ANSI/NFPA 1231 An American National Standard February 9, 1984

NFPA 1231
Water Supplies for Suburban and Rural Fire Fighting
1984

NFPA

National Fire Protection Association Batterymarch Park, Quincy, MA 02269

NOTICE

All questions or other communications relating to this document should be sent only to NFPA Headquarters, addressed to the attention of the Committee responsible for the document.

For information on the procedures for requesting Technical Committees to issue Formal Interpretations, proposing Tentative Interim Amendments, proposing amendments for Committee consideration, and appeals on matters relating to the content of the document, write to the Secretary, Standards Council, National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

A statement, written or oral, that is not processed in accordance with Section 16 of the Regulations Governing Committee Projects shall not be considered the official position of NFPA or any of its Committees and shall not be considered to be, nor be relied upon as, a Formal Interpretation.

Users of this document should consult applicable Federal, State and local laws and regulations. NFPA does not, by the publication of this document, intend to urge action which is not in compliance with applicable laws and this document may not be construed as doing so.

Policy Adopted by NFPA Board of Directors on December 3, 1982

The Board of Directors reaffirms that the National Fire Protection Association recognizes that the toxicity of the products of combustion is an important factor in the loss of life from fire. NFPA has dealt with that subject in its technical committee documents for many years.

There is a concern that the growing use of synthetic materials may produce more or additional toxic products of combustion in a fire environment. The Board has, therefore, asked all NFPA technical committees to review the documents for which they are responsible to be sure that the documents respond to this current concern. To assist the committees in meeting this request, the Board has appointed an advisory committee to provide specific guidance to the technical committees on questions relating to assessing the hazards of the products of combustion.

Statement on NFPA Procedures

This material has been developed under the published procedures of the National Fire Protection Association, which are designed to assure the appointment of technically competent Committees having balanced representation. While these procedures assure the highest degree of care, neither the National Fire Protection Association, its members, nor those participating in its activities accepts any liability resulting from compliance or noncompliance with the provisions given herein, for any restrictions imposed on materials or processes, or for the completeness of the text.

NFPA has no power or authority to police or enforce compliance with the contents of this document and any certification of products stating compliance with requirements of this document is made at the peril of the certifier

Standard on Water Supplies for

Suburban and Rural Fire Fighting

NFPA 1231-1984

1984 Edition of NFPA 1231

This edition of NFPA 1231, *Standard on Water Supplies for Suburban and Rural Fire Fighting*, was prepared by the Technical Committee on Rural Fire Protection and acted on by the National Fire Protection Association, Inc. at its Fall Meeting held November 14-17, 1983, in Orlando, Florida. It was issued by the Standards Council on January 18, 1984, with an effective date of February 7, 1984, and supersedes all previous editions.

Origin and Development of NFPA 1231

This text originally was NFPA 25, *Recommended Practices for Water Supply Systems for Rural Fire Protection*, and originally was developed by the Subcommittee on Water Supply Systems for Rural Fire Protection of the Committee on Rural Fire Protection and Prevention. It received tentative adoption in 1969 and was further amended and adopted in May 1969 as NFPA 25.

The 1975 edition represented a complete revision of the previous document. This edition underwent a title change to *Water Supplies for Suburban and Rural Fire Fighting* and was renumbered NFPA 1231.

This 1984 edition is the third edition of this standard and represents a complete revision to include both mandatory and advisory material.

Technical Committee on Rural Fire Protection

James W. Simms, *Chairman*
Rolf Jensen & Assoc., Inc.

Donald J. McCarrick, *Vice Chairman*
Mutual Service Office

Louis A. Witzeman, *Secretary*
Scottsdale Fire Dept.

A.R. Antonio, Bancroft Fire Protection District
Junius O. Baker, Jr., USDA - Forest Service
Laura B. Buchbinder, US Fire Administration
R.C. Callahan, Fire Mutual Aid Systems
William J. Fletcher, Nat'l Safety Council
Selby C. Jacobs, Manassas, VA
Paul G. Mason, M & M Protection Consultants
Robert G. Mauney, Maricopa County Government
William F. McQuaid, Mutual Fire Insurance Assn. of NE
Jeanne Priester, US Dept. of Agriculture
Joe L. Rape, Germantown, TN
Rep. Int'l Assn. of Fire Chiefs
Alan Saulsbury, Saulsbury Fire Equipment Corp.

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.

NOTE: Membership on a Committee shall not in and of itself constitute an endorsement of the Association or any document developed by the Committee on which the member serves.

Contents

Standard on Water Supplies for

Suburban and Rural Fire Fighting

NFPA 1231-1984

NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates explanatory material on that paragraph in Appendix A.

Chapter 1 Administration

1-1* Scope. This standard identifies minimum requirements for water supplies for fire fighting purposes in rural and suburban areas in which adequate and reliable water supply systems for fire fighting purposes do not exist.

1-2 Purpose. This standard specifies minimum requirements for water supply for fire fighting purposes to protect property from fire in areas where water must be transported from a river, lake, canal, bay, stream, pond, well, cistern or other similar source of water which is available as suction supply for fire department use. Water obtained by methods outlined in this standard may be used to supplement water for fire fighting available from hydrants on a traditional municipal-type distribution system. Likewise, a hydrant served by a water distribution system may be the source of supply for water which is transported to the rural fire area.

It is the intent of this standard that the authority having jurisdiction, the fire department having jurisdiction, and property owners in the jurisdiction shall work together to provide and maintain these minimum water supplies for fire fighting purposes.

The requirements of this standard are minimums, and nothing herein shall be interpreted to mean that the authority having jurisdiction cannot exceed any or all of these requirement where, in the judgement of the authority having jurisdiction, such additional protection is warranted.

This standard, *Water Supplies for Suburban and Rural Fire Fighting*, is restricted to identifying minimum requirements for water supplies for fire fighting purposes. Discussion of a municipal-type water system would include not only the water available from the hydrants for fire fighting purposes but also such corollary matters as the source of supply, storage, distribution system, and hydrants. Much information has been added to the appendix of this standard concerning rural water supplies, hauling of water, transporting water through large-diameter hose, portable pumping equipment, and automatic sprinkler protection, any or all of which may comprise a rural "water system."

1-3 General.

1-3.1 The requirements of Chapters 5 and 6 of this standard are performance oriented and allow the authority having jurisdiction the option of how to make these water supplies available, with consideration given to local conditions and needs.

1-4 Definitions.

Adequate and Reliable Water Supply. A supply which is sufficient in volume, every day of the year, to control and extinguish any and all fires anticipated in the municipality or particular building served by the water supply.

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.

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."

Building. Any structure erected for the support, shelter, or enclosure of persons, animals, or property of any kind.

Construction Classification Number. A series of numbers from 0.50 through 1.50 that are mathematical factors used in a formula to determine total water supply requirements of this standard only.

Exposure Hazard. A structure within 50 ft (15.2 m) of another building and 100 sq ft (9.3 m^2) or larger in area. If a structure is of Occupancy Hazard Classification Number 3 or 4, it is considered an exposure hazard if within 50 ft (15.2 m) of another building, regardless of size.

Fire Department Having Jurisdiction. The fire department serving the municipality, or any portion of the municipality, governed by the authority having jurisdiction. The authority having jurisdiction and the fire department having jurisdiction may be the same agency.

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.

Large-Diameter Hose. Fire department hose having an inside diameter of 3½ in. (89 mm) or larger.

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.

Municipality. A town, city, county, fire district, or community having powers of local self-government.

Municipal-type Water System. A system having water pipe serving hydrants and designed to furnish a minimum flow of 250 gpm (946 L/min) at 20 psi (139 kPa) residual pressure for a two-hour duration.

Normal Living Area - Dwelling. This area shall include typical rooms, such as living room, dining area, parlor, kitchen, bath, bedroom, halls, library, music room, family room, laundry room, etc., and includes any other areas that are normally heated or cooled plus attic-basement provisions, enclosed parking (garage), and storage areas.

Occupancy Hazard Classification Number. A series of numbers from 3 through 7 that are mathematical factors used in a formula to determine total water supply requirements of this standard only.

Protected Property. Property protected by a water supply which is minimally adequate in volume and duration and a fire department capable of using the water supply to suppress a possible fire within the property.

Shall. Indicates a mandatory requirement.

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

Single Water Point. The point or site at which water supply, such as a pumper with portable folding tank or dry hydrant, etc., may be located to protect a cluster of buildings, such as a subdivision or an estate.

Water Supply Officer. The fire department officer responsible for providing water for fire fighting purposes.

Chapter 2 Structure Surveys

2-1 General.

2-1.1* The fire department having jurisdiction shall perform an on-site survey of all buildings, including type of construction, occupancies, and exposures, within the applicable jurisdiction to obtain the information needed to compute the total water supplies required. At the time of the on-site survey, a record shall be prepared of available water supplies. This information is to be utilized for prefire planning purposes as well as by the water supply officer.

2-1.2 Residential areas specified in 5-2.1, 5-3.1, and 5-4.1 may be surveyed as an area to determine square footage or cubic footage and square meters or cubic meters of each structure and distance to structural exposure hazards, but without a survey of contents.

2-1.3 These surveys may be combined with fire prevention or prefire planning inspections.

Chapter 3 Classification of Occupancy Hazard

3-1 General.

3-1.1 The fire department having jurisdiction, upon completing the survey specified in Chapter 2, shall determine the Occupancy Hazard Classification Number from the sections of this chapter.

3-1.2 Occupancy Hazard Classification Numbers shall not be assigned to any structure not surveyed as specified in Chapter 2.

3-1.3 An Occupancy Hazard Classification Number shall not be assigned to any building when such building is protected by an automatic sprinkler system installed in accordance with applicable NFPA standards.

3-1.4* Storage of products potentially hazardous from the standpoint of increased fire volume or of an explosive nature exists at many rural locations, and such products may be in sufficient quantities to increase the Occupancy Hazard Classification Number of the building.

3-2* Occupancy Hazard Classification Number.

3-2.1 The occupancies listed in each section are only examples of types of occupancies for the particular classification, and these lists of examples shall not be interpreted as being exclusive. Similar occupancies shall be assigned the same Occupancy Hazard Classification Number.

3-2.2 Where more than one occupancy is present in a structure, the Occupancy Hazard Classification Number for the most hazardous occupancy shall be used for the entire structure.

3-2.3 Occupancy Hazard Classification Number 3.

3-2.3.1 Occupancies in this classification are considered SEVERE HAZARD OCCUPANCIES, where quantity and combustibility of contents are very high. Fires in these occupancies can be expected to develop very rapidly and have high rates of heat release. (See 5-5.1.)

3-2.3.2 When an exposing structure is of Occupany Hazard Classification Number 3, it is considered an exposure hazard if within 50 ft (15.2 m) regardless of size.

3-2.3.3 Occupancy Hazard Classification Number 3 examples include:

- Aircraft Hangars
- Cereal or Flour Mills
- Chemical Works and Plants
- Cotton Picker and Opening Operations
- Distilleries
- Explosives and Pyrotechnics Manufacturing and Storage
- Feed and Grist Mills
- Grain Elevators and Warehouses
- Linseed Oil Mills
- Lumberyards
- Oil Refineries
- Plastics Manufacturing and Storage
- Saw Mills
- Solvent Extracting
- Straw or Hay in Bales
- Varnish and Paint Manufacturing

3-2.4 Occupancy Hazard Classification Number 4.

3-2.4.1 Occupancies in this classification are considered HIGH HAZARD OCCUPANCIES, where quantity and combustibility of contents are high. Fires in these occupancies can be expected to develop rapidly and have high rates of heat release.

3-2.4.2 When an exposing structure is of Occupancy Hazard Classification Number 4, it is considered an exposure hazard if within 50 ft (15.2 m) regardless of size.

3-2.4.3 Occupancy Hazard Classification Number 4 examples include:

- Barns and Stables (commercial)
- Building Materials
- Department Stores
- Exhibition Halls, Auditoriums, and Theaters
- Feed Stores (without processing)
- Freight Terminals
- Mercantiles
- Paper and Pulp Mills
- Paper Processing Plants
- Piers and Wharves
- Repair Garages
- Rubber Products - Manufacturing and Storage
- Warehouses, such as:
  - paper
  - furniture
  - paint
  - department store
  - general storage
  - whiskey
- Woodworking Industries

3-2.5 Occupancy Hazard Classification Number 5.

3-2.5.1 Occupancies in this classification are considered MODERATE HAZARD OCCUPANCIES, where quantity and combustibility of contents are moderate and stockpiles of combustibles do not exceed 12 ft (3.7 m) in height. Fires in these occupancies can be expected to develop quickly and have moderately high rates of heat release.

3-2.5.2 Occupancy Hazard Classification Number 5 examples include:

- Amusement Occupancies
- Clothing Manufacturing Plants
- Cold Storage Warehouses
- Confectionery Product Warehouses
- Farm Storage Buildings, such as:
  - dairy barns
  - equipment sheds
  - corn cribs
- Hatcheries
- Laundries
- Leather Goods Manufacturing Plants
- Libraries (with large stock room areas)
- Lithography Shops
- Machine Shops
- Metalworking Shops
- Nurseries (plant)
- Pharmaceutical Manufacturing Plants
- Printing and Publishing Plants
- Restaurants
- Rope and Twine Manufacturing Plants
- Sugar Refineries
- Tanneries
- Textile Manufacturing Plants
- Tobacco Barns
- Unoccupied Buildings

3-2.6 Occupancy Hazard Classification Number 6.

3-2.6.1 Occupancies in this classification are considered LOW HAZARD OCCUPANCIES, where quantity and combustibility of contents are moderate and stockpiles of combustibles do not exceed 8 ft (2.44 m) in height. Fires in these occupancies can be expected to develop at a moderate rate and have moderate rates of heat release.

3-2.6.2 Occupancy Hazard Classification Number 6 examples include:

- Armories
- Automobile Parking Garages
- Bakeries
- Barber or Beauty Shops
- Beverage Manufacturing Plants
- Boiler Houses
- Breweries
- Brick, Tile, and Clay Product Manufacturing Plants
- Canneries
- Cement Plants
- Churches
- Dairy Products Manufacturing and Processing
- Doctors' Offices
- Electronics Plants
- Foundries
- Fur Processing Plants
- Gasoline Service Stations
- Glass and Glass-products Manufacturing Plants
- Municipal Buildings
- Post Offices
- Slaughterhouses
- Telephone Exchanges
- Undertaking Establishments
- Watch and Jewelry Manufacturing Plants
- Wineries

3-2.7 Occupancy Hazard Classification Number 7.

3-2.7.1 Occupancies in this classification are considered LIGHT HAZARD OCCUPANCIES, where quantity and combustibility of contents are low. Fires in these occupancies can be expected to develop at a relatively low rate and have relatively low rates of heat release.

3-2.7.2 Occupancy Hazard Classification Number 7 examples include:

- Apartments
- Colleges and Universities
- Dormitories
- Dwellings
- Fire Stations
- Fraternity or Sorority Houses
- Hospitals
- Hotels and Motels
- Libraries (except large stock room areas)
- Museums
- Nursing and Convalescent Homes
- Offices (including data processing)
- Police Stations
- Prisons
- Schools

Chapter 4 Classification of Construction

4-1 General.

4-1.1 The fire department having jurisdiction, upon completing the survey specified in Chapter 2, shall determine the Construction Classification Number from the sections of this chapter.

4-1.2 For the purpose of this standard, each building surveyed shall be classified as to type of construction and shall be assigned a Construction Classification Number. However, no dwelling shall be assigned a Construction Classification Number higher than 1.0.

4-1.3 Construction Classification Numbers shall not be assigned to any structure not surveyed as specified in Chapter 2.

4-1.4 Where more than one type of construction is present in a structure, the higher Construction Classification Number shall be used for the entire structure.

4-1.5 When a building is located within 50 ft (15.2 m) of the surveyed building and is 100 sq ft (9.3 m^2) or greater in total area, the building is treated as an exposure with the water requirement calculated by the standard multiplied by 1.5.

4-2* Construction Classification Number.

4-2.1 The construction classifications listed in this standard have been simplified for quick use. When a more complete definition is needed, refer to NFPA 220, *Standard on Types of Building Construction*, or the local building code.

4-2.2 Fire-Resistive Construction — Construction Classification Number 0.5. A building constructed of noncombustible materials (reinforced concrete, brick, stone, etc., and having any metal members properly "fireproofed") with major structural members designed to withstand collapse and to prevent the spread of fire.

