the flammable or combustible liquid.

(Log #28)
Committee: FLC-TAN

30- 42 - (2-3.6.7): Reject
SUBMITTER: William Heitzig, Dow Chemical Company
RECOMMENDATION: Remove the word "stable" from the text.
SUBSTANTIATION: The code does not specify which credits to use for unstable liquids. By eliminating the word "stable" the same credits will be used for both stable and unstable liquids.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: Subsection 2-3.6.4 specifically states that special consideration must be given to unstable liquids, because the vent capacity determined in 2-3.6 might not be adequate.

(Log #29)
Committee: FLC-TAN

30- 43 - (2-3.6.7): Reject
SUBMITTER: William Heitzig, Dow Chemical Company
RECOMMENDATION: Add to this section:
"0.2 for a foam-water system in accordance with NFPA 16, Standard for Deluge Foam-Water Sprinkler and Foam-Water Water Spray Systems."
SUBSTANTIATION: Includes recognition of the NFPA 16 system on relief design.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: The submitter offers no technical justification for the change.

(Log #30)
Committee: FLC-TAN

30- 44 - (2-3.6.7): Reject
SUBMITTER: William Heitzig, Dow Chemical Company
RECOMMENDATION: Add to this section:
"0.1 for a foam-water system with drainage in accordance with 2-3.4.2."
SUBSTANTIATION: Includes recognition of drainage and a NFPA 16 design in relief design.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: The submitter offers no technical justification for the change.

(Log #31)
Committee: FLC-TAN

30- 45 - (2-3.6.8): Reject
SUBMITTER: William Heitzig, Dow Chemical Company
RECOMMENDATION: Renumber current 2-3.6.8 and 2-3.6.9 to 2-3.6.9 and 2-3.6.10.
Add new 2-3.6.8 to read:
"Where tanks are protected by a deluge foam-water system designed in accordance with NFPA 16 and drainage is provided in accordance with 2-3.4.2 a fire scenario with a 10 minute time duration may be considered".
SUBSTANTIATION: Currently NFPA 30 does not recognize the extinguishing capability of an NFPA 16 system. This gives the designer clear direction and another design option where an unstable liquid is stored.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: The Technical Committee feels that the duration criteria cited is properly within the jurisdiction of NFPA 16, not NFPA 30. There is no technical justification offered for this factor.

(Log #23)
Committee: FLC-TAN

30- 46 - (2-4.2.1): Reject
SUBMITTER: Jon V. Brannan, Underwriters Laboratories, Inc.
RECOMMENDATION: Revise text as follows:
"All underground tanks shall be installed in accordance with the manufacturer's instructions, where available Where the manufacturer's instructions are not available, refer to PEI Document RP100-90 titled "Recommended Practices for Installation of Underground Storage Systems". Underground Tanks shall be set on firm foundations and surrounded with at least 6 in. (15 cm) of noncorrosive inert material such as clean sand or gravel well tamped in place. The tank shall be placed in the hole with care, since dropping or rolling the tank into the hole can break a weld, puncture or damage the tank, or scrape off the protective coating of coated tanks."
SUBSTANTIATION: Manufacturer's, Owners, Installer's and the Authority Having Jurisdiction need to be aware of the importance of proper installation procedures for Underground Storage Tanks to maintain its structural integrity in various types of installations. The subtle change in the current text of paragraph 2-4.2.1 provides for more emphasis on the PEI Document.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: The Technical Committee on Tank Storage and Piping Systems feels that the items addressed in this proposal are already adequately covered in various areas in Chapter 2 of NFPA 30.

(Log #26)
Committee: FLC-TAN

30- 47 - (2-4.3 (a)6 (New)): Accept
SUBMITTER: Jon V. Brannan, Underwriters Laboratories, Inc.
RECOMMENDATION: Add new text as follows:
6. Underwriters Laboratories, Inc., Standard for External Corrosion Protection Systems for Steel Underground Storage Tanks, UL1746, Part 1.
SUBSTANTIATION: Recently published UL Standard UL1746 covers Cathodic Protection of Steel Underground Storage Tanks.
COMMITTEE ACTION: Accept.

(Log #27)
Committee: FLC-TAN

30- 48 - (2-4.3(b)): Accept
SUBMITTER: Jon V. Brannan, Underwriters Laboratories, Inc.
RECOMMENDATION: Revise text as follows:
(b) Approved or listed corrosion-resistant materials or systems, which may include special alloys, fiberglass reinforced plastic, or fiberglass reinforced plastic coatings. (See Standard for Glass-Fiber-Reinforced Plastic Underground Storage Tanks for Petroleum Products, Alcohols, and Alcohol Gasoline Mixtures, UL1316 and Underwriters Laboratories Standard for External Corrosion Protection Systems for Steel Underground Storage Tanks, UL1746).
SUBSTANTIATION: Recently published UL Standard 1746 covers composite and jacketed corrosion protected steel underground storage tanks. Also, the addition of the reference to UL1316 and UL1746 make this paragraph consistent with 2-4.3(a).
COMMITTEE ACTION: Accept.

(Log #120)
Committee: FLC-TAN

30- 49 - (2-4.4): Accept in Principle
SUBMITTER: Eugene S. Schmitt, Michigan State Police Fire Marshals Division
RECOMMENDATION: 2-4.4.1, 2-4.4.6 and 2-4.4.7 are current 2-4.4.1, 2-4.4.2 and 2-4.4.3 respectively. 2-4.4.2, 2-4.4.3, 2-4.4.4, 2-4.4.5 and 2-4.4.8 is language from Appendix C.
2-4.4 Abandonment, Reuse, or Change of Service of Underground Tanks.
2-4.4.1 Underground tanks taken out of service shall be safe-guarded or disposed of in a safe manner.
2-4.4.2 Tanks shall be rendered temporarily out of service only when it is planned that they will be returned to active service within a reasonable period or pending closure in place or removal within 90 days. Tanks placed in a temporary out of service condition shall be secured as follows:
(a) Vent lines shall remain open and functioning.
(b) Disconnect piping at all tank openings.
(c) Cap or plug all lines such as fill line, gauge opening, pump suction and vapor return.
(d) Secure against tampering.
2-4.4.3 Tanks taken permanently out of service by closure in place shall be secured as follows:
(a) Remove all flammable and combustible liquid and residue from the tank and from all connecting lines.
(b) Disconnect and remove the suction, inlet, gauge and vent lines.
(c) Fill the tank completely with an inert, solid material.
(d) Cap of plug all openings.
2-4.4.4 Tanks taken permanently out of service by removal shall be secured as follows:
(a) Remove all flammable or combustible liquid and residue from the tank and from all connecting lines.
(b) Disconnect and remove the suction, inlet, gauge and vent lines.
(c) Safeguard the tank by purging the flammable or combustible vapors or inerting the potentially explosive atmosphere in the tank prior to dismantling or transporting.
(d) Test the tank to determine that it is safe.
(e) Remove the tank promptly and to a safe area away from public access.
2-4.4.5 All piping having been connected to a tank closed in place or removed from the ground shall be emptied of all flammable and combustible liquids, purged of flammable vapors and removed from the ground.
2-4.4.6 Only those used tanks that comply with the applicable sections of this code and are approved by the authority having jurisdiction shall be installed for flammable or combustible liquid service.
2-4.4.7 Tanks that undergo any change of stored product shall meet the requirements of Section 2-2.
2-4.4.8 If a tank is to be disposed of as junk, it shall be retested for flammable vapors and, if necessary, rendered gas-free. After junking and before releasing to junk dealer, a sufficient number of holes or openings shall be made in it to render unfit for further use. NFPA 327, Standard Procedures for Cleaning or Safeguarding Small Tanks and Containers Without Entry, provides information on safe procedures for such operations.
SUBSTANTIATION: The proper procedure for abandonment, reuse, or change of service of underground tanks is critical. Therefore, provisions in Appendix C should be made part of the main text of the code in order to assure these safe practices are followed.
COMMITTEE ACTION: Accept in Principle.
Revise 2-4.4 to read as follows:
2-4.4 Temporary and Permanent Closure of Underground Tanks.
2-4.4.1 The procedures outlined in this subsection shall be followed when taking underground tanks temporarily out of service, closing them in place permanently, or removing them. All applicable safety procedures associated with working in proximity to flammable and combustible materials shall be strictly adhered to. (See Appendix C for additional information.)
2-4.4.2 Taking Tanks Temporarily Out of Service. Tanks shall be rendered temporarily out of service only when it is planned that they will be returned to active service, closed in place permanently, or removed within a reasonable period not exceeding one year. The following requirements shall be met:
(a) Corrosion protection and release detection systems shall be maintained in operation.
(b) The vent line shall be left open and functioning.
(c) The tank shall be secured against tampering.
(d) All other lines shall be capped or plugged.
Tanks remaining temporarily out of service for more than one year shall be permanently closed in place or removed in accordance with 2-4.4.3 or 2-4.4.4, as applicable.
2-4.4.3 Permanent Closure of Tanks in Place. Tanks shall be permitted to be permanently closed in place, if approved by the authority having jurisdiction. All of the following requirements shall be met:
(a) All applicable authorities having jurisdiction shall be notified.
(b) A safe work place shall be maintained throughout the prescribed activities. Special training might be required.
(c) All flammable and combustible liquids and residues shall be removed from the tank, appurtenances, and piping and shall be properly disposed of.
(d) The tank shall be made safe by either purging it of flammable vapors or inerting the potential explosive atmosphere in the tank. Confirm that the atmosphere in the tank is safe by periodically testing the atmosphere using a combustible gas indicator, if purging, or an oxygen meter, if inerting.
(e) Access to the tank shall be made by careful excavation to the top of the tank.
(f) All exposed piping, gauge and tank fixtures, and other appurtenances, except the vent, shall be disconnected and removed.
(g) The tank shall be completely filled with an inert solid material.
(h) The tank vent and remaining underground piping shall be capped or removed.
(i) The tank excavation shall be backfilled.
2-4.4.4 Removal of Underground Tanks. Tanks shall be removed in accordance with the following requirements:
(a) The steps described in 2-4.4.3(a) through (e) shall be followed.
(b) All exposed piping, gauge and tank fixtures, and other appurtenances, including the vent, shall be disconnected and removed.
(c) All openings shall be plugged, leaving a one-fourth inch opening to avoid buildup of pressure in the tank.
(d) The tank shall be removed from the excavation and shall be secured against movement.
(e) Any corrosion holes shall be plugged.
(f) The tank shall be labeled with its former contents, present vapor state, vapor-freeing method, and a warning against reuse.
(g) The tank shall be removed from the site promptly, preferably the same day.
2-4.4.5 Storage of Removed Tanks. If it is necessary to temporarily store a tank that has been removed, it shall be placed in a secure area where public access is restricted. The following requirements shall be met.
(a) During such temporary storage, the atmosphere in the tank shall be periodically tested according to 2-4.4.3(d) to ensure that it remains safe.
(b) A one-fourth inch opening shall be maintained to avoid buildup of pressure in the tank.
2-4.4.6 Disposal of Tanks. Disposal of tanks shall meet the following requirements:
(a) Before a tank is cut up for scrap or landfill, the atmosphere in the tank shall be tested in accordance with 2-4.4.3(d) to ensure that it is safe.
(b) The tank shall be made unfit for further use by cutting holes in the tank heads and shell.
2-4.4.7 All necessary documentation shall be prepared and maintained, in accordance with all federal, state, and local rules and regulations.
2-4.4.8 Reuse of Underground Tanks. Only those used tanks that comply with the applicable sections of this code and are approved by the authority having jurisdiction shall be installed for flammable or combustible liquids service.
2-4.4.9 Change of Service of Underground Tanks. Tanks that undergo any change of stored product shall meet the requirements of Section 2-2.

COMMITTEE STATEMENT: The Technical Committee's proposed revision of this subsection provides greater clarity and more detail on safety requirements. It adequately meets the intent of the submitter.

(Log #44)
Committee: FLC-TAN

30-50 - (2-4.5.1): Reject
SUBMITTER: John P. Hartmann, Barrington, IL
RECOMMENDATION: Sentences 1 and 2 are unchanged. The third sentence is changed as follows:
"Vent outlets and devices shall be protected to minimize the possibility of blockage from weather, dirt, or insect nests, shall be so located and directed that flammable vapors will not accumulate or travel to an unsafe location, enter building openings, or be trapped under eaves, and shall be at least 5 ft (1.5 m) from building openings and at least 15 ft (4.5 m) from powered building ventilation air intake devices."
Sentences 4 and 5 follow and are unchanged.
SUBSTANTIATION: At least one law suit is based on claims of vapors having been drawn into a convenience store building through a powered ventilation air intake. Tanks vents were located further than 5 ft from the intake (building opening) but the powered ventilation fan is claimed to have drawn vapors into the building during tank filling operations. While no fire occurred, employees claimed physical injury from ingesting motor fuel vapors.
Building codes require building ventilation air intakes to separated from sources of noxious fumes or vapors by at least 15 ft (4.5 m). This proposal eliminates a potential health hazard and a possible inconsistency between NFPA 30 and building mechanical codes.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: Current provisions of NFPA 30 are adequate to protect against fire hazards from this.

(Log #63)
Committee: FLC-TAN

30-51 - (2-5 Exception): Accept in Principle
SUBMITTER: Stephen W. Haines, Loss Control Associates, Inc.
RECOMMENDATION: Add text to read as follows:
Exception: Day tanks, running tanks and surge tanks located in process or manufacturing areas.
SUBSTANTIATION: These tanks were originally exempted from the requirements for storage tanks in paragraph 2-5.1.1 of the 1990 edition of NFPA 30. These tanks, which have a good fire record, are not nearly as hazardous, although they are more common, than those large storage tanks located in structures specifically designed to house them (i.e., Storage Tank Buildings).
As currently written NFPA 30 does not provide adequate guidelines for the use of day, running and surge tanks which are essential to limiting the overall quantity of flammable/combustible liquid storage within process and manufacturing areas. Strict adherence to, and enforcement of, the current NFPA 30 requirements may promote the use of containers and portable tanks resulting in an increase in the number of manual liquid transfer operations required to operate a facility as well as the overall risk of fire.
COMMITTEE ACTION: Accept in Principle.
Add an exception to 2-5 to read:
Exception: Tanks that meet the requirements of 5-4.3.
COMMITTEE STATEMENT: This correlates with Chapter 5.

(Log #55)
Committee: FLC-TAN

30-52 - (2-5.2.5): Accept
SUBMITTER: Robert E. Rhead, Kemper National Insurance Cos.
RECOMMENDATION: Delete this paragraph.
SUBSTANTIATION: There is no requirement in this paragraph. If smoke and heat venting are needed the paragraph should be worded to make it a requirement. To "consider" an item is not the same as a requirement. This could be better located in the appendix.
COMMITTEE ACTION: Accept.

(Log #56)
Committee: FLC-TAN

30-53 - (2-5.4.6): Reject
SUBMITTER: Robert E. Rhead, Kemper National Insurance Cos.
RECOMMENDATION: Delete this paragraph.
SUBSTANTIATION: Discharge of flammable or combustible liquids into a public sewer or waterway is a highly dangerous practice and should not be permitted in the code. Vapors can migrate through the sewer and find their way into other drain connections and areas that contain ignition sources thus presenting fire and explosion potential. Serious health problems and contamination can result from discharge into waterways. Prohibiting such connections as indicated in 2-5.4.2 is the only reasonable and logical approach to avoid injury and/or property damage.
If this change is made, also change the reference to 2-5.4.6 as indicated in 2-5.4.1.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: The current language does provide safeguards for this.

(Log #39)
Committee: FLC-TAN

30-54 - (2-5.6.7): Accept
SUBMITTER: Michael B. Nolan, Distilled Spirits Council of the U.S.
RECOMMENDATION: Revise text to read as follows:
"The inlet of the fill pipe and the outlet of a vapor recovery line for which connections to tank vehicles and tank cars are made and broken shall be located outside of buildings at a location free from any source of ignition and not less than 5 ft (1.5 m) away from any building opening. Such connections shall be closed tight and protected against tampering when not in use and shall be identified."
SUBSTANTIATION: The wording changes are for clarification reasons. This section was written to apply to vehicles pumping flammables into a building. However, it could be interpreted to prevent the use of flexible connections between multiple indoor tanks. Indoor tanks are used throughout general industry for storage and processing of various products. In a number of cases it is not practical to "hard pipe" every possible transfer option between tanks. Therefore, flexible connections (i.e., connections which must be made or broken) are used.
COMMITTEE ACTION: Accept.

(Log #57)
Committee: FLC-TAN

30-55 - (2-5.7.1): Accept
SUBMITTER: Robert E. Rhead, Kemper National Insurance Cos.
RECOMMENDATION: Change the last sentence of the paragraph to read:
"Compliance with 2-5.7.2 through 2-5.7.5 shall be deemed as..."
SUBSTANTIATION: There is no 2-5.7.6 as presented referenced.
COMMITTEE ACTION: Accept.

(Log #71a)
Committee: FLC-TAN

30-56 - (2-6 (New)): Reject
SUBMITTER: Thaddeus A. Nosal, American Insurance Services Group, Inc.
RECOMMENDATION: Add new text to read:
2-6 Tanks in Special Enclosures.
2-6.1 General.
2-6.1.1 Tanks shall be permitted to be installed in special enclosures meeting the requirements of this section upon approval of the authority having jurisdiction.
2-6.2 Location.
2-6.2.1 Aboveground, onground or partially-below ground enclosures shall be located in accordance with the separation distances specified in Table 2-5.1.1.
2-6.2.2 Enclosures with tops at or below grade shall be so located with respect to existing building foundations and supports that the loads carried by the latter cannot be transmitted to the enclosure. The distance from any part of the enclosure to the nearest wall of any basement, pit, or property line shall be at least 1 ft (0.3 m). Enclosures are not permitted beneath buildings.
2-6.2.3 Enclosures inside buildings shall be located in accordance with Section 2-5.
2-6.3 Construction.
2-6.3.1 Enclosures shall be designed for structural integrity in accordance with good engineering practice and shall be capable of withstanding anticipated loadings.

2-6.3.2 There shall be no openings in the enclosure except for access to, inspection of, and filling, emptying and venting of the enclosed tank. Where openings are provided, they shall be liquid and vapor-tight.
2-6.3.3 There shall be sufficient space between the tank and the walls, floor and top of the enclosure to allow for inspection of the tank and it's appurtenances.
2-6.3.4 Enclosures shall be constructed of non-combustible material having a fire-resistance rating at least 3 hr.
Exception: Where enclosure walls extend more than 12 ft above adjacent exposures, the vault roof shall be permitted to be constructed of noncombustible materials and shall be permitted to serve as an explosion vent.
2-6.3.5 Enclosures shall be made liquid-tight. If treated, such treatment shall be compatible with liquid stored within the tank.
2-6.3.6 Enclosures shall be equipped with liquid and vapor detection system. Vapor detectors shall be capable of activating an alarm when the system detects flammable vapors within the enclosure that are at a concentration of 25 percent of the lower flammable limit. Liquid detectors shall activate an alarm upon detection of any liquids within the enclosure, including water. The alarm shall sound at a constantly attended location.
2-6.3.7 Enclosures shall be provided with an approved means to recover liquid from the enclosure.
2-6.4 Tank and Piping.
2-6.4.1 tanks shall be listed for aboveground use. Tanks designed for underground use shall not be permitted.
2-6.4.2 The maximum capacity of a tank storing Class I or Class II liquid shall be 12,000 gal (45,600 L). In compartmentalized tanks, each compartment shall not be considered an individual tank.
2-6.4.3 Vent piping shall be in accordance with 2-3.7.
2-6.5 Ventilation.
2-6.5.1 Connections shall be provided to permit venting of each vault to dilute, disperse, and remove any vapors prior to personnel entering the enclosure.
2-6.5.2 Enclosures containing tanks of Class I liquids shall be provided with continuous mechanical ventilation at a rate sufficient to contain the concentration of vapors within the enclosure at or below 25 percent of the lower flammable limit. Ventilation shall be designed to provide air movement across all areas of the enclosure where flammable vapors may collect. NFPA 91, Standard for Exhaust Systems for Air Conveying of Materials provides information on this subject.
2-6.6 Electrical Equipment.
2-6.6.1 Any electrical equipment provided shall be suitable for use in a Class I, Division I location, as defined in NFPA 70, National Electrical Code.
SUBSTANTIATION: NFPA 30 does not cover tanks in vaults or other types of special fire resistant enclosures. These alternative tank designs are becoming more common. This proposal would provide wording similar to that used in the Uniform Fire Code and NFPA 30A.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: The proposed language is not consistent with provisions of NFPA 30A and with provisions of Section 2-5 of NFPA 30.

(Log #14)
Committee: FLC-TAN

30- 57 - (2-6.3): Reject
SUBMITTER: Dennis P. Nolan, Occidental Int'l Expl. and Prod. Co.
RECOMMENDATION: Insert "Greater than 50,000 gal capacity" after "...piling for tanks..."
SUBSTANTIATION: Small capacity tanks do not require fire proofing as its application would not be beneficial or cost effective (Ref. NFPA 30, Section 2-9.1).
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: The Technical Committee on Tank Storage and Piping Systems points out that many smaller tanks are currently located in populated areas and in buildings, including those tanks covered under Section 2-5, Storage Tank Buildings, of NFPA 30.

(Log #32)
Committee: FLC-TAN

30- 58 - (2-6.3): Reject
SUBMITTER: William Heitzig, Dow Chemical Company
RECOMMENDATION: Add to this section:
"NFPA 16, Standard for Deluge Foam-Water Sprinkler and Foam-Water Spray Systems."
SUBSTANTIATION: NFPA 16 in Section 1-5.2(a) clearly states its primary purpose is the extinguishment of fire in the protected exposure. An NFPA 16 system clearly equals or exceed an NFPA 15 system. By recognizing an NFPA 16 system, a clear expression of the Committee's intent is given to the designer and the enforcement official.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: There is no technical justification to support this change.

(Log #33)
Committee: FLC-TAN

30- 59 - (2-6.3): Reject
SUBMITTER: William Heitzig, Dow Chemical Company
RECOMMENDATION: Remove from Section 2-6.3 the approval for use of an NFPA 13 System.
Delete wording "NFPA 13, Standard for the Installation of Sprinkler Systems".
SUBSTANTIATION: An NFPA 13 designed system will not adequately protect tank legs exposed to a flammable liquid pool fire.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: Based on current language NFPA 13 and NFPA 15 can be considered to provide equivalent protection. But, the Technical Committee points out that passive protection is emphasized, while active protection is allowed only with the approval of the authority having jurisdiction.

(Log #45)
Committee: FLC-TAN

30- 60 - (2-6.3): Reject
SUBMITTER: Dennis P. Nolan, Saudi Arabian Oil Company
RECOMMENDATION: Add the following:
"Tank steel supports or exposed piling for Class III B liquids, when stored or used at or above their flash point, shall be protected by materials having a high rise fire resistance (e.g., UL 1709) of not less than 2 hr, unless steel saddles are less than 12 in. high."
SUBSTANTIATION: When Class III B liquids are heated to above their flash point they can be easily ignited once exposed to an ignition source. When Class III B liquids are used in this manner they are essentially akin to a flammable liquid rather than a combustible liquid and suitable protection measures which are instituted for flammable liquids should be equally applied in this case.
Industry practice already recognizes that combustible liquids operating above their flash point are high fire risks and require fireproofing for structural supports in such cases (Ref. API Publication 2218, "Fireproofing Practices in Petroleum and Petrochemical Processing Plants").
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: The proposed text is redundant with 1-1.3.

(Log #15)
Committee: FLC-TAN

30- 61 - (2-6.3 and 3-3.3.1): Accept
SUBMITTER: Dennis P. Nolan, Occidental Int'l Expl. and Prod. Co.
RECOMMENDATION: Include "ASTME-119" (CELLOOLOGIC) or "UL 1709" (High Rise) as the fire test resistance method to gauge the level to.
SUBSTANTIATION: Paragraphs state materials to have "a fire resistance of not less than 2 hr." The methods of fire endurance are currently available a CELLOLOSIC (ASTM E119) or hydrocarbon fire (UL 1709). Whichever is employed could drastically change protection afforded.
COMMITTEE ACTION: Accept.
Insert references to UL 1709, or equivalent, to relevant sections of Chapters 2 and 3 of NFPA 30 where hydrocarbon exposure fires are indicated. Insert references to NFPA 251 similarly for building fire resistance.

COMMITTEE STATEMENT: The Technical Committee on Tank Storage and Piping Systems agrees with this proposal and feels that similar changes are necessary in other appropriate parts of Chapters 2 and 3 of NFPA 30.

(Log #25)
Committee: FLC-TAN

30- 62 - (2-6.5.1 (New)): Reject
SUBMITTER: Jon V. Brannan, Underwriters Laboratories, Inc.
RECOMMENDATION: Add new text as follows:
2-6.5.1 Supports for Listed Steel Aboveground Tanks shall be identified as covered by the Listing or shall be approved by the Authority Having Jurisdiction.
SUBSTANTIATION: Listing of aboveground storage tanks may or may not cover the supports. This is detailed on the listing mark. This addition will clarify that authorities having jurisdiction will need to determine the suitability of supports on listed aboveground storage tanks where the listing mark does not indicate appropriate coverage of the tanks.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: The Technical Committee on Tank Storage and Piping Systems is not convinced of the necessity for this requirement.

(Log #53)
Committee: FLC-TAN

30- 63 - (2-8.3): Accept in Principle
SUBMITTER: Wayne B. Geyer, Steel Tank Institute
RECOMMENDATION: Revise text:
"~~Single wall underground~~ Primary storage tanks and piping, before being covered, enclosed, or placed in use, shall be tested for tightness hydrostatically or with air pressure. Horizontal atmospheric tanks shall be tested at not less than 3 psi (20.6 kPa) and not more than 5 psi (34.5 kPa). Shop-built vertical atmospheric tanks shall be tested at not less than 1 1/2 psi (10.3 kPa) and not more than 2 1/2 psig (17.3 kPa). For testing of secondary containment tanks, see 2-8.3.1 to 2-8.3.3..."
SUBSTANTIATION: To incorporate test requirements for shop-built vertical aboveground single wall and secondary containment tanks.
COMMITTEE ACTION: Accept in Principle.
Revise 2-8.3 to read as follows:
2-8.3 In addition to the test called for in 2-8.1 and 2-8.2, all tanks and connections shall be tested for tightness. Except for underground tanks, this test shall be made at operating pressure with air, inert gas, or water prior to placing the tank in service. Air pressure shall not be used to test tanks that contain flammable or combustible liquids or vapors. (See Section 3-7 for testing pressure piping.)
2-8.3.1 In the case of field-erected tanks, the test called for in 2-8.1 or 2-8.2 shall be permitted to be considered the test for tank tightness.
2-8.3.2 Horizontal shop-fabricated aboveground tanks shall be tested for tightness either hydrostatically or with air pressure at not less than 3 psi (20.6 kPa) and not more than 5 psi (34.5 kPa). Vertical shop-fabricated aboveground tanks shall be tested for tightness either hydrostatically or with air pressure at not less than 1.5 psi (10.3 kPa) and not more than 2.5 psi (17.3 kPa).
2-8.3.3 Single wall underground tanks and piping, before being covered, enclosed, or placed in use, shall be tested for tightness either hydrostatically or with air pressure at not less than 3 psi (20.6 kPa) and not more than 5 psi (34.5 kPa).
2-8.3.4 Underground secondary containment tanks and horizontal aboveground secondary containment-type tanks shall have the primary (inner) tank tested for tightness either hydrostatically or with air pressure at not less than 3 psi (20.6 kPa) and not more than 5 psi (34.5 kPa). The interstitial space (annulus) of such tanks shall be tested either hydrostatically or with air pressure at 3 to 5 psig (20.6 to 34.5 kPa) or vacuum at 5.3 in. Hg (17.9 kPa) or in accordance with the listing or manufacturers' instructions. The pressure or vacuum shall be held for one hour. Care shall be taken to ensure that the interstitial space is not overpressured or subjected to excessive vacuum.
2-8.3.5 Vertical aboveground secondary containment-type tanks shall have the primary (inner) tank tested for tightness either hydrostatically or with air pressure at not less than 1.5 psi (10.3 kPa) and not more than 2.5 psi (17.3 kPa). The interstitial space (annulus) of such tanks shall be tested either hydrostatically or with air pressure at 1.5 to 2.5 psig (10.3 to 17.3 kPa) or vacuum at 5.3 in. Hg (17.9 kPa) or in accordance with the listing or manufacturers' instructions. The pressure or vacuum shall be held for one hour. Care shall be taken to ensure that the interstitial space is not overpressured or subjected to excessive vacuum.
COMMITTEE STATEMENT: This revision of 2-8.3 better meets the intent of the submitter and presents the requirements of this subsection much more clearly.

(Log #51)
Committee: FLC-TAN

30- 64 - (2-8.3.1): Accept in Principle
SUBMITTER: Wayne B. Geyer, Steel Tank Institute
RECOMMENDATION: Revise text:
"Underground and horizontal aboveground secondary containment tanks shall have the primary (inner) tank tested according to 2-8.3 and the interstitial space (annulus) tested using air at 3-5 psig (20.6 to 34.5 kPa) or vacuum at 5.3 in Hg (17.9 kPa)..."
SUBSTANTIATION: To differentiate the test pressures used for horizontal secondary containment tanks from test pressures used for vertical secondary containment tanks.
COMMITTEE ACTION: Accept in Principle.
Refer to Committee Action on Proposal 30-63 (Log #53).
COMMITTEE STATEMENT: This is addressed by the proposed rewrite of 2-8.3.

(Log #52)
Committee: FLC-TAN

30- 65 - (2-8.3.2 (New)): Accept in Principle
SUBMITTER: Wayne B. Geyer, Steel Tank Institute
RECOMMENDATION: Add new text:
"Shop fabricated aboveground vertical secondary containment tanks shall have the primary (inner) tank tested according to 2-8.3 and the interstitial space (annulus) tested using air at 1 1/2 to 2 1/2 psig (10.3 to 17.3 kPa) or vacuum at 5.3 in Hg (17.9 kPa). The pressure or vacuum shall be held for 1 hr. Care shall be taken to ensure that the interstitial space is not overpressured or subjected to excess vacuum."
SUBSTANTIATION: To establish proper testing procedures for vertical aboveground secondary containment tanks.
COMMITTEE ACTION: Accept in Principle.
Refer to Committee Action on Proposal 30-63 (Log #53).
COMMITTEE STATEMENT: This is addressed by the proposed rewrite of 2-8.3.

(Log #54)
Committee: FLC-TAN

30- 66 - (2-8.3.3 (New)): Reject
SUBMITTER: Wayne B. Geyer, Steel Tank Institute
RECOMMENDATION: Add new text:
"Shop-built aboveground tanks without weak roof to shell joints, shall have normal and emergency vents reinstalled immediately after successful integrity testing to assure safe tank storage operations."
SUBSTANTIATION: This language is offered as an extra safeguard to minimize any chance of overpressurization due to a pool fire during the tank system's initial and subsequent operation.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: This is addressed in subsection 2-3.6.

(Log #CP26)
Committee: FLC-TAN

30- 67 - (2-8.7): Accept
SUBMITTER: Technical Committee on Tank Storage and Piping Systems
RECOMMENDATION: Revise 2-8.7 to read:
"Tanks that have been structurally damaged, have been repaired, or are suspected of leaking shall be tested in a manner acceptable to the authority having jurisdiction. (For information on testing of underground tanks, see NFPA 329, Recommended Practice for Handling Underground Releases of Flammable and Combustible Liquids. For information on testing of aboveground tanks, see API Standard 653, Tank Inspection, Repair, Alteration, and Reconstruction.)"
SUBSTANTIATION: The Technical Committee on Tank Storage and Piping Systems feels that testing should be required of any tank when there is reason to suspect that it might not be structurally sound.
COMMITTEE ACTION: Accept.

(Log #CP27)
Committee: FLC-TAN

30- 68 - (2-8.8): Accept
SUBMITTER: Technical Committee on Tank Storage and Piping Systems
RECOMMENDATION: Add a new 2-8.8 to read:
"Tanks and all tank appurtenances, including normal vents and emergency vents and related devices, shall be properly maintained to ensure that they function as intended. (For additional information , see API Standard 653, Tank Inspection, Repair, Alteration, and Reconstruction.)"
SUBSTANTIATION: The Technical Committee on Tank Storage and Piping Systems feels that this requirement will satisfy the issue of long-term operability of tanks and appurtenances.
COMMITTEE ACTION: Accept.

(Log #18)
Committee: FLC-TAN

30- 69 - (2-9.1): Reject
SUBMITTER: Dennis P. Nolan, Occidental Int'l Expl. and Prod. Co.
RECOMMENDATION: Suggest delete "vertical" from description of tank.
SUBSTANTIATION: If "horizontal" tanks with same conditions were provided, they would be just as hazardous.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: The Technical Committee on Tank Storage and Piping Systems points out that horizontal tanks typically do not exceed 50,000 gal. Also, horizontal tanks do not have a roof, per se.
For vertical tanks, the roof is typically the weakest point of the construction.

(Log #89)
Committee: FLC-TAN

30- 70 - (3-1.1): Accept in Part
SUBMITTER: Sullivan D. Curran, Fiberglass Petroleum Tank & Pipe Institute
RECOMMENDATION: Add to the end of the last sentence in paragraph 3-1.1:
"...distributing, metering, ~~or~~ controlling flow, or secondary containment system for underground tanks and piping."
SUBSTANTIATION: Some 70 percent of new underground tank and piping system installations are secondarily contained. The Chapter on Piping Systems should provide code officials with guidance for these installations.
COMMITTEE ACTION: Accept in Part.
Change the last sentence of 3-1.1 to read:
"...metering, controlling flow, or secondary containment."
COMMITTEE STATEMENT: The deleted words are superfluous.

(Log #CP29)
Committee: FLC-TAN

30- 71 - (3-1.1 Exception (New)): Accept
SUBMITTER: Technical Committee on Tank Storage and Piping Systems
RECOMMENDATION: Add an exception to 3-1.1 to read:
"Exception: Piping systems and components on tanks that do not exceed 1,100 gal and located at farms and isolated sites, as covered in Chapter 6."
SUBSTANTIATION: This exception will eliminate any potential conflict between the requirements of Chapter 3 and the new Chapter 6, which addresses farms and isolated sites.
COMMITTEE ACTION: Accept.

(Log #CP28)
Committee: FLC-TAN

30- 72 - (3-1.1, 3-1.2(b)): Accept
SUBMITTER: Technical Committee on Tank Storage and Piping Systems
RECOMMENDATION: Amend 3-1.1 by adding the words "of liquids and associated vapors" at the end of the sentence and amend 3-1.2(b) by deleting the words "or stationary".
SUBSTANTIATION: These changes clarify the scope of Chapter 3.
COMMITTEE ACTION: Accept.

(Log #37)
Committee: FLC-TAN

30- 73 - (3-1.2(b)): Accept in Principle
SUBMITTER: Thomas Bazzolo, CT Dept of Public Safety, State Fire Marshal Office
RECOMMENDATION: Revise text as follows:
(b) Motor vehicles, aircraft or boats.
SUBSTANTIATION: "Or Portable or Stationary Engine" should be deleted from this sections once Section 5-7.1 of NFPA 37-1990 "Stationary Combustion Engines and Gas Turbines" refers to NFPA 30 for Fuel Piping, Valves and Fittings Installations.
COMMITTEE ACTION: Accept in Principle.
Revise 3-1.2(b) to read:
"Motor vehicles, aircraft, boats, or piping that is integral to a stationary engine assembly."
COMMITTEE STATEMENT: It is not NFPA 30's intent to govern fuel supply piping from a stationary engine back to its day tank or integral fuel tank (such as a base tank).

(Log #48)
Committee: FLC-TAN

30- 74 - (3-3.1): Accept
SUBMITTER: Jon V. Brannan, Underwriters Laboratories, Inc.
RECOMMENDATION: Add the words "flexible connectors" between "faucets" and "fittings" in the first sentence of 3-3.1.
SUBSTANTIATION: For clarification only.
COMMITTEE ACTION: Accept.

(Log #90)
Committee: FLC-TAN

30- 75 - (3-3.1): Accept in Principle
SUBMITTER: Sullivan D. Curran, Fiberglass Petroleum Tank & Pipe Institute
RECOMMENDATION: Add to the end of the last sentence in paragraph 3-3.1:
"...~~and~~ shall be compatible with the fluid service and shall be listed for the application intended.
Exception: Drip pans, sumps or other catch basins designed to capture or direct the flow of incidental drippage.
SUBSTANTIATION: This code update will recognize the general availability of listed double wall tanks (UL 1316, UL 1746) and non-metallic piping (7 companies are UL 971 listed). However, unproven products are being installed and a listing requirement will improve public safety.
COMMITTEE ACTION: Accept in Principle.
In existing 3-3.1, add the words "or shall be listed" after "recognized engineering principles."
COMMITTEE STATEMENT: Not all components are listed and the Technical Committee feels listing does not need to be mandated. This proposal would eliminate use of other acceptable materials, such as brass, aluminum, etc.

(Log #CP30)
Committee: FLC-TAN

30- 76 - (3-3.1): Accept
SUBMITTER: Technical Committee on Tank Storage and Piping Systems
RECOMMENDATION: Revise the first sentence of 3-3.1 to read:
"Pipes, valves, faucets, couplings, flexible connectors, fittings, and other pressure-containing parts..."
SUBSTANTIATION: The Technical Committee on Tank Storage and Piping Systems feels that couplings and flexible connectors should comply with this requirement, to maintain the integrity of the piping system.
COMMITTEE ACTION: Accept.

(Log #65)
Committee: FLC-TAN

30- 77 - (3-3.4): Reject
SUBMITTER: Joseph Valenti, Hose Master Inc.
RECOMMENDATION: Revise text to read as follows:
"Low melting point materials such as aluminum, copper, and brass, materials that soften on fire exposure such as plastics, or nonductile material such as cast iron shall be permitted to be used underground (completely back-filled) for all liquids..."

SUBSTANTIATION: Underground needs to be clearly defined as being completely buried in back-fill. The confusion between underground and underground but open sump should be eliminated.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: Other methods of installing underground piping that do not use full backfill are currently allowed, including by subsection 3-3.4.

(Log #CP31)
Committee: FLC-TAN

30- 78 - (3-3.4): Accept
SUBMITTER: Technical Committee on Tank Storage and Piping Systems
RECOMMENDATION: 1. In the second sentence, add a new item (a) to read:
"(a) resistant to damage by fire;"
2. Add a new sentence to read:
"Nonmetallic piping systems used for the transfer of liquids, including piping that incorporates secondary containment, shall be constructed in accordance with recognized standards of design. They shall be constructed, installed, and used within the scopes of their approvals."
SUBSTANTIATION: These changes add necessary requirements to address low melting point piping materials and nonmetallic piping.
COMMITTEE ACTION: Accept.

(Log #42)
Committee: FLC-TAN

30- 79 - (3-4): Reject
SUBMITTER: Bryan Swinney, Pro Plus, Inc.
RECOMMENDATION: Revise text:
3-4 Pipe Joints.
3-4.1 Joints shall be made liquidtight and shall be either welded, flanged, or threaded (including flexible connectors). Threaded joints shall be made up tight with a suitable thread sealant or lubricant. Joints in piping systems handling Class I liquids shall be welded when located in concealed spaces within buildings.
3-4.2 Pipe joints dependent upon the resiliency of combustible materials for mechanical continuity or liquidtightness of piping shall not be used inside buildings or inside containment sumps. They shall be permitted to be used outside of buildings or containment sumps and below ground. If used aboveground outside buildings or containment sumps, the piping shall either be secured to prevent disengagement of the fittings, or the piping system shall be so designed that any spill resulting from disengagement could not unduly expose persons, important buildings, or structures and could be readily controlled by remote valves.
SUBSTANTIATION: 3-4 Pipe Joints.
3-4.1 There are adequate sources of metallic and nonmetallic flexible connectors available with either welded, flanged, or screwed connections. Nothing is served by leaving the implied approval of friction type flexible connectors in the Code - to the contrary, the Code is weakened by this implied approval. There is a parallel precedent in this removal of friction type flexible connectors from the Code in the past removal of flexible connectors below service station type pumps and dispensers (i.e., dresser couplings). Further, the current terminology of "except that listed flexible connectors..." implies that UL listed flexible connectors should enjoy some special recognition when UL does not have a standard for flexible connectors and does not test them - UL relies upon the manufacturer to determine the suitability of the product for UL-Listing. In this case UL-Listing does not mean anything.
3-4.2 The elimination of friction type flexible connectors will enhance personal safety with a minimum of economical impact and strengthen UL 30.
Additionally, the recent environmental innovation of installing spill containment sumps below service station type pumps and dispensers has changed the fire exposure of the flexible connectors used below pumps and dispensers. Prior practice provided these flexible connectors some protection from direct fire exposure by the soil coverage. Even though some facilities have emergency electrical disconnect switches and/or emergency shutoff valves, these devices do not adequately protect people in the immediate vicinity of the motor fuel dispensing devices, when e dispensing equipment is hit by a moving vehicle - invariably people, operating the dispensing equipment or are incidentally present near the vicinity of the dispensing equipment, receive burns from the resulting fire. Therefore, maintaining the containment integrity of the piping system is imperative in this application. Thus, it appears prudent to limit the type of flexible connector used in this instance to metallic type flexible connectors.
NOTE: Supporting material is available for review at NFPA Headquarters.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: This proposed text offers no improvement. Also, the Technical Committee notes that flexible connectors are included as fittings.

(Log #38)
Committee: FLC-TAN

30- 80 - (3-5.1): Accept in Principle
SUBMITTER: Thomas Bazzolo, CT Dept of Public Safety, State Fire Marshal Office
RECOMMENDATION: Add new text as follows:
"Piping supports shall be either: (a) suitable protected against fire exposure, (b) so located that any leakage resulting form the failure will not unduly expose persons, important buildings, or structures, or (c) located where leakage can readily be controlled by operation of an accessible remotely located valve(s)."
SUBSTANTIATION: Piping support failure due to fire exposure may result in piping breakage and a worsened fire condition.
COMMITTEE ACTION: Accept in Principle.
Add a new 3-5.1 to read:
"Load-bearing piping supports that are located in areas with a high fire exposure risk shall be protected by one or more of the following:
(a) drainage to a safe location to prevent liquid from accumulating under pipeways;
(b) fire resistive construction;
(c) fire resistant protective coatings or systems;
(d) water spray systems designed and installed in accordance with NFPA 15;
(e) other alternate means acceptable to the authority having jurisdiction.
Also, add an appendix item to read:
A-3-5.1 API 2218 contains guidance on selecting and installing fire resistant coatings to protect exposed steel supports from a high challenge fire exposure. It also contains a general discussion on determining need for such protection and estimating the extent of the area exposed.
COMMITTEE STATEMENT: The Technical Committee's version of this requirement is more comprehensive and provides more guidance to the user.

(Log #79)
Committee: FLC-TAN

30- 81 - (3-5.1 (New)): Accept in Principle
SUBMITTER: Gary Austerman, Burns & McDonnell Engineering Company
RECOMMENDATION: Add new text to read:
3-5.1 Underground piping systems within the same trench shall be separated a minimum of 9-in. between pipes. Burial depths shall be per manufacturer's recommendations and engineering design.
SUBSTANTIATION: Improper laying of pipes can contribute to failure of the piping system.
COMMITTEE ACTION: Accept in Principle.
Refer to Committee Action on Proposal 30-82 (Log #119).
COMMITTEE STATEMENT: Proposal 30-82 (Log #119) addresses the submitter's concerns.

(Log #119)
Committee: FLC-TAN

30- 82 - (3-7 (New)): Accept
SUBMITTER: Eugene S. Schmitt, Michigan State Police Fire Marshals Division
RECOMMENDATION: Add a new Section 3-7 and renumber remaining sections.
3-7 Underground Piping. In areas subject to vehicle traffic, the trench shall be of sufficient depth to permit a bedding of at least 6 in. (15 cm) of well compacted backfill material and shall be covered with at least 18 in. (45.7 cm) of well compacted backfill material and pavement. In areas not subject to vehicle traffic, the piping shall be provided with a bedding of at least 6 in. (15 cm) of well compacted backfill material. A greater burial depth shall be provided when required by the manufacturer's instructions or where frost conditions are present.

3-7.1 Piping within the same trench shall be separated as follows:
(a) One pipe diameter between steel lines.
(b) Two pipe diameters between fiberglass-reinforced plastic lines.
3-7.2 Two or more levels of pipes within the same trench shall be separated by a minimum 6 in. (15 cm) of well compacted backfill.
SUBSTANTIATION: The code is silent on burial depth and lateral separation for underground piping. Improper piping systems are subject to leaks. Improper laying of pipe can contribute to failure of the piping system.
NOTE: Supporting material is available for review at NFPA Headquarters.
COMMITTEE ACTION: Accept.
Change the word "bedding" to "cover" in the second sentence. Also, in 3-7.1(a), change "One" to "Two" and add a new item (c) to read:
"Piping need not be separated by more than 9 in."
COMMITTEE STATEMENT: The changes made bring this new section in line with accepted industry practices. Also, an upper limit is needed to prevent impractical separation of large diameter piping.

