TO: Region Chiefs
Ranger Unit Chiefs

January 29, 1991

FM: Bob Paulus

Subject: PRC 4290 Implementation
Transmitted via Email

To assist you in initiating discussions with local government and in planning for implementation of PRC 4290, these policies and guidelines have been established.

o CDF will support and assist in the implementation of PRC 4290. All administrative units will support implementation and participate in reviewing projects, making wildland fire protection recommendations, and inspecting for compliance based on available resources.

o No additional staffing or resources are forthcoming, nor are anticipated at this time. Support should be based on existing staff and resources.

o The implementation of PRC 4290 will increase the workload of ranger unit and region personnel, including Battalion Chiefs and Fire Prevention personnel.

o All administrative units will make a positive effort to interface with local government in implementation and support the positive application of these regulations.

The Department is continuing to look at alternatives and opportunities to resolve the staffing deficiency that accompanies the implementation of these regulations.

6/1/91 DRAFT
FIRE SAFE PROGRAM
9040

## INTRODUCTION 9040.1

Due to California's vegetation, topography, climate, and population, we experience one of the most severe wildfire problems in the world. Between 1923 and 1990, over 5,400 homes and other structures have been destroyed by wildfire, over 3600 of those since 1970. More than 135 Californians have lost their lives due to wildfires since 1923. Creating a fire safe California is not the responsibility of one person, or one agency, but the collective responsibility of all California residents and all levels of government.

### The Problem 9040.2

The continuing increase of homes and other structures in the wildlands of California creates a growing threat to life and property from wildfires. The adoption of statewide minimum Fire Safe standards will result in a regulated encroachment of development into State Responsibility Areas (SRA). Individual homes and developments need to be designed to provide reasonable safety for the structure and it's occupants and fire fighters in the face of a wildfire.

While the legislature has vested the state with the responsibility and authority to provide wildland fire protection, local government has been granted the authority to approve and permit development and construction. This has led to a conflict between overlapping responsibilities and authorities. This division of authority has given local government the ability to approve development and construction with minimal consideration of wildland fire protection needs and placed the state in a role that is predominately advisory.

The lack of statewide minimum Fire Safe standards has been an issue since the early 1960's. In 1965, the County Supervisors Association of California (CSAC), authored and published The Fire Safety Guides for California Watersheds. Since then, eight additional reports and studies have pointed out the need for and encouraged California to adopt statewide Fire Safe standards. In 1980, the California Department of Forestry and Fire Protection published the Fire Safe Guides for Residential Development in California which is endorsed by CSAC, and provides preferred fire safety standards for construction and development in SRA.

### Board of Forestry Policies 9040.3

Historically, the Board of Forestry has urged the cities and counties of California to incorporate Fire Safe standards and fire protection planning measures in the placement of any development in forest, watershed and rangelands designated as State Responsibility Area. The Board also encourages the adoption of the Fire Safe Guides for Residential Development in California as part of the General Plan Safety Element.

In 1989, SB 186, (Chapter 778) authored by Senator Ralph Dills, required counties to submit to the Board of Forestry, for review of wildland fire protection policies, any proposed updates of their safety element. The Board must return to the county any comments and recommendations within 60 days. If the county rejects the Boards comments, the county must notify the Board of the reasons for rejection. During their review of these documents, the Board may request, through channels, ranger unit review and comments on the proposals. Each administrative unit shall support this need based upon available resources.

With the passage of SB 1075 (Chapter 955), authored by Senator Don Rogers, in 1987, the Board has taken an increasingly stronger stand on the issue of prudent firesafe development. This legislation directed the Board to prepare minimum development and construction standards for wildland fire protection, specifically relating to access, water supplies, street signing and building addresses and fuel modification. These comprehensive regulations became effective in February 1991.

Each county containing SRA is required to implement and enforce PRC 4290 or request the Board of Forestry to certify their local rules and ordinances as meeting the same practical effect as the PRC 4290 regulations. The Board has directed the Department to implement the approved regulations and to review and comment on development in SRA.

**Program Intent** **9040.4**

The intent of the Fire Safe program is to minimize the loss of structures, lives and resources due to uncontrolled wildfires. Fire Safe combines the philosophy of self protection with the concept of defensible space. Self protection places some of the burden of fire protection on the homeowner, builder and or developer, incorporating basic fire protection measures into the home or development, as it is built. The concept of defensible space provides a reasonably safe location from which firefighters can protect a structure, with a greater potential of saving the structure. Each home, subdivision, and development in SRA should have built into its design adequate emergency equipment access, building and street identification, and a reasonable water supply for fire suppression needs. Every homeowner, developer, and local government planner should understand the importance of planning for fire protection, the need to clear flammable vegetation around structures (PRC 4291), and the benefits of greenbelts and fuelbreaks in and around subdivisions and developments.

**Department Authority and Responsibility** **9040.5**

The Board of Forestry has delegated to the Department the responsibility to implement PRC 4290. Ranger Units shall review appropriate permits and tentative maps for development and construction in SRA for appropriate wildland fire protection mitigation and shall make recommendations to local jurisdictions relative to the Forest and Fire Laws and requirements contained in Title 14, Division 1.5, Chapter 7, Article 5.5, Sections 1270-1276. Each ranger unit shall also review project environmental documentation provided via the State Clearing House or the local jurisdiction for conformance with CGC 1270-1279, the Forest and Fire Laws and other CDF program interests.

**Program Objectives** **9040.6**

- o Develop uniform statewide minimum standards for wildland fire protection.
- o Reduce loss and damage to structures and resources.
- o Create a safer environment for occupants living in the wildlands who are at risk from wildfires.
- o Require self-protection, with less dependence upon the state and local fire agencies.
- o Provide defensible space for firefighters, reducing firefighter risk.
- o Reduce the vulnerability of homes and developments to wildfire.
- o Support CDF's resource protection mission.

Each Ranger Unit shall address the local implementation of PRC 4290, including these objectives, in their Ranger Unit Fire Prevention Plan.

**Complementing Programs** **9040.7**

Fire Safe standards, on their own, will not solve California's conflict between development and wildfire. Catastrophic weather conditions, the buildup of fuels, and the increasing risk from wildland users will continue to plague California fire agencies. **An integrated approach, using Education and Engineering programs and activities as identified in the Ranger Unit Fire Prevention Plan shall be utilized for both discretionary and ministerial activities.** The application of complementing regulations, standards and requirements such as PRC 4291, clearance of flammable vegetation, vegetation management to eliminate disastrous fuel buildups; Forest and Fire Laws, including industrial and utility requirements and fire safe measures to provide built-in fire protection will reduce the problem to an acceptable level of risk.

**COUNTY GENERAL PLANS** **9041.0**

California Government Code, Section 65302(i), requires all counties to address Fire Safe standards in the safety element of their general plan; specifically, evacuation routes, peak load water supplies, minimum road widths and clearances around structures. This was to be completed by 1974. Most counties did address some level of Fire Safe measures in their general plan. However, many did not. Even where they did address Fire Safe standards, the standards are widely varied in specifics and effectiveness. On the other hand, several counties have adopted strong Fire Safe ordinances that require strong fire protection measures. Even if all counties had developed Fire Safe standards in their general plans, the need for minimum statewide standards that provide continuity would still exist. **CDF, as the fire agency responsible for protecting SRA, believes that firefighter safety is an issue that crosses governmental**

**boundaries, and is an issue that requires statewide commitment.**

As the State's wildland fire protection agency, CDF becomes a responsible agency on many projects in SRA, requiring receipt and review of project environmental documentation. Where deficiencies in the General Plan are identified, the Director's Office and the Board of Forestry should be notified. The notice should include a clear description of the deficiency and recommendations or alternatives for correction. The Sacramento headquarters Environmental Coordinator and Fire Prevention Engineering Officer will coordinate these activities.

General information on the county general plan, the development process and strategic fire planning can be found in A Discussion of the County General Plan and the Role of Strategic Fire Protection Planning, prepared under contract for CDF on September 30, 1989, as well as the Governor's Office of Planning and Research publications: Planning, Development and Zoning Laws; County General Plan Guidelines; CEQA: the California Environmental Quality Act, Statutes and Guidelines.

**Planning for Fire Hazard Severity** **9041.1**

Although wildfire is a hazard wherever people and developments intrude upon the wildlands, the degree of hazard and the required amount of fire prevention and safety measures vary from area to area. A fire hazard severity classification system based on three factors has been developed to provide land-use planners a practical and logical system for classifying the severity of fire hazard in California's wildlands. The expected result is construction and development commensurate with the on-site hazard and risks. General Plans and the resulting zoning ordinances should reflect these conditions. Fuel type, slope, fire weather, and frequency of occurrence of different levels of burning indices (BI) are the primary criteria for identifying and classifying the severity of the fire hazard in any given area. The original system was established in 1973 as the result of a Housing and Urban Development grant (A Fire Hazard Severity Classification System for California's Wildlands, 1973). The system was revised in 1985 as required by the legislature as the basis for implementation of the State Fire Marshal's requirement to adopt a fire resistant roofing and attic opening regulation applicable to SRA (Instructions for Zoning Fire Hazard Severity in State Responsibility Area in California, December 1983).

These maps will serve as a basic tool in defining fire hazard severity and effective administration of fire safety measures. The official maps (7.5 minute USGS quadrangles) are located in room 1653-10, at 1416 9th Street, Sacramento, California, 95814. Copies of these maps are found in each ranger unit and copies have been distributed to each county planning office.

**Timing** **9041.2**

Comprehensive land-use plans should be prepared well in advance of development and should be prepared and reviewed relative to fire hazard severity zones and anticipated development. In this way, problems can be resolved before the projected development is begun. Situations hazardous to life and property that are allowed to develop because of lack of land-use planning are generally beyond correction. In such cases, all concerned must acknowledge and be willing to accept the resultant level of risk and the inevitable damages from wildfire unless fuel modification programs can be integrated into the overall plan to reduce loss and damage.

The Fire Hazard Severity Zones should be used by local government planners to classify degrees of fire hazard in wildland areas and specify conditions under which the use and development of specific areas can take place. The classification system can also provide a base for detailed fire hazard zoning. In addition, the future use of the California Fire Economics Simulator (CFES), as a part of a series of analytical programs, may assist in identifying the effect of development, whether fire safe or not, to CDF's wildland fire protection mission.

**LOCAL GOVERNMENT INVOLVEMENT** **9042.0**

Each Ranger Unit is responsible for implementing fire safe recommendations in their area of responsibility. Ranger Unit personnel, as assigned by the ranger unit chief, should work with local government planners, building officials, developers and Boards of Supervisors to integrate fire safe standards into the county general plan, permit issuance and subdivision/development review process.

Local government should be encouraged to adopt and enforce the standards specified in the Fire Safe Guides for Residential Development in California. If circumstances warrant, more restrictive standards, created in conjunction with local jurisdictions should be developed, proposed and implemented.

**Strategic Fire Planning** **9042.1**

Strategic Fire Planning should be developed and implemented for large cohesive units under the guidance of the General Plan Safety Element and in conjunction with the planning for drainage, soil erosion, flood control, and sanitation. Planning for fire protection is necessary for full and safe development of watershed areas. To illustrate this planning concept and the basic relationship of fire protection to the development of mountain land, local planning and fire authorities should develop examples of how planning could be applied to an actual problem area. Such examples or area models would encourage mutual understanding of fire planning principles between planners, land developers, builders, and regulatory agencies of government. A description of this process and an approach to development is found in A discussion of the County General Plan and the Role of Strategic Fire Protection Planning prepared under contract for CDF by Bob Irwin.

**Review of Development Plans** **9042.2**

Proposed lot splits, subdivisions, and other developments should be reviewed for fire protection needs by CDF and local fire agencies in a manner similar to that given by water, road, health, and flood control authorities. Planning recommendations should also be made for large scale housing or planned-unit developments and not just for the traditional subdivisions. In addition to new development plans, appropriate variances and use permits should be reviewed by the responsible fire agencies, including CDF, as well as other control agencies in order to provide the most acceptable levels of fire safety. Changes in zoning relating to use and density as well as area and specific plans or other long and short range plans should also be reviewed.

**Recognition of Special Fire Problems** **9042.3**

In establishing conditions for use or development of an area, local government planners should confer with the fire protection agency in whose jurisdiction the area is located. The fire protection agencies, along with local planners, will be able to recommend a comprehensive land-use system which recognizes special fire problems and requirements related to vegetation, topography, weather, transportation systems, water supply systems, building density, hazard reduction, and risk. The overriding concern in developing recommendations must emphasize the implementation of CDF's full mission; protection of life and property from wildfire and prevention of damage to adjacent watersheds and other natural resources. The cost versus risk analysis and economic impact of any recommendations should be considered.

**Large Development Projects** **9042.4**

During each phase of a large development project in high fire-hazard areas, the developer should be required to provide at least two access routes until all phases of development and the permanent road system can be completed. From the start to the completion of a project, the developer should be prepared to provide fire prevention and protection measures deemed necessary by the responsible fire protection agency. Current and projected fire protection needs, including fire facility sites, should be included in all development plans. Assurance bonds of performance can be used to ensure that developers provide firesafe measures that give new residents a reasonable level of protection. The amounts of assurance bonds should be sufficient to compensate for increased costs due to inflated values over the duration of the development. Mutual understanding of fire and construction problems in the hazardous fire areas can lead to a degree of fire protection which would help both the construction industry and the fire protection agencies.

**Division of Land** **9042.5**

In order to assure that firesafe standards are applied to high fire hazard areas developed outside of major subdivisions, any division of land into two or more parcels for the purpose of lease, sale, conveyance, or transfer, whether immediate or future, which is not defined as a subdivision, should also be subject to review by the appropriate fire protection authority. Counties may apply the same requirements to major

and minor subdivisions, such as road and water requirements, but many have chosen to apply lesser standards to 4x4s and other parcel splits.

**Public Responsibility** **9043.0**

Every Ranger Unit should solicit the support of local officials, citizens and advocacy groups to facilitate adoption of Fire Safe standards. Public education efforts should use existing and locally developed publications, news releases and interviews with the media, and presentations at club, group and public presentations. Each and every wildland resident and wildland user must understand the steps necessary to act in a fire safe manner. They must accept the responsibility of self-protection by implementing the requirements of law and appropriate Fire Safe recommendations. Public oriented activities shall be incorporated into the Ranger Unit Fire Prevention Plan.

**DEFENSIBLE SPACE GUIDELINES** **9044.0**

This term was first used in the foreword of the 1980 Fire Safe Guides for Residential Development in California and now provides the cornerstone of intent and description for the Board of Forestry's firesafe regulations and CDF's wildland fire protection planning program. **Defensible space is the area within the perimeter of a parcel, development, neighborhood and community where basic wildland fire protection practices and measures are implemented, providing the key point of defense from an approaching wildfire or defense against encroaching wildfires or escaping structure fires.** The perimeter as used in this regulation is the area encompassing the parcel or parcels proposed for construction and/or development, excluding the physical structure itself. The area is characterized by the establishment and maintenance of emergency vehicle access, emergency water reserves, street names and building identification, and fuel modification measures. CDF shall assist and provide guidance to local jurisdictions, agencies, professionals and the public in implementing these measures.

The future design and construction of structures, subdivisions and developments in State Responsibility Area (SRA) shall provide for defensible space, providing built-in wildland fire protection as prescribed in conjunction with local jurisdictions and fire agencies.

**Maintenance of Defensible Space** **9044.1**

The maintenance of defensible space requirements are essential to the success of CDF's wildland fire protection mission and should be secured as a condition of any permit or map approved by local government. To ensure continued maintenance of properties in conformance with any recommended standards and measures to assure continued availability, access, and utilization of the defensible space during a wildfire, all maintenance shall be secured as conditioned during the permit, parcel or map approval process. Maintenance timing, whether annual or more frequent shall be considered during the conditioning phase. (CGC 1270-1276)

**Access Considerations** **9044.2**

Road and street networks, whether public or private, shall provide for safe access for emergency wildland fire equipment and civilian evacuation concurrently, and shall provide unobstructed traffic circulation during a wildfire emergency. (CGC 1270-1276) CDF recommends two separate points of ingress/egress to each development.

**Street Signs and Address Considerations** **9044.3**

Street signs and building addresses are necessary to facilitate the location of a fire and to avoid delays in response. All newly constructed or approved roads, streets, and buildings shall be designated by names or numbers, posted on signs clearly visible and legible from the roadway. (CGC 1270-1276)

**Emergency Water Considerations** **9044.4**

Emergency water supplies are necessary to provide available and accessible emergency water for wildfire protection, in sufficient quantities and locations to attack a wildfire or defend property from a wildfire. Such emergency water may be provided in a fire agency mobile water tender, or naturally occurring or

manmade containment structure, as long as the specified quantity is immediately available. (CGC 1270-1276)

Water should be available on-site prior to the completion of road construction where a community water system is approved or prior to the completion of building construction, where an individual system is approved. (CGC 1270-1276)

Water systems that meet or exceed the standards specified in Public Utilities Commission of California (PUC) revised General Order #103, Section VIII Fire Protection Standards and other applicable sections relating to fire protection water delivery systems, static water systems equaling or exceeding the National Fire Protection Association (NFPA) Standard 1231, "Standard on Water Supplies for Suburban and Rural Fire Fighting" or mobile water systems that meet the Insurance Services Office Rural Class 8 standard shall be considered as meeting the requirements of wildland fire protection. (CGC 1270-1276)

**Fuel Modification Considerations** **9044.5**

Fuel modification is necessary to reduce the intensity of a wildfire by reducing the volume and density of flammable vegetation, these areas shall provide (1) increased safety for emergency fire equipment and evacuating civilians; and (2) a point of attack or defense from a wildfire; and (3) strategic siting of fuel modification and greenbelts. (CGC 1270-1276) Efforts through CEQA review of projects and site specific mitigation at the permit and map review stage, shall be made to secure perimeter and interior fuel modification zones, including building setback to apply PRC 4291, fuel modification zones along roads and the strategic siting of greenbelts.

**Roofing Standards and Considerations** **9044.6**

Section 13108.5 of the Health and Safety Code requires the installation of, at minimum, Class C roofs on all structures built in SRA after October, 1988. Class B and A roof assemblies should be encouraged whenever possible.

**Construction Considerations** **9044.7**

Every new building or remodel of an existing structure should be constructed to at least meet the requirements specified in Volume 1 of the current edition of the Uniform Building Code (UBC) as published by the International Conference of Building Officials (ICBO) for the group and type of occupancy intended. More stringent standards may be necessary as determined by the local jurisdiction.

Eaves, balconies, unenclosed roofs and floors and other similar surfaces should be protected on the exposed underside by materials approved for one-hour fire-resistant construction. All supporting members, vertical, horizontal and diagonal, used in stilt or cantilevered construction shall be built to one-hour fire-resistant construction as set forth in Chapter 43, UBC, Volume 1.

All attic openings, soffit vents, foundation louvers or other ventilation openings in vertical exterior walls, eave overhangs, and vents through a roof should not exceed 144 square inches each and should be covered with one-quarter-inch mesh metal screen that is non-combustible and corrosion resistant.

Every chimney or vent attached to any solid or liquid fuel-burning device shall be provided with an approved, securely attached spark arrester consisting of (12-gauge recommended) welded or woven wire mesh screen with openings a maximum of one-half inch across (UBC, California Amendments, 3205(c)). It shall be maintained in effective working condition. and shall be mounted in a vertical or near vertical position and visible from the ground (PRC 4291 c and f).

Exterior walls of buildings should be protected with materials of not less than one-hour fire-resistant construction on the exterior side (see table 43-B, UBC). The materials should extend from the top of the foundation to the underside of the roof sheathing.

The spaces between rafters, the wall plate line and the underside of the roof sheathing should be filled with not less than two-inch nominal thickness wood or equivalent solid blocking.

Windows, especially large vista windows, should be limited in number on the side of a building that faces high hazard fuels. Windows should be dual- or triple-glazed to resist breaking and radiant heat.

**Siting, Spacing and Density Considerations** **9044.8**

Structure density, spacing and siting should be based on the fire hazard severity classification and the on-site topography. As fuels and slopes increase, low density or planned unit developments should be considered. From a protection standpoint, it is easier to protect these two strategies of development.

Building must be setback at least 30' from the property line on parcels 1 acre and larger and buildings on a single property should be separated by at least 60'. Since close spacing is common in mobile home parks, those situated in wildland areas are particularly susceptible to destruction by wildfire. Spacings should conform to those standards already mentioned.

Building densities should be as follows: 15-30% slope, no more than three dwellings per acre; 31-50% slope, no more than one dwelling per 3-5 acres. Where slopes and fuels exhibit very high fire danger, local government should prohibit development or apply more stringent standards. In all cases, development of ridge tops, canyons or ridgeline saddles should be limited or mitigated with greater levels of built-in fire protection.

**FIRE PROTECTION PLANNING (PRC 4290 & CEQA)** **9045.0**

**Application and Map Review** **9045.1**

Environmental project documentation for discretionary projects received from the county should be routed back to the county. Environmental project documentation for discretionary proojects received from the State Clearing House should be routed back through the Department's Environmental coordinator.

Whether environmental documentation for a descretionary project or a ministerial project being processed at the local level, it is preferable to meet with an applicant to discuss construction and development requirements, to review possible exceptions and alternatives prior to the submission of a tentative map or application for a permit. Initial review and joint inspections of the project site with the applicant may resolve many problems, easing the reviewers time commitment and simplifying negotiations and approval. Station personnel, Battalion Chiefs, Division Chiefs and resource management personnel should be involved and consulted when appropriate. In any case, good notes of the meeting should be kept for future review.

**Processing Time Frames** **9045.2**

CDF review of permit applications and tentative maps shall be accomplished within the time frames set by, and in use by the local jurisdiction. Review of environmental documentation through the State Clearing House shall be accomplished in accordance with the time frames specified on the Clearing House cover sheet.

**Inspection of Projects** **9045.3**

Ranger Units will develop cooperative agreements with local government to accomplish inspection of construction and development projects, relative to PRC 4290, in SRA. Local government inspectors routinely inspect for county and state building standards as well as locally mandated requirements for subdivisions. CDF should support the inspection of construction and development projects as determined by the Ranger Unit as resources are available. The use of local government forms is highly recommended.

During preliminary field inspections of projects, the adequacy of proposed activities, measures and practices should be reviewed and discussed. Requests for alternatives or exceptions should be evaluated and if warranted, should be endorsed. Where alternatives are not appropriate, recommendations should be provided by the CDF inspector. Field notes should be taken and a letter to the applicant, indicating areas of agreement and disagreement as well as recommendations should be prepared. In all cases, reference all documents to the project using the parcel number or project number and retain a copy of all notes and transmittals. If possible station, battalion or supervisory personnel should be involved if

possible.

Inspections following the issuance of an application or approval of a tentative parcel map should evaluate the conformance of project activities with the conditions placed on the permit or map and notes taken during any preliminary meeting or inspection. Documentation of non-conforming activities and measures shall be based on local procedures.

**Violations** **9045.4**

Action taken to correct any non-conforming activity shall be based on procedures developed in conjunction with local government. Alternatives include: notice of corrective action, violation based on the permit or map authority, or an infraction transitioning into a misdemeanor as provided for in the regulations. Local government is required to provide CDF with notice of any corrective action taken relative to PRC 4290. Each Ranger Unit shall maintain a record of these notices and shall prepare and transmit to the Sacramento Fire Prevention Engineering Officer a summary of action taken for the calendar year, who shall provide that information to the Board of Forestry.

**Appeals** **9045.5**

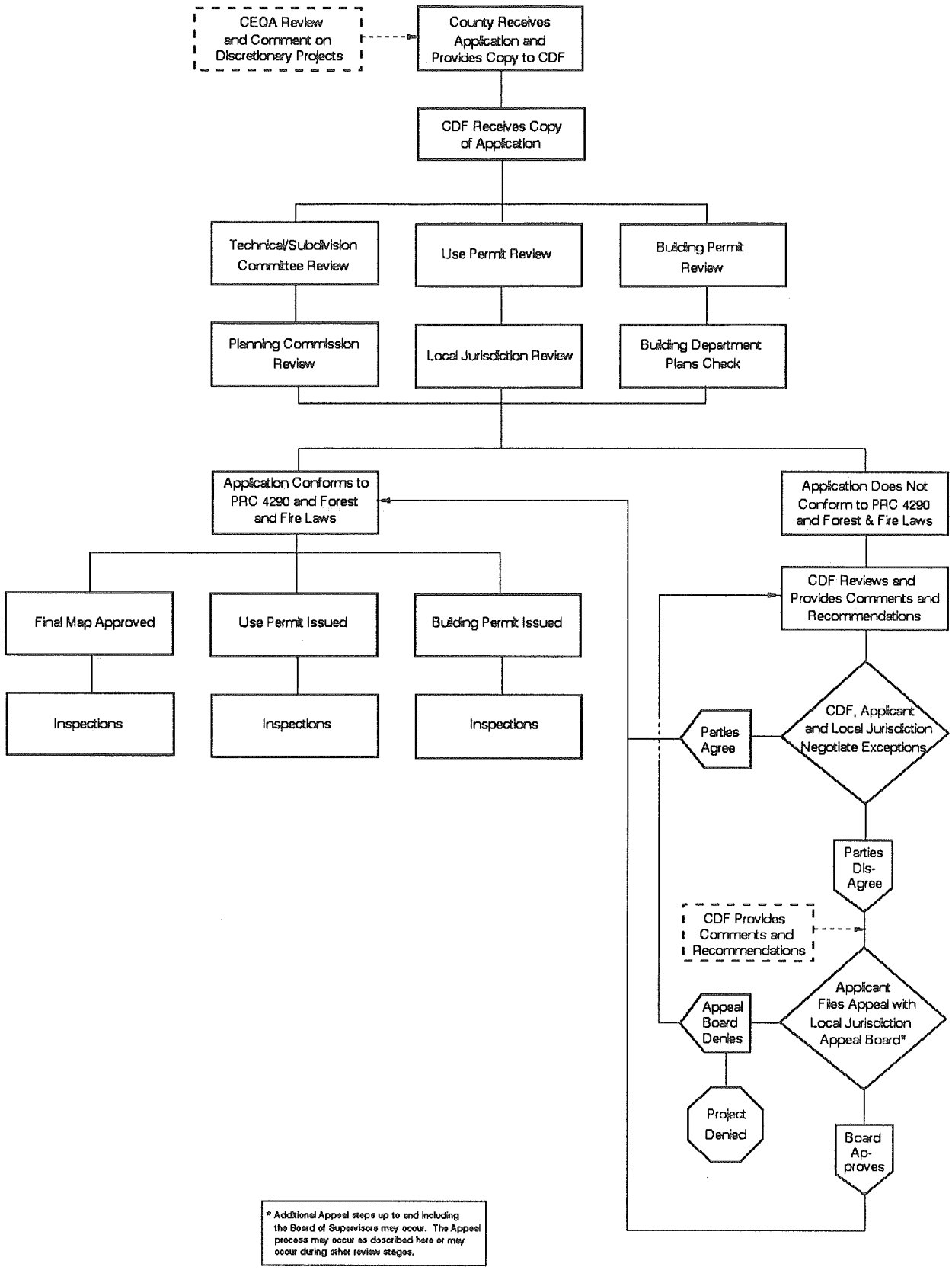
When an applicant appeals a requirement relating to PRC 4290, the local jurisdiction's appeal board is required to request from CDF, when CDF is the inspection authority, information relating to the appropriateness of the applicant's proposal and CDF's recommendation as to the appropriate action or performance. If the local appeal board grants the applicant's appeal, they must provide in writing their reasons for granting the appeal and their determination as to how the proposed practice meets the intent of PRC 4290. The Ranger Unit shall transmit their recommendation and the appeal board's findings to the Sacramento Fire Prevention Engineering Officer, who shall provide that information to the Board of Forestry.

**Inquiries and Interpretations** **9045.6**

Inquiries, questions or requests for interpretations from Ranger Unit personnel shall be transmitted through channels to the Region Fire Prevention Program Manager, who will transmit that request to the Sacramento Fire Prevention Engineering Officer. These requests shall be promptly processed and responded to.

**Reporting Requirements** **9045.6**

An annual report shall be prepared and submitted with the annual Ranger Unit Fire Prevention Plan as specified in Chapter 9050, Fire Prevention Planning. The form FP-5, Fire Protection Planning Annual Report shall be used.




## GENERALIZED PERMIT AND MAP APPROVAL PROCESS

**PRC 4290 GUIDEBOOK**

CALIFORNIA DEPARTMENT OF FORESTRY & FIRE PROTECTION

Senate Bill No. 1075

# CHAPTER 955

An act to amend Section 13108.5 of the Health and Safety Code, and to add Section 4290 to the Public Resources Code, relating to fire safety.

[Approved by Governor September 21, 1987. Filed with Secretary of State September 22, 1987.]

LEGISLATIVE COUNSEL'S DIGEST

SB 1075, Rogers. Fire safety regulations: state responsibility areas.

(1) Existing law requires the State Fire Marshal to adopt regulations for roof coverings and openings into attic areas of buildings in designated fire hazard severity zones.

This bill would require the State Fire Marshal to report to the Legislature by February 1, 1988, on these regulations and to identify the fire hazard severity zones and the agency responsible for enforcement in each zone.

(2) Existing law requires the State Board of Forestry to classify all lands within the state to determine state responsibility areas in which the state has the primary financial responsibility for preventing and suppressing fires. The Director of Forestry and Fire Protection is required to classify lands within state responsibility areas into fire hazard severity zones.

This bill would require the state board to adopt minimum fire safety standards applicable to state responsibility area lands under the authority of the Department of Forestry and Fire Protection. The bill would require all residential, commercial, and industrial building construction approved after July 1, 1989, within state responsibility areas to comply with the regulations.

*The people of the State of California do enact as follows:*

SECTION 1. Section 13108.5 of the Health and Safety Code is amended to read:

13108.5. (a) The State Fire Marshal shall adopt, amend, and repeal regulations for roof coverings and openings into the attic areas of buildings in those fire hazard severity zones designated by the Director of Forestry pursuant to Article 9 (commencing with Section 4201) of Chapter 1 of Part 2 of Division 4 of the Public Resources Code.

The regulations shall be consistent with the rules and regulations adopted by the Commission of Housing and Community Development pursuant to Section 17922 and shall apply to buildings subject to this part located in fire hazard severity zones within state responsibility areas. The regulations shall be enforced by the agency



responsible for enforcement of this part within e[illegible]one.

The State Fire Marshal shall take into account the rating, reflecting the degree of severity of fire hazard assigned pursuant to Section 4203 of the Public Resources Code for each of the fire hazard severity zones.

The regulations adopted pursuant to this section are applicable to new buildings constructed and to existing buildings when 50 percent or more of the roof area is reroofed pursuant to a building permit when the application for the permit is filed after the effective date of the regulations. When there is no building permit, the regulations are applicable to buildings constructed and to buildings where 50 percent or more of the roof area is reroofed after the effective date of the regulations.

(b) The State Fire Marshal shall report to the Legislature by February 1, 1988, describing the regulations adopted pursuant to subdivision (a) for roof coverings and openings that are applicable to each of the fire hazard severity zones designated by the Director of Forestry and Fire Protection. The report shall also generally identify the fire hazard severity zones and the agency responsible for enforcement of the regulations within each zone.

SEC. 2. Section 4290 is added to the Public Resources Code, to read:

4290. The board shall adopt regulations implementing minimum fire safety standards related to defensible space which are applicable to state responsibility area lands under the authority of the department. These regulations apply to the perimeters and access to all residential, commercial, and industrial building construction within state responsibility areas approved after July 1, 1989. The board may not adopt building standards, as defined in Section 18909 of the Health and Safety Code, under the authority of this section. As an integral part of fire safety standards, the State Fire Marshal has the authority to adopt regulations for roof coverings and openings into the attic areas of buildings specified in Section 13108.5 of the Health and Safety Code. The regulations apply to the placement of mobile homes as defined by National Fire Protection Association standards. These regulations do not apply where an application for a building permit was filed prior to July 1, 1989, or to parcel or tentative maps or other developments approved prior to July 1, 1989, if the final map for the tentative map is approved within the time prescribed by the local ordinance. The regulations shall include all of the following:

(a) Road standards for fire equipment access.

(b) Standards for signs identifying streets, roads, and buildings.

(c) Minimum private water supply reserves for emergency fire use.

(d) Fuel breaks and greenbelts.

These regulations do not supersede local regulations which equal or exceed minimum regulations adopted by the state.

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BOARD OF FORESTRY
FINAL STATEMENT OF REASONS
FOR ADOPTION OF RULES

## I. PROBLEM DESCRIPTION:

Various sections of the California Government Code (CGC) require counties to address the safety of dwellings and communities from fire and other disasters. Specifically, Section 65302 (i) requires the safety element of the general plan to include features necessary for such protection evacuation routes, peak load water supplies, minimum road widths, and clearances around structures.

In consideration of the above, in 1987 Senate Bill 1075 by Senator Rogers became law as Chapter 955 of the statutes of 1987. The bill added Section 4290 to the Public Resources Code. Section 4290 requires the Board of Forestry to adopt minimum fire safe standards applicable to state responsibility area lands under the fire protection authority of the Department of Forestry and Fire Protection (CDF). All residential, commercial, and industrial buildings constructed after the effective date of the regulations within state responsibility areas will be required to be developed in compliance with the regulations. The regulations adopted by the Board must include the areas of 1) road standards for fire equipment, 2) standards for signs identifying streets, roads, and buildings, 3) minimum private water supply reserves for emergency fire use, and 4) fuelbreaks and greenbelts.

The statute was adopted by the legislature to deal with an increasing fire protection problem in California. Since 1923 over 5,300 homes have been destroyed by wildfire and 149 lives lost. More than half of those homes have been destroyed since 1970. This year alone over 500 homes were destroyed in Santa Barbara and San Diego Counties. Increasingly, the loss of homes is not confined to the remote foothills and mountains of the state, but also occurs in subdivision and developments that are contiguous to or intermixed with the wildlands. Over 2 million residences now exist in the wildlands.

The fire agencies in California no longer have the equipment or funding necessary to provide an engine to protect each home during large wildland fires. Implementation of the concept of "defensible space", is one step necessary to mitigate wildland fire structural losses. This concept addresses the area around a structure or development and makes it safer and easier to provide fire protection. Each residence built in the wildlands must provide some basic level of protection around the home if it is to survive a wildland fire. This can include providing water, adequate roads, flammable vegetation clearance, or proper building identification. These measures provide a point of attack or defense for fire protection forces and increase the chance of survival for a residence or other development. If "defensible space" is not provided the inevitable increase in the loss of homes to wildland fires will continue.

## II. SPECIFIC PURPOSE AND STATEMENT OF NECESSITY FOR PROPOSED ACTION:

Section 4290 of the Public Resources Code requires that the Board of Forestry adopt minimum fire safe standards to address: 1) road standards for fire equipment access, 2) standards for signs identifying streets, roads, and buildings, 3) minimum private water supply reserves for emergency fire use, and 4) fuelbreaks and greenbelts. The following regulations are being proposed to meet the requirement and provide "defensible space" for residential and commercial development in the states wildlands:

Article 1, Administration

Section 1270 is necessary to inform the public of the reference to be used for the fire safe standards.

Section 1270.01 is needed to inform the public of the purpose of the article and to convey the message that these are only minimum standards and to establish specific conditions and timeframes for the application, adoption and implementation of the following articles and sections. Specifically, reasonable time frames for local certification, determination of when permits and maps fall within the authority of these regulations. This section also provides necessary guidance and transition from the legislation to the minimum nature of these regulations, the exceptions allowed and the intent of each article within this sub-chapter. It is also necessary to allow a time period for processing of requests by counties for having local ordinances certified by the Board as being equal protection.

Section 1270.02 sets out the conditions under which these regulations apply. The section makes specific the limits in the statute by stating the areas of application including structures, manufactured homes, and roads. It also provides for exemptions where the Board determined "fire safe" is not a concern. Incorporation by reference is provided in these regulations. The diversity of standards and sections (12) and the volume of reference material (over 200 pages) if incorporated as text in these regulations would create a cumbersome, unwieldy document. The volume of text would most likely keep individuals from digesting the requirements of these regulations. The encapsulation of references in these regulations does not detract from their readability, nor their usefulness, but does make them more readable. The documents incorporated in this section were available to the public upon request during the initial and extended public review period.

Section 1270.03 sets out the limits of the Board's regulations as they would interact with state regulation or local ordinances dealing with fire safe. The Board's rules would not affect local ordinances which provide equal protection. It is also necessary to have the Board certify that local ordinances do provide equal protection to meet the objective of this statute.

Section 1270.04 sets out the interaction between CDF and the local jurisdiction issuing the permit. The local jurisdiction must notify the Director of the permits to provide for review and incorporation of the fire safe standards provided by this article. Attachment of the rule standards to the permit are necessary to ensure enforceability.

Section 1270.05 is necessary to provide clarification of who has responsibility and authority for inspections to determine compliance with the proposed regulations. It is also necessary to provide guidance on a reporting procedure for the results of the inspections since CDF has ultimate responsibility for fire safe compliance. Local government conditions permits and maps through their development approval process and inspects for improvements required under their permit. The multiple-agency authority ensures inspections will occur as personnel and expertise are available.

Section 1270.06 provides specific guidance as to when inspections should be conducted to insure compliance is obtained at the time of completion of a project or during periods when interim actions are required. This sets time periods when identified violations can be corrected.

Section 1270.07 provides an exception. This is necessary to permit parties to proceed with their project when equal protection can be provided but the action would not otherwise be allowable under the regulations. There will be situations occur where fuel conditions, building materials or practices, topography or other factors combine to form a set fire safe conditions which could not

have been anticipated in these rules. It is this potential that an exception is needed to address.

Section 1270.08 sets out the standards for requesting such an exception. The approving authority must receive the exception in writing and with a description of the proposal which is complete enough to determine if equal protection will result.

Section 1270.09 is needed to describe the process for appealing the disapproval of a requested exception by a local jurisdiction. The application of these regulations occurs through the local government building and planning processes which utilize an appeal process. This section defines the authority of local government to hear an appeal, specifies the role of the participants and ensures that the California Board of Forestry, as the responsible agency, is informed of deviations from the standards proposed in this regulation. A ground review of the proposal by the inspection authority is needed to insure the local jurisdiction has all available facts to consider during the appeal process. Findings of equal protection are necessary to insure a proper record is maintained on a determination of equal protection. California Department of Forestry and Fire Protection (CDF) must be notified of the decision since they have the primary enforcement authority under the Public Resources Code. The CDF notification and report are also needed to determine if the rules are providing the intended defensible space.

Section 1271.00 provides definitions necessary to provide clarity and consistency in application of the proposed regulations. Processes and definitions differ throughout the state. Each county uses a different version of model codes, standards and ordinances and adopts their own local supplements. To apply these regulations with consistency and equity, definitions as they apply to these regulations have been developed. These definitions are commonly used national, state or local terminology. The provision of these definitions will facilitate statewide consistency and uniformity of application as directed in the authorizing legislation.

Accessory buildings and Buildings must be defined to clarify where vegetation treatment can be required. Agriculture must be defined to clarify what areas are exempted. "CDF" must be added for clarity.

A "dead-end" road must be defined since specific length limitations apply. "Defensible space" must be described to set the performance objective for exceptions. The objective of the defensible space is to provide effective fire protection and therefore must be included in the definition. An explanation of perimeter must be provided so that common expectations can be established.

"Development" is defined to maintain consistency of application with permits issued by local jurisdictions. The term "Director" is defined for clarity since other jurisdictions are referenced in the proposed rules.

The "driveway" definition uses two buildings with dwellings as a limit to reduce potential traffic on poor access during a wildfire. Three buildings would increase traffic by an additional two cars and this would increase potential interference with emergency vehicles on that roadway. "Dwelling unit" and "structure" must be defined for clarity in application in other definitions. They are also the basis for identification of activity limitations on parcels and in zoned areas. Their use facilitates a smooth interaction with local government processes and definitions, especially relating to zoning and building permits.

The definition of an "exception" provides the necessary guidance on the basis for requesting an exception. The "fire valve/hydrant" definition insures those water sources can be used by a standard equipped engine which uses two and one-half and four inch

valve fittings.

The definition of "fuel modification area" provides the general area in which later vegetation treatment requirements apply. The "greenbelt" definition establishes those conditions which provide sufficient fuel modification as they exist to slow or stop the spread of a wildfire.

The terms "hammerhead/T"; "one-way road"; "roads", "streets", "private lanes"; "roadway"; "roadway structure"; "shoulder"; "traffic lane"; "turnaround"; "turnouts" and "vertical clearance" are needed to provide consistent and clear application of descriptions for transportation routes and structures. Terminology relating to roads and highways are found in a plethora of publications and documents, with many differing definitions. In addition, national, state and local uses vary widely. Established standards are used where they suit the functional need and modifications are used where there is significant variation or the existing definitions do not apply.

"Local Jurisdiction" must be defined to clearly establish who has the rights and responsibilities created by these rules. "Subdivision", "State Responsibility Area", and "Wildfire" are defined through incorporation by reference to maintain consistency. Inserting actual code language would require transferring definitions from all codes and would become unwieldy and would also reduce clarity by bringing in unconnected terms.

"Same Practical Effect" must be defined to set the standards for determining when equal protection occurs under these rules. Like terminology, the geographical conditions and strategies of fire suppression vary throughout the state, even within CDF. This is due to local infrastructure, demographics, fuel conditions, topography and accepted practices. The awareness of environmental, health and safety needs of the public and private sector require the ability to meet the on-site conditions while staying within the parameters and intent of the regulatory standard. This definition provides the sensitivity to meet those varying needs through application of section 1270.08. The criteria chosen by the Board is set by the intent section of each subject area of the Fire Safe rules.

The terms "traffic lane", "turnaround", "turnouts" and "vertical clearance", through consultation with CalTrans and local public works departments, specify the application and use of these structures, to provide clarity as the definition of these terms varies from county to county. These definitions will provide consistency and define common expectations.