4-2.3 Noncombustible Construction — Construction Classification Number 0.75. A building having all structural members (including walls, floors, and roofs) of noncombustible materials and not qualifying as fire-resistive construction.

4-2.4 Ordinary Construction — Construction Classification Number 1.0. Any structure having exterior walls of masonry or other noncombustible material, in which the other structural members are wholly or partly of wood or other combustible material.

4-2.5 Wood Frame Construction — Construction Classification Number 1.50. Any structure in which the structural members are wholly or partly of wood or other combustible material and the construction does not qualify as ordinary construction.

When a dwelling is classified as wood frame construction (that is, having structural members wholly or partly of wood or other combustible material) assign a Construction Classification Number of 1.0.

Chapter 5 Determining Total Water Supplies

5-1 General.

5-1.1 The fire department having jurisdiction for structural surveys specified in Chapter 2, after completing the survey and determining the Occupancy Hazard Classification Number, shall compute the total water supply, in gallons (liters), needed for the structure in its authority.

5-2 Structures Without Exposure Hazards.

5-2.1 Single- and Two-Family Dwellings, 1,200 Square Feet (111.8 m²) and Under (without Exposure Hazards).

5-2.1.1* For single- and two-family dwellings of not greater than 1,200 sq ft (111.8 m²) of normal living area including any attached structures, and with no portion of any unattached structural exposure hazard closer than 50 ft (15.2 m) unless it is smaller than 100 sq ft (9.3 m²), the total water supply in gallons shall be determined by the total cubic footage of the structure including any attached structures, divided by the Occupancy Hazard Classification Number, determined from Chapter 3, and multiplied by the Construction Classification Number, as determined from Chapter 4, or see Table 5-5.1(a).

$$\text{TOTAL WATER SUPPLY} = \frac{\text{Total Cu Ft of Structure}}{\text{Occupancy Hazard Classification}} \times \text{Construction Classification No.}$$

5-2.1.2 The total water supply required for any structure specified in 5-2.1 shall not be less than 2,000 gal (7570 L) [*see Table 5-5.1(b)*].

5-2.1.3 The total water supply, as determined for any structure specified in 5-2.1.1 and 5-2.1.2, shall be available on the fireground at, and the fire department shall be capable of utilizing the total water supply at, the rates specified in Table 5-5.1(c).

5-2.2 All Structures Except Dwellings (without Exposure Hazards).

5-2.2.1* For all structures other than dwellings covered in Section 5-2, with no portion of any unattached structural exposure hazard closer than 50 ft (15.2 m) unless it is smaller than 100 sq ft (9.3 m²), the total water supply in gallons shall be determined by the total cubic footage of the structure, including any attached structures, divided by the Occupancy Hazard Classification Number as determined from Chapter 3, and multiplied by the Construction Classification Number as determined from Chapter 4; or see Table 5-5.1(a).

$$\text{TOTAL WATER SUPPLY} = \frac{\text{Total Cu Ft of Structure}}{\text{Occupancy Hazard Classification}} \times \text{Construction Classification No.}$$

5-2.2.2 The total water supply required for any structure specified in 5-2.2.1 shall not be less than 2,000 gal (7570 L) [*see Table 5-5.1(b)*].

5-2.2.3 The total water supply, as determined for any structure specified in 5-2.2.1 and 5-2.2.2, shall be available on the fireground at, and the fire department shall be capable of utilizing the total water supply at, the rates shown in Table 5-5.1(c).

5-3 Structures with Exposure Hazards.

5-3.1 Single- and Two-Family Dwellings, 1,200 Square Feet (111.8 m²) and Under (with Exposures).

5-3.1.1* For single- and two-family dwellings of not greater than 1,200 sq ft (111.8 m²) of normal living area in total area, including any attached structures, and with unattached structural exposure hazard closer than 50 ft (15.2 m) to any portion of the dwelling and larger than 100 sq ft (9.3 m²), the total water supply, in gallons, shall be determined by the total cubic footage of the structure, including any attached structures, divided by the Occupancy Hazard Classification Number determined from Chapter 3, multiplied by the Construction Classification Number as determined by Chapter 4.

$$\text{TOTAL WATER SUPPLY} = \frac{\text{Total Cu Ft of Structure}}{\text{Occupancy Hazard Classification}} \times \text{Construction Classification No.} \times 1.5$$

5-3.1.2 The total water supply required for an area as specified in 5-3.1.1 shall not be less than 3,000 gal (11 355 L). See Table 5-5.1(b).

5-3.1.3 The total water supply, as determined for any structure specified in 5-3.1.1 and 5-3.1.2, shall be available on the fireground at, and the fire department shall be capable of utilizing the total water supply at, the rates specified in Table 5-5.1(c).

5-3.2 All Structures Except Dwellings (with Exposures).

5-3.2.1* For all structures other than dwellings covered in Section 5-3, with unattached structural exposure hazards closer than 50 ft (15.2 m) to any portion of the structure and larger than 100 sq ft (9.3 m²), the total water supply, in gallons, shall be determined by the total cubic footage of the structure, including any attached structures, divided by the Occupancy Hazard Classification Number determined from Chapter 3, multiplied by the Construction Classification Number as determined from Chapter 4, and multiplied by 1.5; or see Table 5-5.1(a).

$$\text{TOTAL WATER SUPPLY} = \frac{\text{Total Cu Ft of Structure}}{\text{Occupancy Hazard Classification}} \times \text{Construction Classification No.} \times 1.5$$

5-3.2.2 The total water supply required for any structure specified in 5-3.2.1 shall not be less than 3,000 gal (11 355 L). See Table 5-5.1(b).

5-3.2.3 The total water supply as determined for any structure specified in 5-3.2.1 or 5-3.2.2 shall be available on the fireground at, and the fire department shall be capable of utilizing the total water supply at, the rates specified in Table 5-5.1(c).

5-4 Multiple Structures — Single Water Point.

5-4.1 Where structures are close enough together that they may be served from a single water point, the water supply shall be computed from the structure having the largest total water supply requirement.

5-4.2 For all structures with no portion of any unattached structural exposure hazard closer than 50 ft (15.2 m) unless it is smaller than 100 sq ft (9.3 m^2), the total water supply, in gallons, shall be determined by the total cubic footage of the structure, including any attached structures, divided by the Occupancy Hazard Classification Number as determined from Chapter 4; or, see Table 5-5.1(a).

$$\text{TOTAL WATER SUPPLY} = \frac{\text{Total Cu Ft of Structure}}{\text{Occupancy Hazard Classification}}$$

$\times$ Construction Classification No.

5-4.3* For all structures with unattached structural exposure hazards closer than 50 ft (15.2 m) to any portion of the structure and larger than 100 sq ft (9.3 m^2), the total water supply, in gallons, shall be determined by the cubic footage of the structure, including any attached structures, divided by the Occupancy Hazard Classification Number, as determined from Chapter 3, multiplied by the Construction Classification Number, as determined from Chapter 4, and multiplied by 1.5; or see Table 5-5.1(a).

$$\text{TOTAL WATER SUPPLY} = \frac{\text{Total Cu Ft of Structure}}{\text{Occupancy Hazard Classification}}$$

$\times$ Construction Classification No. $\times$ 1.5

5-4.4 The total water supply required for any structure specified in 5-4.2 and 5-4.3 shall not be less than 3,000 gal (11355 L). See Table 5-5.1(b).

5-4.5 The total water supply, as determined for any structure specified in 5-4.2, 5-4.3, and 5-4.4 shall be available on the fireground at, and the fire department shall be capable of utilizing the total water supply at, the rate specified in Table 5-5.1(c).

5-5 Special Fire Protection Problems.

5-5.1* This standard is not intended to provide details for calculating an adequate amount of water for large special fire protection problems such as bulk flammable liquid storage, bulk flammable gas storage, large varnish and paint factories, some plastics manufacturing and storage, aircraft hangars, distilleries, refineries, lumberyards, grain elevators, and large chemical plants. For suggested protection, see appropriate NFPA standards.

The following tables are included as a quick method for determining the water requirements suggested by this standard for structures without exposures. For structures with exposures, multiply the water requirements developed by the "quick method" tables by 1.5.

An example of the use of the tables:

A farm storage building housing a dairy barn (Occupancy Hazard Classification Number 4), constructed of Ordinary Construction (Construction Classification Number 1.0) with a cubic area of 160,000 cu ft (4480 m^3) will produce, by the tables, a water requirement of 40,000 gal (151 400 L).

Table 5-5.1(a) Precalculated Minimum Water Supplies by Occupancy Hazard and Construction Classification.
(no exposures)

Occupancy Hazard Class.	3				4				5				6				7			
Construction Class.	.5	.75	1.0	1.5	.5	.75	1.0	1.5	.5	.75	1.0	1.5	.5	.75	1.0	1.5	.5	.75	1.0	1.5
Cubic Feet	*Gallons*				*Gallons*				*Gallons*				*Gallons*				*Gallons*			
8,000		2,000	2,667	4,000			2,000	3,000				2,400				2,000				
12,000	2,000	3,000	4,000	6,000		2,250	3,000	4,500			2,400	3,600			2,000	3,000				2,571
16,000	2,667	4,000	5,333	8,000	2,000	3,000	4,000	6,000		2,400	3,200	4,800		2,000	2,667	4,000			2,286	3,429
20,000	3,333	5,000	6,667	10,000	2,500	3,750	5,000	7,500	2,000	3,000	4,000	6,000		2,500	3,333	5,000		2,143	2,857	4,286
24,000	4,000	6,000	8,000	12,000	3,000	4,500	6,000	9,000	2,400	3,600	4,800	7,200	2,000	3,000	4,000	6,000		2,571	3,429	5,143
28,000	4,667	7,000	9,333	14,000	3,500	5,250	7,000	10,500	2,800	4,200	5,600	8,400	2,333	3,500	4,667	7,000	2,000	3,000	4,000	6,000
32,000	5,333	8,000	10,667	16,000	4,000	6,000	8,000	12,000	3,200	4,800	6,400	9,600	2,667	4,000	5,333	8,000	2,286	3,429	4,571	6,857
36,000	6,000	9,000	12,000	18,000	4,500	6,750	9,000	13,500	3,600	5,400	7,200	10,800	3,000	4,500	6,000	9,000	2,572	3,857	5,143	7,714
40,000	6,667	10,000	13,333	20,000	5,000	7,500	10,000	15,000	4,000	6,000	8,000	12,000	3,333	5,000	6,667	10,000	2,857	4,286	5,714	8,571
44,000	7,333	11,000	14,667	22,000	5,500	8,250	11,000	16,500	4,400	6,600	8,800	13,200	3,667	5,500	7,333	11,000	3,143	4,714	6,286	9,429
48,000	8,000	12,000	16,000	24,000	6,000	9,000	12,000	18,000	4,800	7,200	9,600	14,400	4,000	6,000	8,000	12,000	3,429	5,143	6,857	10,286
52,000	8,667	13,000	17,333	26,000	6,500	9,750	13,000	19,500	5,200	7,800	10,400	15,600	4,333	6,500	8,667	13,000	3,715	5,571	7,429	11,143
56,000	9,333	14,000	18,667	28,000	7,000	10,500	14,000	21,000	5,600	8,400	11,200	16,800	4,667	7,000	9,333	14,000	4,000	6,000	8,000	12,000
60,000	10,000	15,000	20,000	30,000	7,500	11,250	15,000	22,500	6,000	9,000	12,000	18,000	5,000	7,500	10,000	15,000	4,286	6,429	8,571	12,857
64,000	10,667	16,000	21,333	32,000	8,000	12,000	16,000	24,000	6,400	9,600	12,800	19,200	5,333	8,000	10,667	16,000	4,572	6,857	9,143	13,714
68,000	11,333	17,000	22,667	34,000	8,500	12,750	17,000	25,500	6,800	10,200	13,600	20,400	5,667	8,500	11,333	17,000	4,857	7,286	9,714	14,571
72,000	12,000	18,000	24,000	36,000	9,000	13,500	18,000	27,000	7,200	10,800	14,400	21,600	6,000	9,000	12,000	18,000	5,143	7,714	10,286	15,429
76,000	12,667	19,000	25,333	38,000	9,500	14,250	19,000	28,500	7,600	11,400	15,200	22,800	6,333	9,500	12,667	19,000	5,429	8,143	10,857	16,286
80,000	13,333	20,000	26,667	40,000	10,000	15,000	20,000	30,000	8,000	12,000	16,000	24,000	6,667	10,000	13,333	20,000	5,715	8,571	11,429	17,143
84,000	14,000	21,000	28,000	42,000	10,500	15,750	21,000	31,500	8,400	12,600	16,800	25,200	7,000	10,500	14,000	21,000	6,000	9,000	12,000	18,000
88,000	14,667	22,000	29,333	44,000	11,000	16,500	22,000	33,000	8,800	13,200	17,600	26,400	7,333	11,000	14,667	22,000	6,286	9,429	12,571	18,857
92,000	15,333	23,000	30,667	46,000	11,500	17,250	23,000	34,500	9,200	13,800	18,400	27,600	7,667	11,500	15,333	23,000	6,572	9,857	13,143	19,714
96,000	16,000	24,000	32,000	48,000	12,000	18,000	24,000	36,000	9,600	14,400	19,200	28,800	8,000	12,000	16,000	24,000	6,857	10,286	13,714	20,571
100,000	16,667	25,000	33,333	50,000	12,500	18,750	25,000	37,500	10,000	15,000	20,000	30,000	8,333	12,500	16,667	25,000	7,143	10,714	14,286	21,429
104,000	17,333	26,000	34,667	52,000	13,000	19,500	26,000	39,000	10,400	15,600	20,800	31,200	8,667	13,000	17,333	26,000	7,429	11,143	14,857	22,286
108,000	18,000	27,000	36,000	54,000	13,500	20,250	27,000	40,500	10,800	16,200	21,600	32,400	9,000	13,500	18,000	27,000	7,715	11,571	15,429	23,143
112,000	18,667	28,000	37,333	56,000	14,000	21,000	28,000	42,000	11,200	16,800	22,400	33,600	9,333	14,000	18,667	28,000	8,000	12,000	16,000	24,000
116,000	19,333	29,000	38,667	58,000	14,500	21,750	29,000	43,500	11,600	17,400	23,200	34,800	9,667	14,500	19,333	29,000	8,286	12,429	16,571	24,857
120,000	20,000	30,000	40,000	60,000	15,000	22,500	30,000	45,000	12,000	18,000	24,000	36,000	10,000	15,000	20,000	30,000	8,572	12,857	17,143	25,714
124,000	20,667	31,000	41,333	62,000	15,500	23,250	31,000	46,500	12,400	18,600	24,800	37,200	10,333	15,500	20,667	31,000	8,857	13,286	17,714	26,571
128,000	21,333	32,000	42,667	64,000	16,000	24,000	32,000	48,000	12,800	19,200	25,600	38,400	10,667	16,000	21,333	32,000	9,143	13,714	18,286	27,429
132,000	22,000	33,000	44,000	66,000	16,500	24,750	33,000	49,500	13,200	19,800	26,400	39,600	11,000	16,500	22,000	33,000	9,429	14,143	18,857	28,286
136,000	22,667	34,000	45,333	68,000	17,000	25,500	34,000	51,000	13,600	20,400	27,200	40,800	11,333	17,000	22,667	34,000	9,715	14,571	19,429	29,143
140,000	23,333	35,000	46,667	70,000	17,500	26,250	35,000	52,500	14,000	21,000	28,000	42,000	11,667	17,500	23,333	35,000	10,000	15,000	20,000	30,000
144,000	24,000	36,000	48,000	72,000	18,000	27,000	36,000	54,000	14,400	21,600	28,800	43,200	12,000	18,000	24,000	36,000	10,286	15,429	20,571	30,857
148,000	24,667	37,000	49,333	74,000	18,500	27,750	37,000	55,500	14,800	22,200	29,600	44,400	12,333	18,500	24,667	37,000	10,572	15,857	21,143	31,714
152,000	25,333	38,000	50,667	76,000	19,000	28,500	38,000	57,000	15,200	22,800	30,400	45,600	12,667	19,000	25,333	38,000	10,857	16,286	21,714	32,571
156,000	26,000	39,000	52,000	78,000	19,500	29,250	39,000	58,500	15,600	23,400	31,200	46,800	13,000	19,500	26,000	39,000	11,143	16,714	22,286	33,429
160,000	26,667	40,000	53,333	80,000	20,000	30,000	40,000	60,000	16,000	24,000	32,000	48,000	13,333	20,000	26,667	40,000	11,429	17,143	22,857	34,286

Note: For structures with exposures, multiply results by 1.5 for water supply requirements.