(Log #CP32)
Committee: FLC-TAN

30-83 - (Chapter 6): Accept
SUBMITTER: Technical Committee on Tank Storage and Piping Systems
RECOMMENDATION: Add a new Chapter 6 to read as follows:
Chapter 6 Special Requirements for the Storage of Flammable and Combustible Liquids at Farms and Isolated Sites
6-1 Scope.
6-1.1* This chapter shall apply to the storage of Class I flammable liquids and Class II and Class IIIA combustible liquids, as defined in this code in containers or tanks that do not exceed 1,100 gal (4,164 L) individual capacity:
(a) On farms and in rural areas;
(b) At isolated construction sites and isolated earth-moving projects, including gravel pits, quarries, and borrow pits, where, in the opinion of the authority having jurisdiction, it is not necessary to comply with the more restrictive requirements of Chapters 2, 3, and 4; and
(c) At any private site where isolation or separation from other structures or where temporary use makes it unnecessary, in the opinion of the authority having jurisdiction, to comply with the more restrictive requirements of Chapters 2, 3, and 4.
6-1.2 This chapter shall not apply to:
(a) The storage, handling, and use of fuel tanks and containers that are installed or used in accordance with NFPA 31, Standard for the Installation of Oil-Burning Equipment; NFPA 37, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines; or NFPA 30A, Automotive and marine Service Station Code, and
(b) The storage of 25 gal (95 L) or less of Class I flammable liquid and Class II and Class III combustible liquids in containers that do not exceed a capacity of 5 gal (19 L).
6-2 Types of Approved Storage. Storage of Class I, Class II, and Class IIIA liquids, as covered by this chapter, shall be permitted in any of the following:
(a) In aboveground or underground tanks that meet the requirements of Section 2-2;
(b) In containers that meet the requirements of Section 4-2;
(c) In containers that do not exceed 60 gal (227 L), in accordance with Section 6-3; and
(d) In tanks of more than 60 gal (227 L) but not more than 1,100 gal (4,164 L) capacity, in accordance with Section 6-4.
6-3 Individual Containers No Exceeding 60 Gallon Capacity.
6-3.1 Storage of liquids shall be in containers approved by the U.S. Department of Transportation or in other approved containers.
6-3.2 Capacity of containers shall not exceed 60 gal (227 L).
6-3.3 Dispensing or transfer devices that require the container to be pressurized shall be prohibited.
6-3.4 Pumping devices and faucets shall be well maintained to prevent leakage.
6-3.5 Individual containers shall not be interconnected or manifolded and shall be kept tightly closed when not in use.
6-3.6 Containers used for the storage of Class I liquids shall be kept outside and at least 10 ft (3 m) from any building.
Exception: Containers shall be permitted to be stored inside any building that is used exclusively for the storage of Class I, Class II, or Class IIIA liquids, is located at least 10 ft (3 m) from any other building, and is provided with cross ventilation using at least 2 vents. Each vent shall have a net open area of 64 in^2 (645 mm^2) and shall be placed at floor level, in opposite walls.
6-4 Tanks of 60 to 1,100 Gallon Capacity.
6-4.1 Tanks shall be of single-compartment design and shall be constructed in accordance with good engineering practice. All seams and joints shall be riveted and caulked, riveted and welded, or welded. Tank heads that are greater than 6 ft (2 m) in diameter shall be dished, stayed, braced, or otherwise reinforced.
6-4.2 Tanks shall meet the following minimum plate thickness:

Capacity		Minimum Steel Thickness
Gallons	Liters	Mfrs. Standard Gauge No.
60 to 560	230 to 2,120	14
561 to 1,100	2,120 to 4,165	12

6-4.3 Each tank shall be provided with a fill opening with a closure that is designed to be locked. The fill opening shall be separate from the vent opening.
6-4.4* Each tank shall be provided with a free-open vent that shall relieve either the vacuum or the pressure that might develop during normal operation or fire exposure.
6-4.4.1 The minimum vent size shall be as follows:

Tank Capacity		Vent Diameter	
Gallons	Liters	Inches	Millimeters
Up to 275	1040	1/2	38
276 - 660	1040 - 2500	2	51
661 - 900	2500 - 3410	2 1/2	64
900 - 1100	3410 4165	3	76

6-4.4.2 Vents shall be arranged to discharge so as to prevent localized overheating of or direct flame impingement on any part of the tank in the event that vapors from the vent are ignited.
6-4.5 Tanks shall be located outside and at least 40 ft (12 m) from any building. They shall also be located so that any vehicle, equipment, or container that is filled directly from the tanks is at least 40 ft (12 m) from any building.
6-4.6 Tanks provided for in this section shall be permitted to have top openings only or shall be permitted to be elevated for gravity discharge.
6-4.6.1 Tanks that have top openings only shall be mounted and equipped as follows:
(a) Stationary tanks shall be mounted on timbers or blocks 6 in. (150 mm) in height so as to protect the bottom of the tank from corrosion due to contact with the ground and to maintain the tank in a stable position.
(b) Movable tanks shall be equipped with attached metal legs that rest on shoes or runners designed so that the tank is supported in a stable position and so that the tank and its supports can be moved as a single unit.
(c) Tanks shall be equipped with a tightly and permanently attached approved pumping device having an approved hose of sufficient length for filling the vehicles, equipment, or containers to be served by the tank.
(d) The dispenser nozzle and hose shall be equipped so that it can be padlocked to its hanger to prevent tampering.
(e) The pump discharge shall be equipped with an effective antisiphoning device, or the discharge hose shall be equipped with a self-closing nozzle.
(f) Siphons or internal pressure discharge devices shall be prohibited.
6-4.6.2 Tanks elevated for gravity discharge shall be mounted and equipped as follows:
(a) Tanks shall be supported on steel or wood supports having adequate strength and design to provide stability. Alternately, tanks shall be permitted to be placed on a pile of earth or near the edge of a cut bank to provide the necessary elevation and shall be supported on timbers or blocks for stability and to prevent corrosion from contact with the ground.
(b) Discharge connections shall be made to the bottom or to the end of the tank.
(c) The discharge connection shall be equipped with a valve that shall automatically close in the event of a fire by means of operation of an effective heat-actuated device. This valve shall be located adjacent to the tank shell. If this valve cannot be operated manually, an additional valve that can be manually operated shall be provided.
(d) The discharge connection shall be provided with an approved hose of sufficient length for filling vehicles, equipment, and containers to be served by the tank. The hose shall be provided with a self-closing nozzle at the discharge end.
(e) The hose shall be equipped so that it an be padlocked to its hanger to prevent tampering.
6-5 Marking of Tanks and Containers.
6-5.1 Tanks and containers shall be conspicuously marked with the name of the product contained and with the following marking:

"FLAMMABLE — KEEP FIRE AND FLAME AWAY."

6-5.2* Tanks shall also bear the following marking:

"KEEP 40 FT FROM BUILDINGS."

6-6 Fire Prevention and Control.

6-6.1 Storage areas shall be kept free of weeds and other extraneous combustible materials.

6-6.2 Open flames and smoking materials shall not be permitted in areas where Class I liquids are stored.

Appendix A Explanatory Material

A-6-1.1 On isolated construction and earth-moving projects and on other similarly isolated sites, it is customary for the property owner or the contractor to obtain fuel in bulk and to dispense the fuel under his or her direct control.

A-6-4.4 Vent sizes are based on limiting the internal pressure of the tank to 3.0 psig (20.7 kPa) [120 percent of 2.5 psig (17.2 kPa), the maximum internal pressure allowed for an atmospheric storage tank], using an orifice coefficient of 0.8 and an environmental factor of 0.5. The 0.5 environmental factor recognizes the limited time that a small tank will be exposed to fire, loss of fuel by absorption into the soil, and drainage of liquid away from the tank. Calculations are based on 2-3.5 of NFPA 30, Flammable and Combustible Liquids Code.

A-6-5.4.2 This 40 ft (12.2 m) clearance distance should also apply to other combustible structures, haystacks, etc.

SUBSTANTIATION: This proposal incorporates into NFPA 30 as a new chapter the entire text of NFPA 395, Standard for the Storage of Flammable and Combustible Liquids at Farms and Isolated Sites. By so doing, the requirements for storage of flammable and combustible liquids are found in a single Code, to the benefit of the user and enforcing official alike.

COMMITTEE ACTION: Accept.

(Log #49)
Committee: FLC-TAN

30-84 - (A-2-3.4.3(b) (New)): Accept in Principle

SUBMITTER: Wayne B. Geyer, Steel Tank Institute

RECOMMENDATION: Add a new Appendix item to 2-3.4.3(b) to read:

"The aboveground storage tank dike is normally sized to contain the entire contents of the largest single tank plus sufficient freeboard to allow for precipitation. Governing jurisdictions generally establish a basis for the amount of freeboard and incorporate additional environmental protection requirements.

Although EPA spill prevention regulations do not mandate a specific design for determining freeboard, EPA has recommended a basis for freeboard sufficient to contain a 25 year storm in its 1991 proposed revisions to 40 CFR Part 112 for Spill Prevention Control and Countermeasures of the Oil Pollution Prevention promulgated under the Clean Water Act.

Many jurisdictions establish additional freeboard as a percentile basis of dike capacity. For instance, the States of New York, Minnesota, South Dakota and Florida require 110 percent capacity of the largest tank. The Commonwealth of Massachusetts and Wisconsin required 125 percent capacity of the largest tank.

Steel dikes built and often shipped with UL 142 factory fabricated tanks are mandated by UL and STI standards (UL 142 and STI F911™) to contain 110 percent of the tank capacity."

SUBSTANTIATION: The amount of freeboard to be incorporated into a design is driven by local regulations on an increasing basis. This paragraph is added to the Appendix to give the Code user a better understanding of the degree of freeboard required by jurisdictions.

COMMITTEE ACTION: Accept in Principle.

Add the following new A-2-3.4.3(b):

"An aboveground storage tank dike is normally sized to contain the entire contents of the largest single tank within it. Some designs might also incorporate sufficient freeboard (additional capacity) to accommodate precipitation or fire fighting water. The amount of this freeboard is usually governed by local conditions."

COMMITTEE STATEMENT: The Technical Committee's version is more clear.

(Log #50)
Committee: FLC-TAN

30-85 - (A-2-8.3 (New)): Accept

SUBMITTER: Wayne B. Geyer, Steel Tank Institute

RECOMMENDATION: Add a new Appendix item to 2-8.3 to read:

"See PEI RP 200-94 "Recommended Practices for Installation of Aboveground Storage Systems for Motor Vehicle Fueling" and STI R931-93 "Double Wall AST Installation and Testing Instructions" for additional requirements to test secondary containment tanks."

SUBSTANTIATION: None.

COMMITTEE ACTION: Accept.

Also, add the following text to subsection 2-3.1:

"See PEI RP200, Recommended Practices for Installation of Aboveground Storage Systems for Motor Vehicle Fueling, for additional information."

COMMITTEE STATEMENT: The Technical Committee feels that a reference to RP200 should also be in 2-3.1.

(Log #91)
Committee: FLC-TAN

30-86 - (Appendix C): Accept

SUBMITTER: Sullivan D. Curran, Fiberglass Petroleum Tank & Pipe Institute

RECOMMENDATION: Proposed revisions have been reviewed and approved for submission by the Technical Committee.

Appendix C Temporarily-Out-of-Service, Closure in Place or Closure by Removal of Underground Tanks

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

C-1 Introduction.

C-1-1 Care is required not only in the handling and use of flammable or combustible liquids, but also in the process of rendering temporarily-out-of-service, closing or removing tanks that have held flammable or combustible liquids. This is particularly true of underground service station tanks that are most frequently used for the storage of motor fuel and occasionally for the storage of other flammable or combustible liquids, such as crankcase drainings (which may contain some gasoline). Through carelessness, explosions have occurred because flammable or combustible liquid tanks have not been properly conditioned before being rendered temporarily-out-of-service, closed, or removed.

C-1-2 In order to prevent accidents caused by improper conditioning, it is recommended that the procedures outlined below be followed when underground tanks are temporarily taken out of service, closed, or removed.

C-1-3 Underground tanks taken out of service can be safeguarded or disposed of by any one of the three following means:

(a) Placed in a temporarily out of service condition. Tanks should be rendered temporarily out of service only when it is planned that they will be returned to active service within a reasonable period or pending closure-in-place or closure by removal.

(b) Permanent closure-in-place, with proper safeguarding.

(c) Permanent closure by removal.

C-1-4 In cases where tanks are either rendered temporarily-out-of-service or permanently closed, records should be kept of tank size, location, date of closure and method used for placing the closed tank in a safe condition.

C-1-5 Procedures for carrying out each of the above methods of disposing of underground tanks are described in the following sections. No cutting torch or other flame- or spark-producing equipment should be used until the tank has been completely purged or otherwise rendered safe. In each cause, the numbered steps given should be carried out successively.

C-2 Rendering Tanks "Temporarily Out of Service."

C-2.1 When the underground storage tank system (UST) is temporarily-out-of-service for less than three (3) months, the owners and operators must comply with the following:

(a) Continue operation and maintenance of corrosion protection. Requirements can be found in U.S. Environmental Protection Agency (EPA), Title 40, Code of Federal Regulations (CFR), Part 280, "Technical Standards and Requirements for Owners and Operators of Underground Storage Tanks", Paragraph 280.31.

(b) Continue operation and maintenance of any release detection in accordance with U.S. EPA 40 CFR Part 280, Subpart D, or empty the UST system by removing all materials so that no more than 2.5 centimeters (1 in.) of residue, or 0.3 percent (%) by weight of the total capacity of the UST system, remains in the system.

C-2-2 When an UST system is temporarily-out-of-service for three (3) months or more, owners and operators must also comply with the following requirements:

(a) Leave vent lines open and functioning.
(b) Cap or plug all other lines such as fill line, gauge opening, pump suction, and ancillary equipment. Secure against tampering.

C-3 When an UST system is temporarily closed for more than twelve (12) months, owners and operators must permanently close the UST system in accordance with U.S. EPA 40 CFR Part 280.71-280.74. An extension of this 12 month period may be granted by the implementing agency. However, before such an extension can be applied for, a site assessment must be completed in accordance with U.S. EPA 40 CFR Part 280.72.

C-4 Closure of Underground Tanks in Place.

C-4-1 At least 30 days before beginning closure procedures, owners and operators must notify the implementing agency of their intent to close unless such action is in response to corrective action proceedings.

C-4-2 Closure of tanks either in-place or by removal, requires the owners and operators to measure for the presence of a release where contamination is most likely to be present at the UST site. This requirement may be satisfied if one of the external release detection methods allowed in 40 CFR Part 280.43 (e) and (F) is operating in accordance with the requirements in Part 280.43 at the time of closure, and indicates no release has occurred.

C-4-3 Prepare a safe work place by following the special safety precautions, cleaning and closure procedures in:
(a) American Petroleum Institute Recommended Practice 1604, "Removal and Disposal of Used Underground Petroleum Storage Tanks", or
(b) New England Interstate Water Pollution Control Commission (NEIWPCC), "Tank Closure Without Tears: An Inspector's Safety Guide".

C-4-4 Safe work preparation should include:
(a) No smoking in the area.
(b) Shutting down all open flame and spark producing equipment not necessary for the removal of the underground tank.
(c) Using only hand tools to expose tank fittings and preparing for the vapor freeing procedures.
(d) Controlling static electricity or providing a conductive path to discharge static electricity by bonding or grounding equipment and vehicles.
(e) Roping off tank area from pedestrian and vehicular traffic.
(f) Locating and marking all utility lines on site.
(g) Determining meteorological conditions. Vapor accumulation may occur on still and high humidity days. Under these conditions, test the area for vapor accumulation (refer to Section C-4-10) and if present either provide additional forced ventilation or delay the job until there is a breeze and it is less humid.
(h) Ensuring personnel are wearing hard hats, safety shoes, safety glasses and a combustible gas indicator is available. Provide any other safety measures or methods that may be required to meet local requirements.

C-4-5 Remove all flammable or combustible liquid and residue from the tank and from all connecting lines.

C-4-6 Residual product and solids must be disposed of properly(3).

C-4-7 Excavate to the top of tank.

C-4-8 Disconnect the suction, inlet, gauge and all other tank fixtures, except the vent line. The vent line should remain connected until the tank is purged.

C-4-9 Make the tank safe either by purging the tank of flammable vapors or inerting the potentially explosive atmosphere in the tank.
(a) Purging or ventilating the tank replaces the flammable vapors in the tank with air, reducing the flammable mixture of fuel and oxygen below the lower explosive limit or LFL. Two methods may be used to introduce air into the tank. One is the use of a "diffused-air blower" to pump air into the bottom of the tank through the fill pipe or a properly bonded air-diffusing pipe. The second method is the use of an "eductor-type air mover", typically driven by compressed air. It draws vapors out of the tank and brings fresh air into the tank. The vent pipe can be used to exhaust vapors 12 ft above grade and 3 ft from any roof lines.
(b) Inerting the tank does not replace the flammable vapors, but instead reduces the concentration of oxygen to a level insufficient to support combustion (refer to Section C-4-10). Two inert gasses may be used. Carbon dioxide gas can be generated by crushing and distributing dry ice evenly over the bottom of the tank. The dry ice will release carbon dioxide as it warms. Nitrogen gas can be pumped into the tank from a hose through the fill hole to the bottom of the tank. Oxygen will be reintroduced into the tank unless all holes are effectively plugged except for the vent line.

C-4-10 Testing the tank to determine if it is safe.
(a) When purging, a "combustible gas indicator", commonly known as an explosion meter, is used to measure the reduction in the concentration of flammable vapors. The meter reads from 0 to 100 percent of the LFL. The goal is to achieve a reading of 10-20 percent LFL for petroleum tanks.
(b) When inerting, an "oxygen meter" is used to determine when a tank has been successfully inerted. The meter reads from 0 to 100 percent oxygen content. The goal is to achieve a reading of 1-10 percent, which is safe for most petroleum products.

C-4-11 Fill the tank completely with an inert solid material. One or more holes may be cut in the tank top if existing tank openings are not adequate for the introduction of the inert material. Cap or remove remaining underground piping. The tank can now be backfilled.

C-5 Closure by Removal of Underground Tanks.

C-5-1 Observe all procedures listed under Section C-4, Closure of underground tanks-in-place, except for Section C-4-11, filling the tank with an inert solid material and backfilling the excavation.

C-5-2 After the tank has been made safe by following purging or inerting procedures and before it is removed from the excavation, plug or cap all accessible holes. One plug should have an 1/8-in. vent hole to prevent the tank from being subjected to excessive differential pressure caused by temperature changes. This vent should be positioned on top of the tank during subsequent transportation or storage.

C-5-3 Excavate around the tank to uncover it for removal. Remove the tank from the excavation and check for corrosion holes in the tank shell. Use screwed boiler plugs to plug any corrosion holes.

C-5-4 Tanks should be labeled with information about the former contents, present vapor state, vapor freeing treatment method and a warning against reuse.

C-5-5 Tanks should be removed from the site promptly and preferably the same day as removal since additional vapor may be released from liquid absorbed in tank wall corrosion or residues. However before removal, the tank atmosphere must be checked to ensure the flammable vapor concentration does not exceed safe levels.

C-6 Disposal of Tanks.

C-6-1 If the reuse of a tank is permitted by the controlling jurisdiction, the tank should be certified tight, structurally sound and will meet all requirements of a new installation.

C-6-2 The storage of used tanks should be in secure areas where the public will not have access. Tanks should be rendered safe consistent with Section C-4-9, C-4-10 and vented consistent with C-5-10.

C-6-3 If a steel tank is to be disposed of, it should retested for flammable vapors and, if necessary, again rendered gas-free. Tanks that have been lined internally or coated externally with fiberglass, epoxy-based or similar materials may not be accepted by scrap processors. Before releasing to a scrap metal dealer, a sufficient number of holes or openings should be made in the tank to render it unfit for further use. NFPA 327, Standard Procedures for Cleaning or Safeguarding Small Tanks and Containers Without Entry, provides information on safe procedures for such operations.

C-7 If the tank to be disposed of is non-metallic or is a steel tank lined internally or coated externally with fiberglass, epoxy-based or similar materials, it may not be accepted by scrap metal dealers. An alternative disposal method would be to cut up the tank in sections suitable for disposal in a sanitary landfill.

C-8 Record keeping is required to demonstrate compliance with closure requirements under 40 CFR 280.74. The results of the excavation zone assessment required in Part 280.72 must be maintained for at least three (3) years after completion of permanent closure.

C-9 Other resources to check for information related to safety during tank closure include:

1. American Petroleum Institute's (API) Recommended Practice 1604, Removal and Disposal of Used Underground Petroleum Storage Tanks, 1987.
2. API's Recommended Practice 1631, Interior Lining of Underground Storage Tanks, 1987.
3. API Publication 2015, Cleaning Petroleum Storage Tanks, 1985.
4. API Publication 2217A, Guidelines for Work in Inert Confined Spaces in the Petroleum Industry, 1987.
5. API Publication 2219, Safe Operating Guidelines for Vacuum Trucks in Petroleum Service, 1986.
6. Occupational Safety & Health Administration (OSHA) 2226, Excavation & Trenching Operations, 1990.
7. National Institute for Occupational Safety and Health (NIOSH), Criteria for Recommended Standard... Working in Confined Spaces, 1979.
8. NIOSH Publication 87-113, A Guide to Safety in Confined Spaces, 1987.
9. National Fire Protection Association NFPA 69, Explosion Prevention Systems, 1986. (Table with minimum oxygen levels necessary to support combustion for various products)
10. NFPA 77, Static Electricity, 1988.
11. NFPA 326, Standard Procedures for Safe Entry of Underground Storage Tanks.

12. NFPA 327, Cleaning or Safeguarding Small Tanks and Containers, 1987.
13. NFPA 306, Control of Gas Hazards on Vessels, 1988. (Practical procedures for vapor-freeing tanks and testing guidance
14. New England Interstate Water Pollution Control Commission, 85 Merrimac Street, Boston, MA 02114, "Tank Closure Without Tears: An Inspector's Safety Guide", May 1988.

SUBSTANTIATION: This update of Appendix C will incorporate the new requirements of U.S. EPA, Title 40, Code of Federal Regulations, "Technical Standards and Requirements for Owners and Operators of Underground Storage Tanks."

COMMITTEE ACTION: Accept.

Add to C-4.4(g) the following text:

"Excavated soil should be tested for vapor release. Artificial ventilation or repeated turning of excavated soil might be necessary to avoid ignitable concentration of vapors."

COMMITTEE STATEMENT: The Technical Committee agrees with the proposal, but has added a necessary safety guideline.

(Log #118)
Committee: FLC-TAN

30-87 - (Appendix C): Reject

SUBMITTER: Eugene S. Schmitt, Michigan State Police Fire Marshals Division

RECOMMENDATION: Delete Appendix C.

SUBSTANTIATION: The Technical Committee proposes that the provisions in Appendix C be put into mandatory language and incorporated into Section 2-4.4.

COMMITTEE ACTION: Reject.

COMMITTEE STATEMENT: The Technical Committee on Tank Storage and Piping Systems has accepted a new Appendix C via Proposal 30-86 (Log #91).

(Log #110)
Committee: FLC-SWC

30-88 - (4-1): Accept in Principle

SUBMITTER: John Davenport, Industrial Risk Insurers

RECOMMENDATION: Change the Title of Section 4-1 to read as follows:

~~Scope~~ General Provisions

SUBSTANTIATION: This provision is needed to direct the code user to the proper storage arrangement tables in Chapter 4.

COMMITTEE ACTION: Accept in Principle.

Revise Section 4-1 to read as follows:

4-1 General.

4-1.1 Scope.

4-1.1.1 This chapter shall apply to the storage of liquids in drums or other containers that do not exceed 60 gal (227 L) individual capacity and in portable tanks that do not exceed 660 gal (2498 L) individual capacity and to limited transfers incidental thereto. For portable tanks that exceed 660 gal (2498 L), Chapter 2 shall apply.

4-1.1.2 This chapter shall not apply to the following:

(a) Storage of containers in bulk plants, service stations, refineries, chemical plants, and distilleries.

(b) Liquids in the fuel tanks of motor vehicles, aircraft, boats, or portable or stationary engines.

(c) Beverages, where packaged in individual containers that do not exceed 1 gal (3.8 L) capacity.

(d) Medicines, foodstuffs, cosmetics, and other consumer products that contain not more than 50 percent by volume of water-miscible liquids, with the remainder of the solution not being flammable where packaged in individual containers that do not exceed 1 gal (3.8 L) capacity.

(e) Liquids that have no fire point when tested by ASTM D 92, Cleveland Open Cup Test Method, up to the boiling point of the liquid or up to a temperature at which the sample being tested shows an obvious physical change.

(f) Distilled spirits and wines in wooden barrels or casks.

4-1.2 General Provisions.

4-1.2.1 For the purpose of this chapter, unstable liquids shall be treated as Class IA liquids.

COMMITTEE STATEMENT: Editorial improvement.

(Log #74)
Committee: FLC-SWC

30-89 - (4-1.2 (New)): Reject

SUBMITTER: David C. Tabar, The Sherwin-Williams Company

RECOMMENDATION: Change paragraph "(f)" to "(g)",. and add new "(f)" as follows:

(f) Mixtures where at least 85 percent of the ingredients (by volume) are not susceptible to burning, and the Flammability Hazard Ratings of ingredients susceptible to burning do not exceed:

0 percent for aggregate Flammability Hazard 4 ingredients, and

5 percent for aggregate Flammability Hazard 2 and 3 ingredients, and

15 percent for aggregate Flammability Hazard 1, 2, and 3 ingredients;

-OR-

0 percent for aggregate Flammability Hazard 4 ingredients, and

15 percent for aggregate Flammability Hazard 1, 2, and 3 water-miscible ingredients

(See NFPA 704, Standard System for the Identification of the Fire Hazards of Materials, and NFPA 325, Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids.)

SUBSTANTIATION: ASTM D92, "Cleveland Open Cup Test Method" fire point testing and formula analysis involving coatings products. See also NFPA 30 intent: "The liquids intended for exclusion by the section of the Code are those that show a flash point when tested in accordance with a Tag or other closed-cup methods, but which do not burn. Water-based paints, which are formulated with small amounts of flammable or combustible solvents, are on example." ...NFPA Flammable and Combustible Liquids Code Handbook.

In Test #1, a latex dryfall, flat white coatings product was tested for fire point via ASTM D-92, and for flash point via ASTM D-93PMCC (Pensky-Martens Closed Cup). The selected sample product had a higher concentration of hydrocarbon volatiles (VM&P Naphtha @ 9.7 percent by volume) than typical "latex paints," which have very little concentrations, if any, of Class IB (Flammability Hazard Rating 3) ingredients.

Note: Flammability Hazard Ratings are covered in NFPA 704, Standard System for the Identification of the Fire Hazards of Materials (1990). See NFPA 704 for further information regarding flash point, burn temperatures, and burn durations for clarification. Also see NFPA 325, Guide to Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids (1994). Generally, the susceptibility of materials to burning are identified as follows:

Flammability Hazard Rating	Identification of Flammability Susceptibility of Materials to Burning
4	Materials that will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature, or that are readily dispersed in air and that will burn readily.
3	Liquids and solids that can be ignited under almost all ambient temperature conditions.
2	Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur.
1	Materials that must be pre-heated before ignition can occur.
0	Materials that will not burn.

Under the PMCC flash point test method, no flash point was observed by the independent test laboratory. The ASTM D-92 fire point test method requires the determination of ignition and subsequent burning of the test material for at least five seconds. This is accomplished by a test flame passed across the open test cup during a slow, constant, measurable rise in temperature.

The sample product was slowly heated in the Cleveland Open Cup Test Apparatus. Early into the test, the sample began to solidify at the surface, thus achieving "a physical change". Note that NFPA 30 Section 4-1.2(e) (1993) considers "an obvious physical change" to be a means by which "no fire point" could established. However, after continued heating between 185-190°F, the solid surface material broke through with only a single "bubble" which burned very briefly for a period of approximately five seconds. Beyond that, no further burning resulted. Since the ASTM D-92 test method requires that the burning be evident for a period of at least five seconds, this could be considered a borderline test. Looked at conservatively, one could conceivably state that the product had a fire point of 190°F; however, no flash point was observed via PMCC! Conversely, one could argue that "an obvious physical change" occurred (from liquid to solid) and that the burning in the open cup which occurred (from liquid to solid) and that the burning in the open cup which

occurred briefly was not sufficient to be concerned about. Generally, the constituents of this product involved the following ingredients: VM&P Naphtha (4.9 percent by weight, and 9.7 percent by volume), other oils, alcohols, glycols, polymers, surfactants, solids (earth, talc, TIO2, etc.) and water. A further breakdown would show the following aggregate summation of consistuent ingredients, by volume, as identified by their Flammability Hazard Ratings:

Latex Dryfall Flat White #1001

NFPA 704 Flammability Hazard Rating	Aggregate Ingredients by Volume
"0"	80.3 percent
"1"	9.8 percent
"2"	0.2 percent
"3"	9.7 percent
"4"	0.0 percent
	Total 100.0 percent

In Test #2, an industrial maintenance latex gloss enamel coatings product was tested. The product formulation consists of 22 ingredients. The majority of the ingredients (e.g., acrylic emulsion, solids, surfactants and water) had a Flammability Hazard Rating of "0".

The breakdown of the aggregate ingredients by NFPA 704 Flammability Hazard Ratings were as follows:

Industrial Material Latex Gloss Enamel #101

Flammability Hazard Rating	Aggregate Ingredients by Volume
"0"	86.7 percent
"1"	9.0 percent
"2"	4.3 percent
"3"	0.0 percent
"4"	0.0 percent
	Total 100.0 percent

In this test, the independent test laboratory found—via the Cleveland Open Cup Test Method (ASTM D-92)—that the product "Foamed over @ 155°F", and had no identifiable fire point per ASTM D-92. A flash point of 166°F using ASTM D-93 (PMCC) was identified and reported. Clearly, the product would not be capable of burning in a real-world fire scenario, particularly in a sprinklered occupancy.

COMMITTEE ACTION: Reject.

COMMITTEE STATEMENT: The Technical Committee feels that the NFPA 704 system is not appropriate for this purpose. Also, more technical data is needed to substantiate this change.

(Log #66)
Committee: FLC-SWC

30-90 - (4-1.2(a)): Reject

SUBMITTER: David C. Kirby, Union Carbide Corporation

RECOMMENDATION: In paragraph 4-1.2(a), delete the exemption for chemical plants, refineries, etc..., and revise as follows:

"This chapter shall not apply to facilities whose primary function is manufacturing or processing of flammable or combustible liquids or flammable gases, unless the storage in containers and portable tanks significantly increases the inherent fire risk of the facility*. Lack of drainage or containment to prevent the flow of liquids under emergency conditions to adjacent properties, or lack of fire walls or adequate separation distance between container and portable tank storage and adjacent properties are situations which might significantly increase the fire risk."

Add Appendix item to read:

A-4-1.2 Facilities such as chemical plants, refineries, and bulk terminals generally have design, layout, protection, and emergency response capabilities commensurate with the inherent risk associated with the manufacturing, processing, and handling or bulk quantities of flammable or combustible liquids or hazardous materials. In these situations the fire or explosion risk of the storage in containers or portable tanks is incidental to, and usually only a small part of overall risk. Only in special and unusual cases, as determined by the authority having jurisdiction, where the risk posed by the storage of flammable or combustible liquids in containers or portable tanks is unacceptable and significantly increases fire risk above the inherent risk of the operation, should the requirements of Chapter 4 be applied.

SUBSTANTIATION: None.

COMMITTEE ACTION: Reject.

COMMITTEE STATEMENT: 1. No substantiation was provided for the change and the proposed text is not definitive.

2. There is no technical basis for concluding that buildings housing container storage of liquids that are located on bulk plants, refineries, chemical plants, and distilleries are immune from fires that could put personnel, the environment, etc. at risk. These exemptions should be removed unconditionally. Whether the perceived risk of the storage is "large" or "small" relative to the risk of the rest of the facility should not be a factor in deciding whether or not to follow Chapter 4.

3. The proposal was written does not address all facilities of concern. Small facilities and large facilities have different abilities to respond to emergencies. Many businesses handle primarily Class IIIA and Class IIIB liquids. This proposal needs to address each type of facility separately. The exemption should not be removed and replaced with the proposed language.

4. There is not guidance on what is meant by "significantly increases the fire risk." Application would be difficult to enforce. How would one treat a warehouse located at a chemical plant or a manufacturing plant?

5. The proposal contains language that is not "code-enforceable." The revised wording further confuses those facilities that are exempt.

(Log #CP3)
Committee: FLC-SWC

30-91 - (4-1.2(g) (New)): Accept

SUBMITTER: Technical Committee on Storage and Warehousing of Containers and Portable Tanks

RECOMMENDATION: Add a new item (g) to 4-1.2 to read:

"Containers that do not exceed 60 gallons located at farms and isolated sites, as covered in Chapter 6."

SUBSTANTIATION: This exemption will eliminate potential conflict between the requirements of Chapter 4 and the new Chapter 6.

COMMITTEE ACTION: Accept.

(Log #13)
Committee: FLC-SWC

30-92 - (4-1.2(g) (New) and G-1.1): Reject

SUBMITTER: Dennis P. Nolan, Occidental Int'l Expl. and Prod. Co.

RECOMMENDATION: 1. Add new item (g):

"Laboratories handling incidental amounts of flammable liquids."

2. Add reference NFPA 45 to Section G-1.1.

SUBSTANTIATION: NFPA 45 provides requirements for the handling of incidental quantities of flammable/combustible liquids (chemicals) in laboratories.

COMMITTEE ACTION: Reject.

COMMITTEE STATEMENT: It is the opinion of the Technical Committee on Storage and Warehousing of Containers and Portable Tanks that Subsection 1-1.8 states that laboratories meeting the requirements of NFPA 45, Standard on Fire Protection for Laboratories Using Chemicals, are deemed as meeting the requirements of NFPA 30. NFPA 45 properly governs the quantities of liquids stored in the laboratory work area. Further, NFPA 45 requires that laboratory storage rooms in laboratory buildings meet the appropriate requirements of NFPA 30. NFPA 45 does contain exemptions for laboratory facilities and operations that use only small quantities of liquids, e.g., instrument laboratories and quality control laboratories. Finally, the submitter offers no guidance as to what can be considered to be "incidental amounts".

(Log #111)
Committee: FLC-SWC

30-93 - (4-1.4 (New)): Accept in Principle

SUBMITTER: John Davenport, Industrial Risk Insurers

RECOMMENDATION: Add a new Section 4-1.4 to read:

4-1.4 For the purposes of this chapter, protected storage shall mean storage that is protected in accordance with Section 4-8. All other storage shall be considered to be unprotected storage.

SUBSTANTIATION: This provision is needed to direct the code user to the proper storage arrangement tables in Chapter 4.

COMMITTEE ACTION: Accept in Principle.

Add an exception to new 4-1.4 to read:

Exception: As provided for in Section 4-5.

COMMITTEE STATEMENT: It is not the intent to apply this philosophy to occupancies governed by 4-5.

(Log #41a)
Committee: FLC-SWC

30-94 - (4-2.1, 4-2.2, 4-2.3, 6-1.2.10): Accept in Principle
SUBMITTER: Gerald A. Gordon, Rigid Intermediate Bulk Container Assn.
RECOMMENDATION: Revise text. Additions are underlined, deletions are in [brackets].

Chapter 4 Container and Portable Tank Storage

4-2.1 Only approved containers, [and] portable tanks and IBC's shall be used.

(a) Metal containers, metal IBC's and metal portable tanks...

(e) "Rigid plastic" IBC's (31H1 and 31H2) and "Composite" IBC's (31HZ1) meeting the requirements of, and containing products authorized by, Chapter I, Title 49 of the Code of Federal Regulations (U.S. Department of Transportation Hazardous Materials Regulations) or Chapter 16 of the United Nations "Recommendations on the Transport of Dangerous Goods" shall be acceptable.

4-2.2 Each portable tank or IBC

4-2.3 The maximum allowable size of a container, IBC or portable tank shall not exceed that specified in Table 4-2.3.

Table 4-2.3 Maximum Allowable Size of Containers , IBC's and Portable Tanks

Liquids Container Type	Flammable Liquids Class IA	Class IB	Class IC	Combustible Class II	Class III
Approved Metal Portable Tanks	660 gal	660 gal	660 gal	660 gal	660 gal
IBC's	793 gal	793 gal	793 gal	793 gal	793 gal
Rigid Plastic IBC's (31H1 or 31H2) or Composite IBC's (31HZ1)	=	=	=	793 gal	793 gal

Chapter 6 Referenced Publications

6-1.2.10 UN Publication, Labelmaster, 5724 N. Pulaski Road, Chicago, IL 60646, Phone (800) 621-5808).

Recommendations on the Transport of Dangerous Goods.

SUBSTANTIATION: Intermediate Bulk Containers (IBC's) have been approved for the shipment of flammable and combustible liquids by the US Department of Transportation (DOT) and by regulatory bodies in most of the other countries in the world (as indicated by provisions for their use in the UN "Recommendations on the Transport of Dangerous Goods"). Their use is rapidly growing both in the United States and worldwide. The basic types allowed for use in the packaging of flammable and combustible liquids, as defined in the regulations (and in the proposed amendment to NFPA 30), are Metal IBC's, Rigid Plastics IBC's, and Composite IBC's, but only Metal Portable Tanks (of which Metal IBC's compose a subset) are recognized in NFPA 30 for the storage of Liquids. The results of fire tests sponsored by the Rigid IBC Association (RIBCA) on Rigid Plastics and Composite IBC's are shown in the accompanying videotape and report. These results indicate that appropriate levels of sprinkler protection can prevent loss of lading from such IBC's even when engulfed in an intense pool fire.

IBC's containing flammable and combustible liquids will be showing up in warehouses in increasing numbers. NFPA 30 should recognize that fact and be pro-active in setting guidelines for their storage.
COMMITTEE ACTION: Accept in Principle.

Refer to Committee Action on Proposals 30-151 (Log #CP16) and 30-152 (Log #CP17).
COMMITTEE STATEMENT: The Committee Action on Proposals 30-151 (Log #CP16) and 30-152 (Log #CP17) meet the intent of the submitter.

(Log #CP1)
Committee: FLC-SWC

30-95 - (4-2.1 and 4-2.1(a)): Accept
SUBMITTER: Technical Committee on Storage and Warehousing of Containers and Portable Tanks
RECOMMENDATION: 1. In 4-2.1, add "and intermediate bulk containers (IBCs)" after "portable tanks."

2. Revise 4-2.1(a) to read:

"Metal containers, metal intermediate bulk containers, and metal portable tanks meeting the requirements of and containing products authorized by Title 49, Transportation, Chapter 1, of the Code of Federal Regulations, Chapter 9 or Chapter 16 of the United Nations Recommendations for the Transport of Dangerous Goods, or NFPA 386, Standard for Portable Shipping Tanks for Flammable and Combustible Liquids, shall be acceptable."
SUBSTANTIATION: This change recognizes current terminology for a certain type of portable tank and correlates with a similar change to the definition of "Portable Tank" in Chapter 1 of NFPA 30.
COMMITTEE ACTION: Accept.

(Log #112)
Committee: FLC-SWC

30-96 - (4-2.1(a)): Accept
SUBMITTER: John Davenport, Industrial Risk Insurers
RECOMMENDATION: Add to the end of the existing paragraph:

"Any metal container larger than 60 gal and meeting the requirements of NFPA 386 shall be considered a portable tank for the purposes of this Chapter."
SUBSTANTIATION: The Technical Committee Task Group on Protection Criteria has determined that there is a need to allow for the use of metal Intermediate Bulk Containers and other types of metal containers if they meet the requirements of NFPA 386, Portable Shipping Tanks for Flammable and Combustible Liquids.
COMMITTEE ACTION: Accept.

(Log #CP2)
Committee: FLC-SWC

30-97 - (4-2.1(e) (New)): Accept
SUBMITTER: Technical Committee on Storage and Warehousing of Containers and Portable Tanks
RECOMMENDATION: In 4-2.1 add a new item (e) to read:

"Rigid plastic intermediate bulk containers and composite intermediate bulk containers meeting the requirements of and containing products authorized by Title 49, Transportation, Chapter 1 of the Code of Federal Regulations, or Chapter 16 of the United Nations Recommendations for the Transport of Dangerous Goods, for class 31H1, 31H2, and 31HZ1, shall be acceptable."
SUBSTANTIATION: This change recognizes two particular classes of intermediate bulk containers that are authorized for transportation of certain liquids.
COMMITTEE ACTION: Accept.

(Log #CP4)
Committee: FLC-SWC

30-98 - (4-2.2): Accept
SUBMITTER: Technical Committee on Storage and Warehousing of Containers and Portable Tanks
RECOMMENDATION: In the first sentence of 4-2.2, add "or intermediate bulk container" after the words "Each portable tank."
SUBSTANTIATION: This clarifies that the requirements of 4-2.2 also apply to intermediate bulk containers.
COMMITTEE ACTION: Accept.

(Log #CP5)
Committee: FLC-SWC

30-99 - (4-2.3): Accept
SUBMITTER: Technical Committee on Storage and Warehousing of Containers and Portable Tanks
RECOMMENDATION: Revise Table 4-2.3 by the following:

1. Change the entry for "approved metal portable tanks" by adding "and IBCs".

2. Add a new entry to the table for "Rigid Plastic IBCs (UN 31H1 or 31H2) and Composite IBCs (UN 31HZ1)". In the same row as this new entry, add "660" to the columns for Class II and Class III. Add a "dash" to the other columns.

SUBSTANTIATION: This proposal establishes the maximum allowable quantities and allowable liquids contained for these types of intermediate bulk containers.
COMMITTEE ACTION: Accept.

(Log #35)
Committee: FLC-SWC

30- 100 - (4-2.3.3): Accept in Principle
SUBMITTER: Philip R. Sherman, P.R. Sherman, Inc.
RECOMMENDATION: Revise text as follows:
Class IA and IB liquids shall be permitted to be stored in glass containers of not more than 1.1 gal (4 L) capacity, if the required liquid purity (such as ACS analytical reagent grade or higher) would be affected by storage in metal containers or if the liquid can cause excessive corrosion of the metal container.
SUBSTANTIATION: Laboratories typically work with 4 liter sized containers. This size container is slightly larger than 1 gal (4 L = 1.06 gal), however, the intent of the code would be met.
COMMITTEE ACTION: Accept in Principle.
COMMITTEE STATEMENT: See Committee Statement to Proposal 30-116 (Log #34).

(Log #CP6)
Committee: FLC-SWC

30- 101 - (4-3): Accept
SUBMITTER: Technical Committee on Storage and Warehousing of Containers and Portable Tanks
RECOMMENDATION: Revise Section 4-3 to read as follows:
4-3 Design, Construction, and Capacity of Storage Cabinets.
4-3.1 Not more than 120 gal (454 L) of Class I, Class II, and Class IIIA liquids shall be stored in a storage cabinet. Of this 120 gal total, not more than 60 gal (227 L) shall be Class I and Class II liquids.
4-3.2 Not more than three storage cabinets shall be located in any one fire area.
Exception: In an industrial occupancy, additional storage cabinets shall be permitted to be located in the same fire area, if a minimum separation of 100 ft (30m) is maintained between each group of not more than three cabinets.
4-3.3* Storage cabinets that meet at least one of the following sets of requirements, as specified in 4-3.3.1, 4-3.3.2, or 4-3.3.3, shall be acceptable for storage of liquids.
(a) Storage cabinets that are designed and constructed to limit the internal temperature at the center of the cabinet and 1 in. (2.5 cm) from the top of the cabinet to not more than 325°F (162.8°C), when subjected to a 10-min fire test that simulates the fire exposure of the standard time-temperature curve specified in NFPA 251, Standard Methods of Fire Tests of Building Construction and Materials, shall be acceptable. All joints and seams shall remain tight and the door shall remain securely closed during the test.
(b) Metal storage cabinets that are constructed in the following manner shall be acceptable. The bottom, top, door, and sides of the cabinet shall be at least No. 18 gage sheet steel and shall be double-walled, with 1 1/2 (3.8 cm) air space. Joints shall be riveted, welded, or made tight by some equally effective means. The door shall be provided with a three-point latch arrangement and the door sill shall be raised at least 2 in. (5 cm) above the bottom of the cabinet to retain spilled liquid within the cabinet.
(c) Wooden cabinets constructed in the following manner shall be acceptable. The bottom, sides, and top shall be constructed of exterior grade plywood that is at least 1 in. (2.5 cm) thick and of a type that will not break down or delaminate under fire conditions. All joints shall be rabbetted and shall be fastened in two directions with wood screws. Where more than one door is used, there shall be a rabbetted overlap of not less than 1 in. (2.5 cm). Doors shall be equipped with a means of latching and hinges shall be constructed and mounted in such a manner as to not lose their holding capacity when subjected to fire exposure. A raised sill or pan capable of containing a 2 in. (5 cm) depth of liquid shall be provided at the bottom of the cabinet to retain spilled liquid within the cabinet.
(d) Listed storage cabinets that have been constructed and tested in accordance with 4-3.3(a) shall be acceptable.
4-3.4 The storage cabinet shall not be required by this Code to be vented for fire protection purposes and vent openings shall be sealed with the bungs supplied with the cabinet or with bungs specified by the manufacturer of the cabinet. However, if the storage cabinet is vented for any reason, the cabinet shall be vented directly to outdoors in such a manner that will not compromise the specified performance of the cabinet and in a manner that is acceptable to the authority having jurisdiction.
4-3.5 Storage cabinets shall be marked in conspicuous lettering: "FLAMMABLE — KEEP FIRE AWAY."
SUBSTANTIATION: Editorial improvement.
COMMITTEE ACTION: Accept.

(Log #59)
Committee: FLC-SWC

30- 102 - (4-3.1 Exception): Accept in Principle
SUBMITTER: Gerald J. Rosicky, General Motors Corp
RECOMMENDATION: In the last sentence add an additional exception to state:
"in an industrial occupancy with sprinkler protection in accordance with Chapters 5 or 6 of NFPA 13, Standard for the Installation of Sprinkler Systems, the number of cabinets shall not limited."
SUBSTANTIATION: When flammable and combustible liquids are located inside cabinets designed according to 4-3 and sprinkler protection is provided according to NFPA 13, a limit of three cabinets with 100 ft separation is not necessary. Conversely, in an unprotected facility, the limitation and space separation is justified.
COMMITTEE ACTION: Accept in Principle.
Add an exception to 4-3.1 to read:
"In an industrial occupancy that is protected by an automatic sprinkler system designed and installed in accordance with Chapters 5 or 6 of NFPA 13, the number of cabinets in any one group shall be permitted to be increased to six."
COMMITTEE STATEMENT: A doubling of the allowable number is reasonable.