Section 1271.05 specifies the method of measuring distances required by the rules. Distances can be stated either as a slope distance or a horizontal distance. The same measurement under each method will create a different point of application or placement. This section defines which method is cited and is necessary to provide clarity to the public. The specified ground distance method is most easily performed by the average lay public who are not design engineers. Calculations by engineers are very simple and well within the realm of their knowledge and ability.

Section 1272.00 is necessary to insure that fire safe conditions are retained after a project is completed. It is necessary to provide means to maintain the fire safe conditions so that lead agencies and project proponents are advised of possible methods of compliance. Having maintenance included in the local jurisdiction permitting process creates the least duplication and provides the greatest local control.

Article 2, Emergency Access Standards

Section 1273.00 provides an intent section which is needed to describe the objective to be achieved by the regulations on roads and driveway standards. Unobstructed traffic circulation is needed to provide for efficient use of fire equipment during an emergency and provide guidance for proposed exceptions.

Section 1273.01 sets a minimum road width that two-nine foot lanes must be provided to allow safe passage of fire engines and passenger vehicles during a fire. Nine feet per traffic lane is the physical minimum needed for a standard CDF engine. The standard CDF fire engine is nine feet six inches wide with side mirrors extended. This provides reasonable safe passage for the CDF engine and the average narrower passenger car or truck. Exceptions are provided where safe traffic flow can be demonstrated.

Section 1273.02 sets the performance strength standard for a road surface to allow passage of fire equipment. The 40,000 pounds is the minimum necessary to support passage of a standard CDF engine given a standard equipment complement, 500-1100 gallons of water, 3-5 member crew and unladen vehicle weight.

Section 1273.03 a maximum road grade is necessary to match the power limitations of fire engines. Again, the 16% is the maximum grade that can be safely negotiated by a CDF engine at 20 miles per hour. This standard was determined by test runs by the CDF mobile equipment section and validation of normal operation conditions and procedures.

Section 1273.04 is needed to provide a safe turning radius for fire engines on dead-end roads. The distances listed are those required for a CDF engine. This standard was determined by test runs by the CDF mobile equipment section and validation of normal operation conditions and procedures.

Section 1273.05 establishes the minimum size for a turnaround that is required at the end of a dead-end road, driveway, or along the length of a dead-end road. The 40' radius will allow a standard CDF fire engine to turnaround without making a three-point turn. This is essential during emergency evacuation conditions and smoky visibility conditions, generally in locations where the apparatus driver has not driven to before. Dead-end roads without turnarounds are traps that can lead to injury and death for fire fighters and civilians. When roads are blocked by a fire crossing the road or fallen trees, a safety island is needed where fire fighters and civilians can weather the fire storm. Where environmental conditions or physical site limitations preclude the construction of a turnaround, the hammerhead/T is a valid alternative. Although not providing the safety of a turnaround, it is mutually accommodating. This standard was determined by test runs by the CDF mobile equipment section and validation of normal operation conditions and procedures.

Section 1273.06 is needed to provide for the safe passage of two fire engines or passenger vehicles on a one-way road. The turnout length is needed to accommodate a CDF engine. The length is based on the physical need for the engine to exit the road, stop completely off of the road while the opposing vehicle passes and return to the road. A lesser distance would not allow the engine (26 feet long) to pull completely off of the road. The taper must be on both ends allowing vehicles traveling in either direction to utilize the turnout.

Section 1273.07, through consultation with CalTrans and local public works departments, is necessary to insure that the roadway structures installed in developments are capable of supporting the safe passage of fire equipment. For consistency the California Vehicle Code standard is used for roadway structure (bridge) performance standards. The California Vehicle

Code also specifies the minimum clearance of overhead structures. This standard is included to provide standardized minimum parameters for roads and bridges, allowing CDF fire suppression access and operations along roads and leading to safer conditions for fire fighters and civilians. Unobstructed visibility is essential on a narrow, one-lane bridge to allow one vehicle to see the other approaching. The turnout will allow one vehicle to stop in a manner that will allow the other vehicle to pass when exiting the bridge.

Section 1273.08 places limits on one-way roads to insure safe ingress and egress of residents and fire equipment during a wildfire. One-way roads are hazards to fire fighters, providing narrower than normal road widths, close exposure to flammable fuels, the potential for evacuating civilians traveling the wrong way, potential access by fire apparatus counter to normal traffic flow, hazardous travel in smokey conditions and long travel distances under these difficult conditions. This section limits these hazardous conditions. The distances and dwellings limitations were selected to meet this objective in consideration of rapid fire spread, fire intensity under heavy fuel conditions, evacuation traffic, fire fighter safety and emergency access needs. 10 dwelling units would reasonably place 20 vehicles on a narrow one-way road during an emergency. To limit the expected traffic to a level that does not clog the road and maintains a safe evacuation, no more than 10 dwelling units may be constructed along a one-way road. The 10 foot traffic lane is based on the physical width of the standard CDF engine (see section 1273.01). The limitation to 2640 feet limits the distance a CDF engine may face opposing traffic on a one lane road and places a safety egress within a maximum of three minutes of travel (very little time in the face of a fast moving fire storm) at 20 mph. One-way roads, actually a single lane road, is an unsafe location for fire fighting operations and is thus limited in length with safety zones (turnouts and two-lane roads) within reasonable escape distances.

Section 1273.09 sets a limit on the length of dead-end roads. This again was selected to consider safe emergency ingress and egress during a wildfire. Dead-end roads require that civilians and fire fighters exit the road at the same point they entered that road. Like a one-way road, there are many hazardous limitations including being trapped by a wall of flame, falling trees, disabled vehicles, long travel distances before being able to turn around, and the potential for large numbers of vehicles traveling that road. This section limits or reduces the potential dangers of a dead-end road to fire fighters and civilians. The distances were selected to consider the number of possible vehicles, fire spread, and the fire intensity under heavy fuel conditions. Turnaround and turnouts are necessary to provide for fire engine passage and the ability to turnaround, drive forward and exit the road. In addition, limitations are based on the volume of vehicle traffic that may be present and utilizing a road with only one point of ingress and egress during an emergency. This will allow more rapid evacuation and escape of civilians without conflict with arriving fire resources. The need is stated in sections 1273.05, 1273.08. The distances and zoning limit the amount of traffic and the distances to be traveled to provide reasonable safety for the fire fighters as described in 1273.08 above.

Section 1273.10 provides limits on driveway length, clearance heights, widths and use of turnouts and turnarounds. The clearance height, and width limitations are based on the minimum needs for a CDF engine. The minimum vertical clearance for roads in the California Vehicle Code (CVC) is 13'6". The driveway width is discussed in 1273.08 above. Driveways are not regulated in the CVC. Fire suppression action, including clear access to the top of fire engines is required on roads and driveways. Wide roads seldom have overhanging trees which are flammable and they generally provide greater safety through their greater width. To provide additional safety for fire fighters on driveways, which are narrower than roads, 15' is required. The length and spacing limitation on the turnouts is based on the rate of spread of a wildfire and the time required to travel the driveway considering fire intensity, evacuation travel of civilians, safety of fire crews traveling the driveway, and escape sequences for fire fighters. Without turnouts, the fire engine or civilian vehicle will be

required to back the vehicle to the structure, the road or a suitable turnaround off of the driveway. This section limits the hazards presented by narrow driveways with encroaching flammable fuels, access blocked by a disabled vehicle, limits the volume of traffic, inability to readily turn around a standard fire engine or passenger car, or to allow another vehicle to pass. Lengths and distances are based on safe distances to back a large fire engine on a narrow road and a reasonable expectation of reaching a turnout within that nominal distance. The 50 distance from a structure will allow existing pre-connected fire hoses to reach the rear of most structures without delays to attach additional lengths of hose.

Section 1273.11 sets standards for gate widths, distances to street and turnarounds. Gates can inhibit access and place fire fighting crews in danger while they are being opened and closed. Significant vehicle damage can be eliminated by setting standards that will allow the majority of CDF fire apparatus to access any gate. The standards are set on what is necessary to accommodate a CDF engine and a passenger vehicle for entering the property simultaneously, parking, and turning. Gates narrower than specified will limit access and damage fire apparatus. The 30 foot setback from the road allows a standard CDF fire engine, 26 feet long, to stop and open the gate without obstructing traffic on the through road. The gate opening direction facilitates the safe stopping to open the gate. The turning radius is CalTrans recommendation to allow vehicle to enter the gated road from a narrow through road.

Article 3, Signing and Building Numbering Standards

Section 1274.00 is needed to set out the objectives which are to be met with application of the signing regulations and to provide some additional guidance for determining equal protection when considering an exception. There is no signing and addressing standard that applies throughout the state. In several counties, there is no standard for addressing and signing and in many others, there is no application or there are major rule deficiencies. Emergency access is dependent upon identifying the single road with the given name or number, having that road signed and being able to identify the structure that relates to that address number. Unique road names, sequential numbering and posting with some standardization to allow reasonable sighting by emergency responders are specified in this article.

Section 1274.01 sets the size of letters and numbers for street signs. The reflectorized requirement is so fire protection forces can locate a residence number after dark. The size and stroke of letters and numbers, the reflectorized alphanumerics and the contrasting requirement are based on field testing and validation of operational activities.

Section 1274.02 The size was set to be visible from a distance of 100 feet based on average terrain (visibility) and smoky conditions. This sets the minimum distance from which sign letters must be readable and that they be visible from both sides of the sign. This is necessary to insure that engines traveling on residential streets can locate the proper cross street or residence. The visibility distance is based on field testing and validation of operational activities.

Section 1274.03 require street signs to be set at a uniform height county wide. This is necessary so that fire protection forces know where to look for signs. Under emergency conditions this will reduce the time spent looking for signs, and the possibility of not locating an address.

Section 1274.04 requires uniform numbering sequences, mounting, and orientation on a countywide basis. This is necessary to reduce the time required looking for residence addresses during emergency response situations and to guide fire fighters to a specific site. The uniformity of mounting establishes a reasonable expectation for the emergency responder.

Section 1274.05 requires street signs to be placed at the intersection of streets to make street identification easier.

Section 1274.06 requires signing to identify traffic access limitations. This is necessary to prevent fire equipment from entering into positions where they are in danger. The 100' requirement will allow emergency responders to react to the sign with reasonable certainty that the vehicle can stop before placing itself and passengers in a hazardous situation such as stopping on a bridge designed for less than the weight of the vehicle.

Section 1274.07 requires signs be installed before final acceptance of the road systems by the local jurisdiction. This is needed to insure timely completion. Waiting until after such approval could easily result in delays in completing such signing efforts.

Section 1274.08 requires separate addresses for each building and dwelling within the building. This is necessary to be able to locate a building or individual in need of assistance during an emergency wildfire situation.

Section 1274.09 sets the number and letter size requirements for address signs. This is necessary for identification and the basis is a size which can be seen from approximately a 100 foot distance based on terrain visibility and smoky conditions. The address of a structure must be easily visible to the emergency responder who is driving under difficult conditions; either "code 3" or under smoky conditions that severely limit visibility. This standard will ensure that address numbers are reasonably visible to emergency responders under difficult conditions. The size and stroke of letters and numbers, the reflectorized alphanumerics and the contrasting requirement are based on field testing and validation of operational activities.

Section 1274.10 establishes the location where signs must be placed. This is necessary for visibility by fire protection forces during emergency responses. Placement at the driveway signifies that access to the structure is via that driveway. Responding vehicles must identify a given address along the road they are traveling in response to the stated emergency. Visibility from both directions on a one-way road accommodates emergency vehicle that are likely to travel the "wrong" way when responding to a fire or other emergency. Single post mounting of multiple addresses meets the expectation of emergency responders, focusing the drivers attention at a single point rather than over 20 to 100 feet of addresses and mailboxes.

Article 4, Emergency Water supply Standards

Section 1275.00 establishes the objectives of the regulations requiring provision of a water supply for emergency use. It also sets some guidance for use when determining equal protection under a request for an exception.

Section 1275.01 sets a specific standard when the water system regulations would apply. Water supply requirements are limited to the creation of new parcels to prevent impacts on persons previously purchasing property where a water source does not exist. Requiring the water sources to be available at specified times insures they are present before permits are satisfied and therefore compliance is simpler to obtain.

Section 1275.10 sets the standards for an emergency water supply system. It is set by incorporating existing standards of the Public Utilities Commission, the National Fire Protection Association, and the Insurance Services Office. These standards will provide a dependable water supply for emergency wildfire needs. Incorporation by reference is provided in these regulations. The diversity of standards and sections (12) and the volume of reference material (over 200 pages)

if incorporated as text in these regulations would create a cumbersome, unwieldy document. The volume of text would most likely keep individuals from digesting the requirements of these regulations. The encapsulation of references in these regulations does not detract from their readability, nor their usefulness, but does make them more readable. The documents incorporated in this section were available to the public upon request during the initial and extended public review period.

Section 1275.15 establishes the locations of hydrants and fire valves. The standards for emergency water supplies referenced in the regulation do not specify the location, type, size and required distances for fire hydrants. A hydrant must be located where it is accessible by fire apparatus, away from flammable vegetation, within distances from a roadway limited by equipment on the fire apparatus and in a location safe for the equipment and fire fighters. Travel time to a water source and the quantity available determines the fire attack strategy, determining the loss and damage that results. This section provides a quantifiable set of criteria to provide reasonable fire hydrant standards. These standards are set on the basis of the minimum performance standards of a CDF engine and compatibility of the equipment complement. The 18" height for the hydrant valve allows the standard hydrant wrench to open the hydrant cap and tighten hose couplings to the valve without removing the wrench. The eight foot spacing provides the minimum distance from flammable vegetation, allowing fire fighters and apparatus to safely use the hydrant with adjacent burning vegetation. The 4-12 foot distance from the road allows for flexibility in placement but provides a safety margin for apparatus to park and to protect the hydrant from being struck by a car. Lesser distances place the hydrant in a location that is a safety risk to normal traffic. Greater distances increase the disturbance of the site and terrain to place the hydrant. The distance from a building provides the parameters for reasonable expectation for the fire fighters and provides for reasonable spacing for access and refills by all fire apparatus. These requirements are based on field testing and validation of operational activities. The specification for the hydrant head is based on the normal expectation of fire fighters throughout California and is an informal minimum statewide standard.

Section 1275.20 sets the standards for locating fire hydrants or valves. The standards are consistent with the professional standard in current use and the State Fire Marshal's Guidelines for Fire Hydrant Markings Along State Highways and Freeways. This consistency will make locating water sources easier for interagency forces. The location and placement of the hydrant sign is based on the reasonable expectation of the fire fighter to locate the fire hydrant. The specified marker and its location is readily available for purchase and provides rapid recognition based on field testing and validation of operational activities.

Article 5, Fuel Modification Standards

Section 1276.00 sets the objective standards of the fuel modification regulations and provides guidance for determining equal protection when evaluating a request for an exception.

Section 1276.01 requires a 30 foot setback from property lines for buildings and accessory buildings. Traditionally, local government establishes setback from a property line to allow utility easements, generally 5 feet from the property line. This places buildings in close proximity and exposed to a significant fire threat from the adjacent structure. Current wildfire prevention law (PRC 4291) requires each homeowner to provide a minimum of 30' clearance of flammable vegetation or to the property line if closer. This is necessary to minimize risk of exposure to an adjacent structural fire and the conflagration potential of the spread of fire from structure to structure and to insure sufficient area is provided to meet the minimum 30 foot clearance standards of PRC 4291. It is also necessary to apply this to a parcel size which can accommodate the 30 foot setback. Parcels less than one acre in size may not be able to provide the 30' on all

sides. It is key to provide that setback on the side facing the highest risk from wildfire. Providing the same practical effect for smaller parcels insures that fire risk exposure is minimized.

Section 1276.02 requires removal or other treatment of vegetative material created by site development before final approval of the building or project. This is necessary to reduce the fire hazard on the property.

Section 1276.03 requires that greenbelts be used to separate buildings from wildland fuels. This is necessary to provide increased fire protection by utilizing resources already being placed into a plan by a project proponent.

III. RELEVANT DOCUMENTS:

Fire Safe Guides for Residential Development in California's Wildlands, California Building Code, 1989 Amendments, Chapter 11, Division 1, Occupancy; National Fire Code, Section 501A, Standard for Fire Safety Criteria for Manufactured Home Installations, Sites and Communities, Chapter 1, Section 1-2, Definitions, page 4, 1987 ed., National Fire Protection Association, Public Utilities Commission of California (PUC), Revised General Order #103, Adopted June 12, 1956 (corrected September 7, 1983, Decision 83-09-001), Section VIII Fire Protection Standards (sections relating to fire protection water delivery systems); National Fire Protection Association (NFPA), Standard 1231, "Standard on Water Supplies for Suburban and Rural Fire Fighting", 1989 ed.; Insurance Services Office (ISO) Rural Class 8, second ed., 3-80., State Fire Marshal's Guidelines for Fire Hydrant Markings Along State Highways and Freeways, May 1988.

IV. COSTS:

There are no additional costs to any state agency, nor any state-mandated costs to local agencies of government or school districts that require reimbursement under Part 7, Division 4 (commencing with Section 17500) of the Government Code because of any duties, obligations, or responsibilities imposed on state or local agencies or school districts. This order can be accomplished with no additional net costs or where such costs exist they are entered into voluntarily. This order does not create any savings or additional costs of administration for any agency of the United States Government over and above the program appropriations made by Congress.

There are no mandates to local governments or school districts.

The proposed regulations do contain inspection authority for the California Department of Forestry and Fire Protection and for the appropriate local jurisdiction. These inspections are not mandated are therefore create no additional cost.

The proposed regulations may have a cost effect on new residential, commercial, and industrial building construction. The effect will occur in those counties of the state which do not have standards stricter than those minimums set out in the proposal. Where cost effects occur they will be in the areas of road construction, driveway construction, address signing, and, provision of water supply. Values assigned were obtained by interviewing contractors, local building and public works departments in seven counties at locations throughout the state.

Roads will have a minimum width of two nine foot traffic lanes with an estimated construction cost of $7,000 to $60,000 per mile for dirt surface. Most residential roads are now constructed to a width of one to one and a half lanes of travel (12 to 15 feet) with turnouts. The cost of construction of this minimum level of road is estimated to be $7,000 per mile. Depending upon the difficulty of

construction the upper range of construction cost could also approach the $60,000 level. The actual cost effect of the regulation would be the added expense of constructing a road to two lane standard versus the single lane with turnout standard. The required increase in road width is 1/3 greater, therefore the increase would not be expected to exceed this percentage. This would be a range of increase of $2,000 to $20,000 per mile.

The estimated cost of construction for a nine foot wide dirt surfaced driveway is $600 to $10,000 per 1/4 mile. The required drive way is a 10 foot traffic lane with turnouts a 400 foot intervals. Most driveways are a minimum of 8 feet wide just to accommodate standard vehicles. Again the cost is the difference in construction for a 10 foot versus an nine foot wide driveway. In this instance the difference in construction cost would be about 10% with a range of increase from $66.00 to $1108.00 per 1/4 mile of driveway.

The cost of signing will be $30 to $105 per address sign and $40 to $265 per sign for street signs.

The cost of providing minimum water supply reserves for emergency fire use will range from $100 to $5,010 per parcel depending on the system selected. The range reflects the cost of performing actions from improving access to an existing pond to installation of a 2500 gallon water storage tank.

These items taken together total to the range of potential cost increase created by the proposed regulations. These costs can only be attributed to the rules where local jurisdictions have standards less than the proposal. The range of potential increase for one mile of dirt road, 1/4 mile of dirt driveway, a street sign and address sign, and a supplemental water supply is $2236.00 to $26,488.00.

The Board of Forestry has determined that no statewide alternative considered would be more effective in carrying out the purpose for which this regulation was adopted and would be as effective and less burdensome to affected private persons than the proposed action. The legislature has identified a need to strengthen wildland fire protection after 25 years of Fire Safe Guidelines, 20 years of safety element requirements and 30 years of public information messages. There is still a significant deficiency statewide in creating defensible subdivisions and homes. Voluntary standards and recommendations, being advisory in nature, are never as binding or as successful as legal mandates. The legislation specifically requires the development of regulations in the areas of access, water, signing and addressing and fuel modification. This regulation is the product of three years of meetings and discussions with legislators, county boards of supervisors, state agencies, professional staff in the planning, building and public works professions, private consultants, professional organizations, the fire service throughout the state and the public.

## V. IMPACTS ON HOUSING COSTS AND BUSINESSES:

The proposed action may have a significant cost to small businesses. Those businesses which will locate on state responsibility lands in counties which do not have regulations stricter than those adopted by the Board will be impacted to the level described in the Costs section of this notice. The types of small businesses which may be impacted cover the scope of businesses which would locate in rural areas, including builders, farm supplies, logging supplies, grocery stores, farmers, sawmills, and hardware stores. There will be no reporting or record keeping requirements in these regulations and compliance requirements are set out in the Initial Statement of Reasons and the proposed text of the regulations.

The Board of Forestry finds that the adoption of these regulations may have a significant adverse

economic impact on small businesses. The Board of Forestry has considered proposed alternatives that would lessen any adverse economic impact on small business and invites you to submit such proposals.

The regulatory proposal will also have a potential significant impact on housing cost. This again depends on the existing local requirements. Where local government building, grading, or fire safe requirements exceed those proposed by the Board in this proposal there will be no cost increase. Where local requirements are less than this proposal then the cost impacts will fall within the ranges set out in the cost section of this notice.

VI. STRIKEOUT AND UNDERSCORE:

(See next page)

CALIFORNIA OFFICE OF ADMINISTRATIVE LAW
SACRAMENTO, CALIFORNIA

NOTICE OF APPROVAL OF
REGULATORY ACTION
(Gov. Code, Sec. 11349.3)

OAL File No. 91-0501-02 R

In re:

FORESTRY BOARD

REGULATORY ACTION:
Adopt sections 1270 - 1276.03;
Amend, adopt or renumber
subchapter 1, 2, 3, Article 6
& 7 headings, of Title 14,
California Code of Regulations

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SUMMARY OF REGULATORY ACTION

On May 1, 1991, the Board of Forestry and Fire Protection (Board) resubmitted the above referenced regulatory action to the Office of Administrative Law (OAL) for review. The action would implement minimum fire safety standards related to defensible space which are applicable to state responsibility area (SRA) lands. The proposed regulations include road standards, standards for signs, private water supply reserves, and fuel breaks and greenbelts, as mandated by Public Resources Code section 4290, but would not supercede local regulations which equal or exceed these standards.

OFFICE OF ADMINISTRATIVE LAW DECISION

OAL approves the above-referenced regulatory action.

REASON FOR DECISION

All legal requirements applicable to the proposed regulatory action were met.

DATE: 05/30/91

Victoria S. Cline

VICTORIA S. CLINE
Staff Counsel

for: JOHN D. SMITH
Deputy Director

Original: Dean Cromwell, Executive Officer
cc: Doug Wickizer
app.ltr

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TITLE 14 - NATURAL RESOURCES
DIVISION 1.5 - DEPARTMENT OF FORESTRY
CHAPTER 7 - FIRE PROTECTION

1. Adopt new subchapter

Subchapter 1. Fire Protection

2. Adopt new subchapter

Subchapter 2. SRA Fire Safe Regulations

3. Adopt heading for new article

Article 1. Administration

4. Adopt Section 1270 as follows:

1270. Title

These regulations shall be known as the "SRA Fire Safe Regulations," and shall constitute the basic wildland fire protection standards of the California Board of Forestry.

NOTE: Authority cited: Section 4290 Public Resources Code. Reference: Sections 4102, 4126, 4127, and 4290, Public Resources Code.

5. Adopt Section 1270.01 as follows:

1270.01. Purpose

These regulations have been prepared and adopted for the purpose of establishing minimum wildfire protection standards in conjunction with building, construction and development in SRA. A local jurisdiction may petition the Board for certification pursuant to Section 1270.03. Where Board certification has not been granted, these regulations shall become effective September 1, 1991. The future design and construction of structures, subdivisions and developments in State Responsibility Area (SRA) shall provide for basic emergency access and perimeter wildfire

protection measures as specified in the following articles. These measures shall provide for emergency access; signing and building numbering; private water supply reserves for emergency fire use; and vegetation modification. The fire protection standards which follow shall specify the minimums for such measures.

NOTE: Authority cited: Section 4290, Public Resources Code. Reference: Sections 4290 and 4291, Public Resources Code.

6. Adopt Section 1270.02 as follows:

1270.02. Scope

These regulations do not apply to existing structures, roads, streets and private lanes or facilities. These regulations shall apply as appropriate to all construction within SRA approved after January 1, 1991. Affected activities include but are not limited to:

(a) Permitting or approval of new parcels, excluding lot line adjustments as specified in Government Code (GC) Section 66412(d),

(b) application for a building permit for new construction, not relating to an existing structure,

(c) application for a use permit,

(d) the siting of manufactured homes (manufactured homes are as defined by the National Fire Protection Association, National Fire Code, Section 501A, Standard for Fire Safety Criteria for Manufactured Home Installations, Sites and Communities, Chapter 1, Section 1-2, Definitions, page 4, 1987 edition and Health and Safety Code Sections 18007, 18008, and 19971).

(e) road construction, including construction of a road that does not currently exist, or extension of an existing road.

Exemption: Roads required as a condition of tentative parcel maps prior to the effective date of these regulations; roads for agricultural or mining use solely on one ownership; and roads used solely for the management and harvesting of wood products.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4290 and 4291, Public Resources Code.

7. Adopt Section 1270.03 as follows:

1270.03. Local Ordinances

Nothing contained in these regulations shall be considered as abrogating the provisions of any ordinance, rule or regulation of any state or local jurisdiction providing such ordinance, rule, regulation or general plan element is equal to or more stringent than these minimum standards. The Board may certify local ordinances as equaling or exceeding these regulations when they provide the same practical effect.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4117 and 4290, Public Resources Code.

8. Adopt Section 1270.04 as follows:

1270.04. Provisions for Application of these Regulations

This subchapter shall be applied as follows:

(a) local jurisdictions shall provide the Director with notice of applications for building permits, tentative parcel maps, tentative maps, and use permits for construction or development within SRA.

(b) the Director shall review and make fire protection recommendations on applicable construction or development permits or maps provided by the local jurisdiction.

(c) the local jurisdiction shall ensure that the applicable sections of this subchapter become a condition of approval of any applicable construction or development permit or map.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4290 and 4291, Public Resources Code.

9. Adopt Section 1270.05 as follows:

1270.05. Inspection Authority

(a) Inspection shall be made pursuant to Section 1270.06 by:

(1) the Director, or

(2) local jurisdictions that have assumed state fire protection responsibility on SRA lands, or

(3) local jurisdictions where these regulations have been implemented through that jurisdiction's building permit or subdivision approval process.

(b) Reports of violations shall be provided to the CDF Ranger Unit headquarters that administers SRA fire protection in that county.

NOTE: Authority cited: Sections 4119 and 4290, Public Resources Cod
Reference: Section 4290, Public Resources Code.

10. Adopt Section 1270.06 as follows:

1270.06. Inspections.

The inspection authority may inspect for compliance with these regulations. When inspections are conducted, they

should occur prior to: the issuance of the use permit; certificate of occupancy; the recordation of the parcel map or final map; the filing of a notice of completion; or the final inspection of any project or building permit.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4119, 4290 and 4291, Public Resources Code.

11. Adopt Section 1270.07 as follows:

1270.07. Exceptions to Standards

Upon request by the applicant, exceptions to standards within this subchapter and mitigated practices may be allowed by the inspection authority, where the exception provides the same overall practical effect as these regulations towards providing defensible space.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4290 and 4291, Public Resources Code.

12. Adopt Section 1270.08 as follows:

1270.08. Requests for Exceptions

Requests for an exception shall be made in writing to the inspection authority by the applicant or the applicant's authorized representative. The request shall state the specific section(s) for which an exception is requested, material facts supporting the contention of the applicant, the details of the exception or mitigation measure proposed, and a map showing the proposed location and siting of the exception or mitigation measure.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4290 and 4291, Public Resources Code.

13. Adopt Section 1270.09 as follows:

1270.09. Appeals

Where an exception is not granted by the inspection authority, the applicant may appeal such denial to the local jurisdiction. The local jurisdiction may establish or utilize an appeal process consistent with existing local building or planning department appeal processes.

Before the local jurisdiction makes a determination on an appeal, the inspection authority shall be consulted and shall provide to that local jurisdiction documentation outlining the effects of the requested exception on wildland fire protection.

If an appeal is granted, the local jurisdiction shall make findings that the decision meets the intent of providing defensible space consistent with these regulations. Such findings shall include a statement of reasons for the decision. A written copy of these findings shall be provided to the CDF Ranger Unit headquarters that administers SRA fire protection in that county.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4290 and 4291, Public Resources Code.

14. Adopt Section 1271.00 as follows:

1271.00. Definitions

**Accessory building:** Any building used as an accessory to residential, commercial, recreational, industrial, or educational purposes as defined in the California Building Code, 1989 Amendments, Chapter 11, Group M, Division 1, Occupancy that requires a building permit.

**Agriculture:** Land used for agricultural purposes as defined in a local jurisdiction's zoning ordinances.

**Building:** Any structure used or intended for supporting or sheltering any use or occupancy that is defined in the California Building Code, 1989 Amendments, Chapter 11, except Group M, Division 1, Occupancy. For the purposes of this subchapter, building includes mobile homes and manufactured homes, churches, and day care facilities.

**CDF:** California Department of Forestry and Fire Protection.

**Dead-end road:** A road that has only one point of vehicular ingress/egress, including cul-de-sacs and looped roads.

**Defensible space:** The area within the perimeter of a parcel, development, neighborhood or community where basic wildland fire protection practices and measures are implemented, providing the key point of defense from an approaching wildfire or defense against encroaching wildfires or escaping structure fires. The perimeter as used in this regulation is the area encompassing the parcel or parcels proposed for construction and/or development, excluding the physical structure itself. The area is characterized by the establishment and maintenance of emergency vehicle access, emergency water reserves, street names and building identification, and fuel modification measures.

**Development:** As defined in Section 66418.1 of the California Government Code.

**Director:** Director of the Department of Forestry and Fire Protection or his/her designee.

**Driveway:** A vehicular access that serves no more than two buildings, with no more than 3 dwelling units on a single parcel, and any number of accessory buildings.

**Dwelling unit:** Any building or portion thereof which contains living facilities, including provisions for sleeping, eating, cooking and/or sanitation for not more than one family.

**Exception:** An alternative to the specified standard requested by the applicant that may be necessary due to health, safety, environmental conditions, physical site limitations or other limiting conditions such as recorded historical sites, that provides mitigation of the problem.

**Fire valve:** see hydrant.

**Fuel modification area:** An area where the volume of flammable vegetation has been reduced, providing reduced fire intensity and duration.

**Greenbelts:** A facility or land-use, designed for a use other than fire protection, which will slow or resist the spread of a wildfire. Includes parking lots, irrigated or landscaped areas, golf courses, parks, playgrounds, maintained vineyards, orchards or annual crops that do not cure in the field.

**Hammerhead/T:** A roadway that provides a "T" shaped, three-point turnaround space for emergency equipment, being no narrower than the road that serves it.

**Hydrant:** A valved connection on a water supply/storage system, having at least one 2 1/2 inch outlet, with male

American National Fire Hose Screw Threads (NH) used to supply fire apparatus and hoses with water.

**Local Jurisdiction:** Any county, city/county agency or department, or any locally authorized district that issues or approves building permits, use permits, tentative maps or tentative parcel maps, or has authority to regulate development and construction activity.

**Occupancy:** The purpose for which a building, or part thereof, is used or intended to be used.

**One-way road:** A minimum of one traffic lane width designed for traffic flow in one direction only.

**Roads, streets, private lanes:** Vehicular access to more than one parcel; access to any industrial or commercial occupancy; or vehicular access to a single parcel with more than two buildings or four or more dwelling units.

**Roadway:** Any surface designed, improved, or ordinarily used for vehicle travel.

**Roadway structures:** Bridges, culverts, and other appurtenant structures which supplement the roadway bed or shoulders.

**Same Practical Effect:** As used in this subchapter, means an exception or alternative with the capability of applying accepted wildland fire suppression strategies and tactics, and provisions for fire fighter safety, including:

(a) access for emergency wildland fire equipment,

(b) safe civilian evacuation,

(c) signing that avoids delays in emergency equipment response,

(d) available and accessible water to effectively attack wildfire or defend a structure from wildfire, and

(e) fuel modification sufficient for civilian and fire fighter safety.

**Shoulder:** Roadbed or surface adjacent to the traffic lane.

**State Board of Forestry (SBOF):** A nine member board, appointed by the Governor, which is responsible for developing the general forest policy of the state, for determining the guidance policies of the Department of Forestry and Fire Protection, and for representing the state's interest in federal land in California.

**State Responsibility Area (SRA):** As defined in Public Resources Code Sections 4126-4127; and the California Code of Regulations, Title 14, Division 1.5, Chapter 7, Article 1, Sections 1220-1220.5.

**Structure:** That which is built or constructed, an edifice or building of any kind, or any piece of work artificially built up or composed of parts joined together in some definite manner.

**Subdivision:** As defined in Section 66424 of the Government Code.

**Traffic lane:** The portion of a roadway that provides a single line of vehicle travel.

**Turnaround:** A roadway, unobstructed by parking, which allows for a safe opposite change of direction for emergency equipment. Design of such area may be a hammerhead/T or terminus bulb.

**Turnouts:** A widening in a roadway to allow vehicles to pass.

**Vertical clearance:** The minimum specified height of a bridge or overhead projection above the roadway.

**Wildfire:** As defined in Public Resources Code Sections 4103 and 4104.

NOTE: Authority cited: Section 4290, Public Resources Code. Reference: Sections 4290 and 4291, Public Resources Code.

15. Adopt Section 1271.05 as follows:

1271.05. Distance Measurements

All specified or referenced distances are measured along the ground, unless otherwise stated.

NOTE: Authority cited: Section 4290, Public Resources Code. Reference: Sections 4290 and 4291, Public Resources Code.

16. Adopt Section 1272.00 as follows:

1272.00. Maintenance of Defensible Space Measures.

To ensure continued maintenance of properties in conformance with these standards and measures and to assure continued availability, access, and utilization of the defensible space provided for in these standards during a wildfire, provisions for annual maintenance shall be included in the development plans and/or shall be provided as a condition of the permit, parcel or map approval.

NOTE: Authority cited: Section 4290, Public Resources Code. Reference: Sections 4290 and 4291, Public Resources Code.

17. Adopt heading for new article

Article 2. Emergency Access

18. Adopt Section 1273.00 as follows:

1273.00. Intent

Road and street networks, whether public or private, unless exempted under Section 1270.02(e), shall provide for safe access for emergency wildland fire equipment and civilian evacuation concurrently, and shall provide unobstructed traffic circulation during a wildfire emergency consistent with Sections 1273.00 through 1273.11.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4290 and 4291, Public Resources Code.

19. Adopt Section 1273.01 as follows:

1273.01. Road Width

All roads shall be constructed to provide a minimum of two nine-foot traffic lanes providing two-way traffic flow, unless other standards are provided in this article, or additional requirements are mandated by local jurisdictions or local subdivision requirements.

NOTE: Authority cited: Section 4290, Public Resources Code.
References: Sections 4290 and 4291, Public Resources Code.

20. Adopt Section 1273.02 as follows:

1273.02. Roadway Surface

The surface shall provide unobstructed access to conventional drive vehicles, including sedans and fire engines. Surfaces should be established in conformance with local ordinances, and be capable of supporting a 40,000 pound load.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4290 and 4291, Public Resources Code.

21. Adopt Section 1273.03 as follows:

1273.03. Roadway Grades

The grade for all roads, streets, private lanes and driveways shall not exceed 16 percent.

NOTE: Authority cited: Section 4290, Public Resources Code. Reference: Sections 4290 and 4291, Public Resources Code.

22. Adopt Section 1273.04 as follows:

1273.04. Roadway Radius

(a) No roadway shall have a horizontal inside radius of curvature of less than 50 feet and additional surface width of 4 feet shall be added to curves of 50-100 feet radius; 2 feet to those from 100-200 feet.

(b) The length of vertical curves in roadways, exclusive of gutters, ditches, and drainage structures designed to hold or divert water, shall be not less than 100 feet.

NOTE: Authority cited: Section 4290, Public Resources Code. Reference: Sections 4290 and 4291, Public Resources Code.

23. Adopt Section 1273.05 as follows:

1273.05. Roadway Turnarounds

Turnarounds are required on driveways and dead-end roads as specified in this article. The minimum turning radius for a turnaround shall be 40 feet from the center line of the road. If a hammerhead/T is used, the top of the "T" shall be a minimum of 60 feet in length.

NOTE: Authority cited: Section 4290, Public Resources Code. Reference: Sections 4290 and 4291, Public Resources Code.

24. Adopt Section 1273.06 as follows:

1273.06. Roadway Turnouts

Turnouts shall be a minimum of 10 feet wide and 30 feet long with a minimum 25 foot taper on each end.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4290 and 4291, Public Resources Code.

25. Adopt Section 1273.07 as follows:

1273.07. Roadway Structures

(a) All driveway, road, street, and private lane roadway structures shall be constructed to carry at least the maximum load and provide the minimum vertical clearance as required by Vehicle Code Sections 35550, 35750, and 35250.

(b) Appropriate signing, including but not limited to weight or vertical clearance limitations, one-way road or single lane conditions, shall reflect the capability of each bridge.

(c) A bridge with only one traffic lane may be authorized by the local jurisdiction; however, it shall provide for unobstructed visibility from one end to the other and turnouts at both ends.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4290 and 4291, Public Resource Code.

26. Adopt Section 1273.08 as follows:

1273.08. One-Way Roads

All one-way roads shall be constructed to provide a minimum of one 10-foot traffic lane. The local jurisdiction may approve one-way roads. All one-way roads shall connect to a two-lane roadway at both ends, and

shall provide access to an area currently zoned for no more than 10 dwelling units. In no case shall it exceed 2640 feet in length. A turnout shall be placed and constructed at approximately the midpoint of each one-way road.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4290 and 4291, Public Resources Code.

27. Adopt Section 1273.09 as follows:

1273.09. Dead-End Roads

(a) The maximum length of a dead-end road, including all dead-end roads accessed from that dead-end road, shall not exceed the following cumulative lengths, regardless of the number of parcels served:

| | |
|---|---|
| parcels zoned for less than one acre | 800 feet |
| parcels zoned for 1 acre to 4.99 acres | 1320 feet |
| parcels zoned for 5 acres to 19.99 acres | 2640 feet |
| parcels zoned for 20 acres or larger | 5280 feet |

All lengths shall be measured from the edge of the roadway surface at the intersection that begins the road to the end of the road surface at its farthest point. Where a dead-end road crosses areas of differing zoned parcel sizes, requiring different length limits, the shortest allowable length shall apply.

(b) Where parcels are zoned 5 acres or larger, turnarounds shall be provided at a maximum of 1320 foot intervals.

(c) Each dead-end road shall have a turnaround constructed at its terminus.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4290 and 4291, Public Resources Code.

28. Adopt Section 1273.10 as follows:

1273.10. Driveways

All driveways shall provide a minimum 10 foot traffic lane and unobstructed vertical clearance of 15 feet along its entire length.

(a) Driveways exceeding 150 feet in length, but less than 800 feet in length, shall provide a turnout near the midpoint of the driveway. Where the driveway exceeds 800 feet, turnouts shall be provided no more than 400 feet apart.

(b) A turnaround shall be provided at all building sites on driveways over 300 feet in length, and shall be within 50 feet of the building.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4290 and 4291, Public Resources Code.

29. Adopt Section 1273.11 as follows:

1273.11. Gate Entrances

(a) Gate entrances shall be at least two feet wider than the width of the traffic lane(s) serving that gate.

(b) All gates providing access from a road to a driveway shall be located at least 30 feet from the roadway and shall open to allow a vehicle to stop without obstructing traffic on that road.

(c) Where a one-way road with a single traffic lane provides access to a gated entrance, a 40 foot turning radius shall be used.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4290 and 4291, Public Resources Code.

30. Adopt heading for new article.

Article 3. Signing and Building Numbering

31. Adopt Section 1274.00 as follows:

1274.00. Intent

To facilitate locating a fire and to avoid delays in response, all newly constructed or approved roads, streets, and buildings shall be designated by names or numbers, posted on signs clearly visible and legible from the roadway. This section shall not restrict the size of letters or numbers appearing on street signs for other purposes.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4290 and 4291, Public Resources Code.

32. Adopt Section 1274.01 as follows:

1274.01. Size of Letters, Numbers and Symbols for Street and Road Signs

Size of letters, numbers, and symbols for street and road signs shall be a minimum 3 inch letter height, 3/8 inch stroke, reflectorized, contrasting with the background color of the sign.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4290 and 4291, Public Resources Code.

33. Adopt Section 1274.02 as follows:

1274.02. Visibility and Legibility of Street and Road Signs

Street and road signs shall be visible and legible from

both directions of vehicle travel for a distance of at least 100 feet.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4290 and 4291, Public Resources Code.

34. Adopt Section 1274.03 as follows:

1274.03. Height of Street and Road Signs

Height of street and road signs shall be uniform county wide, and meet the visibility and legibility standards of this article.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4290 and 4291, Public Resources Code.

35. Adopt Section 1274.04 as follows:

1274.04. Names and Numbers on Street and Road Signs

Newly constructed or approved public and private roads and streets must be identified by a name or number through a consistent countywide system that provides for sequenced or patterned numbering and/or non-duplicating naming within each county. All signs shall be mounted and oriented in a uniform manner. This section does not require any entity to rename or renumber existing roads or streets, nor shall a roadway providing access only to a single commercial or industrial occupancy require naming or numbering.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4290 and 4291, Public Resources Code.