SI units: 1 gal = 3.785 L; 1 cu ft = 0.0283 m^3

Table 5-5.1(a) Continued.

Occupancy*	3				4				5				6				7			
Construction**	.5	.75	1.0	1.5	.5	.75	1.0	1.5	.5	.75	1.0	1.5	.5	.75	1.0	1.5	.5	.75	1.0	1.5
Cubic Feet	*Gallons*				*Gallons*				*Gallons*				*Gallons*				*Gallons*			
175,000	29,167	43,750	58,333	87,500	21,875	32,813	43,750	65,625	17,500	26,250	35,000	52,500	14,583	21,875	29,167	43,750	12,500	18,750	25,000	37,500
200,000	33,333	50,000	66,667	100,000	25,000	37,500	50,000	75,000	20,000	30,000	40,000	60,000	16,667	25,000	33,333	50,000	14,286	21,429	28,571	42,857
225,000	37,500	56,250	75,000	112,500	28,125	42,188	56,250	84,375	22,500	33,750	45,000	67,500	18,750	28,125	37,500	56,250	16,071	24,107	32,143	48,214
250,000	41,667	62,500	83,333	125,000	31,250	46,875	62,500	93,750	25,000	37,500	50,000	75,000	20,833	31,250	41,667	62,500	17,857	26,786	35,714	53,571
275,000	45,833	68,750	91,667	137,500	34,375	51,563	68,750	103,125	27,500	41,250	55,000	82,500	22,917	34,375	45,833	68,750	19,643	29,464	39,286	58,929
300,000	50,000	75,000	100,000	150,000	37,500	56,250	75,000	112,500	30,000	45,000	60,000	90,000	25,000	37,500	50,000	75,000	21,429	32,143	42,857	64,286
325,000	54,167	81,250	108,333	162,500	40,625	60,938	81,250	121,875	32,500	48,750	65,000	97,500	27,083	40,625	54,167	81,250	23,214	34,821	46,429	69,643
350,000	58,333	87,500	116,667	175,000	43,750	65,625	87,500	131,250	35,000	52,500	70,000	105,000	29,167	43,750	58,333	87,500	25,000	37,500	50,000	75,000
375,000	62,500	93,750	125,000	187,500	46,875	70,313	93,750	140,625	37,500	56,250	75,000	112,500	31,250	46,875	62,500	93,750	26,786	40,179	53,571	80,357
400,000	66,667	100,000	133,333	200,000	50,000	75,000	100,000	150,000	40,000	60,000	80,000	120,000	33,333	50,000	66,667	100,000	28,571	42,857	57,143	85,714
425,000	70,833	106,250	141,667	212,500	53,125	79,688	106,250	159,375	42,500	63,750	85,000	127,500	35,417	53,125	70,833	106,250	30,357	45,536	60,714	91,071
450,000	75,000	112,500	150,000	225,000	56,250	84,376	112,500	168,750	45,000	67,500	90,000	135,000	37,500	56,250	75,000	112,500	32,143	48,214	64,286	96,429
475,000	79,167	118,750	158,333	237,500	59,375	89,063	118,750	178,125	47,500	71,250	95,000	142,500	39,583	59,375	79,167	118,750	33,929	50,893	67,857	101,786
500,000	83,333	125,000	166,667	250,000	62,500	93,751	125,000	187,500	50,000	75,000	100,000	150,000	41,667	62,500	83,333	125,000	35,714	53,571	71,429	107,143
525,000	87,500	131,250	175,000	262,500	65,625	98,438	131,250	196,875	52,500	78,750	105,000	157,500	43,750	65,625	87,500	131,250	37,500	56,250	75,000	112,500
550,000	91,667	137,500	183,333	275,000	68,750	103,126	137,500	206,250	55,000	82,500	110,000	165,000	45,833	68,750	91,667	137,500	39,286	58,929	78,571	117,857
575,000	95,833	143,750	191,667	287,500	71,875	107,813	143,750	215,625	57,500	86,250	115,000	172,500	47,917	71,875	95,833	143,750	41,071	61,607	82,143	123,214
600,000	100,000	150,000	200,000	300,000	75,000	112,501	150,000	225,000	60,000	90,000	120,000	180,000	50,000	75,000	100,000	150,000	42,857	64,286	85,714	128,571
625,000	104,167	156,250	208,333	312,500	78,125	117,188	156,250	234,375	62,500	93,750	125,000	187,500	52,083	78,125	104,167	156,250	44,643	66,964	89,286	133,929
650,000	108,333	162,500	216,667	325,000	81,250	121,876	162,500	243,750	65,000	97,500	130,000	195,000	54,167	81,250	108,333	162,500	46,429	69,643	92,857	139,286
675,000	112,500	168,750	225,000	337,500	84,375	126,563	168,750	253,125	67,500	101,250	135,000	202,500	56,250	84,375	112,500	168,750	48,214	72,321	96,429	144,643
700,000	116,667	175,000	233,333	350,000	87,500	131,251	175,000	262,500	70,000	105,000	140,000	210,000	58,333	87,500	116,667	175,000	50,000	75,000	100,000	150,000
725,000	120,833	181,250	241,667	362,500	90,625	135,938	181,250	271,875	72,500	108,750	145,000	217,500	60,417	90,625	120,833	181,250	51,786	77,679	103,571	155,357
750,000	125,000	187,500	250,000	375,000	93,750	140,626	187,500	281,250	75,000	112,500	150,000	225,000	62,500	93,750	125,000	187,500	53,571	80,357	107,143	160,714
775,000	129,167	193,750	258,333	387,500	96,875	145,313	193,750	290,625	77,500	116,250	155,000	232,500	64,583	96,875	129,167	193,750	55,357	83,036	110,714	166,071
800,000	133,333	200,000	266,667	400,000	100,000	150,001	200,000	300,000	80,000	120,000	160,000	240,000	66,667	100,000	133,333	200,000	57,143	85,714	114,286	171,429
825,000	137,500	206,250	275,000	412,500	103,125	154,688	206,250	309,375	82,500	123,750	165,000	247,500	68,750	103,125	137,500	206,250	58,929	88,393	117,857	176,786
850,000	141,667	212,500	283,333	425,000	106,250	159,376	212,500	318,750	85,000	127,500	170,000	255,000	70,833	106,250	141,667	212,500	60,714	91,071	121,429	182,143
875,000	145,833	218,750	291,667	437,500	109,375	164,064	218,750	328,125	87,500	131,250	175,000	262,500	72,917	109,375	145,833	218,750	62,500	93,750	125,000	187,500
900,000	150,000	225,000	300,000	450,000	112,500	168,751	225,000	337,500	90,000	135,000	180,000	270,000	75,000	112,500	150,000	225,000	64,286	96,429	128,571	192,857
925,000	154,167	231,250	308,333	462,500	115,265	173,439	231,250	346,875	92,500	138,750	185,000	277,500	77,083	115,625	154,167	231,250	66,071	99,107	132,143	198,214
950,000	158,333	237,500	316,667	475,000	118,750	178,126	237,500	356,250	95,000	142,500	190,000	285,000	79,167	118,750	158,333	237,500	67,857	101,786	135,714	203,571
975,000	162,500	243,750	325,000	487,500	121,875	182,814	243,750	365,625	97,500	146,250	195,000	292,500	81,250	121,875	162,500	243,750	69,643	104,464	139,286	208,929
1,000,000	166,667	250,000	333,333	500,000	125,000	187,501	250,000	375,000	100,000	150,000	200,000	300,000	83,333	125,000	166,667	250,000	71,429	107,143	142,857	214,286

*Occupancy Hazard Classification

**Construction Classification

Note: For structures with exposures, multiply results by 1.5 for water supply requirements.

SI units: 1 gal = 3.785 L; 1 cu ft = 0.0283 m³

Table 5-5.1(b)
Minimum Water Requirements
(Examples)

Structure Without Exposures

Paragraph	Type of Occupancy	Min. Gal. Water
5-2.1.2	1 & 2 Family Dwellings 1200 sq ft (111.8 m²) or less	2,000 (7570 L)
5-2.2.2	All structures, except dwellings	2,000 (7570 L)

Structure With Exposures

Paragraph	Type of Occupancy	Min. Gal. Water
5-3.1.2	1 & 2 Family Dwellings 1200 sq ft (111.8 m²) or less	3,000 (11 355 L)
5-3.2.2	All structures, except dwellings	3,000 (11 355 L)

Multiple Structures - Single Water Point

Paragraph	Type of Occupancy	Min. Gal. Water
5-4.4	All Structures, with or without exposures	3,000 (11 355 L)

Table 5-5.1(c)
Minimum Capability of Fire Department to Transport and to Use Water

Total Water Supply Required (Gallons)	Rate Water Is Available to Fireground and Fire Department's Capability for Using Water (GPM)
up to 2,499 (up to 9459 L)	250 (946 L/min)
2,500 to 9,999 (9460 L to 37 849 L)	500 (1893 L/min)
10,000 to 19,999 (37 850 L to 75 699 L)	750 (2839 L/min)
20,000 or more (75 700 L)	1000 (3785 L/min)

5-6 Structures with Automatic Sprinkler Protection.

5-6.1 For any structure protected by an automatic sprinkler system that fully meets the requirements of NFPA 13, *Installation of Sprinkler Systems*, the fire department having jurisdiction may waive any requirement for additional water supply required by this standard. (*See Appendix F.*)

5-6.1.1* The water supply for automatic sprinkler systems referred to in 5-6.1 contemplates the use of outside hose lines; therefore, this water supply shall be available to the fire department outside the structure for manual fire fighting purposes.

5-6.1.2 Automatic sprinkler systems referred to in 5-6.1 shall, in all cases, be provided with a fire department connection as described in NFPA 13, *Installation of Sprinkler Systems*, Section 2-7.

5-6.2 For a structure protected by an automatic sprinkler system that does not fully meet the requirements of NFPA 13, *Installation of Sprinkler Systems*, the fire department having jurisdiction may reduce the total water supply required by this standard, for fire fighting purposes, in Section 5-2, 5-3 or 5-4, whichever is applicable.

5-7 Structures with Other Automatic Fire Suppression Systems.

5-7.1* For any structure fully or partially protected by an automatic fire suppression system other than specified in 5-6.1, the fire department having jurisdiction shall determine the total water supply required for fire fighting purposes.

Chapter 6 Water Supply

6-1 The water supplies for fire fighting purposes, as specified in Chapter 5, may be supplied from natural bodies of water and man-made sources of water. Natural bodies of water are defined as bodies of water contained by earth only and include ponds, lakes, rivers, streams, bays, creeks, springs, artesian wells, and irrigation canals. Man-made sources of water include aboveground tanks, elevated gravity tanks, livestock watering tanks, cisterns, swimming pools, wells, quarries, mines, reservoirs, aquaducts, tankers, and hydrants served by a water system. See Appendix B.

6-2 The transfer of water from a water source to the scene of the fire can be done by a number of different methods. A few of these are tanker shuttles, pumper relays using large diameter [normally 3½-in. (89 mm) or greater] hose, pumper relays, portable piping, irrigation piping and ditching, helicopter, railroad tank cars, etc. See Appendices C, D, and E.

6-3 The total water supply from whatever source or combination of sources shall meet the requirements of Chapter 5.

6-4* Accessibility. Water supplies for fire fighting purposes shall be accessible to fire fighting equipment. The fire department having jurisdiction shall, as part of its property survey, determine maximum safe load limits of roadways, laneways, and bridges and various climatic conditions, to determine accessibility.

Chapter 7 Reports and Records

7-1 Plans for New Construction and Additions.

7-1.1 Where the appropriate governmental entity has building laws that require plans to be submitted for review before building construction is started, the plans shall be submitted to the fire department for review and approval.

7-1.2 Where no building laws exist or plans are not required for review, the fire department shall request cooperation of property owner(s) in voluntary compilance with provisions of this standard.

7-2 Requirements for the Fire Department.

7-2.1 The fire department having jurisdiction for property surveys specified in Chapter 2, after completing the survey and computing the total water supply required, shall notify, in writing, the authority having jurisdiction of the results of the surveys and the total water supplies required. In all cases, the building(s) owner(s) shall be advised of the total water supply required. Fire department personnel shall be available to the citizen for appropriate consultation.

7-3 Requirements for Property Owners or Occupants.

7-3.1 The property owner shall notify, in writing, the authority having jurisdiction before any structures are erected or any alterations are made to any existing structure which will increase the total cubic footage of the structure. The property owner shall provide for the authority having jurisdiction complete written plans and drawings of any proposed structure, including all measurements, construction, intended occupancy, and a description of contents.

7-3.2 The property owner or occupant shall notify, in writing, the authority having jurisdiction before any changes are made in the contents of a structure or occupancy of a structure, other than residential occupancies, that would materially affect the Occupancy Hazard Classification Number as specified in Section 3-2. The property owner or occupant shall provide the authority having jurisdiction with a complete written report of contents or occupancy changes.

7-4 Changes in Automatic Sprinkler Protection.

7-4.1 The property owner or occupant shall notify in writing the authority having jurisdiction whenever any alterations are made that would cause any change to an automatic sprinkler system covered in Section 5-5.1. The property owner or occupany shall provide the authority having jurisdiction with a complete written report of alterations to any existing sprinkler system or of the installation of a new sprinkler system.

7-4.2* The property owner or occupant shall promptly notify the authority having jurisdiction whenever any automatic sprinkler system or other automatic suppression system or portion of any system is shut off or is to be out of service for any reason.

7-5 Retention of Reports. The fire department shall file all plans, reports and surveys by street address whenever possible and shall retain a copy of all reports specified in this standard.

Chapter 8 Mandatory Referenced Publications

8-1 This chapter lists the publication referenced within this document which, in whole or in part, is part of the requirements of this document.

8-1.1 NFPA Publication.

NFPA 13-1983, *Installation of Sprinkler Systems*

Appendix A

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

A-1-1 In some areas, water supply systems have been installed for domestic water purposes only. These systems may be equipped with hydrants which may not be standard fire hydrants with volume, pressure, and duration of flow available being less than needed for adequate fire fighting purposes. Where such conditions exist, this standard (appendix) may be applied in water supply matters.

A-2-1.1 Information needed to compute the total water supplies to be collected during the building survey includes:

(a) Area of all floors, including attics, basements, and crawl spaces.

(b) Height between floors or crawl spaces and in the attics from floor to ridge pole.

(c) Construction materials used in each building, including walls, floors, roofs, ceilings, interior partitions, stairs, etc.

(d) Occupancy (occupancies) of buildings.

(e) Occupancy (occupancies) of yard areas.

(f) Exposures to buildings and yard storage and distances between them.

(g) Fire protection systems - automatic and manual protection systems, hydrants, yard mains, and other protection facilities.

(h) On-premises water supplies including natural and man-made sources of water.

A-3-1.4 In addition to the storage of products potentially hazardous from the standpoint of increased fire load, farm properties present certain inherent dangers to the rural fire fighter that are not contemplated by the urban fire fighter. Storage of products potentially hazardous to fire fighters from the standpoint of increased fire volume, explosion, and toxicity exists at most rural fire locations. Among these are:

(a) Bulk storage of petroleum fuels, more frequently fuel oil, but often gasoline and propane. While some tanks are underground, many are aboveground and often located within 50 ft (15.2 m) of farm buildings.

(b) Many farmers use and store blasting agents such as dynamite, often extended with ammonium-nitrate (the latter of greater explosive impact per unit weight).

(c) Nearly all farms use and store different pesticides. Some of these chemical compounds give off very toxic fumes when burning. Two compounds which are safe when independent of each other may be very hazardous to the fire fighter when mixed together in a fire situation.

(d) Localized problems also exist in corn growing areas; for instance, anhydrous-ammonia is stored and used in large amounts during the early growing season.

The rural fire department needs to work with the farmer to reduce the fire and life potential hazard of these products by storing them safely. However, fire fighters of the rural fire departments must know the potential hazards presented by the products and the fire fighting precautions to be taken. The department membership should be forewarned of the above items through the survey of the farm by the water supply officer or other inspector, and appropriate provisions should be taken to protect the membership of the department from potential hazards.

A-3-2 The Occupancy Hazard Classification Number is a mathematical factor to be used in calculating total water supplies. The lowest Occupancy Hazard Classification Number is 3 and is assigned to the highest hazard grouping. The highest Occupancy Hazard Classification Number is 7 and is assigned to the lowest hazard grouping.