(Log #58)
Committee: FLC-SWC

30- 103 - (4-4.2.5): Accept
SUBMITTER: David C. Kirby, Union Carbide Corp
RECOMMENDATION: Revise 4-4.2.5 to read as follows:
New text is underlined and deleted text is ~~strikethrough~~.
4-4.2.5 Where Class IA or IB liquids or unstable liquids are dispensed, or where Class IA liquids or unstable liquids are stored in containers larger than 1 gal (4L), the exterior wall or roof construction shall incorporate deflagration venting. (NFPA 68, Guide for Venting of Deflagrations, provides information on this subject).
Exception No. 1: This does not apply to inside storage rooms.
Exception No. 2: This does not apply to Class IB liquids dispensed from containers smaller than 60 gal capacity.
SUBSTANTIATION: Dispensing IB liquids from containers smaller than 60 gal (e.g., 55 gal drums) is not a significant room/building explosion hazard to require deflagration venting in accordance with NFPA 68. This is substantiated by a long history of favorable loss experience reported by industry and insurance companies. Ventilation requirements to meet health standards further reduces the change of vapor accumulation/need for explosion venting.
COMMITTEE ACTION: Accept.

(Log #64)
Committee: FLC-SWC

30- 104 - (4-4.2.5 Exception, 4-4.2.9): Accept
SUBMITTER: Anthony Ordile, Loss Control Associates, Inc.
RECOMMENDATION: Remove the word "storage" from the phrase "inside storage rooms" which appears in the Exception of 4-4.2.5 and twice in 4-4.2.9.
SUBSTANTIATION: For clarification and editorial purposes; the 1993 edition defines inside liquid storage area and inside room, but does not define inside storage room.
It is believed that the intent of inside storage room as used in 4-4.2.5 and 4-4.2.9 is meant to apply to an inside room. Use of the term inside room would be consistent with section 4-4.2.4 and 4-4.4.2.
COMMITTEE ACTION: Accept.
Change "inside storage room(s)" to "inside room(s)" throughout text.

(Log #103)
Committee: FLC-SWC

30- 105 - (4-4.2.6): Accept in Principle
SUBMITTER: William J. Tomes, Tomes, Van Rickley & Associates
RECOMMENDATION: Revise text to read as follows:
"When required by Figure 4-4.2.6, floors and drains shall be constructed to provide adequate containment, and the storage area shall be liquidtight where the walls join the floor."
SUBSTANTIATION: To the knowledge of the Task Group, a "liquidtight" impermeable floor can not be guaranteed with conventional construction methods. Only the seams where the walls and floors are required to be constructed as liquidtight. This is where fire spread (to neighboring building areas or other exposures) must be prevented. Therefore, the continued use of this term "liquidtight", as applied to all floor construction, is a misnomer.
COMMITTEE ACTION: Accept in Principle.
Revise 4-4.2.6 to read:
"Effective January, 1, 1997, when required by Figure 4-4.2.6, containment or drainage shall be provided. The storage area shall be liquidtight where the walls join the floor."
COMMITTEE STATEMENT: This revision is clearer.

(Log #102)
Committee: FLC-SWC

30- 106 - (Figure 4-4.2.6 (New)): Accept in Principle
SUBMITTER: William J. Tomes, Tomes, Van Rickley & Associates
RECOMMENDATION: Add a new Figure 4-4.2.6 as follows:

Containment/Drainage Requirements for Inside Liquid Storage Areas

Effective for New Construction Beginning 1/1/96

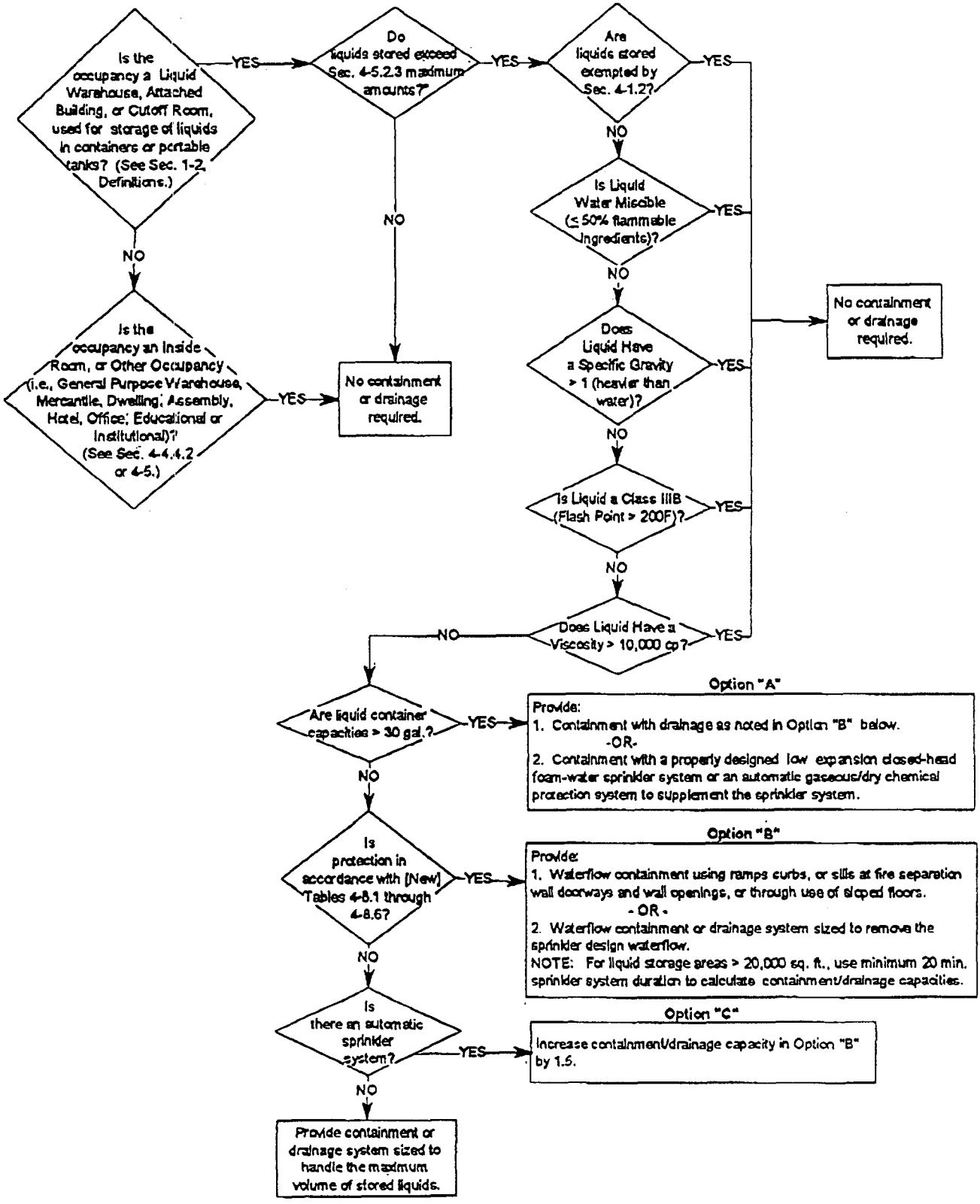

Figure 4-4.2.6

SUBSTANTIATION: This figure provides decision tree clarification involving special construction features for "containment" or "drainage", which improves upon the existing text of Section 4-4.2.7 and 4-4.2.8. The decision tree also clarifies how (1) the adequacy of the protection features, (2) the volume of the individual container, and (3) the type of liquid affects the necessary construction features. The figure provides this information in a clear, user-friendly format. It should be noted that the primary responsibility of this NFPA 30 Chapter is to provide documents on criteria for safeguarding against the fire and explosion hazards associated with the storage, warehousing, merchandising and display of flammable and combustible liquids in containers and portable tanks. Therefore, the concern of this code is fire prevention, fire protection and control. While some environmental concerns may be addressed by these containment or drainage requirements, this Code section is not intending to provide environmental design criteria. As an example, standard expansion and control joints in concrete floors are suitable for purposes of "safeguarding against fire and explosion hazards" for most liquids in storage. The decision tree does not require impermeable concrete floors, as this would represent an environmental design.

New 20 minute waterflow duration requirements are based upon anticipated Fire Department response times, and the time necessary to bring a fire under control. The requirement for this duration are proposed to be increased by 1.5 times for "inadequately protected" liquid storage occupancies due to the additional time necessary to bring a fire under control with less-than-adequate fire protection. Due to the potential impact on existing facilities (the Code previously did not establish duration times), the new provisions are proposed to be effective January 1, 1996.

Class III-A liquids are no longer exempted from containment requirements in order to maintain consistency with other fire protection requirements, and due to lack of evidence for continued exemption. The other exemptions listed in this figure are existing in Section 4-1.2 and are included in this figure for clarity and user-friendliness.

COMMITTEE ACTION: Accept in Principle.

Revise diagram as shown. (See on the following page.)

COMMITTEE STATEMENT: *The revised diagram is more accurate with regards to intent of Committee.*

(Log #104)
Committee: FLC-SWC

30- 107 - (4-4.2.7 (New)): Accept

SUBMITTER: William J. Tomes, Tomes, Van Rickley & Associates

RECOMMENDATION: Add new text as follows:

"When containment or drainage is required by Figure 4-2.6, means shall be provided to prevent the flow of burning liquids under emergency conditions into adjoining building areas, property, or critical natural resources."

Delete existing Section 4-4.2.7 and replace with the above.

SUBSTANTIATION: The existing text is clarified and replaced by the new Figure 4-4.2.6.

COMMITTEE ACTION: Accept.

(Log #105)
Committee: FLC-SWC

30- 108 - (4-4.2.8): Accept in Principle

SUBMITTER: William J. Tomes, Tomes, Van Rickley & Associates

RECOMMENDATION: Delete existing Section 4-4.2.8 in its entirety.

SUBSTANTIATION: The existing text is clarified and replaced by the new Figure 4-4.2.6 and new text in Section 4-4.2.7.

COMMITTEE ACTION: Accept in Principle.

Instead of deleting this text, make the following changes to the revised diagram in Proposal 30-106 (Log #102).

1. In the box that states combined drainage requirements, add a third item to read "Containment with a properly designed low expansion closed-head foam-water sprinkler system or an automatic gaseous or dry chemical suppression system."
2. In the diamond leading to this box revise to read "Is protection in accordance with Section 4-8?"

COMMITTEE STATEMENT: This amendment to Table 4-4.2.6 better accomplishes the submitter's goal.

(Log #113)
Committee: FLC-SWC

30- 109 - (4-4.4): Accept

SUBMITTER: John Davenport, Industrial Risk Insurers

RECOMMENDATION: Delete existing Tables 4-4.4(b) and 4-4.4(c).

SUBSTANTIATION: Storage height limitations for protected palletized and rack storage of liquids in containers and portable tanks is specified in Tables 4-8.1 through 4-8.6. The Protection Criteria Task Group believes that quantities need not be limited for protected storage of liquids.

COMMITTEE ACTION: Accept.

(Log #94)
Committee: FLC-SWC

30- 110 - (4-4.4.1): Accept

SUBMITTER: Douglas Rivers, 3M Company

RECOMMENDATION: Revise the section to read:

4-4.4.1 Except as provided for in 4-4.4.2 through 4-4.4.4, indoor unprotected liquid storage shall comply with Table 4-4.4(a). Where storage of liquids is protected, the protection shall meet the requirements of Section 4-8.

Delete Tables 4-4.4(b) and 4-4.4(c).

SUBSTANTIATION: Based on the inclusion of protection criteria in Section 4-8, storage arrangements must meet the criteria as tested eliminating the need for tables 4-4.4(b) and 4-4.4(c).

COMMITTEE ACTION: Accept.

(Log #106)
Committee: FLC-SWC

30- 111 - (Table 4-4.4.2 Note 3 (New)): Accept in Principle

SUBMITTER: William J. Tomes, Tomes, Van Rickley & Associates

RECOMMENDATION: Add the following text:

Note 3: Spill control shall be provided by ramps, curbs or sills, or by drainage to a safe location in anticipation of the largest possible credible spill. Rooms shall be liquidtight where the floor meets walls.

SUBSTANTIATION: Due to the limited size and small concentration of liquids allowed within Inside Storage Rooms, no special requirements for containment and drainage are necessary. The proposed "spill control" requirements for Inside Rooms are not included in (new) Figure 4-4.2.6.

COMMITTEE ACTION: Accept in Principle.

Refer to Committee Action on Proposal 30-106 (Log #102).

COMMITTEE STATEMENT: The action on Proposal 30-106 (Log #102) addresses this issue.

(Log #96)
Committee: FLC-SWC

30- 112 - (4-4.4.3): Accept

SUBMITTER: Douglas Rivers, 3M Company

RECOMMENDATION: Delete the second sentence as shown:

4-4.4.3 Unprotected storage of liquids in racks shall not exceed the maximum total quantities allowed by Table 4-4.4(a).

Exception: Liquid warehouses need not comply with this requirement.

SUBSTANTIATION: Based on the inclusion of protection criteria in section 4-8, storage arrangements must meet the criteria as tested eliminating the need for Table 4-4.4(c).

COMMITTEE ACTION: Accept.

(Log #97)
Committee: FLC-SWC

30- 113 - (4-4.4.4): Accept

SUBMITTER: Douglas Rivers, 3M Company

RECOMMENDATION: Add "for unprotected storage" and delete reference to Tables 4-4.4(b) and 4-4.4(c).

4-4.4.4 The total quantity of liquids stored in a liquid warehouse shall not be restricted. However, the storage heights and maximum quantity per pile for unprotected storage shall comply with Tables 4-4.4(a).

SUBSTANTIATION: Based on the inclusion of protection criteria in section 4-8, storage arrangements must meet the criteria as tested eliminating the need for Tables 4-4.4(b) and 4-4.4(c).

COMMITTEE ACTION: Accept.

Existing Exception remains.

(Log #93)
Committee: FLC-SWC

30- 114 - (Table 4-4.4(a)): Accept in Principle

SUBMITTER: Douglas Rivers, 3M Company

RECOMMENDATION: Revise table heading to read:

"Table 4-4.4(a) Indoor Unprotected Storage of Liquids in Containers and Portable Tank and IBC's".

Revise column headings to read:

"Container Storage" to "Container/Non-Metallic IBC Storage"

"Portable Tank Storage" to "Portable Tank/Metallic IBC Storage".

SUBSTANTIATION: The DOT allows the transport of liquid in IBCs. The addition of IBCs to this table acknowledges this and provides guidance on safe storage of liquid in unprotected liquid storage areas.

COMMITTEE ACTION: Accept in Principle.

Refer to Committee Action on Proposal 30-115 (Log #95).

COMMITTEE STATEMENT: The Action on Proposal 30-115 (Log #95) affects these changes.

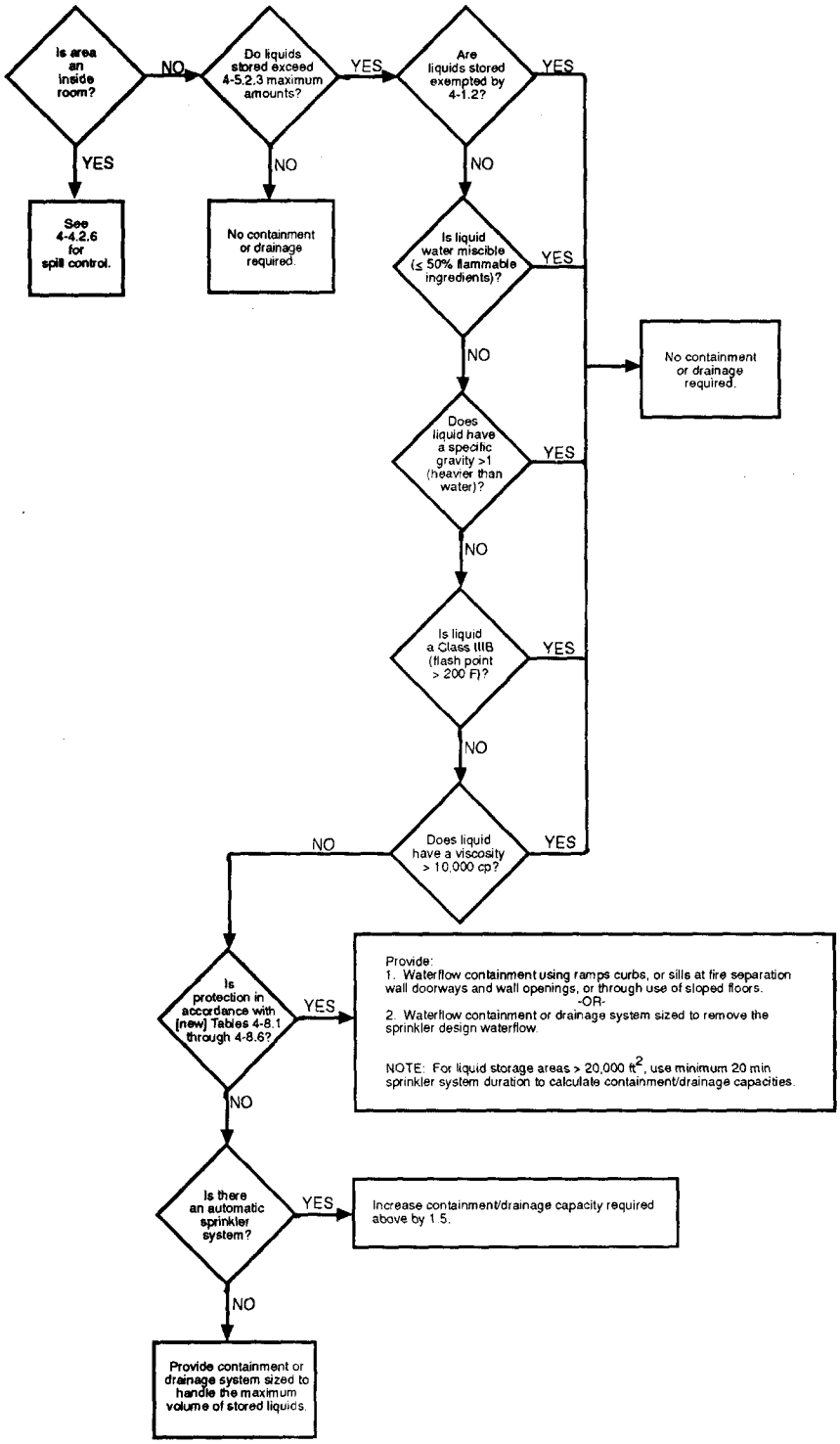
Is area an inside room?
NO
Do liquids stored exceed 4-5.2.3 maximum amounts?
YES
Are liquids stored exempted by 4-1.2?
YES
YES
See 4-4.2.6 for spill control.
NO
No containment or drainage required.
NO
Is liquid water miscible (≤ 50% flammable ingredients)?
YES
NO
No containment or drainage required.
Does liquid have a specific gravity >1 (heavier than water)?
YES
NO
Is liquid a Class IIIB (flash point > 200 F)?
YES
NO
Does liquid have a viscosity > 10,000 cp?
YES
NO
Is protection in accordance with (new) Tables 4-8.1 through 4-8.6?
YES
Provide:
1. Waterflow containment using ramps curbs, or sills at fire separation wall doorways and wall openings, or through use of sloped floors.
-OR-
2. Waterflow containment or drainage system sized to remove the sprinkler design waterflow.
NOTE: For liquid storage areas > 20,000 ft^2, use minimum 20 min sprinkler system duration to calculate containment/drainage capacities.
NO
Is there an automatic sprinkler system?
YES
Increase containment/drainage capacity required above by 1.5.
NO
Provide containment or drainage system sized to handle the maximum volume of stored liquids.

Figure 4-4.2.6

(Log #95)
Committee: FLC-SWC

30- 115 - (Table 4-4.4(a)): Accept in Principle
SUBMITTER: Douglas Rivers, 3M Company
RECOMMENDATION: Add "**" and footnote to Table 4-4.4(a).
Under new container/non-metallic IBC storage columns for IA Liquids Footnote to read: "** Non-Metallic IBCs not Permitted". See the following table.

Table 4-4.4(a) Indoor Unprotected Storage of Liquids in Containers, Portable Tanks and IBCs

	Containers/Non-Metallic IBC Storage			Portable Tank/Metallic IBC Storage		
Class	Max. Pile Height (ft)	Max. Quant. per Pile (gal)	Max. Total Quant. (gal)*	Max. Pile Height (ft)	Max. Quant. per Pile (gal)	Max. Total Quant. (gal)*
IA	5	660**	660**	-	Not Permitted	-
IB	5	1,375	1,375	7	2,000	2,000
IC	5	2,750	2,750	7	4,000	4,000
II	10	4,125	8,250	7	5,500	11,000
IIIA	15	13,750	27,500	7	22,000	44,000
IIIB	15	13,750	55,000	7	22,000	88,000

SI Units: 1 ft = 0.3 m; 1 gal = 3.8 L

* Applies only to cutoff rooms and attached buildings.
**Non-Metallic IBCs not permitted.

SUBSTANTIATION: This footnote is added to provide consistency because IA liquids are not allowed for portable tank/metallic IBC storage.
COMMITTEE ACTION: Accept in Principle.
Change the Table as follows:
1. Delete "Non-Metallic IBC" from above Columns 2 through 4.
2. Add a new set of columns to table as follows:

Rigid Plastic & Composite Intermediate Bulk Containers		
Max. Pile Height, ft	Max. Quantity per Pile, Gal	Max. Total Quantity Gal
—	—	—
—	—	—
7	4125	8250
7	13,750	27,500
7	13,750	55,000

3. Also delete double-asterisked entry below table.
COMMITTEE STATEMENT: This arrangement of the table is easier to understand.

(Log #34)
Committee: FLC-SWC

30- 116 - (4-5.2.3): Accept in Principle
SUBMITTER: Philip R. Sherman, P.R. Sherman, Inc.
RECOMMENDATION: Revise text as follows:
"Class IB and IC liquids in containers of 1.1 gal (4 L) or less capacity, Class II liquids in containers of 5 gal (18.9 L) or less capacity, and Class III liquids in contains of 60 gal (227 L) or less capacity shall be permitted..."
SUBSTANTIATION: Laboratories typically work with 4 liter sized containers. This size container is slightly larger than 1 gal (4 L = 1.06 gal), however, the intent of the code would be met.
COMMITTEE ACTION: Accept in Principle.
COMMITTEE STATEMENT: The Technical Committee on Storage and Warehousing of Containers and Portable Tanks feels that the 4 liter containers at issue here can be considered to be equivalent to a 1 gal container for purposes of NFPA 30. The Technical Committee intends to provide more consistent SI equivalents after the NFPA Standards Council provides a policy and guidance on conversion to SI units.

(Log #61)
Committee: FLC-SWC

30- 117 - (4-5.2.5): Accept
SUBMITTER: Hugh Patrick Toner, Society of the Plastics Industry
RECOMMENDATION: Revise text to read as follows:
4-5.2.5 Palletized, Solid Pile, or Rack Storage. Liquids in containers shall be permitted to be stored on pallets, in solid piles, or on racks, subject to the maximum total quantity and maximum storage height provisions of 4-5.2.3. ~~provided the storage is protected in accordance with Section 4-8, as applicable.~~
SUBSTANTIATION: Section 4-5.2.5 is a permissive provision subject to the limitations in Section 4-5.2.3. Section 4-5.2.3 limits the quantities and heights of liquids to be stored in general purpose warehouses provided the area is protected with sprinklers in accordance with NFPA 231 for 20-ft (6-m) high storage of Class IV commodities. Section 4-8 specifies protection requirements for larger quantities and greater storage heights. The reference to Section 4-8 is inappropriate in section 4-5.2.5.
COMMITTEE ACTION: Accept.

(Log #CP7)
Committee: FLC-SWC

30-118 - (4-5.6): Accept

SUBMITTER: Technical Committee on Storage and Warehousing of Containers and Portable Tanks

RECOMMENDATION: Revise Section 4-5.6 to read as follows:

4-5.6 Mercantile Occupancies.

4-5.6.1 This section shall apply to mercantile occupancies that handle, store, and display flammable and combustible liquids, as defined in this Code.

4-5.6.2 The display arrangement, storage arrangement, and maximum total quantity of liquids allowed shall meet the requirements of this subsection and Table 4-5.6.

4-5.6.3 On floors above ground level, the storage or display of Class I and Class II liquids shall be limited to 60 gal in unprotected occupancies and 120 gal in protected occupancies.

4-5.6.4 Class I and Class II liquids shall not be permitted to be stored or displayed in basements.

4-5.6.5 Liquids in containers of capacity greater than 5 gal shall not be stored or displayed in areas that are accessible to the public.

Exception: Liquids that are exempt from the requirements of this Chapter by 4-1.2.

4-5.6.6 Shelving shall be of stable construction. Floor storage shall be stacked securely.

4-5.6.7 Protection systems for storage and display of liquids that are designed and developed based on full-scale fire tests performed at an approved test facility shall be considered an acceptable alternative to the protection criteria set forth in Section 4-8. Such alternative protection systems shall be acceptable to the authority having jurisdiction.

4-5.6.8 Means of egress from mercantile occupancies shall meet applicable requirements of NFPA 101, Life Safety Code.

4-5.6.9 Power-operated industrial trucks that are used to move Class I liquids shall be selected, maintained, and operated in accordance with NFPA 505."

Also, add a new definition to Chapter 1 to read as follows:

"Mercantile Occupancy. The occupancy or use of a building or structure or any portion thereof for the wholesale or retail display, storage, and merchandising of goods or wares."

SUBSTANTIATION: This section has been revised to specify the maximum allowable storage and display of flammable and combustible liquids in mercantile occupancies and to encourage the use of fire protection criteria that have been verified by full-scale fire tests. The proposed Table 4-5.6 (1) reduces the allowable quantities of Classes IB, IC, II, and IIIA liquids in unprotected mercantile occupancies constructed after 1-1-97; (2) maintains the quantity limitations of the 1993 edition of NFPA 30 for mercantile occupancies that are protected by an Ordinary Hazard-Group 2 sprinkler system (in accordance with NFPA 13); and (3) permits up to 30,000 gallons of Classes IB through IIIA liquids with no density/area limitation for a single mercantile occupancy that is protected in accordance with criteria developed from full-scale fire tests. Areas "accessible" and "not accessible" to the public have been replaced by an area concept with a maximum of two areas per occupancy, separated from each other by a one hour fire separation. The storage of Class I and Class II liquids in basements is prohibited.

COMMITTEE ACTION: Accept.

Table 4-5.6 Allowable Storage and Display Amounts for Mercantile Occupancies

Level of Protection		Liquid Classification IA	IB, IC, II and IIIA (Any Combination)	IIIB
Unprotected	Max. Qty. Allowed: [1]	60 gal[2]	3,750 gal[3] per building area. A maximum of two areas permitted per occupancy when separation is provided by a minimum 1-hr rated fire separation wall.	15,000 gal
	Max. Storage Density:	2 gal per square foot in storage or display area and adjacent aisles		
NFPA 13 Ordinary Hazard, Group 2 Sprinkler System	Max. Qty. Allowed: [1]	120 gal[2]	7,500 gal per building area. A maximum of two areas permitted per occupancy when separation is provided by a minimum 1-hr rated fire separation wall.	Unlimited
	Max. Storage Density:	4 gal per square foot in storage or display area and adjacent aisles.		
NFPA 30, Section 4-8	Max. Qty. Allowed: [1]	120 gal[2] (see also Section 4-5.6.9)	30,000 gal per occupancy.	Unlimited

1. Does not include liquids exempted by Section 4-1.2.
2. Ground level floor only.
3. Existing unprotected mercantile occupancies in operation prior to January 1, 1997 are permitted to store or display up to 7,500 gal of Class IB, IC, II and IIIA liquids (any combination) in each area.

(Log #101)
Committee: FLC-SWC

30- 119 - (Table 4-7): Accept in Principle
SUBMITTER: Douglas Rivers, 3M Company
RECOMMENDATION: Add non-metallic and metallic IBCs to the Table 4-7 as shown:
SUBSTANTIATION: The DOT allows transport of liquids in IBCs and this revision acknowledges this and provides guidance on the storage of IBCs.

Table 4-7 Outdoor Liquid Storage in Containers, Portable Tanks and IBCs

	1		2		3	4	5
Class	Container & Non-Metallic IBC Storage - Max. per Pile		Portable Tank & Metallic IBC Storage Max, per Pile Gallons [1]		Distance between Piles or Racks (ft)	Distance to Property Line that Is or Can Be Built Upon (ft) [2,3]	Distance to Street, Alley, or a Public Way (ft) [3]
	Gallons [1,4,3]	Height (ft)	Gallons [1,4]	Height (ft)			
IA	1,100	10	2,200	7	5	50	10
IB	2,200	12	4,400	14	5	50	10
IC	4,400	12	8,800	14	5	50	10
II	8,800	12	17,600	14	5	25	5
III	22,000	18	44,000	14	5	10	5

SI Units: 1 ft = 0.3 m; 1 gal = 3.8L

[1] See 4-7.1.1 regarding mixed class storage.
[2] See 4-7.1.3 regarding protection for exposures
[3] See 4-7.1.4 for smaller pile sizes
[4] For storage in racks, the quantity limits per pile do not apply, but the rack arrangements shall be limited to a maximum of 50 ft (15 m) in length and 2 rows or 9 ft (2.7 m) in depth
[5] Storage of Class IA Liquids in Non-Metallic IBC's not permitted

COMMITTEE ACTION: Accept in Principle.
Revise the table as shown.

Table 4-7 Outdoor Storage of Liquids in Containers and Portable Tanks

Class	Containers Max. per Pile		Rigid Plastic & Composite IBCs Max, per Pile Gallons [5]		Portable Tanks & Metal IBCs Max, per Pile Gallons [1]		Distance between Piles or Racks (ft)	Distance to Property Line that Is or Can Be Built Upon (ft) [2,3]	Distance to Street, Alley, or a Public Way (ft) [3]
	Gallons [1,4,3]	Height (ft)	Gallons	Height	Gallons [1,4]	Height (ft)			
IA	1,100	10	—	—	2,200	7	5	50	10
IB	2,200	12	—	—	4,400	14	5	50	10
IC	4,400	12	—	—	8,800	14	5	50	10
II	8,800	12	8,800	12	17,600	14	5	25	5
III	22,000	18	22,000	18	44,000	14	5	10	5

SI Units: 1 ft = 0.3 m; 1 gal = 3.8L
[1] See 4-7.1.1 regarding mixed class storage.
[2] See 4-7.1.3 regarding protection for exposures
[3] See 4-7.1.4 for smaller pile sizes
[4] For storage in racks, the quantity limits per pile do not apply, but the rack arrangements shall be limited to a maximum of 50 ft (15 m) in length and 2 rows or 9 ft (2.7 m) in depth
[5] Storage of Class I Liquids in Rigid Plastic & Composite IBC's not permitted

COMMITTEE STATEMENT: The Technical Committee's version is easier to understand.

(Log #98)
Committee: FLC-SWC

30- 120 - (4-7.1): Accept
SUBMITTER: Douglas Rivers, 3M Company
RECOMMENDATION: Add IBCs as follows:
4-7.1 Outdoor storage of liquids in containers, portable tanks and IBCs shall be in accordance with Table 4-7 and 4-7.1.1 through 4-7.1.4 and 4-7.2 through 4-7.4.
SUBSTANTIATION: The DOT allows transport of liquids in IBCs and this revision acknowledges this and provides guidance on storage of IBCs.
COMMITTEE ACTION: Accept.

(Log #99)
Committee: FLC-SWC

30- 121 - (4-7.1.2): Accept
SUBMITTER: Douglas Rivers, 3M Company
RECOMMENDATION: Add IBCs as follows:
4-7.1.2 No container, portable tank or IBC shall be more than 20 ft from a 12 ft wide access way to permit approach of fire control apparatus under all weather conditions.
SUBSTANTIATION: The DOT allows transport of liquids in IBCs and this revision acknowledges this and provides guidance on storage of IBCs.
COMMITTEE ACTION: Accept.

(Log #100)
Committee: FLC-SWC

30- 122 - (4-7.2): Accept
SUBMITTER: Douglas Rivers, 3M Company
RECOMMENDATION: Add IBCs as follows:
"4-7.2 A maximum of 1100 gal of liquids in closed containers, portable tanks, and IBCs shall be permitted to be stored adjacent to a building when the same management provided that:..."

SUBSTANTIATION: The DOT allows transport of liquids in IBCs and this revision acknowledges this and provides guidance on the storage of IBCs.
COMMITTEE ACTION: Accept.

(Log #114)
Committee: FLC-SWC

30-123 - (4-8): Accept
SUBMITTER: John Davenport, Industrial Risk Insurers
RECOMMENDATION: Delete existing Section 4-8 and replace with the following:

4-8 Fire Protection and Control.

4-8.1 Scope. Section 4-8 shall apply to all storage of liquids in containers and portable tanks as specified in Sections 4-2 through 4-7.

4-8.1.1 Where different liquid classes and container types are stored in the same occupancy, protection shall conform to the requirements for the most severe hazard class.

4-8.1.2 Where storage on racks exists as permitted in this code, racks storing Class I or Class II liquids shall be either single-row or double-row, as described in NFPA 231C, Standard for Rack Storage of Materials.

4-8.2 Automatic Systems.

4-8.2.1 Automatic Sprinklers. Where automatic sprinklers or low expansion foam-water systems are used, except as otherwise permitted in Sections 4-2 through 4-7, the protection criteria found in Tables 4-8.1 through 4-8.6 shall be followed for the applicable liquid classifications, container types and storage configurations. Figure 4-8.2 shall be permitted to be used to specify protection criteria for liquid classes, container types, and storage configurations not covered by Tables 4-8.1 through 4-8.6. (For additional information, see Appendix D).

Table 4-8.1 Water Sprinkler Protection
Single or Double Row Rack
Container Construction - Metal
(For Non-Miscible Liquids or Miscible > 50%)

Non-Relieving Style Containers

Liquid Class	Container Size and Arrangement	Maximum Storage Height	Maximum Ceiling Height	Ceiling Sprinkler Type Orifice*	Ceiling Sprinkler Type Response**	Density gpm/ft^2	Design Area Sq Ft***	In-Rack Sprinkler Protection	Notes
IB, II, IIIA	≤ 1 gal	16'	30'	ELO	QR	0.60	2,000	One line 8' above floor.	(2),(5)
		20'	30'	LO or ELO	SR or QR	0.60	2,000	One line 6' above floor. One line 12' above floor.	(2),(5)
IB, II, IIIA	≤ 5 gal	25'	30'	STD or LO	SR or QR	0.30	3,000	Every level	(2)
IIIB	≤ 5 gal	40'	50'	STD or LO	SR or QR	0.30	2,000	One line every other level, beginning above first storage level.	(2),(6)
IB, II, IIIA	> 5 gal ≤ 60 gal	25'	30'	LO or ELO	SR	0.40	3,000	Every level	(4)
IIIB	> 5 gal ≤ 60 gal	40'	50'	STD or LO	SR	0.30	3,000	One line every other level, beginning above first storage level.	(2),(6)

Relieving Style Containers

IB, II, IIIA	≤ 5 gal	14'	18'	ELO	QR	0.65	2,000	None	(1),(3)
		25'	30'	STD or LO	SR or QR	0.30	3,000	One line every other level, beginning above first storage level.	(2),(7)
IIIB	≤ 5 gal	40'	50'	STD or LO	SR or QR	0.30	2,000	One line every other level, beginning above first storage level.	(2),(6)
IB, II, IIIA	> 5 gal ≤ 60 gal	25'	30'	LO or ELO	SR	0.60	3,000	One line every other level, beginning above first storage level.	(2)
IIIB	> 5 gal ≤ 60 gal	40'	50'	STD or LO	SR	0.30	3,000	One line every other level, beginning above first storage level.	(2),(6)
IB, IC, II, IIIA	Portable Tanks	25'	30'	LO or ELO	SR	0.60	3,000	Every level	(4)
IIIB	Portable Tanks	40'	50'	LO	SR	0.30	3,000	One line every other level, beginning above first storage level.	(4)

*Larger orifice sprinklers are preferred when installed in accordance with NFPA 13, *Installation of Sprinkler Systems.*
**SR = Standard Response, QR = Quick Response (quick-response preferred where optional).
***Ceiling Sprinklers High Temperature

NOTES:
(1) Double row racks 6 ft wide maximum.
(2) Space in-rack sprinklers on maximum 9 ft centers staggered vertically, 30 gpm per head, STD or LO, QR, with shields, 165°F, six hydraulically most remote sprinklers each level (upper 3 levels) operating. Eight sprinklers operating, if only one level.
(3) Use pendent-style ELO ceiling sprinklers.
(4) Space in-rack sprinklers on maximum 9 ft centers staggered vertically, 30 gpm per head, STD or LO, QR or SR, with shield, 165°F, six hydraulically most remote sprinklers each level (upper 3 levels) operating. Eight sprinklers operating, if only one level.
(5) Protection for uncartoned or case-cut non-solid shelf display up to 6-1/2 ft and storage above in pallets on racking, shelf material, open wire mesh or 2 in. x 6 in. wooden slats, spaced a minimum of 2 in. apart.
(6) A 0.60 density shall be used if more than one level of storage exists above the top level of in-rack sprinklers (LO or ELO* orifice for ceiling sprinklers).
(7) A 0.60 density/2,000 ft^2 shall be used if more than one level of storage exists above the top level of in-rack sprinklers (LO or ELO* orifice for ceiling sprinklers).

Table 4-8.2 Water Sprinkler Protection
Bulk or Palletized Storage
Container Construction - Metal
(For Non-Miscible Liquids or Miscible > 50%)

Non-Relieving Style Containers

Liquid Class	Container Size and Arrangement	Maximum Storage Height	Maximum Ceiling Height	Ceiling				Notes
				Sprinkler Type		Density gpm/ft^2	Design Area Sq Ft***	
				Orifice*	Response**			
IB	≤ 5 gal	4'	18'	STD or LO	SR or QR	0.21	1,500	(1),(2)
IC,	≤ 5 gal	5'	18'	STD or LO	SR or QR	0.30	3,000	
II,	≤ 5 gal	6-1/2'	30'	LO or ELO	QR	0.45	3,000	
IIIA	> 5 gal ≤ 60 gal	5' (1-high)	18'	LO or ELO	SR	0.40	3,000	
IIIB	≤ 5 gal	18'	30'	STD or LO	SR or QR	0.25	3,000	
	> 5 gal ≤ 60 gal	10' (3-high)	20'	STD or LO	SR	0.25	3,000	
		18'	30'	STD or LO	SR	0.35	3,000	

Relieving Style Containers

IB, IC	≤ 5 gal	12'	30'	ELO	QR	0.60	3,000	(3),(4)
II,	> 5 gal ≤ 60 gal	5' (1-high)	30'	LO or ELO	SR	0.40	3,000	
IIIA	> 5 gal ≤ 60 gal	6-1/2' (2-high)	30'	LO or ELO	SR	0.60	3,000	(5)
IIIB	≤ 5 gal	18'	30'	STD or LO	SR or QR	0.25	3,000	
	> 5 gal ≤ 60 gal	10' (3-high)	20'	STD or LO	SR	0.25	3,000	
		18'	30'	STD or LO	SR	0.35	3,000	
IB, IC	Portable Tanks	1-high	30'	STD or LO	SR	0.30	3,000	
II, IIIA		2-high	30'	LO or ELO	SR	0.60	5,000	
IIIB	Portable Tanks	1-high	30'	STD or LO	SR	0.25	3,000	
		2-high	30'	LO or ELO	SR	0.50	3,000	

*Larger orifice sprinklers are preferred when installed in accordance with NFPA 13, *Installation of Sprinkler Systems.*
**SR = Standard Response, QR = Quick Response (quick-response preferred where optional).
***Ceiling Sprinklers High Temperature

NOTES:
(1) Using 5 gal cylindrical metal containers with plastic spouts or solid plastic caps and 1 gal F-style (oblong) metal containers.
(2) Minimum hose stream demand 250 gpm for 2-hr.
(3) Sprinklers shall also be hydraulically calculated to provide a density of 0.80 gpm/ft^2 over 1000 ft^2.
(4) Use pendent-style ELO ceiling sprinklers.
(5) Drums placed on open slotted pallet, not nested, to allow pressure relief from drums on lower levels.

Table 4-8.3 Foam-Water Sprinkler Protection
Single or Double Row Racks
Container Construction - Metal
(For Non-Miscible Liquids or Miscible > 50%)

Non-Relieving Style Containers

Liquid Class	Container Size and Arrangement	Maximum Storage Height	Maximum Ceiling Height	Ceiling				In-Rack Sprinkler Protection	Notes
				Sprinkler Type		Density gpm/ft^2	Design Area Sq Ft***		
				Orifice*	Response **				
IB, II, IIIA	≤ 5 gal	25'	30'	STD or LO	SR or QR	0.30	2,000	Every level	(1),(2)
IB, IC, II, IIIA	> 5 gal ≤ 60 gal	25'	30'	STD or LO	SR	0.30	3,000	Every level	(1),(3)
IIIB	≤ 60 gal	40'	50'	STD or LO	SR	0.30	2,000	One line every other level, beginning above first storage level	(1)

Relieving Style Containers

IB, II, IIIA	≤ 5 gal	25'	30'	STD or LO	SR or QR	0.30	2,000	One line every other level, beginning above first storage level.	(1),(2)
IB, IC, II, IIIA	> 5 gal ≤ 60 gal and Portable Tanks	25'	30'	STD or LO	SR	0.30	3,000	One line every other level, beginning above first storage level	(1),(3)
IIIB	≤ 60 gal	40'	50'	STD or LO	SR	0.30	2,000	One line every other level, beginning above first storage level	(1)

*Larger orifice sprinklers are preferred when installed in accordance with NFPA 13, *Installation of Sprinkler Systems.*
**SR = Standard Response, QR = Quick Response (quick-response preferred where optional).
***Ceiling Sprinklers High Temperature

NOTES: (1) Space in-rack sprinklers on maximum 9 ft centers staggered vertically, 30 gpm per head, Standard (STD) or Large Orifice (LO), QR or SR, with shields, 165°F, six heads per level - 3 levels operating simultaneiously. Hydraulic design can be reduced to three heads operating per level - 3 levels operating simultaneously when using a pre-primed foam-water system installed in accordance with NFPA 16A, *Closed-Head Foam-Water Sprinkler Systems*, and maintained according to NFPA 25, *Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.*
(2) Design area can be reduced to 1,500 ft^2 when using a pre-primed foam-water system installed in accordance with NFPA 16A and maintained according to NFPA 25.
(3) Design area can be reduced to 2,000 ft^2 when using a pre-primed foam-water system installed in accordance with NFPA 16A and maintained according to NFPA 25.

Table 4-8.4 Foam-Water Sprinkler Protection
Bulk or Palletized Storage
Container Construction - Metal
(For Non-Miscible Liquids or Miscible > 50%)

Non-Relieving Style Containers

Liquid Class	Container Size and Arrangement	Maximum Storage Height	Maximum Ceiling Height	Ceiling				Notes
				Sprinkler Type		Density gpm/ft^2	Design Area Sq Ft***	
				Orifice*	Response**			
IB, IC, II, IIIA	≤ 5 gal Cartoned	11'	30'	LO or ELO	SR or QR	0.40	3,000	(2)
	≤ 5 gal Uncartoned	12'	30'	STD or LO	SR or QR	0.30	3,000	(2)
	> 5 gal ≤ 60 gal	5' (1-high)	30'	STD or LO	SR	0.30	3,000	
Relieving Style Containers								
IB, IC, II, IIIA	> 5 gal ≤ 60 gal	6-1/2' (2-high)	30'	STD or LO	SR	0.30	3,000	(1)
IB, IC, II, IIIA	Portable Tanks	2-high maximum	30'	STD or LO	SR	0.30	3,000	

*Larger orifice sprinklers are preferred when installed in accordance with NFPA 13, *Installation of Sprinkler Systems.*
**SR = Standard Response, QR = Quick Response (quick-response preferred where optional).
***Ceiling Sprinklers High Temperature

NOTES:
(1) Drums placed on open slotted pallet, not nested, to allow pressure relief from drums on lower levels.
(2) Design area can be reduced to 2,000 ft^2 wen using a pre-primed foam-water system installed in accordance with NFPA 16A, *Closed-Head Foam-Water Sprinkler Systems,* and maintained according to NFPA 25, *Inspection, Testing and Maintenance of Water-Based Fire Protection Systems.*

Table 4-8.5 Water Sprinkler Protection
Single, Double or Multi-Row Open Frame Racks
Container Construction - Plastic in Corrugated Fibreboard Boxes
(For Non-Miscible Liquids or Miscible > 50%)

Liquid Class	Container Size and Arrangement	Maximum Storage Height	Maximum Ceiling Height	Ceiling			In-Rack Sprinkler Protection	Notes
				Sprinkler Type	Density gpm/ft^2	Design Area Sq Ft		
IIIB	≤ 5 gal	Unlimited	Unlimited	STD, LO, ELO, Large Drop or ESFR	0.20	3,000	**Double Row Racks:** Three lines per level with deflectors no more than 9 in. below each barrier and no less than 6 in. above the top of the storage. One line of in-rack sprinklers shall be located in the longitudinal flue and one line shall be located at each face of the racks. **Multiple Row Racks:** Protect as described for double row racks, except that there shall be an in-rack sprinkler located at each intersection of transverse and longitudinal flue, as well as the rack faces. **Single Row Racks (up to 5 ft wide):** Protect using a barrier above the second tier of storage with a single line of in-rack sprinklers down the center of the rack. Sprinklers shall be spaced 4 to 5 ft apart, at each transverse flue. As an alternate method, for single row racks that will be loaded from one side, in - rack sprinklers can be installed beneath the barrier at each rack upright at the face of the rack on the side from which the rack is loaded. On the opposite face, in-rack sprinklers shall be installed at the transverse flue centered between the rack uprights.	(1), (2), (3), (4), (5)

NOTES:
(1) Ceiling sprinkler system design shall be based on demand of surrounding occupancy or minimum design as stated, whichever is greater. If Class IIIB liquid storage does not extend to full height of rack, protection for other commodity stored above barrier shall be in accordance with appropriate standard and based on height of storage of other commodity.
(2) Provide plywood (minimum 3/8 in.) or sheet metal (minimum 22 ga.) barriers within rack at approximately 10 ft vertical intervals (maximum 12 ft) including over top level of Class IIIB liquid storage. Barrier shall be solid and continuous except at rack uprights where a maximum 12 in. gap is allowed, assuming minimum 8 ft spacing between rack uprights. For Class IIIB liquids having a closed cup flashpoint ≥ 450°F, a horizontal barrier is not necessary (see Figure 1).
(3) Longitudinal flue sprinklers shall be located at each transverse flue between pallet loads (approximately 4 to 5 ft on centers). Face sprinklers shall be located in the transverse flue at rack uprights on maximum 10 ft centers. If rack uprights are more than 10 ft on center, locate face sprinklers centered between rack uprights and at uprights. In-rack sprinklers shall be quick-response, large orifice with shields, 165°F, 57 gpm per head, most remote six heads per level (three on two lines), if one horizontal barrier level; or most remote eight heads per level (four on two lines), if two or more horizontal barrier levels (see Figure 2).
(4) Ceiling sprinkler demand shall not be included in hydraulic calculations.
(5) If there are adjacent bays of in-rack arrays not dedicated to Class IIIB liquid storage, the barrier and in-rack sprinkler protection shall be extended at least one rack bay (approximately 8 ft) beyond the Class IIIB liquid storage. Additionally, a vertical plywood barrier or similar insulating material, shall be installed at both ends of the Class IIIB liquid storage area. The vertical barrier shall extend the full rack width and shall fit flush against any horizontal barriers. Clearance at cut-outs for both in-rack sprinkler piping and horizontal rack members shall not exceed 3 in.