36. Adopt Section 1274.05 as follows:

1274.05. Intersecting Roads, Streets and Private Lanes

Signs required by this article identifying intersecting roads, streets and private lanes shall be placed at the intersection of those roads, streets, and/or private lanes.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4290 and 4291, Public Resources Code.

37. Adopt Section 1274.06 as follows:

1274.06. Signs Identifying Traffic Access Limitations

A sign identifying traffic access or flow limitations, including but not limited to weight or vertical clearance limitations, dead-end road, one-way road or single lane conditions, shall be placed:

(a) at the intersection preceding the traffic access limitation, and

(b) no more than 100 feet before such traffic access limitation.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4290 and 4291, Public Resources Code.

38. Adopt Section 1274.07 as follows:

1274.07. Installation of Road, Street and Private Lane Signs

Road, street and private lane signs required by this article shall be installed prior to final acceptance by the local jurisdiction of road improvements.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4290 and 4291, Public Resources Code.

39. Adopt Section 1274.08 as follows:

1274.08. Addresses for Buildings

All buildings shall be issued an address by the local jurisdiction which conforms to that jurisdiction's overall address system. Accessory buildings will not be required to have a separate address; however, each dwelling unit within a building shall be separately identified.

NOTE: Authority cited: Section 4290, Public Resources Code. Reference: Sections 4290 and 4291, Public Resources Code.

40. Adopt Section 1274.09 as follows:

1274.09. Size of Letters, Numbers and Symbols for Addresses

Size of letters, numbers and symbols for addresses shall be a minimum 3 inch letter height, 3/8 inch stroke, reflectorized, contrasting with the background color of the sign.

NOTE: Authority cited: Section 4290, Public Resources Code. Reference: Sections 4290 and 4291, Public Resources Code.

41. Adopt Section 1274.10 as follows:

1274.10. Installation, Location and Visibility of Addresses

(a) All buildings shall have a permanently posted address, which shall be placed at each driveway entrance and visible from both directions of travel along the road. In all cases, the address shall be posted at the beginning of construction and shall be maintained thereafter, and the address shall be visible and legible from the road on which the address is located.

(b) Address signs along one-way roads shall be visible from both the intended direction of travel and the opposite direction.

(c) Where multiple addresses are required at a single driveway, they shall be mounted on a single post.

(d) Where a roadway provides access solely to a single commercial or industrial business, the address sign shall be placed at the nearest road intersection providing access to that site.

NOTE: Authority cited: Section 4290, Public Resources Code. Reference: Sections 4290 and 4291, Public Resources Code.

42. Adopt heading for new article

Article 4. Emergency Water Standards

43. Adopt Section 1275.00 as follows:

1275.00. Intent

Emergency water for wildfire protection shall be available and accessible in quantities and locations specified in the statute and these regulations, in order to attack a wildfire or defend property from a wildfire.

Such emergency water may be provided in a fire agency mobile water tender, or naturally occurring or manmade containment structure, as long as the specified quantity is immediately available.

NOTE: Authority cited: Section 4290, Public Resources Code. Reference: Sections 4290 and 4291, Public Resources Code.

44. Adopt Section 1275.01 as follows:

1275.01. Application
The provisions of this article shall apply when new parcels are approved by a local jurisdiction. The emergency water system shall be available on-site prior to the completion of road construction, where a community water system is approved, or prior to the completion of building construction, where an individual system is approved.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4290 and 4291, Public Resources Code.

45. Adopt Section 1275.10 as follows:

1275.10. General Standards

Water systems that meet or exceed the standards specified in Public Utilities Commission of California (PUC) revised General Order #103, Adopted June 12, 1956 (Corrected September 7, 1983, Decision 83-09-001), Section VIII Fire Protection Standards and other applicable sections relating to fire protection water delivery systems, static water systems equaling or exceeding the National Fire Protection Association (NFPA) Standard 1231, "Standard on Water Supplies for Suburban and Rural Fire Fighting", 1989 Edition, or mobile water systems that meet the Insurance Services Office (ISO) Rural Class 8, 2nd Edition 3-80, standard shall be accepted as meeting the requirements of this article. These documents are available at CDF Ranger Unit Headquarters.

Nothing in this article prohibits the combined storage of emergency wildfire and structural firefighting water supplies unless so prohibited by local ordinance or

specified by the local fire agency.

Where freeze protection is required by local jurisdictions, such protection measures shall be provided.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Section 4290 and 4291, Public Resources Code.

46. Adopt Section 1275.15 as follows:

1275.15. Hydrant/Fire Valve

(a) The hydrant or fire valve shall be 18 inches above grade, 8 feet from flammable vegetation, no closer than 4 feet nor farther than 12 feet from a roadway, and in a location where fire apparatus using it will not block the roadway.

The hydrant serving any building shall:

(1) be not less than 50 feet nor more than 1/2 mile by road from the building it is to serve, and

(2) be located at a turnout or turnaround, along the driveway to that building or along the road that intersects with that driveway.

(b) The hydrant head shall be brass with 2 1/2 inch National Hose male thread with cap for pressure and gravity flow systems and 4 1/2 inch draft systems. Such hydrants shall be wet or dry barrel as required by the delivery system. They shall have suitable crash protection as required by the local jurisdiction..lm 11

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4290 and 4291, Public Resources Code.

47. Adopt Section 1275.20 as follows:

1275.20. Signing of Water Sources

Each hydrant/fire valve or access to water shall be identified as follows:

(a) if located along a driveway, a reflectorized blue marker, with a minimum dimension of 3 inches shall be located on the driveway address sigh and mounted on a fire retardant post, or

(b) if located along a street or road,

(1) a reflectorized blue marker, with a minimum dimension of 3 inches, shall be mounted on a fire retardant post. The sign post shall be within 3 feet of said hydrant/fire valve, with the sign no less than 3 feet nor greater than 5 feet above ground, in a horizontal position and visible from the driveway, or

(2) as specified in the State Fire Marshal's Guidelines for Fire Hydrant Markings Along State Highways and Freeways, May 1988.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4290 and 4291, Public Resources Code.

48. Adopt heading for new article

Article 5. Fuel Modification Standards

49. Adopt Section 1276.00 as follows:

1276.00. Intent

To reduce the intensity of a wildfire by reducing the volume and density of flammable vegetation, the strategic

siting of fuel modification and greenbelts shall provide (1) increased safety for emergency fire equipment and evacuating civilians; and (2) a point of attack or defense from a wildfire.

NOTE: Authority cited: Section 4290, Public Resources Code. Reference: Sections 4290 and 4291, Public Resources Code.

50. Adopt Section 1276.01 as follows:

1276.01. Setback for Structure Defensible Space

(a) All parcels 1 acre and larger shall provide a minimum 30 foot setback for buildings and accessory buildings from all property lines and/or the center of a road.

(b) For parcels less than 1 acre, local jurisdictions shall provide for the same practical effect.

NOTE: Authority cited: Section 4290, Public Resources Code. Reference: Sections 4290 and 4291, Public Resources Code.

51. Adopt Section 1276.02 as follows:

1276.02. Disposal of Flammable Vegetation and Fuels

Disposal, including chipping, burying, burning or removal to a landfill site approved by the local jurisdiction, of flammable vegetation and fuels caused by site development and construction, road and driveway construction, and fuel modification shall be completed prior to completion of road construction or final inspection of a building permit.

NOTE: Authority cited: Section 4290, Public Resources Code. Reference: Sections 4290 and 4291, Public Resources Code.

52. Adopt Section 1276.03 as follows:

1276.03. Greenbelts

Subdivisions and other developments, which propose greenbelts as a part of the development plan, shall locate said greenbelts strategically, as a separation between wildland fuels and structures. The locations shall be approved by the inspection authority.

NOTE: Authority cited: Section 4290, Public Resources Code.
Reference: Sections 4290 and 4291, Public Resources Code.

53. Adopt new subchapter

Subchapter 3. Fire Hazard

54. Amend existing heading for Article 6 as follows:

Article 6 1. Fire Hazard Severity

55. Amend existing heading for Article 7 as follows:

Article 7 2. Fire Hazard Reduction
Standard for Railroad
Right-of-Way

## Distance Measurements

### 1271.05. Distance Measurements

All specified or referenced distances are measured along the ground, unless otherwise stated.

Background

Measurements along the ground are much easier to verify than those based on horizontal distances. This will require some changes in procedure for engineers laying out a project, however, this can be easily accomplished.

## Maintenance

### 1272.00. Maintenance of Defensible Space

To ensure continued maintenance of properties in conformance with these standards and measures and to assure continued availability, access, and utilization of the defensible space provided for in these standards during a wildfire, provisions for annual maintenance shall be included in the development plans and/or shall be provided as a condition of the permit, parcel or map approval.

Background

It is one thing to require that a practice or measure be constructed or placed, and it is entirely another to ensure that a practice or measure remains and operates when needed. Most counties are not used to providing a long term maintenance requirement, relying on the "good intentions" of the applicant or owner. This section requires that maintenance become a part of the permit or map and allows compliance action to occur at a later date. Local government may utilize any legal, binding requirement to ensure that maintenance will occur, including: bonding, CC&Rs, deed restrictions, easements, county service areas etc..

**Issue**

The regulations do not provide for dedicated open space and endangered species.

Response

These concerns are handled at the project review level through the CEQA process. Conditions for maintenance and protection of open space and endangered species can be addressed when conditioning a project.

**Issue**

The state should be able to require the maintenance to be done when the owner fails to comply, upon notice and then bill the owner or place a lien on the property.

Response

Compliance can be obtained through infraction and misdemeanor enforcement, violation of a condition of a building permit or approved parcel map, or any other lawful tool available to the local jurisdiction.

**Issue**

Maintenance requirements are not feasible for anything other than major subdivisions or other large development projects.

Response

Existing state laws and regulations as well as county ordinances such as building permits require individuals to initially meet specified standards and to maintain those standards in accordance with those regulations and ordinances. A goal of 100% compliance with any rule is unrealistic.

**Issue**

It is not practical to enforce maintenance through the subdivision process.

Response

Counties currently require specific activities by conditioning tentative parcel maps. Maintenance requirements in many cases are specified as conditions of that map and compliance is obtained through a wide variety of processes including county service areas, property owner associations, bonding etc. Where counties do not specify maintenance, they imply that the conditions are an on-going requirement. A county does not require a house to meet an electrical standard at inspection time, then not expect it to be maintained. The difference is that this regulation specifically states that maintenance must be guaranteed by the owner.

**Issue**

Will the county be legally liable if required ongoing maintenance is not performed.

Response

Only if the county is currently liable for another's failure to maintain a practice that the county or state requires. If the county identifies itself as the responsible maintenance party, and fails to perform, then yes, the county is in violation.

**Issue**

Conditions for maintenance applied to a permit shall be the responsibility of the subdivider, not the landowner.

Response

A permit for construction is may be requested by the landowner who wants to build a single home, therefore the subdivider has no responsibility for or interest in the property at that time. This language is too limiting.

**Issue**

Who is responsible for inspection and enforcement to assure long-term compliance?

Response

Inspection and enforcement are the responsibility of CDF and the local jurisdiction who issues the permit or approves the parcel map.

**Issue**

Is the permit holder also responsible for costs of improvement and maintenance of public as well as private road and street networks.

Response

The local jurisdiction specifies who is responsible for a road or street. If the responsibility lies with an association or improvement district, then that group is responsible for maintenance. An individual property owner is very unlikely to be named as the responsible party for a road.

## ARTICLE 2. Road Standards

### 1273.00. Intent

Road and street networks, whether public or private, unless exempted under Section 1270.02(e), shall provide for safe access for emergency wildland fire equipment and civilian evacuation concurrently, and shall provide unobstructed traffic circulation during a wildfire emergency consistent with Sections 1273.00 through 1273.11.

Background

Access is a major fire protection need, whether wildland or structural. Failure to provide a reasonable access for emergency equipment and evacuation egress for civilians can result in major loss of life, property and natural resources. Fire apparatus, sitting at an intersection, waiting for civilians to exit on a narrow road cannot provide the necessary fire suppression action. Safe access requires street and road networks that limit dead-end roads and provide reasonable widths, grades and curves on roads and driveways.

**Issue**

The regulations must take into consideration the regional nature of the state and the erosion quality of each area in construction of roads and fuel breaks.

Response

CEQA review and requirements overlay these regulations as they relate to discretionary projects for environmental review. Single parcel development is generally handled by local grading ordinances. In both cases, 1270.08 allows for mitigation of both conditions.

**Issue**

CDF firefighters are not complaining about the lack of access nor the inability to turn engines around.

Response

The Board and CDF have highlighted this issue and attempted to gain voluntary resolutions for over 25 years.

**Issue**

The road standards will cause greater road cuts and will increase dirt movement into the creek.

Response

These regulations have been assembled from national, state and local standards, by planning, building, public works and fire professionals. Any potential adverse impact, such as erosion, is addressed through the CEQA process and may also be addressed under 1270.08.

### 1273.01 Roadway Width

All roads shall be constructed to provide a minimum of two nine-foot traffic lanes providing two-way traffic

flow, unless other standards are provided in this article, or additional requirements are mandated by local jurisdictions or local subdivision requirements.

Background

The CDF Model 9 measures 9'4" from mirror to mirror. Two 9' traffic lanes should provide a reasonable lane width for the vast majority of circumstances, normally a car in one lane and the fire engine in another. The two lanes provide a reasonable level of safety to fire fighters and civilians through easy access and circulation and have less chance of becoming obstructed by a parked car or a vehicle accident.

**Issue**

Change the fire apparatus rather than require larger roads and it will be more cost effective.

Response

Fire apparatus are designed to carry out specific missions based upon current strategies and tactics of fire suppression. The available chassis for fire apparatus are very limited and significant redesign and increased costs would be incurred. The opportunity to mitigate the increased risk and hazard posed by homes in the wildlands occur when construction and development begin, thus the need to create safe access for civilians and fire fighters through prudent design considerations.

**Issue**

Road widths and grades in mountain areas will create significant problems in many areas in SRA.

Response

Development and construction in many counties are having a significant impact on CDF's wildland fire mission. Inadequately designed roads have increased the risk to fire fighters and delayed emergency responses while civilian traffic exits a fire area. Steep, narrow roads contribute to increasing fire losses.

**Issue**

Many fires in residential areas are extinguished by residents without CDF involvement. The existing roads of 8' and 12' provided adequate firebreaks.

Response

Wildland fire response times are much longer than municipal response times due to the hazard and risk nature of the protection missions. In many cases, the failure of an agency to respond is based on the failure of the populous to report that fire to the fire agency. While 8 and 12 foot roads make good fuelbreaks in light fuels, they do not provide safe and reasonable access.

**Issue**

Suggests that a 14 foot wide road with inter-visible turnouts will handle the same amount of traffic with a greater margin of safety.

Response

It is difficult to envision where a narrower road and turnouts, causing traffic to pull on and off of the traveled surface will provide greater safety, however, if that is true in a specific set of conditions, this option may be valid. 1270.08 provides for that option.

**Issue**

Is it the intent of the regulations to regulate the width of off-site public and private roads?

Response

Yes.

**Issue**

This regulation, as presented, would apply to all subdivisions irrespective of the parcel size or number of parcels served by an access corridor.

Response

The application of these regulations are a minimum standards. Where wider roads and flatter grades are necessary, local government may apply such standards.

**Issue**

Does a looped one-way road require only one lane.

Response

Yes, through the preference as stated in this section is two lanes.

**Issue**

Do side roads have to be 18' wide.

Response

All roads, unless allowed otherwise in these regulations shall be 18 feet wide.

**Issue**

Shoulders should be required.

Response

The Board agrees in part with this statement. Shoulders are not a requirement of a road that is created solely through grading. However, where local government requires shoulders be constructed, 1270.03 allows for this.

**Issue**

The regulations should adopt by reference the provisions of the Uniform Fire Code, 1988 Edition,

Section 10.207(c).

Response

The Board reviewed this code section and rejected its' inclusion. Part of this section provides standards more stringent than those in this regulation. Local jurisdictions may apply more stringent standards as per 1270.03. In addition, this section allows the Fire Chief to apply unspecified or unstated standards to turning radii and grades. These regulations provide specific standards and requirements.

**Issue**

What is the intent of "all roads"? Does this section delete the ability of the county to construct access roads to a different standard due to location, stops or use?

Response

The intent of the phrase "all roads" includes any newly constructed road, irrespective of ownership or control, under the direction of 1270.02. Local jurisdictions may apply more stringent standards under 1270.03, or exceptions may be applied under 1270.08.

**Issue**

The road width does not provide any clearance for a 20-ton truck on the edge of a filled slope, should add 5 feet.

Response

The Board rejects this comment. These are minimum standards that meet the need of CDF equipment and local jurisdictions may apply more stringent standards.

**Issue**

CDF has recommended wider roads for years in the Fire Safe Guide. Why the change. Many developments have been implemented under these existing recommendations.

Response

CDF has recommended a 24', two lane road as the basic access route for over 10 years and where parking is allowed, an additional 16' is recommended. CDF still supports and recommends these standards where possible. The new regulations specify minimum standards, when in many cases, more stringent requirements should be applied.

**Issue**

If you can defend the wildlands with 14' logging roads, you can protect home with them.

Response

Roads are primarily designed to provide access and secondarily as potential fuel or fire breaks. Safe traffic flow is the basic design criteria for road width, curvature and grade.

**Issue**

Street widths and turnarounds will prevent development on existing parcels.

Response

These regulations do not apply to existing roads providing service to existing parcels, nor to approved subdivision easements where roads have not been constructed. Where a parcel is not accessed by a road or easement for an approved unconstructed road, these road standards apply. Exceptions are provided in 1270.08.

**Issue**

What is the application of an 18' road; does it have to go to the next road that equals or exceeds 18'?

Response

When new construction occurs, the road beginning at the end of the existing road and ending at the end of the new construction must meet this standard.

**Issue**

Two lane roads for all developed parcels is just not practical.

Response

These regulations apply to roads and existing parcels where there is no access to that parcel. Where this requirement cannot be met, section 1270.08 may apply.

**1273.02. Roadway Surface**

The surface shall provide unobstructed access to conventional drive vehicles, including sedans and fire engines. Surfaces should be established in conformance with local ordinances, and be capable of supporting a 40,000 pound load.

Background

The heaviest CDF engine weighs 38,000 pounds. Road conditions should allow a passenger car as well as CDF fire apparatus to traverse any road established under these regulations. This section requires available access at any time a wildfire may occur, not just during the summer. Hard surfacing is not required, but may be necessary if the normal ground conditions will not support the required weight. 40,000 pounds is the minimum load capability specified in the California Vehicle Code.

**Issue**

40,000 lbs. does not specify load per axle or details of loading type for design consideration.
Response

Design manuals specify loads per axle, but this is a performance standard. CalTrans states that all bridges are designed to handle 40,000 pounds as specified in the California Vehicle Code. The vehicles, through the number of axles and the spacing of axles determines the total load that the

vehicle may carry.

**Issue**

The regulations should exempt driveways

Response

It is intended driveways to be able to support a fire engine.

**1273.03. Roadway Grades**

The grade for all roads, streets, private lanes and driveways shall not exceed 16 percent.

Background

This grade was selected as the maximum, unsurfaced roadway a CDF engine could safely traverse at 20 mph on a driveway and 30 mph on a two-lane road.

**Issue**

The Board should recognize that the sixteen percent grade standard will, in some cases, result in additional grading thereby affecting road stability and increasing erosion.

Response

This regulation does not require regrading of existing roads. Any grading requirements that exceed current standards are addressed through CEQA and are provided for through road design plans.

**Issue**

Increase the grade allowance to 20% and exempt private drives less than 150' feet in length.

Response

Grades in excess of 16%, without surfacing, significantly reduce the access speed for fire equipment on an upgrade, or severely threaten the safety of users especially on a downgrade. The exemption of driveways less than 150' in length does not provide reasonably safe access to the structure.

**Issue**

The maximum grade of a roadway should not exceed 12 percent unless it is hard surfaced.

Response

Language has been included that allows local jurisdictions to apply more stringent standards as they deem necessary in 1270.03.

**Issue**

16% is too stringent. Why not just require a hard-top surface when over, say 18 or 20 percent grades.

Response

A CDF fire engine on a 16% grade with the specified widths and curvature on a dirt road can safely travel at 20 mph. Surfacing where steeper grades may be approved is a good alternative.

**Issue**

This section should be rewritten to standard that are more in keeping with unstable north coast terrain. Many appeals will be generated.

Response

Included language will allow for mitigation of environmental, health, safety or physical site limitations in 1270.08. Any new standard requires adjustment by both the regulator and the applicant until the new standard has been tried and accepted. Appeals tend to be heavy at the beginning as the system is tested and the level of application is determined. This grade is not unsafe at 20 mph, however, lesser grades, wider roads and wider curves can increase the safety factor of any road. This is an option of local government.

**Issue**

It is physically impossible to construct a driveway conforming to a 16% grade between many houses and the county road.
Response

Response

There are situations where it is impossible to meet a specific standard or even preferable to propose an alternative as is allowed in 1270.08.

**1273.04. Roadway Radius**

(a) No roadway shall have a horizontal inside radius of curvature of less than 50 feet and additional surface width of 4 feet shall be added to curves of 50-100 feet radius; 2 feet to those from 100-200 feet.

(b) The length of vertical curves in roadways, exclusive of gutters, ditches, and drainage structures designed to hold or divert water, shall be not less than 100 feet.

Background

The radius of curvature is the minimum, based on heavy equipment, road width and 20 mph on driveways or 30 mph on a two-lane road. Curve widening allows for large equipment to make the curve without the rear wheels cheating over the center line. Obviously, roads with faster travel speeds will have larger turning radii. Where a road changes grade or another road intersects that road the change in curvature or grade must be transitioned so that equipment will not high-center or drag the body behind the rear axle.

**Issue**

Is the turning radius sufficient?

Response

The Board believes that the turning radius, as a minimum standard is sufficient for access by CDF fire apparatus at the referenced speed of travel.

**Issue**

Reduce the radius to 50'.

Response

This radius does not provide the necessary turning radius for CDF equipment to provide a safe turnaround during a fire emergency. CalTrans states this is necessary to allow large vehicles to turn a corner without "cheating" over the line into the other lane.

**Issue**

The curve radius for driveways are too large.

Response

This radius is the minimum radius for CDF equipment based upon a speed of 20 mph and the turning radius of CDF equipment.

**Issue**

Driveways should be exempted from this section.

Response

It is specifically intended for driveways to provide turns that will safely handle fire engines.

**1273.05. Roadway Turnarounds**

Turnarounds are required on driveways and dead-end roads as specified in this article. The minimum turning radius for a turnaround shall be 40 feet from the center line of the road. If a hammerhead/T is used, the top of the "T" shall be a minimum of 60 feet in length.

Background

To provide a safe turnaround area for fire fighters and civilians under emergency conditions, turnarounds are required on driveways and dead-end roads. Based upon the turning radius for CDF equipment, this minimum radius will allow a "single-pass" turnaround. Alternatives to a terminus bulb include the hammerhead/T or the lateral slip. The hammerhead/T requires a minimum 60' long roadway at the top of the T.

**Issue**

Recommend the minimum radius be reduced from 40 feet to 35 feet

Response

CalTrans recommends that 40' is the minimum acceptable radius based upon CDF equipment specifications and safety.

**Issue**

Turnarounds of 80' in agricultural areas is excessive. If the need is there, can it be met by flat terrain rather than road.

Response

The regulations provide for alternatives where feasible, however, flat terrain does not necessarily indicate that the surface will support a 40,000 pound fire engine, nor that it is safe to drive through tall grass that may hide obstacles or debris that can damage equipment.

**Issue**

With an 80 foot diameter turnaround we can use reverse gear and stay within the existing easements.

Response

This is possible under 1270.08, however, the point of the minimum radius is to allow the engine to make a single pass turn around during an emergency.

**Issue**

The minimum radius for a terminus bulb should be increased to 42 feet. The average outside turning radius for fire apparatus ranges from 36 to 42 feet. CDF engines may have the smaller turning radius, but the majority of equipment used by other fire protection agencies will have a larger turning radius.

Response

The responsibility for setting criteria for local government fire apparatus is local government, not the Board. Local government has always had the ability to apply standards that meet their needs.

**Issue**

Why is a turnaround needed when current training requires backing in to a structure during an emergency. How will a turnaround improve their ability to leave.
Response

Response

This training is based on safety for fire fighters who have been required to travel substandard, unsafe roads to protect homes and suppress wildland fires. Because it has been done in the past

doesn't mean that it is the correct approach. A turnaround means the driver does not have to back an engine down a road for miles either coming or going
and provides a safety island at the end of that road.

**1273.06. Roadway Turnouts**

Turnouts shall be a minimum of 10 feet wide and 30 feet long with a minimum 25 foot taper on each end.

Background

Turnouts are required on roadways that do not provide two-way traffic flow. The 25' taper and 30 foot body of the turnout should provide enough room for a fire engine or RV to pull off the roadway, allowing another vehicle to pass. The 10' width provides the equivalent of another traffic lane width.

**Issue**

Concerned over why length of turnout is by size of fire engine rather than the standard car length.

Response

Turnouts must be designed to handle either emergency equipment or civilian vehicles. Many civilian vehicles, including RVs and vehicles pulling trailers, are larger than CDF fire engines. There is no certainty that the civilian vehicle will take the turnout, especially during evacuation.

**Issue**

Turnouts should be 40' in order to accommodate modern fire apparatus.

Response

Local government may apply more stringent standards as per 1270.03. This standard meets the needs of CDF equipment.

**Issue**

How do we know the turnout is there without driving down there.

Response

Possible indicators include conformance with other standards in this regulation, local tracking of new construction, and knowledge of emergency response area by fire crews.

**1273.07. Roadway Structures**

(a) All driveway, road, street, and private lane roadway structures shall be constructed to carry at least the maximum load and provide the minimum vertical clearance as required by Vehicle Code Sections 35550, 35750, and 35250.

(b) Appropriate signing, including but not limited to weight or vertical clearance limitations, one-way road or single lane conditions, shall reflect the capability of each bridge.

(c) A bridge with only one traffic lane may be authorized by the local jurisdiction; however, it shall

provide for unobstructed visibility from one end to the other and turnouts at both ends.

Background

Bridges and other road structures have historically created problems when responding or performing fire suppression activities. They limit access due to weight and width limitations and in some cases cause serious injury to fire fighters and damage to equipment. Bridges, culverts and other roadway structures must be able to support the minimum design load of the rest of the roadway. In addition, the minimum vertical clearance specified in the California Vehicle Code must be met. Limitation signs, such as weight and height capability shall be posted at or near each bridge. Bridges with only one traffic lane must have turnouts at both ends, allowing a reasonable flow of traffic and a driver approaching one end of this bridge must be able to see any other traffic on that bridge. These conditions improve safety and traffic circulation during an emergency.

**1273.07(a)**

(a) All driveway, road, street, and private lane roadway structures shall be constructed to carry at least the maximum load and provide the minimum vertical clearance as required by Vehicle Code Sections 35550, 35750, and 35250.

(b) Appropriate signing, including but not limited to weight or vertical clearance limitations, one-way road or single lane conditions, shall reflect the capability of each bridge.

(c) A bridge with only one traffic lane may be authorized by the local jurisdiction; however, it shall provide for unobstructed visibility from one end to the other and turnouts at both ends.

**Issue**

It should state that structures shall be constructed to carry minimum H-20 and HS alternative loading design per AASHTO.

Response

The performance criteria has been referenced from the California Vehicle Code. Other standards that meet or exceed this standard may be utilized as allowed in 1270.03.

**1273.07(c)**

(c) A bridge with only one traffic lane may be authorized by the local jurisdiction; however, it shall provide for unobstructed visibility from one end to the other and turnouts at both ends.

**Issue**

Why is standard for turnouts at the end of bridge not the same as proposed for driveways.

Response

Bridges have different design criteria and construction considerations than a standard driveway. It is reasonable from the standpoint of safety and construction to require turnouts at both ends of a bridge. Turnouts provided a both ends of the bridge allows for either vehicle to pull over, increasing safety for all.

### 1273.08. One-Way Roads

All one-way roads shall be constructed to provide a minimum of one 10-foot traffic lane. The local jurisdiction may approve one-way roads. All one-way roads shall connect to a two-lane roadway at both ends, and shall provide access to an area currently zoned for no more than 10 dwelling units. In no case shall it exceed 2640 feet in length. A turnout shall be placed and constructed at approximately the midpoint of each one-way road.

Background

One way roads create major safety and access problems during a wildfire. Limited visibility during smoky conditions and large numbers of civilian vehicles and fire equipment create a potential catastrophe. During evacuation, civilians and fire fighters may use these roads traveling in the "wrong direction". To alleviate this problem, lengths and potential residential traffic have been limited and all must connect to a two-lane road at each end, easing the flow of traffic into and away from the area. The turnout provides a point for an inoperative vehicle or a place for the fire equipment to standby.

**Issue**

Delete the reference to distance and allow 20 dwelling units on a one-way road. Require multiple turnouts.

Response

Interconnecting one-way roads do not provide safe and unobstructed traffic circulation during a wildfire emergency. In addition, the allowance for increase dwelling units on a one-way road means more traffic on a road that provides limited access, thus decreasing safety for fire fighters and civilians alike. Emergency equipment may be required to access a fire location from the direction opposite to the traffic flow. The 1/2 mile length minimizes the exposure of civilians and fire fighters under conditions of significantly increased risks and limits the distance and time required to reach a point of reasonable safety, such as a two lane road. As for turnouts, additional locations may be specified by local government per 1270.03.

**Issue**

Allowances should be made for waiver under review for a planned unit concept with approval of the Director.

Response

The regulations provide for the application of alternatives under 1270.08.

**Issue**

Turnouts should be within sight of each other unless the road is truly one way.

Response

This is a minimum standard and more stringent standards can be applied by local government per 1270.03.

**Issue**

One-way roads should be 12' wide plus a 3' shoulder to accommodate and allow fire vehicles to work safely.

Response

This is a minimum standard and local government may apply more stringent standards per 1270.03.

**Issue**

Roads designated as a one-way road for everyday traffic will almost certainly be considered a two-way road when areas are threatened by a wildfire. This type of roadway should be provided with inter-visible turnouts at distances not exceeding 400 feet.

Response

A minimum level of safety has been provided through limited traffic flow due to dwelling unit limitations, specified length of road and a mid-point turnout. More stringent standards can be applied by local government per 1270.03.
1273.08-7Issue

**Issue**

Remove the limitation on dwelling unit zoning.

Response

This proposal allows an unlimited number of dwelling units resulting in significantly increased traffic flow along a narrow road, and will thus create unsafe access conditions for civilians and emergency personnel. Without the addition of other protective measures, the distances to points of safety will be excessive, thus increasing the risk to civilians and fire fighters. This proposal allows an unlimited length one-way road with only turnouts to facilitate safe access.

**Issue**

Two lane roads on both ends of a one-way road cannot done.

Response

It is not a question of "cannot be done" because it is commonly done throughout the state, but rather a question of what is safe for civilians and fire fighters. Access to a subdivision on a one-way road that returns to the same point can mean hundreds of trapped residents during a wildfire.

**Issue**

In reality a one way road may only be utilized for up to five lots. All lots in Nevada County have the ability to apply for a Conditional Use Permit for a "Granny House".

Response

Granny houses are generally not considered in the zoning limits applied by a county. The limitation is based upon the amount of traffic flow that may occur during an emergency.

**1273.09. Dead-End Road**

(a) The maximum length of a dead-end road, including all dead-end roads accessed from that dead-end road shall not exceed the following cumulative lengths, regardless of the number of parcels served:

| | |
|---|---|
| parcels zoned for less than one acre | 800 feet |
| parcels zoned for 1 acre to 4.99 acres | 1320 feet |
| parcels zoned for 5 acres to 19.99 acres | 2640 feet |
| parcels zoned for 20 acres or larger | 5280 feet |

All lengths shall be measured from the edge of the roadway surface at the intersection that begins the road to the end of the road surface at it's farthest point. Where a dead-end road crosses areas of differing zoned parcel sizes, requiring different length limits, the shortest allowable length shall apply.

(b) Where parcels are zoned 5 acres or larger, turnarounds shall be provided at a maximum of 1320 foot intervals.

(c) Each Dead-end road shall have a turnaround constructed at its terminus.

**1273.09(a)**

(a) The maximum length of a dead-end road, including all dead-end roads accessed from that dead-end road shall not exceed the following cumulative lengths, regardless of the number of parcels served:

| | |
|---|---|
| parcels zoned for less than one acre | 800 feet |
| parcels zoned for 1 acre to 4.99 acres | 1320 feet |
| parcels zoned for 5 acres to 19.99 acres | 2640 feet |
| parcels zoned for 20 acres or larger | 5280 feet |

All lengths shall be measured from the edge of the roadway surface at the intersection that begins the road to the end of the road surface at it's farthest point. Where a dead-end road crosses areas of differing zoned parcel sizes, requiring different length limits, the shortest allowable length shall apply.

Background

Dead-end roads and cul-de-sacs are of significant risk to wildland fire fighters and civilians, presenting the possibility of being trapped, cut-off and overrun by fire. To the fire fighter, it doesn't make any difference whether the authorities "plan on that road intersecting with another" in the future or whether it is intended to be a single point of ingress/egress road forever. Lengths of dead-end roads have been limited, based on the potential traffic volume, to reduce the risk of entrapment. The lengths of all dead-end roads that intersect are accumulating. If a dead-end road crosses areas of different zoning, ie., R-5 and R-20, the

most shortest allowable length applies. This section will encourage two routes of ingress and egress and will significantly limit the length of dead-end roads.

**Issue**

Dead-end roads should not be allowed over 800' unless future road connections are planned for and recorded.

Response

It is unrealistic to require all roads to be "through roads". Terrain and economics are significant limitations to this proposal. This proposal does have application to higher levels of fire hazard severity and local jurisdictions may choose adopt this standard under 1270.03.

**Issue**

The regulations should be clarified to address looped road systems.

Response

Looped roads are included in the definition of dead-end roads in 1270.01, thus, this section applies to looped roads.

**Issue**

Parcels zoned for less than one acre should allow 660' and allow this to be doubled for open end cul-de-sac for emergency access.

Response

Local jurisdictions may apply more stringent standards under 1270.03.

**Issue**

The proposed regulations set up a conflict scenario where, as an area develops and zone and parcels sizes decrease, the constraint is the length of a dead end road, therefore, remove the limiting length on dead-end roads.

Response

The parameters that lead to increased risk for civilians and fire fighters on dead-end roads are the volume of traffic using that road, the length of road, width of road, grade and fuel types. High density developments, in SRA, on long dead-end roads have the real potential of becoming major catastrophes. As zoning density increases, the area soon exceeds the criteria for SRA and is thus removed from that classification. However, experience has shown that areas adjacent to SRA are at risk from wildfire or contribute to the high intensity use of fire fighting resources for their protection.

**Issue**

This section should be dropped totally from the regulations because it requires mitigation of existing development.

Response

Excessively long dead-end roads are a major problem of safety for civilians and fire fighters as well as a protection nightmare for fire agencies.

**Issue**

This section will prohibit the development of small canyons, and other areas which would be otherwise suited to development due to the inability of the developer to provide a through road system. This is not practical in mountain areas.

Response

These regulations do not prohibit development. They create safer conditions for residents and fire fighters alike. Canyons are extremely hazardous fire areas with the potential for catastrophic consequences to residents and fire fighters alike. Like environmental, health, and transportation issues, subdivisions must be designed and constructed with wildland fire safety consideration. Longer roads may be approved where appropriate mitigation has been applied per 1270.08. 1273.09(a)-10Issue

**Issue**

Many areas cannot meet the standards.

Response

Existing developments are not affected by these regulations and these standards in conjunction with 1270.09 can be applied effectively throughout the state.

**Issue**

Private roads should not have to be wider than the roads they connect to.

Response

To a wildland fire fighter responding to an emergency, a road, whether public or private, must provide safety and unobstructed access.

**Issue**

Decrease 1 mile to 1/4 mile distance. Your regulations may increase trapping of residents and firefighters in an emergency situation.

Response

In cases where local government identifies areas of extreme hazard and risk to fire fighters and more stringent requirements can be developed by local government per 1270.03

**Issue**

Geographical limitations and inability to acquire easements relating to loop roads and dead-end roads will prohibit development. There is no variance provision.

Response

Section 1270.08 allows mitigation to be applied to any appropriate project.

**1273.09(b)**

(b) Where parcels are zoned 5 acres or larger, turnarounds shall be provided at a maximum of 1320 foot intervals.

Background

The intent of this section is to provide a location along the mid-point of the road where fire equipment can safely and rapidly turnaround without making a three-point maneuver.

**Issue**

Replace turnarounds with turnouts.

Response

A turnout does not provide the same effect as a turnaround.

**1273.09(c)**

(c) Each Dead-end road shall have a turnaround constructed at its terminus.

Background

The intent is to provide an unobstructed, safe turnaround at the end of the road.

**Issue**

A turnaround is not required on a looped road.

Response

Correct, as a looped road does not have a terminus or end.

**Issue**

Place the turnaround within 300 feet of its terminus.

Response

Placement before the end of a road requires emergency equipment to back-up that distance under emergency conditions to reach a turnaround.

**1273.10. Driveways**

All driveways shall provide a minimum 10 foot traffic lane and unobstructed vertical clearance of 15 feet along its entire length.

(a) Driveways exceeding 150 feet in length, but less than 800 feet in length, shall provide a turnout near the midpoint of the driveway. Where the driveway exceeds 800feet, turnouts shall be provided no more than 400 feet apart.

(b) A turnaround shall be provided at all building sites on driveways over 300 feet in length, and shall be within 50 feet of the building.

Background

Few counties in California have developed driveway standards. The driveway is the key, final access to a structure for emergency personnel, and as is common in the rural setting, may be hundreds of feet to several miles long. These conditions create a major risk to civilians and fire fighters. The width, height and weight of fire apparatus, the safety of driving conditions, the ability to access a turnout to allow traffic to pass and the ability to site an engine and turn around at the end of the driveway are elements that have been addressed in this section. Extra vertical clearance has been provided to increase the safety factor where fire fighters may be working on top of parked apparatus and the turnaround has been sited near the building so pre-connects will reach the far side of the structure.

**Issue**

Why have a vertical clearance standard for driveways if it is not required for roads. A more reasonable standard should be considered.

Response

The minimum vertical clearance for roads in the California Vehicle Code (CVC) is 13'6". Driveways are not regulated in the CVC. Fire suppression action, including clear access to the top of fire engines is required on roads and driveways. Wide roads seldom have overhanging trees which are flammable and they generally provide greater safety through their greater width. To provide additional safety for fire fighters on driveways, which are narrower than roads, 15' is required.

**Issue**

Driveway should be 12' wide with a 3' shoulder. 10' is totally unsafe. Turnouts should be at a maximum of 200'.

Response

The regulations have provided the ability for local government to meet regional needs through 1270.03.

**Issue**

Clarify whether an existing driveway serving one dwelling must be upgraded per the proposed regulations at the time a second dwelling which uses the same driveway is constructed.

Response

When new construction is approved that exceeds the dwelling or building limits stated in the driveway definition, the driveway must be upgraded to a road.

**Issue**

Add a new section that applies 13'6" clearance to all roads.

Response

This proposal reduces the safety margin below the minimum necessary to protect fire fighters.

**1273.10(a)**

(a) Driveways exceeding 150 feet in length, but less than 800 feet in length, shall provide a turnout near the midpoint of the driveway. Where the driveway exceeds 800 feet, turnouts shall be provided no more than 400 feet apart.

**Issue**

Remove the length limitation on driveways.

Response

The Board considered and rejected this proposal. This language not exempt driveways under 150 feet in length and allows the distance from the road to the first turnout to increase up to 325 feet.

**Issue**

A local water source could be a benefit requiring the turnout.

Response

This requirement is found in 1275.15.

**Issue**

The requirement for turnouts are not physically possible.

Response

Narrow roads commonly have turnouts. Proper planning and design and the application of 1270.08 can meet the intent of this section.

**Issue**

400 feet is unrealistic.

Response

The Board disagrees with this statement. 400' on a driveway, barely wider than a fire engine, with a fire approaching or life and property threatened or burning, is a reasonable distance to locate a site to pass another vehicle.

**1273.10(b)**

(b) A turnaround shall be provided at all building sites on driveways over 300 feet in length, and shall be within 50 feet of the building.

**Issue**

Remove the 50' requirement to a structure.

Response

The 50 foot requirement provides a specified distance from the structure, not allowing the driveway to end hundreds of feet from the structure where additional lengths of hose must be connected to reach that structure. It also provides a safety zone within a reasonable distance from the structure for fire equipment and residents.

**Issue**

Conflicts with 1273.08 as to distance between turnouts.

Response

The regulation intends to provide increased protection on narrower driveways, thus requiring turnouts at closer intervals. Driveways and roads have different widths, travel speeds and traffic volume.

**1273.11. Gate Entrances**

(a) Gate entrances shall be at least two feet wider than the width of the traffic lane(s) serving that gate.

(b) All gates providing access from a road to a driveway shall be located at least 30 feet from the roadway and shall open to allow a vehicle to stop without obstructing traffic on that road.

(c) Where a one-way road with a single traffic lane provides access to a gated entrance, a 40 foot turning radius shall be used.

Background

This section improves access to and through gates on roads and driveways. Gate access has limited access and damaged equipment over the years. Gate entrances must be wider that the road surface, be set back from the roadway so a vehicle can stop without blocking the roadway, and gates must open so the vehicle doesn't have to park on the road. Where a narrow, one-way road accesses another narrow road or driveway through a gate, a 40' radius must be provided to ease entry.

**Issue**

If this references the road providing access to the driveway, then this distance should take into account gate swing if appropriate

Response

The Regulation intent includes gates on any roadway and provides reasonable swing room for a

gate.

**Issue**

Add wording to prohibit use of unapproved locking should be added.

Response

Local jurisdictions may apply lock standards under 1270.03.