A-4-2 The Construction Classification Number is a mathematical factor to be used in calculating total water supplies. The "slowest burning" or lowest hazard type of construction, fire resistive, takes a Construction Classification Number of 0.50. The fastest burning or highest hazard type of construction, wood frame, takes a construction class number of 1.50. All dwellings shall be assigned a Construction Classification Number of 1.0 or lower when construction is noncombustible or fire resistive.

A-5-2.1.1 Examples of Calculating Total Water Supply. Single- and two-family dwellings — 1,200 sq ft (111.8 m²) and under (without exposure hazard).

(a) Residential:

Dwelling: 50 ft by 24 ft; 2 stories, 8 ft each; pitched roof, 8 ft from attic floor to ridge pole; wood frame construction.

50 × 24 = 1,200 (sq ft)
Heights 8 + 8 + 4* = 20 (ft)
1,200 × 20 = 24,000 (cu ft)
Occupancy Hazard Classification Number 7
Construction Classification Number 1.0 (frame dwelling)
24,000 ÷ 7 × 1.00 = 3,429 gal
Total Water Supply = 3,429 gal

For SI Units: 1 ft = 0.305 m; 1 sq ft = .092 m²; 1 cu ft = .028 m³; 1 gal = 3.785 L.

*For pitched roofs, figure half the distance from attic floor to ridge pole.

If a structure is of Occupancy Hazard Classification Number 3 or 4, it is considered an exposure hazard if within 50 ft (15.2 m), regardless of size. See 5-3.1. For a dwelling, Construction Classification Number is no larger than 1.0.

A-5-2.2.1 All structures except dwellings (without exposure hazard).

(b) Commercial:

Farm equipment shed: 125 ft × 100 ft; height 14 ft; 1 story; flat roof; noncombustible construction.

125 × 100 = 12,500 (sq ft)
Height = 14 (ft)
12,500 × 14 = 175,000 (cu ft)
Occupancy Hazard Classification Number 5
Construction Classification Number 0.75
175,000 ÷ 5 × 0.75 = 26,250
Total Water Supply = 26,250 gal

For SI Units: 1 ft = 0.305 m; 1 sq ft = .092 m²; 1 cu ft = .028 m³; 1 gal = 3.785 L.

If a structure is of Occupancy Hazard Classification Number 3 or 4, it is considered an exposure hazard if within 50 ft (15.2 m), regardless of size.

A-5-3.1.1 Single- and two-family dwellings — 1200 sq ft and under (with Exposures).

(c) Residential:

Dwelling 50 ft × 24 ft; 1 story, 8 ft high; pitched roof, 8 ft from attic floor to ridge pole; brick construction and exposed on one side by a frame dwelling with a separation of less than 50 ft and with areas greater than 100 sq ft.

50 × 24 = 1200 (sq ft)
Heights 8 + 4* = 12 (ft)
1200 × 12 = 14,400 (cu ft)
Occupancy Hazard Classification Number 7
Construction Classification Number 1.00 (brick dwelling)
14,400 ÷ 7 × 1 = 2,057
As the dwelling is exposed by a frame dwelling, multiply by the exposure factor of 1.5
2,057 × 1.5 = 3,086
Total Water Supply = 3,086 gal

For SI Units: 1 ft = 0.305 m; 1 sq ft = .092 m²; 1 cu ft = .028 m³; 1 gal = 3.785 L.

*For pitched roofs, figure half the distance from attic floor to ridge pole.

If a structure is of Occupancy Hazard Classification Number 3 or 4, it is considered an exposure hazard if within 50 ft (15.2 m), regardless of size. For a dwelling, Construction Classification Number is no larger than 1.0.

A-5-3.2.1 All Structures Except Dwellings (with Exposures).

(d) Assembly:

Church: 130 ft × 60 ft; height 25 ft to ridge pole (15 ft from ground to eaves with ridge pole 10 ft above the eaves); brick construction with brick constructed office building within 40 ft of church.

130 × 60 = 7,800 (sq ft)
Height 15 + 5 = 20 ft
7,800 × 20 = 156,000 (cu ft)
Occupancy Hazard Classification Number 6
Construction Classification Number 1.0
156,000 ÷ 6 × 1.0 = 26,000
As church is exposed by a brick office building, multiply by the exposure factor of 1.5
26,000 × 1.5 = 39,000
Total Water Supply = 39,000 gal

For SI Units: 1 ft = 0.305 m; 1 sq ft = .092 m^2; 1 cu ft = .028 m^3; 1 gal = 3.785 L.

If a structure is of Occupancy Hazard Classification Number 3 or 4, it is considered an exposure hazard if within 50 ft, regardless of size.

A-5-4.3 Multiple Structures — Single Water Point.

(e) A row of five dwellings, same house as example (a), except one has a brick barn measuring 80 ft by 40 ft and located 35 ft from the dwelling. The barn is larger than 100 sq ft in area and is closer than 50 ft to the dwelling. Therefore, the total water supply for this dwelling (3500 gal) must be multiplied by 1.5 for the exposure.

3429 × 1.5 = 5,144 gal

If the dwellings and barn are to be protected by the same water supply, as they most likely would be, the water supply must be calculated on the structure that requires the largest total water supply, which would be the barn in this case. Thus, if the barn has no hay storage and is 25 ft (7.2 m) in height to the ridge pole, and the ridge pole is 10 ft (3 m) above the eaves, the calculations would be as follows:

80 × 40 = 3200 (sq ft)
Height 15 + 5 = 20 (ft)
3200 × 20 = 64,000 (cu ft)
Occupancy Hazard Classification Number 4 (for the barn with no hay storage)
Construction Classification number is 1.0
64,000 ÷ 4 × 1.0 = 16,000
16,000 × 1.5 (for exposure hazard - the dwelling) = 24,000
Total Water Supply = 24,000 gal

For SI Units: 1 ft = 0.305 m; 1 sq ft = .092 m^2; 1 cu ft = .028 m^3; 1 gal = 3.785 L.

(f) Farm equipment shed, same as A-5.2.2.1 (b) only with a one-story, pitched roof dwelling measuring 50 ft by 25 ft located 45 ft from the equipment shed. The dwelling is larger than 100 sq ft in area and is closer than 50 ft to the equipment shed. Therefore, the total water supply for the equipment shed (26,250 gal) must be multiplied by 1.5.

26,250 × 1.5 = 39,375
Total Water Supply = 39,375 gal.
The total water supply for the dwelling is:
50 × 25 = 1,250 (sq ft)
Height 8 + 4 = 12
1,250 × 12 = 15,000 (cu ft)
Occupancy Hazard Classification Number 7
Construction Classification Number 1.0
15,000 ÷ 7 × 1.0 = 2,143 gal

For SI Units: 1 ft = 0.305 m; 1 sq ft = .092 m^2; 1 cu ft = .028 m^3; 1 gal = 3.785 L.

Since the equipment shed requires the larger total water supply, if these two buildings were to be protected by the same water supply, that total water supply would be the 39,375 gal.

If a structure is of Occupancy Hazard Classification Number 3 or 4, it is considered an exposure hazard if within 50 ft (15.2 m), regardless of size. For a dwelling, Construction Classification Number is no larger than 1.0.

A-5-5.1 The fire department having jurisdiction should consider the number of fire streams required to control a potential fire in such an occupancy, multiplying the estimated total application rate in gpm by a liberal estimate of time in minutes (60 minutes or more) required to control and extinguish the fire. A review of appropriate NFPA standards is suggested as properties having special fire protection problems are beyond the scope of this standard on rural water supplies.

A-5-6.1.1 The fire department should employ measures to supplement the sprinkler system to ensure adequate water and pressure for efficient operation of the sprinklers and should use care not to "rob" water from the supply for the sprinklers to supply hand lines. See Appendix F.

A-5-7.1 Other automatic suppression systems could include foam, carbon dioxide, dry chemical, halon, etc., installed in part or all of the structure.

A-6-4 Accessibility to water supplies should incorporate whatever features necessary to ensure year-round travel, taking into consideration local climatic conditions and topography. See Appendix B-6 for further information on access to water supplies.

A-7-4.2 When the fire department is advised of a sprinkler system impairment, every effort should be made to restore the protection to service as quickly as possible. In some cases, the property owner may be able to provide a "make-shift" arrangement or to secure a part that will enable the restoration of the system, either completely or with only a very small number of sprinkler heads out of service until full sprinkler protection is restored.

Appendix B Water Supply

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

B-1 Water Supply.

B-1-1 General. The fire fighter operating without a water system with hydrants (or with a very limited number of hydrants) has two means of getting water: from supplies on the fireground, which may be natural or man-made, or from supplies transported to the scene. This appendix discusses the variety and potential of these sources.

B-1-2 Water Supply Officer. Many progressive rural fire departments depend on a water supply officer. The work of a properly trained and equipped water supply officer makes it possible for the officer supervising the actual fire attack to plan it on the basis of reliable water supply information, to coordinate that attack to the available water supplies, and to help prevent the confusion inherent in fighting a major fire when the chief officer at the scene must divert too much of his attention from the attack to the logistics of backing it up.

B-1-2.1 Duties of Water Supply Officer. The officer is designated to provide sufficient water at the fire site, to plan availability of additional water sources, and to determine water requirements at the various locations over the district. He may maintain and even carry with him a complete set of files, which should include cards showing water points and lists of mutual aid tankers available. Modern technology in optics and computers makes it feasible for even a relatively low budget department to reduce this data to microfiche or photographic slides which can be maintained in the fire alarm communication center and taken to the scene of every fire and used on small, even hand held, viewers. The water supply officer is, basically, the individual who implements the water supply prefire planning.

B-1-2.2 Duties at Fire. At the fire scene, the water supply officer becomes the rural equivalent of the water department representative who responds to major municipal fires. The water supply officer's duty to maintain continuous fire streams in rural areas is frequently a very complicated task involving setting up several water hauling facilities, assembling water-carrying equipment of mutual aid departments, calculating estimated arrival times of tankers, and having a thorough knowledge of available water supplies throughout a wide area of fire department jurisdiction.

B-1-2.3 Duties Before the Fire. Before the fire, the water supply officer participates in the prefire planning and in calculating the fire flow requirements for the various buildings in the area under the department's jurisdiction.

To satisfy these water requirements, the water supply officer may survey the district and the surrounding areas for available water for fire fighting purposes. Water supplies may exist on the property to be protected or may need to be transported. He should develop preplans and see that the fire department is kept aware of all the water supplies available to the entire area. This means close coordination between the water supply officer and the fire department training officer and assistance in joint water supply training sessions with neighboring fire departments. He should make periodic inspections of all water supplies and structural changes in his department's jurisdiction.

The water supply officer or his designate must meet with property owners and secure their permission to use the water supply (*see B-1-2.5*), to develop an all weather road to the supply (*see B-6-1*) and to install dry hydrants (*see B-5-1*).

If called upon, he should be available to consult with the owner in the design of a water source on a property to be protected.

B-1-2.4 Water Source Cards. A recommended practice is to prepare individual water source cards for each water point (there may be one or more applicable to a given potential fireground) and note them on master grid maps of the area. Thus, the grid map will show the index location of water source cards on which pertinent data will be noted. These data should include type of source (stream, cistern, domestic system, etc.), point of access ["100 ft (30.4 m) north of barn," etc.] gallonage available ["flows minimum 200 gpm (757 L/min)," "10,000 gal (37 850 L/min) storage," etc.] and any particular problem such as weather conditions which may make a source unusable. It is a good practice to attach a snapshot of the water point to the card. Also, it is advisable to note an alternate source.

These water source cards should be used as the basis of regular inspections to make sure the source continues to be available and to note any improvement or deterioration of its usefulness. A program to develop additional sources as needed, including water sources for new construction as it evolves, should be an ongoing program in an alert organization.

B-1-2.5 Water Usage Agreement. The water supply officer must make arrangements with the owner of water supplies before a fire develops. Such agreements should be made in writing in close cooperation with the municipal, town, or county attorney. Also, it is highly desirable that the agreement be reviewed by a representative of the highway or the county road department or other persons who will be required to build, service, and maintain the access road to the supply, including such things as snow plowing in certain areas of the country. The property owner also should have a copy of the agreement. Following is an example of such a document which has been used by several fire departments with the approval of their county or town attorney.

Figure B-1-2.5

ANYTOWN FIRE DEPARTMENT, U.S.A.
WATER USAGE AGREEMENT

I, We the undersigned owner(s) of a lake or pond located at ______
do hereby grant the Anytown Fire Department permission to erect and maintain, at its expense, a dry hydrant and access roadway to said lake or pond to be utilized for emergency fire suppression purposes.

All other uses of said pond or lake shall be after notification and permission of the owners.

The Anytown Fire Department shall be responsible for any and all damages to property resulting from fire department exercises.

This contract can be cancelled at any time by written notice thirty days in advance to the Anytown Fire Department located at Scott and College Road, Anytown, U.S.A.

OWNER	DATE	PRESIDENT ANYTOWN FIRE DEPARTMENT
OWNER	DATE	SECRETARY ANYTOWN FIRE DEPARTMENT
		CHIEF ANYTOWN FIRE DEPARTMENT

Agreement provided by Guilford College Fire Department, Guilford, College, North Carolina.

B-1-2.6 Water Map. Each water supply officer should maintain a map showing the location and amount of water available at each water site. A copy of this map should be located in the fire alarm dispatcher's headquarters when such an alarm facility is available and should be carried on at least one pumper and the chief's car and by the water supply officer. Any problems which may be encountered at the supply should be recorded.

B-1-2.7 Inspection of Water Supplies. It is the responsibility of the water supply officer to make inspections of all water sources available as often as conditions warrant and note any changes in the facilities. This is particularly true during adverse weather conditions, such as droughts, very wet periods, heavy freezing, and following a snowstorm.

B-1-2.8 Sign. The water supply officer should see that an appropriate sign is erected at each water point identifying the site for fire department emergency use and including the name, or a number, for the water supply.

B-1-2.9 Water Operations. The water supply officer and the training officer, in conjunction with the fire chief, should develop standard operating procedures for hauling water to fires. The standard operating procedures should be put in motion for all structural fires; however, they may be discontinued after the officer in charge has evaluated the fire and determined that water hauling capabilities will not be needed.

B-2 First-Aid Fire Protection Using On-Site Water Systems.

B-2-1 General. The individual domestic water supply system provided in many rural homes and business establishments, if properly equipped and maintained, is an effective "first-aid fire extinguisher." For large establishments, an elevated water storage tank or reservoir connected to hydrants and standpipes could provide substantial fire streams as well.

B-2-2 Domestic Water Systems. For domestic (farm) water systems to have some degree of reliability in case of fire, the pump or pumps should be placed in a fire resistive location. The electric power supply should have the maximum protection from being deenergized by fire or other cause. In some cases, standby power and pumps may be justified.

B-2-3 Delivery of First-Aid Fire Protection. For first-aid fire protection to be effective, every portion of the dwelling and outlying buildings should be within reach of a hose stream. This may require some additional pipelines beyond those needed for other purposes. A garden hose long enough to reach any point in a structure is often valuable for fire use. Care should be taken so that water is drained from hose or pipes that could be subject to freezing weather.

B-2-4 In-Depth Fire Protection. To provide for in-depth fire protection, three types of water supplies may be needed: (1) first-aid via the domestic water system, (2) a bulk water supply at the property, which may be a stream, pond, elevated tank, ground level tanks, or cistern, or (3) an area system of static water supplies with drafting points and means for transporting the water to the fire site.

B-3 Natural Water Sources.

B-3-1 Streams. Streams, including rivers, bays, creeks, and irrigation canals, may represent a continuously flowing source of substantial capacity. Factors for the fire department to determine when considering water from flowing streams as potential water sources include the following:

(a) **Flowing Capacity.** The stream should deliver water in capacities compatible with those outlined in the water requirements of this standard. (*See Chapter 5.*)

(b) **Climatic Characteristics.** Streams that deliver water throughout the year and are not susceptible to drought are desirable for fire protection. However, where such streams are not available, a combination of supplies may be necessary. In many sections of the country, streams cannot be relied upon during drought seasons. If the stream is subject to flooding or freezing, special evolutions may be necessary to make the stream usable under such conditions. Similar circumstances may exist during wet periods or when the ground is covered with snow.

(c) **Accessibility.** A river or other source of water may not be accessible to the fire department for use during a fire. Distance and terrain from the all-weather road to the source must be such as to make the water readily available. In some cases, special equipment must be used to obtain the water. See B-6 and Appendix E, Portable Pumps. Where roadways are provided to the water supply, they should be constructed in accordance with B-6-2.