Table 4-8.6 Water Sprinkler Protection
Shelf Storage
Container Construction - Metal
(For Non-Miscible Liquids or Miscible > 50%)

Liquid Class	Container Size and Arrangement	Maximum Storage Height	Maximum Ceiling Height	Ceiling				Notes
				Sprinkler Type		Density gpm/ft^2	Design Area $Sq\ Ft^{2***}$	
				Orifice*	Response**			
IB, II, III	≤ 1 gal	6'	18'	STD or LO	SR or QR	0.19	1,500	(1),(2)

*Larger orifice sprinklers are preferred when installed in accordance with NFPA 13, *Installation of Sprinkler Systems* .
**SR = Standard Response, QR = Quick Response (quick-response preferred where optional).
***Ceiling Sprinklers High Temperature

NOTES:
(1) Protection for "gondola"-type shelving 2 ft or less in depth per side.
(2) Minimum hose stream demand 250 gpm for 2-hours.

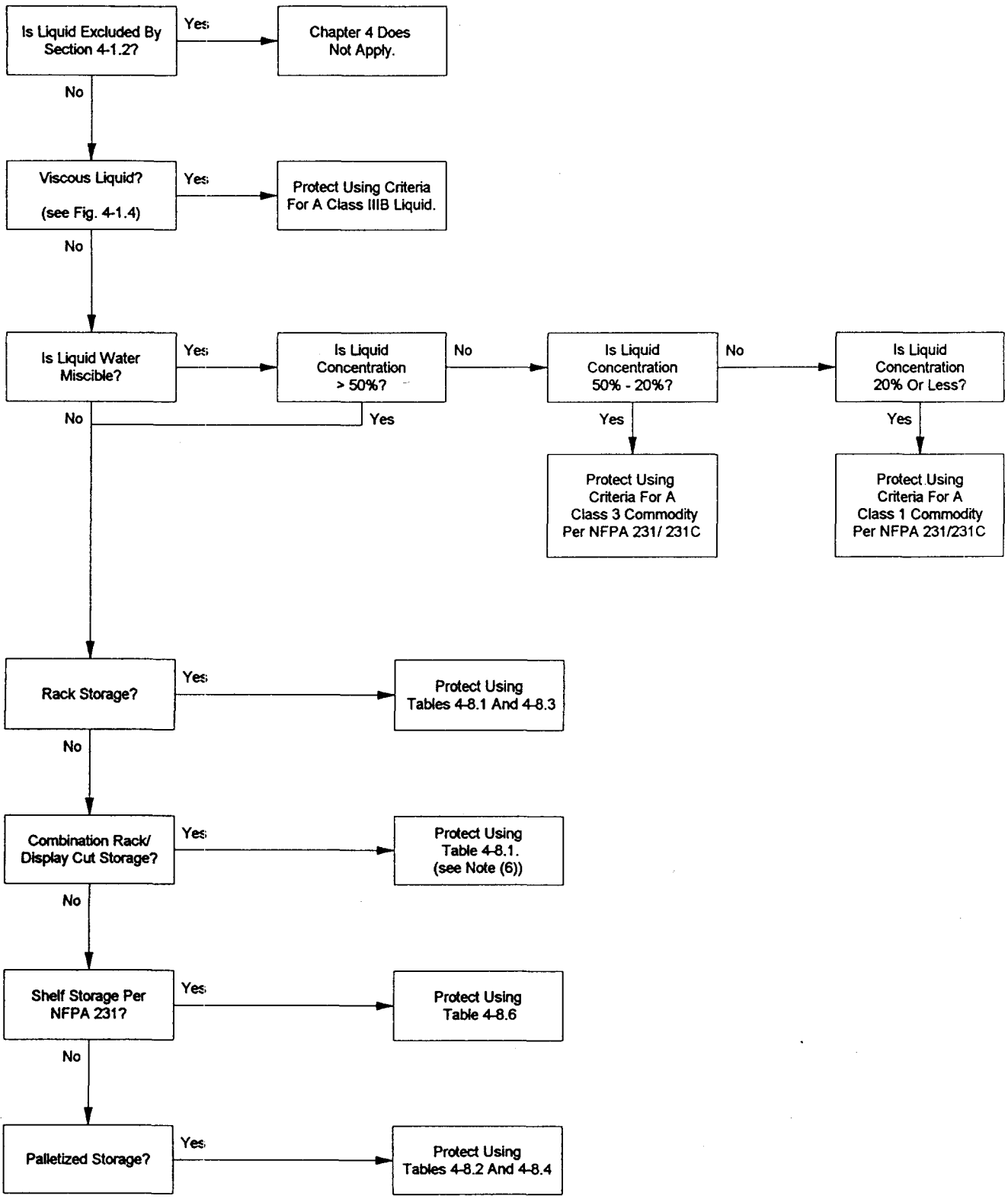

Figure 4-8.2(a) Fire protection criteria decision tree metal containers.

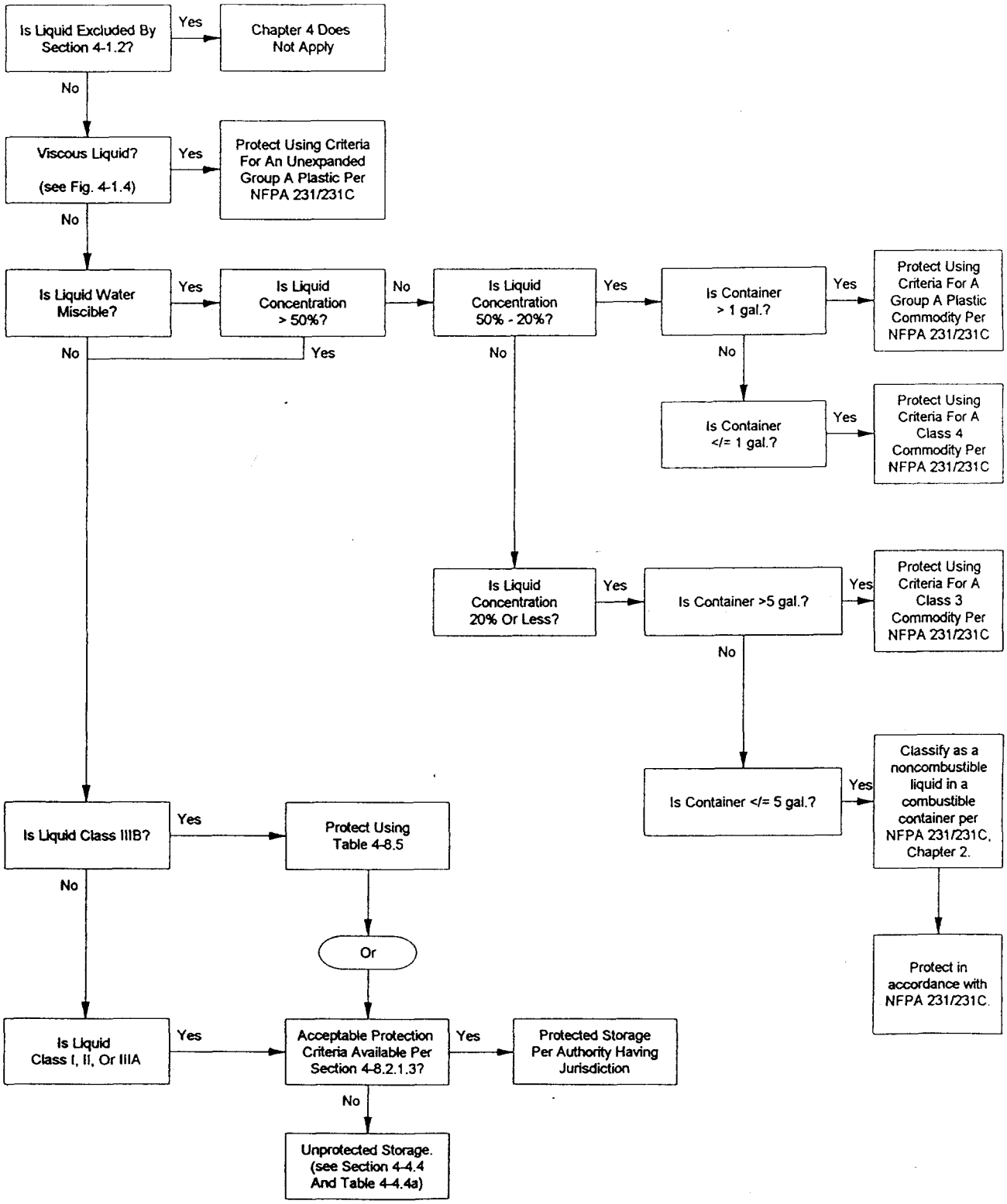

Figure 4-8.2(b) Fire protection criteria decision tree plastic/fiberboard containers.

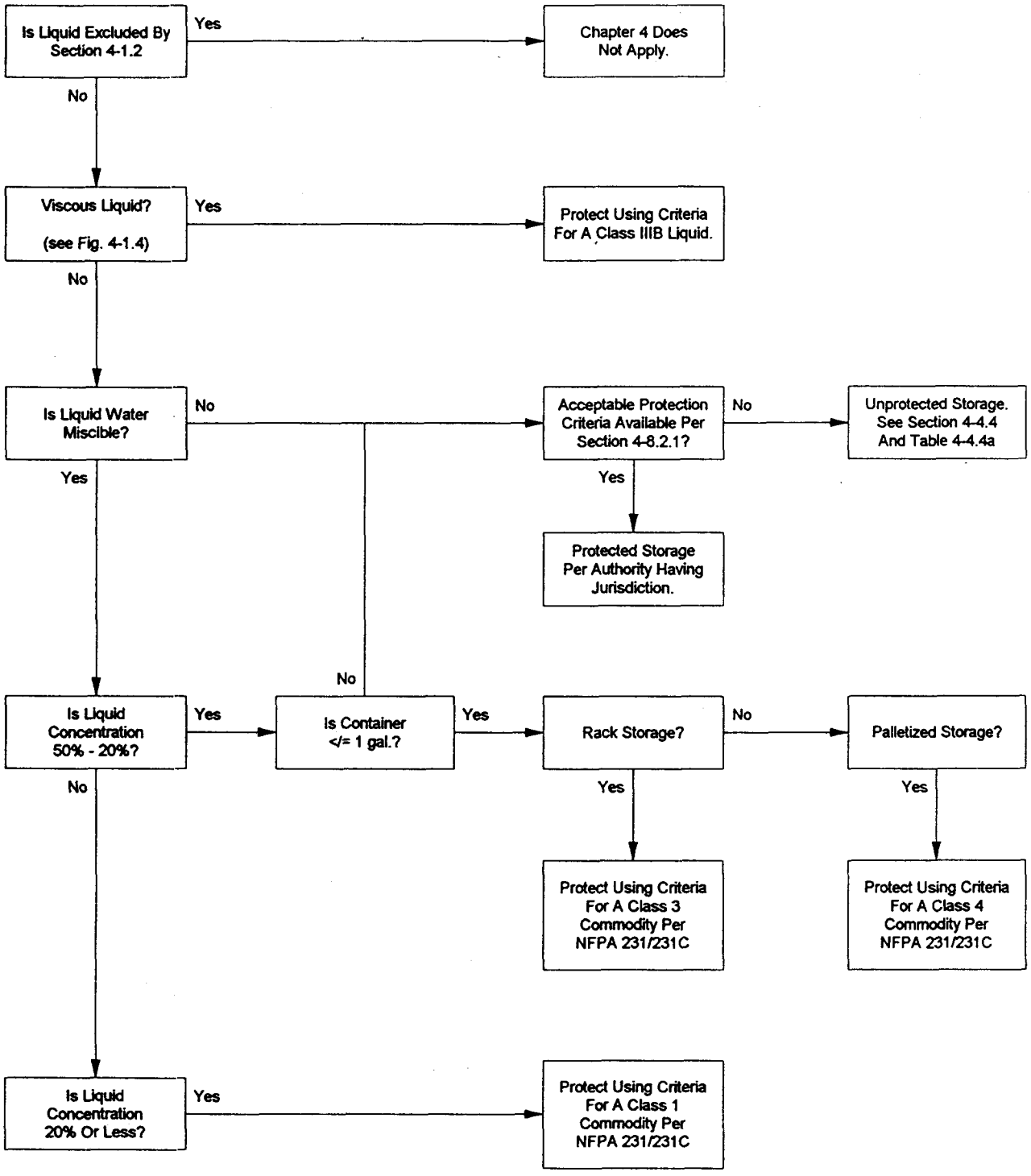

Figure 4-8.2(c) Fire protection criteria decision tree glass containers.

Note: Unstable liquids are not covered by Protection Tables 4-8.1 through 4-8.6.

4-8.2.1.1 In-rack sprinklers shall be installed in accordance with the provisions of NFPA 231C, Standard for Rack Storage of Materials, except as modified by 4-8.2. Alternate lines of in-rack sprinklers shall be staggered vertically in the longitudinal flue space. Multiple levels of in-rack sprinkler heads shall be provided with water shields unless otherwise separated by horizontal barriers or unless the sprinkler heads are listed for such installations.

4-8.2.1.2 Ceiling sprinklers shall be installed in accordance with NFPA 13, Standard for the Installation of Sprinkler Systems, and shall be permitted with the following maximum head spacings:

Class I, II, and IIIA Liquids	100 ft^2 per sprinkler
Class IIIB Liquids	120 ft^2 per sprinkler

4-8.2.1.3 Protection criteria developed from full-scale fire testing conducted at a fire testing laboratory(ies) shall be permitted in lieu of protection Tables 4-8.1 through 4-8.6, if approved by the authority having jurisdiction. (For additional information, see Appendix E.)

4-8.2.1.4 Water-based fire protection systems shall be inspected, tested, and maintained in accordance with NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.

4-8.2.1.5 Ceiling heights indicated in Tables 4-8.1 through 4-8.6 can be increased by a maximum of 10 percent if an equivalent percentage increase in ceiling sprinkler design density is provided.

4-8.2.2 Suppression Systems.

4-8.2.2.1 Suppression systems such as automatic water-spray systems, high expansion foam, dry chemical, water mist, and alternate sprinkler system configurations, or other combinations of systems shall be permitted if approved by the authority having jurisdiction. Such systems shall be designed and installed in accordance with the appropriate NFPA Standard(s) and manufacturer's recommendations for the system(s) selected.

4-8.2.2.2 Where low expansion closed-head foam-water sprinkler systems are used they shall be installed in accordance with NFPA 16A, Installation of Closed-Head Foam-Water Sprinkler Systems. At least 15 min of foam concentrate shall be provided as determined by the design flow required.

4-8.3 Hoselines and Portable Extinguishers. Suitable fire extinguishers or preconnected hose lines, either 1-1/2 in. (3.98 cm) lined or 1 in. (2.5 cm) hard rubber, shall be provided where liquids are stored. Where 1-1/2 in. (3.8 cm) fire hose is used, it shall be installed in accordance with NFPA 14, Standard for the Installation of Standpipe and Hose Systems.

4-8.3.1 Hoselines.

4-8.3.1.1 In protected general purpose warehouses and in protected liquid storage areas, hand hose lines shall be provided in sufficient number to reach all liquid storage areas.

4-8.3.1.2 The water supply shall be sufficient to meet the fixed fire protection demand, plus a total of at least 500 gal (1892 L) per min for inside and outside hose lines, except as otherwise specified in Tables 4-8.1 through 4-8.6.

4-8.3.2 Portable Extinguishers.

4-8.3.2.1 At least one portable fire extinguisher having a rating of not less than 40-B shall be located outside of, but not more than 10 ft (3 m) from, the door opening into any inside storage area.

4-8.3.2.2 At least one portable fire extinguisher having a rating of not less than 40-B shall be located not more than 30 ft (9 m), or at least one portable fire extinguisher having a rating of not less than 80-B shall be located not more than 50 ft (15 m) from any Class I or Class II liquid storage area located outside of an inside storage area or liquid warehouse.

4-8.4 Control of Ignition Sources. Precautions shall be taken to prevent the ignition of flammable vapors. Sources of ignition include but are not limited to: open flames; lightning; smoking; cutting and welding; hot surfaces; frictional heat; static, electrical, and mechanical sparks; spontaneous ignition, including heat-producing chemical reactions; and radiant heat.

4-8.4.1 Materials with a water reactivity as outlined in NFPA 704, Standard System for the Identification of the Fire Hazards of Materials, shall not be stored in the same area with other liquids.

4-8.4.2 Power-operated industrial trucks used to move containers of Class I liquids shall be selected, maintained, and operated in accordance with NFPA 505, Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Maintenance, and Operations.

SUBSTANTIATION: The NFPA 30 Task Group on Protection Criteria was formed to develop protection criteria for storage of containers of flammable and combustible liquids and to insert this protection criteria into the body of Chapter 4 of NFPA 30. These new protection criteria are based on full-scale fire testing that has been done to develop protection methods for flammable and combustible liquids. The technical justification for the criteria found in proposed new Tables 4-8.1 through 4-8.6 follows. Criteria for portable extinguishers, as shown in proposed new 4-8.3.2.1 and 4-8.3.2.2 is consistent with the new ratings used by NFPA 10, Standard for Portable Extinguishers.

The information that follow, labeled TJ-4-8.1 through TJ-4-8.6, provide the technical justification for each entry in proposed new Tables 4-8.1 through 4-8.6. The tests referred to (e.g., "Test S-22", "Test S-40") are contained in Directory of Fire Tests Involving Storage of Flammable and Combustible Liquids in Small Containers, authored by David P. Nugent and published by the Society of Fire Protection Engineers, One Liberty Square, Boston, MA 02109-4825. To assist the user, Tables X-4-8.1 through X-4-8.6 have also been added to cross reference the specific test data with the proposed new protection criteria tables. These "X" tables are duplicates of Tables 4-8.1 through 4-8.6, but with an additional column labeled "Fire Test Ref." The numbers in this column correspond with the numbered entries in the technical justification.

The portable extinguisher criteria in Sections 4-8.3.2.1 and 4-8.3.2.2 has been changed to be consistent with new ratings in NFPA 10.

In the above tables, the tables in Section 4-8 have been modified to include a "Fire Test Reference" column. The following technical justification refers to the line number in that column.

TJ-4-8.1

TABLE
LINE TECHNICAL JUSTIFICATION FOR TABLE 4-8.1

1. Based on Test S-42. Test data plus extrapolated test ceiling height of 27 ft to 30 ft.
2. Based on Test S-40. Test data plus extrapolated test ceiling height of 27 ft to 30 ft.
3. Based on Tests S-22 through S-44 with particular emphasis on Test S-40 in which no ceiling sprinklers opened. Test S-26 was used as justification for going from 1 gal to 5 gal containers.
4. Extrapolated the previous line with an increase in storage height and ceiling height and decreased protection due to the reduced hazard of Class IIIB liquids. Also recognition of previous protection guidelines which allowed storage to 40 ft.
5. Based on line 3 with an increase in ceiling density and elimination of QR sprinklers in recognition of larger spill size potential.
6. Based on Tests S-22 through S-44. Based on line 5 with an increase in storage height and ceiling height and decreased protection due to the decreased hazard of Class IIIB liquids. Increased area over line 4 due to increase in container size.
7. Based on Test S-31.
8. Based on Tests S-22 through S-44 with particular emphasis on Test S-40. Compared with line 3. Relieving style container may prevent BLEVE but contribute to rate of heat release.
9. Based on line 4 in recognition that there is little advantage of providing relieving style containers for Class IIIB liquids.
10. Based on Tests S-22 through S-46. See line 5. Increased ceiling density as a trade off to in-rack sprinklers at every level in consideration of relieving style containers.
11. Based on line 6 in recognition that there is little advantage of providing relieving style containers for Class IIIB liquids.
12. Based on protection of portable tanks now found in Appendix D considering review of rack storage tests with drums (Tests S-45 and S-467).
13. Based on existing Appendix D-criteria for portable tanks with increased density and in-rack sprinklers at every other level in consideration of protection specified for drum storage of Class IIIB liquids in line 11.

TJ-4-8.2

TABLE
LINE TECHNICAL JUSTIFICATION FOR TABLE 4-8.2

1. Based on Test S-15.
2. Based on consideration of Test S-5 and Tests S-13 through S-15 with particular emphasis on Test S-5.
3. Based on Test S-5 and Tests S-13 through S-18 and applying engineering judgment to Test S-13.
4. Based on Test S-5 and Tests S-19 through S-21. Also based on line 2 but with increased density due to larger container size.
5. Based on Test S-5 and Tests S-13 through S-18. Also based on protection now in Appendix D (Table D-2.2). QR sprinklers added due to experience in testing of containers less than 5 gal.
6. Based on Test S-5 and Tests S-13 through S-21. Also based on protection now in Appendix D (Table D-2.2).

7. Based on Test S-5 and Tests S-13 through S-21. Also based on protection now in Appendix D (Table D-2.2).
8. Based on Test S-18 and consideration of Tests S-16 and S-17.
9. Based on line 4 and increased ceiling height due to relieving style container.
10. Based on lines 4 and 9 with increase in density to allow storage 2 levels high with relieving style container.
11. Same as line 5 recognizing that relieving style container is of little advantage for Class IIIB liquids.
12. Same as line 6 recognizing that relieving style container is of little advantage for Class IIIB liquids.
13. Same as line 7 recognizing that relieving style container is of little advantage for Class IIIB liquids.
14. Based on protection criteria now found in Appendix D (Table D-2.2) considering Tests S-19 through S-21 for drums.
15. Based on protection criteria now found in Appendix D (Table D-2.2) considering Tests S-19 through S-21 for drums.
16. Based on protection criteria now found in Appendix D (Table D-2.2) considering Tests S-19 through S-21 for drums.
17. Based on protection criteria now found in Appendix D (Table D-2.2) considering Tests S-19 through S-21 for drums.

TJ-4-8.3

TABLE
LINE TECHNICAL JUSTIFICATION FOR TABLE 4-8.3

1. Based on Test S-33. Also consideration of Tests S-32 and S-34.
2. Based on Tests S-45 and S-46.
3. Based on line 2 with less in-rack sprinklers because of reduced hazard of Class IIIB liquids.
4. Based on line 1 with fewer in-rack sprinklers due to relieving style containers.
5. Based on line 2 with fewer in-rack sprinklers due to relieving style containers.
6. Based on line 3 with recognition that relieving style containers offer little advantage for Class IIIB liquids.

TJ-4-8.4

TABLE
LINE TECHNICAL JUSTIFICATION FOR TABLE 4-8.4

1. Based on Test S-12 extrapolating ceiling height from 25 ft to 30 ft.
2. Based on Test S-6 extrapolating ceiling height from 27 ft to 30 ft.
3. Based on Tests S-6 and S-19 through S-21 (ceiling height extrapolated for Test S-6).
4. Based on line 3 with increase to 2 in. high with relieving style containers.
5. Based on line 4.

TJ-4-8.5

TABLE
LINE TECHNICAL JUSTIFICATION FOR TABLE 4-8.5

1. Based on Tests P-21 through P-31.

TJ-4-8.6

TABLE
LINE TECHNICAL JUSTIFICATION FOR TABLE 4-8.6

1. Based on Test S-47.

COMMITTEE ACTION: Accept.
Incorporate the following changes:
1. In 4-8.1.1, change "occupancy" to "protection area."
2. Add a new 4-8.1.3 to read:
"For the purposes of this Section, a relieving-style container shall mean a metal container or portable tank that is equipped with at least one pressure-relieving mechanism at its top that is designed and sized to relieve the internal pressure generated due to exposure to fire so as to prevent rupture of the container or portable tank."
3. Add a new 4-8.1.4 to read: "For new fire protection systems installed after January 1, 1997, fire protection systems shall meet the requirements of this Section."
4. In Table 4-8.1, add "IC" after "IB" in each entry of the column headed "Liquid Class."
5. In Table 4-8.2, change the entry for "Class IIIA" in the column labeled "Maximum Ceiling Height" from 18 ft to 30 ft.
6. In Table 4-8.3, add "IC" to the first entry of the column labeled "Liquid Class" in both tables.
7. In Table 4-8.5, delete the parenthetical references in Notes 2 and 3 and delete the words "per level" in Note 3.
8. In Table 4-8.6, add "IC" to the first entry of the column labeled "Liquid Class."
9. Revise Figure 4-8.2(b) as shown in the new diagram.
10. In 4-8.2.1.3, change "nationally-recognized...laboratory" to "a fire test facility acceptable to the authority having jurisdiction."

Table X-4-8.1 Water Sprinkler Protection
Single or Double Row Rack
Container Construction - Metal
(For Non-Miscible Liquids or Miscible > 50%)

Non-Relieving Style Containers

Liquid Class	Container Size and Arrangement	Maximum Storage Height	Maximum Ceiling Height	Ceiling Sprinkler Type Orifice*	Ceiling Sprinkler Type Response**	Ceiling Density gpm/ft^2	Ceiling Design Area Sq Ft***	In-Rack Sprinkler Protection	Notes	Fire Test Ref.
IB, II, IIIA	≤ 1 gal	16'	30'	ELO	QR	0.60	2,000	One line 8' above floor.	(2),(5)	1
		20'	30'	LO or ELO	SR or QR	0.60	2,000	One line 6' above floor. One line 12' above floor.	(2),(5)	2
IB, II, IIIA	≤ 5 gal	25'	30'	STD or LO	SR or QR	0.30	3,000	Every level	(2)	3
IIIB	≤ 5 gal	40'	50'	STD or LO	SR or QR	0.30	2,000	One line every other level, beginning above first storage level.	(2),(6)	4
IB, II, IIIA	> 5 gal ≤ 60 gal	25'	30'	LO or ELO	SR	0.40	3,000	Every level	(4)	5
IIIB	> 5 gal ≤ 60 gal	40'	50'	STD or LO	SR	0.30	3,000	One line every other level, beginning above first storage level.	(2),(6)	6

Relieving Style Containers

IB, II, IIIA	≤ 5 gal	14'	18'	ELO	QR	0.65	2,000	None	(1),(3)	7
		25'	30'	STD or LO	SR or QR	0.30	3,000	One line every other level, beginning above first storage level.	(2),(7)	8
IIIB	≤ 5 gal	40'	50'	STD or LO	SR or QR	0.30	2,000	One line every other level, beginning above first storage level.	(2),(6)	9
IB, II, IIIA	> 5 gal ≤ 60 gal	25'	30'	LO or ELO	SR	0.60	3,000	One line every other level, beginning above first storage level.	(2)	10
IIIB	> 5 gal ≤ 60 gal	40'	50'	STD or LO	SR	0.30	3,000	One line every other level, beginning above first storage level.	(2),(6)	11
IB, IC, II, IIIA	Portable Tanks	25'	30'	LO or ELO	SR	0.60	3,000	Every level	(4)	12
IIIB	Portable Tanks	40'	50'	LO	SR	0.30	3,000	One line every other level, beginning above first storage level.	(4)	13

*Larger orifice sprinklers are preferred when installed in accordance with NFPA 13, *Installation of Sprinkler Systems.*
**SR = Standard Response, QR = Quick Response (quick-response preferred where optional).
***Ceiling Sprinklers High Temperature

NOTES:
(1) Double row racks 6 ft wide maximum.
(2) Space in-rack sprinklers on maximum 9 ft centers staggered vertically, 30 gpm per head, STD or LO, QR, with shields, 165°F, six hydraulically most remote sprinklers each level (upper 3 levels) operating. Eight sprinklers operating, if only one level.
(3) Use pendent-style ELO ceiling sprinklers.
(4) Space in-rack sprinklers on maximum 9 ft centers staggered vertically, 30 gpm per head, STD or LO, QR or SR, with shield, 165°F, six hydraulically most remote sprinklers each level (upper 3 levels) operating. Eight sprinklers operating, if only one level.
(5) Protection for uncartoned or case-cut non-solid shelf display up to 6-1/2 ft and storage above in pallets on racking, shelf material, open wire mesh or 2 in. x 6 in. wooden slats, spaced a minimum of 2 in. apart.
(6) A 0.60 density shall be used if more than one level of storage exists above the top level of in-rack sprinklers (LO or ELO* orifice for ceiling sprinklers).
(7) A 0.60 density/2,000 ft^2 shall be used if more than one level of storage exists above the top level of in-rack sprinklers (LO or ELO* orifice for ceiling sprinklers).

Table X-4-8.2 Water Sprinkler Protection
Bulk or Palletized Storage
Container Construction - Metal
(For Non-Miscible Liquids or Miscible > 50%)

Non-Relieving Style Containers

Liquid Class	Container Size and Arrangement	Maximum Storage Height	Maximum Ceiling Height	Ceiling				Notes	Fire Test Ref.
				Sprinkler Type		Density gpm/ft^2	Design Area Sq Ft***		
				Orifice*	Response**				
IB	≤ 5 gal	4'	18'	STD or LO	SR or QR	0.21	1,500	(1),(2)	1
IC,	≤ 5 gal	5'	18'	STD or LO	SR or QR	0.30	3,000		2
II,	≤ 5 gal	6-1/2'	30'	LO or ELO	QR	0.45	3,000		3
IIIA	> 5 gal ≤ 60 gal	5' (1-high)	18'	LO or ELO	SR	0.40	3,000		4
	≤ 5 gal	18'	30'	STD or LO	SR or QR	0.25	3,000		5
IIIB	> 5 gal ≤ 60 gal	10' (3-high)	20'	STD or LO	SR	0.25	3,000		6
		18'	30'	STD or LO	SR	0.35	3,000		7

Relieving Style Containers

IB, IC	≤ 5 gal	12'	30'	ELO	QR	0.60	3,000	(3),(4)	8
II,	> 5 gal ≤ 60 gal	5' (1-high)	30'	LO or ELO	SR	0.40	3,000		9
IIIA	> 5 gal ≤ 60 gal	6-1/2' (2-high)	30'	LO or ELO	SR	0.60	3,000	(5)	10
	≤ 5 gal	18'	30'	STD or LO	SR or QR	0.25	3,000		11
IIIB	> 5 gal ≤ 60 gal	10' (3-high)	20'	STD or LO	SR	0.25	3,000		12
		18'	30'	STD or LO	SR	0.35	3,000		13
IB, IC	Portable Tanks	1-high	30'	STD or LO	SR	0.30	3,000		14
II, IIIA		2-high	30'	LO or ELO	SR	0.60	5,000		15
IIIB	Portable Tanks	1-high	30'	STD or LO	SR	0.25	3,000		16
		2-high	30'	LO or ELO	SR	0.50	3,000		17

*Larger orifice sprinklers are preferred when installed in accordance with NFPA 13, *Installation of Sprinkler Systems.*
**SR = Standard Response, QR = Quick Response (quick-response preferred where optional).
***Ceiling Sprinklers High Temperature

NOTES:
(1) Using 5 gal cylindrical metal containers with plastic spouts or solid plastic caps and 1 gal Fstyle (oblong) metal containers.
(2) Minimum hose stream demand 250 gpm for 2-hr.
(3) Sprinklers shall also be hydraulically calculated to provide a density of 0.80 gpm/ft^2 over 1000 ft^2.
(4) Use pendent-style ELO ceiling sprinklers.
(5) Drums placed on open slotted pallet, not nested, to allow pressure relief from drums on lower levels.

Table X-4-8.3 Foam-Water Sprinkler Protection
Single or Double Row Racks
Container Construction - Metal
(For Non-Miscible Liquids or Miscible > 50%)

Non-Relieving Style Containers

Liquid Class	Container Size and Arrangement	Maximum Storage Height	Maximum Ceiling Height	Ceiling				In-Rack Sprinkler Protection	Notes	Fire Test Ref.
				Sprinkler Type		Density gpm/ft^2	Design Area Sq Ft***			
				Orifice*	Response**					
IB, II, IIIA	≤ 5 gal	25'	30'	STD or LO	SR or QR	0.30	2,000	Every level	(1),(2)	1
IB, IC, II, IIIA	> 5 gal ≤ 60 gal	25'	30'	STD or LO	SR	0.30	3,000	Every level	(1),(3)	2
IIIB	≤ 60 gal	40'	50'	STD or LO	SR	0.30	2,000	One line every other level, beginning above first storage level	(1)	3

Relieving Style Containers

IB, II, IIIA	≤ 5 gal	25'	30'	STD or LO	SR or QR	0.30	2,000	One line every other level, beginning above first storage level.	(1),(2)	4
IB, IC, II, IIIA	> 5 gal ≤ 60 gal and Portable Tanks	25'	30'	STD or LO	SR	0.30	3,000	One line every other level, beginning above first storage level	(1),(3)	5
IIIB	≤ 60 gal	40'	50'	STD or LO	SR	0.30	2,000	One line every other level, beginning above first storage level	(1)	6

*Larger orifice sprinklers are preferred when installed in accordance with NFPA 13, *Installation of Sprinkler Systems.*
**SR = Standard Response, QR = Quick Response (quick-response preferred where optional).
***Ceiling Sprinklers High Temperature

NOTES:
(1) Space in-rack sprinklers on maximum 9 ft centers staggered vertically, 30 gpm per head, Standard (STD) or Large Orifice (LO), QR or SR, with shields, 165°F, six heads per level - 3 levels operating simultaneiously. Hydraulic design can be reduced to three heads operating per level - 3 levels operating simultaneously when using a pre-primed foam-water system installed in accordance with NFPA 16A, *Closed-Head Foam-Water Sprinkler Systems*, and maintained according to NFPA 25, *Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.*
(2) Design area can be reduced to 1,500 ft^2 when using a pre-primed foam-water system installed in accordance with NFPA 16A and maintained according to NFPA 25.
(3) Design area can be reduced to 2,000 ft^2 when using a pre-primed foam-water system installed in accordance with NFPA 16A and maintained according to NFPA 25.

Table X-4-8.4 Foam-Water Sprinkler Protection
Bulk or Palletized Storage
Container Construction - Metal
(For Non-Miscible Liquids > 50%)

Non-Relieving Style Containers

Liquid Class	Container Size and Arrangement	Maximum Storage Height	Maximum Ceiling Height	Ceiling				Notes	Fire Test Ref.
				Sprinkler Type		Density gpm/ft^2	Design Area Sq Ft***		
				Orifice*	Response**				
IB, IC, II, IIIA	≤ 5 gal Cartoned	11'	30'	LO or ELO	SR or QR	0.40	3,000	(2)	1
	≤ 5 gal Uncartoned	12'	30'	STD or LO	SR or QR	0.30	3,000	(2)	2
	> 5 gal ≤ 60 gal	5' (1-high)	30'	STD or LO	SR	0.30	3,000		3

Relieving Style Containers

IB, IC, II, IIIA	> 5 gal ≤ 60 gal	6-1/2' (2-high)	30'	STD or LO	SR	0.30	3,000	(1)	4
IB, IC, II, IIIA	Portable Tanks	2-high maximum	30'	STD or LO	SR	0.30	3,000		5

*Larger orifice sprinklers are preferred when installed in accordance with NFPA 13, *Installation of Sprinkler Systems.*
**SR = Standard Response, QR = Quick Response (quick-response preferred where optional).
***Ceiling Sprinklers High Temperature

NOTES:
(1) Drums placed on open slotted pallet, not nested, to allow pressure relief from drums on lower levels.
(2) Design area can be reduced to 2,000 ft^2 wen using a pre-primed foam-water system installed in accordance with NFPA 16A, *Closed-Head Foam-Water Sprinkler Systems,* and maintained according to NFPA 25, *Inspection, Testing and Maintenance of Water-Based Fire Protection Systems.*

Table X-4-8.5 Water Sprinkler Protection
Single, Double or Multi-Row Open Frame Racks
Container Construction - Plastic in Corrugated Fibreboard Boxes
(For Non-Miscible Liquids or Miscible > 50%)

Liquid Class	Container Size and Arrangement	Maximum Storage Height	Maximum Ceiling Height	Ceiling			In-Rack Sprinkler Protection	Notes	Fire Test Ref.
				Sprinkler Type	Density gpm/ft^2	Design Area Sq Ft			
IIIB	≤ 5 gal	Unlimited	Unlimited	STD, LO, ELO, Large Drop or ESFR	0.20	3,000	**Double Row Racks:** Three lines per level with deflectors no more than 9 in. below each barrier and no less than 6 in. above the top of the storage. One line of in-rack sprinklers shall be located in the longitudinal flue and one line shall be located at each face of the racks. **Multiple Row Racks:** Protect as described for double row racks, except that there shall be an in-rack sprinkler located at each intersection of transverse and longitudinal flue, as well as the rack faces. **Single Row Racks (up to 5 ft wide):** Protect using a barrier above the second tier of storage with a single line of in-rack sprinklers down the center of the rack. Sprinklers shall be spaced 4 to 5 ft apart, at each transverse flue. As an alternate method, for single row racks that will be loaded from one side, in-rack sprinklers can be installed beneath the barrier at each rack upright at the face of the rack on the side from which the rack is loaded. On the opposite face, in-rack sprinklers shall be installed at the transverse flue centered between the rack uprights.	(1), (2), (3), (4), (5)	1

NOTES:
(1) Ceiling sprinkler system design shall be based on demand of surrounding occupancy or minimum design as stated, whichever is greater. If Class IIIB liquid storage does not extend to full height of rack, protection for other commodity stored above barrier shall be in accordance with appropriate standard and based on height of storage of other commodity.
(2) Provide plywood (minimum 3/8 in.) or sheet metal (minimum 22 ga.) barriers within rack at approximately 10 ft vertical intervals (maximum 12 ft) including over top level of Class IIIB liquid storage. Barrier shall be solid and continuous except at rack uprights where a maximum 12 in. gap is allowed, assuming minimum 8 ft spacing between rack uprights. For Class IIIB liquids having a closed cup flashpoint ≥ 450°F, a horizontal barrier is not necessary (see Figure 1).
(3) Longitudinal flue sprinklers shall be located at each transverse flue between pallet loads (approximately 4 to 5 ft on centers). Face sprinklers shall be located in the transverse flue at rack uprights on maximum 10 ft centers. If rack uprights are more than 10 ft on center, locate face sprinklers centered between rack uprights and at uprights. In-rack sprinklers shall be quick-response, large orifice with shields, 165°F, 57 gpm per head, most remote six heads per level (three on two lines), if one horizontal barrier level; or most remote eight heads per level (four on two lines), if two or more horizontal barrier levels (see Figure 2).
(4) Ceiling sprinkler demand shall not be included in hydraulic calculations.
(5) If there are adjacent bays of in-rack arrays not dedicated to Class IIIB liquid storage, the barrier and in-rack sprinkler protection shall be extended at least one rack bay (approximately 8 ft) beyond the Class IIIB liquid storage. Additionally, a vertical plywood barrier or similar insulating material, shall be installed at both ends of the Class IIIB liquid storage area. The vertical barrier shall extend the full rack width and shall fit flush against any horizontal barriers. Clearance at cut-outs for both in-rack sprinkler piping and horizontal rack members shall not exceed 3 in.

Table X-4-8.6 Water Sprinkler Protection
Shelf Storage
Container Construction - Metal
(For Non-Miscible Liquids or Miscible > 50%)

Liquid Class	Container Size and Arrangement	Maximum Storage Height	Maximum Ceiling Height	Ceiling				Notes	Fire Test Ref.
				Sprinkler Type		Density gpm/ft^2	Design Area Sq Ft^2***		
				Orifice*	Response**				
IB, II, III	≤ 1 gal	6'	18'	STD or LO	SR or QR	0.19	1,500	(1), (2)	1

*Larger orifice sprinklers are preferred when installed in accordance with NFPA 13, *Installation of Sprinkler Systems*
**SR = Standard Response, QR = Quick Response (quick-response preferred where optional).
***Ceiling Sprinklers High Temperature

NOTES:
(1) Protection for "gondola"-type shelving 2 ft or less in depth per side.
(2) Minimum hose stream demand 250 gpm for 2-hours.

(Log #6)
Committee: FLC-SWC

30- 124 - (4-10 (New)): Accept in Principle
SUBMITTER: Dennis Kirson, US Dept of Energy
RECOMMENDATION: Add new text as follows:
4-10 Hazardous Materials Storage Located Outside Under a Canopy. Canopies provided for weather protection of outside storage of hazardous waste confine the heat from a fire, resulting in increased temperature and rate of fire spread within the storage area. They may also shield the fire from the effective use of hose streams directed by fire fighting forces.
Regarding environmental concerns, the most effective way to limit the amount of hazardous waste released into the environment as a result of fire is to extinguish the fire as promptly as possible, before the number of heat-ruptured hazardous waste containers escalates. This, of course, requires sprinkler protection. Over 90 percent of all fires in fully sprinkler protected facilities are controlled by four or less sprinklers. A typical sprinkler nominally flows 25 gpm. By contrast, a single 2 1/2 in. fire hose nominally flows 250 gpm, and rarely is only one hose used. Thus, sprinkler protection results in less runoff spreading escaping hazardous wastes to the surrounding environment than the absence of sprinkler protection, whereupon fire hose streams would be required.
4-10.1 Canopies provided for the protection of outside storage of hazardous waste should be subject to the approval of the authority having jurisdiction. The canopies should be arranged to provide at least the minimum separation distance between individual canopies, distance from canopy to property line that is or can be built upon, and distance from canopy to nearest side of public ways or to important buildings on the same property, as given in Table B-3.3.1 and explanatory notes 1, 2, and 3 as applicable.

Table 4-10.1 Canopy Protection

Area Beneath Canopy (sq ft)	Distance between Individual Canopies (ft)	Distance from Canopy to Property Line that Is or Can Be Built Upon (1) (ft)	Distance from Canopy to Nearest Side of Public Ways or to Important Buildings on Same Property (1)(2) (ft)
≤100	5	10	5
>100≤500	5	20	10
>500≤1500 (3)	5	30	20

NOTES:
(1) Distances apply to properties that have protection for exposures, as defined. If there are exposures and such protection for exposures does not exist, the distances should be doubled.
(2) When the exposed building has an exterior wall, facing the canopy, that has a fire resistance rating of at least 2 hr and has no openings to above grade areas within 10 ft horizontally and no openings to below grade areas within 50 ft horizontally of the canopy, the distances can be reduced to half of those shown in the table, except they should never be less than 5 ft.
(3) When a single canopy has a gross floor area greater than 1500 sq ft or when multiple canopies exceed the area limit of 1500 sq ft, the authority having jurisdiction should be consulted for approval of distances.

4-10.1.1 Once the canopy site is approved, it should not be changed without the approval of the authority having jurisdiction.
4-10.1.2 When more than one canopy is located on a designated site, a separation distance should be provided between individual canopies in accordance with Table B-3.3.1.
4-10.1.3 Canopies located with less separation distance from canopy to property line that is or can be built upon, or less separation distance from canopy to nearest side of public ways or to important buildings on the same property, as given in Table 11-3.3.1 and explanatory notes 1, 2, and 3 as applicable, should be sprinkler protected.
SUBSTANTIATION: NFPA 30, Chapter 4 covers open outdoor storage (4-8) and storage lockers (4-9), but does not address outdoor storage beneath open canopies. This proposal addresses that oversight.
COMMITTEE ACTION: Accept in Principle.
Add a new Subsection 4-7.5 to read:
"Outdoor container storage that has a canopy or roof that does not limit the dissipation of heat or dispersion of flammable vapors and does not restrict fire fighting access and control shall be treated as an outside storage in accordance with Section 4-7 and shall not be considered an inside storage area subject to the requirements of Section 4-4."
COMMITTEE STATEMENT: The language proposed by the Technical on Storage and Warehousing of Containers and Portable Tanks meets the intent of the submitter in an easier-to-understand fashion.

(Log #CP8)
Committee: FLC-SWC

30- 125 - (A-4-8.9 (New)): Accept
SUBMITTER: Technical Committee on Storage and Warehousing of Containers and Portable Tanks,
RECOMMENDATION: Add an Appendix item to 4-8.9 to read:
"Subsection 1-5.3.2 of NFPA 505, Fire Safety Standard for Powered Industrial Trucks, Including Type Designations, Areas of Use, Maintenance, and Operation, states "In location used for the storage of liquids in sealed containers or liquefied or compressed flammable gases in containers, approved power-operated industrial trucks designated as Types DS, ES, GS, LPS, or GS-LPS may be used if permitted for such locations by the authority having jurisdiction. Compared to the above Types, industrial trucks that are designated DY or EE have significantly less potential for igniting flammable vapors (such as might result from a spill of Class I liquid) and should be used in inside liquid storage areas where conditions warrant."
SUBSTANTIATION: This provides useful guidance on the types of lift trucks that can be used in storage areas.
COMMITTEE ACTION: Accept.