**Issue**

Road standard conflict with forest practice rules authority.

Response

The Forest Practice rules are limited to addressing roads for harvesting and managing forest products, not subdivision roads.

**Issue**

How will environmental concerns over increased erosion from roads be handled.

Response

This concern can be addressed through the existing CEQA project requirements. Additional review and mitigation will occur through the local CEQA project review requirements.

**1273.11(a)**

(a) Gate entrances shall be at least two feet wider than the width of the traffic lane(s) serving that gate.

**Issue**

Widths and heights should accommodate a D-9 dozer or a D-9 on a transport where the need for this type of equipment to extinguish a fire.

Response

Included language that allows vehicle capable of driving on a road of a specified width to pass through the required gate. Clearance is specified in sections 1273.10 and1273.07(a).

**Issue**

Gates don't need to be any wider than 10 feet since it isn't common for two fire engines to pass each other; the smaller the gate opening the better.

Response

Safety and common sense require gate openings to be wider than the roadway.

**1273.11(b)**

(b) All gates providing access from a road to a driveway shall be located at least 30 feet from the roadway and shall open to allow a vehicle to stop without obstructing traffic on that road.

**Issue**

There should be statement that indicates the gate swing toward public roadway shall be prohibited.

Response

The Board has addressed this through the statement "shall open to allow a vehicle to stop without obstructing traffic on that road".

**Issue**

Change 30' from roadway to 30' from right-of-way.

Response

This proposal exceeds the minimum requirements needed for civilian and fire fighter safety. Local government may apply more stringent standards under 1270.03.

**1273.11(c)**

(c) Where a one-way road with a single traffic lane provides access to a gated entrance, a 40 foot turning radius shall be used.

**Issue**

Replace the 40' turning radius with a turnaround..

Response

A turnaround does not provide the same effect as a radius turn.

**Issue**

Include gated, single traffic lane driveway along with one-way road, and set a minimum 40 foot turning radius, and add that the outside radius have an added 4 feet for tracking or 54 feet minimum outside radius for both these slow speed entrance avenues.

Response

The volume of vehicle traffic and the speed of travel differ significantly between a one-way road and a driveway. The majority of CDF fire engines can negotiate a 40' radius turn that accesses a gate. Larger fire apparatus may be required to make a 3-point turn. Very large equipment such as bulldozers and transports will not be able to negotiate the turn. Local government may apply more stringent standards per 1270.03.

## ARTICLE 3. Signing and Addressing

### 1274.00. Intent

To facilitate locating a fire and to avoid delays in response, all newly constructed or approved roads, streets, and buildings shall be designated by names or numbers, posted on signs clearly visible and legible from the roadway. This section shall not restrict the size of letters or numbers appearing on street signs for other purposes.

Background

The difficulty of locating an un-named or poorly signed road during an emergency, especially under smoky conditions is a major problem to wildland fire fighters. Beyond that, many jurisdictions allow duplicate numbering and naming for roads and addresses, further compounding the location problem. The loss of resources, property and life take on greater potential without a countywide addressing and numbering system.

**Issue**

Local variations should be allowed that will authorize local systems.

Response

Sections 1270.03 and 1270.08 provide for this.

### 1274.01. Size of Letters, Numbers and Symbols for Street and Road Signs

Size of letters, numbers, and symbols for street and road signs shall be a minimum 3 inch letter height, 3/8 inch stroke, reflectorized, contrasting with the background color of the sign.

Background

This size and style is recommended by the 1980 Fire Safe Guides and is readily available statewide.

**Issue**

Letter size is in conflict with standards for many agencies.

Response

Exceptions may be provided under 1270.08, or local standard may be certified by the Board per 1270.03.

### 1274.02. Visibility and Legibility of Street and Road Signs

Street and road signs shall be visible and legible from both directions of vehicle travel for a distance of not less than 100 feet.

Background

Road name and structure numbers must be visible to present early identification and safe turns for responding fire apparatus under limited visibility conditions.

**Issue**

If visibility is limited due to natural contours or mountains, is the 100 foot dimension to become a constant appeal item.

Response

Allowable mitigation can be provided through 1270.08.

**1274.03. Height of Street and Road Signs**

Height of street and road signs shall be uniform county wide, and meet the visibility and legibility standards of this article.

Background

Height of road signs should be consistent so the vehicle driver and passengers can anticipate where to locate the sign.

**1274.04. Names and Numbers on Street and Road Signs**

Newly constructed or approved public and private roads and streets must be identified by a name or number through a consistent countywide system that provides for sequenced or patterned numbering and/or non-duplicating naming within each county. All signs shall be mounted and oriented in a uniform manner. This section does not require any entity to rename or renumber existing roads or streets, nor shall a roadway providing access only to a single commercial or industrial occupancy require naming or numbering.

Background

The system must be consistent, sequenced and non-repetitive so that street names and addresses are not duplicated. This section only applies to new roads, however, to make it work effectively, many jurisdictions may apply their standard to resolve existing duplications or non-sequential numbers. Access to a commercial or industrial operation does not require a street name or number.

**1274.05. Intersecting roads, Streets and Private Lanes**

Signs required by this article identifying intersecting roads, streets and private lanes shall be placed at the intersection of those roads, streets, and/or private lanes.

Background

This section requires street signs to be place at each street intersection.

**1274.06. Signs Identifying Traffic Access Limitations**

A sign identifying traffic access or flow limitations, including but not limited to weight or vertical clearance limitations, dead-end road, one-way road or single lane conditions, shall be placed:

(a) at the intersection preceding the traffic access limitation, and
(b) no more than 100 feet before such traffic access limitation.

Background

Road access limitations can significantly increase the risk to fire fighters. Bridges without weight limitations, dead-end roads, one-way roads etc. can place fire fighters in positions of great danger. This section requires such notification to be place at the intersection preceding the limitation and again no more than 100 feet before the point that provides that traffic limitation, ie., a bridge.

**Issue**

One-way road or single lane should not be subject to signing at the intersection preceding the traffic access limitation.

Response

Signing must occur at the last reasonable point to change the travel route to an emergency incident. This is at the intersection before that obstacle, not at the obstacle where backing up on a one-way road is required.

**Issue**

This provision for signing makes 1273.07(b) unnecessary.

Response

Signing does not provide safe access or the ability to turnaround, it only provides notice of a safety limitation.

**1274.07. Installation of Road and Street Signs**

Road, street and private lane signs required by this article shall be installed prior to final acceptance by the local jurisdiction of road improvements.

Background

Fire occurrence increases when new roads allow access into new areas. Road and street signs, to be effective, must be in place when road access is opened to the public or to residents. The local jurisdiction issues the permit and performs the final inspection.

**Issue**

Why is local jurisdiction required to insure that signs are installed.

Response

This section requires that installation be accomplished, most likely by the developer, prior to the local jurisdiction's approval of or acceptance of road improvements. In most cases, counties inspect road improvements before they approve them, as they condition developments for road improvements.

**Issue**

This section does not require a width adequate to handle fire equipment.

Response

Roadway structures are defined as a part of a roadway, therefore, the width must be consistent with the width of the roadway.

**1274.08. Addresses for Buildings**

All buildings shall be issued an address by the local jurisdiction which conforms to that jurisdiction's overall address system. Accessory buildings will not be required to have a separate address; however, each dwelling unit within a building shall be separately identified.

Background

Buildings without an address number are difficult to locate. All buildings and dwelling units must have an address, however, accessory buildings do not require one. These addresses must conform to the intent of 1274.00.

**1274.09. Size of Letters, Numbers and Symbols for Addresses**

Size of letters, numbers and symbols for addresses shall be a minimum 3 inch letter height, 3/8 inch stroke, reflectorized, contrasting with the background color of the sign.

Background

This size and style is recommended by the 1980 Fire Safe Guides and is readily available statewide.

**1274.10. Installation, Location and Visibility of Addresses**

(a) All buildings shall have a permanently posted address, which shall be placed at each driveway entrance and visible from both directions of travel along the road. In all cases, the address shall be posted at the beginning of construction and shall be maintained thereafter, and the address shall be visible and legible from the road on which the address is located.

(b) Address signs along one-way roads shall be visible from both the intended direction of travel and the opposite direction.

(c) Where multiple addresses are required at a single driveway, they shall be mounted on a single post.

(d) Where a roadway provides access solely to a single commercial or industrial business, the address sign shall be placed at the nearest road intersection providing access to that site.

Background

Building numbers must be visible from both directions of travel on a two-way road and shall be posted at the driveway entrance at the beginning of construction. Address on one way roads need to be visible from both potential directions of travel as emergency equipment may be required to travel opposite to the normal travel direction. Multiple addressed must be mounted on a single post. Commercial and industrial numbers will be posted at the nearest road intersection since access to these facilities are roads.

**1274.10(a)**

(a) All buildings shall have a permanently posted address, which shall be placed at each driveway entrance and visible from both directions of travel along the road. In all cases, the address shall be posted at the beginning of construction and shall be maintained thereafter, and the address shall be visible and legible from the road on which the address is located.

**Issue**

An exception should be provided if the residence is a certain distance from the road and the number on the house can clearly be seen from the road.

Response

This has been allowed for in 1270.03.

**Issue**

Enforcement of permanently posted addressed should be retroactive.

Response

The authorizing legislation prohibits retroactive application of these standards.

**1274.10(b)**

(b) Address signs along one-way roads shall be visible from both the intended direction of travel and the opposite direction.

**Issue**

Why should addresses be visible from both directions on one way roads?

Response

During an emergency, it is likely that emergency vehicles will need to access a one-way road from the direction opposite of normal travel.

## ARTICLE 4. Emergency Water

### 1275.00 Intent

Emergency water for wildfire protection shall be available and accessible in quantities and locations specified in the statute and these regulations, in order to attack a wildfire or defend property from a wildfire. Such emergency water may be provided in a fire agency mobile water tender, or naturally occurring or manmade containment structure, as long as the specified quantity is immediately available.

Background

The application of water and the construction of fireline are the primary tools wildland fire fighters have to contain and control a wildfire. The siting and availability of sufficient quantities of water are essential to fire suppression and fire fighter safety. While a single system of water delivery is adequate, the effectiveness of any suppression system increases with diversity.

**Issue**

Concerns that no assurance that this is the sole use that will be made of this publicly accessible water source, no provision to protect the providing party will have any water left to defend his own property, or to prevent some unauthorized user or vandal from drawing from this convenient source since all connectors and valves are standard.

Response

Urban fire hydrants are subject to the same conditions as described here without significant problem. Individual hydrants and common sources are protected by local and private property laws. Authorized use is only be fire agencies. The valves and connections are standardized in the fire service so all engines can be connected to any system while carrying a minimum number of adapters.

**Issue**

This section has no application to many counties. We have no problem with CDF.

Response

Wildland fires and the resulting loss of life, property and resources is a statewide problem that must be addressed through general plan policies and specific ordinances.

**Issue**

Water supplies should be tailored to the fire hazard zones.

Response

The regulation has addressed this issue through development of water requirements that apply to the moderate fire hazard severity zone mapped by CDF. More stringent standards may be applied by local government under 1270.03.

### 1275.01 Application

The provisions of this article shall apply when new parcels are approved by a local jurisdiction. The emergency water system shall be available on-site prior to the completion of road construction, where a community water system is approved, or prior to the completion of building construction, where an individual system is approved.

Background

This section requires available and accessible water on site before roads in a subdivision are completed and before building construction depending upon how the water requirement is conditioned. The key is having the water on site as the hazard and risk increases.

**Issue**

This section should only apply to new subdivisions and developments that involve the construction of multiple units.

Response

Single family homes have the greatest impact on the state's wildlands, not multiple dwelling unit buildings.

**Issue**

This section requires a water supply for fire protection when new parcels are approved by local government. An emergency water supply needs to be provided for each building placed or constructed as the fire problem is not limited to new parcels only.

Response

This is not necessarily true for wildfire control. There is also a significant difficulty in equitably and fairly applying emergency water supply requirements to the wide range of variables that affect a single parcel.

**Issue**

Conflicts with Section 1270.2 (b) (c) and (d). This requirement should be imposed at the time a building permit is issued.

Response

Infrastructure requirements for subdivisions are commonly applied and required when the development begins. The risk increase from roads and associated development activities may require water before the structures are built.

**Issue**

Tanks need to be earthquake proof.

Response

These regulations do not specify the construction criteria for tanks. This is the role of state building standards and local government.

**Issue**

Water supplies should be required at the time the road(s) is/are constructed for a subdivision.

Response

There is a need to specify a point of accomplishment for water, requiring on-site prior to the completion of road construction for community systems and prior to completion of construction for individual systems.

**Issue**

It is unclear whether water applies to building and use permits.

Response

The water requirements apply only when a new parcel is approved by local government, ie., parcel splits and subdivisions.

**1275.10 General Standards**

Water systems that meet or exceed the standards specified in Public Utilities Commission of California (PUC) revised General Order #103, Adopted June 12, 1956 (Corrected September 7, 1983, Decision 83-09-001), Section VIII Fire Protection Standards and other applicable sections relating to fire protection water delivery systems, static water systems equaling or exceeding the National Fire Protection Association (NFPA) Standard 1231, "Standard on Water Supplies for Suburban and Rural Fire Fighting", 1989 Edition, or mobile water systems that meet the Insurance Services Office (ISO) Rural Class 8, 2nd Edition 3-80, standard shall be accepted as meeting the requirements of this article. These documents are available at CDF Ranger Unit Headquarters.

Nothing in this article prohibits the combined storage of emergency wildfire and structural firefighting water supplies unless so prohibited by local ordinance or specified by the local fire agency.

Where freeze protection is required by local jurisdictions, such protection measures shall be provided.

Background

Three widely recognized and accepted standards have been selected for application. The preference order is community water systems, static water systems then mobile water systems. In fact, most suppression systems will utilize two or three of the types of systems allowed. By combining two or all three water storage and delivery systems together, an extremely effective system can be created. The weakest system is one that depends solely on mobile water tenders. Without established static sources, large numbers of engines are diverted to shuttle water, rather than being assigned directly to suppression or protection duties. There are significant differences of opinion between separate or combined domestic and emergency water supplies as well as health department requirements that need to be consulted. Where

## CDF Fire Apparatus Turning Radius

| | |
|---|---|
| Model #9 | 27' 6" |
| Model #12 | 29' |
| OES | 33' 8" |

## CDF Maximum Fire Apparatus Weight

| | |
|---|---|
| Fire Engine | 35,000 pounds |
| Dozer/Transport | 78,000 pounds |

## Calculating the Volume of a Water Containment Structure

Volume of Water in a Cylinder: $\pi r^2$ x L x 7.5 gallons/cubic foot

Swimming Pool Calculations: L x W x D x 7.5 gallons/cubic foot

2500 Gallon Structures

6' x 11.8' 8' x 6.65' 10' x 4.25'

7' x 8.7' 9' x 5.25'

## Calculating Water Storage Requirements from NFPA 1231

STEP 1: Determine the cubic footage of each structure.

STEP 2: Determine the structure's Occupancy Hazard Number (3-7) as described in Chapter 3.

Example: a dwelling has an Occupancy Hazard Classification of 7

STEP 3: Determine the Classification of Construction as described in Chapter 4

Example: a dwelling with wood siding is a Type V with a construction classification number of 1.50. However, 4-1.2 states that a dwelling shall be assigned a number no higher than 1.0, therefore, the construction number for this dwelling is 1.0.

STEP 4: Calculate the water storage requirements.

Example 1:

Single Structure without Exposures (5-2.1, no other structure of 100 sq. ft. or larger within 50'.

$$\text{Water Storage} = \frac{\text{Cubic Footage of Structure}}{\text{Occupancy Hazard Classification \#}} \times \text{Construction Classification \#}$$

Sample:

1200 square foot structure with 8' ceilings (assume 10' height avg. with attic)

$$\text{Water Storage} = \frac{12{,}000}{7} \times 1.0 = 1{,}714 \text{ gallons}$$

However, 5-2.1.1 places the minimum for any structure without an exposure hazard at 2,000 gallons

Example 2:

Single Structure with an Exposure Hazard.

$$\text{Water Storage} = \frac{\text{Cubic Footage of Structure}}{\text{Occupancy Hazard Classification \#}} \times \text{Construction Classification \#} \times 1.5$$

Sample:

1200 square foot structure with 8' ceilings (assume 10' avg. height with attic)

$$\text{Water Storage} = \frac{12{,}000}{7} \times 1.0 \times 1.5 = 2571 \text{ gallons}$$

However, 5-3.1.1 places the minimum for any structure with exposures at 3,000 gallons.

Example 3:

Multiple structures without an exposure hazard. Calculate based on the single largest structure as in Example 1

Note that 5-4.1.1 places a minimum for any structure without an exposure hazard of 3,000 gallons.

Example 4:

Multiple structures with an exposure hazard. Calculate based on the single largest structure as in Example 2.

Note that 5-4.1.1 places a minimum for any structure with an exposure hazard of3,000 gallons.

NOTE: Table 5-9.1(a) in NFPA 1231 will speed up your water supply calculations.

freeze protection is needed, local requirements should be followed.

**Issue**

The regulations should recognize that expanded water (foam) is a recognized, approved and effective fire fighting agent, and that provisions be made that standards be developed.

Response

The regulation allows for exceptions and more stringent requirements in 1270.08 and 1270.03.

**Issue**

This section implies that a fire agency water truck is adequate to meet the requirements of this section. Expand on this and determine the number of trucks in a ratio to the number of structures that would be adequate for emergency water.

Response

The regulation includes the ability of a fire agency to utilize mobile water tenders as meeting the intent of the regulations as long as they comply with the referenced Insurance Services Office Rural Class 8 standard. Calculations can be made from that document.

**Issue**

Our fire department heats their tanks during cold weather. Are we going to have to bury the lines.

Response

The regulation has provided for these conditions through 1270.03, 1270.08 and 1275.10.

**Issue**

Include an alternative owner builder section to provide realistic requirements for construction of homes. Fire wise this includes 2500 gallons of water per structure. Increased risk as population increases is moot since the populace is highly motivated and responsive to the fire problem, thus smaller fire acreages.

Response

Statewide, the standards within a jurisdiction are same, whether a contractor or an owner/builder. Fire safety requirements need to be applied uniformly to benefit individuals and fire fighters, such as these minimum fire safety standards. A mobile, responsive populace does not change the effect of fire on structure and resource loss, a small fire will destroy resources and homes as easily as a large fire.

**Issue**

Should implement the standardization of public water storage at school sites. Where they could have easy access.

Response

Schools are currently required by state law to provide fire protection systems, including water supplies. Yet schools are not located to provide water for an emergency. Water is necessary at other sites.

**Issue**

It is obvious from Section 1275.15 that these standards are not adequate, since they are overruling them in terms of valve sizes.

Response

The Board rejects this comment. The language is clear and concise. 1275.15 does not overrule the referenced standards, but provides a minimum hydrant performance standard which is not provided in the other documents.

**Issue**

The NFPA standard 1231 which is an alternate for the PUC 103 is for individual static water systems and should not be applicable except for large multiple building locations.

Response

NFPA 1231, a nationally accepted standard specifically addresses single family residential water supplies.

**Issue**

Remove the reference to mobile water systems.

Response

The Board rejects this language proposal. Mobile water systems are one of several opportunities to meet the need for wildland water supplies. To eliminate this option will limit the effectiveness of these regulations and will negate the effect that mobile water systems can have on wildland fire protection.

**Issue**

Suggest climatic zones be used as a basis for water regulations. Because wildland fires are not an issue during the winter months, requirements for freeze protection are questioned

Response

Fire season is not determined by the time of year, but rather the weather and fuel conditions that exist. Wildfires regularly occur during the winter months in freezing weather. The requirement here implies availability whenever wildfires may occur, however, it is unreasonable to expect that homeowners will drain their primary emergency water supply during the winter. Thus the freeze protection requirement as required by local government.

**Issue**

What road mile distance and what supplemental water distances are needed. Propose a 10 mile road distance from water tender, beyond, require supplemental water sources.

Response

The requirements for mobile water tenders is found in the ISO rural standard referenced.

**Issue**

The regulations should specify holding structures and delivery systems for water, as well as refill requirements.

Response

What works well in one area may not in another. For wildland fire suppression, any system, whether pressure, gravity or draft, can reasonable provide water to refill an engine.

**Issue**

Should add a section which recognizes the fire fighting value of the public operated water ditch. A section which prevents abandoning a public operated water ditch without prior approval by the BOF.

Response

The regulations do not required specific containment structures, preferring to accept any structure which provides the necessary quantity that is readily accessible to fire equipment. The Board does not have the authority to regulate water conveyances. That authority lies with the PUC.

**Issue**

Automatic sprinkler systems for various structures would quite helpful in some circumstances.

Response

The regulations accept the value that interior residential sprinklers provide in protecting life and property from a fire that starts on the interior of a structure and in fact, can prevent a structure fire from spreading to the wildlands. However, an interior residential sprinkler system has little effect on a fast moving, intensely burning wildfire. There are no exterior, automatic systems that are on the market or have proven themselves.

**Issue**

Inyo County does not require a building permit (as per Uniform Building Code) for small water tanks, does this mean that the county code must be changed?

Response

These regulations do not require that a building permit be issued for a water tank, only that a building, which is approved by a building permit, may be required to meet a water storage

requirement. The intent here is to require emergency water supplies in subdivisions. Where provided as a condition of a map, the individual homeowner may be required to provide that water. In this case, the building permit process becomes a good tool to apply this requirement.

**Issue**

2500 gallons of storage only provides 3 minutes of water pumping, this is inadequate.

Response

The primary purpose of water storage relative to wildfire is to shuttle and refill fire engines placed at hose lays. Under actual conditions, engines do not pump at maximum capacity, which would provide 25 minutes of water for a single CDF wildland engine based on standard nozzles and hose capability. This quantity has proven to be sufficient based upon field experience.

**1275.15. Hydrant/Fire Valve**

(a) The hydrant or fire valve shall be 18 inches above grade, 8 feet from flammable .LM 6 vegetation, no closer than 4 feet nor farther than 12 feet from a roadway, and in a location where fire apparatus using it will not block the roadway.

The hydrant serving any building shall:

(1) be not less than 50 feet nor more than 1/2 mile by road from the building it is to serve, and

(2) be located at a turnout or turnaround, along the driveway to that building or along the road that intersects with that driveway.

(b) The hydrant head shall be brass with 2 1/2 inch National Hose male thread with cap for pressure and gravity flow systems and 4 1/2 inch draft systems. Such hydrants shall be wet or dry barrel as required by the delivery system. They shall have suitable crash protection as required by the local jurisdiction.

Background

The above grade requirement allows clearance for a hydrant wrench to remove the cap, while the distance from flammable vegetation provides a safety area and security for the hydrant and the user. The siting requirement also provides a safe distance from the structure and a reasonable expectation that hydrants will by available near structures yet located throughout an area. The turnout or turnaround requirement allows apparatus to access a hydrant, yet keep the road or driveway clear. The hydrant specifications are minimums and in most cases, local standards will be greater. Crash protection is another arguable subject and local requirements should be followed.

**Issue**

All hydrants should be reachable with 1 length of suction hose. This distance should be set at 7'. Hydrant serving buildings should be no farther than 300' from the building.

Response

These requirements meet the needs of CDF fire apparatus and allow for some flexibility of

placement. Local government may adopt more stringent standards per 1270.03.

**Issue**

The hydrant/fire valve should be located not less than 150 feet, or more than 750 feet from the structure protected. By locating not less than 150 feet, fire apparatus can park a safe distance from the structure and still use the normal 150 foot pre-connect attack lines. When located more than 750 feet, a minimal water supply is not effective due to the time and equipment needed in setting a water shuttle operation.

Response

Wildland fire conditions do not follow the patterns of structural fire protection. Water supplies for wildland fire protection should be strategically placed and easy to access. In each case, the water required should be reasonably associated with the building to ensure conformance and as a secondary measure, to provide some element of protection to that building. The water requirement in these regulations does not apply to structural fire protection which is the responsibility of local government. Local requirements are authorized under 1270.03.

**1275.15(a)1)**

(a) The hydrant or fire valve shall be 18 inches above grade, 8 feet from flammable .LM 6 vegetation, no closer than 4 feet nor farther than 12 feet from a roadway, and in a location where fire apparatus using it will not block the roadway.

The hydrant serving any building shall:

(1) be not less than 50 feet nor more than 1/2 mile by road from the building it is to serve, and

**Issue**

Unsafe minimum GPM. The minimum GPM for the engine should be one that qualifies for a fire insurance rating.

Response

The water requirement here does not address structural fire which is the responsibility of local government. Local requirements are authorized under 1270.03.

**1275.15(a)2)**

(2) be located at a turnout or turnaround, along the driveway to that building or .LM 11 along the road that intersects with that driveway.

**1275.15(b)**

(b) The hydrant head shall be brass with 2 1/2 inch National Hose male thread with cap for pressure and gravity flow systems and 4 1/2 inch draft systems. Such hydrants shall be wet or dry barrel as required by the delivery system. They shall have suitable crash protection as required by the local jurisdiction.

**Issue**

How will you insure that all tanks will hook-up to these water sources.

Response

The Board has provided for this in 1275.15(b), requiring nationally recognized and CDF compatible adapters.

**Issue**

Add minimum 4" pipe to this section, providing a minimum 500 gallons per minute.

Response

The minimum size is generally considered to be 2 1/2" pipe for a pressure system and 4" pipe for a draft system, though this may be specified by the local jurisdiction.

**1275.20. Signing of Water Sources**

Each hydrant/fire valve or access to water shall be identified as follows:

(a) if located along a driveway, a reflectorized blue marker, with a minimum dimension of 3 inches shall be located on the driveway address sign and mounted on a fire retardant post, or

(b) if located along a street or road,

1) a reflectorized blue marker, with a minimum dimension of 3 inches shall be mounted on a fire retardant post. The sign post shall be within 3 feet of said hydrant/fire valve, with the sign no less than 3 feet nor greater than 5 feet above ground, in a horizontal position and visible from the driveway, or

2) as specified in the State Fire Marshal's Guidelines for Fire Hydrant Markings Along State Highways and Freeways, May 1988.

Background

Second in priority to the establishment of water storage or delivery systems is the identification of those locations. During smoky or night conditions it may be very difficult to find that hydrant or source. Signing may follow the requirements above or the SFM's guidelines.

**Issue**

Is the sign the blue marker, and does it go on top of the post and what driveway?

Response

The blue marker that identifies the hydrant location is referred to as a "sign".

**Issue**

Blue reflectorized markers for hydrants should also include pavement markers on the centerline of

the road, as an alternative.

Response

The regulations include this option through 1270.03 and 1270.08.

## ARTICLE 5. Fuel Modification

### 1276.00. Intent

To reduce the intensity of a wildfire by reducing the volume and density of flammable vegetation, the strategic siting of fuel modification and greenbelts shall provide (1) increased safety for emergency fire equipment and evacuating civilians; and (2) a point of attack or defense from a wildfire.

Background

The establishment of physical barriers between a structure and the wildland is recognized as a major deterrent and loss reduction measure and should be considered the key to individual and community defensible space. While fuel breaks have strategic application over large geographical areas, they are expensive to construct and maintain. Other measures, such as the strategic siting of roads, recreational parks, irrigated landscaping, setback from property lines and fuel modification around structures are more suitable in and around homes and subdivisions.

**Issue**

Many areas are so remote that CDF engines may not arrive for up to 1 hour. Require fuelbreaks and greenbelts in these areas. Road widths may not be applicable nor may unobstructed circulation be feasible.

Response

These regulations will protect wildland areas and structures and communities. The placement of fuelbreaks and greenbelts are commonly used fire defense practices throughout California and the nation. Roads are primarily designed to provide access and secondarily as fuelbreaks.

**Issue**

The need for a 10 foot wide hazard reduction area along each side of all access roadways is critical.

Response

These regulations are based on the hazard of a moderate fire hazard severity zone. Local government may require more stringent standards where deemed appropriate based on higher levels of fire hazard severity per 1270.03.

**Issue**

Roads should not be approved until prescribed burning is completed.

Response

Prescribed burning is not mandatory, but is an option available to local jurisdictions under 1270.03 and 1270.08. CDF maintains an aggressive prescribed fire program that cost shares necessary work and costs with landowners.

**1276.01. Setback for Structure Defensible Space**

(a) All parcels 1 acre and larger shall provide a minimum 30 foot setback for buildings and accessory buildings from all property lines and/or the center of a road.

(b) For parcels less than 1 acre, local jurisdictions shall provide for the same practical effect.

Background

The key to individual defensible space is the setback requirement that will provide the opportunity to clear flammable vegetation the minimum 30' as provided for in PRC 4291. Local government has required setbacks of 5-10' for utility easements between structures, not for exposure protection. This requirement will improve exposure protection as well as provide defensible space on an individual property. It is difficult to achieve the 30' setback on smaller parcels due to their limited building sites. Where 30' cannot be achieved on all sides, efforts should focus on the directions of greatest threat to the wildlands and to the structure. While these regulations cannot require fire resistant construction as a mitigation, this is probably the most effective alternative to setback and could be required by the local jurisdiction.

**Issue**

Apply the setback requirement to parcels 5.1 acres and larger.

Response

This section requires a 30' setback for parcels one acre or larger and requires smaller parcels to provide for the same practical effect. The 30' setback can be accomplished on much smaller parcels and provides the area necessary to accomplish the minimum clearance required by PRC 4291. This is the basic or cornerstone protection requirement for wildland resources and structures.

**Issue**

Looks like an unusually large setback for some of the higher uses that are allowed in the SRA.

Response

State law currently requires clearance of flammable vegetation for a minimum of 30' around structures in SRA. This provision only allows that clearance to be provided. Where higher density developments are proposed, perimeter protection or alternative protection measures can be considered.

**Issue**

Will result in numerous requests for exceptions and appeals

Response

It is common for exceptions and appeals to be requested in large numbers during the early stages of regulation/ordinance implementation. These requests taper-off as the rules are enforced uniformly and consistently.

**Issue**

If this defensible space is provided around the subdivision it would not be necessary to have a 30 foot setback on all lots within the permitter of the defensible space.

Response

Burning brands travel in advance of the main fire front, landing "behind the lines", possibly in areas that are not protected through the clearance of flammable vegetation. Both interior and exterior fuel modification is needed.

**Issue**

What about commercial development in community areas being subject to this requirement even if there is no adjacent wildland to protect with the 30 ft. setback.

Response

Commercial structures are just as vulnerable to wildfire as residential and provide the same risk to wildlands, in some cases, more.

**Issue**

Will a setback apply to individual parcels that have been designed to be fire safe due to a community planning design that provides a perimeter buffer that achieves overall deforested space?

Response

Setback applies to the individual parcel. Greenbelts apply to developments and subdivisions.

**Issue**

Will the setback apply to all structures (house, garage, storage building, barns, fences that require building permit, etc.

Response

Section 1276.01 applies to all buildings.

**Issue**

The current county building code setback requirement is adequate.

Response

Current setbacks are provided for utility and access easements and separation of structures in the event one catches fire. Structure fire do not throw burning brands to the extent that wildfires do.

**Issue**

Recommend that the minimum setback distance be applicable only to those parcels submitted for

creation after the adoption of the regulations.

Response

The provision of defensible space through clearance of flammable vegetation applies to any structure in SRA. This section only enhances the application and effectiveness of PRC 4290 which requires said clearance.

**Issue**

Setback will limit the area of buildability on small and narrow parcels.

Response

Alternatives or mitigation can be provided through 1270.08.

**Issue**

Amend performance requirements for water and architecture and vegetation modification to alleviate setback. A more active role at the general plan and zoning level may alleviate this problem.

Response

The Board and the Department do not have the authority to create building standards and water upgrades alone will not resolve the problem. The Board and CDF have been actively involved in the general plan process for 28 years with limited success. Local government must become active and responsive in it's own process relative to wildland fire protection.

**Issue**

Does setback apply to all sides of the property. If so, suggest that greenbelts be used instead so total perimeter of a subdivision can be protected in high fire hazard zones.

Response

Setback applies to all sides of a parcel, however, credit for the defensible space provided by a road may be applied where a road abuts the property. Where a road does not abut the property boundary, the property boundary becomes the measuring point. The setback distance is based on a moderate fire hazard severity zone threat. More stringent standards may be applied by local government under 1270.03. This setback will allow the application of the minimum fuel modification requirements in PRC 4291, acting as a greenbelt around each individual structure.

**Issue**

Agricultural parcels should be excluded from this requirement.

Response

The Board rejected this proposal as future changes in land use designations and zoning may accelerate the risk and hazard these sites present and face.

**Issue**

Allows circumvention of rules by subdividing into less than 1/3 acre parcels.

Response

Parcels less than 1 acre must provide for consideration of the setback requirement through other activities that provide the same practical effect.

**1276.01(a)**

(a) All parcels 1 acre and larger shall provide a minimum 30 foot setback for buildings and accessory buildings from all property lines and/or the center of a road.

**1276.01(b)**

(b) For parcels less than 1 acre, local jurisdictions shall provide for the same practical effect.

**1276.02. Disposal of Vegetation and Fuels**

Disposal, including chipping, burying, burning or removal to a landfill site approved by the local jurisdiction, of flammable vegetation and fuels caused by site development and construction, road and driveway construction, and fuel modification shall be completed prior to completion of road construction or final inspection of a building permit.

Background

The accumulation of construction and site development debris will significantly increase the hazard and risk to the wildlands and structures. This material must be disposed of as specified in this section.

**Issue**

Change landowner to developer as the responsible party.

Response

The developer is the landowner and is responsible for disposal during development construction. When an individual building is constructed on an individual parcel, the landowner becomes the responsible individual. Fuels can be a significant problem in either situation.

**Issue**

Would this section allow for on-site burning? If final inspection came during no burn periods could the ultimate removal/burning be bonded?

Response

Yes if allowed by local burning regulations. Bonding is allowable under 1270.08.

**1276.03. Greenbelts**

Subdivisions and other developments, which propose greenbelts as a part of the development plan, shall

locate said greenbelts strategically, as a separation between wildland fuels and structures. The locations shall be approved by the inspection authority.

Background

Greenbelts are highly effective buffers and barriers to a threatening wildfire. When a developer proposes the construction of greenbelts as a part of the development plan, they must be strategically located to improve wildland fire protection. These locations must be determined at the local level and may require on-site determination.

**Issue**

Concerns that other tools may be available, also use of greenbelt might be being used to mitigate noise from some source.

Response

The Board has addressed this issue through 1270.08.

**Issue**

The current wording appears to leave all discretion to the Director or his designee with no guidance.

Response

The location of greenbelts to provide fire protection are dependent upon the design and layout of the subdivision and the on-site physical conditions that will identify areas of needed or priority wildfire protection. These discretionary activities can be easily applied during the review process or through CEQA comments. Guidance comes from CDF as the wildland fire expert.

**Issue**

Is this mandatory with the review and approval of new subdivisions? It should be for all new developments in SRAs that have high wildland fire potential.

Response

The review for greenbelt application is mandatory relative to subdivisions and developments. All of California's wildlands have the potential for catastrophic burning conditions, thus the application to all areas of SRA.

GENERAL ORDER 103

# Public Utilities Commission of the State of California

## RULES GOVERNING WATER SERVICE INCLUDING MINIMUM STANDARDS FOR DESIGN AND CONSTRUCTION

Adopted June 12, 1956; Effective July 1, 1956
Decision No. 53204, Case No. 5463

Amended May 17, 1960; Decision No. 60104
Amended January 24, 1967; Decision No. 71886
Amended April 15, 1975; Decision No. 84334
Amended April 21, 1982, Effective May 21, 1982; Decision 82-04-089 *
Amended June 15, 1983, Effective July 15, 1983; Decision 83-06-065
*(Corrected August 17, 1983; Decision 83-08-046 **)
**(Corrected September 7, 1983; Decision 83-09-001)

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## I. GENERAL

1. Intent.

   a. Purpose. The purpose of these rules is to promote good public utility practices, to encourage efficiency and economy and to establish minimum standards to be hereafter observed in the design, construction and operation of waterworks facilities by water utilities operating under the jurisdiction of the Commission. The standards herein prescribed are intended as minimum standards applicable after adoption and continued full utilization of existing facilities is contemplated. Nothing contained in any of the rules herein promulgated shall be construed to require the replacement or abandonment prior to the expiration of economic utilization of facilities in use at the time of adoption of these rules unless the Commission, after hearing, shall enter an order directing the abandonment or replacement of particular facilities found to be inadequate for the rendition of proper public utility service.

   b. Absence of Civil Liability. These rules are adopted by the Commission to establish minimum standards in relation to the design, construction and operation of waterworks facilities by water utilities operating under the jurisdiction of the Commission. Such establishment shall not impose upon these utilities, and they shall not be subject to, any civil liability for damages, which liability would not exist at law if these rules had not been adopted.

2. Applicability. These rules are designed primarily for utility systems supplying potable water under pressure but shall apply insofar as they may be appropriate to utility systems supplying water not intended or claimed to be potable from ditches, canals or other conduits. The paragraphs of these rules applicable to utility systems supplying such non-potable water are set forth in Appendix A hereto.

3. Definitions.

   a. Commission. In the interpretation of these rules the word "Commission" shall be construed to mean the Public Utilities Commission of the State of California.

   b. Utility. Any person, firm, or corporation, their lessees, trustees, receivers or trustees appointed by any court whatsoever, owning, controlling, operating, or managing any water system within this State, who sells, leases, rents, or delivers water to any person, firm, corporation, municipality, or any other political subdivision of the State, whether under contract or otherwise, is a public utility, except as provided in Sections 2704, 2705 and 2706 of the Public Utilities Code.

   c. Customer. The word "customer" shall be construed to mean

any person, firm, association, corporation or governmental agency supplied or entitled to be supplied with water service for compensation by a utility.

d. Meter. The word "meter" shall be construed to mean any device used for the purpose of measuring the quantity of water delivered by a utility to a customer.

e. Service Pipe. The term "service pipe" shall be construed to mean the connection between the utility's mains and the service connection and shall include all of the pipe, fittings and valves necessary to make the connection.

f. Service Connection. The term "service connection" shall be construed to mean the point of connection to the customer's piping or ditch with the meter, service pipe or ditch owned by the utility.

4. Information Available to Public. The utility shall maintain, open for public inspection, at its more important commercial offices pertinent information regarding the service rendered including the following:

a. Characteristics of Water. A description in writing of the kind of water to be furnished, whether filtered or unfiltered and whether treated or untreated and the extent thereof.

b. Rates and Rules. A copy of the tariff schedules consisting of rates, general rules of the utility, service area maps and forms of contracts and applications applicable to the territory served from that office.

c. Reading Meters. Information about method of reading meters.

d. Bill Analysis. A statement of the past readings of the meter or meters serving a customer's own premises for a period of two years.

5. Access to Property. The utility shall at all reasonable hours have access to meters, service connections and other property owned by it which may be located on customer's premises for purposes of installation, maintenance, operation or removal of its property at the time service is to be terminated. The customer's system should be open for inspection at all reasonable times to authorized representatives of the utility. Any employee of the utility whose duties require him to enter the customer's premises shall wear a distinguishing uniform or other insignia, identifying him as an employee of the utility, or carry on his person a badge or other identification which will identify him as an employee of the utility, the same to be shown by him upon request.

6. Discontinuance of Service.

a. For Noncompliance with Rules. No utility shall discontin



service to any customer for violation of its rules without first having diligently tried to induce the customer to comply with its rules on file with the Commission. After such effort on the part of the utility, service may be discontinued after the utility has given the customer at least five day's written notice of such intention either by mail or by leaving such notice in a conspicuous place at the customer's premises. Where safety of water supply is endangered, service may be discontinued immediately without notice.

b. For Nonpayment of Bills. No utility shall discontinue service to any customer for nonpayment of bills (including delayed payment charges) without first having diligently tried to induce the customer to pay same. After such effort on the part of the utility, service may be discontinued after the utility has given the residential customer at least 15 days and the nonresidential customer at least 7 days written notice of such intention in the manner provided in the preceding paragraph, commencing after the 19-day normal payment period, except that no service may be discontinued on any Saturday, Sunday, legal holiday, or at any time in which the business offices of the company are not open to the public. Provided further that the utility shall make a reasonable attempt to personally contact an adult on the residential customer's premises, either by telephone, by visit, or by mail delivery at least 24 hours prior to termination. For elderly or handicapped residential customers, the utility shall provide at least 48 hours notice by telephone or visit. For these customers, if a personal contact cannot be made, a notice shall be posted in a conspicuous location at the service address at least 48 hours prior to termination.

c. For Unsafe Apparatus or Where Service is Detrimental or Damaging to the Utility or Its Customers. If an unsafe or hazardousd condition is found to exist on the customer's premises, or if the use of water thereon by apparatus, appliances, equipment or otherwise is found to be detrimental or damaging to the utility or its customers, the service may be shut off without notice, provided that the utility shall notify the customer immediately of the reasons for the discontinuance and the corrective action to be taken by the customer before service can be restored.

d. For Fraudulent Use of Service. When the utility has discovered that a customer has obtained water service by fraudulent means, or has diverted the water service for unauthorized use, the service to that customer may be discontinued without notice. The utility shall not be required to restore service until the customer has complied with all filed rules and reasonable requirements of the utility and the utility has been r ursed

for the full amount of the service rendered and the actual cost to the utility incurred by reason of the fraudulent use.

e. Reconnection. In all cases of discontinuance of service as herein defined, and after the cause for discontinuance has been corrected, and all rules of the utility on file with the Commission have been complied with, the utility shall, without unreasonable delay, restore service to the customer.

f. Charge for Reconnection. Where service has been discontinued for violation of rules or for nonpayment of bills, the utility may charge $10.00 for reconnection of service during regular working hours or $15.00 for reconnection of service at other than regular working hours when the customer has requested that the reconnection be made at other than regular working hours.

7. Refusal to Serve.

a. Conditions for Refusal. The utility may refuse to serve an applicant for service under the following conditions:

(1) If the applicant fails to comply with the rules of the utility as filed with the Commission.