B-3-2 Ponds. Ponds may include lakes or farm ponds used for watering livestock, irrigation, fish culture, recreation, or other purposes while serving a secondary function for fire protection. Most of the factors listed in B-3-1 relative to streams are pertinent to ponds also with the following additional items to be checked:

(a) Minimum annual level must be adequate to meet water supply needs of the fire problem the pond serves.

(b) Freezing of a stationary water supply, contrasted with the flowing stream, presents a greater problem.

(c) Silt and debris may accumulate in a pond or lake, reducing its actual capacity, while its surface area and level remain constant. This may provide a deceptive impression of capacity and calls for at least seasonal inspections.

(d) Accessibility should always be considered. Many recreational lakes are provided with access by roads, driveway, and boat launching ramps and are available for fire department use. Some large lakes, formed by a dam on a river, may have been constructed for such purposes as to generate power, for flood control, or to regulate the flow of a river. During certain periods of the year (droughts, drawdowns, etc.) such bodies of water may have very low water levels. The water under such conditions may not be accessible to the fire department for drafting by the fire department pumper even where a paved road, for boat launching, has been provided and extended into the water at normal water levels for several feet. Under such conditions, other provisions should be made to make the water supply fully accessible to the fire department.

B-3-3 Other Natural Sources. These might include springs and artesian wells. Individual springs and occasional artesian water supplies exist in some areas and, again, while generally of more limited capacity, may be useful for water supply subject to reasonable application of the factors listed for ponds and streams. In many cases, it may be necessary to form a temporary natural pool or form a pond with a salvage cover, for instance, to collect water for the use of the fire department when using a spring or an artesian well.

B-4 Man-Made Sources of Water.

B-4-1 General. The man-made sources of water supplies adapted for fire fighting are limited only to the innovative nature of the fire department. They range from cisterns, swimming pools, quarries, mines, automotive sprinkler system supplies, stationary tanks, driven wells, and "dry hydrants" to the occasions when fire fighters have drafted water out of the basement of a burning building into which it was pumped only minutes before to the fight the fire.

B-4-2 Cisterns. Cisterns are one of man's oldest sources of emergency water supply, both for fire fighting and drought storage. They are very important sources of water in many rural and beach areas.

Cisterns should have a minimum usable volume of 3,000 gal (11355 L) (with minimum size required for fire protection determined by methods described in Chapter 5 of this standard). They should be accessible to the fire truck or other pumping device and should be located far enough from the structure they protect so as not to be endangered by a fire in that structure. The cistern may be designed to store rainwater, as well as water from other sources such as wells, or water hauled to the cistern by tank truck. They offer an obvious method of augmenting the supply of a seasonally lowered stream or pond. The cistern presents a freezing problem more severe than some other sources in that its surface is often relatively inaccessible. The fire fighter must be prepared to break the frozen surface or the cistern should be built so as not to be subject to problems of freezing. One method is to use a dry hydrant protruding into the water level at a point below the local frostline. Cisterns should be capped for safety, but they should have openings to permit inspection, use of suction hose if it is needed, and ready determination of available capacity. See B-4-1 and Figure B-4-2.

B-4-3 Protection from Freezing. A heavy pipe or a pike pole may be adequate to break an ice formation, depending on local weather conditions. The weight of the suction hose itself may make it a practical tool providing there is no danger of damage to the hose or its strainer.

Provision of an ice-free water surface area in a cistern or the other water sources mentioned in this Appendix may be provided by, but is not limited to:

(a) Floating a log, a bale of hay or straw, etc., on the surface of the water.

(b) Placing a barrel filled with nonflammable, nontoxic antifreeze on the surface of the water.

B-4-4 Guide to Cistern Capacity. A ready guide to the capacity of cisterns with vertical sides is given in Table B-4-4.

Table B-4-4
Cistern Storage Capacity

Inside Diameter in Feet	Storage Capacity per Foot of Depth
6 (1.8 m)	212 gal (802 L)
7 (2.1 m)	288 gal (1090 L)
8 (2.4 m)	376 gal (1423 L)
9 (2.7 m)	476 gal (1801 L)
10 (3.0 m)	588 gal (2226 L)

WARNING: Reference is made to water depths in cisterns, swimming pools, streams, lakes and other sources in a number of places in this Appendix. The fire fighter should always remember that the depth with which he is concerned is the *usable* depth. See B-5-4. In a cistern, a bottom bed of gravel protecting a dry hydrant inlet, for instance, decreases the usable depth to the area above the gravel.

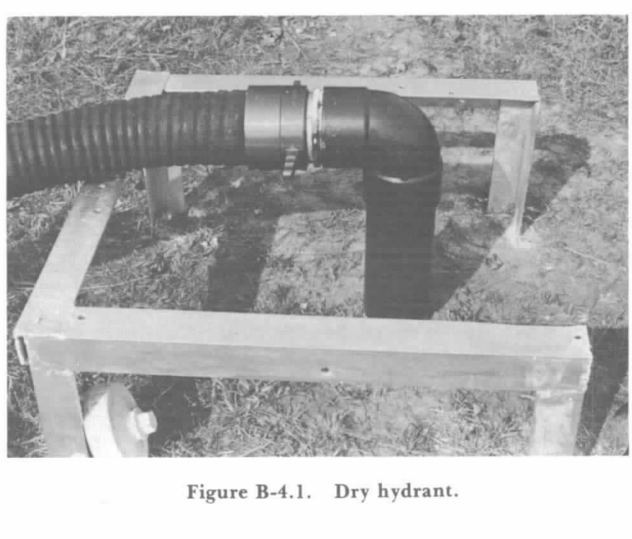


Figure B-4.1. Dry hydrant.

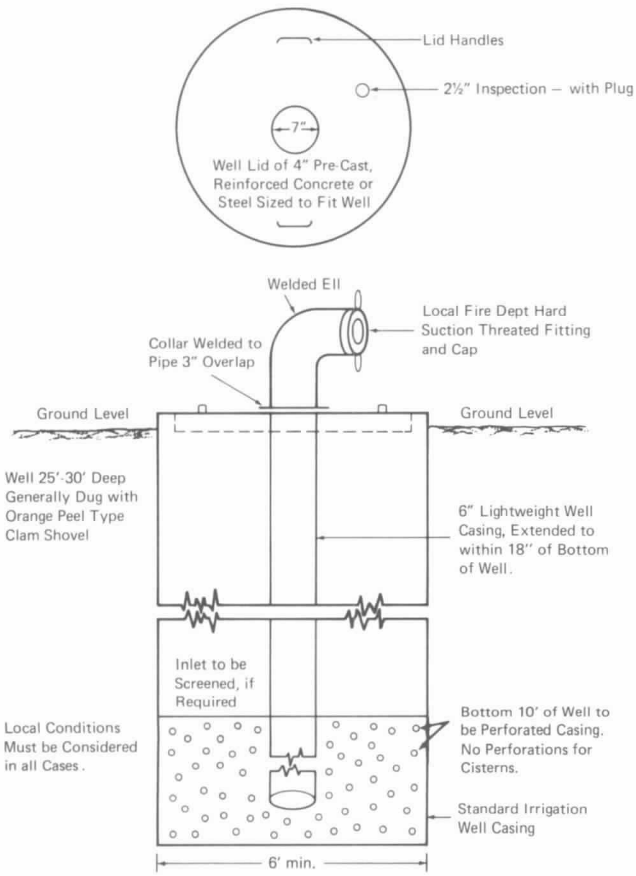


Figure B-4-2. Typical well (cistern) with dry hydrant installed. Same design suitable for cistern if bottom of casing is not perforated. For usable water depth see B-4-4 warning.

Construction of cisterns is governed by local conditions of soil and material availability. Practical information can be obtained from local governmental departments or agricultural agencies. Maintenance factors to be considered by the fire department include the danger of silting, evaporation loss or other low water conditions, and freezing problems previously discussed.

B-4-5 Swimming Pools. Swimming pools are an increasingly common source of water for fire protection. Even in some areas with normally adequate hydrant water supplies, they have been a factor in providing protection, such as instances in which water demands have exceeded availability because of wildfire disasters, etc. They have an advantage in that they are sources of clean water, but have a major drawback in normally poor accessibility for large apparatus. There are some areas of the country in which "swimming pool distribution" is better than hydrant distribution. Should the water supply officer intend to use a swimming pool as a supply of water, it is a good practice to develop these water sources through working with property owners and preplanning. It should be required that the fire department be notified in the event of drainage of such pools.

B-4-5.1 Pool Accessibility. If fire department accessibility is considered with the design of the pool, a usable water supply may be available to the fire department for supplying direct hose lines or a source of water for tanker supply. Most swimming pools are built in areas requiring security fencing or walls and these can complicate the problem of accessibility. Fences and walls can be designed for fire department use (see Figure B-4-5.1) or, depending on constructon, are susceptible to forcible entry by cutters, sledgehammers, etc. In most cases, a solution to the problems of accessibility can be arrived at through preplanning and may call for long lengths of suction hose, portable pumps, dry hydrants, or properly spaced gates. Portable (or floating) pumps designed for large volume delivery at limited pressures delivering water to portable folding tanks or fire department pumpers are frequently ideal where accessibility problems exist. (*See Appendix E-1.2.6.*)

A swimming pool virtually under the eaves of a burning house may be a very poor location from which to pump if there are problems of fire exposure to the work area, etc. Pumping from a neighboring pool, if it is close enough, or setting in motion the water hauling program is frequently preferable to pumping from the pool of the burning house.

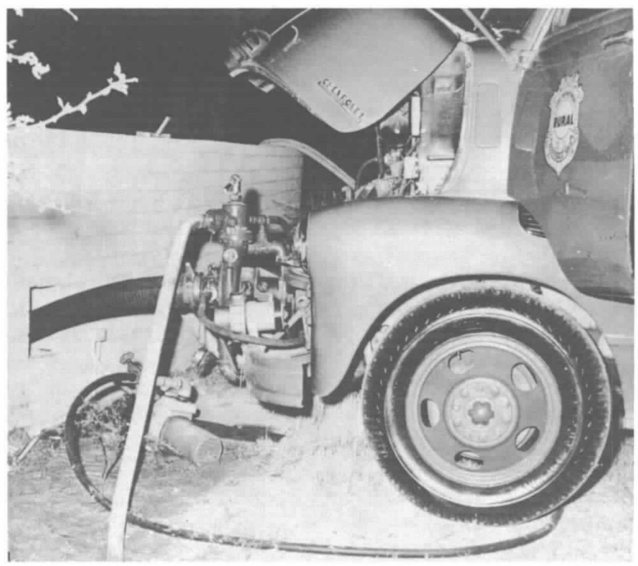


Figure B-4-5.1. Pool accessibility. Opening in wall designed for suction access permits rapid use of swimming pool water supply. (*Photo by Rural/Metro Fire Department, Arizona*)

B-4-5.2 Pool Capacity. A short-form method of estimating pool capacity is:

$L \times W \times D \times 7.5$ = estimated capacity (in gallons).

L = length in feet.

W = width in feet.

NOTE: These dimensions may be estimated or rounded off if pool is of stylized construction.

D = estimated average depth in feet, from water line.

7.5 = number of gallons in a cu ft of water.

Consideration should be given for more suction hose on engines responding in areas dependent on swimming pools. Fast rigging of such suction hose demands special training. Using long lengths of hose over walls and other obstacles typical of swimming pools demands techniques other than those used for drafting from ponds or streams. Adequate prefire planning requires knowledge of individual pools so that the method of obtaining water at the property is known. Lightweight or flexible-type suction hose can be advantageous for this purpose.

B-4-5.3 Care in Use of Pools. Care must be exercised to be sure structural damage will not be done to a pool and the surrounding area if the water is used for fire fighting. Lightly built cement, gunite, or poured concrete pools may present danger of structural damage, cracking, or collapse when drained. There is a further possibility that a pool in extremely wet soil will tend to float upwards when drained; therefore, it may be necessary to refill the pool as soon as the fire is under control and tankers can be released from fire duties.

Some pools are compacted earth covered by a plastic surfacing or light-gauge metal panels placed against such earth or a special fill. Such pools may collapse internally if emptied. It may be possible to use a limited portion of such water sources but not possible to use the entire depth apparently available. It may be prudent not to use these pools at all.

The water supply officer should study and know the various pool limitations within the area he serves by consulting with the builders and installers of these pools.

B-4-6 Livestock Watering Ponds and Tanks. Many farms have livestock water tanks and other similar facilities. If the farmer is aware of the water needs for his farm buildings for fire fighting purposes, such tanks and ponds may be so sized as to be adequate in volume for both farm and fire department use and so located as to be readily available to the fire department. Tanks may be placed on the edge of the barnyard and on a side accessible to the fire department with the pumper or pump taking suction through a connection on the tank or by suction hose. These watering tanks and ponds are often filled and maintained full by a pump operated by a windmill or by an electric pump.

When a well fitted with an electric pump is used for irrigation or industrial use, the fuses may be pulled for periods of time when the farmer or plant does not need the water supply. Therefore, the fire department should carry fuses for all of the pumps in their district, and provisions should be made for an electrician or a power company employee or someone well-versed in pumps to respond on all alarms of fire.

B-4-7 Sprinkler Systems. In some rural areas, the only large water supply may be storage provided for use of a sprinklered building. The supply may be from an underground water distribution system, a pond or suction tank with pumps, an elevated tank, or a combination of these. In many cases, preplan arrangements can be made to use the water. This is particularly true if the property owner is contacted before he installs his sprinkler protection, as it may be necessary to increase the capacity of the storage or to install a hydrant which is accessible to the fire department and connected to the private yard distribution system.

Extreme care must be exercised in the use of water supplies provided for sprinkler protection. A certain amount of water must be retained in these systems for minimum sprinkler protection. A careful study and preplan must be made to determine such use.

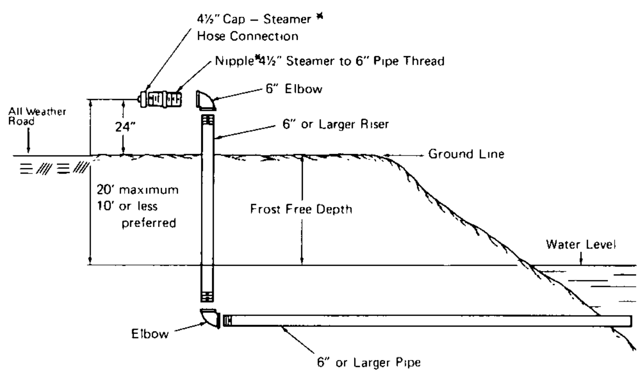
Some states and municipalities may have special ordinances requiring sprinkler protection for certain properties such as nursing homes. Frequently, the water supplies for these systems are minimal and may be from pressure tanks of limited capacity. Where this is the case, it is suggested that the fire department not consider such supplies in their planning, as the rural fire department must be careful that it does not disrupt the protection at such a property. See Appendix F for additional information on sprinkler systems.

B-4-8 Driven Wells. Wells and well systems are becoming increasingly popular as water supplies for fire fighting purposes at industrial properties, shopping centers, subdivisions, and farm houses located in rural areas beyond the reach of a municipal water distribution system.

In areas with suitable soil conditions, for instance those of a very sandy nature, it may be possible to use driven wells to obtain water for fire fighting. These wells are, in essence, pipes, usually with perforations about the base to permit entry of water, driven into the ground. From the threaded pipe head (or a fitting attached to the body of the pipe) a pump connection may be made to draft water much as from a well hydrant. Material on this technique is available from the U.S. Forest Service. A high water table is a prerequisite to using this method. Fire fighting units in areas conducive to this technique should have the necessary equipment for such installations.

B-5 Dry Hydrants.

B-5-1 General. The use of natural water sources and man-made water sources requires an understanding of dry hydrant construction, as the dry hydrant provides a ready means of suction supply without the longer time often involved in direct drafting. Although most rural fire departments are equipped to draft water directly from farm ponds or streams, and all should be, a dry



Exploded view of dry hydrant construction

Figure B-5-2(a). Dry hydrant construction. See Figure B-5-2b.

NOTE: Riser should be protected by post if subject to damage by auto or fire equipment.

*Steamer should be fire department's hard suction hose size and thread type.