(Log #115)
Committee: FLC-SWC

30- 126 - (Appendix D): Accept
SUBMITTER: John Davenport, Industrial Risk Insurers
RECOMMENDATION: Delete existing Appendix D and replace it with the following:
Appendix D Development of Protection Criteria shown in Section 4-8 and Suggested Fire Protection for Some Containers of Flammable and Combustible Liquids not covered in Section 4-8.
This Appendix is not part of the requirements of this NFPA document but is included for informational purposes only.
The development of suppression-oriented protection criteria for liquids in containers relies almost exclusively on the evaluation of large-scale fire test data. Characterization of fire development, fire spread to adjacent containers/materials, suppression system activation, and suppression system effectiveness based on first principles is not well established. Reliance on actual test data for all situations and scenarios is not, however, practical from a cost standpoint. Development of NFPA 30 protection criteria, therefore, relies on data from representative test scenarios. Alternative materials and scenarios are then evaluated in terms of the specific test data, historical test data, and engineering experience with the hazards. Pending the complete development of engineering tools to evaluate hazards, this approach represents the best method to meet the NFPA policy that codes and standards be scientifically based.
In developing the protection criteria found in Section 4-8, the Task Group evaluated numerous tests which have been summarized in Directory of Fire Involving Storage of Flammable and Combustible Liquids in Small Containers by David P. Nugent, Schirmer Engineering Corporation. This summary of 85 full scale tests is available from Society of Fire Protection Engineers, One Liberty Square, Boston, MA 02109-4825.
There are a number of commodities for which there was no or insufficient test data to develop definitive protection tables. One example is Class IA liquids. Tables D-1 through D-3 contain the protection that was contained in Appendix D of NFPA 30-1993 for Class IA liquids. (See Tables D-1 through D-3 on the following page.)
SUBSTANTIATION: A discussion of the methodology used to develop the protection criteria in Section 4-8 is discussed in this appendix. This discussion is valuable in understanding the protection tables. Protection criteria for most container storage configurations are proposed to be covered in Section 4-8. Where the Task Group was unable to develop protection criteria, such as for Class IA liquids, protection criteria based on the tables in NFPA 30-1993 are proposed to be placed in this appendix.
COMMITTEE ACTION: Accept.

Table D-1 Foam-Water Sprinkler Protection
Single or Double Row Racks
Container Construction - Metal
(For Non-Miscible Liquids or Miscible > 50%)

Liquid Class	Container Size and Arrangement	Storage Height	Ceiling Height	Ceiling				In-Rack Sprinkler Protection	Notes
				Sprinkler Type		Density	Design Area***		
				Orifice*	Response**				
IA	> 5 gal ≤ 60 gal	25'	30'	STD or LO	SR	0.30	1500	Every level	(1)

*ELO sprinklers are preferred when installed according to the requirements of NFPA 13, *Installation of Sprinkler Systems* (minimum 10 psi end head pressure).
**SR = Standard Response, LO = Large Orifice
***Ceiling Sprinklers High Temperature

NOTES: (1) Space in-rack sprinklers on maximum 9 ft centers staggered vertically, 30 gpm per head, Standard (STD) or Large Orifice (LO), QR or SR, with shields, 165°F, six heads per level - 3 levels operating simultaneously. Hydraulic design can be reduced to three heads operating per level - 3 levels operating simultaneously when using a pre-primed foam-water system installed in accordance with NFPA 16A, *Closed-Head Foam-Water Sprinkler Systems* , and maintained according to NFPA 25, *Inspection, Testing and Maintenance of Water Based Fire Protection Systems*

Table D-2 Water Sprinkler Protection
Single or Double Row Racks
Container Construction - Metal
(For Non-Miscible Liquids or Miscible > 50%)

Liquid Class	Container Size and Arrangement	Storage Height	Ceiling Height	Ceiling				In-Rack Sprinkler Protection	Notes
				Sprinkler Type		Density	Design Area***		
				Orifice*	Response**				
IA	≤ 5 gal	25'	30'	LO or ELO	SR	0.40	3,000	Every level	(1)
	> 5 gal ≤ 60 gal	25'	30'	LO or ELO	SR	0.60	3,000	Every level	(1)

*ELO sprinklers are preferred when installed according to the requirements of NFPA 13, *Installation of Sprinkler Systems* (minimum 10 psi end head pressure).
**SR = Standard Response
***Ceiling Sprinklers High Temperature

NOTES: (1) Space in-rack sprinklers on maximum 9 ft centers staggered vertically, 30 gpm per head, Standard (STD) or Large Orifice (LO), QR, with shields, 165°F, six hydraulically most remote sprinklers each level (upper 3 levels) operating. Eight sprinklers operating, if only 1 level.

Table D-3 Water Sprinkler Protection
Bulk or Palletized Storage
Container Construction - Metal
(For Non-Miscible Liquids or Miscible > 50%)

Liquid Class	Container Size and Arrangement	Storage Height	Ceiling Height	Ceiling				Notes
				Sprinkler Type		Density	Design Area***	
				Orifice*	Response**			
IA	≤ 5 gal	5'	N/A	STD or LO	SR	0.30	3,000	(1)
	> 5 gal ≤ 60 gal	5' (1-high)	N/A	LO or ELO	SR	0.60	5,000	(1)

*ELO sprinklers are preferred when installed according to the requirements of NFPA 13, *Installation of Sprinkler Systems* (minimum 10 psi end head pressure).
**SR = Standard Response
***Ceiling Sprinklers High Temperature

NOTES: (1) Minimum hose stream demand 750 gpm for 2-hr.

(Log #116)
Committee: FLC-SWC

30-127 - (Appendix E): Accept

SUBMITTER: John Davenport, Industrial Risk Insurers

RECOMMENDATION: Delete existing Appendix E and replace it with the following:

"Appendix E Suggested Fire Protection for Containers of Flammable and Combustible Liquids"

With the introduction and widespread use of larger containers, such as Intermediate Bulk Container (IBCs), and the introduction of alternative container materials, there is a need to evaluate these materials from a fire performance standpoint. There is a need to provide manufacturers, warehouses, and enforcement officials with guidance on developing and evaluating protection criteria where data are not currently available. The following example test protocol is intended to outline guidance for conducting representative fire tests to establish protection criteria for liquids in containers. Specifically, this outline is developed for liquids in large containers, e.g., greater than 18.9 L (5 gal). While there is a substantial amount of data for smaller containers, there is a lack of data for large containers. (See References and Bibliography). Most of these data are for 208 L (55 gal) drums.

Example Fire Test Protocol for Evaluating Liquids in Large Containers.

Important variables in evaluating hazards for liquids in small containers have been identified [Reference 1]. These include liquid properties, container design and size, packaging material, ignition scenario, storage arrangement, and sprinkler system design parameters.

Of particular importance for large containers is control of pressure in the container to prevent a BLEVE and the prevention of a large discharge of liquid. While these are a problem with smaller containers, the hazard to personnel and facilities increases dramatically for larger containers. A fundamental measure of performance is the limitation of pressure buildup in the container and maintenance of container integrity to prevent a large spill. Prevention of a BLEVE must be tempered by the discharge of liquid and associated heat release through pressure relieving mechanisms. The pressure relieving mechanisms may be a designed-in feature or may be inherent in the container material. Container integrity, along with pile or rack stability, is important to prevent a large discharge of liquid. Suppression systems may not be adequate to control a large release of liquid. Engineering tools are available to evaluate specific consequences of uncontrolled pool fires on facility integrity [Reference 2].

The following example test protocol is provided to aid in the development of protection criteria similar to that developed in Tables 4-8.1 through 4-8.4 for steel drums. The intent is to provide guidance for the acceptance of alternative materials/designs under the "protected" classification of stored liquids. The primary basis of this outline is previous testing of drum storage [e.g., Reference 3].

1. *Storage Configuration.*

(a) Facility. If containers are to be protected indoors, tests should be conducted in an enclosed facility with minimal impact from the outside environment. In particular, the building height should be representative for the proposed indoor storage height. Building height affects response time of the suppression system, penetration of suppression agent through the fire plume, and response of building structural elements to the threat.

(b) Storage Array. A representative array should be selected, e.g., solid pile storage or rack storage. Arrays should consider the width of aisles to adjacent stored materials and whether these materials have higher or lower ignition and fire growth characteristics.

(c) Container. The container storing the liquid should be representative of a production-type unit, unless the evaluation is a scoping series to determine container effects. Potential venting capabilities of a container should be identified, i.e., the thermally "weak link" of the constructed assembly. If the container will have an outer wrapping, packaging or pallet, this should be considered in the overall "container" system.

(d) Liquid in Container. The most hazardous liquid to be stored should be evaluated. The hazard of a liquid should be assessed based on its volatility (vapor pressure), heat of combustion, specific gravity, miscibility (water solubility), ignition temperature, flash point, fire point, boiling point, and vapor density. The NFPA 30 rating system, based on flash point, vapor pressure, and boiling point, can be used as a guide to assess the hazard. The other properties should be considered as they may affect both the hazard and the suppression system effectiveness.

Class IA liquids should be considered independently from other liquids because of their inherent hazards. Protection criteria can be developed for different classes of liquids, for example motor oils which have different protection criteria than Class IB liquids. For a maximum reasonable hazard, n-heptane has been used for general evaluation for liquids up to and including Class IB. When tests are performed on large containers, water may be substituted in place of the actual flammable liquid to improve the overall safe conduct of the test. It is important to include liquid in the container. Internal pressure should be recorded. The liquid also serves as a heat sink for the container. Structural failure of the container can occur where there is no liquid interfacing with the container [Reference 3]. The container ullage (vapor space) should be representative of actual conditions.

2. Protection System.

(a) The protection system proposed for adoption should be represented in the actual test, e.g., deluge sprinkler system, wet or dry pipe closed head system, foam system, or gaseous agent system. Where system actuation is dependent on auxiliary equipment (e.g., detectors), these devices should be included in the test with representative spacing and response characteristics.

(b) For sprinkler suppression systems, representative application rates and sprinkler spacing which would be proposed for adoption should be used.

(c) For tests involving closed head sprinklers, appropriate sprinkler orifice sizes (standard, large orifice, extra large orifice), temperature rating, and response time index (RTI) should be identified and utilized.

(d) For deluge and gaseous agent system tests, appropriate detection equipment proposed for protection should be used in testing.

(e) For foam system tests, prepriming or the actual foam discharge time from sprinklers should be addressed. The foam concentrate should be listed or approved for the specific hazard.

3. Fire Scenario.

(a) The fire scenario is crucial in determining the hazard of the stored product. It is recognized that an installed suppression system may not be able to protect against an absolute worst case scenario, e.g., the total release of multiple storage containers. For large containers, the rapid release of contents may pose a significant challenge to an installed suppression system. This is particularly true if it is a highly volatile liquid, e.g., Class I liquid. The philosophy for determining protection effectiveness is predicated on a reasonable anticipated threat. Even with an installed suppression system, there is some risk of a significant loss. Part of this risk is associated with suppression system reliability, which should be addressed in the actual design/specification of protection systems.

(b) A representative scenario for large containers was developed during drum storage tests [Reference 3]. The scenario was a liquid gravity leak of 7.6 Lpm (2.0 gpm) to 56.7 Lpm (15 gpm) from a hole at or near the bottom of a container. This leak can be simulated by flow from a pipe. If containers are stacked or placed more than one high, then the simulated container leak should be placed high in the total array. The leak should be allowed to flow prior to ignition, simulating fuel spread after the mishap and a delay in ignition. In the Reference 3 tests, 38 L (10 gal) of liquid was allowed to spill before ignition. Reference 4 provides additional details on the effects of spill rate and initial spill size for tests involving an AFFF suppression system.

An alternative worst-case scenario may be the total release of liquid from a large container, with ignition delayed until the contents are totally discharged. Ignition of this large pool fire may severely challenge an installed suppression system.

(c) If the scenario involves a flowing fuel fire, the recommended length of the test should be equal to the total time of the flow from one container. Alternately, the evaluation can be terminated shortly after total extinguishment. Time should be allowed to determine any post-extinguishment pressure buildup in containers or subsequent container failure due to inadequate cooling. For water and foam systems, fire control will likely be the measure of performance instead of extinguishment since it is unlikely that the three-dimensional running fuel fire will be extinguished with these agents. If a larger spill rate is used, a reduced test time equal to the time to discharge the contents of one container may be appropriate. The length of a pool fire test would be based on the success or failure of the suppression system to control/extinguish the fire.

4. Measures of Performance.

(a) Criteria for acceptable performance should include (but not be limited to) the following:

1. Prevent pressure buildup in containers or actual BLEVEs;
2. Prevention of substantial loss of liquid from a container;
3. Limit the number of sprinklers operating;
4. Prevent ignition of adjacent target arrays or failure to control a fire in an adjacent target array;
5. Limit temperature of structural or rack steel;
6. Control sustained ceiling gas temperatures; and
7. Prevent collapse of the stored containers or arrays.

(b) The type of container material will affect the establishment of the performance criteria. The prevention of a BLEVE is an important characteristic. The loss of some liquid from a container (particularly by controlled venting) may be deemed acceptable or even preferable. Catastrophic failure of a container (e.g., total content release) may be deemed unacceptable. The resulting large spill may not be controlled (particularly if water sprinklers are used) and lead to cascading container failures.

(c) Scoping tests may be required to determine failure mechanisms and worst case situations for specific container materials. Reference 5 is an example of scoping tests performed to determine failure mechanisms of small metal and plastic containers. Steel drum failure mechanisms are described in Reference 3. There is a lack of published information on large container failure mechanisms, particularly for IBCs and nonmetallic or composite drums (e.g., fiber drums).

(d) Pressure Buildup. 104 kPa (15 psi) is an example of a critical pressure in steel drums, above which BLEVE may occur [Reference 3].

(e) Loss of Liquid. Loss of any substantial amount of liquid from a container is generally considered as a criteria for failure. For the originally involved container, this may be loss of contents at a rate greater than the design scenario spill rate. Fire spread to the outer limits of the test array is generally considered a failure. For adjacent or target arrays, the level of fire involvement should be considered. Loss due to vapor venting may be considered acceptable. For metallic containers, loss of liquid to a rupture/BLEVE may be considered unacceptable.

(f) Number of Sprinklers Operating and Operating Time. This may be used as a judgment of overall suppression system effectiveness. As the number of sprinklers operating increases, the probability of overall success decreases. The philosophy in combustible/flammable liquid protection has shifted from traditional warehouse success criteria, where a "success" might be judged for a test involving the operation of 30 or more sprinklers. The trend in liquid protection is for more rapid actuation and cooling/control through the use of lower RTI, intermediate level, larger orifice, and ESFR sprinklers.

(g) Ignition of Target Arrays. Prevention of the ignition of adjacent targets (e.g., across aisles) is a fundamental measure of performance. If target arrays ignite, adequate protection should be provided (e.g., through the use of in-rack sprinklers or increased suppression agent rate).

(h) Integrity of Structural Steel. Structural steel, in the form of building columns, beams, or rack elements, potentially fail at 649-704°C (1200-1300°F). Scenarios where elements reach this temperature for any prolonged time may be judged unsuccessful for "protected" situations.

(i) Collapse of stored containers inherently increase the risk of container liquid discharge. It also increases the potential for shielding of a flowing fuel or pool fire, with a resulting increase in BLEVE potential or catastrophic liquid discharge.

Spills of any magnitude may not be suppressed by water-only suppression systems. Water may act to cool containers, but it also spreads the pool fire. For situations where there is the potential for large spills, floor drainage systems may be used to mitigate the spread of burning liquids. The area contained within the drains can be considered for establishing sprinkler design operating areas. Alternatively, foam-water sprinkler systems may be used to control/suppress floor pool fires to prevent burning liquid spread. Where there is rack storage, in-rack sprinklers at every level have demonstrated good cooling for drum storage [Reference 3].

Test documentation should include test setup, results, and damage assessment. Photographic and video documentation is desirable.

References

[1] Nugent, D.P., "Fire Tests Involving Storage of Flammable and Combustible Liquids in Small Containers," Journal of Fire Protection Engineering, 6(1), 1994, pp. 1-10.

[2] Scheffey, J.L., Gewain, R.G., and Hunt, S.P., "Analytical Techniques for Performance-based Code Requirements - Warehouse Structural Protection," Hughes Associates, Inc., Columbia, MD (in preparation).

[3] Newman, R.M., Fitzgerald, P.M., and Young, J.R., "Fire Protection of Drum Storage Using 'Light Water' Brand AFFF in a Closed-head Sprinkler System," Factory Mutual Research Corporation Report FMRC Ser. No. 22464, RC75-T-16, Norwood, MA, March 1975.

[4] Young, J.K., and Fitzgerald, P.M., "The Feasibility of Using 'Light Water' Brand AFFF in a Closed-head Sprinkler System for Protection Against Flammable Liquid Spill Fires," Factory Mutual Research Report FMRC Ser. No. 22352, RC75-T-4, Norwood, MA, January 1975.

[5] Hill, J.P., "International Foam-water Sprinkler Research Project: Task 3 - Range Finding Tests," Factory Mutual Research Report J.I. OTOR6.RR, prepared for the National Fire Protection Research Foundation, Norwood, MA, July 1991.

Bibliography

Allahdadi, F.A., Luehr, C., Morehouse, T., and Campbell, P., "Modeling Response of Tanks Containing Flammables to Fire Impingement," ESL-TR-87-53, Engineering and Services Laboratory, Tyndall AFB, FL, July 1988.

American Petroleum Institute, "API 2000, Venting Atmospheric and Low Pressure Storage Tanks," API, Washington, DC, 1982.

Bainbridge, B.L., and Keltner, N.R., "Heat Transfer to Large Objects in Large Pool Fires," SAND-87-0641C, Sandia National Laboratories, Albuquerque, NM, 1987.

Birk, A.M., "Modeling the Effects of a Torch-type Fire Impingement on a Rail or Highway Tanker," Fire Safety Journal, 15, 1989, pp. 277-296.

Committee on Hazardous Materials, Division of Chemistry and Chemical Technology, National Research Council (ed.), Pressure-Relieving Systems for Marine Cargo Bulk Liquid Containers, National Academy of Sciences, Washington, DC, 1973.

Factory Mutual Laboratories, Research Project No. 11365, November 2, 1949, p. 26, "Fire Tests of Vent Fittings for Paint Drums," Laboratory Report No. 13604, February 1958.

Johnson, M.R., "Temperatures, Pressures and Liquid Levels of Tank Cars Engulfed in Fires - Volume I, Results of Parametric Analyses," DOT/FRA/OR&D-84/08.11, Federal Railroad Administration, Washington, DC, June 1984.

McLain, W.H., "Investigation of the Fire Safety Characteristics of Portable Tanks - Polythylene Tanks Containing Flammable Liquids," Report No. CG-M-1-88, U.S. Coast Guard Marine Technical and Hazardous Materials Division, Avery Point, CT, March 1988.

Richards, R.C., and White K. T., "Fire Exposure Tests of Polyethylene and Fifty-five Gallon Steel Drums Loaded with Flammable Liquids, Phase I," Report No. CG-D-116-76, Department of Transportation, U.S. Coast Guard, Washington, DC, September 1976.

Richards R.C., and Munkenbeck, G.J., " Fire Exposure Tests of Polyethylene and Fifty-five Gallon Steel Drums Loaded with Flammable Liquids, Phase II," Report No. CG-D-86-77, Department of Transportation, U.S. Coast Guard, Washington, DC, August 1977.

Rogerson, J.E., "Flammable and Combustible Liquid Drum Storage Problems," American Institute of Chemical Engineers Summer National Meeting Progress, Paper No. 63, 1981.

Russel, L.H., and Canfield, J.A. "Experimental Measurement of Heat Transfer to a Cylinder Immersed in a Large Aviation Fuel Fire," Journal of Heat Transfer, August 1973.

Sumitra, P.S. and Troup, J.M.A., "The Effect on Sprinkler Protection of Using "Thin" Pallets for Palletized Barrelled Whiskey Storage," FMRC J.I. OEOR1.RR, RC 79-T-60, March 1980.

Sumitra, P.S. and Troup, J.M.A., "Fire Protection Requirements for Six-Barrel High Palletized Storage of Distilled Spirits," FMRC J.I. OC2R6.RR, RC 78-T-42, February 1979.

Sumitra P.S. and Troup, J.M.A., "The Protection Requirements for Six-barrel High Palletized Storage of Distilled Spirits, Phase II," FMRC J.I. OEOR1.RR, RC 79-T-66, November 1979.

Silicone Products Department of General Electric, "Bulging and Rupture Characteristics of 55-Gallon, Steel Closed-Top Drums at known Pressure," Company Report No. R-65-Ch-SD-529, September 30, 1965.

Tavares, R., and Delichatsios, M.A., "Pressure Relief in Flammable-liquid Drums by Pressure-activated and Plastic Bunds," FMRC J.I. OFOR4.RA 070(A), Factory Mutual Research Corporation, Norwood, MA, March 1981.

Yao, C., "Flammable Liquid Drum Fire Protection System Development," FMRC Report No. 16425, prepared for the Manufacturing Chemists Association, Norwood, MA, May 5, 1967.

[1]Reports by Factory Mutual Research Corporation (FMRC) cited in the Bibliography may not be available to the general public. FMRC reports cited in the References are on file at NFPA Headquarters in the NFPA 30 Committee files.

SUBSTANTIATION: There is a need to give guidance for criteria for future fire tests to develop data for inclusion of storage configurations not covered in the proposed revisions to Section 4-8.

COMMITTEE ACTION: Accept.

Make the following editorial changes:

1. Bold print all section headings.
2. In sentence 5, paragraph 3, change "BLEVE must" to "BLEVE should."
3. In sentence 3, paragraph 3, change to read:

"the hazard to test facilities and personnel"

(Log #3)
Committee: FLC-SWC

30- 128 - (E-4-6(b)): Reject

Note: This proposal appeared as comment 30-55 which was held for further study from the Annual 93 TCD, which was on proposal 30-90.

SUBMITTER: David P. Nugent, The Sherwin-Williams Co.

RECOMMENDATION: Add a new entry to "Section E-4-6(b) Fire Tests - Small Containers" that would be numbered "(6) 1992 Fire Tests". See "Appendix E" for remainder of proposal.

Appendix E

Add a new entry to "Section E-4-6(b) Fire Tests - Small Containers" that would be numbered "(7) 1992 Fire Tests". See "Appendix E" for remainder of proposal.

Appendix E

E-4-6(b) Fire Tests - Small Containers.

(7) 1992 Fire Tests.

A series of three rack array fire tests involving the storage of flammable liquids was conducted at Underwriters' Laboratories, Inc. in Northbrook, Illinois.

The flammable liquid was packaged in 5 gal (18.9 L) metal tighthead containers equipped with plastic pull-up pour spouts and cartoned 1 gal (3.8 L) metal F-style containers with metal nozzles and caps.

2 gal (7.5 L) heptane spill was used as the ignition scenario in all of these tests.

A summary of these tests is contained in Table 7.

SUBSTANTIATION: A series of fire tests were conducted during 1992 at Underwriters Laboratories' fires test facilities in Northbrook, IL. The testing was sponsored by the Sherwin-Williams Company. This project sought further technical data on the protection of flammable/combustible liquids. The flammable/combustible liquids were packaged in cartoned and uncartoned metal containers. The flammable/combustible liquid tests were arranged in a rack storage arrangement. The tests were intended to determine the effectiveness of a standard sprinkler system against a fire involving this commodity using a pool fire ignition scenario. The Code, as written, is currently lacking in fire test data pertaining to these scenarios.

COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: The Technical Committee on Storage and Warehousing of Containers and Portable Tanks feels that to include more raw data in the Appendix to NFPA 30 will add to the confusion of the user. However, the Technical Committee does feel that the information should be evaluated and could possibly be included as a supplement to the Flammable and Combustible Liquids Code Handbook.

Table 7

Fire tests involving flammable and combustible liquids:

1. Test Location: Underwriters Laboratories Inc., Northbrook, IL

RACK STORAGE - TEST 1

2. Ceiling Height: 18 ft (5.5 m)

3. Storage Arrangement:

Rack Configuration and Ignitor	Horizontal Rack Member Height	Shelving Material	Tiered Storage Arrangement and Total Flammable Liquid Fuel Load in Center Bay
24 ft 9 in. (7.5 m) long double row rack with 6-in. (150 mm) longitudinal flue space and overall width of 5 ft 4 in. (1.63 m). Aisle width 7-1/2 ft (2.3 m)	5 ft (1.52 m) and 10 ft (3.04 m)	None	1st Tier 5 gal (18.9 L) metal tighhead containers stacked three high on a wood pallet totalling 47 in. (1.2 m). Twenty-four containers per pallet with 120 gal (454 L) on each pallet and 240 gal (908 L) on two pallets.
Flammable liquid in center bay of double row rack.			*Cartoned 1 gal (3.79 L) metal F-style containers* with metal spouts and caps stacked four high on a wood pallet totalling 49 in. (1.24 m). Forty cartons containing 4 gal (15.1 L) each with 160 gal (605 L) on each pallet and 320 gal (1211 L) total on two pallets.
Corrugated cardboard target commodity in both single row target racks opposite aisle and N. and S. bays of the double. (1)			2nd Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps *containers with metal spouts and caps* stacked four high on a wood pallet totalling 49 in. (1.24 m). Forty cartons containing 4 gal (15.1 L) each with 160 gal (605 L) on each pallet and 640 gal (2423 L) on four pallets.
2 gal (7.58 L) heptane spill in aisle adjacent to rack centered below two sprinklers.			3rd Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked four high on a wood pallet totalling 49 in. (1.24 m). Forty cartons containing 4 gal (15.1 L) each with 160 gal (605 L) on each pallet and 640 gal (2423 L) on four pallets. Total: 1,840 gal (6965 L) of heptane (2)

Note 1: Corrugated cardboard target commodity consists of empty tri-wall cardboard boxes containing a metal cross divider.
Note 2: All pallet loads were stretch-wrapped
Note 3: N/A - Not Applicable

4. Ignition: 2 gal (7.58 L) heptane spill in aisle adjacent to rack centered below two sprinklers.

5. Sprinkers:

Ceiling Sprinkler System Details	In-rack Sprinkler Type and No. of Levels
Discharge Density 0.55 gpm per sq ft (22.4 mm/min) Orifice Size 17/32 in. (13.5 mm) K-Factor 8.0 (115) Temperature Rating 286°F (141°C) Response Time Index 400 (ft-sec) $^{1/2}$ (228(m-sec) $^{1/2}$	None

Sprinkler Spacing
100 ft^2 (9.3 m^2)

Arrangement
Pendent

6. Sprinkler System Type: Wet Pipe - Water only

7. Fuel Quality, Gal. (L): 1,840 gal (6965 L) of heptane

8. Storage Height, In. (m): 14 ft 1 in. (4.3 m)

9. Sprinkler Actuation:

No. of Operating Ceiling Sprinklers, Sprinkler No. & Operating Times	No. of Operating In-rack Sprinklers, Operating Times & Flow
4 Sprinklers #10 @ 1:11 #11 @ 4:50 #6 @ 5:17 #7 @ 5:17	N/A (3)

10. Fire Controlled: No

Damage Assessment	Comments
5 gal (18.9 L) - Plastic pour spout vented on several containers. Top and bottom of several containers bulged, resulting in a number of containers falling over into the aisle. 1 gal (3.79 L) - Pour spout vented on numerous containers. Several containers fell into the flue spaces and the aisle. Cardboard packaging material completely consumed on face of rack and in the transverse and logitudinal flue spaces near ignition point.	Heptane ignitor fire out at approximately 3 min. 36 sec.
	After cardboard packaging material consumed on rack face adjacent to ignition point, combustion throughout remainder of test consisted of burning corrugated cardboard commodity and heptane from 1 gal (3.79 L) and 5 gal (18.9 L) containers at pour spouts or caps. Fire most intense near ignition point at face of rack and within transverse flue space. Intermittent floor fires due to toppling containers. Fire manually extinguished via a hand held CO_2 extinguisher at 41 min. 15 sec.
No damage to commodity on face of rack opposite ignition point. Also, stretch - wrap and cardboard packaging material was intact.	
Corrugated cardboard target commodity burned through in N. & S. bay at transverse flue space.	
No aisle jump.	

Table 7

1. Test Location: Underwriters Laboratories Inc., Northbrook, IL

RACK STORAGE - TEST 2

2. Ceiling Height: 18 ft (5.5 m)

3. Storage Arrangement:

Rack Configuration and Ignitor	Horizontal Rack Member Height	Shelving Material	Tiered Storage Arrangement and Total Flammable Liquid Fuel Load in Center Bay
24 ft 9 in. (7.5 m) long double row rack with 6-in. (150 mm) longitudinal flue space and overall width of 5 ft 4 in. (1.63 m). Aisle width 7-1/2 ft (2.3 m)	5 ft (1.52 m) and 10 ft (3.04 m)	None	1st Tier 5 gal (18.9 L) metal tighhead containers stacked three high on a wood pallet totalling 47 in. (1.2 m). Twenty-four containers per pallet with 120 gal (454 L) on each pallet and 240 gal (908 L) on two pallets.
Flammable liquid in center bay of double row rack.			Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked four high on a wood pallet totalling 49 in. (1.24 m). Forty cartons containing 4 gal (15.1 L) each with 160 gal (605 L) on each pallet and 320 gal (1211 L) total on two pallets.
Corrugated cardboard target commodity in both single row target racks opposite aisle and N. and S. bays of the double.row rack (1)			2nd Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked four high on a wood pallet totalling 49 in. (1.24 m). Forty cartons containing 4 gal (15.1 L) each with 160 gal (605 L) on each pallet and 640 gal (2423 L) on four pallets.
2 gal (7.58 L) heptane spill in aisle adjacent to rack centered below two sprinklers.			3rd Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked four high on a wood pallet totalling 49 in. (1.24 m). Forty cartons containing 4 gal (15.1 L) each with 160 gal (605 L) on each pallet and 640 gal (2423 L) on four pallets. Total: 1,840 gal (6965 L) of heptane (2)

Note 1: Corrugated cardboard target commodity consists of empty tri-wall cardboard boxes containing a metal cross divider.
Note 2: All pallet loads were stretch-wrapped
Note 3: N/A - Not Applicable

5. Sprinklers:

Ceiling Sprinkler System Details	In-rack Sprinkler Type and No. of Levels
Discharge Density 0.55 gpm per sq ft (22.4 mm/min.) Orifice Size .64 in. (16.3 mm) K-Factor 11.1 (160) Temperature Rating 286°F (141°C) Response Time Index 260 (ft-sec) $^{1/2}$ [146(m-sec) $^{1/2}$] Sprinkler Spacing 100 ft^2 (9.3 m^2) Arrangement Pendent	None

6. Sprinkler System Type: Wet Pipe - Water only

7. Fuel Quality, Gal. (L): 1,840 gal (6965 L) of heptane

8. Storage Height, In. (m): 14 ft 1 in. (4.3 m)

9. Sprinkler Actuation:

No. of Operating Ceiling Sprinklers, Sprinkler No. & Operating Times	No. of Operating In-rack Sprinklers, Operating Times & Flow	
3 Sprinklers #11 @ 1:19 #10 @ 1:40 #7 @ 2:01	N/A	(3)

10. Fire Controlled: Yes

11. Significant Observations:

Damage Assessment	Comments
5 gal (18.9 L) - Plastic pour spout vented on several containers. 1 gal (3.79 L) - Pour nozzle vented on several containers.	Heptane ignitor fire out at approximately 3 min. 36 sec.
Cardboard packaging material partially consumed on face of rack and completely consumed within transverse and logitudinal flue spaces near ignition point.	After cardboard packaging material partially consumed on rack face adjacent to ignition point, combution throughout remainder of test consisted of burning heptane from 1 gal (3.79 L) and 5 gal (18.9 L) containers at pour spouts or caps. Fire less intense than test No. 1 and confined to the lower pallet of 1 gal (3.79 L) F - style containers with metal nozzles and caps facing the ignition point.
No damage to commodity on face of rack opposite ignition point. Also, stretch - wrap and cardboard packaging material was intact.	Fire self-extinguished at 29 min.
Corrugated cardboard target commodity partially charred in south bay at transverse flue space, 1st tier.	
No aisle jump.	

Table 7

1. Test Location: Underwriters Laboratories Inc., Northbrook, IL

RACK STORAGE - TEST 3

2. Ceiling Height: 18 ft (5.5 m)

3. Storage Arrangement:

Rack Configuration and Ignitor	Horizontal Rack Member Height	Shelving Material	Tiered Storage Arrangement and Total Flammable Liquid Fuel Load in Center Bay
24 ft 9 in. (7.5 m) long double row rack with 6-in. (150 mm) longitudinal flue space and overall width of 5 ft 4 in. (1.63 m). Aisle width 7-1/2 ft (2.3 m)	5 ft (1.52 m) and 10 ft (3.04 m)	None	1st Tier 5 gal (18.9 L) metal tighhead containers stacked three high on a wood pallet totalling 47 in. (1.2 m).Twenty-four containers per pallet with 120 gal (454 L) on each pallet and 240 gal (908 L) on two pallets.
Flammable liquid in center bay of double row rack.			Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked four high on a wood pallet totalling 49 in. (1.24 m). Forty cartons containing 4 gal (15.1 L) each with 160 gal (605 L) on each pallet and 320 gal (1211 L) total on two pallets.
Corrugated cardboard target commodity in both single row target racks opposite aisle and N. and S. bays of the double row rack (1)			2nd Tier 5 gal (18.9 L) metal tighthead containers stacked three high on a wood pallet totalling 47 in. (1.2 m). Twenty-four containers per pallet with 120 gal (454 L) on each pallet and 240 gal (908 L) on two pallets.
2 gal (7.58 L) heptane spill in aisle adjacent to rack centered below two sprinklers.			Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked four high on a wood pallet totalling 49 in. (1.24 m). Forty cartons containing 4 gal (15.1 L) each with 160 gal (605 L) on each pallet and 320 gal (1211 L) on two pallets.

3rd Tier
Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked four high on a wood pallet totalling 49 in. (1.24 m). Forty cartons containing 4 gal (15.1 L) each with 160 gal (605 L) on each pallet and 640 gal (2423 L) on four pallets.

Total: 1,760 gal (6662 L) of heptane (2)

Note 1: Corrugated cardboard target commodity consists of empty tri-wall cardboard boxes containing a metal cross divider.
Note 2: All pallet loads were stretch-wrapped
Note 3: N/A - Not Applicable

4. Ignition: 2 gal (7.58 L) heptane spill in longitudinal flue centered below four sprinklers.

5. Sprinklers:

Ceiling Sprinkler System Details	In-rack Sprinkler Type and No. of Levels
Discharge Density 0.55 gpm per sq ft (22.4 mm/min.)	None
Orifice Size .64 in. (16.3 mm)	
K-Factor 11.1 (160)	
Temperature Rating 286°F (141°C)	
Response Time Index 55 (ft-sec) $^{1/2}$ (31 (m-sec) $^{1/2}$	
Sprinkler Spacing 100 ft^2 (9.3 m^2)	
Arrangement Pendent	

6. Sprinkler System Type: Wet Pipe - Water only

7. Fuel Quality, Gal. (L): 1,760 gal (6662 L) of heptane

8. Storage Height, In. (m): 14 ft 1 in. (4.3 m)

9. Sprinkler Actuation:

No. of Operating Ceiling Sprinklers, Sprinkler No. & Operating Times	No. of Operating In-rack Sprinklers, Operating Times & Flow	
3 Sprinklers #6 @ 0:49 #10 @ 0:49 #7 @ 1:11	N/A	(3)

10. Fire Controlled: Yes

11. Significant Observations:

Damage Assessment	Comments
5 gal (18.9 L) - Plastic pour spout vented on 6 to 8 containers. Additionally, 2 to 3 containers fell over.	After heptane ignitor fire burned out, limited fire involvement of flammable liquid commodity adjacent to flue spaces in center bay of double row rack.
Cardboard packaging material consumed within logitudinal flue space and a portion of the transverse flue space.	Fire less intense than Test No. 2.
No damage to commodity on both rack faces. The cardboard packaging material was intact.	Fire self-extinguished at approximately 5 min. 34 sec.
Corrugated cardboard target commodity partially charred in south bay at transverse flue spaces, 1st tier.	
No aisle jump.	

(Log #4)
Committee: FLC-SWC

30-129 - (E-4-6(b)): Reject

Note: This proposal appeared as comment 30-56 which was held for further study from the Annual 93 TCD, which was on proposal 30-90.

SUBMITTER: David P. Nugent, The Sherwin-Williams Co.

RECOMMENDATION: Add a new entry to "Section E-4-6(b) Fire Tests - Small Containers" that would be numbered "(6) 1992 Fire Tests". See "Appendix E" for remainder of proposal.

Appendix E

E-4-6(b) Fire Tests - Small Containers.

(6) 1992 Fire Tests.

A series of five rack, nine mixed rack storage and display, and two display fire tests involving the storage of flammable and combustible liquids were conducted at Underwriters Laboratories, Inc. in Northbrook, Illinois.

The flammable liquid was packaged in uncartoned 5 gal (18.9 L) metal tighthead containers equipped with plastic pull-up pour spouts; uncartoned, cartoned and display-cut 1 gal (3.8 L) metal F-style (oblong) containers with metal nozzles and caps; and display cut 1 qt (.95 L) metal F-style containers with metal spouts and caps. The combustible liquids were packaged in cartoned and display-cut 1 gal (3.8 L) metal friction lid containers and display cut 1 gal (3.8 L) polyethylene containers.

The flammable and combustible liquid was arranged in a fire test facilities rack storage array, a display array, and a combination array of rack storage and display. A 2 gal (7.5 L) heptane spill was used as the ignition scenario in all of these tests.

A summary of these tests is contained in Table 6.

SUBSTANTIATION: A series of fire tests were conducted during 1992 at Underwriters Laboratories' fires test facilities in Northbrook, IL. The testing was sponsored by the National Fire Protection Research Foundation, as part of the National Wholesale/Retail Occupancy Fire Research Project. This project sought further technical data on the protection of flammable/combustible liquids in mercantile occupancies. The flammable/combustible liquids were packaged in cartoned and uncartoned metal and plastic containers. The flammable/combustible liquid tests were arranged in a rack storage array, a hand-pick (shelf storage) array, and a combination array of rack storage and hand-picking. The tests were intended to determine the effectiveness of a standard sprinkler system against a fire involving the commodity using a pool fire ignition scenario. The Code, as written, is currently lacking in fire test data pertaining to these scenarios.

COMMITTEE ACTION: Reject.

COMMITTEE STATEMENT: The Technical Committee on Storage and Warehousing of Containers and Portable Tanks feels that to include more raw data in the Appendix to NFPA 30 will add to the confusion of the user. However, the Technical Committee does feel that the information should be evaluated and could possibly be included as a supplement to the Flammable and Combustible Liquids Code Handbook.

(Log #CP9)
Committee: FLC-OPS

30-130 - (Chapter 5): Accept

SUBMITTER: Technical Committee on Operations,

RECOMMENDATION: Reorganize Chapter 5 using the following outline:

5-1 Scope.	Current 5-1
5-2 General.	Current 5-2
5-3 Operations	Current 5-3, 5-4.1, 5-4.2
5-4 RESERVED	Future Expansion
5-5 Incidental Operations	Current 5-4.3
5-6 Tank Vehicle Loading & Unloading Operations	Current 5-4.4.1
5-7 Wharves and Piers	Current 5-4.4.2
5-8 Transportation	Future Expansion
5-9 Control of Ignition Sources	Current 5-6.2
5-10 Vapor Recovery Systems	Current 5-5
5-11 Fire Safety Management	NEW
5-12 Fire Protection & Suppression	5-6.1, 5-6.3 through 5-6.7

SUBSTANTIATION: This is the first phase of a complete reorganization of NFPA 30 to make it more easily used.

COMMITTEE ACTION: Accept.

(Log #CP10)
Committee: FLC-OPS

30-131 - (5-1.1 Exception (New)): Accept

SUBMITTER: Technical Committee on Operations,

RECOMMENDATION: Add an exception to read:

"Exception: Operations at farms and isolated sites, as covered in Chapter 6."

SUBSTANTIATION: This exception will eliminate potential conflict between the requirements of Chapter 5 and new Chapter 6.

COMMITTEE ACTION: Accept.

(Log #CP11)
Committee: FLC-OPS

30-132 - (5-2.1): Accept

SUBMITTER: Technical Committee on Operations,

RECOMMENDATION: Add a new 5-2.1 to read:

"Requirements for specific operations are covered in Sections 5-3 through 5-8. Requirements for procedures and practices for fire prevention, fire protection, and fire control in these operations are covered in Sections 5-9 through 5-12 and shall be applied as appropriate."

SUBSTANTIATION: This statement provides guidance for the user in properly applying the various provisions of Chapter 5.

COMMITTEE ACTION: Accept.

Table 6

Fire Tests involving flammable and combustible liquids:

1. Test Location: Underwriters Laboratories Inc., Northbrook, IL

TEST No. 1

2. Ceiling Height: 18 ft (5.49 m)

3. Rack Storage Arrangement:

Rack Configuration and Ignitor	Horizontal Rack Member Height	Shelving Material	Tiered Arrangement and Flammable Liquid Fuel Load in Center Bay
24 ft 9 in. (7.5 m) long double row rack with 6-in. (150 mm) flue space and overall width of 7-1/2 ft (2.3 m). Aisle width 7-1/2 ft (2.3 m) Flammable liquid in center bay of double row rack. Corrugated cardboard target commodity in both target racks, opposite aisle and N. and S. bays of the double row rack. (1) 2 gal (7.58 L) heptane spill in longitudinal flue centered below four sprinklers.	3 ft 6 in. (1.07 m) and 7 ft 6 in. (2.3 m)	2 in x 6 in. (50 mm x 150 mm) wood slats spaced 2 in. (50 mm) apart.	1st Tier on Floor 5 gal (18.9 L) metal tighthead containers with plastic pull-up pour spouts stacked two high on a wood pallet totaling 33 in. (.84 m). Twenty-four containers per pallet with 120 gal (45.4 L) on each pallet and 480 gal (1817 L) on four pallets. 2nd Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked three high on a wood pallet totaling 38 in. (.965 m). Thirty-nine cartons containing 4 gal (15.1 L) each with 156 gal pallet and 624 gal (59.1 L) on each (2362 L) on four pallets. 3rd Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked three high on a wood pallet totaling 38 in. (.965 m). Thirty-nine cartons containing 4 gal (15.1 L) each with 156 gal (59.1 L) on each pallet and 624 gal (2362 L) on four pallets. Total: 1,728 gal (6541 L) of heptane (2)

Note 1: Corrugated cardboard target commodity consists of empty tri-wall cardboard boxes containing a metal cross divider.
Note 2: All pallet loads were stretch-wrapped

4. Ignition: 2 gal. (7.58 L) heptane spill in longitudinal flue centered below four sprinklers.

5. Sprinklers:

Ceiling Sprinkler System Details	In-rack Sprinkler Type and No. of Levels
Discharge Density 0.50 gpm per sq ft (20.4 mm/min.) Orifice Size 17/32 in. (13.5 mm) K-Factor 8.0 (115) Temperature Rating 286°F (141°C) Response Time Index 400 $(ft\text{-}sec)^{1/2}$ $(224(m\text{-}sec)^{1/2})$ Sprinkler Spacing 100 ft^2 (9.3 m^2) Arrangement Pendent	None

6. Sprinkler System Type: Wet Pipe - Water only

7. Fuel Quality, Gal. (L): 1,728 gal (6541 L) of heptane

8. Storage Height, In. (m): 10 ft 8 in. (3.25 m)

9. Sprinkler Actuation:

No. of Operating Ceiling Sprinklers, Sprinkler No. & Operating Times	No. of Operating In-rack Sprinklers, Operating Times & Flow
6 Sprinklers #10 @ 1:26 #7 @ 2:11 #3 @ 4:44 #6 @ 4:53 #16 @ 11:17 #15 @ 11:56	None

10. Fire Controlled: No

11. Significant Observations:

Damage Assessment	Comments
5 gal (18.9 L) - Plastic pour spout vented on 10-12 containers	Test terminated at 7 min. 50 sec. Finally extinguished manually 1 hr. after ignition.

Table 6

Fire Tests involving flammable and combustible liquids:

1. Test Location: Underwriters Laboratories Inc., Northbrook, IL

TEST No. 2

2. Ceiling Height: 18 ft (5.49 m)

3. Rack Storage Arrangement:

Rack Configuration and Ignitor	Horizontal Rack Member Height	Shelving Material	Tiered Arrangement and Flammable Liquid Fuel Load in Center Bay
24 ft 9 in. (7.5 m) long double row rack with 6-in. (150 mm) flue space and over-all width of 7-1/2 ft (2.3 m). Aisle width 7-1/2 ft (2.3 m).	3 ft 6 in. (1.07 m)	Open wire mesh.	1st Tier on Floor 5 gal (18.9 L) metal tighhead containers with plastic pull-up pour spouts stacked two high on a wood pallet totaling 33 in. (.84 m). Twenty-four containers per pallet with 120 gal (45.4 L) on each pallet and 480 gal (1817 L) on four pallets.
Flammable liquid in center bay of double row rack.			2nd Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked three high on a wood pallet totaling 38 in. (.965 m).
Corrugated cardboard target commodity in both target racks, opposite aisle and N. and S. bays of the double row rack. (1)			Thirty-nine cartons containing 4 gal (15.1 L) each with 156 gal (591 L) on each pallet and 624 gal (2362 L) on four pallets
2 gal (7.58 L) heptane spill in longitudinal flue centered below four sprinklers.			.Total: 1,104 gal (4179 L) of heptane(2)

Note 1: Corrugated cardboard target commodity consists of empty tri-wall cardboard boxes containing a metal cross divider.
Note 2: All pallet loads were stretch-wrapped

4. Ignition: 2 gal. (7.58 L) heptane spill in longitudinal flue centered below four sprinklers.

5. Sprinklers:

Ceiling Sprinkler System Details	In-rack Sprinkler Type and No. of Levels
Discharge Density 0.50 gpm per sq ft 20.4 mm/min.) Orifice Size 17/32 in. (13.5 mm) K-Factor 8.0 (115) Temperature Rating 286°F (141°C) Response Time Index 400 $(ft\text{-}sec)^{1/2}$ $(224(m\text{-}sec)^{1/2})$ Sprinkler Spacing 100 ft^2 (9.3 m^2) Arrangement Pendent	None

6. Sprinkler System Type: Wet Pipe - Water only

7. Fuel Quality, Gal. (L): 1,104 gal (4179 L) of heptane

8. Storage Height, In. (m): 6 ft 8 in. (2.03 m)

9. Sprinkler Actuation:

No. of Operating Ceiling Sprinklers, Sprinkler No. & Operating Times	No. of Operating In-rack Sprinklers, Operating Times & Flow
2 Sprinklers #6 @ 1:57 #10 @ 2:03	None

10. Fire Controlled: No

11. Significant Observations:

Damage Assessment	Comments
5 gal (18.9 L) - Plastic pour spout vented on 10-12 containers 1 gal (3.79 L) - Several containers ruptured.	Test terminated at 4 min. 50 sec. Manual AFFF system on.