(2) If the intended use of the service is of such a nature that it will be detrimental or injurious to the service furnished to existing customers.

(3) If, in the judgment of the utility, the applicant's installation for utilizing the service is unsafe or hazardous, or of such a nature that satisfactory service cannot be rendered.

(4) Where service has been discontinued for fraudulent use, it shall be the duty of the utility before making service connections to a new customer to ascertain that prior fraudulent use of the facilities will not be attributed to the new customer. Where service has been discontinued for fraudulent use, the utility shall not be required to serve an applicant until the utility has determined that all conditions of fraudulent use or practice have been corrected.

b. Notification to Customers. When an applicant is refused service under the provisions of this rule, the utility shall notify him promptly of the reason for the refusal to serve and of his right to appeal the utility's decision to the Commission.

8. Complaints. Upon complaint to the utility by a customer either at its office, by letter or by telephone, the utility shall promptly make a suitable investigation and advise the complainant of the results thereof. It shall keep a record of all complaints which shall show the name and address of the complainant, the date and nature of the complaint, and the adjustment or disposition thereof for a period of two years subsequent to the final settlement of the complaint. After two years the utility shall keep at its option either the original complaints or a summary of such com-



plaints for an additional three years. Complaints with reference to rates or charges which require no further action by the utility need not be recorded.

9. Accidents. The utility shall cooperate with the Commission to promote a reduction in hazards within the industry and to the public. The utility shall keep a record of any accident endangering the public in general, or its employees, or disrupting the facilities for supplying water to the public which may have caused substantial property damage, serious personal injury or death, which shall be available for inspection by the Commission for the period prescribed by the California Code of Civil Procedure for the commencement of actions thereon but in no instance less than five years. The utility shall assist the Commission in the event of an investigation by the Commission staff.

10. Records and Reports.

a. System Maps. Each utility shall have on file at its principal office located within the state, drawings, maps or other permanent records for the purpose of aiding in the operation of the water system. The scale of such maps or drawings shall be such that all data recorded thereon shall be clear and legible. These records, unless the Commission otherwise authorizes, shall show the following:

(1) Location of all principal pumping stations, diversion works, water treatment and filter plants, sources of supply, storage facilities, size, character, and location of all mains and ditches, including valves and gates, gauges, interconnections with other systems and fire hydrants.

(2) Location, size and kind of each service pipe.

(3) Layout of all principal pumping stations, water treatment and filter plants to show size, location and character of all major equipment, pipelines, connections, valves and other equipment used in connection therewith.

(4) The date of construction of all principal items of plant and extensions of main.

b. Location of Records. All records required by these rules shall be kept at the principal office of the utility or other suitable storage place located within the state and shall be made available to representatives, agents or employees of the Commission upon reasonable notice and at all reasonable hours.

c. Reports to the Commission. The utility shall furnish to the Commission, at such times and in such form as the Commission may require, the results or summaries of any tests required by these rules. The utility shall also furnish the Commission with any information concerning the utility's facilities or operations which the Commission may request and need for determining rates or judging the practices of the utility.

11. Deviations from Any of These Rules. In those cases where the application of any of the rules incorporated herein results in undue hardship or expense to the utility, it may request specific relief by filing a formal application in accordance with the Commission's Rules of Procedure, except that where the relief to be requested is of minor importance or temporary in nature, the Commission may accept an application and showing of necessity by letter.

## II. STANDARDS OF SERVICE

1. Quality of Water.

   a. General. Any utility serving water for human consumption or for domestic uses shall provide water that is wholesome, potable, in no way harmful or dangerous to health and, insofar as practicable, free from objectionable odors, taste, color and turbidity. Any utility supplying water for human consumption shall hold or make application for a permit as provided by the Health and Safety Code of the State of California, and shall comply with the laws and regulations of the state or local Department of Health Services. It is not intended that any rule contained in this paragraph II 1 shall supersede or conflict with an applicable regulation of the State Department of Health Services. A compliance by a utility with the regulations of the State Department of Health Services on a particular subject matter shall constitute a compliance with such of these rules as relate to the same subject matter except as otherwise ordered by the Commission.

   b. Water Supply. In the absence of comparable requirements of the State Department of Health Services, the following general rules shall apply:

      (1) Source. Water supplied by any utility shall be:

         (a) Obtained from a source free from pollution; or obtained from a source adequately purified by natural agencies; or adequately protected by artificial treatment.

         (b) From a source reasonably adequate to provide a continuous supply of water.

         (c) Of such quality as to meet the United States Environmental Protection Agency Drinking Water Standards.

      (2) Operation of Supply System.

         (a) The water supply system, including wells, reservoirs, pumping equipment, treatment and filtration works, mains, meters and service pipes shall be free from sanitary defects.

         (b) No physical connection between the distribution system of a public potable water supply and that of ar



other water supply shall be permitted except in compliance with the Regulations Relating to Cross-Connections of the State Department of Health Services contained in Title 17 of the California Administrative Code.

         (c) The presence of algae, crenothrix and other growths in the water shall be controlled by proper treatment.

   c. Testing of Water.

      (1) Test. Each utility shall have representative samples of the water supplied by it examined by the state or local Department of Health Services or by an approved water laboratory as defined in Title 17 of the California Administrative Code, at intervals specified by the state or local Department of Health Services, in accordance with the United States Environmental Protection Agency Drinking Water Standards.

      (2) Reports of Tests. The Commission shall be promptly notified in writing by the utility and supplied with a preliminary report describing the situation when matters of water quality are under review by the state or local Health Department as a result of not meeting the United States Environmental Protection Agency Drinking Water Standards. A final report shall be submitted to the Commission within a reasonable time after final disposition of the matter.

2. Continuity of Service.

   a. Emergency Interruptions. Each utility shall make all reasonable efforts to prevent interruptions to service and when such interruptions occur shall endeavor to reestablish service with the shortest possible delay consistent with the safety to its customers and the general public. Where an emergency interruption of service affects the service to any public fire protection device, the utility shall promptly endeavor to notify the Fire Chief or other public official responsible for fire protection of such interruption and of subsequent restoration of normal service.

   b. Scheduled Interruptions. Whenever any utility finds it necessary to schedule an interruption to its service, it shall, where feasible, notify all customers to be affected by the interruption, stating the approximate time and anticipated duration of the interruption. Scheduled interruptions shall be made at such hours as will provide least inconvenience to the customers consistent with reasonable operations. Where public fire protection is provided by the mains affected by the interruptions, the utility shall promptly endeavor to notify the Fire Chief or other officials responsible for fire protection ting

the approximate time and anticipated duration. In addition, the Fire Chief or other official responsible for fire protection shall be notified promptly upon restoration of service.

c. Record of Interruptions. Each utility shall keep a complete record of all major interruptions, both emergency and scheduled. This record shall show the cause for interruption, date, time, duration, location, approximate number of customers affected and, in cases of emegency interruptions, the remedy and steps taken to prevent recurrence.

d. Reports to Commission. All emergency interruptions involving an entire system, an entire separately operated system of a multi-system utility or a major portion of an entire or separately operated system shall be reported to the Commission by the utility as soon as possible after occurrence by telephone or telegraph stating the cause, date, time, estimated duration, location, approximate number of customers affected and remedial steps being taken to restore service. Written reports thereof shall be submitted to the Commission within 48 hours after restoration of service giving the information outlined in subparagraph c above, together with such other data as may be appropriate under the circumstances.

3. Pressures.

a. Variations in Pressure. The utility shall maintain normal operating pressures of not less than 40 p.s.i.g. nor more than 125 p.s.i.g. at the service connection, except that during periods of hourly maximum demand the pressure at the time of peak seasonal loads may be not less than 30 p.s.i.g. and that during periods of hourly minimum demand the pressure may be not more than 150 p.s.i.g. Subject to the minimum pressure requirement of 40 p.s.i.g., variations in pressures under normal operation shall not exceed 50% of the average operating pressure. The average operating pressure shall be determined by computing the arithmetical average of at least 24 consecutive hourly pressure readings.

b. Main Sizing. As new mains are installed or as mains which have reached the end of their useful lives are replaced, the new or replacement main shall be sized and designed to accommodate the standards of paragraph II 3 a.

c. Delineation of Minimum Normal Operating Pressures. Other minimum normal operating pressures are applicable within delineated areas as set forth on the utility's Commission approved tariff sheets.

d. Pressure Gauges. Each utility shall provide itself with one or more recording pressure gauges for each separately operated system for the purpose of making pressure surveys as required by these rules. These gauges shall be able to record the pressure experienced on such system and shall be able to record a continuous 24-hour test. Each utility serving 1,000 or more customers in a separately operated system or 1,000 or more customers in any separately operated system of a multi-system utility shall maintain one or more of these recording pressure gauges in service at some representative point or points on the utility's system.



e. Pressure Surveys. At regular intervals, but not less than once each year, each utility shall make a survey of pressures in its distribution system of sufficient magnitude to indicate the pressures maintained at representative points on its system. Such surveys should be made at or near the period of maximum usage. The pressure charts for these surveys shall show the date and time of beginning and end of the test and the location at which the test was made. Records of these pressure surveys shall be maintained by the utility for a period of at least three years and shall be made available to representatives, agents or employees of the Commission upon request.

4. Water Supply Measurement.

a. Measuring Devices. Each utility shall install a suitable measuring device, or otherwise determine production, at each source of supply in order that a record may be maintained of the quantity of water produced by each source.

b. Records. At least once each month, the quantity produced from each source of supply shall be determined. Twelve-month totals by sources shall be recorded and transmitted to the Commission in the utility's annual report to the Commission.

## III. STANDARDS OF DESIGN

1. General. The system shall be adequate to deliver the water requirements of all customers and meet the requirements of paragraph II 3 a.

2. Distribution System.

a. Minimum Pipe Sizes. The distribution system shall be of adequate size, and so designed in conjunction with related facilities to maintain the minimum pressures required by paragraph II 3 a and the minimum pipe size required by paragraph VIII 3. In no event, however, should the minimum pipe size for new mains be less than four inches in diameter.

3. Transmission Systems. The transmission pipelines from sources of supply shall be designed to deliver in combination with related storage facilities and to the limits of the capacity of those sources of supply the maximum requirements of that portion of the system which is dependent upon such transmission pipelines.

4. Water Supply Requirements. The quantity of water delivered to the distribution system from all source facilities should be sufficient to supply adequately, dependably and safely the total requirements of all customers under maximum consumption, and should be determined so as to maintain the specified pressures as required by paragraph II 3 a. Combined flow from sources of supply and storage capacity should be adequate for four consecutive days of maximum use. The utility may make use of the Water Supply Requirements Chart (Chart 1), appended hereto and made a part of these Minimum Standards for average requirements of service. For other than such average requirements, the results obtained from Chart 1 shall be supplemented as appropriate.

5. Materials and Specifications.

a. Qualification. Metallic and nonmetallic materials may be used separately and in combination to construct component parts of a water system including, but not limited to, conduits, pipes, couplings, caulking materials, protective linings and coatings, services, valves, hydrants, pumps, tanks and reservoirs; provided:

(1) The material shall have a reasonable useful service life.

(2) The material shall be capable of withstanding with ample safety factors the internal and external forces to which it may be subjected in service.

(3) The material shall not cause the water to become impure, unwholesome, unpotable or unhealthful.

(4) Materials and equipment shall be so selected as to mitigate corrosion, electrolysis and deterioration.

b. Specification. Materials and equipment shall be specified by a properly qualified person.

c. Newly Developed Materials and Equipment. It is not the intention to prevent the use of newly developed materials and equipment that otherwise meet the requirements of paragraphs a and b, above.

d. Minimum Requirements for Steel Pipeline. The requirements as set forth in paragraphs a, b and c, above, are intended to be general in nature in order to permit full discretion in the selection of proper materials and equipment by the qualified person. However, in distribution and transmission systems the following minimum requirements shall be met in the design of steel pipelines.

(1) Outside Coating. Any of the following, except that those portions laid above ground may be protected on the outside after cleaning by painting only:

(a) Coal tar enamel wrapped as specified by American Water Works Association Specification No. C203.



(b) Asphalt with asbestos felt or fiberglass wrapping in accordance with the Specifications shown in Appendix B.

(c) Reinforced concrete in accordance with American Water Works Association Specification No. C205.

(2) Inside Lining. Any of the following:

(a) Coal tar enamel in accordance with American Water Works Association Specification No. C203.

(b) Asphalt as specified in the Specifications shown in Appendix B.

(c) Cement lining in accordance with American Water Works Association Specification No. C205 or Federal Specification WWP 406, where applicable.

(3) Pipes Under 4-inches Outside Diameter. Pipes under 4-inches in outside diameter may be dipped in asphalt after cleaning without wrapping, provided they have a minimum wall thickness of 12-gauge. If wrapped outside in accordance with the specifications outlined in paragraph d(1), above, the minimum gauge shall be 14-gauge.

(4) Pipes 4-inches Outside Diameter and Larger. The wall thickness of pipes 4-inches in outside diameter and larger shall meet the following minimum gauge requirements:

(a) 4-inch O.D. to and including 6⅝-inch O.D. pipe—12-gauge.

(b) 7-inch O.D. to and including 10¾-inch O.D. pipe—10-gauge.

(c) Pipes over 10¾-inches in outside diameter shall be of 10-gauge minimum steel thickness.

All such pipes shall meet the standard specifications of the American Water Works Association Specification No. C202 and be of adequate design for the existing conditions.

(5) Exception when Used for Reinforcing. Where steel pipe is used as reinforcing for cement coated and lined pipe, steel of lesser wall thickness may be used provided the design is such that the strength of the reinforced concrete is equal to the American Water Works Association Specification No. C202 or Federal Specifications SS-P-381 for a steel pipe of the same diameter.

(6) Exception for Non-corrosive Soils. Where maximum operating pressures will not exceed 200 p.s.i.g. and where soil resistivities are not less than 2,500 ohms/cm³ by tests along the proposed route at intervals not exceeding 250 feet as determined by a properly qualified person or a satisfactory history of service lilfe or prior test along the proposed route which can be certified to be correct and [illegible]n to

be reliable information by the owner or an officer of the utility, steel of the following lesser wall thicknesses may be used for pipes coated in accordance with paragraph d (1) (a) or (b), above, and lined in accordance with paragraph d (2) (a) or (c), above, as follows:

(a) Coal tar lined pipes:
   1. 4-inch O.D. to and including 6⅝-inch O.D.—14-gauge.
   2. 7-inch O.D. to and including 10¾-inch O.D.—12-gauge.

(b) Cement-mortar lined pipes, minimum lining ¼-inch;
   1. 4-inch O.D. to and including 8⅝-inch O.D.—14-gauge.
   2. 9-inch O.D. to and including 12¾-inch O.D.—12-gauge.

## IV. STANDARDS OF CONSTRUCTION

1. General. The design and construction of the utility's water plant shall conform to standard acceptable engineering practices. It shall be designed and operated so as to provide reasonably adequate and safe service to its customers and shall conform to the requirements of the state or local Department of Health Services with reference to sanitation and potability of water.

2. Disinfection of Facilities. All new mains, pumps, tanks, wells and other facilities for handling potable water and insofar as practicable, repaired mains and other facilities, shall be thoroughly disinfected before being connected to the system. The method of disinfection shall be as approved by the State Department of Health Services.

3. Mains.

   a. Depth of Mains. Water mains should be installed below the frost line or be otherwise protected to prevent freezing and shall not have less than 30-inches of cover over the top of the pipe in public streets or alleys except where it is necessary to avoid underground obstructions or rocky or hardpan conditions where such depth is not feasible.

   b. Dead Ends. Insofar as practicable, the utility shall design its distribution system so as to avoid dead ends in its mains. Where dead ends are necessary, the utility shall provide a means for flushing the mains where the normal consumption does not provide adequate circulation of the water. Mains with dead ends shall be flushed as often as necessary to maintain the proper quality of the water.

   c. Segmentation of Systems. Valves shall be provided in distribution mains at reasonable intervals so that repairs may be effected by the utility with interruptions to the service of a minimum number of customers. When feasible, valves shall be provided in the mains at intervals not to exceed one continuous block or 500 feet, whichever is greater, except where a dead end run is not intended to serve any intervening customers.



   d. Grid Systems. Wherever feasible, the distribution system shall be laid out in a properly segmented grid so that in case of breaks or repairs the interruption to service to the customers can be kept to a minimum in number.

4. Service Connections.

   a. Size of Service Pipe. The size, design, material and installation of the service pipe shall conform to the reasonable requirements of the utility, provided, however, that the minimum size of the pipe shall not be less than ¾-inch nominal size. The utility may require the customer to provide such data as may be necessary for the utility to properly size a service larger than ¾-inch nominal size consistent with the requirements of paragraph II 3 a. The utility in installing ¾-inch and 1-inch services may use the following formula as a guide provided the requirements of paragraph II 3 a are met:

      ¾-Inch Service
         Residential Lot Area—Metered Service—8,000 square feet
            Flat Rate Service—10,000 square feet
         Business—Not over 10 outlets and only one flush-o-meter toilet.

      1-Inch Service
         Residential Lot Area—Metered Service—8,000 to 20,000 square feet
            Flat Rate Service—10,000 to 25,000 square feet
         Business—From 10 to 30 outlets and from 1 to 2 flush-o-meter toilets.

   b. Depth of Service Pipe. Except in unusual conditions all service pipes shall be laid at a depth sufficient to prevent freezing, except where services are not intended for use during freezing weather and are actually drained prior to such weather, and at a depth of not less than 18 inches except at its termination in connecting with the meter or customer's piping.

## V. EXTENSION OF SERVICE

1. Mains. Each utility shall file with this Commission as a part of each of its regularly filed tariff schedules the main extension rule prescribed by this Commission.

2. Service Connections.

   a. Ownership of Service.

      (1) Charge for Service Connections. The utility shall make no charge to a customer for making a service connection

except in case of connections for private fire protection service, connections for temporary service, changes made at the request and for the convenience of the customer, where additional connections are requested, because of divisions of land ownership when the land before division was receiving service, and as otherwise provided in the utility's main extension rules.

(2) Utility's Responsibility. In urban areas with dedicated front streets, rear service roads, or public utility easements the utility shall furnish and install the service pipe, curb stop, meter and meter box at its own expense for the purpose of connecting its distribution system to the customer's piping. The service connection, curb stop, meter and meter box may be installed at a convenient place between the property line and the curb, or inside the customer's property line where necessary. The service connection shall determine the point of delivery to the customer of water service by the utility. No rent or other charge will be paid by the utility where such utility owned service facilities are located on a customer's premises. In areas which do not have dedicated front streets, rear service roads, or public utility easements the utility shall furnish and install the service pipe, curb stop, meter and meter box at a convenient point on or near the customer's property except for service beyond the service area.

(3) Customer's Responsibilities Precedent to Receiving Service. The customer as a condition precedent to receiving service shall furnish and lay the necessary piping to make the connection from the service connection to the place of consumption and shall keep such piping in good repair in accordance with such resonable requirements of the utility as may be incorporated in its rules. A main valve shall also be provided by the customer on his piping between the service connection and the point of use. Where service is rendered at or near the service area boundary for use beyond the service area the customer will be required to install, operate and maintain the facilities necessary to provide service.

b. Location of Service. The customer's piping shall extend to that point on the curb line or property line easiest of access to the utility from its existing distribution system or requiring the least extension of the existing distribution main. The utility should be consulted before installation thereof and its approval of location secured.



## VI. MEASUREMENT OF SERVICE

1. Method of Measuring Service.

a. Metering. All water sold by a utility shall be upon the basis of metered volume sales except that the utility may at its option provide flat rate or estimated service for the following:

(1) Residential, business, commercial, industrial (in special situations) and irrigation service after authorization has first been obtained from the Commission.

(2) Temporary service where the water use can be readily estimated.

(3) Public and private fire protection service.

(4) Water used for street sprinkling and sewer flushing, when provided for by contract between the utility and the municipality or other local governmental authority.

b. Registration of Meter. All meters used for metered sales excluding sales from irrigation systems or other irrigation sales shall have registration devices indicating the volume of water in either cubic feet or United States gallons. Where a constant or multiplier is necessary to convert the meter reading to cubic feet or gallons, the constant shall be indicated on the meter or on the meter reading sheet.

c. Irrigation Meters. Irrigation service may be provided with meters which measure in acre feet or miner's inch days. This service may also be rendered on a volume basis by the use of a calibrated orifice such as the miner's inch box, by the use of weirs or otherwise measured as provided in applicable tariff schedules.

d. Charge for Meter Installation. No utility shall charge for its installation of any devices for metering service to a customer, except for temporary service where the utility may charge its actual cost of installation and removal of its metering devices or where irrigation service is rendered through more than one outlet for the convenience of the customer.

2. Meter Test Facilities and Equipment.

a. Test Facilities. Each utility furnishing metered water service shall provide the necessary standard facilities, instruments and other equipment for testing its meters in compliance with these rules. Any utility may be excepted from this requirement provided that satisfactory arrangements are made for test of its meters by another utility or agency equipped to test meters in compliance with these rules.

b. Shop Equipment. The meter test shop shall be provided with the necessary equipment to test up through 2-inch displacement meters, including a quick acting valve for controlling the starting and stopping of the test and a device for re- -ating the

flow of water through the meter under test. The accuracy of the test equipment and test procedures shall be sufficient to enable shop test of displacement meters with an error not to exceed 0.3 of 1%.

c. Test Measurement Standards. Measuring devices for test of meters shall consist of calibrated tanks for volumetric measurement, tanks mounted upon scales for weight measurement or standard meters.

(1) Basic Standards. When a volumetric tank is used, it shall be accompanied by a certificate of accuracy acceptable to the Commission from a County Sealer of Weights and measures or from a standards laboratory. When a weight standard is used, the scales shall be tested and calibrated at least once every year by such approved laboratory, or County Sealer of Weights and Measures and a record maintained of the results of the test. Standard meters may be used for field tests of meter accuracy provided they are tested and calibrated to permit the test of meters within the limits of accuracy required by these rules, either by the utility with its volumetric or weight standard equipment or by an approved laboratory at least once every 60 days while the standard meter is in use and a record of such tests shall be kept by the utility for a period of not less than five years.

(2) Size of Basic Standards. When basic standards are used for meter tests, they shall be of a capacity sufficient to insure accurate determinations. The minimum requirement for testing disc meters from ⅝ × ¾-inch through 2 inches in size shall include a 10 and a 1 cubic-foot tank for meters registering in cubic feet or a 100 and a 10-gallon tank for meters registering in gallons.

3. Accuracy Requirements of Water Meters.

a. General. All meters used for measuring quantities of water delivered to customers shall be in good mechanical condition, shall be adequate in size and design for the type of service which each measures and shall be accurate to within generally accepted standards. The standards of accurancy for displacement meters are set forth in paragraphs b and c, following.

b. Test Flows. For determination of minimum test flow and normal test flow limits, the Commission adopts as a guide the appropriate standard specifications of the American Water Works Association for the various types of meters. These test flows for displacement type cold water meters are as follows:



| *Nominal Meter Size Inches* | *Minimum Test Flow Gallons per Minute* | *Normal Test Flow Limits Gallons per Minute* |
|---|---|---|
| ⅝ or ⅝ × ¾ | ¼ | 1–20 |
| ¾ | ½ | 2–30 |
| 1 | ¾ | 3–50 |
| 1–½ | 1–½ | 5–100 |
| 2 | 2 | 8–160 |
| 3 | 4 | 16–300 |
| 4 | 7 | 28–500 |
| 6 | 12 | 48–1000 |

c. Determination of Accuracy. Displacement meters shall be tested at three or more test flows: one at the minimum test flow, one at 10% of the maximum normal test flow limit and one at a rate over 35% of the maximum normal test flow limit. A meter shall not be placed in service if it registers less than 95% of the water passed through it at the minimum test flow or over or under registers more than 1½% in the normal test flow limits; with the exception that a repaired meter shall register not less than the following appropriate percentage of the water passed through it at the minimum test flow and shall not over or under register more than 2% in the normal test flow limits,

If manufactured on or after January 1, 1947 ..... 90%
If manufactured prior to January 1, 1947 ..... 85%

d. Sealing of Meter. Upon completion of adjustment and test of any water meter under the provisions of these rules, the utility shall affix thereto a suitable seal in such a manner that adjustment or registration of the meter cannot be tampered with without breaking the seal.

e. Record of Test. A complete record of all displacement and other mechanical meter tests and data sufficient to allow checking of test calculations, shall be recorded by the meter tester. Such record shall include: the identifying number of the meter; the type and size of the meter; the constant of the meter; the date and kind of tests made; the reading of the meter before making any test; the error as found at each test; and, if readjusted, the percentage of registration as left after each test. The complete record of tests of each meter shall be retained for at least five years.

4. Initial Tests and Storage of Meters. Every water meter shall be tested as required by these rules prior to its installation either by the manufacturer, the utility or any reliable organization equipped for meter testing. Each meter should be stored in an inverted position or utilize a type of intermediate gear train lubricant which will not flow into the measuring chamber during

storage, and unless so stored or lubricated it shall be so tested immediately before installation.

5. Repaired or Tested Meters. All water meters removed from service for repair or tested in accordance with these rules shall be restored to the prescribed limits of accuracy as required by these rules before again being placed in service.

6. Periodic Tests of Water Meters.

   a. General. The length of time that a meter shall be allowed to remain in service before being tested, or overhauled and tested, should be determined from an economic analysis.

   b. Test Periods.

      (1) Adoption of Test Periods by Utility. A utility may adopt a test period for the periodic test of meters within any well defined separate system as the utility may deem appropriate, based upon a consideration of relevant economic factors and accuracy of meters, provided authorization for such test period for any such separate system is first obtained from the Commission. Requests for such authorization may be made by an application and showing of necessity by letter.

      (2) Test Periods if Not Adopted by Utility. Unless a test period for such periodic tests of meters shall have been adopted as provided in paragraph (1), above, no meter shall be allowed to remain in service without retesting for more than the number of years indicated in the following tabulation:

| *Size of Meter* | *Maximum Period* |
|---|---|
| Smaller than 1-inch | 20 years |
| 1-inch | 15 years |
| Larger than 1-inch | 10 years |

      Nothing in these rules shall be construed to mean that such periodic tests may not be made more frequently than the maximum period specified herein.

   c. Report of Periodic Tests of Meters. Each utility shall make a summary of all periodic tests of meters made each calendar year as required by these rules and shall submit such summary concurrently with, or as part of, the utility's Annual Report to the Commission for that year.

7. Tests on Customer Request.

   a. Compliance by Utility. The utility shall within one week after request by a customer proceed to test the meter serving his premises, except where service is rendered from open conduits such test may be deferred for a reasonable length of time when it would necessitate the interruption of service to any other customer. Such test of meters other than displacement





meters shall consist of an acceptable method of verifying the accuracy of the meter.

   b. Charge for Test. No charge shall be made for such a test, except where a customer requests a test within six months after installation of the meter or more often than once a year, in which cases the customer shall be required to deposit with the utility the following amount to cover the cost of each such test:

| *Size of Meter* | *Amount of Deposit* |
|---|---|
| One inch or smaller | $2.00 |
| Larger than one inch | 3.50 |

   c. Test Procedure. Every meter tested at the request of a customer shall be tested in the condition as found in the customer's service prior to any alteration or adjustment in order to determine the average meter error. This test shall consist of testing at the three rates of flow as determined in paragraph 3c, above, and in addition, at twice the minimum test flow. The average meter error shall be considered to be the algebraic average of the errors of the three highest test flows.

   d. Return of Deposit. Any deposit made under paragraph b, above, will be returned to the customer if the average meter error is found to be more than 2% fast. The customer will be notified not less than five days in advance of the time and place of the test.

   e. Location of Test. A customer shall have the right to require the utility to conduct the test in his presence or in the presence of his representative. Where the utility has no proper meter testing facilities available locally, the meter may be tested by a meter manufacturer or its agency, or by any other reliable organization equipped for water meter testing or by the utility's meter testing plant where located in some other community, in which latter case the utility upon demand of the customer shall furnish the customer with a notarized statement certifying as to the method used in making the test and as to the accuracy of the meter.

   f. Report of Test to Customer. A report showing the results of the test shall be furnished to the customer within 15 days after the completion of the test.

8. Meter Records. Each utility shall keep records giving for each displacement and other mechanical meter owned and used by it for any purpose the identification number, name of manufacturer, serial number, type, size and the dates of installation and removal. These records shall also give condensed information, including dates, concerning all tests.

## VII. RATES AND BILLING

1. Filing of Tariffs. Each utility shall file with the Commission its tariff schedules containing all tariff sheets in accordance with the

procedure prescribed by the Commission.

2. Information on Bills. Each utility shall render a bill to each customer for each billing period. Bills for metered service shall show at least the reading of the meter at the end of the period for which the bill is rendered, the meter constant, if any, the number and kinds of units, and date of the current meter reading.

3. Adjustment of Bills for Meter Error.

   a. Fast Meters. When, upon test, a meter is found to be registering more than 2% fast, the utility shall refund to the customer the amount of the overcharge based on corrected meter readings for the period the meter was in use but not to exceed a period of six months.

   b. Slow Meters.

      (1) Commercial Service. When, upon test, a meter used for commercial (residential and business) service is found to be registering more than 25% slow, the utility may bill the customer for the amount of the undercharge based upon corrected meter readings for the period the meter was in service but not to exceed a period of three months.

      (2) Other Than Commercial Service. When, upon test, a meter used for other than commercial service, is found to be registering more than 5% slow, the utility may bill the customer for the amount of the undercharge based upon corrected meter readings for the period the meter was in service but not to exceed a period of three months.

   c. Nonregistering Meters. The utility may bill the customer for water consumed while the meter was nonregistering, but not to exceed a period of three months, at the minimum monthly meter rate, or upon an estimate of the consumption based upon the customer's prior use during the same season of the year if conditions were unchanged, or upon an estimate based upon a reasonable comparison with the use of other customers during the same period receiving the same class of service under similar circumstances and conditions.

   d. General. When it is found that the error in a meter is due to some cause, the date of which can be fixed, the overcharge or the undercharge shall be computed back to but not beyond such date.

## VIII. FIRE PROTECTION STANDARDS

1. Design Requirements. The flow standards for public fire protection purposes set forth below are those the Commission considers appropriate for application on an average statewide basis. However, the Commission recognizes that there are widely varying conditions bearing on fire protection throughout the urban, suburban, and rural areas of California. Therefore, the standards



prescribed by the local fire protection agency or other prevailing local governmental agency will govern. Such local flow standards shall be provided whether greater or lesser than those set forth below, except that mains designed for and capable of providing flows in excess of the requirements set forth in the following table opposite the classification of land use shall be considered mains providing excess flow for the purpose of the application of the utility's main extension rule.

(a) Initial Construction, Extension, or Modification. In the initial construction, extension, or modification of a water system, any one of which is required to serve (a) a new applicant or (b) a change in use, the facilities constructed, extended, or modified shall be designed to be capable of providing, for a sustained period of at least two hours, in addition to the requirements of the average daily demand within the area to be served, the minimum flow requirements set forth below opposite the classification of land use to be served, or such other fire flow, either higher or lower, as determined either necessary or adequate by appropriate local governmental agency.

| *Land Use* | *Minimum Flow* |
|---|---|
| 1. Rural, residential with a lot density of two or less per acre primarily for recreational and/or parttime occupancy. | 250 gpm |
| 2. Lot density of less than one single-family residential unit per acre. | 500 gpm |
| 3. Lot density of one or two single-family residential units per acre. | 750 gpm |
| 4. Lot density of three or more single-family residential units per acre, including mobile home parks. | 1,000 gpm |
| 5. Duplex residential units, neighborhood business of one story. | 1,500 gpm |
| 6. Multiple residential, one and two stories; light commercial or light industrial. | 2,000 gpm |
| 7. Multiple residential, three stories or higher; heavy commercial or heavy industrial. | 2,500 gpm |

Except as provided in Section VIII 1. (b) below, cost of facilities to meet the governing fire flow standards shall be advanced or contributed in accordance with the utility's tariffs by the party requesting such facilities, unless assumed by the fire protection agency under a signed written agreement.

An existing main which is adequate to provide residential, commercial, or industrial service, but is not sized for the required fire flow, need not be modified for an additional service connection of the same land use classification when no main extension is involved, unless local authority determines that there is increased

exposure of life and property to fire hazards.

Modification of a main to meet requirements set forth under "Land Use" is required for a new land use requiring higher fire flow. No modification is required when existing apartments, receiving service, are converted to condominiums without change of use unless higher fire flows are required by a government agency.

(b) Replacement of Mains. The utility shall not be responsible for modifying or replacing at its expense an existing main, which is otherwise adequate, to provide increased fire flow. However, when the utility initiates the replacement of an existing main the replacement main, if used or useful for fire protection purposes, shall be constructed at the expense of the utility and be sized to accommodate the governing fire flow standard.

2. Flow Tests. The flows set forth in paragraph 1 above are to be calculated on the basis of a residual pressure of 20 p.s.i.g. in the distribution system under flowing conditions.

3. Fire Hydrants. Fire hydrants shall be attached to the distribution system at the locations designated by the agency responsible for their use for fire fighting purposes. Any new mains to which a hydrant may be attached shall be not less than six inches in diameter.

4. Fire Hydrant Service Agreement. The Commission encourages all water utilities to provide fire hydrant service by agreement between the utility and the fire protection agency responsible for the use of the hydrants. Each water utility is expected to make all reasonable efforts to make or renew agreements advantageous to the utility and its customers.

When such written agreement is entered into between the utility and the fire protection agency which requires the utility to be responsible for all or any portion of the capital expenditures or maintenance costs associated with providing fire hydrant service, such expenditures and costs may be included by the utility in its general plant accounts and operating expenses for ratemaking purposes. The utility may bill the fire protection agency for fire hydrant service charges only under written agreement with the agency that it will pay such charges. Fire hydrant charges made under written agreement will also be included in revenues for ratemaking purposes.

In the absence of any written agreement between the utility and the fire protection agency, the utility will be responsible for maintaining fire hydrant service to the extent of its means. All costs associated with providing this service may be included for ratemaking purposes.



Fire hydrant service agreements between the fire protection agency and the utility which deviate materially from a standard fire hydrant service agreement on file in the utility's tariffs shall be submitted by advice letter in accordance with General Order 96-A.

5. Source of Supply. Each separately operated water system shall have not less than two independent sources of supply.

PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

By R.J. PAJALICH
Secretary

## APPENDIX A

**Sections of Rules Governing Water Service Including Minimum Standards for Design and Construction which shall be applicable to utility water systems supplying water not intended or claimed to be potable from ditches, canals, or other conduits.**

Section I—General
All paragraphs of the section, except (2), (3), and (4) of paragraph 10a.

Section II—Standards of Service
Paragraphs 2 and 4 of this section, except that paragraph 2c shall not apply to scheduled interruptions as provided in applicable tariffs.

Section III—Standards of Design
None.

Section IV—Standards of Construction
None.

Section V—Extension of Service
Paragraph 2a (1) of this section.

Section VI—Measurement of Service
All paragraphs of the section, except when sales are measured by other than displacement meters as provided in applicable tariff schedules only paragraphs 1, 3a and e, 5, 6a, 7a, e and f and 8 shall apply.

Section VII—Rates and Billing
All paragraphs of the section, except when sales are measured by other than displacement meters as provided in applicable tariff schedules only paragraphs 1, 2 and 3c and d shall apply.

Section VIII—Fire Protection Standards
None.

## APPENDIX B

### Specification for the Coating and Wrapping of Steel Water Pipe

1. *Scope.*
These specifications cover the material for the asphalt coating of steel water pipe by the double dip process and the wrapping of same with asbestos felt or fiberglass.

2. *Materials.*
Asphalt: Asphalt shall be Union Oil Company's "190 Pipe Dip", or an approved equivalent, and shall conform to the physical requirements set forth below. (Penetration and softening points shall meet the ASTM standard methods of test as specified under the specification Designations ASTM-D5-52 and ASTM-D36-26, respectively.)

| | |
|---|---|
| Penetration at 115° F | 0.75 cm max. |
| Penetration at 77° F | Not less than 0.27 cm |
| Penetration at 32° F | Not less than 0.20 cm |
| Softening point | Not less than 190° F |
| Flash point | Not less than 425° F |
| Ductility at 77° F | Not less than 2.0 cm |
| Solubility in $CCl_4$ | Not less than 99.0% |
| Loss on heating (% by weight) | 0.75 max. |
| Penetration after loss on heating | 80% min. |

3. *Wrapping, Asbestos Felt or Fiberglass.*
After completion of asphalt coating of pipe it shall be machine wrapped with asbestos felt or fiberglass. The wrapping shall be completely sealed and bonded onto the dipped pipe by use of a hot asphaltic coating composition. This asphalt seal coat shall also be applied between the overlaps of the wrapping. Special sections, such as tapers, elbows, and other fittings, may be wrapped by hand. The wrapping shall be applied in a spiral manner providing a minimum overlap of ½-inch. It shall be applied smoothly under suitable mechanical tension to give a good tight wrapping free from wrinkles, buckles, air pockets and tears. At each end of each section of pipe the wrapping shall be omitted for a sufficient distance to permit making the field joints. The minimum distance shall be such as to expose at least 1-inch of asphalt.



4. *Cleaning of Pipe.*
All metal surfaces to be coated shall be thoroughly cleaned of all loose mill scale, dirt, oil, grease, rust and other foreign matter.

5. *Transporting and Handling Coated Pipe.*
The coated pipe shall at all times be handled in such manner, and with such equipment, as will prevent any damage to the protective coating. In loading pipe for shipment, adequate blocking, cradles, braces and padding shall be used as necessary to properly support and secure the pipe and to prevent any abrasion or other damage to the coating in transit.

*Photoelectronic composition by*
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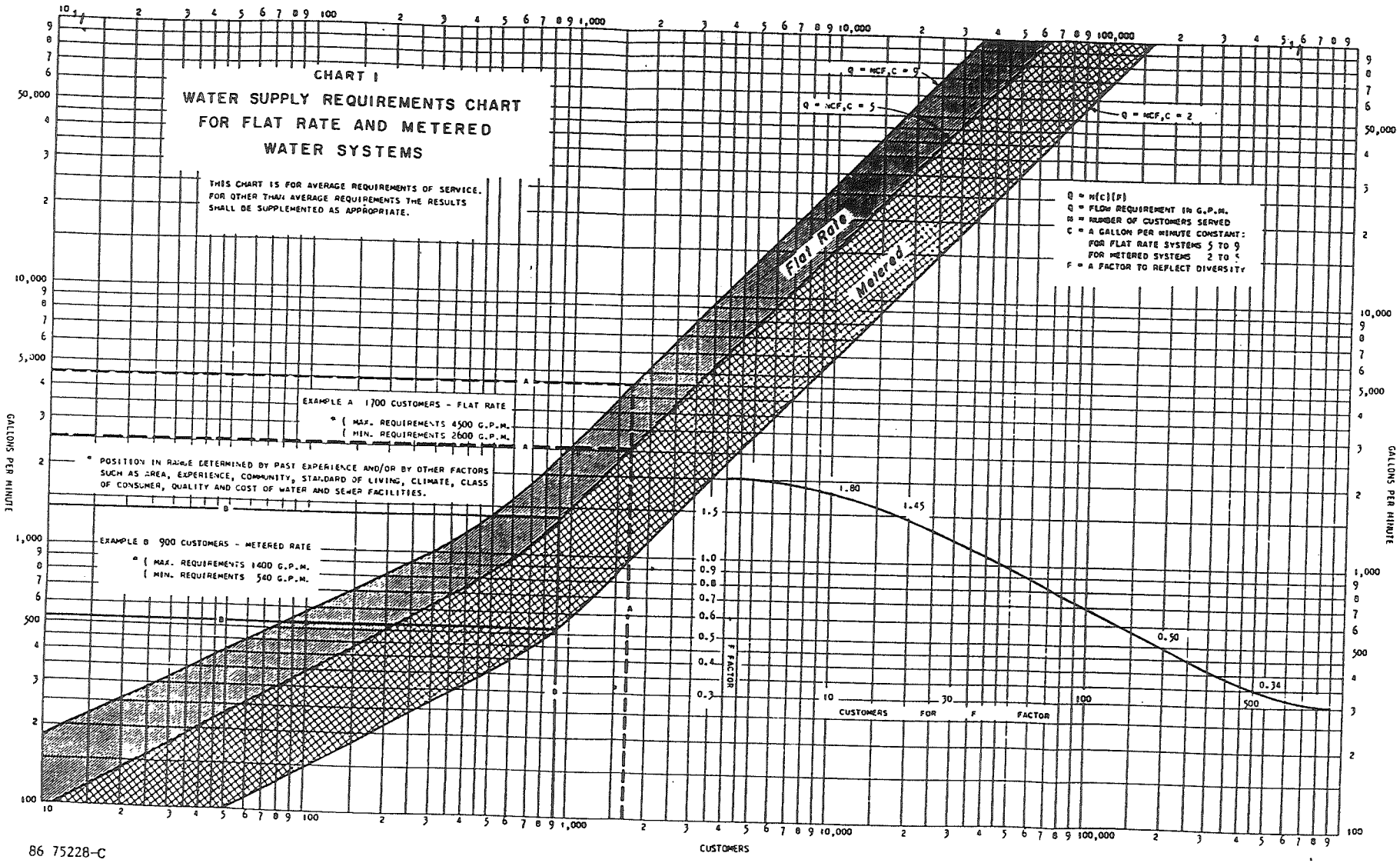


CHART I
WATER SUPPLY REQUIREMENTS CHART
FOR FLAT RATE AND METERED
WATER SYSTEMS
THIS CHART IS FOR AVERAGE REQUIREMENTS OF SERVICE. FOR OTHER THAN AVERAGE REQUIREMENTS THE RESULTS SHALL BE SUPPLEMENTED AS APPROPRIATE.
Q = N(C)(F)
Q = FLOW REQUIREMENT IN G.P.M.
N = NUMBER OF CUSTOMERS SERVED
C = A GALLON PER MINUTE CONSTANT:
FOR FLAT RATE SYSTEMS 5 TO 9
FOR METERED SYSTEMS 2 TO 5
F = A FACTOR TO REFLECT DIVERSITY
Q = NCF,C = 9
Q = NCF,C = 5
Q = NCF,C = 2
Flat Rate
Metered
EXAMPLE A 1700 CUSTOMERS - FLAT RATE
* ( MAX. REQUIREMENTS 4500 G.P.M.
( MIN. REQUIREMENTS 2600 G.P.M.
* POSITION IN RANGE DETERMINED BY PAST EXPERIENCE AND/OR BY OTHER FACTORS SUCH AS AREA, EXPERIENCE, COMMUNITY, STANDARD OF LIVING, CLIMATE, CLASS OF CONSUMER, QUALITY AND COST OF WATER AND SEWER FACILITIES.
EXAMPLE B 900 CUSTOMERS - METERED RATE
* ( MAX. REQUIREMENTS 1400 G.P.M.
( MIN. REQUIREMENTS 560 G.P.M.
F FACTOR
CUSTOMERS FOR F FACTOR
GALLONS PER MINUTE
CUSTOMERS

86 75228-C

Guidelines For

# FIRE HYDRANT MARKINGS ALONG STATE HIGHWAYS and FREEWAYS

**MAY 1988**

Prepared for the

**California State Board of Fire Services**

by the

**Office of the State Fire Marshal**

James F. McMullen, *Chief*

in cooperation with the

**California Department of Transportation**

# FREEWAY HYDRANT MARKING

In response to the increasing number of emergency incidents that are occurring on our state highways and freeways, the State Board of Fire Services - with the cooperation and assistance of CALTRANS officials - developed a standard statewide procedure for marking the location of fire hydrants along these roadways.