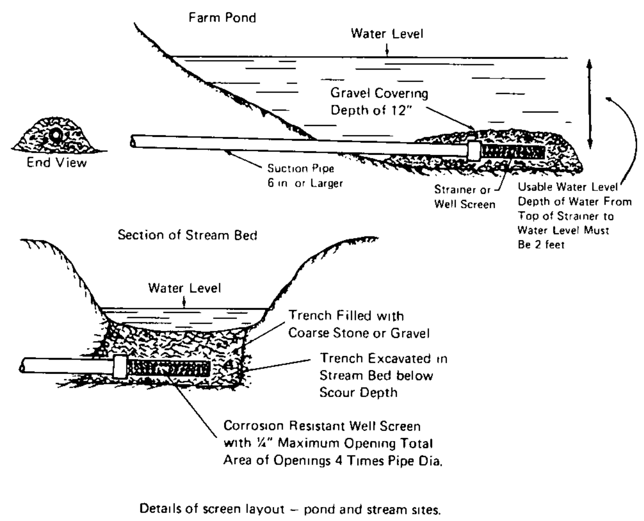


Figure B-5-2(b). Details of screen layout — pond and stream sites.

hydrant (see Figure B-5-2a) with an all-weather road access is preferable.

B-5-2 Dry Hydrant Construction. Depending upon the desired flow, the distance to the water, and the difference in elevation between the hydrant and water source, a 6-in. (152-mm) or larger pipe is necessary. The pipe and material should be suitable for the use and installed to manufacturer's standard. In some areas of the country, PVC pipe is being used for the construction of dry hydrants. See B-5-2.1. However, in other areas of the country, brass or bronze caps and steamer connections are being used along with iron pipe elbows and risers with asbestos cement or bituminized fiber pipe between risers and the water supply. Pipe and material used should be based on local conditions and common usage.

Table B-5-2(c) may be used to determine pipe size of a given hydrant line basing the flow upon 10 psi or 20 ft of head.

Table B-5-2(c)
Gallons per Minute Flow at 20 Feet of Head on Typical 6-in. Pipe

Length	Bituminous Fiber or Steel (C= 120)	Cast Iron (C= 110)	Asbestos Cement (C= 130)
25 ft	3,400	3,060	3,650
50 ft	2,300	2,100	2,500
100 ft	1,600	1,475	1,700
500 ft	660	615	720
1000 ft	460	425	495

For SI Units: 1 ft = 0.305 m; 1 gpm = 3.785 L/min.

Based upon the Hazen-Williams formula with estimated values of C. *Courtesy of Dr Gilbert Levin.*

A strainer or well screen is needed for the suction end of the pipe line to keep foreign materials out of the pipe and the pumper using the dry hydrant. A well screen as a strainer is shown in Figure B-5-2b. However, a strainer may be constructed by boring ¼- (6.4 mm) or ⅜-in. (127 mm) holes through the pipe. The holes should be spaced on ½-in. (9.5 mm) centers, with at least 12 rows drilled. Total area of strainer holes must exceed four times the area of the diameter of the pipe. The end of the pipe should be plugged, placed in the deepest portion of the pond or other water source, and raised off the bottom about 2 ft (6096 m) so it will be above any silt that may accumulate. The strainer should be covered with crushed rock to exclude marine growth and to prevent mechanical damage.

For stream bed installations, the strainer must be buried deep enough to prevent scouring action of the stream during periods of high runoff from exposing the strainer and tearing it loose from the supply pipe. The depth at which the pipe is installed should be below the frost free depth for the area. This depth may be obtained from a hydraulic engineer, university extension service, or the U.S. Soil Conservation System. (*See Figure B-5-2a.*)

For a dry hydrant, the pipe should be laid at a minimum slope [2 or 3 in. (50.8 or 76.2 mm) per 100 ft (30.5 m)] up to the hydrant riser. For a pressure hydrant, the pipe should be sloped downhill to the hydrant riser and be fitted with a gate valve. Where the supply line passes through the dike of a pond, anti-seep collars should be attached to the pipe to prevent water from seeping and channeling beside the pipe. The riser on a dry hydrant should be exposed above ground approximately 24 in. (610 mm).

The design of the following dry hydrant installation has been carefully planned to incorporate several desirable advantages which tend to bring the installation of the PVC Dry Hydrant within the manpower and financial resource of a large number of rural fire departments or the property owners; however, in areas where other types of material are used, such materials may be substituted for the PVC pipe and fittings. The design features are listed here to simplify the understanding of the installation of the dry hydrant.

B-5-2.1 Design Features and Step-by-Step Procedures for Installing a Dry Hydrant Using PVC Pipe.

I. Design Features for Dry Hydrant.

A. It is recommended that dry hydrants be constructed of 6 in. or larger piping and fittings.

B. No PVC piping or fittings of less than schedule 40 should be considered.

C. All piping or fittings exposed to sunlight should be primed and painted.

D. A minimum number of 90 degree elbows, preferably no more than two, are suggested to be used in the total system.

E. All connections should be cleaned and properly cemented so as to have all connections airtight.

F. The strainer may be formed in the end of the pipe by drilling 960, ⅜-in. (9.5-mm) holes along piping. A 4-in. (102-mm) strip should be reserved on the pipe to be installed on top to reduce the possibility of whirlpool during drought periods.

II. Step-by-Step Procedures for Installing a Dry Hydrant.

(Installation is made easy by some simple preplanning.)

1. Consider average water level at piping entry location.

2. Lift in excess of 15 ft (4.5 m) needs to be avoided [22 ft (6.8 m) maximum].

3. It is recommended that a backhoe or similar ditching equipment be utilized to excavate entire ditch to a horizontal elevation 3 ft (.9144 m) below water level.

4. The ditch should be excavated beginning at the most distant point from the water (riser location). Maintain a reasonable level and dig the ditch into the pond.

5. The horizontal and vertical portion (pipe and riser) should be assembled and lowered in one piece, as ditch should now have water it's entire length.

6. Back-filling should begin at the riser. It is suggested that the soil around the riser be tamped so it is rigidly supported with surrounding soil.

7. The ditch water is automatically forced back to the water source as back-filling is completed. This area should be firmly packed so as not to have low areas occur at a later date due to the settling of the soil.

8. At this point is is necessary to have personnel enter the water and place cement blocks, gravel, or other permanent supports underneath pipe in the water. The support should be heavy and prevent piping from coming in contact with bottom of water source. The strainer or well screen is now to be covered with 12 in. (30.5 mm) of coarse gravel to secure it in place and to prevent movement and must be at least 2 ft (.6096 m) under water. The supports can also be secured to the pipe with copper wire to stablize piping.

B-5-3 Maintenance of Dry Hydrant. These facilities require periodic checking, testing, and maintenance at least quarterly. Checking and testing by actual drafting should be a part of fire department training and drills. Thorough surveys should reveal any deterioration in the water supply situation in pond, streams, or cisterns.

Particular attention should be given to streams and ponds. They may need frequent removal of debris, dredging or excavation of silt, and protection from erosion. The hydrants should be tested at least annually with a pumper. Back flushing, followed by a pumper test at a maximum designed flow rate, with records kept of each test, is highly desirable. Tests of this kind will not only verify proper condition but also keep the line and strainer clear of silt and the water supply available for any fire emergency.

Location and Directions: ______________________________

____

____

Depth of Water Above Intake ________

Date ____________

DATE OF INSP.	BY	DEPTH OF WATER	AMOUNT OF WATER AVAILABLE	CONDITION OF WATER	EROSION	DRY HYDRANT		WEED CONTROL	ROAD CONDITION	SIGN	REMARKS
						TEST	FLOW				

Figure B-5-3.1.

The pond should be maintained as free of aquatic growth as possible. USDA Farmer's Bulletin, "Waterweed Control on Farms and Ranches," is a source of good information on this subject. At times it may be necessary to drain the pond to control this growth.

Inspection procedures should include safety items such as posting warning signs and seeing that life preservers, ropes, etc., are available. Particular attention should be given to local authorities' regulations governing such water points.

It is important to consider appearance of this water point. Grass should be kept trimmed and neat. The hydrant should be freshly painted as needed. The cap can be painted a reflective material to improve visibility during emergencies. All identification signs should be approved by the Department of Transportation prior to installation if they are to be on the right of way or come under state laws.

B-5-3.1 Maintenance Record for Dry Hydrant. It is suggested that a record of inspection be maintained with a separate card on each dry hydrant. (*See Figure B-5-3.1.*)

B-5-4 Useful Depth of Water Sources. Careful note must be made of the fact that installation of dry hydrants, as noted in Section B-5, calls for care in measuring water storage capacities. The useful depth of a lake with a dry hydrant installation, for instance, is from the minimum foreseeable low-water surface level to the top of the suction strainer, not to the bottom of the lake, and must be not less than 2 ft (.6096 m) of water. This becomes a very important point where hydrants are installed on a body of water affected by tide or on a lake which is lowered to maintain the flow of a river during drought conditions or to generate power. A pump suction requires a submergence below the water surface of 2 ft (.6096 m) or more, depending upon the rate of pumping, to prevent the formation of a vortex or whirlpool. Baffle and anti-swirl plates may be added to minimize vortex problems and allow additional water use. The vortex allows air to enter the pump, which may cause the loss of the pump prime. Therefore, pumping rates must be adjusted as the water level is lowered. This factor should be considered by the water control officer when estimating the effective rate at which water can be drawn from all suction supplies. Floating strainers may reduce the need for a 2-ft (.6096-m) usable depth.

B-6 Access to Water Supplies.

B-6-1 General. The fact that an adequate water supply is in sight of the main road does not assure that the water can be used for fire fighting purposes. Many times, it is necessary that a suitable approach be provided to reach within 10 ft (3.05 m) of the water supply. This needs to be done and the department trained in the use and limitations of the water supply before the fire occurs. A suitable approach may call for a roadway. However, at some sites and in some areas of the country, it may not be necessary that a roadway be constructed due to soil conditions. Other sites may already have roadways provided or pavement installed with the construction of an entrance way or a gate necessary to give access to the water supply. Other sites may be reached by foot only and may necessitate that a path be constructed and maintained so that portable pumps may be carried to the site. Each site must be evaluated by the water supply officer to determine the best way, within the fire department's means, for using the water supply.

B-6-2 Roadway Access. Most man-made lakes are constructed with heavy earth-moving equipment. In order for the property owner to construct a roadway for fire department use, the water supply officer should make the property owner aware of the needs of the fire department while the heavy equipment is still on the job. Table B-6-2 details considerations which should be kept in mind when planning access.

Table B-6-2
Recommendations for Roads to Water Supplies

Width:	Roadbed - 12 ft (3.7 m) Tread - 8 ft (2.4 m) Shoulders - 2 ft (.6096 m)
Alignment:	Radius centerline curvature - 50 ft (15.2 m).
Gradient:	Sustained grade - 8 percent.
Side Slopes:	All cut and fill slopes to be stable for the soil involved.
Drainage:	Bridges, culverts or grade dips at all drainageway crossings. Roadside ditches deep enough to provide drainage. Special drainage facilities (tile, etc.) at all seep areas and high-water-table areas.
Surface:	Treatment as required for year-round travel.
Erosion Control:	Measures as needed to protect road ditches, cross drains, and cut and fill slopes.
Load Carrying Capacity:	Adequate to carry maximum vehicle load expected.
Condition:	Suitable for all-weather use.

B-6-3 Dry Hydrant with Suction Line. In some cases, it may be desirable to install a dry hydrant with a suction line in lieu of an access road. This may be true in marsh or swamp areas. In this case, the fire department will have access to the hydrant from the shoulder of the main road. So as not to block the road during pumper operations, a suitable parking area on the shoulder of the road should be provided. Basic recommendations in Table B-6-2 can be useful in the design of such an area so that pumpers can be used efficiently and safely.

B-7 Bridges.

B-7-1 General. It is expected that the general condition of the bridges in most of our states is poor. A large number of these bridges are very old, and many which were built for farm-to-market-type use are now in urban areas with greatly increased traffic loads.

The condition of the nation's bridges was brought to the public's attention in the late '60s when the collapse of a large bridge received "headline reporting" from the news services. Furthermore, it developed that many of the states did not provide complete bridge inspection and maintenance programs.

B-7-1.1 Federal Legislation. As a result of this bridge failure, the Federal Highway Act of 1968 was passed, which required, among other things, that all states, counties, and cities receiving federal highway funding implement a program to inspect each bridge in the federally funded system every two years. Additional bridge collapses prompted ammendment of this law in 1976 to include all bridges on the public roads system.

B-7-1.2 Bridge Inspection Programs. During the last few years, a number of states have set up bridge inspection programs and the current safe tonnage is being posted. Over the entire county, a large number of bridges have been restricted to below the legal weight limit for which the road and bridge were originally designed.

One state with over 15,000 bridges reports that 50 percent of all its bridges are now posted below the original maximum load limits and 25 percent of these bridges are unsafe for use by a fully loaded school bus or normal fire department equipment.

B-7-1.3 Repair Programs. The highway departments are doing what they can with the money available to improve the situation. Priority is given to bridge upkeep on primary roads, with the bridges on the less important roads having to take what is left. Some highway departments are upgrading or raising the tonnage on their bridges as much as possible with repairs; however, many cannot be brought up to standard without complete rebuilding. Most states do not have money available for such an overhaul program.

In some states, the state highway department has consulted fire officials, explained the situation, and required that the fire department list the unsafe bridges in order of their importance to the fire service. The highway departments are then attempting to upgrade these bridges on the basis of fire department priority.

B-7-1.4 Effect on the Fire Service. The long-range nature of the bridge problem makes it a matter for serious consideration when planning purchases of apparatus. Tanker size, especially, must be restricted to gallonages which will not cause overloading. Any situations, such as an area isolated by an unsafe bridge, which may require particular equipment should be anticipated.

Whether or not a fire service would be held financially responsible for damage to a bridge would depend on state law; however, a good policy for every rural fire department is to check the bridge load restrictions before purchasing a new piece of apparatus. The lighter the equipment, the more bridges the department may be able to use.

B-7-1.5 Fire Department Responsibility. The fire department should check every bridge in its response districts, both primary response and mutual aid, to be sure that all bridges will safely carry the fire department load. This may not be the overwhelming task it appears. In view of the current use of computers by state highway departments to inventory their bridges, load limits may be readily available.

The fire department will need to make whatever special provision is indicated to protect an area isolated by an unsafe bridge. For example, providing a temporary station to house equipment in the isolated area; using a pumper taking suction from the river to pump water across the bridge through large hose lines; or servicing the area from another station which has a safe bridge to the area or, even better, does not have to use a bridge to respond.

B-8 Preplanning Water Supply.

B-8-1 Preplanning. Structures within the district of responsibility of the fire department should be surveyed in accordance with Chapter 2. The water requirement should be calculated, and the type and amount of equipment that should respond on first alarm should be designated. The response of fire apparatus, in conjunction with capacity of tankers, travel distance to haul water, and the volume of water supply, can then be arranged so that a constant flow to equal the water flow requirements is obtained. The procedure should be verified under training conditions prior to a fire emergency. This training exercise should include the spotting of equipment to protect the fire property and the exposures, exploration of the water sources, designation of fire lanes or routes, and review and modification of the operations to meet unusual conditions.

Aircraft and aerial photographs may be very helpful in the survey of static water availability. Such photographs are usually available from the county agriculture department or the county office of planning and zoning. Topographical maps from the U.S. Government, also, may be of value in this survey. Once sites are located, they need to be prepared for use according to the directions in this section, Appendix B.

Appendix C Water Hauling

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

C-1 Moving Water by Tanker.

C-1.1 General. The fire service has always experienced fire control difficulties in isolated areas. The difficulties have been many and varied, but one of the big factors is the lack of an adequate water supply. An adequate amount of water for control and extinguishment is a major consideration of most rural fire chiefs and influences the majority of their fire fighting decisions. A portion of the training of the rural fire department is taken up with engraving on the mind of the membership the need for the conservation of the meager water supply that is available in many areas.

This situation of a limited water supply at a working fire in a rural area demands the best in all phases of fire fighting. Therefore, this Appendix discusses the procedures for moving water in those areas where there are no municipal-type water distribution systems with fire hydrants.

Over the years, rural departments depending on hauled water have tended to utilize anything that will carry water and have exercised a great deal of ingenuity to make it work. Recently, there has been a trend in fire departments in rural areas to use "standard" pumpers and tankers with tanks in the 1000 to 1500 gal (3785 to 5678 L) range. Giant steps have been made in such tanker techniques as loading, unloading, and maintaining a continuous fire stream, based on the fire flow study, during the entire fire fighting operations. In this publication, a tanker is defined as a fire apparatus, the primary purpose of which is to move water from a source to the fire site. This is in contrast to a fire engine having a booster tank (no matter how large the tank) which will be placed at the fire to supply fire lines or placed at the water source to load the tankers.