Table 6

Fire Tests involving flammable and combustible liquids:

1. Test Location: Underwriters Laboratories Inc., Northbrook, IL

TEST No. 3

2. Ceiling Height: 18 ft (5.49 m)

3. Rack Storage Arrangement:

Rack Configuration and Ignitor	Horizontal Rack Member Height	Shelving Material	Tiered Arrangement and Flammable Liquid Fuel Load in Center Bay
24 ft 9 in. (7.5 m) long double row rack with 6-in. (150 mm) flue space and over-all width of 7-1/2 ft (2.3 m). Aisle width 7-1/2 ft (2.3 m)	3 ft 6 in. (1.07 m)	2 in. x 6 in. (50 mm x 150 mm) wood slats spaced 2 in. (50 mm) apart.	1st Tier on Floor 5 gal (18.9 L) metal tighhead containers with plastic pull-up pour spouts stacked two high on a wood pallet totaling 33 in. (.84 m).
Flammable liquid in center bay of double row rack.			Twenty-four containers per pallet with 120 gal (45.4 L) on each pallet and 480 gal (1817 L) on four pallets.
Corrugated cardboard target commodity in both target racks, opposite aisle and N. and S. bays of the double row rack. (1)			2nd Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked three high on a wood pallet totaling 38 in. (.965 m).
2 gal (7.58 L) heptane spill in longitudinal flue centered below four sprinklers.			Thirty-nine cartons containing 4 gal (15.1 L) each with 156 gal (591 L) on each pallet and 624 gal (2362 L) on four pallets.
			Total: 1,104 gal (4179 L) of heptane (2)

Note 1: Corrugated cardboard target commodity consists of empty tri-wall cardboard boxes containing a metal cross divider.
Note 2: All pallet loads were stretch-wrapped

4. Ignition: 2 gal. (7.58 L) heptane spill in longitudinal flue centered below four sprinklers.

5. Sprinklers:

Ceiling Sprinkler System Details	In-rack Sprinkler Type and No. of Levels
Discharge Density 0.50 gpm per sq ft (20.4 mm/min.)	155°F (68°C) standard response, large orifice 17/32 in. (13.5 min), RTI 400 $(ft\text{-}sec)^{1/2}$ $(224(m\text{-}sec)^{1/2})$ at 38 in. (.97 m) deflector to floor.
Orifice Size 17/32 in. (13.5 mm)	Frame parallel to piping. One level of sprinklers.
K-Factor 8.0 (115)	
Temperature Rating 286°F (141°C)	
Response Time Index 400 $(ft\text{-}sec)^{1/2}$ $(224(m\text{-}sec)^{1/2})$	
Sprinkler Spacing 100 ft^2 (9.3 m^2)	
Arrangement Pendent	

6. Sprinkler System Type: Wet Pipe - Water only

7. Fuel Quality, Gal. (L): 1,104 gal (4179 L) of heptane

8. Storage Height, In. (m): 6 ft 8 in. (2.03 m)

9. Sprinkler Actuation:

No. of Operating Ceiling Sprinklers, Sprinkler No. & Operating Times	No. of Operating In-rack Sprinklers, Operating Times & Flow
4 Sprinklers #6 @ 4:24 #10 @ 4:24 #7 @ 5:15 #11 @ 5:15	1 sprinkler at 1:01 at 30 gpm (114 Lpm)

10. Fire Controlled: No

11. Significant Observations:

Damage Assessment	Comments
5 gal (18.9 L) - Plastic pour spout vented on 10-12 containers.	Floor fire out at 5 min. 5 gal (18.9 L) containers began to burn intensely at 5 min. Test terminated at 5 min. 40 sec. Manual AFFF system on.

Table 6

Fire Tests involving flammable and combustible liquids:

1. Test Location: Underwriters Laboratories Inc., Northbrook, IL

TEST No. 4

2. Ceiling Height: 18 ft (5.49 m)

3. Rack Storage Arrangement:

Rack Configuration and Ignitor	Horizontal Rack Member Height	Shelving Material	Tiered Arrangement and Flammable Liquid Fuel Load in Center Bay
24 ft 9 in. (7.5 m) long double row rack with 6-in. (152 mm) flue space and over-all width of 7-1/2 ft (2.3 m). Aisle width 7-1/2 ft (2.3-m)	3 ft 6 in. (1.07 m)	2 in. x 6 in. (50 mm x 150 mm) wood slats spaced 2 in. (50 mm) apart.	1st Tier on Floor 5 gal (18.9 L) metal tighhead containers with plastic pull-up pour spouts stacked two high on a wood pallet totaling 33 in. (.84 m).
Flammable liquid in center bay of double row rack.			Twenty-four containers per pallet with 120 gal (45.4 L) on each pallet and 480 gal (1817 L) on four pallets.
Corrugated cardboard target commodity in both target racks, opposite aisle and N. and S. bays of the double row rack. (1)			2nd Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked three high on a wood pallet totaling 38 in. (.965 m).
2 gal (7.58 L) heptane spill in longitudinal flue centered below four sprinklers.			Thirty-nine cartons containing 4 gal (15.1 L) each with 156 gal (591 L) on each pallet and 624 gal (2362 L) on four pallets. Total: 1,104 gal (4179 L) of heptane(2)

Note 1: Corrugated cardboard target commodity consists of empty tri-wall cardboard boxes containing a metal cross divider.
Note 2: All pallet loads were stretch-wrapped

4. Ignition: 2 gal. (7.58 L) heptane spill in longitudinal flue centered below four sprinklers.

5. Sprinklers:

Ceiling Sprinkler System Details	In-rack Sprinkler Type and No. of Levels
Discharge Density 0.50 gpm per sq ft (20.4 mm/min.)	155°F (68°C) standard response, large orifice 17/32 in. (13.5 min), RTI 400 (ft-sec)$^{1/2}$ (224(m-sec)$^{1/2}$) at 38 in. (.97 m) deflector to floor.
Orifice Size 17/32 in. (13.5 mm)	Frame parallel to piping. One level of sprinklers.
K-Factor 8.0 (115)	
Temperature Rating 155°F (68°C)	
Response Time Index 400 (ft-sec)$^{1/2}$ (224(m-sec)$^{1/2}$)	
Sprinkler Spacing 100 ft^2 (9.3 m^2)	
Arrangement Pendent	

6. Sprinkler System Type: Wet Pipe - Water only

7. Fuel Quality, Gal. (L): 1,104 gal (4179 L) of heptane

8. Storage Height, In. (m): 6 ft 8 in. (2.03 m)

9. Sprinkler Actuation:

No. of Operating Ceiling Sprinklers, Sprinkler No. & Operating Times	No. of Operating In-rack Sprinklers, Operating Times & Flow
4 Sprinklers #6 @ 1:36 #10 @ 1:46 #7 @ 1:59 #11 @ 2:02	1 at 1:55 at 30 gpm, (114 lpm)

10. Fire Controlled: No

11. Significant Observations:

Damage Assessment	Comments
5 gal (18.9 L) - Plastic pour spout vented on 6-8 containers.	No rupture of any containers. Test terminated at 7 min.
1 gal (3.79 L) - Several caps separated from containers. Limited damage to shrink wrap and cardboard on either end rack. Flue temperature greater than 1300°F between IRAS heads.	Manual Water system on. AFFF added at 7 min. 50 sec. AFFF added to ceiling at 10 min. 12 sec., off at 11 min. 20 sec. and on again at 12 min. Hand hose lines at 13 min. 20 sec.

Table 6

Fire Tests involving flammable and combustible liquids:

1. Test Location: Underwriters Laboratories Inc., Northbrook, IL

TEST No. 5

2. Ceiling Height: 18 ft (5.49 m)

3. Rack Storage Arrangement:

Rack Configuration and Ignitor	Horizontal Rack Member Height	Shelving Material	Tiered Arrangement and Flammable Liquid Fuel Load in Center Bay
24 ft 9 in. (7.5 m) long double row rack with 6-in. (152 mm) flue space and over-all width of 7-1/2 ft (2.3 m). Aisle width 7-1/2 ft (2.3 m).	3 ft 6 in. (1.07 m)	2 in. x 6 in. (50 mm x 150 mm) wood slats spaced 2 in. (50 mm) apart.	1st Tier on Floor 5 gal (18.9 L) metal tighhead containers with plastic pull-up pour spouts stacked two high on a wood pallet totaling 33 in. (.84 m).
Flammable liquid in center bay of double row rack.			Twenty-four containers per pallet with 120 gal (45.4 L) on each pallet and 480 gal (1817 L) on four pallets.
Corrugated cardboard target commodity in both target racks, opposite aisle and N. and S. bays of the double row rack. (1)			2nd Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked three high on a wood pallet totaling 38 in. (.965 m).
2 gal (7.58 L) heptane spill in longitudinal flue centered below four sprinklers.			Thirty-nine cartons containing 4 gal (15.1 L) each with 156 gal (591 L) on each pallet and 624 gal (2362 L) on four pallets.
			Total: 1,104 gal (4179 L) of heptane (2)

Note 1: Corrugated cardboard target commodity consists of empty tri-wall cardboard boxes containing a metal cross divider.
Note 2: All pallet loads were stretch-wrapped

4. Ignition: 2 gal. (7.58 L) heptane spill in longitudinal flue centered below four sprinklers.

5. Sprinklers:

Ceiling Sprinkler System Details	In-rack Sprinkler Type and No. of Levels
Discharge Density 0.50 gpm per sq ft (20.4 mm/min.)	155°F (68°C) quick response, large orifice 17/32 in. (13.5 min), RTI 50 (ft-sec) $^{1/2}$ (28(m-sec) $^{1/2}$ at 38 in. (.97 m) deflector to floor.
Orifice Size 17/32 in. (13.5 mm)	Frame perpendicular to piping. One level of sprinklers.
K-Factor 8.0 (115)	
Temperature Rating 155°F (68°C)	
Response Time Index 400 (ft-sec) $^{1/2}$ 224 (m-sec) $^{1/2}$	
Sprinkler Spacing 100 ft^2 (9.3 m^2)	
Arrangement Pendent	

6. Sprinkler System Type: Wet Pipe - Water only

7. Fuel Quality, Gal. (L): 1,104 gal (4179 L) of heptane

8. Storage Height, In. (m): 6 ft 8 in. (2.03 m)

9. Sprinkler Actuation:

No. of Operating Ceiling Sprinklers, Sprinkler No & Operating Times	No. of Operating In-rack Sprinklers, Operating Times & Flow

Table 6

Fire Tests involving flammable and combustible liquids:

1. Test Location: Underwriters Laboratories Inc., Northbrook, IL

TEST No. 6

2. Ceiling Height: 18 ft (5.49 m)

3. Mixed Rack Storage and Display Arrangement:

Rack Configuration and Ignitor	Horizontal Rack Member Height	Shelving Material	Tiered Arrangement and Flammable Liquid Fuel Load in Center Bay
24 ft 9 in. (7.5 m) long double row rack with 6-in. (150 mm) longitudinal flue space and over-all width of 7-1/2 ft (2.3 m). Aisle width 7-1/2 ft (2.3 m) Flammable liquid in center bay west half of double row rack. Corrugated cardboard target commodity in both single row target racks, opposite aisle, the center bay, east half and N. & S. bays of the double row rack. (1) 2 gal (7.58 L) heptane spill in longitudinal flue centered below four sprinklers.	7 in (.175 m), 36 in. (.91 m), 54 in. (1.37 m), 77 in. (1.96 m), and 95 in. (2.4 m)	Open wire mesh	1st Tier on Floor One hundred and ninety-two display cut 1 gal (3.79 L) metal F-style containers with metal nozzles and caps stacked two high on the shelf. Storage height on the shelf was 20.5 in. (.52 m). 2nd Tier Ninety-six display cut 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked one high on the shelf. Storage height on the shelf was 10.25 in. (.184 m). 3rd Tier Three hundred and sixty display cut 1 qt (.95 L) metal F-style containers with metal spouts and caps stacked two high on the shelf. Storage height on the shelf was 15 in. (.38 m). 4th Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked one high on the shelf. Storage height on the shelf was 11 in. (.28 m). Twenty-four cartons with four containers per carton. 5th Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked four high on a wood pallet totaling 49 in. (1.24 m). Fifty-two cartons containing 4 gal (15.1 L) each with 208 gal (787 L) on each pallet and 416 gal (1574 L) on two pallets. Total: 890 gal (3369 L) of heptane

Note 1: Corrugated cardboard target commodity consists of empty tri-wall cardboard boxes containing a metal cross divider.
Note 2: All pallet loads were stretch-wrapped

4. Ignition: 2 gal. (7.58 L) heptane spill in longitudinal flue centered below four sprinklers.

5. Sprinklers:

Ceiling Sprinkler System Details	In-rack Sprinkler Type and No. of Levels
Discharge Density 0.60 gpm per sq ft (24.5 mm/min.) Orifice Size .64 in. (16.26 mm) K-Factor 11.1 (160) Temperature Rating 286°F (141°C) Response Time Index 260 $(ft\text{-}sec)^{1/2}$ (146$(m\text{-}sec)^{1/2}$) Sprinkler Spacing 100 ft^2 (9.3 m^2) Arrangement Pendent	None.

6. Sprinkler System Type: Wet Pipe - Water only

7. Fuel Quality, Gal. (L): 890 gal (3369 L) of heptane

8. Storage Height, In. (m): 12 ft 8 in. (3.66 m)

9. Sprinkler Actuation:

No. of Operating Ceiling Sprinklers, Sprinkler No. & Operating Times	No. of Operating In-rack Sprinklers, Operating Times & Flow
3 Sprinklers #6 @ 0:52 #10 @ 1:08 #11 @ 1:12	None

Table 6

Fire Tests involving flammable and combustible liquids:

1. Test Location: Underwriters Laboratories Inc., Northbrook, IL

TEST No. 7

2. Ceiling Height: 18 ft (5.49 m)

3. Mixed Rack Storage and Display Arrangement:

Rack Configuration and Ignitor	Horizontal Rack Member Height	Shelving Material	Tiered Arrangement and Flammable Liquid Fuel Load in Center Bay
24 ft 9 in. (7.5 m) long double row rack with 6-in. (150 mm) flue space and overall width of 7-1/2 ft (2.3 m). Aisle width 7-1/2 ft (2.3 m) Flammable liquid in center bay west half of double row rack. Corrugated cardboard target commodity in both single row target racks, opposite aisle, the center bay, east half and N. & S. bays of the double row rack. (1) 2 gal (7.58 L) heptane spill in longitudinal flue centered below four sprinklers.	7 in (.175 m), 36 in. (.91 m), 54 in. (1.37 m), 79 in. (2.0 m), and 97 in. (2.46 m)	Open wire mesh	1st Tier on Floor One hundred and ninety-two display cut 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked two high on the shelf. Storage height on the shelf was 20.5 in. (.52 m) 2nd Tier Ninety-six display cut 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked one high on the shelf. Storage height on the shelf was 10.25 in. (.184 m). 3rd Tier Three hundred and sixty display cut 1 qt (.95 L) metal F-style containers with metal spouts and caps stacked two high on the shelf. Storage height on the shelf was 15 in. (.38 m) 4th Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked one high on the shelf. Storage height on the shelf was 11 in. (.28 m). Twenty-four cartons with four containers per carton. 5th Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked four high on a wood pallet totaling 49 in. (1.24 m). Fifty-two cartons containing 4 gal (15.1 L) each with 208 gal (787 L) on each pallet and 416 gal (1574 L) on two pallets. Total: 890 gal (3369 L) of heptane

Note 1: Corrugated cardboard target commodity consists of empty tri-wall cardboard boxes containing a metal cross divider.
Note 2: All pallet loads were stretch-wrapped

4. Ignition: 2 gal. (7.58 L) heptane spill in longitudinal flue centered below four sprinklers.

5. Sprinklers:

Ceiling Sprinkler System Details	In-rack Sprinkler Type and No. of Levels
Discharge Density 0.60 gpm per sq ft (24.5 mm/min.) Orifice Size .64 in. (16.26 mm) K-Factor 11.1 (160) Temperature Rating 286°F (141°C) Response Time Index 260 $(ft\text{-}sec)^{1/2}$ 146 $(m\text{-}sec)^{1/2}$ Sprinkler Spacing 100 ft^2 (9.3 m^2) Arrangement Pendent	155°F (68°C) quick response, large orifice 17/32 in. (13.5 min), RTI 50 $(ft\text{-}sec)^{1/2}$ (28$(m\text{-}sec)^{1/2}$) at 73 in. (1.85 m) deflector to floor. Frame perpendicular to piping. One level of sprinklers.

6. Sprinkler System Type: Wet Pipe - Water only

7. Fuel Quality, Gal. (L): 890 gal (3369 L) of heptane

8. Storage Height, In. (m): 12 ft (3.66 m)

9. Sprinkler Actuation:

No. of Operating Ceiling Sprinklers, Sprinkler No. & Operating Times	No. of Operating In-rack Sprinklers, Operating Times & Flow
2 Sprinklers #11 @ 1:15 #10 @ 1:33	2 at 1:03 and 1:08 at 30 gpm (114 lpm)

10. Fire Controlled: Yes

11. Significant Observations:

Damage Assessment	Comments

Table 6

Fire Tests involving flammable and combustible liquids:

1. Test Location: Underwriters Laboratories Inc., Northbrook, IL

TEST No. 8

2. Ceiling Height: 18 ft (5.49 m)

3. Mixed Rack Storage and Display Arrangement:

Rack Configuration and Ignitor	Horizontal Rack Member Height	Shelving Material	Tiered Arrangement and Flammable Liquid Fuel Load in Center Bay
24 ft 9 in. (7.5 m) long double row rack with 6-in. (150 mm) flue space and overall width of 7-1/2 ft (2.3 m). Aisle width 7-1/2 ft (2.3 m) Flammable liquid in center bay west half of double row rack. Corrugated cardboard target commodity in both single row target racks, opposite aisle, the center bay, east half and N. & S. bays of the double row rack. (1) 2 gal (7.58 L) heptane in aisle adjacent to rack centered below two sprinklers.	7 in (.175 m), 36 in. (.91 m), 54 in. (1.37 m), 79 in. (2.0 m), and 97 in. (2.46 m)	Open wire mesh	1st Tier on Floor One hundred and ninety-two display cut 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked two high on the shelf. Storage height on the shelf was 20.5 in.(.52 m). 2nd Tier Ninety-six display cut 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked one high on the shelf. Storage height on the shelf was 10.25 in. (.184 m). 3rd Tier Three hundred and sixty display cut 1 qt (.95 L) metal F-style containers with metal spouts and caps stacked two high on the shelf. Storage height on the shelf was 15 in. (.38 m). 4th Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal spounts and caps stacked one high on the shelf. Storage height on the shelf was 11 in. (.28 m). Twenty-four cartons with four containers per carton. 5th Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked four high on a wood pallet totalling 49 in. (1.24 m). Fifty-two cartons containing 4 gal (15.1 L) each with 208 gal (787 L) on each pallet and 416 gal (1574 L) on two pallets. Total: 890 gal (3369 L) of heptane.

Note 1: Corrugated cardboard target commodity consists of empty tri-wall cardboard boxes containing a metal cross divider.
Note 2: All pallet loads were stretch-wrapped

4. Ignition: 2 gal. (7.58 L) heptane spill in longitudinal flue centered below two sprinklers.

5. Sprinklers:

Ceiling Sprinkler System Details	In-rack Sprinkler Type and No. of Levels
Discharge Density 0.60 gpm per sq ft (24.5 mm/min.) Orifice Size .64 in. (16.26 mm) K-Factor 11.1 (160) Temperature Rating 286°F (141°C) Response Time Index 260 (ft-sec)$^{1/2}$ 146(m-sec)$^{1/2}$ Sprinkler Spacing 100 ft^2 (9.3 m^2) Arrangement Pendent	None

6. Sprinkler System Type: Wet Pipe - Water only

7. Fuel Quality, Gal. (L): 890 gal (3369 L) of heptane

8. Storage Height, In. (m): 12 ft (3.66 m)

9. Sprinkler Actuation:

No. of Operating Ceiling Sprinklers, Sprinkler No. & Operating Times	No. of Operating In-rack Sprinklers, Operating Times & Flow
1 Sprinkler #7 @ 1:12	None

10. Fire Controlled: Yes

11. Significant Observations:

Damage Assessment	Comments
No rupture of any containers.	Fire was suppressed by 7 min. 12 sec.

Table 6

Fire Tests involving flammable and combustible liquids:

1. Test Location: Underwriters Laboratories Inc., Northbrook, IL

TEST No. 9

2. Ceiling Height: 27 ft (8.23 m)

3. Mixed Rack Storage and Display Arrangement:

Rack Configuration and Ignitor	Horizontal Rack Member Height	Shelving Material	Tiered Arrangement and Flammable Liquid Fuel Load in Center Bay
24 ft 9 in. (7.5 m) long double row rack with 6-in. (150 mm) flue space and overall width of 7-1/2 ft (2.3 m). Aisle width 7-1/2 ft (2.3 m) Flammable liquid in center bay west half of double row rack. Corrugated cardboard target commodity in both single row target racks, opposite aisle, the center bay, east half and N. & S. bays of the double row rack. (1) 2 gal (7.58 L) heptane in aisle adjacent to rack centered below four sprinklers.	7 in (.175 m), 36 in. (.91 m), 54 in. (1.37 m), 79 in. (2.0 m), and 97 in. (2.46 m)	Open wire mesh	1st Tier on Floor One hundred and ninety-two display cut 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked two high on the shelf. Storage height on the shelf was 20.5 in. (.52 m). 2nd Tier Ninety-six display cut 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked one high on the shelf. Storage height on the shelf was 10.25 in. (.184 m). 3rd Tier Three hundred and sixty display cut 1 qt (.95 L) metal F-style containers with metal spouts and caps stacked two high on the shelf. Storage height on the shelf was 15 in. (.38 m). 4th Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked one high on the shelf. Storage height on the shelf was 11 in. (.28 m). Twenty-four cartons with four containers per carton. 5th Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked four high on a wood pallet totalling 49 in. (1.24 m). Fifty-two cartons containing 4 gal (15.1 L) each with 208 gal (787 L) on each pallet and 416 gal (1574 L) on two pallets. Total: 890 gal (3369 L) of heptane.

Note 1: Corrugated cardboard target commodity consists of empty tri-wall cardboard boxes containing a metal cross divider.
Note 2: All pallet loads were stretch-wrapped

4. Ignition: 2 gal. (7.58 L) heptane spill in longitudinal flue centered below four sprinklers.

5. Sprinklers:

Ceiling Sprinkler System Details	In-rack Sprinkler Type and No. of Levels
Discharge Density 0.60 gpm per sq ft (24.5 mm/min.) Orifice Size .64 in. (16.26 mm) K-Factor 11.1 (160) Temperature Rating 286°F (141°C) Response Time Index 260 $(ft\text{-}sec)^{1/2}$ 146$(m\text{-}sec)^{1/2}$ Sprinkler Spacing 100 ft^2 (9.3 m^2) Arrangement Pendent	155°F (68°C) quick response, large orifice 17/32 in. (13.5 mm), RTI 50 $(ft\text{-}sec)^{1/2}$ (2.8$(m\text{-}sec)^{1/2}$ at 73 in. (1.85 m) deflector to floor. Frame perpendicular to piping. One level of sprinklers.

6. Sprinkler System Type: Wet Pipe - Water only

7. Fuel Quality, Gal. (L): 890 gal (3369 L) of heptane

8. Storage Height, In. (m): 12 ft (3.66 m)

9. Sprinkler Actuation:

No. of Operating Ceiling Sprinklers, Sprinkler No. & Operating Times	No. of Operating In-rack Sprinklers, Operating Times & Flow
2 Sprinklers #7 @ 2:42 #11 @ 19:06	2 at 36 sec.

10. Fire Controlled: Inconclusive

11. Significant Observations:

Damage Assessment	Comments

Table 6

Fire Tests involving flammable and combustible liquids:

1. Test Location: Underwriters Laboratories Inc., Northbrook, IL

TEST No. 10

2. Ceiling Height: 27 ft (8.23 m)

3. Mixed Rack Storage and Display Arrangement:

Rack Configuration and Ignitor	Horizontal Rack Member Height	Shelving Material	Tiered Arrangement and Flammable Liquid Fuel Load in Center Bay
24 ft 9 in. (7.5 m) long double row rack with 6-in. (150 mm) flue space and overall width of 7-1/2 ft (2.3 m). Aisle width 7-1/2 ft (2.3 m) Flammable liquid in center bay west half of double row rack. Corrugated cardboard target commodity in both single row target racks, opposite aisle, the center bay, east half and N. & S. bays of the double row rack. (1) 2 gal (7.58 L) heptane spill in longitudinal flue centered below four sprinklers	7 in (.175 m), 36 in. (.91 m), 54 in. (1.37 m), 79 in. (2.0 m), and 144 in. (3.66 m)	Open wire mesh	1st Tier on Floor One hundred and ninety-two display cut 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked two high on the shelf. Storage height on the shelf was 20.5 in.(.52 m). 2nd Tier Ninety-six display cut 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked one high on the shelf. Storage height on the shelf was 10.25 in. (.184 m). 3rd Tier Three hundred and sixty display cut 1 qt (.95 L) metal F-style containers with metal spouts and caps stacked two high on the shelf. Storage height on the shelf was 15 in. (.38 m). 4th Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts nozzles and caps stacked one high on the shelf. Storage height on the shelf was 11 in. (.28 m). Twenty-four cartons with four containers per carton. 5th Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked three high on a wood pallet totalling 38 in. (.97 m). Thirty-nine cartons containing 4 gal (15.1 L) each with 156 gal (590 L) on each pallet and 312 gal (1181 L) on two pallets. 6th Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked four high on a wood pallet totalling 49 in. (1.24 m). Fifty-two cartons containing 4 gal (15.1 L) each with 208 gal (787 L) on each pallet and 416 gal (1574 L) on two pallets. Total: 1,202 gal (4550 L) of heptane.

Note 1: Corrugated cardboard target commodity consists of empty tri-wall cardboard boxes containing a metal cross divider.
Note 2: All pallet loads were stretch-wrapped

4. Ignition: 2 gal. (7.58 L) heptane spill in longitudinal flue centered below four sprinklers.

5. Sprinklers:

Ceiling Sprinkler System Details	In-rack Sprinkler Type and No. of Levels
Discharge Density 0.60 gpm per sq ft (24.5 mm/min.) Orifice Size .64 in. (16.26 mm) K-Factor 11.1 (160) Temperature Rating 286°F (141°C) Response Time Index 260 $(ft\text{-}sec)^{1/2}$ 146 $(m\text{-}sec)^{1/2}$ Sprinkler Spacing 100 ft^2 (9.3 m^2) Arrangement Pendent	155°F (68°C) quick response, large orifice 17/32 in. (13.5 mm), RTI 50 $(ft\text{-}sec)^{1/2}$ (2.8$(m\text{-}sec)^{1/2}$ at 73 in. (1.85 m) and 138 in. (3.51 m) deflector to floor. Frame perpendicular to piping. Two levels of sprinklers.

6. Sprinkler System Type: Wet Pipe - Water only

7. Fuel Quality, Gal. (L): 1.202 gal (4550 L) of heptane.

8. Storage Height, In. (m): 16 ft (4.88 m)

9. Sprinkler Actuation:

No. of Operating Ceiling Sprinklers, Sprinkler No. & Operating Times	No. of Operating In-rack Sprinklers, Operating Times & Flow
None	3 1 top level at 13 sec.

Table 6

Fire Tests involving flammable and combustible liquids:

1. Test Location: Underwriters Laboratories Inc., Northbrook, IL

TEST No. 11

2. Ceiling Height: 27 ft (8.23 m)

3. Mixed Rack Storage and Display Arrangement:

Rack Configuration and Ignitor	Horizontal Rack Member Height	Shelving Material	Tiered Arrangement and Flammable Liquid Fuel Load in Center Bay
24 ft 9 in. (7.5 m) long double row rack with 6-in. (150 mm) flue space and overall width of 7-1/2 ft (2.3 m). Aisle width 7-1/2 ft (2.3 m)	7 in (.175 m), 36 in. (.91 m), 54 in. (1.37 m), 79 in. (2.0 m), and 95 in. (2.4 m) 144 in. (3.66 m) and 188 in. (4.78 m)	Open wire mesh on top shelf. 2 in. x 6 in. (50 mm x 150 mm) wood spaced 2 in. (50 mm) apart on lower shelves.	One hundred and ninety-two display cut 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked two high on the shelf. Storage height on the shelf was 20.5 in.(.52 m).
Flammable liquid in center bay west half of double row rack.			2nd Tier Ninety-six display cut 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked one high on the shelf. Storage height on the shelf was 10.25 in. (.184 m).
Corrugated cardboard target commodity in both single row target racks, opposite aisle, the center bay, east half and N. & S. bays of the double row rack. (1)			3rd Tier Three hundred and sixty display cut 1 qt (.95 L) metal F-style containers with metal spouts and caps stacked two high on the shelf. Storage height on the shelf was 15 in. (.38 m).
2 gal (7.58 L) heptane spill in longitudinal flue centered below four sprinklers			4th Tier Cartoned of 1 gal (3.79 L) metal F-style containers with metal nozzles and caps stacked one high on the shelf. Storage height on the shelf was 11 in. (.28 m). Twenty-four cartons with four containers per carton.
			5th Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal nozzles and caps stacked three high on a wood pallet totalling 38 in. (.97 m). Thirty-nine cartons containing 4 gal (15.1 L) each with 156 gal (590 L) on each pallet and 312 gal (1181 L) on two pallets.
			6th Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal nozzles and caps stacked four high on a wood pallet totalling 38 in. (.97 m). Thirty-nine cartons containing 4 gal (15.1L) each with 156 gal (590 L) on each pallet and 312 gal (1181 L) on two pallets.
			7th Tier Corrugated cardboard commodity consisting of an empty double tri-wall box containing a metal cross divider on a wood pallet totalling 47 in. (1.2 m).
			Total: 1,098 gal (3816 L) of heptane.

Note 1: Corrugated cardboard target commodity consists of empty tri-wall cardboard boxes containing a metal cross divider.
Note 2: All pallet loads were stretch-wrapped

4. Ignition: 2 gal. (7.58 L) heptane spill in longitudinal flue centered below four sprinklers.

5. Sprinklers:

Ceiling Sprinkler System Details	In-rack Sprinkler Type and No. of Levels
Discharge Density 0.60 gpm per sq ft (24.5 mm/min.)	155°F (68°C) quick response, large orifice 17/32 in. (13.5 mm), RTI 50 (ft-sec)$^{1/2}$ (2.8(m-sec)$^{1/2}$ at 73 in. (1.85 m) and 138 in. (3.51 m) deflector to floor. Frame perpendicular to piping. Two levels of sprinklers.
Orifice Size .64 in. (16.26 mm)	
K-Factor 11.1 (160)	
Temperature Rating 286°F (141°C)	
Response Time Index 260 (ft-sec)$^{1/2}$ 146(m-sec)$^{1/2}$	
Sprinkler Spacing 100 ft^2 (9.3 m^2)	
Arrangement Pendent	

6. Sprinkler System Type: Wet Pipe - Water only

7. Fuel Quality, Gal. (L): 1.098 gal (3816 L) of heptane.

8. Storage Height, In. (m): 19 ft (7.5 m)

Table 6

Fire Tests involving flammable and combustible liquids:

1. Test Location: Underwriters Laboratories Inc., Northbrook, IL

TEST No. 12

2. Ceiling Height: 27 ft (8.23 m)

3. Mixed Rack Storage and Display Arrangement:

Rack Configuration and Ignitor	Horizontal Rack Member Height	Shelving Material	Tiered Arrangement and Flammable Liquid Fuel Load in Center Bay
24 ft 9 in. (7.5 m) long double row rack with 6-in. (150 mm) flue space and overall width of 7-1/2 ft (2.3 m). Aisle width 7-1/2 ft (2.3 m)	7 in (.175 m), 36 in. (.91 m), 54 in. (1.37 m), 79 in. (2.0 m) 95 in. (2.4 m), and 144 in. (3.66 m).	Open wire mesh on top shelf. 2 in. x 6 in. (50 mm x 150 mm) wood spaced 2 in. (50 mm) apart on lower shelves.	1st Tier on Floor One hundred and ninety-two display cut 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked two high on the shelf. Storage height on the shelf was 20.5 in.(.52 m).
Flammable liquid in center bay west half of double row rack.			2nd Tier Ninety-six display cut 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked one high on the shelf. Storage height on the shelf was 10.25 in. (.184 m).
Corrugated cardboard target commodity in both single row target racks, opposite aisle, the center bay, east half and N. & S. bays of the double row rack. (1)			3rd Tier Three hundred and sixty display cut 1 qt (.95 L) metal F-style containers with metal spouts and caps stacked two high on the shelf. Storage height on the shelf was 15 in. (.38 m).
2 gal (7.58 L) heptane spill in longitudinal flue centered below four sprinklers			4th Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked one high on the shelf. Storage height on the shelf was 11 in. (.28 m). Twenty-four cartons with four containers per carton.
			5th Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked three high on a wood pallet totalling 38 in. (.97 m). Thirty-nine cartons containing 4 gal (15.1 L) each with 156 gal (590 L) on each pallet and 312 gal (1181 L) on two pallets.
			6th Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked four high on a wood pallet totalling 49 in. (1.24 m). Fifty-two cartons containing 4 gal (15.1 L) each with 208 gal (787 L) on each pallet and 416 gal (1574 L) on two pallets. Total: 1,202 gal (4550 L) of heptane.

Note 1: Corrugated cardboard target commodity consists of empty tri-wall cardboard boxes containing a metal cross divider.
Note 2: All pallet loads were stretch-wrapped

4. Ignition: 2 gal. (7.58 L) heptane spill in longitudinal flue centered below four sprinklers.

5. Sprinklers:

Ceiling Sprinkler System Details	In-rack Sprinkler Type and No. of Levels
Discharge Density 0.60 gpm per sq ft (24.5 mm/min.)	155°F (68°C) quick response, large orifice 17/32 in. (13.5 mm), RTI 50 (ft-sec)$^{1/2}$ (2.8(m-sec)$^{1/2}$ at 73 in. (1.85 m) and 138 in. (3.51 m) deflector to floor. Frame perpendicular to piping. One level of sprinklers.
Orifice Size .64 in. (16.26 mm)	
K-Factor 11.1 (160)	
Temperature Rating 286°F (141°C)	
Response Time Index 260 (ft-sec)$^{1/2}$ 146(m-sec)$^{1/2}$	
Sprinkler Spacing 100 ft^2 (9.3 m^2)	
Arrangement Pendent	

6. Sprinkler System Type: Wet Pipe - Water only

7. Fuel Quality, Gal. (L): 1.202 gal (4550 L) of heptane.

8. Storage Height, In. (m): 16 ft (4.88m)

9. Sprinkler Actuation:

No. of Operating Ceiling Sprinklers, Sprinkler No. & Operating Times	No. of Operating In-rack Sprinklers, Operating Times & Flow

Table 6

Fire Tests involving flammable and combustible liquids:

1. Test Location: Underwriters Laboratories Inc., Northbrook, IL

TEST No. 13

2. Ceiling Height: 27 ft (8.23 m)

3. Mixed Rack Storage and Display Arrangement:

Rack Configuration and Ignitor	Horizontal Rack Member Height	Shelving Material	Tiered Arrangement and Flammable Liquid Fuel Load in Center Bay
24 ft 9 in. (7.5 m) long double row rack with 6-in. (150 mm) flue space and overall width of 7-1/2 ft (2.3 m). Aisle width 7-1/2 ft (2.3 m) Combustible liquid in center bay, west half of double row rack. Corrugated cardboard target commodity in both single row target racks, opposite aisle, the center bay, east half and N. & S. bays of the double row rack. (1) 2 gal (7.58 L) heptane spill in longitudinal flue centered below four sprinklers	7 in (.175 m), 36 in. (.91 m), 55 in. (1.39 m), 83 in. (2.1 m), and 101 in. (2.57 m)	2 in. x 6 in. (50 mm x 150 mm) wood spaced 2 in. (50 mm) apart.	1st Tier on Floor One hundred sixty-eight display cut 1 gal (3.79 L) metal friction lid containers stacked two high on the shelf. Storage height on the shelf was 15 in. (.38 m). 2nd Tier Eighty-four display cut 1 gal (3.79 L) metal friction lid containers stacked one high on the shelf. Storage height on the shelf was 7.5 in. (.191 m). 3rd Tier One hundred sixty-eight display cut 1 gal (3.79 L) metal friction lid containers stacked two high on the shelf. Storage height on the shelf was 15 in. (.38 m). 4th Tier Cartoned 1 gal (3.79 L) metal F-style containers with metal spouts and caps stacked one high on the shelf was 7.75 in. (.197 m).Eighteen cartons with four containers per carton. 5th Tier Cartoned 1 gal (3.79 L) metal friction lid containers stacked four high on a wood pallet totalling 36 in. (.91 m). Total: 780 gal (2953 L) of mineral spirits.

Note 1: Corrugated cardboard target commodity consists of empty tri-wall cardboard boxes containing a metal cross divider.
Note 2: All pallet loads were stretch-wrapped

4. Ignition: 2 gal. (7.58 L) heptane spill in longitudinal flue centered below four sprinklers.

5. Sprinklers.

Ceiling Sprinkler System Details	In-rack Sprinkler Type and No. of Levels
Discharge Density 0.60 gpm per sq ft (24.5 mm/min.) Orifice Size .64 in. (16.26 mm) K-Factor 11.1 (160) Temperature Rating 286°F (141°C) Response Time Index 260 $(ft\text{-}sec)^{1/2}$ (146$(m\text{-}sec)^{1/2}$) Sprinkler Spacing 100 ft^2 (9.3 m^2) Arrangement Pendent	None

6. Sprinkler System Type: Wet Pipe - Water only

7. Fuel Quality, Gal. (L): 780 gal (5950 L) of mineral spirits.

8. Storage Height, In. (m): 11 ft 8 in. (3.56 m)

9. Sprinkler Actuation:

No. of Operating Ceiling Sprinklers, Sprinkler No. & Operating Times	No. of Operating In-rack Sprinklers, Operating Times & Flow
2 Sprinklers #6 @ 1:21 #7 @ 3:36	None

10. Fire Controlled: No

11. Significant Observations:

Damage Assessment	Comments
1 gal (3.79 L) - Forty to fifty friction lid containers were opened resulting in a fire that completely engulfed the test commodity in the array. Numerous containers spilled on the floor. Containers began opening at approximately 42 secs. Horizontal steel rack supports deflected outward due to heat resulting in wood slats and test commodity dropping onto storage below.	Test terminated 5 min. and extinguished by manual foam water deluge system by 5 min. 20 sec. Used containers intended for viscous materials.

Table 6

Fire Tests involving flammable and combustible liquids:

1. Test Location: Underwriters Laboratories Inc., Northbrook, IL

TEST No. 14

2. Ceiling Height: 27 ft (8.23 m)

3. Mixed Rack Storage and Display Arrangement:

Rack Configuration and Ignitor	Horizontal Rack Member Height	Shelving Material	Tiered Arrangement and Flammable Liquid Fuel Load in Center Bay
24 ft 9 in. (7.5 m) long double row rack with 6-in. (150 mm) flue space and overall width of 7-1/2 ft (2.3 m). Aisle width 7-1/2 ft (2.3 m) Combustible liquid in center bay of double row rack. Corrugated cardboard target commodity in both single row target racks, opposite aisle, the center bay, east half and N. & S. bays of the double row rack. (1) 2 gal (7.58 L) heptane spill in longitudinal flue centered below four sprinklers	7 in (.175 m), 36 in. (.91 m), 55 in. (1.39 m), 83 in. (2.1 m), and 101 in. (2.57 m)	Open wire mesh.	1st Tier on Floor Three hundred thirty-six display cut 1 gal (3.79 L) metal friction lid containers stacked two high on the shelves. Storage height on the shelves was 15 in. (.38 m). 2rd Tier One hundred sixty-eight display cut 1 gal (3.79 L) metal friction lid containers stacked two high on the shelf. Storage height on the shelf was 7.5 in. (.191 m). 3rd Tier Three hundred thirty-six display cut 1 gal (3.79 L) metal friction lid containers stacked two high on the shelves. Storage height on the shelves was 15 in. (.38 m). 4th Tier Cartoned 1 gal (3.79 L) metal friction lid containers one high on the shelves was 7.75 in. (.197 m). Thirty-six cartons with four containers per carton. 5th Tier Cartoned 1 gal (3.79 L) metal friction lid containers stacked four high on a wood pallet totalling 36 in. (.91 m). Thirty-six cartons containing 4 gal (15.1 L) each with 144 gal (545 L) on each pallet and 576 gal (2180 L) on four pallets. Total: 1,560 gal (5905 L) of mineral spirits.

Note 1: Corrugated cardboard target commodity consists of empty tri-wall cardboard boxes containing a metal cross divider.
Note 2: All pallet loads were stretch-wrapped

4. Ignition: 2 gal. (7.58 L) heptane spill in longitudinal flue centered below four sprinklers.

5. Sprinklers:

Ceiling Sprinkler System Details	In-rack Sprinkler Type and No. of Levels
Discharge Density 0.60 gpm per sq ft (24.5 mm/min.) Orifice Size .64 in. (16.26 mm) K-Factor 11.1 (160) Temperature Rating 286°F (141°C) Response Time Index 260 $(ft\text{-}sec)^{1/2}$ 146$(m\text{-}sec)^{1/2}$ Sprinkler Spacing 100 ft^2 (9.3 m^2) Arrangement Pendent	None

6. Sprinkler System Type: Wet Pipe - Water only

7. Fuel Quality, Gal. (L): 1,560 gal (5950 L) of mineral spirits.

8. Storage Height, In. (m): 11 ft 8 in. (3.56 m)

9. Sprinkler Actuation:

No. of Operating Ceiling Sprinklers, Sprinkler No. & Operating Times	No. of Operating In-rack Sprinklers, Operating Times & Flow
7 Sprinklers #6 @ 1:42 #14 @ 3:06 #7 @ 3:09 #15 @ 3:09 #11 @ 3:15 #9 @ 3:18 #10 @ 3:21	None

10. Fire Controlled: No

11. Significant Observations:

Damage Assessment	Comments

Table 6

Fire Tests involving flammable liquids:

1. Test Location: Underwriters Laboratories Inc., Northbrook, IL

DISPLAY TEST 4

2. Ceiling Height: 18 ft (5.49 m)

3. Display Arrangement:

Rack Configuration and Ignitor	Shelf Height	Shelving Material	Shelf Storage Arrangement and Total Flammable Liquid Fuel Load
7 ft (2.1 m) wide metal shelf unit with enclosed top, back and sides. Vertical metal divider 3 ft (.91 m) in from one side. Shelf mounted on open wire mesh 7 in. (.18 m) above floor. 2 gal (7.58 L) heptane spill in aisle adjacent to front of shelf.	11.5 in. (.29 m), 35 in. (.89 m), 51.25 in. (1.3 m), 68 in. (1.73 m), and 80.25 in. (2.04 m)	Solid metal.	1st Tier on Floor Fourteen display cut 5 gal (18.9 L) metal tighthead containers with plastic pull-up pour spout. 2rd Tier Forty-eight display cut 1 gal (3.79 L) metal F-style containers with metal spouts and caps. 3rd Tier Forty-eight display cut 1 gal (3.79 L) metal F-style containers with metal spouts and caps. 4th Tier Sixty-eight display cut 1 quart (.95 L) metal containers. 5th Tier Sixty-eight display cut 1 quart (.95 L) metal containers. Total: 200 gal (758 L) of heptane

Note 1: Corrugated cardboard target commodity consists of empty tri-wall cardboard boxes containing a metal cross divider.

4. Ignition: 2 gal. (7.58 L) heptane spill in aisle adjacent to front of shelf.

5. Sprinklers:

Ceiling Sprinkler System Details	In-rack Sprinkler Type and No. of Levels
Discharge Density 0.30 gpm per sq. ft (12.2 mm/min) Orifice Size 17/32 in. (13.5 mm) K-Factor 8.0 (115) Temperature Rating 286°F (141°C) Response Time Index 400 $(ft\text{-}sec)^{1/2}$ 224 $(m\text{-}sec)^{1/2}$ Sprinkler Spacing 100 ft^2 (9.3 m^2) Arrangement Pendent	None.

6. Sprinkler System Type: Wet Pipe - Water only

7. Fuel Quality, Gal. (L): 200 gal (758 L) of heptane.

8. Storage Height, In. (m): 88 in. (2.23 m)

9. Sprinkler Actuation:

No. of Operating Ceiling Sprinklers, Sprinkler No. & Operating Times	No. of Operating In-rack Sprinklers, Operating Times & Flow
12 All but #'s 1, 5, 9 and 13 Between 2 min. 47 sec., and 3 min. 5 sec.	None

10. Fire Controlled: No

11. Significant Observations:

Damage Assessment	Comments
Polyethylene pour spouts vented on all 5 gal (18.9 L) containers. Rupture of several quart containers caused top shelf to move out of place. 29 quart containerson floor.	Several 1 quart (.97 L) metal F-style containers of heptane ruptured a few seconds after the first ceiling sprinkler operated. This caused a total of 12 ceiling sprinklers, all but numbers 1, 5, 9 and 13, to operate over an 18 sec. period.