The following guidelines should be used when planning a freeway hydrant marking program in your jurisdiction:

1. Prior to any work being performed an encroachment permit must be obtained from the Caltrans office in your particular area. (see attached map for addresses and phone numbers)

2. The fire authority initiating the request is responsible for furnishing, installing and maintaining blue markers and signs on State Highways and Freeways. Work may be performed by fire department personnel under the encroachment permit.

3. A Caltrans inspector should accompany fire department personnel whenever work is being done.

4. Installations should be accomplished in a manner that avoids lane closure. In the event this is not possible, the lane closure shall be performed by a Caltrans maintenance crew. The fire authority will be billed for the cost of these closures.

5. Fire apparatus or other emergency vehicles should not be positioned in the work zone.

6. Hydrant markings should not interfere or be confused with official traffic control devices.

**NOTE:** Sign installations are optional at the discretion of the Caltrans District Traffic Engineer.

# GUIDELINES FOR USE
# OF
# BLUE REFLECTIVE PAVEMENT MARKERS

The use of blue retroreflective pavement markers should be reserved for identifying fire hydrant and water supply locations for fire fighting purposes only. Blue markers used for any other purpose should be removed. The fire authority must obtain approval from the Caltrans authority having jurisdiction over the roadway before installation. Encroachment permits are required.

Blue marker installations should conform to the following recommendations:

## RECOMMENDED INSTALLATIONS

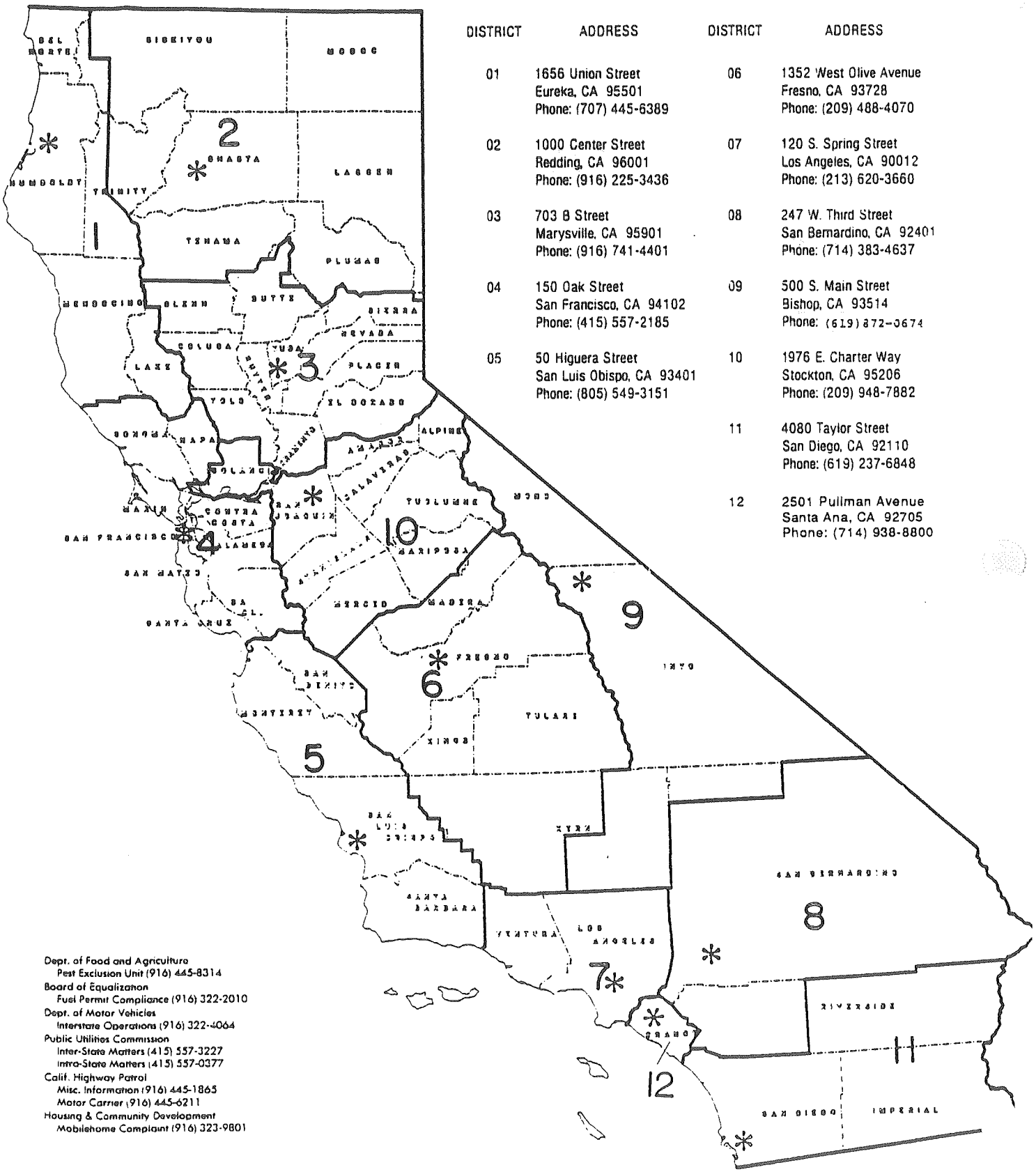
A. Two-way Streets and Roads: Markers should be placed six inches from edge of painted centerline on the side nearest the fire hydrant. If the street has no centerline, the marker should be placed six inches from the approximate center of the roadway on the side nearest the hydrant. (See Figures 1 through 3)

B. Streets with Left Turn Lane at Intersection: Markers should be placed six inches from edge of painted white channelizing line on the side nearest the hydrant. (See Figure 4)

C. Streets with Continuous Two-Way Left Turn Lane: Markers should be placed six inches from the edge of the painted yellow barrier line on the side nearest the fire hydrant. (See Figure 5)

D. Freeways and Expressways: Because of higher maintenance at these locations if placed on roadway, markers should be placed on shoulder one foot to the right of the painted edgeline opposite the off-right of way fire hydrant location. (See Figure 6)

## CALIFORNIA DEPT. OF TRANSPORTATION—TRANSPORTATION PERMIT OFFICES




| DISTRICT | ADDRESS | DISTRICT | ADDRESS |
|---|---|---|---|
| 01 | 1656 Union Street<br>Eureka, CA 95501<br>Phone: (707) 445-6389 | 06 | 1352 West Olive Avenue<br>Fresno, CA 93728<br>Phone: (209) 488-4070 |
| 02 | 1000 Center Street<br>Redding, CA 96001<br>Phone: (916) 225-3436 | 07 | 120 S. Spring Street<br>Los Angeles, CA 90012<br>Phone: (213) 620-3660 |
| 03 | 703 B Street<br>Marysville, CA 95901<br>Phone: (916) 741-4401 | 08 | 247 W. Third Street<br>San Bernardino, CA 92401<br>Phone: (714) 383-4637 |
| 04 | 150 Oak Street<br>San Francisco, CA 94102<br>Phone: (415) 557-2185 | 09 | 500 S. Main Street<br>Bishop, CA 93514<br>Phone: (619) 872-0674 |
| 05 | 50 Higuera Street<br>San Luis Obispo, CA 93401<br>Phone: (805) 549-3151 | 10 | 1976 E. Charter Way<br>Stockton, CA 95206<br>Phone: (209) 948-7882 |
| | | 11 | 4080 Taylor Street<br>San Diego, CA 92110<br>Phone: (619) 237-6848 |
| | | 12 | 2501 Pullman Avenue<br>Santa Ana, CA 92705<br>Phone: (714) 938-8800 |

Dept. of Food and Agriculture
Pest Exclusion Unit (916) 445-8314
Board of Equalization
Fuel Permit Compliance (916) 322-2010
Dept. of Motor Vehicles
Interstate Operations (916) 322-4064
Public Utilities Commission
Inter-State Matters (415) 557-3227
Intra-State Matters (415) 557-0377
Calif. Highway Patrol
Misc. Information (916) 445-1865
Motor Carrier (916) 445-6211
Housing & Community Development
Mobilehome Complaint (916) 323-9801

# TYPICAL HYDRANT MARKER LOCATION

= FIRE HYDRANT

= BLUE PAVEMENT MARKER

FIGURE 1

**TWO LANE STREET**

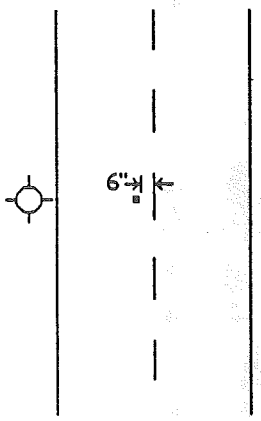



FIGURE 2

**MULTI-LANE STREET**

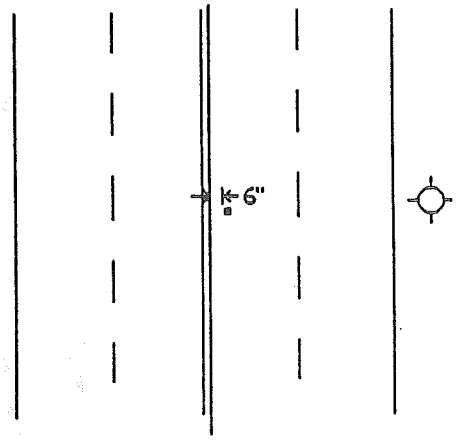



FIGURE 3

**AN INTERSECTION**

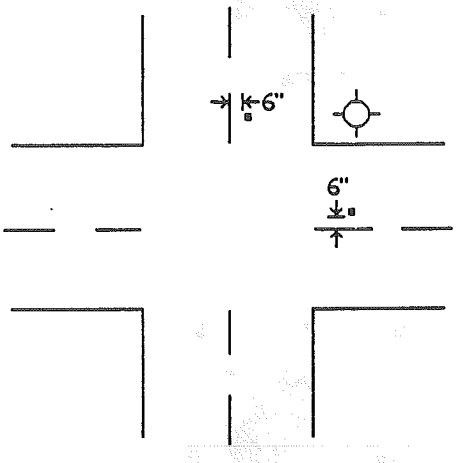



FIGURE 4

**FOUR LANE STREET WITH TURN LANE AT INTERSECTION**

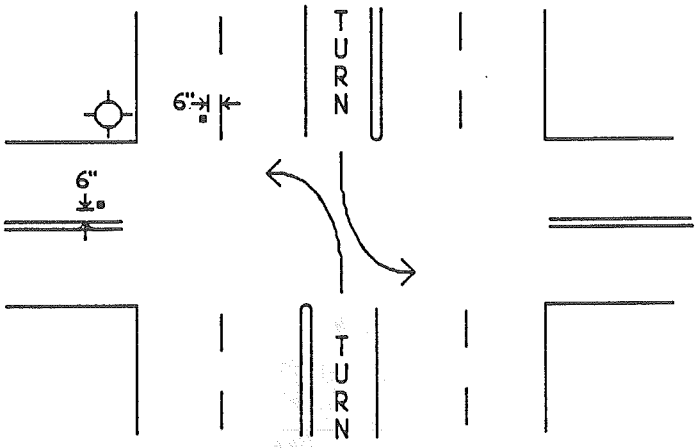



FIGURE 5

**MULTI-LANE STREET WITH TURN LANE**

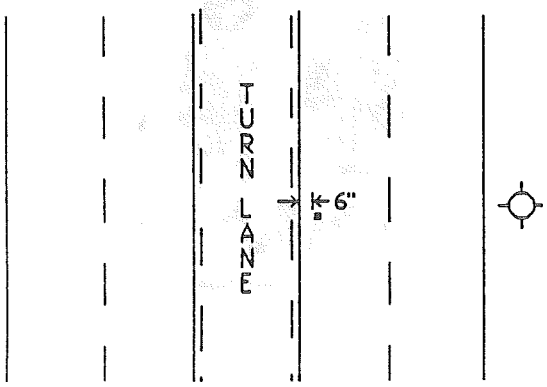
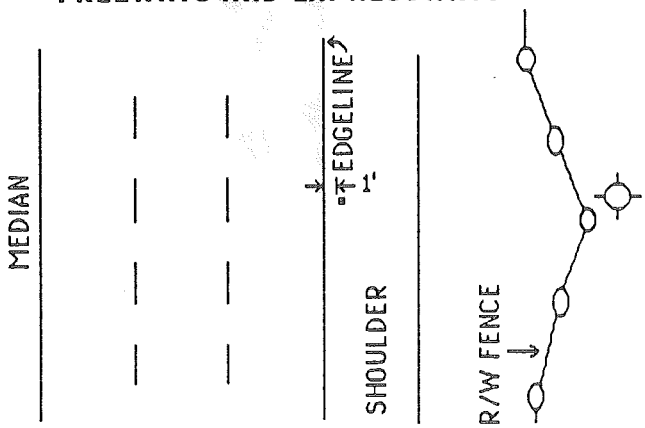
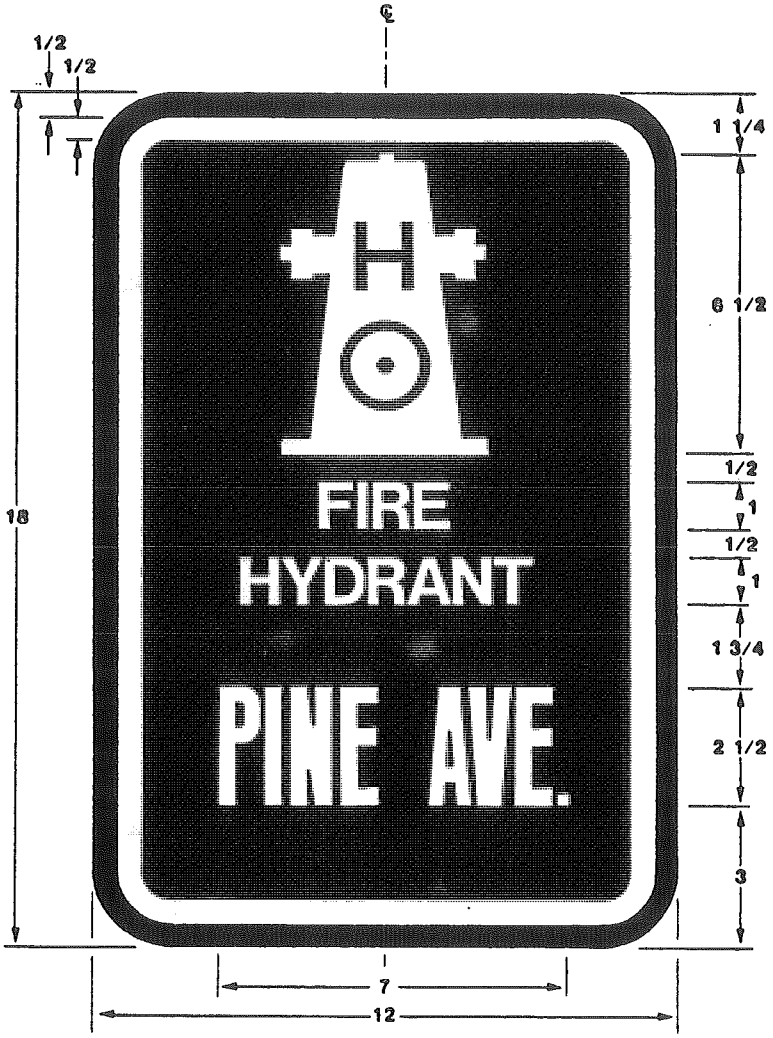


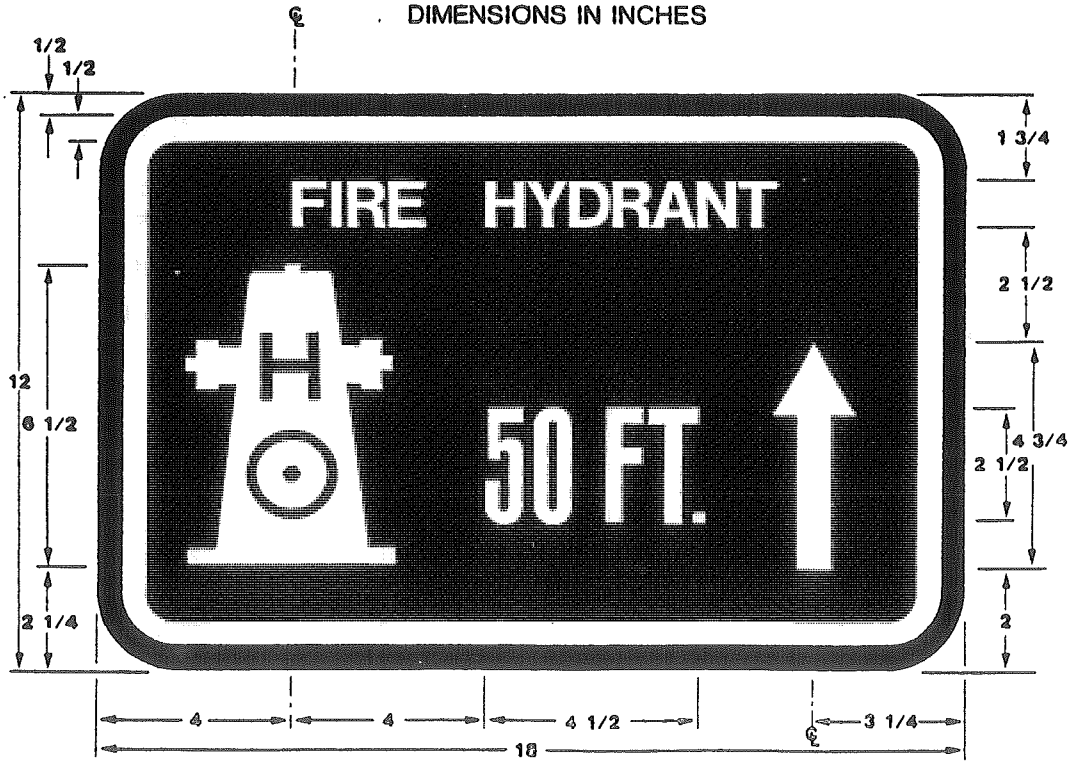

FIGURE 6

**FREEWAYS AND EXPRESSWAYS**






DIMENSIONS IN INCHES



# SIGN MANUFACTURERS

HAWKINS TRAFFIC SAFETY
1255 Eastshore, Berkeley, CA 94710
Sales Phone: (415) 525-4040
Cable Address: HAWKINS CO

SAFEWAY SIGN CO.
1314 W. 13th Street
Gardena, Ca 90247
Phone: (213) 321-4608

WESTERN HIGHWAY PRODUCTS, INC.
Traffic Signs and Safety Division
10650 Fern Ave., Stanton, CA 90680
Phone: (213) 924-6381
(714) 761- 4811
(800) 422-4420

ZUMAR INDUSTRIES, INC.
2828 Stanford Ave.
Los Angeles, CA 90011
Phone: (213) 233-8231
(800) 654-SIGN

# Encroachment Permit Information

## For Work in State Highway Rights of Way

Caltrans

## DEPARTMENT OF TRANSPORTATION

## (CALTRANS)

## Encroachment Permit

### I. Who Needs an Encroachment Permit?

All proposed activity by other than Caltrans or Caltrans contract forces within contract limits for placements of encroachments within, under, or over the State highway right of way, must be covered by an encroachment permit. This applies to persons, corporations, cities, counties, utilities, other governmental agencies, etc. Examples of activities within the right of way that require an encroachment permit include, but are not limited to:

A. Opening or excavating a State highway for any purpose;

B. Placing, changing, or renewing an encroachment;

C. Placing any advertising sign or device;

D. Planting or tampering with vegetation growing along any State highway;

E. Installing or removing tire chains for compensation;

F. Constructing and maintaining road approaches or connections to any State highway; and

G. Any activity affecting the use of the highway.

Caltrans issues encroachment permits:

- to ensure that the proposed encroachment is compatible with the primary uses of the State highway system;
- to ensure the safety of both the permittee and the highway users; and
- to protect the State's investment in the highway facility.

### II. Where Should the Project Sponsor Apply?

Project sponsors should direct inquiries and permit applications to the local Caltrans district office (listed below).

| | |
|---|---|
| District 1<br>Department of Transportation<br>1656 Union Street (95501)<br>P.O. Box 3700 (95502)<br>Eureka, CA<br>ATTN: Permit Engineer<br>(707) 442-5761 | Del Norte, Humboldt, Lake, portion of Western Siskiyou, Mendocino, and Western Trinity Counties |
| District 2<br>Department of Transportation<br>1000 Center Street<br>P.O. Box 2107 (96099)<br>Redding, CA<br>ATTN: Permit Engineer<br>(916) 246-6400 | Lassen, Modoc, Plumas, Shasta Siskiyou, Tehama and Eastern Trinity Counties |
| District 3<br>Department of Transportation<br>703 B Street (95901)<br>P.O. Box 911 (95901)<br>Marysville, CA<br>ATTN: Permit Engineer<br>(916) 741-4401 | Butte, Colusa, El Dorado, Glenn, Nevada, Placer, Sacramento, Sierra, Sutter, Yolo, and Yuba Counties |
| District 4<br>Department of Transportation<br>150 Oak Street (94102)<br>P.O. Box 7310 (94120)<br>San Francisco, CA<br>ATTN: Permit Engineer<br>(415) 557-1984 | Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Santa Cruz, and Sonoma Counties |
| District 5<br>Department of Transportation<br>50 Higuera Street (93401)<br>P.O. Box L (93403)<br>San Luis Obispo, CA<br>ATTN: Permit Engineer<br>(805) 549-3151 | Monterey, San Benito, San Luis Obispo, and Santa Barbara Counties |
| District 6<br>Department of Transportation<br>1352 W. Olive Avenue (93728)<br>P.O. Box 12616 (93778)<br>Fresno, CA<br>ATTN: Permit Engineer<br>(209) 488-4073 | Fresno, Western Kern, Kings, Madera, and Tulare Counties |
| District 7<br>Department of Transportation<br>120 S. Spring Street (90012)<br>P.O. Box 2304 (90051)<br>Terminal Annex<br>Los Angeles, CA<br>ATTN: Permit Engineer<br>(213) 620-2206 | Los Angeles, Orange, and Ventura Counties |

District 8
Department of Transportation
247 W. Third Street (92401)
P.O. Box 231 (92403)
San Bernardino, CA
ATTN: Permit Engineer
(714) 383-4017

San Bernardino, and Western Riverside Counties

District 9
Department of Transportation
500 S. Main Street (93514)
P.O. Box 847 (93514)
Bishop, CA
ATTN: Permit Engineer
(619) 873-8411

Inyo, Eastern Kern, portion of Northwestern San Bernardino and Mono Counties

District 10
Department of Transportation
1976 E. Charter Way (95206)
P.O. Box 2048 (95201)
Stockton, CA
ATTN: Permit Engineer
(209) 948-7882

Alpine, Amador, Calaveras, Mariposa, Merced, San Joaquin, Solano, Stanislaus, and Tuolumne Counties

District 11
Department of Transportation
2829 Juan Street (92110)
P.O. Box 85406 (92138)
San Diego, CA
ATTN: Permit Engineer
(619) 237-6843

Imperial, Eastern Riverside, and San Diego Counties

District 12
Department of Transportation
2501 Pullman Ave. (92705)
Santa Ana, CA
ATTN: Permit Engineer
(714) 938-8800

(After July 1, 1988)

## III. What Information Should the Project Sponsor Provide Upon Application?

Applicants should complete Caltrans "Application for Encroachment Permit", Form DM-M-P-201A, which requests the following information:

Encroachment Permit

A. Location of proposed work or encroachment by county, State highway route and post mile, if known, or distance to nearest major road intersection;

B. Complete description and detailed plans of the proposed work or encroachment;

C. Applicant's name, address and telephone number;

D. Estimated dates to begin and end the proposed work;

E. Width, depth, length, and type of surface to be cut for excavation, if applicable; and

F. Kind, diameter, and pressure of pipes, if applicable.

Proposed encroachments requiring permanent access or maintenance in freeway or expressway rights of way are extreme cases and considered only under the following restrictions:

- Must be a public facility or utility dedicated to public use;
- Any other location would be inordinately difficult or unreasonably costly;
- Must be placed as near as possible to the right of way lines; and
- Must be approved by the Caltrans Encroachment Committee, and possibly Federal Highway Administration (FHWA).

Private facilities running parallel to and falling in the rights of way of conventional highways with franchise rights from local agencies also require approval of the Caltrans Encroachment Committee.

A project sponsor requesting permission to install a facility requiring Caltrans Encroachment Committee approval must provide the following additional information:

1. An index map which should be a print of a small scale key map showing in outline form the general alignment of the freeway, crossroads, frontage roads and ramps and the major geographic features. Generally, title sheets and freeway strip maps will suffice. (Available from appropriate Caltrans District Office.)

2. Plans (50' to 200' scale) showing a graphic outline of the following:

   The pavement and shoulder edges of the freeway or expressway crossroads, collector roads and ramps. It should also show adjacent roads or streets including proposed or existing frontage roads to which the facilities may be reasonably moved.

   Right of way and access denial lines.

   Present and proposed locations of the facility or facilities involved, and physical features which affect the proposed location shall be shown. (A dashed colored line to show existing facilities and a solid line in the same color for relocated position of facility.)

   Trace of slope catch points.

   Existing drainage facilities.

   Fencing and location of locked gates where this means of access is proposed.

   Other features such as topography where pertinent.

   The plans need not be a special drawing. Copies of contract plans, project drawings, etc., are suitable. Whenever feasible, the plan should be as long as necessary to show the entire encroachment. However, separate sheets will also serve.

3. Profiles, cross sections, and contour grading plans shall be included.

4. If the project affects existing drainage, substantiating hydraulic calculations shall be submitted.

5. A full explanation shall be given as to the route and method by which the facility owner will gain ingress and egress to the encroaching facility for maintenance purposes. (Include an explanation of frequency, personnel and equipment required for maintenance.)

6. Furnish an explanation of the available alternatives to the proposed encroachment together with cost estimates and substantiating data necessary for verification.

7. Potential consequences if the requested encroachment is not approved.

8. A statement of how the project is environmentally clear.

9. Potential positive or negative impacts on the State highway facility.

10. If encroachment is on a structure, submit design criteria for the proposed encroachment, geophysical data (when pertinent), structural details and legible calculations of stresses due to the encroachment.

## IV. What Application Fee Should the Project Sponsor Submit?

Caltrans charges a fee that varies by the amount of Caltrans effort required to review and inspect the proposed encroachment permit work. This fee consists of an administrative fee and an hourly charge for review and inspection. The fee is calculated at the time the application is submitted and a deposit is required of all applicants, except public agencies and public utilities, before any further processing. Public agencies are by law exempt from fees and public utilities will be billed for fees at a later date.

In addition, Caltrans may require the applicant to complete Caltrans "Highway Encroachment Permit Bond", Form DM-M-P-208 and file a surety bond to ensure the applicant will comply with the terms and conditions of the permit. If a bond is required, Caltrans will determine the amount. Caltrans normally will not require a bond from public agencies.

## V. How Does the Department Evaluate and Process the Application?

**Criteria for Evaluation.** Caltrans evaluates the permit application to determine:

A. How the project may disrupt traffic and/or result in potential hazards to other highway users:

B. How the proposed encroachment may impair the design, construction, operation, maintenance, or integrity of the highway; and

C. How the project sponsor will restore the highway to its original condition, including landscaping, drainage, etc.

## Encroachment Permit

Caltrans also evaluates the permit application to determine how the proposed encroachment will affect the aesthetics of the highway.

Encroachments along freeways are not permitted except under highly exceptional circumstances. The burden is on the applicant to demonstrate that denial would create an unusual hardship.

**Procedures.** Project sponsors may submit applications to the appropriate Caltrans District Office before obtaining all public agency approvals, but they must secure the consent from all public agencies having jurisdiction over the project before beginning work. If the proposed encroachment is minor and will have no significant effect on the environment or is exempt from the requirements of the California Environmental Quality Act (CEQA), the permit engineer will review the application to determine whether the encroachment is compatible with other highway uses and conforms to the Department's standards. If the application is acceptable, the permit engineer will issue the permit.

If the proposed encroachment is major--such as access to a subdivision or a transmission line--the permit engineer inspects the project area. Other District units, such as Traffic, Design, Hydraulics, and Environmental, may review the application to determine the proposed encroachment's effect on the use of the State highway and on the environment. If these units find the encroachment acceptable, the permit engineer issues the permit. This process may take up to six (6) months, depending on the complexity of the project. Any work on or within the State highway constitutes an acceptance by the permittee of all terms and conditions of the permit.

If the proposed encroachment requires permanent access or maintenance in freeway or expressway rights of way, the district permit engineer reviews the application, makes a recommendation to approve or deny the application. If the district recommends approval, the permit engineer will forward it to the Caltrans Encroachment Committee in Sacramento. This Committee meets monthly to consider permit applications from all Districts. The Committee generally, but not necessarily, follows the recommendations of the District; however, permits are seldom granted unless special circumstances require them. If the Committee approves the application, it returns it to the District permit engineer who issues the permit. The process takes approximately four (4) months. The decision of the Caltrans Encroachment Committee is final.

The terms and conditions of Caltrans encroachment permits are binding on the permittee so long as the encroachment remains.

**Appeals.** Caltrans has no formal appeals process. In cases where the permit engineer and the project sponsor cannot reach agreement, the district maintenance engineer will negotiate with the applicant. If an agreement is not reached at this level, the District Director will negotiate with the applicant. If unsuccessful, the District Director may seek the advice of Department Headquarters in Sacramento to resolve the conflict. The decision of the Director, Department of Transportation, is final.

## VI. What Are the Project Sponsor's Rights and Responsibilities After the Permit Is Granted?

**Rights.** Applicants wishing to amend their permit applications or approved encroachment permits must submit written amendments and accompanying site maps to the appropriate Caltrans district Office. The permit engineer reviews the proposed amendment according to procedures described for original permit applications.

If the permittee cannot complete the approved work by the date specified in the permit, he or she may request the district to extend the permit.

**Responsibilities.** All Caltrans encroachment permits contain the following standard conditions, although there may be additional special conditions.

A. The project sponsor must clean and maintain the project site after the project is complete;

B. The project sponsor must pay Caltrans for its costs incurred in inspecting the encroachment site for performing any permit related work;

C. The project sponsor must take precautions to protect public safety while the project is under construction;

D. The project sponsor must notify the appropriate Caltrans office of completion of the project; and

E. The project sponsor is liable for any damage to State property.

These conditions appear in the "General Conditions", an attachment to each permit. Copies of the general conditions are available in each District Office. In addition, there usually are special provisions relating to the specific application, such as traffic control and work hours. Both the general and special conditions must be fully carried out, unless expressly waived in writing.

Encroachment Permit

Any work on or within the State highway constitutes an acceptance by the permittee of all terms and conditions in the encroachment permit. The permittee may not transfer or assign an approved permit to another party.

The project sponsor must submit Caltrans "Completion Notice" Form DM-M-P212, and As-Built Plans upon finishing the approved project. The permit engineer will then inspect the project site to determine whether the permittee has complied with all terms and conditions of the encroachment permit. If the permittee has not, the District permit engineer will inform the permittee of the infraction(s) and request correction. If the permittee fails to comply with this request, the district may revoke the permit or do any necessary work and recover its expenses.

## VII. What Are the Department's Rights and Responsibilities After the Permit is Granted?

**Rights.** Caltrans may revoke a permit and order the removal of an encroachment if the permittee has not complied with all terms and conditions of an approved permit or if the continuance of the encroachment is incompatible with highway use. Future construction or maintenance of the highway may require the removal or relocation of the encroachment entirely at the permittee's expense.

**Responsibilities.** Caltrans is responsible for assuring the safety and integrity of the State highway system.

## VIII. What Other Agencies Should the Project Sponsor Contact?

Project sponsors should consider whether other agencies, including, but not limited to, the following must issue permits or approve the proposed project:

A. Local -- City, county, or special district

B. State -- California Tahoe Regional Planning Agency
Department of Fish and Game
Public Utilities Commission
Regional Coastal Commission
Regional Water Quality Control Board
San Francisco Bay Conservation and Development Commission
Tahoe Regional Planning Agency

C. Federal -- United States Forest Service and Bureau of Land Management

## IX. What Other Sources of Information Are Available to the Project Sponsor?

Project sponsors may refer to the following publications for more information about Caltrans encroachment permits:

A. Caltrans Encroachment Permit Manual, California Department of Transportation, March 1982, and

B. Streets and Highways Code Section 660-734.

The Caltrans Encroachment Permit Manual is available for review from Caltrans District Offices and may be purchased from the Department of Transportation, Publications Unit, 6002 Folsom Boulevard, Sacramento, CA 95819. The Streets and Highways Code is available from county law libraries, academic libraries, and the State Library in Sacramento.

For additional assistance permit applicants may wish to contact:

A. Office of Permit Assistance within the State Office of Planning and Research, 1400 Tenth Street, Sacramento, California 95814, telephone (916) 322-8515.

## INSTRUCTIONS FOR COMPLETING

## "STANDARD ENCROACHMENT PERMIT APPLICATION"

Items above first double line (collected by: District/County/Route/ Post Mile, Fee/Deposit Paid, Permit Number) will be filled in by State personnel.

Complete all other items inserting "NA" if not applicable or leave spaces blank if permitted by these instructions. Submit all required attachments.

1. **Location (City)**--Insert city name where permit work is located.

2. **County**--Insert county name where permit work is located.

3. **Route**--Insert State highway route number where permit work is located. If unknown, leave blank.

4. **Post Mile**--Insert State highway route post mile where permit work is located. If unknown, leave blank.

5. **Date**--Insert date (day, month, year) of application.

6. **Address or Street Name**--Insert address number and street name where permit work is located.

7. **Cross Street**--Insert nearest cross street name and direction (north, south, east, west) from where permit work is located (i.e., 500' north of "X" Street).

8. **Portion of Right of Way**--Insert where permit is desired within State highway right of way (paved road, shoulder, back of curb, slope, or combinations north, south, east, or west side of center line of highway).

9. **Work to be Performed By**--Check appropriate box as to how the desired permit work will be done. By applicant's "Own Forces" or "Contractor".

10. **Est. Starting Date**--Insert approximate month and year applicant estimates starting the desired permit work.

11. **Est. Completing Date**--Insert approximate month and year applicant estimates completing the desired permit work.

12. **Est. Cost in State R/W**--Insert applicant's estimated cost of desired permit work only within State highway right of way.

DEPARTMENT OF TRANSPORTATION (CALTRANS)

# STANDARD ENCROACHMENT PERMIT APPLICATION

DM-M-P-201A (REV 2/82) PART A

| Collected By: | Permit No. |
|---|---|
| Fee/Deposit Paid $ | Dist/Co/Rte/PM |

Permission is requested to encroach on the State Highway right of way as follows: *(Complete all items: NA if not applicable.) Application is not complete until all required attachments are included.*

| Location: City 1 | County 2 | Route 3 | Post Mile 4 | Date 5 |
|---|---|---|---|---|

| Address or Street Name 6 | Cross Street *(include distance and direction)* 7 | FOR CALTRANS USE |
|---|---|---|
| Portion of Right of Way 8 | Work to be Performed By 9 ☐ Own Forces ☐ Contractor | |
| Est. Starting Date 10 | Est. Completion Date 11 | Estimated Cost in State R/W 12 $ |

| | | | | | |
|---|---|---|---|---|---|
| EXCAVATION | Max. Depth 13 Ft. | Average Depth 14 Ft. | Average Width 15 Ft. | Length 16 Ft. | Surface Type 17 |
| PIPES | Type 18 | Diameter 19 | Voltage/PSIG 20 | Product 21 | |

FULLY DESCRIBE WORK WITHIN STATE R/W: *Attach complete plans (5 sets folded 8½ x 11), specs, calcs, maps, etc., if applicable.*

IS ANY WORK BEING DONE ON APPLICANT'S PROPERTY? *If "Yes" briefly describe and attach site and grading plans.)* 22

☐ Yes ☐ No

THE UNDERSIGNED AGREES THAT THE WORK WILL BE DONE IN ACCORDANCE WITH CALTRANS RULES AND REGULATIONS AND SUBJECT TO INSPECTION AND APPROVAL.

| Organization or Applicant | Phone ( ) | Architect, Engineer or Project Mgr. | Phone ( ) |
|---|---|---|---|

Address *(include city and zip code)*

| Authorized Signature ▶ | Title |
|---|---|

Calc By

FEE CALCULATION BY CALTRANS

SURETY BOND REQUIRED? ☐ No ☐ Yes Amount $ _____

LIABILITY INSURANCE REQUIRED? ☐ No ☐ Yes Amount $ _____

| FEE - DEPOSIT | | FEE | DEPOSIT |
|---|---|---|---|
| a. Bridge Toll (if applicable) | | $ | |
| b. Administration of Permit Office and Application Processing | | $47 | |
| (Check One) c. Review Application | ☐ Set Hours | $ | |
| | ☐ Actual Cost | | |
| Hrs. @$25 per hr. | Estimate _____ Hours | | $ |
| (Check One) d. Inspection | ☐ Set Hours | $ | |
| | ☐ Actual Cost | | |
| Hrs. @$21 per hr. | Estimate _____ Hours | | $ |
| e. Fieldwork (4) | ☐ Actual Cost | | |
| Hrs. @$21 per hr. | Estimate _____ Hours | | $ |
| | | A+B+C+D | C+D+E |
| Total Fee/Deposit $ | | $ | $ |

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IS A CITY/COUNTY/OTHER AGENCY INVOLVED? (Permits, Approval, Etc.)?

☐ Yes Check Environmental Documentation and attach copy to Application ☐ Exempt ☐ N.D. ☐ EIR

ALSO ATTACH A COPY OF THE ENVIRONMENTAL APPROVAL.

☐ No Check the category below which describes the Project

- ☐ SURVEY
- ☐ FLAGS, SIGNS, BANNERS DECORATIONS
- ☐ TEMPORARY SIGNALS
- ☐ PUBLIC UTILITY MODIFICATIONS, EXTENSIONS, HOOKUPS
- ☐ SIDEWALK/GUTTERS
- ☐ FENCE
- ☐ SINGLE FAMILY DWELLING DRIVEWAY
- ☐ REMOVAL-REPLACEMENT OF DISTINCTIVE ROADWAY MARKINGS
- ☐ DITCH PAVING
- ☐ MODIFICATION OF TRAFFIC CONTROL SYSTEMS
- ☐ MAILBOX
- ☐ AGRICULTURAL APPROACH
- ☐ PARADES, CELEBRATIONS
- ☐ COMMUNITY ANTENNA TV SYSTEM
- ☐ EROSION CONTROL
- ☐ MOVIE, TV FILMING
- ☐ MAINTENANCE, RECONSTRUCTION, OR RESURFACING OF A DRIVEWAY OF ROAD APPROACH
- ☐ MAINTENANCE OF EXISTING LANDSCAPING
- ☐ REGULATORY WARNING, INFORMATION SIGNS
- ☐

☐ NONE OF THE ABOVE. IF PROJECT CANNOT BE DESCRIBED IN ABOVE CATEGORIES, REQUEST PART B FROM THE PERMIT OFFICE.