Tankers are necessary for most rural departments and may be a big asset to a department having a weak municipal-type water system. While specially built and designed tankers are ideal, many fire chiefs are facing fires without adequate standard equipment. Since the job of putting out fires will require, on occasion, water-carrying capacity far above normal capability, a sound mutual aid program is necessary and far superior to makeshift equipment which is not designed for emergency service and is unsafe.

In building and buying nonstandard apparatus, utmost care must be exercised to consider safety and serviceability of the equipment as well as the safety of the membership of the department. A department having to depend on a mixture of tankers designed primarily for other use may need expert assistance in checking the equipment for safety before putting it in service.

If satisfactory service is going to be obtained from tankers, the size of chassis necessary to safely carry the load, the horsepower of the engine necessary to perform on the road and at the fire site, the completed vehicle's weight distribution, and the gear train combination best suited for the operation in that specific locale are items that must be carefully considered in the purchase or construction of the apparatus. The apparatus components, such as baffling of tank and center of gravity, are just as important as the engine, axles, and other drive line components and must not be overlooked.

C-1-2 Purchase or Construction of a Tanker. In planning or construction of a tanker, it is necessary that careful attention be given to assure that engine, chassis, baffling, center of gravity, and brakes of adequate specifications are obtained. NFPA 1901, *Automotive Fire Apparatus,* covers tankers, and it is suggested that this standard be carefully followed. The tank should be properly constructed and baffled. Particular attention should be paid to flow rates to and from the tank. Consideration should be given to discharging the tanker to the receiving vehicle, portable tank, or other equipment as rapidly as possible to get back on the road and bring another load of water to the fireground. Some departments are installing very large dump valves with gravity flow; while, other departments are providing a pump with a jet dump arrangement to reduce the time of emptying tankers.

Terrain to be traveled, weather to be encountered, and bridge and road conditions must be considered in buying or building safe tankers.

It is suggested that, for a tanker with a capacity greater than 1,500 gal (5678 L), it may be necessary to utilize a semi-trailer or tandem rear axles, depending on tank size and chassis characteristics. Certain types of chassis may not provide safe carrying capabilities, and a dangerous vehicle could result from assembly. Safe, reliable equipment that at least meets the minimum standards is a must.

It is further recommended that the maximum water tank capacity for tankers should not exceed 4,800 gal (18 168 L) (20 tons of water). In some cases, it may even be found that the cost of two smaller tankers will be little more, if any, than the cost of one large tanker. The mobility, cost of upkeep and bridge weight restrictions may convince many rural fire departments of the need to restrict the weight of their tankers.

C-1-3 Tanker Capacity. In general terms, a tanker is a unit made for specific water hauling requirements. In some forest service areas, where fire fighting is off the road and up steep grades, a 200 gal (757 L) slip-on unit is a tanker. East of the Mississippi River, there is a trend in fire departments in rural areas to use tankers in the 1,000 to 1,500 gal (3785 to 5678 L) range. In flat areas west of the Mississippi, fire departments successfully use tankers with capacities of 3,000 to 5,000 gal (11 355 to 18 925 L) and occasionally more.

In many parts of the country, terrain and bridge and road weight restrictions limit the capacity of tankers to the 1,000 to 1,500 gal (3785 to 5678 L) range (*see B-7-1*). However, the department operating tankers with capacities of 1,000 gal (3785 L) or more will normally find it easy to meet minimum water requirements outlined in this publication where water supplies are readily available.

It is desirable to have tankers of equal water-carrying capacities to prevent them from "stacking" at the fill and discharge points.

C-1-4 Tank Baffles. Some consider the age-old problem associated with tank "baffles" or "swash partitions" as the weakest and most dangerous area of fire engine and tanker design and construction. Considerable improvements have been made in "baffles" since the advent of the computer age. Poor baffling has been responsible for many accidents and each year is accountable for a number of deaths over the country. Therefore, careful consideration must be given to baffles by the designers and builders of the tanks.

C-1-5 Plumbing. It is important to have an outlet of adequate size to empty the tank. The reason is evident when the times to empty a 1600-gal (6056-L) tanker by gravity flow are considered. See table below.

1600 Gallon Tanker
Gravity Flow

Outlet Inch		Discharge Time In Minutes
2½ (65 mm)	=	20
4½ (114 mm)	=	7
6 (152 mm)	=	5
12 (305 mm)	=	1½

Adequate size plumbing is also important in those tankers equipped with a pump with a jet dump arrangement. Many jet dump tankers are capable of discharging at the rate of 1000 gpm (3785 L/min) or more.

Proper venting is a prerequisite to the common evolutions of filling and emptying tanks but it is imperative to rapid filling and discharging of tanks. There must be adequate provision for air to be driven from the tank when it is being filled with water and to enter the tank when that tank is being emptied. It is recommended that as a minimum the vent opening should be four times the cross sectional area of the inlet. Inadequate venting can result in the tank being bowed outward when it is being filled rapidly, or in impairing the discharge flow when emptying.

Adequate pump-to-tank plumbing size is also essential to provide for rapid discharge of water from a tanker through its pump. Many pieces of fire apparatus are in service which cannot deliver the full capacity of their pumps from their tanks because of undersized tank-to-pump plumbing. In a tanker operation, in which the emphasis may be placed on rapid low pressure emptying of a tank, this can be a major limitation of efficiency.

Of major concern, in a water hauling system involving tankers, is the fact that the tanker may not be completely filled at the source of water or water supply or completely emptied at the fire. Some tankers are so designed that as little as 10 gal (38 L) of water is left in the tank while others may have 100 gal (379 L) or more.

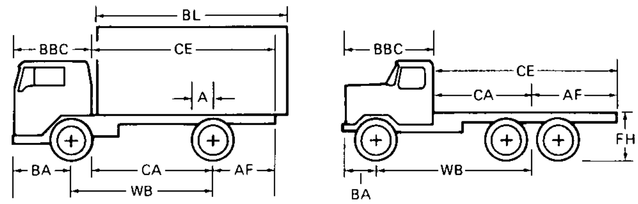
NFPA 1901, *Automotive Fire Apparatus*, contains data on adequate plumbing. Many departments are now exceeding the nominal pipe size requirements for their pumps in order to reduce friction loss and increase their capability to rapidly empty a tank by use of the pump.

C-1-5.1 Fill Line Couplings. Often, time wasted at tanker fill locations is due to difficulties in making and breaking a 2½-in. (65 mm) threaded coupling between fill pumper and the tanker. If this is the case, considerable time may be saved by using either a quarter turn coupling, specially designed large diameter fill pipe, or a rapid fill device which drops into the tank fill opening, thus providing quick breakaway from the fill supply.

C-1-6 Weight Distribution. Weight distribution is all-important in the handling of a heavy piece of fire apparatus and should be properly designed into the unit and then verified by actual weighing of each axle. Only a slight change in the load carried or the distribution of the load may cause the design limits of the truck to be exceeded and turn a safe vehicle into an unsafe vehicle.

Figure C-1-6a provides information as to data necessary to figure accurate weight distribution and how to use this data to make the weight distribution calculation.

Data required pertains to "as is" weights of the chassis to be used, dimensions of the chassis, and weights to be placed on the chassis. "As is" weights are best determined by weighing the chassis, with separate weights obtained on front and rear axles. If the unit has dual rear axles they should be weighed together. In some cases, particularly in using a new chassis, this data may be obtained from the agency providing the chassis, but it should be noted that such items as changes in tire size, lengthening, shortening, or reinforcement may alter such standard factory-provided data, and it is consequently preferable to weigh the chassis upon starting construction planning.



BBC -	Bumper to back of cab
BA -	Bumper to center line of front axle
CE -	Back of cab to end of frame
CA -	Back of cab to center line of rear axle or tandem suspension
AF -	Center of rear axle to end of frame
FH -	Frame height
BL -	Body length
FA -	Front Axle Weight
RA -	Rear Axle Weight
B -	Body Weight - Weight of complete body to be installed on chassis
PL -	Payload Weight - Weight of commodity to be carried
A -	Distance from center line of rear axle to center line of body or payload Center line or body (at ½ body length)
WB -	Wheelbase distance - Distance between center line of front and rear axle or tandem suspension.

Terms:

Chassis - Basic vehicle cab, frame, and running gear

Curb Weight - Weight of chassis only

Gross Vehicle Weight (GVW) - Total of curb, body, and payload weight

The weight carried by the front and rear axle may be calculated from the following formulas:

$$\frac{(B + PL)\,A}{WB} = \text{FA (Front Axle Weight)}$$

$$(B + PL) - FA = \text{RA (Rear Axle Weight)}$$

Figure C-1-6(a). Weight distribution for tankers.

Dimensional data is easily obtained by use of a tape measure or carpenter's ruler. Again, it may be available from the source providing the chassis but should be verified.

Weight of the body to be added to the chassis is a combination, primarily, of the steel and other materials used in the body, the water in the tank itself and the components added to that basic list: such items as, for example, any reels, hose, or miscellaneous equipment planned. While it is not necessary to make an individual calculation for minor items (minor in terms of weight), it is certainly important to calculate weight distribution of terms of a few hundred pounds or more.

This appendix does not attempt to provide complete information on tanker construction or the weight distribution of such a tanker. The chassis manufacturer's recommended weight distribution — generally expressed as a percentage of total weight, including both chassis and the weight placed on that chassis for front and rear axle(s) — is a prudent guideline as to the final weight distribution desired. Component weights may be obtained from the manufacturers of those components. Steel weights may be obtained from the steelyard providing the material.

C-1-7 Turning Radius and Wheelbase. An important consideration in tanker shuttle operations is the area available for turning. Since the tanker may be called upon to reverse direction or to maneuver for position at the water source or the fire site, a multiple of small single axle tankers with 12-in. (305 mm) quick dump or 6-in. (152 mm) jet dumps may actually move more water to the fire location than longer wheelbase tractor-trailers and dual tandem axle tankers.

C-1-8 Tanker Modification. A warning is in order that special care must be used when modifying a tanker built for one purpose to use for another purpose, such as the prevalent practice of adapting an "oil tanker" to fire service. The majority of oil or gasoline tankers are constructed to carry a volatile liquid whose specific gravity is less than that of water. When utilized as a water tanker, the weight may exceed the manufacturer's permissible gross vehicle weight limits. For this reason, it may be prudent to reduce the tank's size to avoid undesirable effects on weight distribution. However, in doing so, special attention should be paid to the problem of altering the center of gravity which makes the vehicle's cornering characteristics more hazardous.

Special attention should be paid to the baffling of such tankers, and the truck should be rejected if it does not meet the demands of cornering, braking, and acceleration required by the fire service.

Other special considerations: A stainless steel milk tanker may be made out of very light gauge metal with no baffling whatever and is difficult to baffle cross and lengthwise.

The steel used in gasoline tankers will corrode extremely fast due to the uncoated interior of such tanks. In addition, the steel used is not of the copper-bearing or stainless type used in most fire apparatus tanks.

Aluminum fuel oil tanks have been found to be subject to corrosion from chlorinated water and corrosive rural water supplies. They may have a life expectancy less than steel if not properly coated and protected.

There is an inherent danger in modifying gasoline tankers — that of an explosion. All gasoline tanks should be steam cleaned before modifications requiring welding are undertaken. This may result in difficulty in installing proper baffling inside such tanks.

The gasoline and milk tanker are usually designed to be filled with the product each morning and to distribute that product during the day under normal traffic conditions rather than emergency conditions as is the case with fire equipment. An oil tanker is not required to stand in the station fully loaded day after day.

C-1-9 Driver Training. An important consideration frequently missed by the rural fire department is that of driver training. There are few people trained to drive a tractor-trailer combination under emergency conditions and the fire department planning to use one must train for it. Even a two- or three-axle vehicle used as a tanker will probably have driving characteristics highly unlike other apparatus, and driver training is a must.

C-1-10 Calculating Water-Carrying Potential. Two primary factors to be considered in the development of tank water supplies are the amount of water carried on initial responding units and the amount which can be continuously delivered thereafter. A knowledge of the tank sizes and estimated arrival times of initial responding units is important.

An appropriate formula to calculate the maximum continuous flow capability at the fire scene is:

$$Q = \frac{V}{A + 2T + B} - 10\%$$

Q	=	Maximum continuous flow capability in gallons per minute;
V	=	Tanker capacity in gallons;
A	=	Time in minutes for tanker to drive 200 ft (61 m), dump water into a drop tank and return to starting point;
T	=	Time in minutes of "one-way" travel from water source to fire, given by formula T = 0.65 + XD. (see Table C-1.10a);
B	=	Time in minutes for tanker to drive 200 ft (61 m), fill tanker at water source and return to starting point;
-10%	=	Amount of water supply (tanker capacity) considered not available due to spillage, underfilling and incomplete unloading.

The dumping time (A) and filling time (B) for the formula may be determined by drill and by close study of water sources. Equipment does not have to be operated under emergency conditions to obtain travel time (T), as this may be calculated from the following equation:

$$T = 0.65 + XD.$$

T = Time in minutes of average round trip travel from fire to water source and back to fire.

D = round trip distance.

When an apparatus is equipped with an adequate engine, chassis, baffling and brakes, a safe constant speed of 35 mph can generally be maintained on level terrain, in light traffic and on an adequate roadway. Where conditions will not permit this speed, the average safe constant speed should be reduced.

Using an average safe constant speed of 35 mph.

$$X = \frac{60}{\text{average safe constant speed}} = \frac{60}{35 \text{ mph}} = 1.70$$

Precalculated values for "X" using various mph have been inserted into the preceding formula (T = 0.65 + XD) as follows:

T = 0.65 + 1.7 D	Constant Speed of 35 mph
T = 0.65 + 2.0 D	Constant Speed of 30 mph
T = 0.65 + 2.4 D	Constant Speed of 25 mph
T = 0.65 + 3.0 D	Constant Speed of 20 mph
T = 0.65 + 4.0 D	Constant Speed of 15 mph

These formulas make it possible to plan water availability at any point in an area. As an example of how to calculate the water available from a supply where the water must be trucked to the fire scene, consider the following applications of the formula:

If tank capacity is 1,500 gal (5678 L) (V), time to dump the tanker load into a portable tank is three minutes (A), round trip time to the refill point is 8 minutes at a speed of 35 mph (T), and time to fill is four minutes (B):

$$Q = \frac{V}{A + T + B} - 10\%$$

$$Q = \frac{1,500}{3 + 8 + 4} - 10\% = \frac{1,500}{15} - 10\% = 90 \text{ gpm}$$

Note the effect on the continuous capability of the tanker to shuttle water, however, when distances increase. When the distances double, the round trip time from fire to water source doubled from 8 to 16 minutes. The formula works out as follows:

$$Q = \frac{1,500}{3 + 16 + 4} - 10\% = \frac{1,500}{23} - 10\% = 58 \text{ gpm}$$

With rural fire response distances what they are, the number and size of tankers available to the department is of paramount importance. Proper planning can determine the probable tanker gallonages that will be available.

Table C-1-10(a) Time Distance Table Using an Average Safe Constant Speed of 35 MPH T = 0.65 + 1.70 D

Distance, Miles	Time, Minutes	Distance, Miles	Time, Minutes	Distance, Miles	Time, Minutes	Distance, Miles	Time, Minutes
0	0						
0.1	0.82	2.6	5.07	5.1	9.32	7.6	13.57
0.2	0.99	2.7	5.24	5.2	9.49	7.7	13.74
0.3	1.16	2.8	5.41	5.3	9.66	7.8	13.91
0.4	1.33	2.9	5.58	5.4	9.83	7.9	14.08
0.5	1.50	3.0	5.75	5.5	10.00	8.0	14.25
0.6	1.67	3.1	5.92	5.6	10.17	8.1	14.42
0.7	1.84	3.2	6.09	5.7	10.34	8.2	14.59
0.8	2.01	3.3	6.26	5.8	10.51	8.3	14.76
0.9	2.18	3.4	6.43	5.9	10.68	8.4	14.93
1.0	2.35	3.5	6.60	6.0	10.85	8.5	15.10
1.1	2.52	3.6	6.77	6.1	11.02	8.6	15.27
1.2	2.69	3.7	6.94	6.2	11.19	8.7	15.44
1.3	2.86	3.8	7.11	6.3	11.36	8.8	15.61
1.4	3.03	3.9	7.28	6.4	11.53	8.9	15.78
1.5	3.20	4.0	7.45	6.5	11.70	9.0	15.95
1.6	3.37	4.1	7.62	6.6	11.87	9.1	16.12
1.7	3.54	4.2	7.79	6.7	12.04	9.2	16.29
1.8	3.71	4.3	7.96	6.8	12.21	9.3	16.46
1.9	3.88	4.4	8.13	6.9	12.38	9.4	16.63
2.0	4.05	4.5	8.30	7.0	12.55	9.5	16.80
2.1	4.22	4.6	8.47	7.1	12.72	9.6	16.97
2.2	4.39	4.7	8.64	7.2	12.89	9.7	17.14
2.3	4.56	4.8	8.81	7.3	13.06	9.8	17.31
2.4	4.73	4.9	8.98	7.4	13.23	9.9	17.48
2.5	4.90	5.0	9.15	7.5	13.40	10.0	17.65

C-1-11 Portable Drop Tanks. There are, generally, three types of drop tanks: the self-supporting tank, the fold-out frame tank and a high-sided fold-out tank for helicopter bucket-lift tanker service. The self-supporting tank is built with the sides reinforced to support the water inside the tank. The fold-out frame-type tank is similar to a child's wading pool — an open tank supported by a steel frame — and is the most common in fire service use. Capacities of drop tanks normally run from 1000 to 2500 gal (3785 to 9463 L) with 1500- to 2000-gal (5676- to 7570-L) tanks as the more popular. The addition of the drop tank for "stockpiling" water has yielded highly desirable results. This "stockpiling" allows for the continuous operation of low-volume supplies and creates a source from which a pumper may draft for supplying hose lines in a direct fire attack.