Table 6

Fire Tests involving Combustible liquids:

1. Test Location: Underwriters Laboratories Inc., Northbrook, IL

DISPLAY TEST 5

2. Ceiling Height: 18 ft (5.49 m)

3. Display Arrangement:

Rack Configuration and Ignitor	Shelf Height	Shelving Material	Shelf Storage Arrangement and Total Flammable Liquid Fuel Load
Double row with 6-inch (150 mm) flue space and overall width of 7-1/2 ft (2.3 m). Corrugated cardboard target commodity on back side. (1) 2 gal (7.58 L) heptane spill in longitudinal flue.	7 in. (.175 m), and 42 in. (1.01 m),	2 in. x 6 in. (50 mm x 150 mm) wood slats spaced 2 in. (50 mm) apart.	1st Tier on Floor Two hundred and sixteen display cut 1 gal (3.79 L) plastic containers stacked two high on the shelf. Storage height on the shelf was 25 in. (.64 m). 2rd Tier Two hundred and sixteen display cut 1 gal (3.79 L) plastic containers 25 in. (.64 m). Total: 432 gal (1635 L) of mineral spirits.

Note 1: Corrugated cardboard target commodity consists of empty tri-wall cardboard boxes containing a metal cross divider.

4. Ignition: 2 gal. (7.58 L) heptane spill in longitudinal flue.

5. Sprinklers:

Ceiling Sprinkler System Details	In-rack Sprinkler Type and No. of Levels
Orifice Size 17/32 in. (13.5 mm)	Orifice Size 17/32 in. (13.5 mm)
K-Factor 8.0 (115)	K-Factor 8.0 (115)
Temperature Rating 155°F (68°C)	Temperature Rating 155°F (68°C)
Response Time Index 400 $(ft\text{-}sec)^{1/2}$ 228 $(m\text{-}sec)^{1/2}$	Response Time Index 50 $(ft\text{-}sec)^{1/2}$ 28 $(m\text{-}sec)^{1/2}$
Sprinkler Spacing 100 ft^2 (9.3 m^2)	Sprinkler Spacing 8 ft 3 in. (2.52 m) at 38 in. (.97 m) deflector to floor
Arrangement Pendent	Arrangement Pendent

6. Sprinkler System Type: Wet Pipe - Water only

7. Fuel Quality, Gal. (L): 432 gal (1635 L) of mineral spirits.

8. Storage Height, In. (m): 67 in. (1.7 m)

9. Sprinkler Actuation:

No. of Operating Ceiling Sprinklers, Sprinkler No. & Operating Times	No. of Operating In-rack Sprinklers, Operating Times & Flow
15 Sprinklers Between 60 sec. and 72 sec.	2 at 27 sec. at 30 gpm (114 lpm)

10. Fire Controlled: No

11. Significant Observations:

Damage Assessment	Comments
Approximately 100 containers partially melted and/or leaked.	Test terminated at 80 sec. AFFF added.

(Log #80)
Committee: FLC-OPS

30-133 - (5-3 (New)): Accept
SUBMITTER: Richard J. Hild, Verlan Fire Insurance Company
RECOMMENDATION: Add a new scope statement, 5-3.1, and move paragraphs 5-4.1.1 through 5-4.2 into this section as shown:

Chapter 5 Operations
5-3 Facility Design.
5-3.1 Scope. This section shall apply to operations where the handling and use of liquids is a principal activity. This section does not apply to operations where the handling and use of liquids is incidental to the principal activity. (See Section 5-5, Incidental Operations.)
5-3.2 (5-3.1) Location.
5-3.2.1 (5-3.1.1) The minimum distance of a processing vessel to adjoining property or to the nearest important building on the same property shall be based on the stability of the liquid and vessel capacity and shall be in accordance with Table 5-3.2.1, except as modified in 5-3.2.2.
5-3.2.2 (5-3.1.2) Where process vessels are located in a building and the exterior wall facing the exposure (line of adjoining property that can be built upon or nearest important building on the same property) is greater than 25 ft (7.6 m) from the exposure and is a blank wall having a fire resistance rating of not less than 2 hr, any greater distances required in Table 5-3.1.1 shall be permitted to be waived. Where a blank wall having a fire resistance rating of not less than 4 hr is provided, distance requirements shall be permitted to be waived. In addition, when Class IA or unstable liquids are handled the wall shall have explosion resistance in accordance with good engineering practice. (See 5-3.2.7 relative to explosion relief of other walls of this building.)
5-3.2.3 (5-3.1.3) Other liquid processing equipment, such as pumps, heaters, filters, exchangers, etc., shall not be located closer than 25 ft (7.6 m) to property lines where the adjoining property is or can be built upon or to the nearest important building on the same property that is not an integral part of the process. This spacing requirement shall be permitted to be waived where exposures are protected as outlined in 5-3.2.2.
NOTE: Equipment operated at pressures over 1000 psig (7000 kPa) may require greater spacing.
5-3.2.4 (5-3.1.4) Processing equipment in which unstable liquids are handled shall be separated from unrelated plant facilities that use or handle liquids by either 25-ft (7.6-m) clear spacing or a wall having a fire resistance rating of not less than 2 hr. The wall shall also have explosion resistance in accordance with good engineering practice.
5-3.2.5 (5-3.1.5) Each process unit or building containing liquid-processing equipment shall be accessible from at least one side for fire fighting and fire control.
5-3.3 (5-3.2) Construction.
5-3.3.1 (5-3.2.1) Processing buildings or structures shall be of fire resistive or noncombustible construction, except that combustible construction shall be permitted to be used where automatic sprinklers or equivalent protection is provided, subject to approval of the authority having jurisdiction. (See NFPA 220, Standard on Types of Building Construction.)
5-3.3.2 (5-3.2.2) Where walls are required for separation of processing operations from other occupancies or property lines, they shall have a fire resistance rating of at least 2 hr. In addition, where Class IA or unstable liquids are stored or processed, the separating wall shall have explosion resistance in accordance with good engineering practice. (See 5-3.3.7 relative to explosion relief of other walls of this building or area.)
5-3.3.3 (5-3.2.3) Class I liquids shall not be handled or used in basements. Where Class I liquids are handled or used above grade within buildings with basements or closed pits into which flammable vapors can travel, such below grade areas shall be provided with mechanical ventilation designed to prevent the accumulation of flammable vapors. Means shall be provided to prevent liquid spills from running into basements.
5-3.3.4 (5-3.2.4) Provision for smoke and heat venting shall be permitted to assist access for fire fighting. (NFPA 204M, Guide for Smoke and Heat Venting, provides information on this subject.)
5-3.3.5 (5-3.2.5) Areas shall have exit facilities arranged to prevent occupants from being trapped in the event of fire. (NFPA 101, Life Safety Code, provides information on the design of exit facilities.) Exits shall not be exposed by the drainage facilities described in 5-3.4.***
5-3.3.6 (5-3.2.6) Adequate aisles shall be maintained for unobstructed movement of personnel and fire protection equipment.
5-3.3.7 (5-3.2.7) Areas where Class IA or unstable liquids are processed shall have explosion venting through one or more of the following methods:
(a) open air construction;
(b) lightweight walls and/or roof;
(c) lightweight wall panels and roof hatches;
(d) windows of explosion-venting type.
(NFPA 68, Guide for Venting of Deflagrations, provides information on this subject.)
5-3.4 (5-3.3) Ventilation.
5-3.4.1 (5-3.3.1) Enclosed processing areas handling or using Class I liquids or Class II or Class III liquids at temperatures above their flash points shall be ventilated at a rate sufficient to maintain the concentration of vapors within the area at or below 25 percent of the lower flammable limit. This shall be confirmed by one of the following:
(a) Calculations based on the anticipated fugitive emissions (see Appendix F for calculation method), or
(b) Sampling of the actual vapor concentration under normal operating conditions.

Table 5-3.2.1 Location of Processing Vessels from Property Lines and Nearest Important Building on the Same Property Where Protection for Exposures Is Provided

Vessel Maximum Operating Liquid Capacity (gal)	Minimum Distance from Property Line that Is or Can Be Built Upon, Including Opposite Side of Public Way (ft)				Minimum Distance from Nearest Side of Any Public Way or from Nearest Important Building on Same Property that Is Not an Integral Part of the Process (ft)			
	Stable Liquid Emergency Relief		Unstable Liquid Emergency Relief		Stable Liquid Emergency Relief		Unstable Liquid Emergency Relief	
	Not Over 2.5 psig	Over 2.5 psig	Not Over 2.5 psig	Over 2.5 psig	Not Over 2.5 psig	Over 2.5 psig	Not Over 2.5 psig	Over 2.5 psig
275 or less	5	10	15	20	5	10	15	20
276 to 750	10	15	25	40	5	10	15	20
751 to 12,000	15	25	40	60	5	10	15	20
12,001 to 30,000	20	30	50	80	5	10	15	20
30,001 to 50,000	30	45	75	120	10	15	25	40
50,001 to 100,000	50	75	125	200	15	25	40	60
Over 100,000	80	120	200	300	25	40	65	100

NOTE: Double all of above distances where protection for exposures is not provided.

The sampling shall be conducted at a 5-ft (1.5-m) radius from each potential vapor source extending to or toward the bottom and the top of the enclosed processing area. The vapor concentration used to determine the required ventilation rate shall be the highest measured concentration during the sampling procedure.

(NOTE: Equipment in enclosed processing areas can deteriorate over time, and periodic sampling should be conducted to ensure that leakage rates have not increased or that the ventilation rate is adequate for any increase in leakage rates.)

An acceptable alternate is to provide ventilation at a rate of not less than 1 cu ft per min per sq ft of solid floor area (0.3 m^3 per min per m^2). Ventilation shall be accomplished by natural or mechanical ventilation, with discharge or exhaust to a safe location outside the building, without recirculation of the exhaust air.

Exception: Recirculation is permitted where it is monitored continuously using a fail-safe system that is designed to automatically sound an alarm, stop recirculation, and provide full exhaust to the outside in the event that vapor-air mixtures in concentration over one-fourth of the lower flammable limit are detected.

Provision shall be made for introduction of make-up air in such a manner as to avoid short-circuiting the ventilation. Ventilation shall be arranged to include all floor areas or pits where flammable vapors may collect. Where natural ventilation is inadequate, mechanical ventilation shall be provided and shall be kept in operation while flammable liquids are being handled. Local or spot ventilation may be needed for the control of special fire or health hazards. Such ventilation, if provided, can be utilized for up to 75 percent of the required ventilation. (NFPA 91, Standard for Exhaust Systems for Air Conveying of Materials, and NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems, provide information on this subject.)

5-3.4.2 (5-3.3.2) Equipment used in a building and the ventilation of the building shall be designed to limit flammable vapor-air mixtures under normal operating conditions to the interior of equipment and to not more than 5 ft (1.5 m) from equipment that exposes Class I liquids to the air. Examples of such equipment are dispensing stations, open centrifuges, plate and frame filters, open vacuum filters, and surfaces of open equipment.

5-3.5 (5-3.4) Drainage.

5-3.5.1 (5-3.4.1) Emergency drainage systems shall be provided to direct liquid leakage and fire protection water to a safe location. This might require curbs, scuppers, or special drainage systems to control the spread of fire. (Appendix A of NFPA 15, Standard for Water Spray Fixed Systems for Fire Protection, provides information on this subject.)

5-3.5.2 (5-3.4.2) Emergency drainage systems, if connected to public sewers or discharged into public waterways, shall be equipped with traps or separators.

5-3.5.3 (5-3.4.3) A facility shall be designed and operated to prevent the discharge of liquids to public waterways, public sewers, or adjoining property.

5-3.6 (5-3.5) Electrical Equipment.

5-3.6.1 (5-3.5.1) This section shall apply to areas where Class I liquids are stored or handled and to areas where Class II or Class III liquids are stored or handled at temperatures at or above their flash points, (see 1-1.3).

5-3.6.2 (5-3.5.2) All electrical equipment and wiring shall be of a type specified by, and installed in accordance with, NFPA 70, National Electrical Code.

5-3.6.3 (5-3.5.3) So far as it applies, Table 5-3.6.3 shall be used to delineate and classify areas for the purpose of installation of electrical equipment under normal conditions. In the application of classified areas, a classified area shall not extend beyond a floor, wall, roof, or other solid partition that has no communicating openings. The designation of classes and divisions is defined in Chapter 5, Article 500, of NFPA 70, National Electrical Code. [See NFPA 497A, Recommended Practice for Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas, and NFPA 497M, Manual for Classification of Gases, Vapors, and Dusts for Electrical Equipment in Hazardous (Classified) Locations, for guidance.]

5-3.6.4 (5-3.5.4) The area classifications listed in Table 5-3.6.3 are based on the premise that the installation meets the applicable requirements of this code in all respects. Should this not be the case, the authority having jurisdiction shall have the authority to classify the extent of the area.

5-3.6.5 (5-3.5.5) Where the provisions of 5-3.6.1, 5-3.6.2, 5-3.6.3, and 5-3.6.4 require the installation of electrical equipment suitable for Class I, Division 1 or Division 2 locations, ordinary electrical equipment including switchgear shall be permitted to be used if installed in a room or enclosure that is maintained under positive pressure with respect to the classified area. Ventilation make-up air shall not be contaminated. (NFPA 496, Standard for Purged and Pressurized Enclosures for Electrical Equipment, provides details for these types of installations.)

5-3.7 (5-4) Liquid Handling, Transfer, and Use.

5-3.7.1 (5-4.1.1) Class I liquids shall be kept in closed tanks or containers when not actually in use. Class II and Class III liquids shall be kept in closed tanks or containers when ambient or process temperature is at or above their flash point.

5-3.7.2 (5-4.1.2) Where liquids are used or handled, provisions shall be made to promptly and safely dispose of leakage or spills.

5-3.7.3 (5-4.1.3) Class I liquids shall not be used outside closed systems where there are open flames or other ignition sources within the classified areas as set forth in Table 5-3.6.3.

5-3.7.4 (5-4.1.4) Transfer of liquids among vessels, containers, tanks, and piping systems by means of air or inert gas pressure shall be permitted only under all of the following conditions:

(a) The vessels, containers, tanks, and piping systems shall be designed for such pressurized transfer and shall be capable of withstanding the anticipated operating pressure.

(b) Safety and operating controls, including pressure relief devices, shall be provided to prevent overpressure of any part of the system.

(c) Only inert gas shall be used to transfer Class I liquids. Inert gas shall be used to transfer Class II and Class III liquids that are heated above their flash points.

5-3.7.5 (5-4.1.5) Positive displacement pumps shall be provided with pressure relief discharging back to the tank, pump suction, or other suitable location or shall be provided with interlocks to prevent overpressure.

5-3.7.6 (5-4.1.6) Piping, valves, flexible connectors and fittings shall be in accordance with Chapter 3, "Piping Systems."

5-3.7.7 (5-4.1.7) Approved hose shall be permitted to be used at transfer stations.

5-3.8* (5-4.2*) Equipment. Equipment shall be designed and arranged to prevent the unintentional escape of liquids and vapors and to minimize the quantity escaping in the event of accidental release.

SUBSTANTIATION: This is being proposed in conjunction with the Technical Committee's efforts to revise Chapter 5.

COMMITTEE ACTION: Accept.

Make the following corrections:

1. In 5-3.7.6 (former 5-4.1.6), delete the words "flexible connectors."
2. In 5-3.7.7 (former 5-4.1.7), revise the sentence to read "Listed flexible connectors shall be permitted to be used where vibration exists. Approved hose shall be permitted to be used at transfer stations."
3. Mark Section 5-4 "RESERVED."

COMMITTEE STATEMENT: The first two items are corrections of errors. It was not the submitter's intent to make any changes to the wording. Since part of former Section 5-4 has been incorporated into new Section 5-3 and the rest of 5-4 is incorporated into a new Section 5-5, Section 5-4 is being reserved for future use.

NOTE: Where vertical rules are absent, the text has been further revised by subsequent proposals.

(Log #87)
Committee: FLC-OPS

30- 134 - (5-3 (New)): Reject

SUBMITTER: Richard J. Hild, Verlan Fire Insurance Company

RECOMMENDATION: Add the following paragraph to the end of Section 5-3:

5-3.9 Control of Static Electricity. Static electricity controls, which include bonding and grounding, shall be provided in accordance with 5-9.4.

SUBSTANTIATION: This paragraph is needed to highlight the importance of static electricity controls and to direct the user to the requirements in Section 5-9.

COMMITTEE ACTION: Reject.

COMMITTEE STATEMENT: This is already covered in 5-6.2.4.

Table 5-3.6.3 Electrical Area Classifications

Location	NEC Class I Division	Extent of Classified Area
Indoor equipment installed in accordance with 5-3.3.2 where flammable vapor-air mixtures may exist under normal operation	1	Area within 5 ft of any edge of such equipment, extending in all directions.
	2	Area between 5 ft and 8 ft of any edge of such equipment, extending in all directions. Also, area up to 3 ft above floor or grade level within 5 ft to 25 ft horizontally from any edge of such equipment.*
Outdoor equipment of the type covered in 5-3.3.2 where flammable vapor-air mixtures may exist under normal operation	1	Area within 3 ft of any edge of such equipment, extending in all directions.
	2	Area between 3 ft and 8 ft of any edge of such equipment, extending in all directions. Also, area up to 3 ft above floor or grade level within 3 ft to 10 ft horizontally from any edge of such equipment.
Tank—aboveground	1	Area inside dike where dike height is greater than the distance from the tank to the dike for more than 50 percent of the tank circumference.
Shell, ends, or roof and dike area	2	Within 10 ft from shell, ends, or roof of tank. Area inside dikes to level of top of dike.
Vent	1	Within 5 ft of open end of vent, extending in all directions.
	2	Area between 5 ft and 10 ft from open end of vent, extending in all directions.
Floating roof	1	Area above the roof and within the shell.
Underground tank fill opening	1	Any pit, box, or space below grade level, if any part is within a Division 1 or 2 classified area.
	2	Up to 18 in. above grade level, within a horizontal radius of 10 ft from a loose fill connection and within a horizontal radius of 5 ft from a tight fill connection.
Vent—discharging upward	1	Within 3 ft of open end of vent, extending in all directions.
	2	Area between 3 ft and 5 ft of open end of vent, extending in all directions.
Drum and container filling outdoors, or indoors with adequate ventilation	1	Within 3 ft of vent and fill openings, extending in all directions.
	2	Area between 3 ft and 5 ft from vent or fill opening, extending in all directions. Also, up to 18 in. above floor or grade level within a horizontal radius of 10 ft from vent or fill openings.
Pumps, bleeders, withdrawal fittings, meters and similar devices		
Indoors	2	Within 5 ft of any edge of such devices, extending in all directions. Also up to 3 ft above floor or grade level within 25 ft horizontally from any edge of such devices.
Outdoors	2	Within 3 ft of any edge of such devices, extending in all directions. Also up to 18 in. above grade level within 10 ft horizontally from any edge of such devices.
Pits		
Without mechanical ventilation	1	Entire area within pit if any part is within a Division 1 or 2 classified area.
With adequate mechanical ventilation	2	Entire area within pit if any part is within a Division 1 or 2 classified area.
Containing valves, fittings, or piping, and not within a Division 1 or 2 classified area	2	Entire pit.
Drainage ditches, separators, impouding basins		
Outdoor	2	Area up to 18 inches above ditch, separator, or basin. Also up to 18 inches above grade within 15 ft horizontally from any edge.
Indoor		Same as pits.

*The release of Class I liquids may generate vapors to the extent that the entire building, and possibly a zone surrounding it, should be considered a Class I, Division 2 location.

(continued)

Table 5-3.6.3, cont.

Location	NEC Class I Division	Extent of Classified Area
Tank vehicle and tank car* loading through open dome	1	Within 3 ft of edge of dome, extending in all directions.
	2	Area between 3 ft and 15 ft from edge of dome, extending in all directions.
Loading through bottom connections with atmospheric venting	1	Within 3 ft of point of venting to atmosphere, extending in all directions.
	2	Area between 3 ft and 15 ft from point of venting to atmosphere, extending in all directions. Also up to 18 in. above grade within a horizontal radius of 10 ft from point of loading connection.
Office and rest rooms	Ordinary	If there is any opening to these rooms within the extent of an indoor classified area, the room shall be classified the same as if the wall, curb, or partition did not exist.
Loading through closed dome with atmospheric venting	1	Within 3 ft of open end of vent, extending in all directions.
	2	Area between 3 ft and 15 ft of open end of vent, extending in all directions. Also within 3 ft of edge of dome, extending in all directions.
Loading through closed dome with vapor control	2	Within 3 ft of point of connection of both fill and vapor lines, extending in all directions.
Bottom loading with vapor control any bottom unloading	2	Within 3 ft of point of connections, extending in all directions. Also up to 18 in. above grade within a horizontal radius of 10 ft from point of connections.
Storage and repair garage for tank vehicles	1	All pits or spaces below floor level.
	2	Area up to 18 in. above floor or grade level for entire storage or repair garage.
Garages for other than tank vehicles	Ordinary	If there is any opening to these rooms within the extent of an outdoor classified area, the entire room shall be classified the same as the area classification at the point of the opening.
Outdoor drum storage	Ordinary	
Indoor warehousing where there is no flammable liquid transfer	Ordinary	If there is any opening to these rooms within the extent of an indoor classified area, the room shall be classified the same as if the wall, curb, or partition did not exist.
Piers and wharves		See Figure 5-3.5.6.

*When classifying extent of area, consideration shall be given to the fact that tank cars or tank vehicles can be spotted at varying points. Therefore, the extremities of the loading or unloading positions shall be used.

(Log #81)
Committee: FLC-OPS

30-135 - (5-3.1 (New)): Accept in Part
SUBMITTER: Richard J. Hild, Verlan Fire Insurance Company
RECOMMENDATION: Add the underlined wording:
5-3.2 (5-3.1) Location. Liquid processing vessels and buildings containing liquid processing vessels shall be so located that a fire involving the vessels shall not constitute an exposure hazard to other occupancies for a period of time consistent with the response and suppression capabilities of the fire fighting operations available to the location. The separation distances shall be determined by an engineering evaluation of the operation, followed by the application of sound fire protection and process engineering principles. Compliance with 5-3.2.1 or 5-3.2.2 shall be deemed as meeting the requirements of 5-3.2.
SUBSTANTIATION: This will add performance language to this section that is currently not provided. Similar language is used in paragraph 2-5.1 of NFPA 30.

COMMITTEE ACTION: Accept in Part.
Change the first sentence by deleting everything after the word "occupancies."
COMMITTEE STATEMENT: The Technical Committee on Operations does not think the deleted language can be interpreted or enforced.
NOTE: This is an amendment to Subsection 5-3.2 of Proposal 30-133 (Log #80).

(Log #82)
Committee: FLC-OPS

30-136 - (Table 5-3.1.1): Reject
SUBMITTER: Richard J. Hild, Verlan Fire Insurance Company
RECOMMENDATION: Replace the current table with the following table:

Table 5-3.1.1 Location of Processing Vessels from Property Lines and Nearest Important Building on the Same Property Where Protection for Exposures is Not Provided

	Minimum Distance from Property Line that Is or Can Be Built Upon, Including Opposite Side of Public Way (ft)				Minimum Distance from Nearest Side of Public Way or from Nearest Important Building on Same Property that is Not an Integral Part of the Process (ft)			
Vessel Maximum	Stable Liquid Emergency Relief		Unstable Liquid Emergency Relief		Stable Liquid Emergency Relief		Unstable Liquid Emergency Relief	
Operating Liquid Capacity (gal)	Not Over 2.5 psig	Over 2.5 psig	Not Over 2.5 psig	Over 2.5 psig	Not Over 2.5 psig	Over 2.5 psig	Not Over 2.5 psig	Over 2.5 psig
275 or Less	10	20	30	40	10	20	30	40
276 to 750	20	30	50	80	10	20	30	40
751 to 12,000	30	50	80	120	10	20	30	40
12,001 to 30,000	40	60	100	160	10	20	30	40
30,001 to 50,000	60	90	150	240	20	30	50	80
50,001 to 100,000	100	150	250	400	30	50	80	120
Over 100,000	160	240	400	600	50	80	130	200

NOTE: Reduce all of the above distances by 50% where protection for exposures is provided.

SUBSTANTIATION: Current table assumes that there is protection for exposures and then requires that the values be doubled if protection for exposures is not provided. Since protection for exposures is a protection feature that is not always provided, we feel it would be best to list the higher numbers in the table and allow the user to reduce the value 50 percent if protection for exposures is provided.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: The submitter does not provide sufficient justification for this amended table.

(Log #20)
Committee: FLC-OPS

30-137 - (5-3.1.5): Reject
SUBMITTER: Dennis P. Nolan, Occidental Int'l Expl. and Prod. Co.
RECOMMENDATION: Add new text as follows:
"Where roads are provided to facilitate access to a process unit or building containing liquid processing equipment they should be a minimum of 12 ft wide with 22 ft overhead clearance."
SUBSTANTIATION: Lack of guidance on requirements for emergency vehicle access to hazardous areas.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: Depending on the arrangement of any one specific process, it might not be possible to comply with this requirement. Also, the submitter does not provide justification for the dimensions given.

(Log #17)
Committee: FLC-OPS

30-138 - (5-3.2.1): Accept in Principle
SUBMITTER: Dennis P. Nolan, Occidental Int'l Expl. and Prod. Co.
RECOMMENDATION: Include:
"steel supports of exposed piling for vessels storing Class 1, Class 2 liquids of quantities greater than 10,000 gal or 250 psi shall be protected by materials having a fire resistance rating of not less than 1 hr measured by UL 1709 test method except steel saddles need not be protected if less than 12 in."
SUBSTANTIATION: Protection for tank supports is given in Section 2-6.3 but not for vessels.
COMMITTEE ACTION: Accept in Principle.
Refer to Committee Action on Proposal 30-141 (Log #88).
COMMITTEE STATEMENT: The Action taken on Proposal 30-141 (Log #88) should satisfy the submitter's intent.

(Log #CP12)
Committee: FLC-OPS

30-139 - (5-3.2.4): Accept
SUBMITTER: Technical Committee on Operations,
RECOMMENDATION: Delete 5-3.2.4.
SUBSTANTIATION: This paragraph contains no mandatory text.
COMMITTEE ACTION: Accept.

(Log #83)
Committee: FLC-OPS

30-140 - (5-3.3): Accept
SUBMITTER: Richard J. Hild, Verlan Fire Insurance Company
RECOMMENDATION: Replace the current Section 5-3.3 with the following Section 5-3.4:
5-3.4 Ventilation.
5-3.4.1 Enclosed processing areas handling or using Class I liquids or Class II or Class III liquids heated to temperatures at or above their flash points shall be ventilated at a rate sufficient to maintain the concentration of vapors within the area at or below 25 percent of the lower flammable limit. Compliance with Sections 5-3.4.2 through 5-3.4.4 shall be deemed as meeting the requirements of 5-3.4.1.
5-3.4.2 Ventilation requirements shall be confirmed by one of the following:
(a) Calculations based on the anticipated fugitive emissions (see Appendix F for calculation method), or
(b) Sampling of the actual vapor concentration under normal operating conditions. The sampling shall be conducted at a 5-ft (1.5-m) radius from each potential vapor source extending to or toward the bottom and the top of the enclosed processing area. The vapor concentration used to determine the required ventilation rate shall be the highest measured concentration during the sampling procedure.
(NOTE: Equipment in enclosed processing areas can deteriorate over time, and periodic sampling should be conducted to ensure that leakage rates have not increased or that the ventilation rate is adequate for any increase in leakage rates.)
Exception: Where a ventilation rate of not less than 1 cu ft per min per sq ft of solid floor area (0.3 m^3 per min per m^2) is provided, the above ventilation confirmation requirement shall not apply.
5-3.4.3 Ventilation shall be accomplished by mechanical or natural exhaust ventilation. Exhaust ventilation discharge shall be to a safe location outside the building, without recirculation of the exhaust air.
Exception: Recirculation is permitted where it is monitored continuously using a fail-safe system that is designed to automatically sound an alarm, stop recirculation, and provide full exhaust to the outside in the event that vapor-air mixtures in concentration over one-fourth of the lower flammable limit are detected.
5-3.4.4 Provision shall be made for introduction of make-up air in such a manner as to avoid short-circuiting the ventilation. Ventilation shall be arranged to include all floor areas or pits where

flammable vapors can collect. Local or spot ventilation might be needed for the control of special fire or health hazards. Such ventilation, if provided, shall be permitted to be utilized for up to 75 percent of the required ventilation. (NFPA 91, Standard for Exhaust Systems for Air Conveying of Materials, and NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems, provide information on this subject.)

5-3.4.5 Equipment used in a building and the ventilation of the building shall be designed to limit flammable vapor-air mixtures under normal operating conditions to the interior of equipment and to not more than 5 ft (1.5 m) from equipment that exposes Class I liquids to the air. Examples of such equipment are dispensing stations, open centrifuges, plate and frame filters, open vacuum filters, and surfaces of open equipment.

SUBSTANTIATION: The current Section 5-3.3 is not in Code format. The proposed section uses the format used in Section 2-5.3 of NFPA 30.

COMMITTEE ACTION: Accept.

NOTE: This replaces 5-3.4 in Proposal 30-133 (Log #80).

(Log #88)
Committee: FLC-OPS

30-141 - (5-3.3.2 (New)): Accept in Principle

SUBMITTER: Richard J. Hild, Verlan Fire Insurance Company

RECOMMENDATION: Add the following paragraph to Section 5-3.2:

5-3.3.2* Where Class I, Class II or Class IIIA liquids are handled, exposed steel supporting the building, vessels, piping, and equipment shall be protected as appropriate and as dictated by a fire hazard evaluation. The protection may consist of automatic sprinklers, fire protective coatings, or other means to limit fire exposure to the steel and to delay structural steel failure.

Add the following explanatory material to Appendix A:

A-5-3.3.2 Heat from a liquids fire can be extremely intense and result in rapid failure of supporting steel. This is especially true in enclosed buildings where roofs and walls help contain the heat and hamper manual fire fighting. Failure of the supporting steel can in turn seriously endanger the safety of building occupants and potentially result in the release of additional liquids, thereby intensifying the fire. Fire protection, such as automatic sprinklers, spray-on fireproofing, and other methods, can be used to reduce heat flux into supporting steel and extend the time to failure. However, the need for such protection, including the type and extent provided, depends on a number of factors, such as: type and adequacy of other protection (e.g., sprinklers, foam, etc.), number of occupants, exit facilities, drainage facilities, size and geometry of building, volume and location of liquids, processing conditions, process design, other safeguards, etc. It is therefore recommended that experienced fire protection personnel be consulted to assist in defining the protection appropriate in each case.

SUBSTANTIATION: The task group feels that protection should be provided for exposed steel supports which could fail as stated in the proposed explanatory material.

COMMITTEE ACTION: Accept in Principle.

Add a new 5-3.3.2 to Proposal 30-133 (Log #80):

5-3.3.2* Load bearing building supports and load bearing supports of vessels and equipment capable of releasing appreciable quantities of liquids so as to result in a fire of sufficient intensity and duration to cause substantial property damage shall be protected by one or more of the following:

- drainage to a safe location to prevent liquids from accumulating under vessels or equipment;
- fire resistive construction;
- fire resistant protective coatings or systems;
- water spray systems designed and installed in accordance with NFPA 15;
- other alternate means acceptable to the authority having jurisdiction.

A-5-3.3.2 API 2218 *contains guidance on selecting and installing* fire resistant coatings to protect exposed steel supports from a high challenge fire exposure. It also contains a general discussion on determining need for such protection and estimating the extent of the area exposed.

COMMITTEE STATEMENT: The Technical Committee on Operations feels that its version is more specific and correlates with a similar requirement in Chapter 3.

(Log #84)
Committee: FLC-OPS

30-142 - (5-3.4): Reject

SUBMITTER: Richard J. Hild, Verlan Fire Insurance Company

RECOMMENDATION: Replace the current Section 5-3.4 with the following 5-3.5:

5-3.5 Drainage.

5-3.5.1 Liquid processing areas, rooms and buildings shall be designed to minimize fire exposure, due to an uncontrolled flow of liquid, to other processing areas, other building areas and other important buildings, adjoining property, or critical natural resources. Compliance with 5-3.5.2 through 5-3.5.6 shall be deemed as meeting the requirements of 5-3.5.1.

5-3.5.2 A facility shall be designed and operated to prevent the discharge of liquids to public waterways, public sewers, or adjoining property.

5-3.5.3* (4-4.2.7) Means shall be provided to prevent the flow of liquids under emergency conditions into adjoining building areas. This shall be accomplished by providing one or a combination of the following across the entire width of each opening:

(a) Noncombustible, liquidtight raised sills, curbs, or ramps of suitable height.

(b) Open-grated trenches, across the width of the opening inside of the room, that drain to a safe location.

(c) Other means acceptable to the authority having jurisdiction.

Exception: This requirement shall not apply to areas where only Class IIIB liquids are processed.

5-3.5.4 (4-4.2.6) Except for drains, floors shall be liquidtight, and the area shall be liquidtight where the walls join the floor and for at least 4 in. (10 cm) above the floor.

5-3.5.5* (4-4.2.8*) Where automatic sprinkler protection is provided, in addition to the requirements of 5-3.5.3, means shall also be provided to prevent burning liquids from exposing other process areas, other building areas and other important buildings, adjoining property, or critical natural resources.

Exception No. 1: This requirement shall not apply to areas where only the following are processed:

(a) Class *IIIB* liquids;
(b) Liquids that are heavier than water;
(c) Water-miscible liquids;
(d) Liquids having viscosities greater than 10,000 centipoise.

Exception No. 2: This requirement shall not apply to areas where fire protection (, such as total flooding CO_2, high expansion foam or AFFF, is provided to extinguish the fire.) is provided by non-water extinguishing systems, such as total flooding CO_2, high expansion foam, or AFFF.

5-3.5.6 (5-3.4.2) Emergency drainage systems, if connected to public sewers or discharged into public waterways, shall be equipped with traps or separators.

SUBSTANTIATION: The current Section 5-3.4 is vague and offers little guidance to the user. The proposed section uses the format used in Section 2-5.4 of NFPA 30 and language from paragraphs 4-4.2.6, 4-4.2.7 and 4-4.2.8 of NFPA 30.

COMMITTEE ACTION: Reject.

COMMITTEE STATEMENT: The current text is deemed adequate. The proposed revision offers no improvement.

(Log #56a)
Committee: FLC-OPS

30-143 - (5-3.4.2): Reject

SUBMITTER: Robert E. Rhead, Kemper National Insurance Cos.

RECOMMENDATION: Delete this paragraph.

SUBSTANTIATION: Discharge of flammable or combustible liquids into a public sewer or waterway is a highly dangerous practice and should not be permitted in the code. Vapors can migrate through the sewer and find their way into other drain connections and areas that contain ignition sources thus presenting fire and explosion potential. Serious health problems and contamination can result from discharge into waterways. Prohibiting such connections as indicated in 2-5.4.2 is the only reasonable and logical approach to avoid injury and/or property damage.

If this change is made, also change the reference to 2-5.4.6 as indicated in 2-5.4.1.

COMMITTEE ACTION: Reject.

COMMITTEE STATEMENT: The current language provides for traps and separators and is adequate.

(Log #CP13)
Committee: FLC-OPS

30- 144 - (5-3.5): Accept
SUBMITTER: Technical Committee on Operations,
RECOMMENDATION: 1. Replace the existing text in 5-3.5 [5-3.6 of Proposal 30-133 (Log #80)] with the following:
"Electrical wiring and utilization equipment shall meet the requirements of Section 5-9."
2. Move the existing text of 5-3.5 to 5-9.2 and revise to read as follows:
5-9.2 Electrical Installations.
5-9.2.1 This section shall apply to areas where Class I liquids are stored or handled and to areas where Class II or Class III liquids are stored or handled at temperatures above their flash points (see 1-1.3).
5-9.2.2 Electrical wiring and utilization equipment shall be designed and installed in accordance with NFPA 70, National Electrical Code, and this Section. Electrical wiring and utilization equipment in hazardous (classified) locations shall be designed and installed in accordance with Chapter 5 of NFPA 70, National Electrical Code.
5-9.2.3* Table 5-9.2.3 shall be used to determining the extent of hazardous (classified) locations for the purpose of installation of electrical equipment. In establishing the extent of a hazardous (classified) location, it shall not extend beyond a floor, wall, roof, or other solid partition that has no communicating openings. (For additional information, see NFPA 497A, Recommended Practice for Classification of Class I Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas, and NFPA 497M, Manual for Classification of Gases, Vapors, and Dusts for Electrical Equipment in Hazardous (Classified) Locations.)
5-9.2.4 Where the provisions of 5-9.2 require the installation of Class I, Division 1 or Class I, Division 2 electrical equipment, ordinary electrical equipment, including switchgear, shall be permitted to be used if installed in a room or enclosure that is maintained under positive pressure with respect to the classified area. Ventilation make-up air shall not be contaminated. (NFPA 496, Standard for Purged and Pressurized Enclosures for Electrical Equipment, provides details for these types of installations.)
A-5-9.2.3 The classifications listed in Table 5-9.2.3 are based on the premise that the installation meets all applicable requirements of this code and NFPA 70, National Electrical Code. Should this not be the case, the authority having jurisdiction has the authority to determine the extent of the hazardous (classified) locations.
SUBSTANTIATION: The requirements for electrical equipment and system installation should be in a section that is generally applicable, as opposed to being in a section that applies to only one class of occupancies. The text has been revised to make it more understandable.
COMMITTEE ACTION: Accept.

(Log #16)
Committee: FLC-OPS

30- 145 - (Table 5-3.5.3): Reject
SUBMITTER: Dennis P. Nolan, Occidental Int'l Expl. and Prod. Co.
RECOMMENDATION: 1. Change "vent" to "low pressure atmospheric vent."
2. Add new item to address outlets from pressurized sources (i.e. greater than 15 psi).
SUBSTANTIATION: Some venting sources may relieve gases at a high pressure resulting in a larger vapor cloud release and larger area needing hazardous area recognition.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: This proposal does not provide sufficient information either in the Recommendation or the Substantiation for the Technical Committee to effect a change. The Technical Committee is not sure what action the submitter desires.

(Log #85)
Committee: FLC-OPS

30- 146 - (5-3.5.6, Figure 5-3.5.6): Accept
SUBMITTER: Richard J. Hild, Verlan Fire Insurance Company
RECOMMENDATION: Delete the entire following paragraph and Figure 5-3.5.6:
~~5-3.5.6 For marine terminals handling flammable liquids, Figure 5-3.5.6 shall be used as a minimum basis to delineate and classify areas for the purpose of installation of electrical equipment.~~
SUBSTANTIATION: This information should be deleted from the electrical requirements of Section 5-3 if they are properly covered in the proposed new Section 5-7, Wharves and Piers.
COMMITTEE ACTION: Accept.

(Log #8)
Committee: FLC-OPS

30- 147 - (5-4.1.4.1 (New)): Reject
SUBMITTER: Dennis P. Nolan, Occidental Int'l Exploration and Production Co.
RECOMMENDATION: Add new text as follows:
"When 3 in. or larger piping, vessels or tanks are placed in operation, the air in systems shall be displaced with steam, water, or an inert gas prior to the introduction of volatile hydrocarbon liquids. The system(s) shall be purged until free of air (oxygen less than 1 percent)."
SUBSTANTIATION: Document does not address safety precautions of placing new or modified piping tanks, vessels in service when air is normally present which poses an internal detonation/explosion hazard. Ref. NFPA 54, Sec. 4-3.2.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: This proposal might cause more hazard than it seeks to eliminate, since it does not identify all necessary safeguards. Also, other equally safe methods might be available.

(Log #86)
Committee: FLC-OPS

30- 148 - (5-4.1.6, 5-4.1.7): Accept
SUBMITTER: Richard J. Hild, Verlan Fire Insurance Company
RECOMMENDATION: Add the underlined wording to paragraph 5-4.1.6 (Separate proposal to be 5-3.7.6) as shown:
5-4.1.6 Piping, valves, <u>flexible connectors</u> and fittings shall be in accordance with Chapter 3, "Piping Systems."
and delete the first sentence in paragraph 5-4.1.7 (Separate proposal to be 5-3.7.7) as shown:
5-4.1.7 ~~Listed flexible connectors shall be permitted to be used where vibration exists.~~ Approved hose shall be permitted to be used at transfer stations.
SUBSTANTIATION: Currently, Chapter 5 does not give requirements for flexible connectors except to say that listed flexible connectors are permitted where vibration exists. By adding "flexible connectors" to paragraph 5-4.1.6, the user is directed to Chapter 3 for requirements. Since Chapter 3 covers flexible connectors and does not limit their use, the first sentence in paragraph 5-4.1.7 is not needed.
COMMITTEE ACTION: Accept.

Table 5-9.2.3 Electrical Area Classifications

Location	NEC Class I Division	Extent of Classified Area
Indoor equipment installed in accordance with 5-3.3.2 where flammable vapor-air mixtures may exist under normal operation	1	Area within 5 ft of any edge of such equipment, extending in all directions.
	2	Area between 5 ft and 8 ft of any edge of such equipment, extending in all directions. Also, area up to 3 ft above floor or grade level within 5 ft to 25 ft horizontally from any edge of such equipment.*
Outdoor equipment of the type covered in 5-3.3.2 where flammable vapor-air mixtures may exist under normal operation	1	Area within 3 ft of any edge of such equipment, extending in all directions.
	2	Area between 3 ft and 8 ft of any edge of such equipment, extending in all directions. Also, area up to 3 ft above floor or grade level within 3 ft to 10 ft horizontally from any edge of such equipment.
Tank—aboveground	1	Area inside dike where dike height is greater than the distance from the tank to the dike for more than 50 percent of the tank circumference.
Shell, ends, or roof and dike area	2	Within 10 ft from shell, ends, or roof of tank. Area inside dikes to level of top of dike.
Vent	1	Within 5 ft of open end of vent, extending in all directions.
	2	Area between 5 ft and 10 ft from open end of vent, extending in all directions.
Floating roof	1	Area above the roof and within the shell.
Underground tank fill opening	1	Any pit, box, or space below grade level, if any part is within a Division 1 or 2 classified area.
	2	Up to 18 in. above grade level, within a horizontal radius of 10 ft from a loose fill connection and within a horizontal radius of 5 ft from a tight fill connection.
Vent—discharging upward	1	Within 3 ft of open end of vent, extending in all directions.
	2	Area between 3 ft and 5 ft of open end of vent, extending in all directions.
Drum and container filling outdoors, or indoors with adequate ventilation	1	Within 3 ft of vent and fill openings, extending in all directions.
	2	Area between 3 ft and 5 ft from vent or fill opening, extending in all directions. Also, up to 18 in. above floor or grade level within a horizontal radius of 10 ft from vent or fill openings.
Pumps, bleeders, withdrawal fittings, meters and similar devices		
Indoors	2	Within 5 ft of any edge of such devices, extending in all directions. Also up to 3 ft above floor or grade level within 25 ft horizontally from any edge of such devices.
Outdoors	2	Within 3 ft of any edge of such devices, extending in all directions. Also up to 18 in. above grade level within 10 ft horizontally from any edge of such devices.
Pits		
Without mechanical ventilation	1	Entire area within pit if any part is within a Division 1 or 2 classified area.
With adequate mechanical ventilation	2	Entire area within pit if any part is within a Division 1 or 2 classified area.
Containing valves, fittings, or piping, and not within a Division 1 or 2 classified area	2	Entire pit.
Drainage ditches, separators, impouding basins		
Outdoor	2	Area up to 18 inches above ditch, separator, or basin. Also up to 18 inches above grade within 15 ft horizontally from any edge.
Indoor		Same as pits.

*The release of Class I liquids may generate vapors to the extent that the entire building, and possibly a zone surrounding it, should be considered a Class I, Division 2 location.

(continued)

Table 5-9.2.3, cont.

Location	NEC Class I Division	Extent of Classified Area
Tank vehicle and tank car* loading through open dome	1	Within 3 ft of edge of dome, extending in all directions.
	2	Area between 3 ft and 15 ft from edge of dome, extending in all directions.
Loading through bottom connections with atmospheric venting	1	Within 3 ft of point of venting to atmosphere, extending in all directions.
	2	Area between 3 ft and 15 ft from point of venting to atmosphere, extending in all directions. Also up to 18 in. above grade within a horizontal radius of 10 ft from point of loading connection.
Office and rest rooms	Ordinary	If there is any opening to these rooms within the extent of an indoor classified area, the room shall be classified the same as if the wall, curb, or partition did not exist.
Loading through closed dome with atmospheric venting	1	Within 3 ft of open end of vent, extending in all directions.
	2	Area between 3 ft and 15 ft of open end of vent, extending in all directions. Also within 3 ft of edge of dome, extending in all directions.
Loading through closed dome with vapor control	2	Within 3 ft of point of connection of both fill and vapor lines, extending in all directions.
Bottom loading with vapor control any bottom unloading	2	Within 3 ft of point of connections, extending in all directions. Also up to 18 in. above grade within a horizontal radius of 10 ft from point of connections.
Storage and repair garage for tank vehicles	1	All pits or spaces below floor level.
	2	Area up to 18 in. above floor or grade level for entire storage or repair garage.
Garages for other than tank vehicles	Ordinary	If there is any opening to these rooms within the extent of an outdoor classified area, the entire room shall be classified the same as the area classification at the point of the opening.
Outdoor drum storage	Ordinary	
Indoor warehousing where there is no flammable liquid transfer	Ordinary	If there is any opening to these rooms within the extent of an indoor classified area, the room shall be classified the same as if the wall, curb, or partition did not exist.
Piers and wharves		See Figure 5-3.5.6.

*When classifying extent of area, consideration shall be given to the fact that tank cars or tank vehicles can be spotted at varying points. Therefore, the extremities of the loading or unloading positions shall be used.

(Log #CP14)
Committee: FLC-OPS

30-149-(5-4.3): Accept
SUBMITTER: Technical Committee on Operations,
RECOMMENDATION: Replace Existing 5-4.3 with the following new Section 5-5.

5-5 Incidental Operations.

5-5.1* This section shall apply to areas where the use, handling, and storage of liquids is only a limited activity to the established occupancy classification. Examples include automobile assembly, assembly of electronic equipment, furniture manufacturing, and areas within refineries, distilleries and chemical plants where the use of liquids is incidental, such as in maintenance shops, office equipment, or vehicle repair shops.

5-5.2 Class I liquids or Class II or Class III liquids that are heated up to or above their flashpoints shall be drawn from or transferred into vessels, containers, or portable tanks using one of the following methods:

(a) From original shipping containers with a capacity of 5 gal (19 L) or less;
(b) From safety cans;
(c) Through a closed piping system;
(d) From portable tanks or containers by means of a device that has anti-siphoning protection and that draws through an opening in the top of the tank or container;
(e) By gravity through a listed self-closing valve or self-closing faucet.