**FEE SCHEDULE: (1)**

| CODE (2) | TYPE PERMIT | REVIEW APPLICATION SET HOURS (3) | INSPECTION SET HOURS (3) |
|---|---|---|---|
| AD | Advertising Display, Marquees, Arcades, Awnings, Bldgs. | 1 | 1 |
| AS | Airspace Rental (6) | Exempt | Exempt |
| AR | Archaeological | 2 | 1 |
| AP | Art Program (6) | Exempt | Exempt |
| | Banner, Decor, Temp. Sign: | | |
| BR | - Repeat | 0 | 0 |
| BN | - New | 1 | 1 |
| BP | Bike Path | Actual | Actual |
| BS | Bus Passenger Waiting Shelter | 2 | 2 |
| CN | Chain Installer | 1 | 0 |
| CR | Coffee/Rest Stop | 0 | 1 |
| CD | Commercial Development | Actual | Actual |
| CS | Curb/Gutter/Sidewalk | 2 | 2 |
| DP | Double Permit | 1 | As Per Type (8) |
| | Drainage: | | |
| DM | - Minor | 1 | 0 |
| DD | - Needs Design Review | 5 | Actual |
| | Fence: | | |
| FM | - Repair | 0 | 0 |
| FN | - New/Modify | 2 | 1 |
| FL | Filming | 2 | Actual |
| | Geo-physical Testing: | | |
| GC | - Cable Xing | 1 | 0 |
| GV | - Vibroseis | 1 | Actual |
| | Grading: | | |
| GM | - Minor | 1 | 1 |
| GN | - Major | Actual | Actual |
| | Landscape: | | |
| LM | - Maintenance | 0 | 0 |
| LT | - Tree Trim | 1 | 1 |
| LC | - Conventional | 2 | 0 |
| LF | - Freeway | Actual | Actual |
| LR | Litter Cleanup (6) | Exempt | Exempt |
| MB | Mail/News Box (6) | Exempt | Exempt |
| OA | Outdoor Advertising | 2 | Actual |
| | Visibility Improvement | | |
| CC | City/County Issued Major Permit (7) | As Per Type | Actual |

| CODE (2) | TYPE PERMIT | REVIEW APPLICATION SET HOURS (3) | INSPECTION SET HOURS (3) |
|---|---|---|---|
| | Rider: | | |
| RD | - Caltrans Initiate (6) | Exempt | Exempt |
| RT | - Time Extension | 0 | Already Covered |
| | - Modify Work | As Per Type | Already Covered |
| | Road Approach/ Driveway: | | |
| RA | - Agricultural | 3 | 1 |
| RS | - Single Family | 3 | 1 |
| RM | - Resurface/Reissue | 0 | 0 |
| RR | - Reconstruct | 1 | 1 |
| RL | - Multiple Residence | Actual | Actual |
| RC | - Commercial | Actual | Actual |
| RP | - Public/Private Road | Actual | Actual |
| RX | RR Crossing | Exempt | Exempt |
| | Signals/Lighting: | | |
| SM | - Repair | 0 | 0 |
| ST | - Temporary | 1 | 4 |
| SN | - New/Modify | Actual | Actual |
| | Special Event: | | |
| SR | - Ramp Closure | Actual | Actual |
| SP | - Parade (routine) (7) | 0 | 0 |
| SE | - Other | Actual | Actual |
| SC | State Highway Construction Contract | 0 | 0 |
| SV | Survey | 1 | 0 |
| TC | Traffic-Counter Controls, Safety Devices | 2 | 2 |
| TN | Tunnel Under Road (d 24") | Actual | Actual |
| | Utilities/Cable TV: | | |
| US | - Service Connect/Pothole | 0 | 1 |
| UM | - Modify | 1 | 2 |
| UP | - Cathodic Protection | 2 | 1 |
| UA | - Aerial Longit. | 2 | 1 |
| | - Aerial Transv.: | | |
| UF | Freeway | 1 | 4 |
| UC | Conventional | 1 | 1 |
| UL | - Underground Longit. | 3 | Actual |
| UT | - Underground Transv. | 1 | 2 |
| UB | - Annual Maintenance | 0 | 0 |
| WL | Wall | Actual | Actual |
| LA | Caltrans is Lead Agency for Environmental Study | Actual | As Per Type |
| MC | Miscellaneous (5) | 0 or Actual | 0 or Actual |

NOTES:
(1) Public corporations (but not contractors doing work for public corporations) are exempt from this fee schedule.
(2) Two digit code used in Permit No.
(3) Any unusual type permit can be charged actual cost at option of Permit Engineer.
(4) "Field Work," furnished by Caltrans, will be billed by actual costs.
(5) At Permit Engineer's option.
(6) Exempt from all fees.
(7) Exempt from administrating/process fee.
(8) Inspection will be charged under original permit or double permit, not both.

DEPARTMENT OF TRANSPORTATION (CALTRANS)

# ENCROACHMENT PERMIT

DM-M-P-202A (REV. 2/82)

| | |
|---|---|
| Permit No. | |
| Dist/Co/Rte/PM | |
| Date | |
| Fee Paid in Advance $ | Deposit $ |
| Bond Amount $ | |
| Bond Company | |
| Bond Number | |

In compliance with *(Check one)*:

☐ Your application of _____

☐ Utility Notice No. _____ of _____

☐ Agreement No. _____ of _____

☐ R/W Contract No. _____ of _____

TO:

_____, PERMITTEE

and subject to the following, PERMISSION IS HEREBY GRANTED to:

The following attachments are also included as part of this permit *(Check applicable)*:

| | | |
|---|---|---|
| ☒ Yes | ____ | General Provisions |
| ☐ Yes | ☐ No | Utility Maintenance Provisions |
| ☐ Yes | ☐ No | Special Provisions |
| ☐ Yes | ☐ No | A Cal-OSHA permit required prior to beginning work: # _____ |

In addition to fee, the permittee will be billed actual costs for:

| | | |
|---|---|---|
| ☐ Yes | ☐ No | Review |
| ☐ Yes | ☐ No | Inspection |
| ☒ Yes | ____ | Field work |

*(If any Caltrans effort expended)*

☐ Yes ☐ N.A. The information in the environmental documentation has been reviewed and considered prior to approval of this permit.

This permit is void unless the work is completed before _____, 19 ____.
This permit is to be strictly construed and no other work other than specifically mentioned is hereby authorized.
No project work shall be commenced until all other necessary permits and environmental clearances have been obtained.

APPROVED:

_____, District Director

BY:

_____, District Permit Engineer

ISO COMMERCIAL RISK SERVICES, INC.
3000 EXECUTIVE PARKWAY SUITE 510 SAN RAMON, CA 94583 (415) 830-8778

## SUPPLEMENTAL CRITERIA

A SUPPLEMENT TO THE FIRE SUPPRESSION RATING SCHEDULE ——— ESTABLISHING CRITERIA FOR PUBLIC PROTECTION CLASSIFICATION IN AREAS NOT HAVING A WATER SUPPLY RATABLE UNDER THE FIRE SUPPRESSION RATING SCHEDULE.

### DWELLINGS

Section A: To qualify for Dwelling Class 8, conditions must be equal to, or superior to the following -

1. The fire department qualifies as a recognized fire department.
2. Areas are within a five-mile response (road) distance of the closest engine (pumper) company, and within an eight-mile distance of the balance of any apparatus units required under A-8(b).
3. For more than one unit of apparatus, all assigned apparatus is radio equipped.
4. For more than one unit of apparatus, there are not less than five men responding on first alarm.
5. There is additional manpower as necessary to meet the conditions of A-7 and 8(b).
6. At least one unit of apparatus is a pumper constructed and equipped in accordance with the intent of the Standards of NFPA No. 1901.
7. The department demonstrates a capability to effectively develop and continuously apply water for not less than 20 minutes at a rate of not less than 200 gpm, commencing with the initial evolutions of the first due company.
8. Apparatus
   (a) For areas adequately served by fire flows (available throughout the year) of not less than 200 gpm, a single pumper may suffice.
   (b) For all other areas, there are not less than two units and all units are suitable for the intended service.

NOTE: (a) Additional apparatus may be from another department providing arrangements equivalent to "automatic aid" are in effect.

(b) Adverse conditions affecting response shall be considered when evaluating response distances.

### CROPS

Section B: Recognized fire departments meeting the basic provisions of A-3 and 4 may be considered as providing Crop Protection Class 1 up to a ten-mile response distance whenever apparatus is suitable for "off highway" use and

1. there are at least three units of apparatus, two of which are capable of pumping in motion, and
2. apparatus meets the intent of NFPA No. 1901 for such service, and
3. personnel have demonstrated a proficiency in tactics necessary for crop fires.

Section C: Recognized departments not meeting the basic provisions of Section B may be considered as providing Crop Protection Class -

II when there are two units suitable for "off highway" use and capable of pumping while in motion.

III when there is only one such unit.



A SUBSIDIARY OF INSURANCE SERVICES OFFICE, INC.

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# NFPA 1231

## Standard on Water Supplies for

# Suburban and Rural Fire Fighting

## 1989 Edition

This edition of NFPA 1231, *Standard on Water Supplies for Suburban and Rural Fire Fighting*, was prepared by the Technical Committee on Forest and Rural Fire Protection and acted on by the National Fire Protection Association, Inc. at its Annual Meeting held May 15-18, 1989 in Washington, DC. It was issued by the Standards Council on July 14, 1989, with an effective date of August 7, 1989, and supersedes all previous editions.

The 1989 edition of this standard has been approved by the American National Standards Institute.

## 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.

The 1984 edition represented a complete revision to include both mandatory and advisory material.

This 1989 edition is the fourth revision and incorporates some significant changes and additions.

## Technical Committee on Forest and Rural Fire Protection

**R. L. Bjornsen,** *Chairman*
Fire Management Associates

**Donald G. Perry,** *Vice Chairman*
Santa Barbara County Fire Dept., CA

**James T. Wooters,** *Vice Chairman*
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**George R. Cowan,** Wormald CDN Inc.
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**Dennis Dube,** Canadian Forestry Service
**J. A. Foster,** ISO Commercial Risk Services Inc.
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**Louis G. Jekel,** Rural/Metro Corp.
**Ralph R. Lafferty,** MacMillan Bloedel Ltd
**John F. Marker,** Forest Service USDA
**Paul G. Mason,** M&M Protection Consultants
**Richard E. Montague,** Incident Management Concepts
**Frederick S. Richards,** Office of Fire Prev. & Control, NYS Dept. of State
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**Bill Baden,** NFPA Staff Liaison

*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.

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# NFPA 1231

## Standard on Water Supplies for

# Suburban and Rural Fire Fighting

## 1989 Edition

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

Information on referenced publications can be found in Chapter 8 and Appendix H.

## 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 that 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 that is transported to the rural fire area.

It is the intent of this standard to provide and maintain minimum water supplies for fire fighting purposes through the establishment of a cooperative working arrangement among the authority having jurisdiction, the fire department having jurisdiction, and the property owners in the jurisdiction.

This standard provides minimum requirements and nothing herein shall be interpreted to mean that the authority having jurisdiction cannot exceed any or all of these requirements where, in the judgment of such authority having jurisdiction, additional protection is warranted.

This standard is restricted to identifying minimum requirements for water supplies for fire fighting purposes. 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 to specify how these water supplies are made available, thereby giving consideration to local conditions and need.

**1-3.2** Although the water requirements developed by this standard are performance oriented, it must be emphasized that they are minimum in scope. The water available to the fire department, which may come from single or multiple water points, must be delivered to the fire scene. The authority having jurisdiction may determine that additional water supplies are warranted. Appendix G contains secondary water supply requirements useful when the authority having jurisdiction determines additional water supplies are desirable.

**1-3.3** Fire apparatus and associated equipment are important components of the water transport process. Many alternative approaches to fulfilling this process are provided in Appendices C, D, and E.

Apparatus shall meet the requirements outlined in NFPA 1901, *Standard on Automotive Fire Apparatus*, and other applicable NFPA standards.

**1-3.4** Fire control and extinguishment is probable only when a prompt alarm notification initiates an immediate response, which in return results in effective agent application confining the fire to the area or origin.

**1-3.5** The effectiveness and reliability of fixed fire protection systems is a documented fact. Strong consideration shall be given to installation of sprinkler systems as outlined in NFPA 13, *Standard for the Installation of Sprinkler Systems*, and NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Mobile Homes*.

**1-4 Definitions.**

**Adequate and Reliable Water Supply.** A supply that is sufficient every day of the year to control and extinguish anticipated fires in the municipality, particular building, or building group 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."

**Automatic Aid.** A plan developed between two or more fire departments for immediate joint response on first alarms.

**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.

**Minimum Requirements for Water Supply.** The smallest quantity of water supply suggested for any degree of fire control. In some fires this supply may be suitable for protecting exposures only.

**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, over and above domestic consumption, a minimum flow of 250 gpm (946 L/min) and 20 psi (139 kPa) residual pressure for a two-hour duration.

**Mutual Aid.** A plan developed between two or more departments to render assistance to the parties of the agreement. Often the request for such aid to be rendered comes only after an initial response has been made and the fire scene status has been determined.

**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 that is minimally adequate in volume and duration and by a fire department capable of using the water supply to suppress a possible fire within the property.

**Secondary (Design) Water Supply.** The estimated rate of flow (expressed in gpm for a prescribed time period) that is considered necessary to control a major fire in a building or structure.

**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 minimum 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** 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 struc-

ture 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 those having 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 Type I (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 Types II and IV (Noncombustible) and Heavy Timber 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.

Also, heavy timber construction in which walls are masonry, columns are 8-in. wood supports, floors are 3-in. tongue and grooved plank, and roof decks are 2-in. tongue and grooved plank. All wood beams and girders are 6 in. wide and 10 in. deep.

**4-2.4* Type III (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* Type V (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 Minimum 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 construction classification number and the occupancy hazard classification number, shall compute the minimum water supply, in gallons (liters), needed for the structure in its authority. As the water supplies developed by this standard are minimum and in many cases may be suitable for exposure protection only, the authority having jurisdiction shall review the calculations to see that the flows are available to meet the needs indicated by the preplans.

**5-2 Single Structures without Exposure Hazards.**

**5-2.1*** For single structures with no portion of any unattached structural exposure hazard within 50 ft (15.2 m), unless it is smaller than 100 sq ft (9.3 $m^2$), the minimum 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 5-9.1(a).

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

**5-2.1.1** The minimum water supply required for any structure, without exposure hazards, shall not be less than 2,000 gal (7570 L). [*See Table 5-9.1(b).*]

**5-2.1.2** The minimum water supply, as determined for any structure specified in 5-2.1 and 5-2.1.1, 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 5-9.1(c).

**5-3 Single Structures with Exposure Hazards.**

**5-3.1*** For all single structures 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 $m^2$), the minimum 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 and multiplied by 1.5. [*See Table 5-9.1(a).*]

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

**5-3.1.1** The minimum water supply required for a single structure with exposure hazards specified in 5-3.1 shall not be less than 3,000 gal (11 355 L). [*See Table 5-9.1(b).*]

**5-3.1.2** The minimum water supply, as determined for any structure specified in 5-3.1 and 5-3.1.1, shall be available on the fireground at, and the fire department shall be capable of utilizing the minimum water supply at, the rates specified in Table 5-9.1(c).

**5-4 Multiple Structures — Single Water Point without Exposure Hazards.**

**5-4.1*** For all multiple structures with no portion of any unattached structural exposure hazard within 50 ft (15.2 m) unless it is smaller than 100 sq ft (9.3 $m^2$), the minimum water supply, in gallons, shall be determined by the total cubic footage of the structure, including any attached struc-

tures, divided by the occupancy hazard classification number as determined from Chapter 4, or see Table 5-9.1(a).

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 minimum water supply requirement.

**5-4.1.1** The minimum water supply required for multiple structures specified in 5-4.1 shall not be less than 3,000 gal (11 355 L). [*See Table 5-9.1(b).*]

**5-4.1.2** The minimum water supply as determined for any structure specified in 5-4.1 and 5-4.1.1 shall be available on the fireground at, and the fire department shall be capable of utilizing the minimum water supply at, the rate specified in Table 5-9.1(c).

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

**5-5 Multiple Structures — Single Water Point with Exposure Hazards.**

**5-5.1*** For all multiple structures with unattached structural exposure hazards within 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 5-9.1(a).

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

**5-5.1.1** The minimum water supply required for multiple structures specified in 5-5.1 shall not be less than 3,000 gal (11 355 L). [*See Table 5-9.1(b).*]

**5-5.1.2** The minimum water supply, as determined for any structure specified in 5-5.1 and 5-5.1.1 shall be available on the fireground at, and the fire department shall be capable of utilizing the minimum water supply at, the rate specified in Table 5-9.1(c).

**5-6 Special Fire Protection Problems.**

**5-6.1*** 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, large chemical plants, coal mines, tunnels, subterranean structures, and warehouses using high pack storage for flammables or pressurized aerosols. For suggested protection, consult appropriate NFPA standards.

**5-7 Structures with Automatic Sprinkler Protection.**

**5-7.1*** For any structure protected by an automatic sprinkler system that fully meets the requirements of NFPA 13, *Standard for the Installation of Sprinkler Systems*, and NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Mobile Homes*, the fire department having jurisdiction may waive any requirement for additional water supply required by this standard. (*See Appendix F.*)

**5-7.1.1*** The water supply for automatic sprinkler systems referred to in 5-7.1 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.

**5-7.1.2** Automatic sprinkler systems referred to in 5-7.1 and meeting the requirements of NFPA 13, *Standard for the Installation of Sprinkler Systems*, shall, in all cases, be provided with a fire department connection as described in NFPA 13, Section 2-7.

**5-7.2** For a structure protected by an automatic sprinkler system that does not fully meet the requirements of NFPA 13, *Standard for the Installation of Sprinkler Systems*, and NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Mobile Homes*, the fire department having jurisdiction may reduce the minimum water supply required by this standard, for fire fighting purposes, in Section 5-2, 5-3, 5-4, or 5-5, whichever is applicable.

**5-8 Structures with Other Automatic Fire Suppression Systems.**

**5-8.1*** 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 minimum water supply required for fire fighting purposes.

**5-9 Precalculated Water Supply.**

**5-9.1** 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 5-9.1(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 5-9.1(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 5-9.1(b)**
**Minimum Water Requirements**
**(Examples)**

| Paragraph | Type of Occupancy | Min. Gal. Water |
|---|---|---|
| 5-2.1.1 | Single Structures without Exposures | 2,000 (7570 L) |
| 5-3.1.1 | Single Structures with Exposures | 3,000 (11 335 L) |
| 5-4.1.1 | Multiple Structures — Single Water Point without Exposures | 3,000 (11 335 L) |
| 5-5.1.1 | Multiple Structures — Single Water Point with Exposure Hazard | 3,000 (11 335 L) |

**Table 5-9.1(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) |

## Chapter 6 Water Supply

**6-1 Water Supply for Fire Fighting.** 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, aqueducts, tankers, and hydrants served by a water system. (*See Appendix B.*)

The surface at the pumper access point shall be adequate to support heavy vehicles at all times of the year. Provisions shall be made so that such water suction points are visible and usable in all weather conditions, including heavy snow, brush conditions, and mud slides.

Should a dry hydrant be close to vehicular traffic, suitable barriers shall be constructed to protect fire fighters, equipment, and the dry hydrant.

**6-2 Water Supply Transfer.** 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, helicopters, railroad tank cars, etc. (*See Appendices C, D, and E.*)

**6-3 Minimum Water Supply.** The minimum 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.

**6-4.1** The fire department needs to determine the maximum safe load limits of bridges in its district. The state Department of Transportation (DOT), in most cases, can provide the fire department with a computer printout showing safe load limits for bridges located within the boundries of your city, town, county, fire district, etc. Any means of access shall be constructed in accordance with NFPA 1141, *Standard for Fire Protection in Planned Building Groups.*

**6-5 Identification.** An appropriate sign shall be erected at each water point identifying the site for fire department emergency use. (*See B-1-2.11.*)

## 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 compliance 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 minimum water supply required, shall notify, in writing, the authority having jurisdiction of the results of the surveys and the minimum water supplies required. In all cases, the building(s) owner(s) shall be advised of the minimum water supply required. Fire department personnel shall be available to citizens 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 that 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 Smoke Detector.**

**7-4.1*** Each family living unit shall be provided with smoke detectors as required in NFPA 74, *Standard for the Installation, Maintenance, and Use of Household Fire Warning Equipment.*

**7-5 Changes in Automatic Sprinkler Protection.**

**7-5.1** 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 5-7. The property owner or occupant 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.

**7-5.2*** 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.

**7-6 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 Referenced Publications

**8-1** The following documents or portions thereof are referenced within this standard and shall be considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

**8-1.1 NFPA Publications.** National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

NFPA 13-1989, *Standard for the Installation of Sprinkler Systems*

NFPA 13D-1989, *Standard for the Installation of Sprinkler Systems In One- and Two-Family Dwellings and Mobile Homes*

NFPA 74-1989, *Standard for the Installation, Maintenance, and Use of Household Fire Warning Equipment*

NFPA 220-1985, *Standard on Types of Building Construction*

NFPA 1141-1985, *Standard for Fire Protection in Planned Building Groups*

NFPA 1901-1985, *Standard on Automotive Fire Apparatus.*

## 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 that may not be standard fire hydrants, with available volume, pressure, and duration of flow being less than needed for adequate fire fighting purposes. Where such conditions exist, this standard and appendix may be applied in water supply matters.

**A-2-1.1** Information needed to compute the minimum 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 that 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 minimum 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 minimum 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-4-2.4** Due to cost savings, many Type III (ordinary) and Type V (wood frame) constructed buildings may have wood trusses as a lightweight preengineered framing system used in the roof and floors. As long as the integrity of all members of the unit is intact, the unit is a stable building item. However, this may not be the case should one of the outer members be destroyed or damaged. Should this happen during a fire, the roof or floor supported by the unit may be weakened to the point where it will be unsafe to support fire fighters.

Another weak point found in the lightweight preengineered truss during a fire is the joint formed by metal gussets. The use of metal gussets has reduced the cost and increased production of wood trusses; however, the metal gussets may not retain their strength and integrity when exposed to heat or fire.

Therefore, during the survey of the buildings for water requirements, fire prevention, or prefire planning purposes, the fire department should be aware of such structural fire fighting hazards, take appropriate steps to make all fire fighters aware of the condition, and plan alternate fire tactics.

**A-4-2.5** See A-4-2.4.

**A-5-2.1 Examples of Calculating Minimum 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 × 1.0 = 3,429 gal
Minimum 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.

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.

(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** 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 1.0 (brick dwelling)
14,400 ÷ 7 × 1.0 = 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
Minimum 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.

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-5-4.1 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

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

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
Minimum Water Supply = 39,000 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, regardless of size.

**A-5-5.1 Multiple Structures — Single Water Point without Exposure Hazards.**

(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 minimum water supply for this dwelling (3500 gal) must be multiplied by 1.5 for the exposure.

3429 × 1.5 = 5144 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 minimum 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
Minimum Water Supply = 24,000 gal

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

(f) Farm equipment shed, same as A-5-2.1(b), except 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 minimum water supply for the equipment shed (26,250 gal) must be multiplied by 1.5.

26,250 × 1.5 = 39,375
Minimum 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 m²; 1 cu ft = .028 m³; 1 gal = 3.785 L.

Since the equipment shed requires the larger minimum water supply, if these two buildings were to be protected by the same water supply, that minimum 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-5-6.1** 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-5-7.1** It is the intent of NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Mobile Homes*, to provide additional life safety as the primary goal with property protection as a secondary goal. NFPA, federal agencies, and private organizations are united to provide the research and to develop sprinkler protection for residential occupancies at a low cost. The researchers developed a new sprinkler head for the residential system that has a uniform discharge density and quick response capabilities. The reports coming in from those areas that have adopted NFPA 13D for dwellings, apartments, mobile homes, hotels, and motels are exciting. Therefore, where a water supply is available, NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings*, is highly recommended for the protection of life and property.

**A-5-7.1.1** 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-5-8.1** 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.

The state DOT, in most cases, can provide the fire department with a computer printout showing safe load limits for bridges located within the boundaries of your city, town, county, fire district, etc. This information has proved invaluable to a number of fire departments in checking bridges used to carry fire equipment. (*See Appendix B-6 for further information on access to water supplies.*)

**A-7-1.1** Where a subdivision or other "planned building group" is proposed, it should be in accordance with NFPA 1141, *Standard for Fire Protection in Planned Building Groups.*

Fire and municipal officials having jurisdictional authority in areas where structures interface with wildlands should establish and enforce protective measures in accordance with generally accepted principles and applicable NFPA standards.

**A-7-4.1** Smoke detectors work and are needed. In any given year statistics will reveal that well over 50 percent of all persons killed by fire will die in residential fires. Therefore, it's good news that current estimates indicate that smoke detectors are in approximately 75 percent of the nation's homes. (*See NFPA 74, Standard for the Installation, Maintenance, and Use of Household Fire Warning Equipment.*) The primary concern of the standard is with life protection, and many water hauling fire departments have developed programs to promote the installation of smoke detectors as a first step in saving life and property through early detection. Early detection of a fire will go a long way toward reducing the water requirements needed for fire fighting purposes and toward reducing the water necessary for a water hauling fire department to transport.

**A-7-5.2** 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 makeshift 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 (WSO).** 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 with 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 (WSO).** 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. The WSO may maintain and even carry with him a complete set of files, which should include cards showing water points and lists of automatic and 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.

As the WSO visits neighboring fire departments, a list of all apparatus, equipment, and personnel available to the officer's department should be developed. At this time, arrangements can be developed where certain apparatus and personnel will respond under an automatic aid agreement (first alarm response) or a mutual aid agreement (called as needed), depending on the needs of the department. These needs will be dictated, of course, by the nature of the structure(s) involved.

**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 automatic and 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 Communication Coordination.** In water supply operations, efficient radio communication is absolutely necessary. To develop and sustain large fire flow requires the use of several water sources as well as several drop tanks where water may be dumped. Therefore, good radio communication is a must in readily directing tankers so that time is not lost at the fill and the dump points. To obtain this level of tanker efficiency, a radio frequency separate from that used for the fire ground operations needs to be assigned to the water supply officer (WSO). The water supply officer also needs to have efficient communication with the incident commander.

**B-1-2.4 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 (WSO) 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. The WSO 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. The WSO should make periodic inspections of all water supplies and structural changes in his department's jurisdiction.

The WSO or designee must meet with property owners and secure their permission to use the water supply (*see B-1-2.6*), 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, the WSO should be available to consult with the owner in the design of a water source on a property to be protected.

**B-1-2.5 Water Source Cards.** A recommended practice is to prepare individual water source cards for each water point. This is a job that lends itself ideally to computers. There may be one or more water source applicable to a given potential fireground. In addition to the computer, the water sources should be noted on master grid map of the area. Thus, the grid map will show the index location of water source cards on which pertinent data will be noted. This 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 250 gpm (946 L/min)," "10,000 gal (37 850 L/min) storage," etc.] and any particular problem such as weather condition or seasonal fluctuations that 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-1-2.6 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 that has been used by several fire departments with the approval of their county or town attorney.

### 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<br>ANYTOWN FIRE DEPARTMENT |
| _____ | | _____ |
| OWNER | DATE | SECRETARY<br>ANYTOWN FIRE DEPARTMENT |
| | | _____ |
| | | CHIEF<br>ANYTOWN FIRE DEPARTMENT |

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

**B-1-2.7 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 that may be encountered at the supply should be recorded. (*Also see B-5-3.2.*)

**B-1-2.8 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-1-2.9 Reliability of an Impounded Supply.** For an impounded supply, cistern, tank, or storage facility, the quantity to be considered available is the minimum available [at not over 15-ft (4.5-m) lift] during a drought with an average 50-year frequency (certified by a registered professional engineer). The maximum rate of flow is determined by testing using the pumper(s), hose arrangement, and dry hydrant normally used at this site.

**B-1-2.10 Reliability of a Flowing Stream.** For a supply from a flowing stream, the quantity to be considered available is the minimum rate of flow during a drought with an average 50-year frequency (certified by a registered professional engineer). The maximum rate of flow is determined by testing using the pumper(s), hose arrangement, and dry hydrant normally used at this site.

**B-1-2.11 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. Letters and/or numbers should be at least 3 in. high, with a ½-in. strobe and reflective.

**B-1-2.12 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 fighting 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. Valuable information concerning design of ponds may be obtained from county agricultural agents, cooperative extension offices, county engineers, etc. 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, driveways, 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 pumping unit 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 for fire fighting, domestic consumption, and drought storage in many rural and beach areas.

Cisterns should have a minimum usable volume as determined by the department having jurisdiction using the methods described in Chapter 5 of this standard, and there is no real limit to the maximum capacity. A cistern should be accessible to the fire truck or other pumping device but should be located far enough from the hazard that one is not endangered when in use.

The water level of a cistern can be maintained by rainfall, water pumped from a well, water hauled by a tanker, or by the seasonal high water of a stream or river. The cistern can present a freezing problem in that its surface is often relatively inaccessible and the water is stagnant. One method to minimize freezing is to use a dry hydrant protruding into the water at a point below the local frost line.

Cisterns should be capped for safety, but they should have openings to permit inspections and use of suction hose when needed. [*See B-4-1 and Figure B-4-6(h).*]

**B-4-3 Protection from Freezing.**

If a dry hydrant is not installed in a cistern, then, depending on local conditions, a heavy pipe or a pike hole may be adequate to break an ice formation. In fact, the weight of the suction hose itself may be sufficient provided there is no danger of damaging the strainer or the hose.

There are several methods of providing an ice-free surface area in a cistern or other water source. These include, but are 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-4-7.

**B-4-5 Construction of Cisterns.** 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.

Some engineering considerations to be used in designing cisterns include:

(a) Base, walls, and roof should be designed for the prevailing soil conditions and for the loads encountered when heavy vehicles are parked adjacent.

(b) If groundwater conditions are high, it should not float when empty.

(c) Suction piping should be designed to minimize whirlpooling.

(d) Vent piping must be of sufficient size.

Maintenance factors to be considered by the fire department include the danger of silting, evaporation or other low water conditions, and freezing problems previously discussed.

**B-4-6 Cistern Specifications.** Some political districts, where water systems are not available and water for water hauling fire departments is inadequate, are requiring developers to provide cisterns with all subdivisions that are constructed. As each cistern may provide fire protection for a number of buildings, the capacity is rather large and represents a substantial investment. The following are specifications for cistern design and construction that one political district is using.

**Specification of Cistern Design and Construction.**

1. Cisterns should be located no more than 2200 feet (671 m) truck travel distance from the nearest lot line of the furthermost lot.

2. The design of a cistern should be trouble-free and last a lifetime.

3. The cistern should be 30,000 gallons (113 550 L) minimum, available through the suction piping system.

4. The suction piping system should be capable of delivering 1000 gpm (3800 L/min) for three-quarters of the cistern capacity.

5. The design of the cistern should be submitted to the authority having jurisdiction for approval prior to construction. All plans should be signed by an acceptable registered professional engineer.

6. The entire cistern should be rated for highway loading, unless specifically exempted by the authority having jurisdiction.

7. All drawings are for estimating purposes only and are not intended for use as design.

8. Each cistern should be sited to the particular location by a registered engineer and approved by the authority having jurisdiction.

9. Cast in place concrete should achieve a 28-day strength of 3000 psi (20 700 kPa). It should be placed with a minimum of 4-in. (102-mm) slump and vibrated in a workmanlike manner.

10. The concrete should be mixed, placed, and cured without the use of calcium chloride. Winter placement and curing should follow the accepted American Concrete Institute (ACI) codes.

11. All suction and fill piping should be American Society for Testing and Materials (ASTM) Schedule 40 steel. All vent piping should be ASTM Schedule 40 PVC with glued joints.

12. All PVC piping should have glued joints.

13. The 8 in. × 5 in. (204 mm × 127 mm) eccentric reducer is available from suppliers.

14. The final suction connection should be 4½-in. (114-mm) National Hose male thread. It must be capped.

15. The filler pipe siamese should have 2½-in. (65-mm) National Standard female threads with plastic caps.

16. The entire cistern should be completed and inspected before any backfilling is done.

17. All backfill material should be screened gravel with no stones larger than 1½ in. (38 mm) and should be compacted to 95 percent ASTM 1557.

18. Bedding for the cistern should be a minimum 12 in. of ¾- to 1½-in. crushed, washed stone, compacted. No fill should be used under stone.

19. Filler pipe siamese should be 36 in. (914 mm) above final backfill grade.

20. Suction pipe connection should be 20–24 in. (510–610 mm) above the level of the gravel where vehicle wheels will be located when cistern is in use.

21. Suction pipe should be supported either to top of tank or to a level below frost.

22. Base should be designed so that cistern will not float when empty.

23. Perimeter of tank at floor/wall joint should be sealed with 8-in. (20-cm) PVC waterstop.

24. After backfilling, tank should be protected by fencing or large stones.

25. Backfill over the tank should be:

(a) 4 ft (1.2 m) of fill; or

(b) The top and highest 2 ft (0.6 m) of sides of cistern insulated with vermin-resistant foam insulation, and 2 ft (0.6 m) of fill.

(c) All backfill should extend 10 ft (3 m) beyond the edge of the cistern, then maximum 3:1 slope, loamed and seeded.

26. Bottom of suction pipe to pumper connection should not exceed 14 ft (4.25 m) vertical distance.

27. Pitch of shoulder and vehicle pad from edge of pavement to pumper suction connection should be 1-6 percent downgrade.

28. Shoulder and vehicle pad should be of sufficient length to permit convenient access to suction connection when pumper is set at 45-degrees to road.

29. All construction, backfill, and grading material should be in accordance with proper construction practices and acceptable to the authority having jurisdiction.

30. All horizontal suction piping should slope slightly uphill towards pumper connection.

31. Installer is responsible for completely filling cistern until accepted by the authority having jurisdiction.

Specifications furnished by the New Boston Fire Department, New Boston, NH.

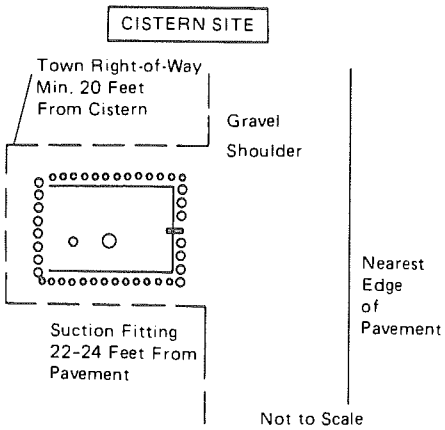



Figure B-4-6(a).

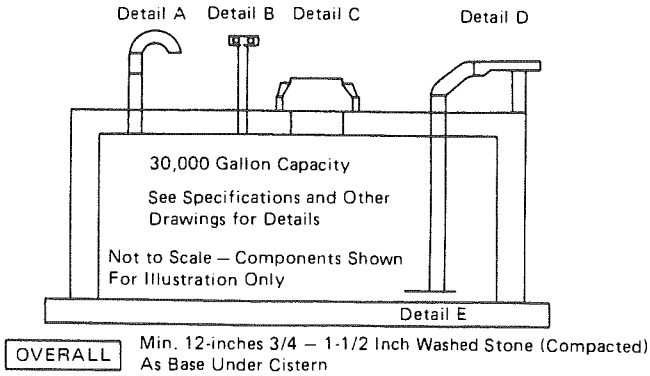



Figure B-4-6(b).

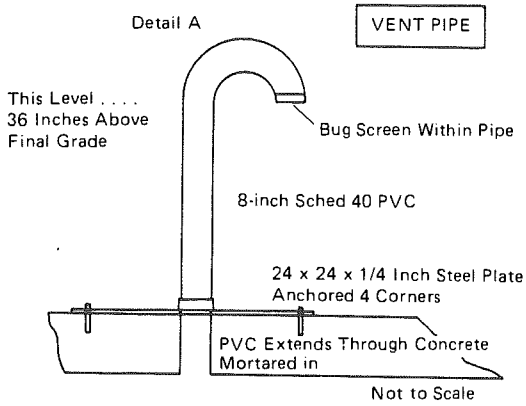



Figure B-4-6(c).

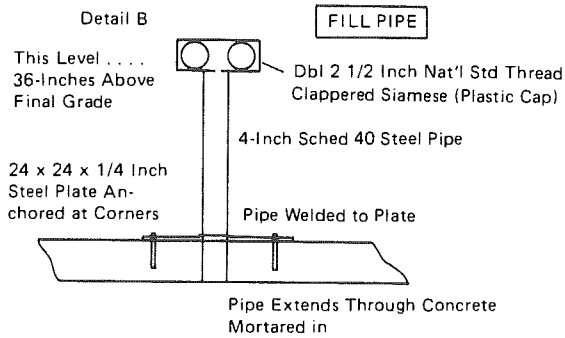



Figure B-4-6(d).

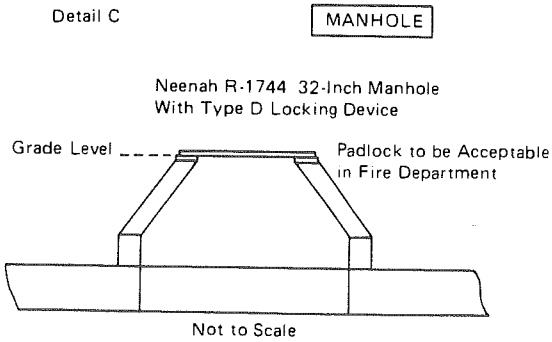



Figure B-4-6(e).

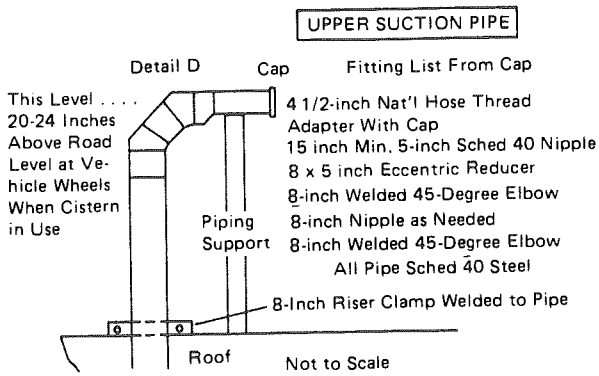



**Figure B-4-6(f).**

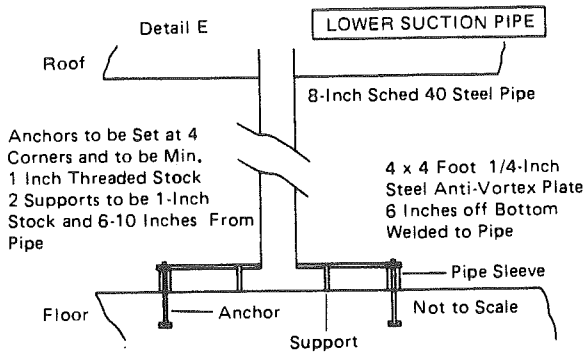



**Figure B-4-6(g).**

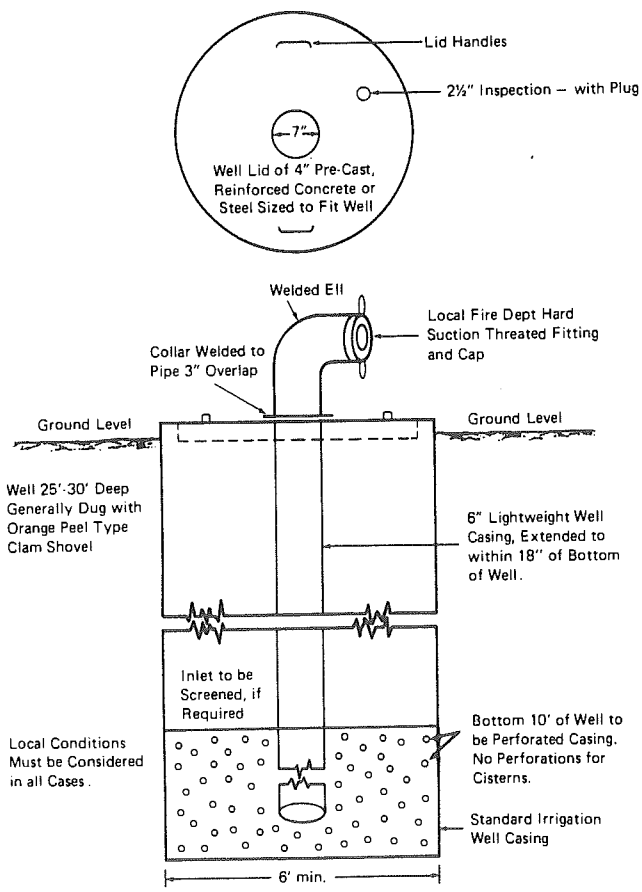



**Figure B-4-6(h) Typical well (cistern) with dry hydrant installed. Same design suitable for cistern if bottom of casing is not perforated. For usable water depth, see B-4-7 warning.**

**B-4-7 Guide to Circular Cistern Capacity.** A ready guide to the capacity of cisterns with vertical sides is given in Table B-4-7.

**Table B-4-7**
**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) |

NOTE: One cubic foot = 7.48 gallons of water.

WARNING: Reference is made to water depths in cisterns, swimming pools, streams, lakes and other sources in a number of places in this Appendix. It should always be remembered that the depth with which the fire fighter 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.

**B-4-8 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-4-8.1 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-4-8.1*) 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.

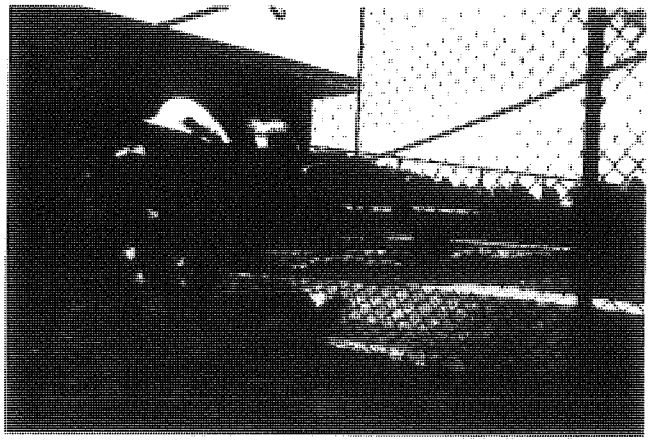


**Figure B-4-8.1 Pool accessibility. Where plans are made before a fire, it may not take elaborate preparation to use a swimming pool as a water supply.**

**B-4-8.2 Pool Capacity.** A short-form method of estimating pool capacity is:

L × W × D × 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.

1 cu ft water = 7.5 gallons

Consideration should be given for providing 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-4-8.3 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.