C-1-12 Discharging the Tanker. In a water-hauling operation, the time it takes to fill the tanker and the time it takes to discharge the tanker are two points at which time may be saved, therefore increasing the amount of water that can be hauled to the fire. The use of jet assisted dump valve arrangements and large dump valve arrangements are two methods that have been used to reduce the dump time.

C-1-12.1 Jet Assisted Dump Valve Arrangement. The introduction of the jet pump in the discharge arrangement of the tanker has more than doubled the efficiency of a tanker when used in conjunction with a drop tank or tanker located at the fire.

A 1500-gal tanker equipped with a jet of water directed into the discharge pipe of the tanker is able to empty at a rapid rate. The rate of discharge is frequently at the rate of 1000 gpm or 90 seconds to empty a 1500-gal (5676-L) tanker. This is with a 6-in. (152-mm) discharge pipe and a jet pump capable of discharging 250 gpm (946 L/min).

C-1-12.2 Large Dump Valve Arrangement. A number of rural fire departments using gravity dump have reduced the time necessary to empty their tankers by increasing the size of the discharge arrangements. Gravity dumping with discharge valves of 10 in. (254 mm) and 12 in. (305 mm) are often used. In calculating flow rates from dump valves of various sizes, fire department personnel should remember these rates vary as the depth of the water in the tank decreases. Actual tests should be made of the installed valve to determine dump time.

C-1-13 Use of Portable Drop Tanks and Tankers. The development of the portable drop tank or portable folding tank and the jet pump to assist the tanker to quickly discharge its load of water has enabled many rural fire departments to utilize isolated water supplies and for the first time to obtain sufficient water for effective fire fighting. Following is a brief outline of how the system is being employed by some departments:

When an alarm of fire is received, equipment is dispatched on a pre-planned basis determined by such things as fire flow needs, hazards involved, water supply available, etc. (See Chapter 5.) A minimum of one tanker and one pumper respond to the fire, and the pumper begins the fire attack with water from its booster tank. The first responding tanker may act as a nurse tanker or may set up a

Figure C-1-13. A mobile water supply (tanker) mounted on a truck chassis of the 27.500 GVW range. Capacity of tank is 1250 gal (4731 L) and can be filled from draft in approximately 4 minutes and discharged in approximately 95 seconds.
(Compliments of the Georgia Forestry Commission)

portable drop tank and begin discharging its load of water into the drop tank. With the use of a jet-type pump, discharging through a 5- or 6-in. (127- or 152-mm) discharge pipe, or a large 12-in. (305-mm) quick dump valve, the water in the tanker can be transferred to the portable drop tank at a rate of approximately 1000 gpm (3785 L/min). A short piece of aluminum pipe with an "L" on one end gives the tanker the flexibility to discharge into the drop tank with the tanker backed up to the drop tank or with the drop tank located on either side of the tanker. As soon as the tanker has emptied its load, it immediately heads to the water supply. In the meantime, another fire department pumper has responded to the water supply, connected to the dry hydrant, and primed its pump. When the empty tanker arrives at the water supply, the pumper is ready to fill the tanker. The refilled tanker returns to the fire site, discharges its water, and the cycle is repeated. It is suggested that it is more efficient to fill one tanker at a time rather than to fill two or more tankers at a slower rate. Also, if all tankers in the department have the same capacity, they will not "stack up" at the source of supply or the fire while waiting for a large tanker to be filled at the source or to discharge its water at the fire. Although pre-planned, each step of this hauling operation is under the direction of the water control officer, and local conditions may dictate variations in this basic system.

As additional tankers arrive at the fire site and dump their water, they fall into the water-hauling cycle. Of course, it may be necessary for the water control officer to open up additional water supply points with additional pumpers. Portable pumps can sometimes be used in this operation, if the additional supply is not readily accessible, however, refill time may be greatly increased. The water control officer at the fire site needs to be in radio contact with the officer in charge of each water supply or suction point. He will also advise the drivers which route to take to the fire site. Whenever possible, an alternate route should be selected for returning vehicles so that emergency vehicles will not be meeting on sharp turns or narrow country roads.

The initial alarm response to certain occupancies which require a large volume of water, based on the study producing the water flow requirements, may be beyond the ability of the local department to produce. Mutual aid pumpers and tankers may be set up to run automatically on first alarm, thereby conserving valuable time and delivering fire flows calculated in Chapter 5.

C-1-14 Chemical Additives and Water Supply.

C-1-14.1 General. Fire departments are using chemicals to increase their fire fighting capacity with their available water supplies. This may be particularly important to the rural fire fighter working in areas with limited water supply, because these chemicals can give more extinguishing capability per gallon of water; however, all types of chemical additives are usually expensive for rural fire department use.

The use of foam extinguishing agents for flammable liquid fires is effective and essential. Equally important is a group of "water stretchers" consisting of chemical penetrants and "wet water." (*See C-1-14.2 and C-1-14.3.*)

In all cases of chemical additives applied in fire fighting, the effect of these compounds on the tanks, pumps, etc., of the fire vehicle should be carefully considered. Most retardants contain corrosion inhibiters, but it is still necessary to do a good job of housekeeping after use to lessen damage.

C-1-14.2 Chemical Retardants. The retardants may be prepared in the form of a slurry which can either be station-stored or carried in separate tanks on fire fighting vehicles for use as required. Many tankers are being built with two tanks; one for the liquid concentrate of retardant and one for water. The chemical is mixed with water through a simple blending device as it is applied upon, or directly in front of, a fire.

A primary benefit of the slurry lies in its ability to "fireproof" brush, grass, etc., ahead of a groundcover blaze and to retain its fire-retarding characteristics even after the water itself has evaporated. Thus, a fire fighter may be able to build a fire break ahead of a fire by simply pumping the slurry along an appropriate perimeter. The fire retardant feature is maintained until heavy rains wash off the chemicals or they are otherwise destroyed. Many such slurries are, additionally, fertilizers which assist in the process of new growth after a fire. Much additional information on these chemicals may be obtained from the NFPA publication, "Chemicals for Forest Fire Fighting."

C-1-14.3 "Wet Waters." The "wet waters" are chemicals which reduce the surface tension of water, permitting it to soak into porous materials more rapidly. Their effects are particularly well known to those who have used them on cotton bale fires and similar materials. Some departments maintain them in their tanks at all times.

Appendix D Large Diameter Hose

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

D-1 Transporting Water Through Large Diameter Hose.

D-1.1 General. The advent of large diameter hose as an accepted tool of fire fighting has major significance in the field of rural water supplies. This hose is viewed as an aboveground water main from a water source to the fire scene, and its use is growing in the United States. Where delivery rates exceed 500 gpm (1893 L/min) and water must be moved long distances, large-diameter hose provides a most efficient means of minimizing friction losses and for developing the full potential of both water supplies and pumping capacities. NFPA has held that, for practical purposes, large diameter hose is that with an inside diameter of 3½-in. (89-mm) or larger.

D-1.2 Characteristics. Large diameter hose is available in either single or double jacketed construction, generally in the following sizes: 3½-in. (89-mm), 4-in. (102-mm), 4½-in. (114-mm), 5-in. (127-mm), and 6-in. (152-mm) The lower friction loss characteristics of such hose increases the usable distance between water source and fire. The department now unable to use water sources more than 1,000 ft (305 m) from a potential fire site may find that 3,000 ft (914 m) or more can become a reasonable distance when taking advantage of large diameter hose.

The basic reasons larger diameter hose moves water more efficiently are its increased size, its lower friction loss, and the relationship of these factors. They may be explained by studying the carrying capacities and friction loss factors shown in Tables D-1.3(a) and D-1.3(b).

D-1.3 Carrying Capacity of Large Hose. Tables D-1.3(a) and D-1.3(b) show, for example, that one 5-in. (127-mm) hose line delivers a volume of water approximately equivalent to six 2½-in. (65-mm) lines or four 3-in. (76-mm) lines at a given pressure and distance. [To use Table D-1.3a to obtain these numbers read horizontally from the 5-in. (127-mm) hose column on the far left. Thus the table shows one 5-in. (127-mm) length of hose to have the carrying capacity of 6.2 lengths of 2½-in. (65-mm) hose, 3.83 lengths of 3-in. (76 mm) hose, 2.56 lengths of 3½-in. (89-mm) hose and so forth.]

Table D-1.3(a) Relative Carrying Capacity of Fire Hose in Hose Lengths

	2½ in.	3 in.	3½ in.	4 in.	4½ in.	5 in.	6 in.
2½ in.	1	.617	.413	.29	.213	.161	0.1 in.
3 in.	1.62	1	.667	.469	.345	.261	.162
3½ in.	2.42	1.5	1	.704	.515	.391	.243
4 in.	3.44	2.13	1.42	1	.735	.556	.345
4½ in.	4.69	2.90	1.94	1.36	1	.758	.469
5 in.	6.20	3.83	2.56	1.8	1.32	1	.619
6 in.	10	6.19	4.12	2.9	2.13	1.61	1

This table shows the relative carrying capacities of hose, 2½ in. to 6 in. in diameter, for the same friction loss. The values in the table are based on the Hazen-Williams Equation.

For SI Units: 1 in. = 25.4 mm.

Table D-1.3(b) Approximate Friction Losses in Fire Hose (psi per 100 feet)

Internal diameter of hose:	2½ in.	3 in.	3½ in.	4 in.	5 in.	6 in.
Flow in GPM:						
250	15	6	2	-	-	-
500	55	25	10	5	2	-
750	-	45	20	11	4	1.5
1000	-	77	36	19	6	2.5
1500	-	-	82	40	14	6
2000	-	-	-	70	25	10

D-1.3.1 Selecting Large Hose. The size and the amount of hose to be carried by the fire department should be selected to fit the needs of the area served and the financial resources of the department. To assist in this selection of hose, Table D-1.3.1 may be helpful. The table is designed to be used primarily in relaying water with pumps discharging at 150 psi (1034 kPa) and at 20 psi (138 kPa) residual pressure at the point receiving the flow.

Table D-1-3.1 Distance in Feet that a Given Size Hose Can Deliver a Quantity of Water

GPM Discharge at 150 PSI Pump Pressure

Hose Size Inches	250 gpm	500 gpm	750 gpm	1000 gpm	1500 gpm	2000 gpm
2½	866 ft	236 ft				
3	2166 ft	520 ft	288 ft	168 ft		
3½	6500 ft	1300 ft	650 ft	361 ft	158 ft	
4		2600 ft	1181 ft	684 ft	325 ft	185 ft
5		6500 ft	3250 ft	2166 ft	928 ft	520 ft
6			8666 ft	5200 ft	2166 ft	1300 ft

Example: A 750-gpm fire flow is needed on the fire which is located 6,500 ft from the water supply. A pumper rated 750 gpm at 150 psi can relay 750 gpm at 20 psi discharge for a distance of only 650 ft if 3½-in. (89 mm) hose is used or 8,666 ft if 6 in. hose is used. Therefore, the department should consider using 6 in. hose to deliver its needed water requirements.

For SI Units: 1 in. = 25.4 mm; 1 gpm = 3.785 L/min; 1 ft = 0.305 m.

D-1-4 Load Capacity. Another important item to consider is hose load capacity. Most large diameter hose is of a lightweight design which results in a coupled 100 ft (30.5 m) length of 5-in. (127-mm) hose weighing approximately 105 lb (48 kg) — little heavier than a length of 100 ft (30.5 m) of conventionally constructed 2½-in. (65-mm) hose, which may weigh approximately 100 lb (45 kg).

One engine company, laying large diameter hose instead of multiple smaller lines, is much more efficient in its water-moving capacity. The use of the large diameter hose with one engine speeds up the operation that would otherwise involve multiple smaller lines with additional pumpers, men, and equipment to accomplish the same job.

D-1-5 Large Cities Using 5-in. (127-mm) Hose. Use of large diameter hose is not limited to the rural fire service. Because of its increased water-carrying capacity and efficiency, 40 percent of the 200 largest cities throughout the U.S. now employ large hose and it may be one of the fastest growing items of technology in the fire service. It has demonstrated further utility as, literally, a portable pipeline used to bridge the gap in a water system when a main ruptures and is being repaired. It has further been used in some drought-stricken areas to bring water to the scene of a fire from a distant lake or stream, conserving municipal water supplies which would otherwise be used. Several communities have installed as much as two miles of 5-in. (127-mm) hose for this purpose. While the large diameter hose is being laid, the initial fire attack is made from hydrants. When the large hose carrying the water from the lake is available at the fireground, the hydrants are shut down and supplies in the municipal water system are conserved.

D-1-6 Hose Reels. A number of powered "reel trucks" with various hose load capacities are now in use.

Much of the lightweight, large diameter hose now available is of a construction which permits field cleaning and does not require drying. The use of the "reel truck" permits rapid reloading with minimum personnel (two) and the unit is "in service" within minutes.

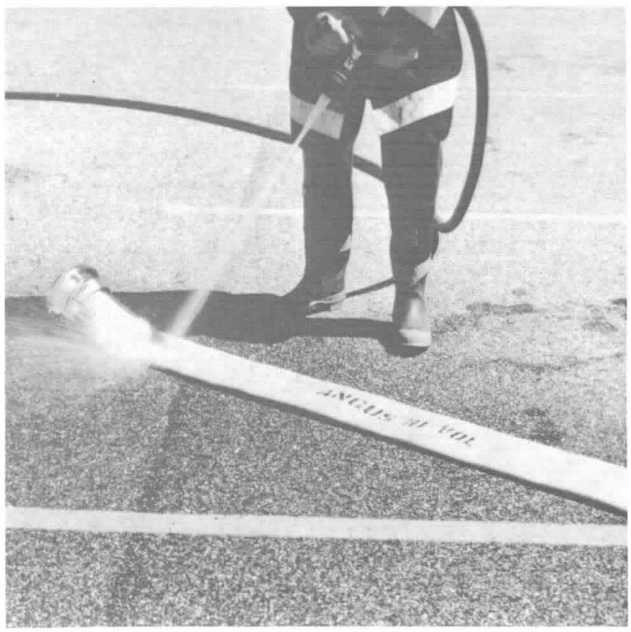


Figure D-1-6(a). Field cleaning large diameter hose.

Double reels mounted in the hose bed of a reel truck can produce a carrying capacity of large diameter hose of up to 6,000 ft (1829 m) over a mile of aboveground water main.

Such "reel trucks" generally require special power-driven systems to rewind the hose. The size of the reels is not conducive to fitting on most standard fire department pump bodies. Therefore, trucks specially designed for this operation are generally used as hose reel vehicles.

Figure D-1-6(b). Apparatus with reels for large diameter hose.

D-1-7 Fittings. Large diameter hose is available from many fire hose manufacturers with either standard threaded couplings or quick-connect hermaphrodite type fittings that eliminate the "male-female" aspect of couplings and, consequently, many adapters.

Special fittings have been developed to be used with large diameter hose. These include:

Figure D-1-7. Large diameter hose supplying a distribution valve from which run two 2½-in. (65-mm) lines, one to a hand line and the other to supply a pumper.