5-5.2.1 If hose is used in the transfer operation, it shall be equipped with a self-closing valve without a hold-open latch in addition to the outlet valve. Only listed or approved hose shall be used.

5-5.2.2 Means shall be provided to minimize generation of static electricity. Such means shall meet the requirements of 5-9.4.

5-5.2.3 Where pumps are used for liquid transfer, means shall be provided to deactivate liquid transfer in the event of a liquid spill or fire.

5-5.3 All storage of liquids shall comply with Chapter 4.

Exception: As provide in 5-5.4 and 5-5.5.

5-5.4 The quantity of liquid located outside of identified storage areas (storage cabinets, other inside liquid storage areas, general purpose warehouses, or other specific processing areas that are cut off from the general plant area by at least a 2-hr fire separation) shall meet 5-5.4.1.

5-5.4.1 The aggregate of the sum of all incidental operations in each single fire area shall not exceed the sum of:

25 gal (95 L) of Class IA liquids in containers;
120 gal (454 L) of Classes IB, IC, II, or III liquids in containers;
Two portable tanks each not exceeding 660 gal (2498 L) of Class IB, IC, Class II, or Class IIIA liquids; and
20 portable tanks each not exceeding 660 gal (2498 L) of Class IIIB liquids.

Exception: Where quantities of liquid in excess of the above limits are needed to supply an incidental operation for one continuous 24 hour period, that greater quantity shall be allowed.

5-5.4.2 Where quantities of liquids in excess of the limits in 5-5.4.1 are necessary, storage shall be in tanks that meet all applicable requirements of Chapter 2 and Section 5-3.

5-5.5 Areas in which liquids are transferred from one tank or container to another container shall be provided with:

(a) Separation from other operations that might represent an ignition source by distance or by fire resistant construction.
(b) Drainage or other means shall be provided to control spills.
(c) Natural or mechanical ventilation that meets the requirements of 5-3.3. (NFPA 91, Standard for the Installation of Blower and Exhaust Systems for Dust, Stock, and Vapor Removal or Conveying, provides information on the design and installation of mechanical ventilation.)

A-5-5.1 Incidental operations are operations that utilize liquids only as a limited activity to that which establishes the occupancy classification. Listed below are four examples where liquid use is incidental to the occupancy classification.

Vehicle Assembly - Vehicle assembly operations usually involve both process and incidental use of liquids. An example of a process operation would be paint storage and mixing utilized for application of the vehicle primer, color coats, and clear coats. For these operations, the requirements of Section 5-3 apply. Examples of incidental use would be sealer deck wipe down operations, windshield washer solvent dispensing, brake fluid filling, and final line paint repair operations. These operations might be continuous. However, the quantities of liquids used and the vapor exposures are significantly reduced from larger volume usage found within vehicle body component paint mixing and storage operations.

Assembly of Electrical Equipment - Examples of incidental use of liquids in these types of occupancies might include wet etching operations in clean rooms, "photoresist" coating operations, "softbaking" operations, wave solder operations and wipe down operations.

Chemical Plant Maintenance Shop - Incidental use of liquids is commonplace in maintenance shops located within a chemical plant. Examples are cutting oils used in a machine shop, Class II solvents for degreasing and Class I and II paint solvents and fuels associated with automotive and industrial truck repair.

Cleaning and Sanitation - Under provisions established by the U. S. Food and Drug Administration (FDA) in the Code of Federal Regulations, Title 21, "GMP for Medical Devices", Class I and Class II liquids can be used for cleaning and sanitation purposes. Limited quantities are used to remove manufacturing materials, mold release compounds, and other contaminants not intended to be on the final product. An example would be the use of isopropyl alcohol (IPA), transferred to a cleaning wipe via a plunger-type liquid dispensing container. The cleaning wipe is then used to remove manufacturing materials not intended to be on final product. The key point here is not that the liquid is not part of the final product, but that limited quantities of liquid are used and the use is incidental to the manufacturing operation which produces the product.

SUBSTANTIATION: This entire section has been rewritten to improve clarity and to make it more easily interpreted. It is being relocated according to a reorganization of Chapter 5.

COMMITTEE ACTION: Accept.

(Log #CP15)
Committee: FLC-OPS

30-150 - (5-4.4.1): Accept

SUBMITTER: Technical Committee on Operations,

RECOMMENDATION: Relocate existing 5-4.4.1 to new Section 5-6 and revise.

5-6 Loading and Unloading Operations.

5-6.1 This section shall apply to operations involving the loading or unloading of tank cars and tank vehicles and the areas in facilities where these operations are conducted.

5-6.2 Bonding requirements, as specified in this subsection shall not be required:

(a) Where vehicles are loaded exclusively with products that do not have static accumulating properties, such as asphalts (including cutback asphalts), most crude oils, residual oils, and water-soluble liquids.

(b) Where no Class I liquids are handled at the loading facility and where the tank vehicles loaded are used exclusively for Class II and Class III liquids.

(c) Where vehicles are loaded or unloaded through closed connections.

5-6.3 Loading and Unloading Facilities.

5-6.3.1* Tank vehicle and tank car loading and unloading facilities shall be separated from aboveground tanks, warehouses, other plant buildings, or the nearest line of adjoining property that can be built upon by a distance of at least 25 ft (7.6 m) for Class I liquids and at least 15 ft (4.6 m) for Class II and Class III liquids, measured from the nearest fill spout or transfer connection. These distances shall be permitted to be reduced if there is suitable protection for exposures. Buildings for pumps or shelters for personnel shall be permitted to be a part of the facility.

5-6.3.2* Loading and unloading facilities shall be provided with drainage systems or other means to contain spills.

5-6.3.3 A loading or unloading facility that has a canopy or roof that does not limit the dissipation of heat or dispersion of flammable vapors and does not restrict fire fighting access and control shall be treated as an outdoor facility.

5-6.3.4 Loading and unloading facilities that are used to load liquids into tank vehicles through open domes shall be provided with bonding means for protection against static electricity hazards. Such protection shall consist of a metallic bond wire permanently, electrically connected to the fill stem or to some part of the facility structure that is in electrical contact with the fill stem. The free end of such wire shall be provided with a clamp or equivalent device for convenient attachment to some metallic part that is in electrical contact with the cargo tank of the tank vehicle.

Exception: Except as modified by 5-6.2.

5-6.3.5 Tank car facilities where flammable and combustible liquids are loaded or unloaded through open domes shall be protected against stray currents by permanently bonding the fill pipe to at least one rail and to the facility structure, if of metal. Multiple pipelines that enter the area shall be permanently bonded together. In addition, in areas where excessive stray currents are known to exist, all pipelines entering the area shall be provided with insulating sections to electrically isolate them from the facility piping.

Exception: These precautions shall not be required where only Class II or Class III liquids are handled and where there is no probability that tank cars will contain vapors from previous cargoes of Class I liquids.

5-6.3.6 Equipment such as piping, pumps, and meters used for the transfer of Class I liquids between storage tanks and the fill stem of the loading facility shall not be used for the transfer of Class II or Class III liquids.

Exception No. 1: This provision shall not apply to water-miscible liquid mixtures where the class of the mixture is determined by the concentration of liquid in water.

Exception No. 2: This provision shall not apply where the equipment is cleaned between transfers.

5-6.3.7 Remote pumps located in underground tanks shall have a listed leak-detection device installed on the pump discharge side that will indicate if the piping system is not essentially liquidtight. This device shall be checked and tested at least annually according to the manufacturer's specifications to ensure proper installation and operation.

5-6.4 Loading and Unloading of Tank Vehicles.

5-6.4.1 Liquids shall be loaded only into cargo tanks whose material of construction is compatible with the chemical characteristics of the liquid. The liquid being loaded shall also be chemically compatible with the liquid hauled on the previous load unless the cargo tank has been cleaned.

5-6.4.2 To prevent a hazard due to a change in flash point of liquids, no cargo tank or cargo tank compartment that has been used for Class I liquid shall be loaded with Class II or Class III liquid until the tank or compartment has been cleaned and made free of ignitible vapors.

5-6.4.3 Before loading tank vehicles through open domes, a bonding connection shall be made to the vehicle or tank before dome covers are raised and shall remain in place until filling is completed and all dome covers have been closed and secured.

Exception: As modified by 5-6.1.2.

5-6.4.4 When transferring class I liquids, engines of tank vehicles or motors of auxiliary or portable pumps shall be shut down during making and breaking hose connections. If loading or unloading is done without requiring the use of the motor of the tank vehicle, the motor shall be shut down throughout any transfer operations involving Class I liquids.

5-6.4.5 Filling through open domes into the tanks of tank vehicles that contain vapor-air mixtures within the flammable range, or where the liquid being filled can form such a mixture, shall be by means of a downspout that extends to within 6 inches of the bottom of the tank. If the downspout does not contact the tank bottom, a reduced fill rate shall be used until the outlet becomes submerged. This precaution shall not be required when loading liquids that are not accumulators of static electric charges. (NFPA 77, Recommended Practice on Static Electricity, provides additional information on protection against static electricity.)

5-6.4.6 When top loading a tank vehicle with Class I or Class II liquids without a vapor control system, valves used for the final control of flow shall be of the self-closing type and shall be manually held open except where automatic means are provided for shutting off the flow when the vehicle is full. Automatic shutoff systems shall be provided with a manual shutoff valve located at a safe distance from the loading nozzle to stop the flow if the automatic system fails. When top loading a tank vehicle with vapor control, flow control shall be in accordance with 5-6.4.7 and 5-4.4.8.

5-6.4.7 When bottom loading a tank vehicle, a positive means shall be provided for loading a predetermined quantity of liquid, together with a secondary automatic shutoff control to prevent overfill. The connecting components between the loading rack and the tank vehicle that are required to operate the secondary control shall be functionally compatible. The connection between the liquid loading hose or pipe and the truck piping shall be by means of a dry disconnect coupling.

5-6.4.8 When bottom loading a tank vehicle that is equipped for vapor control, but when vapor control is not used, the tank shall be vented to the atmosphere, at a height not lower than the top of the cargo tank of the vehicle, to prevent pressurization of the tank.

Connections to the facility's vapor control system shall be designed to prevent the escape of vapor to the atmosphere when not connected to a tank vehicle.

5-6.4.9 When bottom loading is used, reduced flow rates, splash deflectors, or other devices shall be used to prevent splashing and to minimize turbulence.

5-6.4.10 Metal or conductive objects, such as gauge tapes, sample containers, and thermometers, shall not be lowered into or suspended in a compartment while the compartment is being filled or immediately after cessation of pumping to permit the relaxation of charge.

5-6.5 Loading and Unloading of Tank Cars.

5-6.5.1 Liquids shall be loaded only into tank cars whose material of construction is compatible with the chemical characteristics of the liquid. The liquid being loaded shall also be chemically compatible with the liquid hauled on the previous load unless the tank car has been cleaned.

5-6.5.2 To prevent a hazard from a change in flash point of liquids, no tank car or tank car compartment that has been utilized for Class I liquid shall be loaded with Class II or Class III liquid until such tank or compartment has been cleaned.

5-6.5.3 Filling through open domes into the tanks cars that contain vapor-air mixtures within the flammable range or where the liquid being filled can form such a mixture shall be by means of a downspout that extends to within 6 inches of the bottom of the tank. If the downspout does not contact the tank bottom, a reduced fill rate shall be used until the outlet becomes submerged. This precaution shall not be required when loading liquids that are not accumulators of static electric charges. (NFPA 77, Recommended Practice on Static Electricity, provides additional information on static electricity protection.)

5-6.5.4 When bottom loading is used, reduced flow rates, splash deflectors, or other devices shall be used to prevent splashing and to minimize turbulence.

5-6.5.5 Metal or conductive objects, such as gauge tapes, sample containers, and thermometers, shall not be lowered into or suspended in a compartment while the compartment is being filled or immediately after cessation of pumping to permit the relaxation of charge.

A-5-6.3.1 Use of fixed fire protection systems, dikes, fire-rated barriers, or combination of any of these can provide suitable protection from exposures.

A-5-6.3.2 The intent of this requirement is to prevent the spread of uncontrolled, spilled liquid from traveling beyond the loading or unloading area and exposing surrounding equipment and buildings.

SUBSTANTIATION: This entire section has been rewritten to improve clarity and to make it more easily interpreted. It is being relocated according to a reorganization of Chapter 5.

COMMITTEE ACTION: Accept.

(Log #CP16)
Committee: FLC-OPS

30- 151 - (5-4.4.2): Accept

SUBMITTER: Technical Committee on Operations,

RECOMMENDATION: Relocate existing 5-4.4.2 to new Section 5-7 and revise.

5-7 Wharves

5-7.1 This section shall apply to all wharves as defined in Section 1-6 whose primary purpose is the bulk transfer of liquids. General purpose wharves that handle bulk transfer of liquids and other commodities shall meet the requirements of NFPA 307, Construction and Fire Protection of Marine Terminals, Piers and Wharves.

5-7.2 This section shall not apply to the following:

(a) Marine service stations, as covered in NFPA 30A, Automotive and Marine Service Station Code;

(b) Marinas and boatyards, as covered in NFPA 303, Fire Protection Standard for Marinas and Boatyards;

(c) Wharves that handle liquified petroleum gases, as covered in NFPA 59A, Standard for the Production, Storage and Handling of Liquified Natural Gases (LNG) and NFPA 58, Standard for the Storage and Handling of Liquified Petroleum Gases.

5-7.3 Incidental handling of packaged cargo of liquids and loading/unloading of general cargo, such as ships stores, during transfer of liquids shall be conducted only when approved by the wharf supervisor and the senior officer of the vessel.

5-7.4 Wharves at which liquid cargoes are to be transferred in bulk to or from tank vessels shall be at least 100 ft (30 m) from any bridge over a navigable waterway or from any entrance to or superstructure of a vehicular or railroad tunnel under a waterway. The termination of the loading or unloading fixed piping shall be at least 200 ft (60 m) from any bridge or from any entrance to or superstructure of a tunnel.

5-7.5 The substructure and deck of the wharf shall be substantially designed for the use intended. The deck shall be permitted to be of any material that will afford the desired combination of flexibility, resistance to shock, durability, strength, and fire resistance. Heavy timber construction shall be permitted.

5-7.6 Tanks used exclusively for ballast water or Class II or Class III liquids shall be permitted to be installed on a suitably designed wharf.

5-7.7 Loading pumps capable of building up pressures that exceed the safe working pressure of cargo hose or loading arms shall be provided with bypasses, relief valves, or other arrangements to protect the loading facilities against excessive pressure. Relief devices shall be tested at least annually to determine that they function satisfactorily at their set pressure.

5-7.8 All pressure hoses and couplings shall be inspected at intervals appropriate to their service. With the hose extended, the hose and couplings shall be tested using the in-service maximum operating pressure. Any hose showing material deterioration, signs of leakage, or weakness in its carcass or at the couplings shall be withdrawn from service and repaired or discarded.

5-7.9 Piping, valves, and fittings shall meet applicable requirements of Chapter 3 and shall also meet the following requirements:

5-7.9.1 Flexibility of piping shall be assured by appropriate layout and arrangement of piping supports so that motion of the wharf structure resulting from wave action, currents, tides, or the mooring of vessels will not subject the piping to excessive strain.

5-7.9.2 Pipe joints that depend on the friction characteristics of combustible materials or on the grooving of pipe ends for mechanical continuity of piping shall not be permitted.

5-7.9.3 Swivel joints shall be permitted to be used in piping to which hoses are connected and for articulated swivel-joint transfer systems, provided the design is such that the mechanical strength of the joint will not be impaired if the packing materials should fail, for example, by exposure to fire.

5-7.9.4 Each line conveying Class I or Class II liquids leading to a wharf shall be provided with a readily accessible block valve located on shore near the approach to the wharf and outside of any diked area. Where more than one line is involved, the valves shall be grouped in one location.

5-7.9.5 Means shall be provided for easy access to any cargo line valves that are located below the wharf deck.

5-7.10 Pipelines on wharves that handle Class I or Class II liquids shall be adequately bonded and grounded. If excessive stray currents are encountered, insulating flanges or joints shall be installed. Bonding and grounding connections on all pipelines shall be located on the wharf side of insulating flanges, if used, and shall be accessible for inspection. Bonding between the wharf and the vessel shall not be required.

5-7.11 Hose or articulated swivel-joint pipe connections used for cargo transfer shall be capable of accommodating the combined effects of change in draft and change in tide. Mooring lines shall be kept adjusted to prevent surge of the vessel from placing stress on the cargo transfer system. Hose shall be supported to avoid kinking and damage from chafing.

5-7.12 Material shall not be placed on wharves in such a manner as to obstruct access to fire fighting equipment or important pipeline control valves. Where the wharf is accessible to vehicle traffic, an unobstructed roadway to the shore end of the wharf shall be maintained for access of fire fighting apparatus.

5-7.13 Loading or unloading shall not commence until the wharf supervisor and the person in charge of the tank vessel agree that the tank vessel is properly moored and all connections are properly made.

5-7.14 Mechanical work shall not be performed on the wharf during cargo transfer, except under special authorization based on a review of the area involved, methods to be employed, and precautions necessary.

5-7.15 Sources of ignition shall be controlled during transfer of liquids. Mechanical work, including but not limited to vehicular traffic, welding, grinding, and other hot work, shall not be performed during cargo transfer except as authorized by the wharf supervisor and the senior officer on the vessel. Smoking shall be prohibited at all times on the wharf during cargo transfer operations.

5-7.16 For marine terminals handling flammable liquids, Figure 5-7.16 shall be used to determining the extent of hazardous (classified) areas for the purpose of installation of electrical equipment.

5-7.17 Where a flammable atmosphere might exist in the vessel cargo compartment, cargo transfer systems shall be designed to limit the velocity of the incoming liquid stream to 3 feet per second until the compartment inlet opening is sufficiently submerged to prevent splashing.

5-7.18 Filters, pumps, wire screens and, other devices that might produce static electric charges through turbulence shall be so located to allow a minimum of 30 seconds relaxation time prior to discharging cargo into the compartment.

5-7.19* Spill collection shall be provided around manifold areas to prevent spread of liquids to other areas of the wharf or under the wharf. Vapor seals shall be provided on all drain lines leaving the wharf.

5-7.20 Where required, wharves shall have a system to isolate and shutdown the loading operation in the event of failure of a hose, loading arm, or manifold valve. This system shall meet all of the following requirements:

(a) If the protective system closes a valve on a gravity fed or pipeline fed loading system, care shall be taken to ensure the line is protected from any resulting pressure surges.

(b) Emergency shutdown systems shall be permitted to be automatically or manually activated. Manually activated device(s) shall be well marked and accessible during an emergency.

5-7.21* Fire protection for wharves shall be related to the products being handled, emergency response capability, size, location, frequency of use and adjacent exposures.

A-5-7.19 Where practical, the collection basin should be drained to a remote location.

A-5-7.21 Because of the many variables involved, exact requirements cannot be provided. However, Table 5-7.21 provides guidance on the level of fire protection typically provided at wharves and marine terminals handling flammable liquids. (See table below.)

5-7.21.1 Where a fire water main is provided, the main shall be permitted to be wet or dry. In all cases, isolation valves and fire department connections shall be provided at the wharf-to-shore connection.

5-7.21.2 Where a fire water main is provided, hydrants and monitors shall be provided so that effective fire water streams can be applied to any berth or loading manifold from two directions.

5-7.21.3 Fire water pumps, fire hoses, fire water mains, foam systems and other fire suppression equipment shall be maintained and tested in accordance with NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based fire Protection Systems.

5-7.21.5 Where no fire water main is provided, at least two 150 pound dry chemical extinguishers shall be provided. The extinguishers shall be located within 50 feet of pump or manifold areas and shall be easily reached along emergency access paths.

SUBSTANTIATION: This entire section has been rewritten to improve clarity and to make it more easily interpreted. It is being relocated according to a reorganization of Chapter 5.

COMMITTEE ACTION: Accept.

(Log #CP17)
Committee: FLC-OPS

30- 152 - (5-5): Accept

SUBMITTER: Technical Committee on Operations,

RECOMMENDATION: Relocate existing 5-5 to new section 5-10 and revise.

5-10 Vapor Recovery and Vapor Processing Systems.

5-10.1 Scope.

5-10.1.1 This section shall apply to vapor recovery and vapor processing systems where:

(a) The vapor source operates at pressures from vacuum up to and including 1 psig (6.9 kPa), or

(b) There is a potential for vapor mixtures in the flammable range.

5-10.1.2 This section shall not apply to:

(a) Marine systems that comply with U.S. DOT Regulations 33CFR Parts 154, 155, 156, and U.S. Coast Guard Regulations 46CFR Parts 30, 32, 35, 39.

(b) Marine service station systems that comply with NFPA 30A.

5-10.2 Overpressure/Vacuum Protection. Tanks and equipment shall have independent venting for overpressure or vacuum conditions that might occur from malfunction of the vapor recovery or vapor processing system.

Exception: For tanks, venting shall comply with 2-3.5 or 2-3.6.

5-10.3 Vent Location.

5-10.3.1 Vents on vapor processing systems shall be not less than 12 ft (3.6 m) from adjacent ground level, with outlets located and directed so that ignitible vapors will disperse to a concentration below the lower flammable limit (lfl) before reaching any location that might contain an ignition source.

5-10.3.2 Vapor processing equipment and vents shall be located in accordance with 5-3.2.

5-10.4 Vapor Collection Systems.

5-10.4.1 Vapor collection piping shall be designed to prevent trapping liquid.

5-10.4.2 Vapor recovery and vapor processing systems that are not designed to handle liquid shall be provided with a means to eliminate any liquid that carries over to or condenses in the vapor collection system.

5-10.5* Liquid Level Monitoring.

5-10.5.1 A liquid knock-out vessel used in the vapor collection system shall have means to verify the liquid level and a high liquid level sensor that activates an alarm.

5-10.5.2 For unmanned facilities, the high liquid level sensor shall initiate shut down of liquid transfer into the vessel and shutdown of vapor recovery or vapor processing systems.

Table A-5-7.21 Typical Fire Protection for Wharves and Marine Terminals

	Water Demand gpm	Hydrant Monitors gpm [a]	Hose Reels	Fire Extinguisher Dry Chemical		International Shore Connection	Emergency Equipment Lockers	Monitors & Hose Foam Concentrate gal Required	Fire Boat Connection
				30 lb	150 lb Wheeled				
Barge Terminals	500-1000	2-500	Two 1 1/4	2	NR	NR	1	100[b]	NR
Tanks 20,000 DWT and under	1000-2000	2-500	Two 1 1/4	2	1	1	1	300[b]	2
20-70,000 DWT	2000	2-1000	Four 1 1/4[c]	2	2[d]	2	1	2000	2
70,000 DWT and over	2000[f]	2-1000	Four 1 1/4[c]	3	2[d]	2	1	2000[e]	2
Sea Islands	2000-4000[f]	3-1000	Four 1 1/4[c]	4	2	3	2	3000	2

NR = Not Required.
(a) A minimum of two 1 1/2 in. hydrant outlets should be provided at each monitor riser.
(b) Can be provided by onshore mobile equipment.
(c) One hose reel at each berth should have foam capability.
(d) The proximity of adjacent berths may reduce total required.
(e)* Add foam for under-dock system (0.16 x 0.3 x 30 x area).
(f)* Add water for under-dock system (0.16 x area)

*Under-dock systems are optional.

5-10.6 Overfill Protection.
5-10.6.1 Storage tanks served by vapor processing or vapor recovery systems shall be equipped with overfill protection in accordance with Section 2-10.
5-10.6.2 Overfill protection of tank vehicles shall be in accordance with 5-6.4.6 through 5-6.4.8.
5-10.6 Sources of Ignition.
5-10.6.1 Vapor Release. Tank or equipment openings provided for purposes of vapor recovery shall be protected against possible vapor release in accordance with 2-4.6.6, 2-5.4.9, 5-6.4.7, and 5-6.4.8.
5-10.6.2* Electric. Electrical area classification shall be in accordance with 5-3.6.
5-10.6.3* Static Electricity. Vapor collection and vapor processing equipment shall be protected against static electricity in accordance with 5-9.4.
5-10.6.4* Spontaneous Ignition. Where there is the potential for spontaneous ignition, precautions shall be taken either by design or written procedures to prevent ignition.
5-10.6.5* Friction Heat or Sparks from Mechanical Equipment. Mechanical equipment used to move vapors that are in the flammable range shall be designed to prevent sparks or other ignition sources under both normal and equipment malfunction conditions.
5-10.6.6* Flame Propagation. Where there is reasonable potential for ignition of a vapor mix in the flammable range, means shall be provided to stop the propagation of flame through the vapor collection system. The means chosen shall be appropriate for the conditions under which they will be used.
5-10.6.7 Explosion Protection. Where used, explosion protection systems shall comply with NFPA 69, Standard on Explosion Prevention Systems.
5-10.7 Emergency System Shutdown. Emergency shutdown systems shall be designed to fail to a safe position in the event of loss of normal system power (i.e., air or electric) or equipment malfunction.
5-10.8 Fire Protection. Fire protection shall be provided for vapor recovery systems that have flammable vapor enriching systems and shall be capable of reaching the vapor collecting and enriching systems. Small vapor recovery systems shall be permitted to be protected with 150 lb dry chemical extinguishers.
NOTE: All Appendix items are renumbered accordingly.
SUBSTANTIATION: This entire section has been rewritten to improve clarity and to make it more easily interpreted. It is being relocated according to a reorganization of Chapter 5.
COMMITTEE ACTION: Accept.

(Log #CP18)
Committee: FLC-OPS

30- 153 - (5-6.1, 5-6.3 through 5-6.7): Accept
SUBMITTER: Technical Committee on Operations,
RECOMMENDATION: Combine these sections into a new Section 5-12 and revise as follows:
5-12 Fire Protection and Fire Suppression
5-12.1 General
5-12.1.1 This Section covers the commonly recognized management control systems and methods used to prevent or minimize the loss from fire or explosion in liquid processing facilities. Other recognized fire prevention and control factors, involving construction, location, separation, etc., are addressed elsewhere in this Chapter.
5-12.2 The wide range in size, design and location of liquid processing facilities precludes the inclusion of detailed fire prevention and control systems and methods applicable to all such facilities. The authority having jurisdiction shall be consulted on specific cases or qualified engineering judgment shall be exercised
5-12.2 Portable Fire-Control Equipment.
5-12.2.1 Listed portable fire extinguishers shall be provided for facilities in such quantities, sizes, and types as might be needed for the special hazards of operation and storage. (NFPA 10, Standard for Portable Fire Extinguishers, provides information on the suitability of various types of extinguishers.)
5-12.2.2 When the need is indicated, standpipe and hose systems, installed in accordance with NFPA 14, Standard for the Installation of Standpipe and Hose Systems, or hose connections from sprinkler systems using combination spray and straight stream nozzles, installed in accordance with NFPA 13, Standard for the Installation of Sprinkler Systems, shall be used.
5-12.2.3 When the need, mobile foam apparatus shall be provided. (NFPA 11C, Standard for Mobile Foam Apparatus, provides information on the subject.)
5-12.2.4 Automotive and trailer-mounted fire apparatus, where determined necessary, shall not be used for any purpose other than fire fighting.
5-12.2.7 Fixed Fire Control Equipment.
5-12.2.1 A reliable water supply or other suitable fire control agent shall be available in pressure and quantity to meet the fire demands indicated by the special hazards of operation, storage, or exposure.
5-12.2.2 Hydrants, with or without fixed monitor nozzles, shall be provided in accordance with accepted practice. The number and placement will depend on the hazard of the liquid-processing facility, storage. (See NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances, for information on this subject.)
5-12.2.3 Where the need is indicated by the hazards of liquid processing, storage, or exposure, fixed protection shall be provided by means of approved sprinkler systems, water spray systems, deluge systems, fire resistive materials, or a combination of these. (See NFPA 13, Standard for the Installation of Sprinkler Systems, and NFPA 15, Standard for Water Spray Fixed Systems for Fire Protection, for information on these subjects.)
5-12.2.4 Where provided fire control systems shall be designed, installed, and maintained in accordance with the following NFPA standards:
(a) NFPA 11, Standard for Low Expansion Foam and Combined Agent Systems;
(b) NFPA 11A, Standard for Medium- and High-Expansion Foam Systems;
(c) NFPA 12, Standard on Carbon Dioxide Extinguishing Systems;
(d) NFPA 12A, Standard on Halon 1301 Fire Extinguishing Systems;
(e) NFPA 12B, Standard on Halon 1211 Fire Extinguishing Systems;
(f) NFPA 16, Standard on the Installation of Deluge Foam-Water Sprinkler and Foam-Water Spray Systems;
(g) NFPA 17, Standard for Dry Chemical Extinguishing Systems.
5-12.5 Detection and Alarm.
5-12.5.1 An approved means for prompt notification of fire or emergency to those within the plant and to the available public or mutual aid fire department shall be provided.
5-12.5.2 Those areas, including buildings, where a potential exists for a flammable liquid spill shall be monitored as appropriate. Some methods may include:
(a) Personnel observation or patrol;
(b) Process monitoring equipment that would indicate a spill or leak might have occurred;
(c) Provision of gas detectors to continuously monitor the area where facilities are unattended.
5-12.6 Emergency Planning and Training
5-12.6.1 Personnel responsible for the use and operation of fire protection equipment shall be trained in the use of that equipment. Refresher training shall be conducted at least annually.
5-12.6.2 Planning of effective fire control measures shall be coordinated with local emergency response agencies.
5-12.6.3 Procedures shall be established to provide for safe shutdown of operations under emergency conditions. Provisions shall be made for periodic training, inspection, and testing of associated alarms, interlocks, and controls.
5-12.6.4 The emergency procedure shall be kept readily available in an operating area and updated regularly.
5-12.6.5 Where premises are likely to be unattended for considerable periods of time, a summary of the emergency plan shall be posted or located in a strategic and accessible location.
5-12.7 Inspection and Maintenance.
5-12.7.1 All fire protection equipment shall be properly maintained, and periodic inspections and tests shall be done in accordance with both standard practice and equipment manufacturer's recommendations.
5-12.7.2 Maintenance and operating practices shall control leakage and prevent spillage of flammable liquids.
5-12.7.3 Combustible waste material and residues in operating areas shall be kept to a minimum, stored in covered metal containers, and disposed of daily.
5-12.7.4 Ground areas around facilities where liquids are stored, handled, or used shall be kept free of weeds, trash, or other unnecessary combustible materials.
5-12.7.5 Aisles established for movement of personnel shall be maintained clear of obstructions to permit orderly evacuation and ready access for manual fire fighting activities.
SUBSTANTIATION: This entire section has been rewritten to improve clarity and to make it more easily interpreted. It is being relocated according to a reorganization of Chapter 5.
COMMITTEE ACTION: Accept.

(Log #CP19)
Committee: FLC-OPS

30- 154 - (5-6.2): Accept
SUBMITTER: Technical Committee on Operations,
RECOMMENDATION: Relocate current 5-6.2 to new section 5-9. and renumber as follows:
5-9 Control of Ignition Sources.
5-9.1 Precautions shall be taken to prevent the ignition of flammable vapors. Sources of ignition include, but are not limited to:
(a) Open flames
(b) Lightning
(c) Hot surfaces
(d) Radiant heat
(e) Smoking
(f) Cutting and welding
(g) Spontaneous ignition
(h) Frictional heat or sparks
(i) Static electricity
(j) Electrical sparks
(k) Stray currents
(l) Ovens, furnaces, and heating equipment.
5-9.2 Smoking shall be permitted only in designated and properly identified areas.
5-9.3 Welding, cutting, and similar spark-producing operations shall not be permitted in areas containing flammable liquids until a written permit authorizing such work has been issued. The permit shall be issued by a person in authority following his/her inspection of the area to assure that proper precautions have been taken and will be followed until the job is completed. (See NFPA 51B, Standard for Fire Prevention in Use of Cutting and Welding Processes.)
5-9.4 Static Electricity. All equipment, such as tanks, machinery, and piping, where an ignitable mixture may be present shall be bonded or connected to a ground. The bond or ground or both shall be physically applied or shall be inherently present by the nature of the installation. Electrically isolated sections of metallic piping or equipment shall be bonded to the other portions of the system or individually grounded to prevent hazardous accumulations of static electricity. (NFPA 77, Recommended Practice on Static Electricity, provides information on this subject.)
SUBSTANTIATION: This entire section has been rewritten to improve clarity and to make it more easily interpreted. It is being relocated according to a reorganization of Chapter 5.
COMMITTEE ACTION: Accept.

(Log #CP20)
Committee: FLC-OPS

30- 155 - (5-6.3.1): Accept
SUBMITTER: Technical Committee on Operations,
RECOMMENDATION: Add the following to 5-6.3.1:
"Water-based fire protection systems shall be inspected, tested, and maintained in accordance with NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based fire Protection Systems."
SUBSTANTIATION: This addition provides the user with guidance on proper maintenance of fire protection systems.
COMMITTEE ACTION: Accept.

(Log #CP21)
Committee: FLC-OPS

30- 156 - (5-11): Accept
SUBMITTER: Technical Committee on Operations,
RECOMMENDATION: Add a new Section 5-11 to read as follows:
5-11 Management of Fire Hazards
5-11.1 This section shall apply to the management methodology used to identify, evaluate, and control the hazards involved in processing and handling of flammable and combustible liquids. Theses hazards include, but are not limited, to, preparation, separation, purification, and change of state, energy content, or composition.
5-11.2 Operations involving flammable and combustible liquids shall be reviewed to ensure that fire and explosion hazards resulting from loss of containment of liquids are provided with corresponding fire prevention and emergency action plans.
Exception No. 1: Operations where liquids are used solely for on-site consumption as fuels.
Exception No. 2: Operations where Class II or Class III liquids are stored in atmospheric tanks or transferred at temperatures below their flash points.
Exception No. 3: Retail occupancies, crude petroleum exploration and production operations, and normally unoccupied facilities in remote locations.
5-11.3 The extent of fire prevention and control that is provided shall be determined by means of an engineering evaluation of the operation and application of sound fire protection and process engineering principles. This evaluation shall include, but not be limited to:
(a) Analysis of the fire and explosion hazards of the operation.
(b) Analysis of hazardous materials and chemicals and hazardous reactions used in the operation and the safeguards taken to control them.
(c) Analysis of applicable facility design requirements in Sections 5-3 through 5-8.
(d) Analysis of applicable requirements for liquid handling, transfer, and use, as covered in Sections 5-3 through 5-8.
(e) Analysis of local conditions, such as exposure to and from adjacent properties and exposure to floods, earthquakes, and windstorms.
(f) analysis of the emergency response capabilities of the local emergency services.
5-11.4 A written emergency action plan that is consistent with available equipment and personnel shall be established to respond to fires and related emergencies. This plan shall include the following:
(a) Procedures to be followed in case of fire, such as sounding the alarm, notifying the fire department, evacuating personnel, and controlling and extinguishing the fire.
(b) Procedures and schedules for conducting drills of these procedures.
(c) Appointment and training of personnel to carry out assigned duties. These duties shall be reviewed at the time of initial assignment, as responsibilities or response actions change, and whenever anticipated duties change.
(d) Maintenance of fire protection equipment.
(e) Procedures for shutting down or isolating equipment to reduce the release of liquid. This shall include assigning personnel responsible for maintaining critical plant functions or shutdown of plant processes.
(f) Alternate measures for the safety of occupants.
5-11.5 Personnel responsible for the use and operation of fire protection equipment shall be trained in the use of that equipment. Refresher training shall be conducted at least annually.
5-11.6 Planning of effective fire control measures shall be coordinated with local emergency response agencies.
5-11.7 Procedures shall be established to provide for safe shutdown of operations under emergency conditions. Provisions shall be made for periodic training, inspection, and testing of associated alarms, interlocks, and controls.
5-11.8 The emergency procedure shall be kept readily available in an operating area and updated regularly.
5-11.9 Where premises are likely to be unattended for considerable periods of time, a summary of the emergency plan shall be posted or located in a strategic and accessible location.
5-11.10 The fire hazards management review conducted in accordance with 5-11.2 shall be repeated whenever the hazards leading to a fire or explosion change significantly. Conditions that might require repeating a review include, but nit be limited to:
(a) When changes occur in the materials in process.
(b) When changes occur in process equipment.
(c) When changes occur in process control.
(d) When changes occur in operating procedures or assignments.
SUBSTANTIATION: This new section presents a holistic approach to the management of fire hazards and is considered a key step in the prevention of fires and explosions in the process industries. This material summarizes the previous material used by NFPA 30 to cover management issues and provides new material in light of major regulatory developments.
COMMITTEE ACTION: Accept.

(Log #92)
Committee: FLC-OPS

30- 157 - (5-11 (New)): Accept in Principle
SUBMITTER: Byron L Briese, HSB Professional Loss Control
RECOMMENDATION: Combine certain sections of existing text, notably from section 5-6.1.3 and 5-6.4.1 with new material. This newly numbered section would provide a comprehensive approach to Process Hazards Management issues.
5-11.1 This section shall apply to the management methodology used to identify, evaluate and control flammable or combustible liquids processing, handling and storage hazards. Liquid hazards can involve, but are not limited to, preparation; separation;

purification; change of state, energy content, or composition.

5-11.2 Flammable and combustible liquid operations in one location involving 10,000 lb (1200 gal water equivalent) or more shall be reviewed to assure that fire and explosion hazards from a potential loss of containment incident are provided with corresponding fire prevention and emergency action plans. (See Appendix A for assistance in converting pounds of liquid to gallons of liquid).

Exception No. 1: Operations where liquids are used solely for on-site consumption as a fuel, if such fuels are not part of an operation containing another liquid.

Exception No. 2: Operations where Class II or III liquids are stored in atmospheric tanks or transferred at temperatures below their flash points.

Exception No. 3: This provision shall not apply to retail facilities, crude petroleum drilling or servicing operations or normally unoccupied remote facilities.

5-11.3 The process hazards management review should segment the operations into contiguous, homogeneous, process units.

5-11.4 The extent of fire prevention and control provided for the liquid processing facility shall be determined by an engineering evaluation of the operation, followed by the application of sound fire protection and process engineering principles. The evaluation shall include, but not be limited:

(a) Analysis of fire and explosion hazards of the liquid operation.

(b) Analysis of hazardous materials, hazardous chemicals, or hazardous reactions in the operations and the safeguards taken to control such materials, chemicals or reactions.

(c) Analysis of facility design requirements in Section 5-XX.

(d) Analysis of the liquid handling, transfer, and use requirements in Section 5-XX.

(e) Analysis of local conditions, such as exposure to and from adjacent properties, flood potential, or earthquake potential.

(f) Analysis of the capability of the fire department or mutual air response.

5-11.5 A written emergency action plan, consistent with the available equipment and personnel, shall be established to respond to fires and emergencies. This plan shall include the following:

(a) Procedures to be used in case of fire, such as sounding the alarm, notifying the fire department, evacuating personnel, and controlling and extinguishing the fire.

(b) Procedure and schedule for conducting drills of these procedures outlined in 5-11.5(a).

(c) Appointment and training of persons to carry out fire safety duties. The duties shall be reviewed at the time of initial assignment, as responsibilities or actions change, or whenever anticipated duties change.

(d) Maintenance of fire protection equipment.

(e) Shutdown or isolation of equipment to reduce the escape of liquid. This shall incorporate personnel assignments for the maintenance of critical plant functions or shutdown of plant processes.

(f) Alternate measures for the safety of occupants while an fire protection equipment is shut down.

5-11.6 The process hazards management review conducted in accordance with 5-11.2 shall be repeated whenever the hazards leading to fire/explosion are significantly altered. This can occur under, but not be limited to, the circumstances below:

(a) when changes occur in the materials-in-process.

(b) when changes occur in process equipment.

(c) when changes occur in process control.

(d) when changes occur in operating procedures or assignments.

Appendix Material

A-5-11.2 The quantity of 10,000 lb converts to approximately 1,200 gal of water at 50°F (10°C). To compute the gallons of the liquid being considered, divide the 1,200 gal of water by the density of the liquid.

For example, the density of Ethyl Alcohol is 0.8. The 10,000 lb exempt quantity of Ethyl Alcohol would be 1,200 gal/0.8 or 1,500 gal.

A-5-11.4 Fire prevention and control analysis and emergency action plans should be written documents prepared by personnel familiar with the hazards of the subject site. Each site should be examined by specific operations such as: process/manufacturing areas, storage buildings, tank farms, etc.

Appropriate fire prevention measures should be delineated for each site operation. These measures can include: process controls, vessel integrity, ventilation systems, static electricity controls, classified electrical equipment, and control of material handling equipment. Maintenance procedures needed to assure the reliability of these preventative measures should also be included in e document.

The Occupational Health and Safety Administration (OSHA) of the United States Department of Labor has promulgated a standard regarding Process Safety Management (PSM), that requires certain facilities handling designated hazardous materials to implement a Process Safety Management program. The essential elements of the plan are as follows:

1. Employee Participation
2. Process Safety Information
3. Process Hazard Analyses
4. Operating Procedures
5. Training
6. Contractor's Safety
7. Pre-Startup Safety Review
8. Mechanical Integrity
9. Hot Work Permits
10 Management of Change
11. Incident Investigation
12. Emergency Planning and Response
13. Compliance Audits
14. Trade Secrets.

SUBSTANTIATION: The holistic management of process related issues has been identified as a key step in the prevention of fires and explosions within the process industries. This proposal summarizes the previous material used by NFPA 30 to cover management issues and provides new material in the light of major regulatory developments.

COMMITTEE ACTION: Accept in Principle.

Refer to Proposal 30-156 (Log #CP21).

COMMITTEE STATEMENT: The Technical Committee's version meets the intent of this proposal.

PART II

(Log #CP1)

321- 1 - (Entire Document): Accept
SUBMITTER: Technical Committee on Fundamentals
RECOMMENDATION: Withdraw the 1991 edition of NFPA 321.
SUBSTANTIATION: The entire text of NFPA 321 has been incorporated into the proposed 1996 edition of NFPA 30, Flammable and Combustible Liquids Code.
COMMITTEE ACTION: Accept.

PART III

(Log #1)

395- 1 - (1-1.1(b), 1-1.2(a) and 1-2): Reject
SUBMITTER: Rick Thornberry, ConVault
RECOMMENDATION: Revise text to read as follows:
1-1.1(b) At isolated construction sites and isolated earth-moving projects, including gravel pits, quarries, and borrow pits, where, in the opinion of the authority having jurisdiction, it is not necessary to comply with the more restrictive requirements of NFPA 30, Flammable and Combustible Liquids Code, and NFPA 30A, Automotive and Marine Service Station Code; and
1-1.2(a) The storage, handling, and use of ~~fuel~~ tanks and containers that are installed or used in accordance with NFPA 31, Standard for the Installation of Oil-Burning Equipment; NFPA 37, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines; and NFPA 30A, Automotive and Marine Service Station Code, and
1-2 Purpose. The purpose of this standard shall be to provide reasonable requirements for the storage of Class I flammable and Class II and Class IIIA combustible liquids that are less restrictive than the requirements of NFPA 30, Flammable and Combustible Liquids Code, and NFPA 30A, Automotive and Marine Service Station Code, for use in the specific situations set forth in 1-1.1.
SUBSTANTIATION: The purpose of this proposal is to correlate the scopes of NFPA 395 and NFPA 30A regarding fueling of motor vehicles. Companion proposals have been submitted to NFPA 30A to provide an appropriate reference to NFPA 395 with the intent of exempting farms and isolated sites from the requirements of NFPA 30A when permitted by the authority having jurisdiction provided compliance is achieved in accordance with NFPA 395. These revisions will eliminate potential conflicts between the application of the two standards and allow the authority having jurisdiction to make the appropriate judgment as to when NFPA 395 may be used in lieu of NFPA 30A.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: NFPA 395 has been withdrawn and its text incorporated as a separate chapter in NFPA 30. NFPA 30 includes the necessary exclusions to prevent conflict with NFPA 30A.

(Log #2)

395- 2 - (2-3.1 (New)): Reject
SUBMITTER: Rick Thornberry, ConVault
RECOMMENDATION: Add a new Section 2-3.1 to read as indicated in the following and renumber the remaining sections accordingly:
2-3.1 The aggregate capacity of aboveground tanks storing Class I or II liquids shall not exceed 1,100 gal (4,165 L). For locations other than farms, the aggregate capacity of aboveground tanks used for the temporary storage of Class II liquids for not more than 90 days shall not exceed 10,000 gal (437,875).
SUBSTANTIATION: Presently, there are no aggregate capacity limits for regulating the aboveground storage of Class I and II liquids in tanks of 60 to 1,100 gal capacity. For fire safety reasons, a maximum limit should be placed on the storage of such liquids when stored in accordance with this standard instead of NFPA 30 or NFPA 30A. The maximum quantities proposed for permanent tanks is 1,100 gal total for Class I and II liquids stored aboveground. This is a reasonable amount to allow for the day to day operations of a typical relatively small farm. Larger farms should comply with NFPA 30 and 30A due to the increased hazard of the larger quantities of such liquids being stored and dispensed.
For locations other than farms such as construction sites and excavations, temporary storage of Class II liquids is allowed for up to 10,000 gal aggregate capacity for a period not to exceed 90 days. Again, this will allow for the normal operations that occur at such locations. The authority having jurisdiction will have the ability to re-permit such operations every 90 days to ensure that they are being conducted safely.
These limits are based upon similar criteria in the 1994 Uniform Fire Code Section 7904.2.5.1 for private use on farms and rural areas and construction sites, earth-moving projects, gravel pits or borrow pits.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: This proposal would establish limits on storage at such sites heretofore not mandated. The Technical Committee is not sure what constitutes a reasonable upper limit.

(Log #CP1)

395- 3 - (Entire Document): Accept
SUBMITTER: Technical Committee on Tank Storage and Piping Systems
RECOMMENDATION: Withdraw the 1993 Edition of NFPA 395, Standard for the Storage of Flammable and Combustible Liquids at Farms and Isolated Sites.
SUBSTANTIATION: The entire text of NFPA 395 has been incorporated as a Chapter in NFPA 30.
COMMITTEE ACTION: Accept.