Another consideration is whether the ground surrounding a pool will support the weight of a fire department vehicle without collapsing. 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-4-9 Livestock Watering Ponds and Tanks.** Many farms have livestock water tanks and other similar facilities. If the owner is aware of the water needs for the farm's 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-4-10 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 that 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-4-11 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 hydrant [*see Figure B-5-1(b)*] with an all-weather road access is preferable.

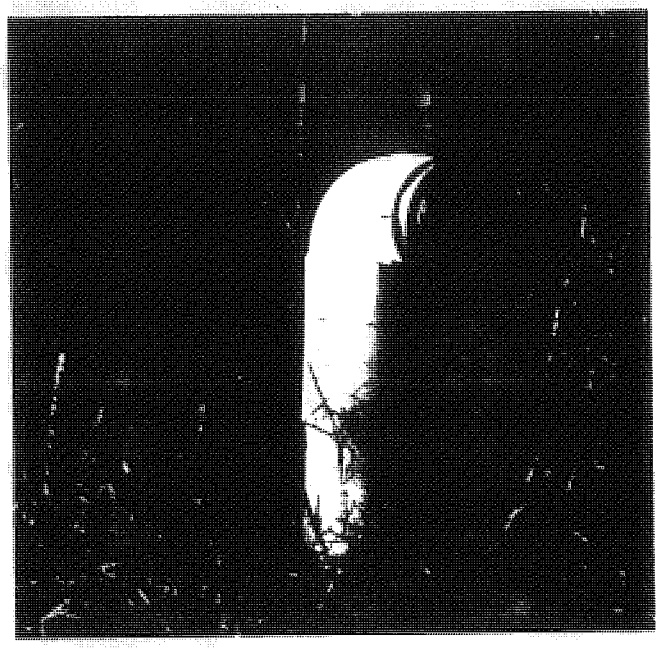
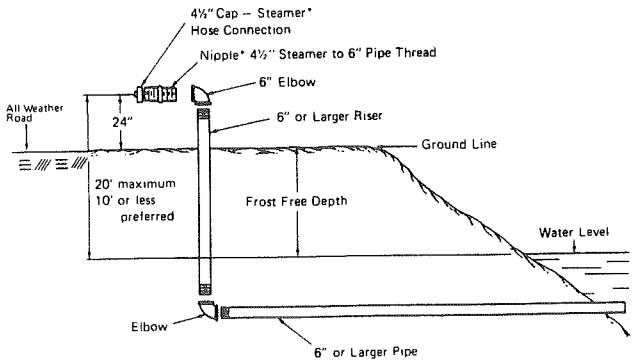


**Figure B-5-1(a) Dry hydrant.**

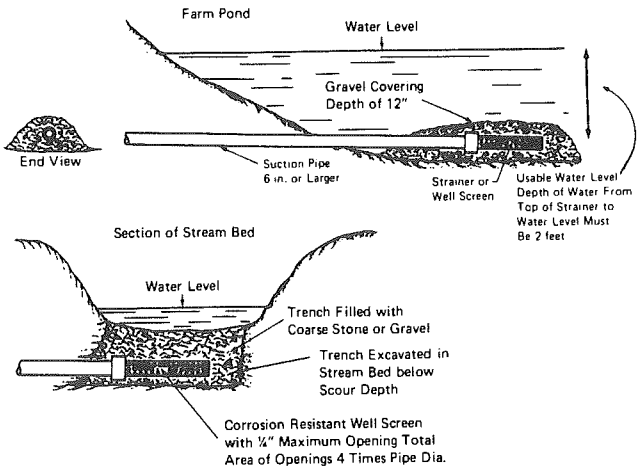



Exploded view of dry hydrant construction.

**Figure B-5-1(b) Dry hydrant construction.** [*See Figure B-5-2(c).*]

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.




Details of screen layout – pond and stream sites.

**Figure B-5-1(c) Details of screen layout — pond and stream sites.**

**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-5-2.2.*) 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 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**
**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 pipeline 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-5-1(c). However, a strainer may be constructed by boring ¼-in. (6.4-mm) or ⅜-in. (9.5-mm) holes through the pipe. The holes should be spaced on ½-in. (12.7-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 (0.6 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-5-1(b).*]

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. The riser on a dry hydrant should be exposed above ground approximately 24 in. (610 mm).

### B-5-2.1 Pressurized Dry Hydrant Sources.

There can be two types of pressurized dry hydrants—those flowing through a dam (or dike) and those coming from an uphill water source emptying at a point downhill from the source. Although the water source uphill can be of extreme advantage when flowed to a downhill source, a major disadvantage could lie in the burying of the PVC pipe below the frost level. 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.

### B-5-2.2 Design Features and Step-by-Step Procedures for Installing a Dry Hydrant Using PVC Pipe.

The design of dry hydrant installations have been carefully planned to incorporate several desirable advantages that 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.

I. Design Features for Dry Hydrant.

A. It is recommended that dry hydrants be constructed of 6 in. (152 mm) or larger piping and fittings; however, for very short lengths of pipe, 5 in. (127 mm) may be considered.

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.

**Figure B-5-2.2(a) A dry hydrant innovation has eliminated the top 90° or 45° elbow on each hydrant.**
*(Photo by Nahunta Volunteer Fire Department, North Carolina)*

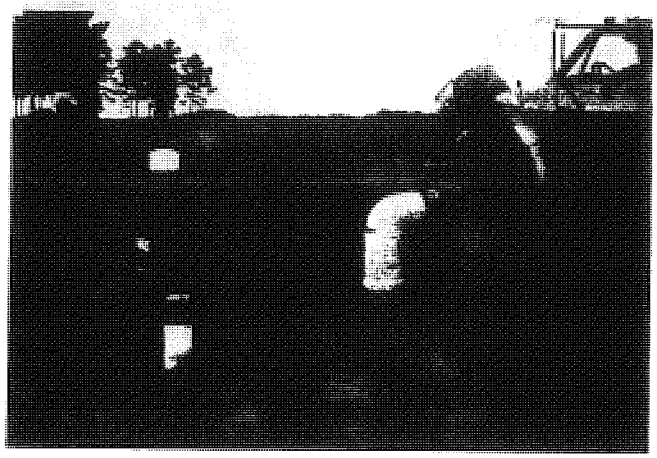


**Figure B-5-2.2(b) Hard suction hose is connected to the pumper. The driver maneuvers the truck as the fire fighter walks the suction end of the hose to the dry hydrant. An "O" ring in the plastic "L" provides a tight fit and allows the operator to draft. This is a quick and simple method to connect the pumper to a dry hydrant.**

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

(Installation is made easy by some simple preplanning.)

A. Consider average water level at piping entry location.

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

C. It is recommended that a backhoe or similar ditching equipment be utilized to excavate entire ditch to a horizontal elevation 3 ft (0.9 m) below water level.

D. 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.

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

F. 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.

G. 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.

H. 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. (305 mm) of coarse gravel to secure it in place and to prevent movement and must be at least 2 ft (0.6 m) under water. The supports can also be secured to the pipe with copper wire to stabilize piping.

I. In rapidly moving streams, the pipe will need to have special protection against the rapidly flowing water and various debris and materials washing down the stream against the pipe.

**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 ponds, 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.

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.

Inspections should include safety procedures 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.

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.

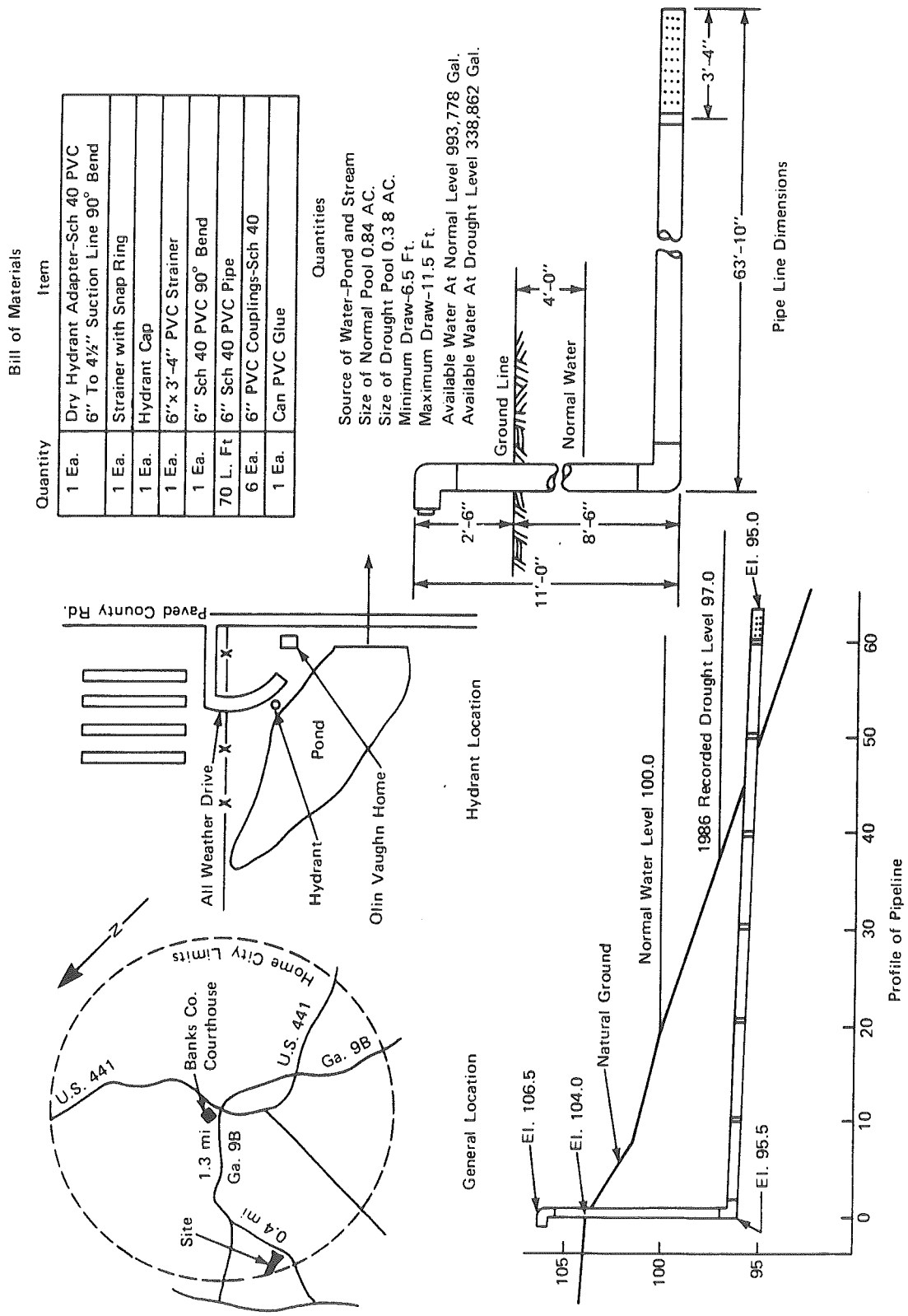



Figure B-5-3.2(a).

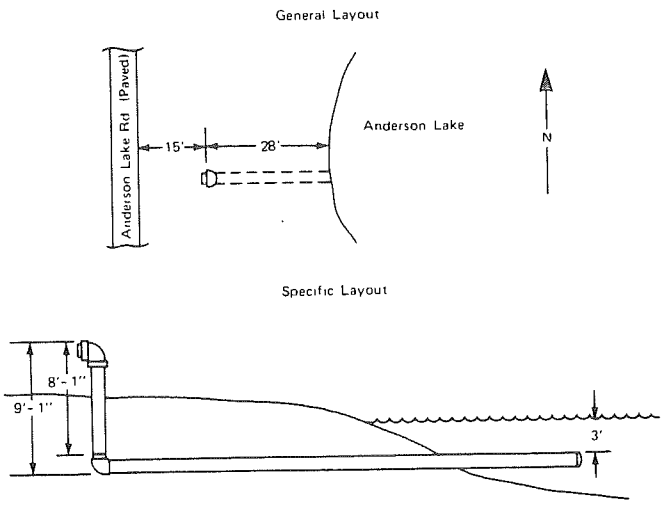



**Figure B-5-3.2(b).**

**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-5-3.2 Map and Location/Detail Drawing.** An official record should be kept of all pertinent information recommended for each dry hydrant area. An example of one type is Figure B-5-3.2(a). Additional information could be kept in format such as shown in Figure B-5-3.2(b). Both will provide invaluable information whenever the need for such is required.

**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 (0.6 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 that 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 (0.6 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 (0.6-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 that 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)<br>Tread — 8 ft (2.4 m)<br>Shoulders — 2 ft (0.6 m) |
| Alignment: | Radius center line curvature — 50 ft (15.2 m). |
| Gradient: | Maximum 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-6-2.1** While the roadway is being developed to the water supply, consideration should be given to providing an 80-ft diameter turn around for the tankers. Where conditions at the supply do not make a turn around feasible, a large underground pipe transmission line may be laid from the water supply to the highway and the tankers filled on the highway right-of-way. However, a turn around or looped facility will still need to be provided at the fill point on the right-of-way.

**B-6-2.2 Bridges Used as Water Points.** In some states, a fire department cannot use a bridge to park a tanker while it is being filled, thereby blocking traffic on a state road. However, the fire department may be able to use the water source by moving the fill point off of the bridge to the right-of-way. Therefore, the department needs to check with the

state DOT and abide by the appropriate laws governing the situation.

**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 that 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 1960s 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 that will not cause overloading. Any situations, such as an area isolated by an unsafe bridge, that 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 that 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. However, the value may be determined by the date that the map was made or revised since an out of date map may prove to be of little value. 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 Mobile Water Supply (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.

Should the water supply be a dry hydrant, a lake, a cistern, a swimming pool, etc., some means must be provided for transporting the water from the supply to the fire. Most fire departments are using a fire department pumper (having a pump capacity of 750 gpm or more and having a minimum 500 gallon tank).

As this vehicle is always assigned to the supply, some departments provide it with little equipment beyond the pumps, the necessary hose for loading the tanker and some preconnected hand lines.

Several departments report that they have developed water supplies where the pumper is actually driven into shallow water at the water supply. Others have developed a trailer with a pump and the trailer is pulled to the water supply. Still other departments have received good service from a permanently installed pump at the supply.

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 or automatic aid program is necessary and far superior to makeshift equipment that 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.

Some fire departments, where their pumpers are equipped with large booster tanks, have retrofitted these pumps with a dump system.

**C-1-2 Purchase or Construction of a Tanker.** In the 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, *Standard on 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 semitrailer 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 or 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 highway bridge weight restrictions may convince many rural fire departments of the need to restrict the weight of their mobile water supply tanker.

Each load bearing tire and rim of the apparatus should carry a weight not in excess of the recommended load for truck tires of the size used, as published by the tire manufacturer's rating, when apparatus is loaded. Compliance should be determined by weighing of the loaded apparatus.

**C-1-3 State Regulations.**

Regardless of rear axle configuration, definite consideration should be given to the state legal weight per axle requirement. All states have single axle weight limits, which are imposed solely due to road surface conditions and longevity of highways. Although axles are designed to carry their rated weight, and vehicle and fire department planners can specify precise chassis requirements to be within the safe tolerances of total vehicle operation and weight, this still does not legally permit the fire apparatus to exceed the state's legal weight rating per axle. Since some axle weight ratings are 26,000 lbs, the consideration and attention paid to state single axle weight limits can become quite significant.

The use of dead (or dummy) axles serves only to reduce the weight per axle load (on weighing scales). In no manner does it allow the engineering parameters of motor, transmission, drive shaft, brakes, etc. designed for the GVW of the chassis to be functional. Using a nonworking axle for load carrying purposes does not make a road-safe chassis.

**C-1-4 Mobile Water Supply (Tanker).** In general terms, mobile water supply vehicles or "tankers" are units 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 similar fill and discharge capability and equal water-carrying capacities to prevent them from "stacking" at the fill and discharge points.

**C-1-5 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 accounts for a number of deaths throughout the country. Therefore, careful consideration must be given to baffles by the designers and builders of the tanks.

A reasonable guide is to have at least one baffled compartment for every 250 gallons (946 L) of water. This is not intended to imply that small tanks (250-300 gallons) do not need baffles.

**C-1-6 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) mobile water supply tanker by gravity flow are considered. (*See Table C-1-6.*)

**Table C-1-6 1600 Gallon Mobile Water Supply (Tanker) Gravity Flows**

| Outlet in Inches | Discharge Time in Minutes |
|---|---|
| 2½ (65 mm) | 20 |
| 4½ (114 mm) | 7 |
| 6 (152 mm) | 5 |
| 10 (200 mm) | 1⅔ |
| 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.

An 8 × 8 in. (203 × 203 mm) vent extending approximately 12 in. (305 mm) high is an adequate vent size. Also, a 3-in. (76-mm) overflow pipe is suggested in NFPA 1901, *Standard on Automotive Fire Apparatus*. This overflow pipe located in the vent pipe area has worked very well for a number of departments.

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 that 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.

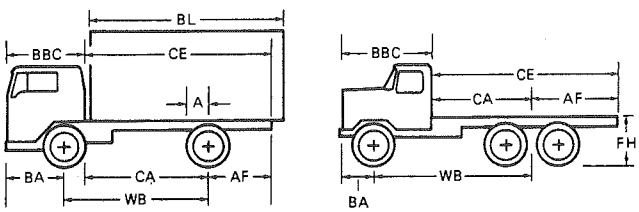
Applicable NFPA standards such as NFPA 1901, *Standard on Automotive Fire Apparatus*, contain data on adequate plumbing. Many departments are now exceeding the nominal pipe size requirements for their pumps in order to reduce friction loss and increase their capability to rapidly empty a tank by use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

**C-1-6.1 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, or some type of flexible hose with a quick discharge, specially designed large diameter fill pipe, or a rapid fill device that drops into the tank fill opening, thus providing quick breakaway from the fill supply.

**C-1-7 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-1-7 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 real 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<br>Center line of 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:

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

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

**Figure C-1-7 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 items 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-1-8 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-1-9 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 be difficult to baffle crosswise 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 that of 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 thoroughly steam cleaned before modifications requiring welding are undertaken.

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 or milk tanker is not required to stand in the station fully loaded day after day.

**Weights of Various Fluids**

| | |
|---|---|
| Milk | — 8.5 lbs/gal |
| Water | — 8.3 lbs/gal |
| Gasoline | — 6.2 lbs/gal |

**C-1-10 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-1-11 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 that can be continuously delivered thereafter.

A number of fire departments have developed water hauling operations to the point where they have a maximum continuous flow capability (a sustained fire flow) of 1,000 to 2,000 gpm (3785 to 7570 L/min) at the fire scene. This, of course, requires a number of tankers to haul such large quantities of water, with a developed water source near the fire site. To improve the safety factor by reducing congestion on the highways, the departments often send the tankers to the water source by one road and use another route for the tankers to return to the fire scene. Therefore, the time for the department to travel from the fire to the water source ($T_1$) may be a different time than the travel time back to the fire ($T_2$). The reduction of congestion on the highway provides for a safer operation and may increase the actual amount of water hauled.

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

$$Q = \frac{V}{A + (T_1 + T_2) + B} - 10\%$$

Where:

| | | |
|---|---|---|
| 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; |
| $T_1$ | = | Time in minutes for tanker to travel from fire to water source, given by formula $T_1 = 0.65 + XD_1$ [*see Table C-1-11(b)*]; |
| $T_2$ | = | Time in minutes for same tanker to travel from water source back to fire, given by formula $T_2 = 0.65 + XD_2$ [*see Table C-1-11(b)*]; |
| 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 one-way trip travel.

D = One-way 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:

**Table C-1-11(a)**

| | |
|---|---|
| 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 available 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 (V) is 1500 gallons (5678 L), time (A) to fill the tanker with water is 3.0 minutes and the time (B) to dump the tanker load of water into a portable tank is 4.0 minutes.

The distance ($D_1$) from the fire to the water source is 2.10 miles. As the tanker returns by a different road, the distance ($D_2$) from the water source is 1.80 miles.

First, solve for $T_1$, the time for the tanker to travel from the fire to the water source and then for $T_2$, the time for the tanker to travel from the water source back to the fire:

Due to good weather and road conditions, the average tanker speed going from the fire to the water source is 35 mph.

Therefore:

$T = 0.65 + XD_1$
$X = 1.7$
$D_1 = 2.10$ miles
At a contrast speed of 35 mph
$T_1 = 0.65 + 1.7\ D_1$
$T_1 = 0.65 + 17 \times 2.10$
$T_1 = 0.65 + 3.57$
$T_1 = 4.22$ minutes

[*Also see Table C-1-11(b).*]

At a constant speed of 35 mph, a tanker traveling 2.1 miles will take 4.22 minutes. Due to traffic lights, the average tanker speed between the fire and the water source is 30 mph.

Therefore:

$$T_2 = 0.65 + XD_2$$

At 30 mph

$$X = 2.0$$
$$D_2 = 1.80 \text{ miles}$$
$$T_2 = 0.65 + 2.0\ D_2$$
$$T_2 = 0.65 + 2.0 \times 1.8$$
$$T_2 = 0.65 + 3.60$$
$$T_2 = 4.25 \text{ minutes}$$

Substituting in the formulas

$$Q = \frac{V}{A + (T_1 + T_2) + B} - 10\%$$

Q = Maximum continuous flow capability in gpm with V = 1500

A = 3.0

$T_1$ = 4.22

$T_2$ = 4.25

B = 4.0

$$Q = \frac{1500}{3.0 + (4.22 + 4.25) + 4.0} - 10\%$$

$$Q = \frac{1500}{3.0 + 8.47 + 4.0} - 10\%$$

$$Q = \frac{1500}{15.47} - 10\%$$

Q = 97 − 10% = 87 gpm maximum continuous flow capacity available from this 1500 gallon tanker.

To increase the maximum continuous flow capability of a tanker, any of the following changes can be made:

1 — Increase the capacity of the tanker
2 — Reduce the fill time
3 — Develop and provide additional fill points, thus reducing travel time
4 — Reduce the dump time.

With rural fire response distances normally being very long, the number and size of tankers available to the department is of paramount importance. This information will assist the department in calculating the probable tanker gallonage that will be available at various fire locations. Equally important in increasing the maximum continuous flow capacity of a tanker is to reduce the distance between the source and the building or fire. This can be accomplished by increasing the number of water supplies and/or the drafting points.

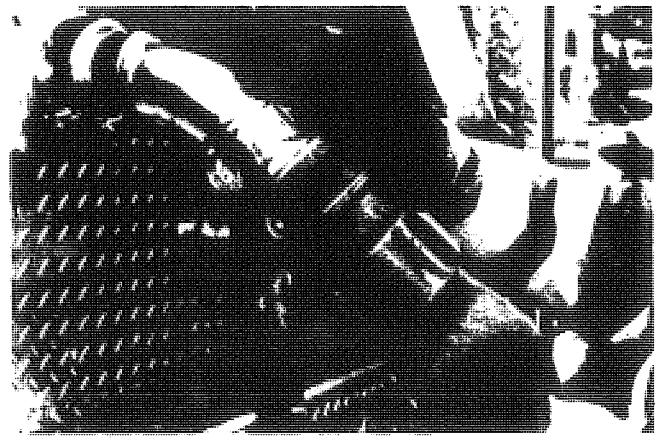


**Figure C-1-11 One way to increase water hauling capacity is to reduce the fill time of the tanker. Here is one type of quick coupling that may help to reduce the fill time.**

**C-1-12 Discharging the Mobile Water Supply (Tanker).** During water hauling operations, tanker dump/fill rates directly affect the fire flow capabilities established at the fire scene. Local needs usually determine tanker configuration and the water hauling protocols adapted. A wide variety of off-loading and filling systems are currently in use. Some departments prefer to pump off their water into portable tanks, while others utilize a nursing type of operation. An increasing number of fire departments are incorporating the use of large dump valves or jet-assisted dump arrangements. To decide which system is best requires an evaluation of effectiveness, efficiency, and overall compatibility with other segments of the water delivery.

During a comprehensive evaluation many factors must be considered. Travel distances, operating site location, and topography greatly affect water hauling turnaround time periods. Usually, the most significant time can be saved during the filling and discharge segments of the tanking operation. Normally, greater quantities of water are made available as filling/discharge rates increase. Of course, increased quantities must be logistically supported by ample water source locations and tanking vehicles.

As with other segments of fireground operations, strategic pre-planning is vital to water hauling evolutions. Preplanning and practice reduce unnecessary actions and minimize unsafe practices. For example, a properly established dump site should eliminate or substantially reduce the need to back vehicles (an act that not only requires precious time but causes 33 percent of all vehicle accidents). The use of flexible discharge tubing or side dumps in conjunction with properly set-up dump sites can often eliminate the necessity of backing.

Because two of the key periods for saving time during water hauling operations center around tanker filling and discharge, many fire departments have incorporated the use of large gravity dump valves or jet dump valve arrangements.

**C-1-12.1 Mobile Water Supplies (Tanker) Equipped with Large Gravity Dumps.** A number of rural fire departments have increased the size of their gravity discharge dumps to reduce the time necessary to empty other water

**Table C-1-11(b) 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 |

hauling tankers. Gravity dumping with discharge valves of 10 in. (254 mm), 12 in. (305 mm), or larger are often used. It must be remembered that dump valve discharge rates will vary as the depth of the water in a given tank decreases. Adequate air intakes and tank baffle cuts must be provided or inefficiency and possible tank damage can result. To check the efficiency of a dump system, actual weight tests must be conducted to determine discharge rates.

**C-1-12.2 Mobile Water Supplies (Tankers) Equipped with Jet-Assisted Dumps.** Basically, a jet is a pressurized water stream used to increase the velocity of a larger volume of water that is flowing by gravity through a given size dump valve. The water jet principle used to expel water from tankers has also been effectively applied to several other devices that can transfer water between portable dump tanks, fill tankers from static water sources, and reduce suction losses at draft. Water jets properly installed in the discharge piping of a tanker or tanker pumper can more than double their water hauling efficiency. Effective jet-assisted arrangements have exceeded a 1000 gpm (3785 L/min) discharge rate when using 6-in. (152-mm) discharge piping and valve. Pumps supplying such jet arrangements should be capable of delivering a minimum of 250 gpm (946 L/min) at 150 psi (1034 kPa). The size and design of the jet nozzle and the diameter and length of the dump valve piping directly affect unit efficiency.

**C-1-12.3 Traditional In-line Jet-Assist Arrangement.** Figure C-1-12.3(a) points out how the traditional jet is installed. A smooth tipped jet nozzle is supplied by a pump capable of delivering at least 250 gpm (946 L/m) at 150 psi (1034 kPa). Nozzle jets range in size from ¾ in. (19 mm) to 1¼ in. (32 mm). The diameter of the tip will be determined by the capacity of the pump being used and the diameter of the discharge piping and dump valve.

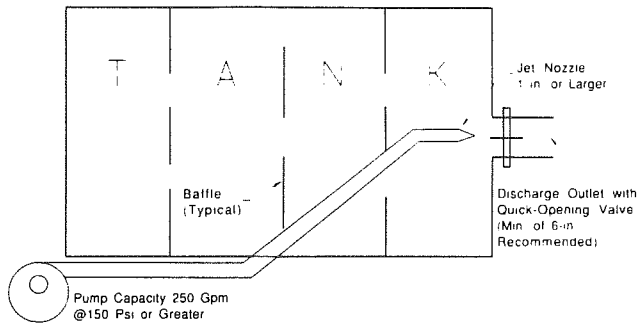



**Figure C-1-12.3(a) Traditional internal jet dump.**

The installation of a jet dump requires several important considerations to be made. In what location will the dump prove to be most useful, the side or the back? Will the fixed piping need to be 1½ in. (38 mm) in diameter or 2 in. (51 mm) in diameter? What is the preferable location for the jet, in-line or at the rear of the tank? The answers to these and other questions should be resolved before construction begins.

In the interests of site versatility, many departments are utilizing lightweight flexible discharge tubes equipped with quick lock or quarter-turn couplings. Such tubing arrangements allow rapid discharge of water to either side of the vehicle and reduce the need for hazardous backing at the dump site.

The rate of discharge will be governed by the size of the dump valve and piping, which can range from 4 in. (102 mm) to 12 in. (305 mm). Normally a 6-in. (152-mm) or 8-in. (203-mm) diameter dump configuration permits adequate flow capacities where water jet systems are employed. Again, it must be stressed that adequate air exchange and water flow passages must be provided for a jet-assisted dump arrangement to function properly. Tanks can collapse when air exchange is restricted. Lack of adequate gravity water flow to the jet area will also adversely effect the discharge efficiency of the water hauling unit.

Although some authorities recommend that the nozzle of the in-line jet be up to 6 in. (152 mm) from the center of the discharge opening, other effective designs have included placement of the nozzle inside the discharge piping. Figure C-1-12.3(b) details how the traditional jet ar-

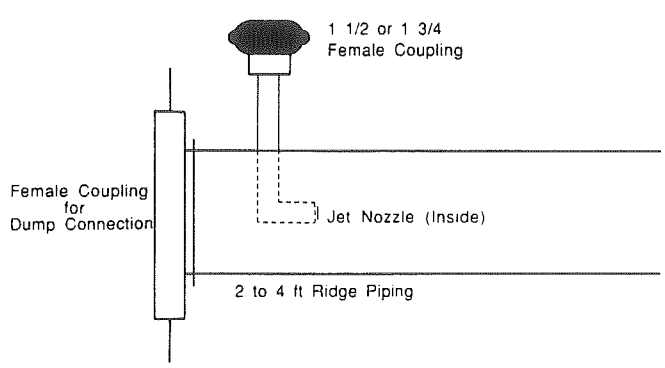



**Figure C-1-12.3(b) Traditional external jet dump.**

rangement can be externally added to an existing dump valve. A short length of 1½-in. (38 mm) hose is attached to the female on the jet device. The length of the added dump piping can be anywhere from 2 ft to 4 ft (0.6 m to 1.2 m) depending on whether or not a flexible tube is utilized during the dump process.

To properly operate, a jet must be able to produce between 50 psi (345 kPa) and 150 psi (1034 kPa) pressure. Higher pressures normally increase operational effectiveness. The diameter of the jet selected must be appropriate for the capacity and pressure capabilities of the pump being utilized. Also important is the size of the piping and valves that make up the jet dump system. External jets do have several advantages over internally fixed units, particularly in terms of system maintenance. Disadvantages might include the need to provide for adequate air exchange during water flow, more time for the initial setup to affix appliances, the restriction of movement around the vehicle, and the general appearance of such extensions.

**C-1-12.4 Peripheral Jet Assist Arrangement.** The peripheral application of jet assist nozzles has proven highly effective. This approach utilizes two or more jets installed in the sides of the discharge piping just outside the quick dump valve. In addition to the reported discharge advantages of peripheral jet streams, the externally fed system is easier to plumb and has fewer maintenance problems. The jets, installed 25 to 30 degrees from the piping wall, contact more surface area of the discharging water, thereby increasing water discharge efficiency. Because the water is drawn through the dump valve, less turbulence is created and the eddy effect often present with traditional in-line jets is overcome. Nozzles made of welding reducer pipe fittings work very effectively as jets. Two thousand gallons per minute (7570 L/min) flow rates have been obtained using a 300 gallons per minute (1136 L/min) pump to supply two ¾-in. (19-mm) nozzles in a 6-in. (152-mm) dump valve configuration. Figures C-1-12.4(a) and C-1-12.4(b) represent a typical installation.

**C-1-12.5 Other Jet Assist Devices.** Innovative fire organizations have put syphons and jet-related devices to good use. Some syphons use only water level differential to transfer water from one tank to another. Normally constructed of PVC pipe, such syphons are placed between portable tanks to equalize water levels. Transfer is initiated by filling the U-shaped tubing with water, placing the caps on the tubing until it is put in place, then removing the caps to allow water flow. Such an arrangement, though useful, have often proven too slow for the type of transfer operations required. A modification of the syphon transfer piping using a jet was developed and has proved useful to many departments. Although 4-in. (102-mm) PVC and aluminum piping have been used for such devices, 6-in. (152-mm) units usually are more practical. Using a ½-in. (12.7-mm) jet nozzle supplied by a 1½-in. (38-mm) hose makes possible transfer flows of 500 gpm (1900 L/min). Some departments merely add the jet to a length of suction. [*See Figures C-1-12.5(a) and C-1-12.5(b).*]

Syphons are commercially available that use the jet principle and are in some cases supplied by 2½-in. (64-mm) hose. These devices are used to remove water from basement areas or increase water supply to fire department pumpers.

In-line jets have also been developed to reduce suction losses during drafting operations. In-line and peripheral jets supplied by 1½-, 1¾-, or 2½-in. (38-, 43-, or 61-mm) hose lines can increase the output capacity of a centrifugal pump at draft up to 40 percent. The jets are placed at the intake and at every 10 ft (3 m) of suction in use. Some departments have developed a jet system for delivering water from a static source to tankers through 4-in. (102-mm) or 6-in. (152-mm) lightweight pipe. This supply piping concept is used to fill tankers through their discharge gates or via top loading or large inlets capable of filling tankers at the rate of 1000 gpm or greater.

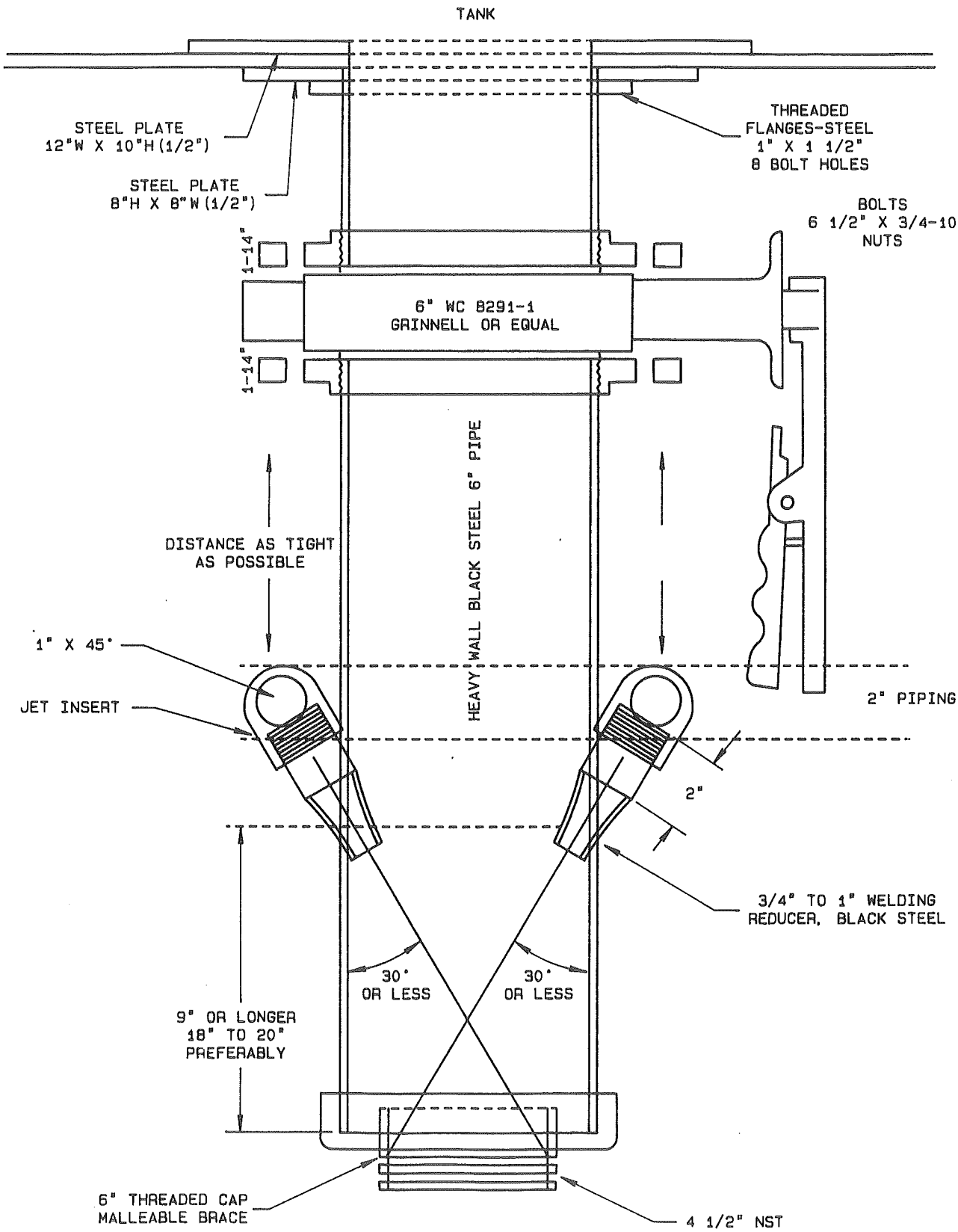
**C-1-12.6 Testing Dump Valve Capacity.** Departments using large gravity dump valves or jet-assisted dump valve arrangements need to determine the flow rate at which they can dump and fill each tanker in use. Generally accepted procedures* for determining flow capacities have been suggested and should be accomplished as follows:

1. Weigh the tanker without any water on board.
2. Again weigh the tanker when it has been completely filled with water.
3. Using only gravity, off-load the tanker for one minute.
4. Reweigh the tanker and determine the gallons off-loaded by gravity.
5. Again refill the tanker and weigh it.
6. Now off-load the tanker for one minute using the jet arrangement.
7. Reweigh the tanker and determine the gallons off-loaded via the jet.
8. Make a comparison of the gallons used by gravity and those depleted using the jet.
9. Once again, fill the tanker and weigh it.
10. Now, for one minute, off-load the tanker by opening the gravity dump and pumping through a 2½-in. (61-mm) discharge.
11. After weighing the tanker, determine the number of gallons off-loaded by pumping and dumping.

An effective jet-assisted dump arrangement should produce at least twice the gpm that would be expected when off-loading by gravity. A good jet arrangement will exceed the gpm experienced during the dumping and pumping test. Whether using large dumps or jet dump arrangements, turnaround drop times and ease of operations must serve as primary considerations.

**C-1-13 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. Tanks are available with an inlet and/or outlet built into the side of the tank. Capacities of drop tanks normally run from

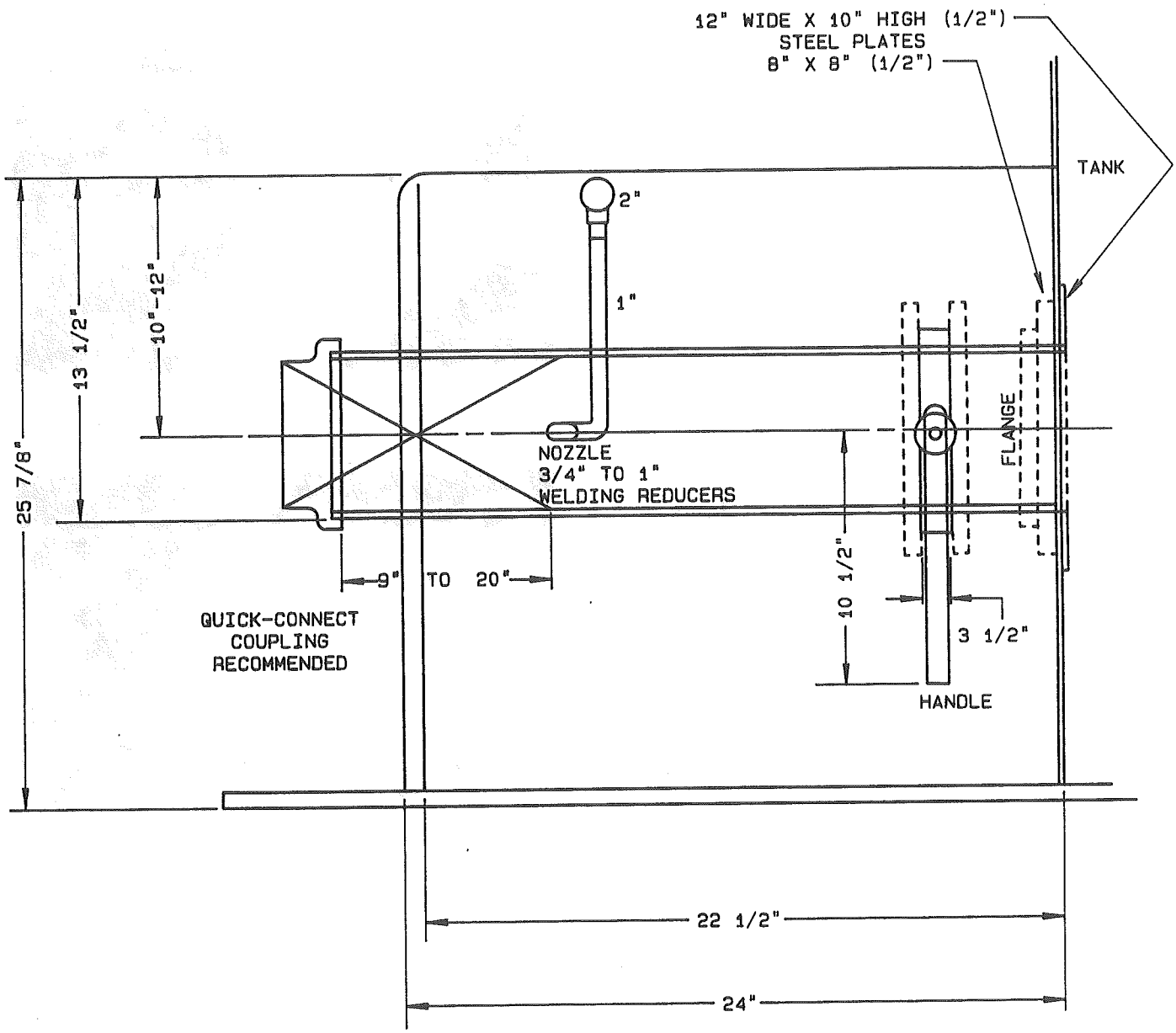
*General procedure referenced from Larry Davis, *Rural Firefighting Operations Book II*, Chapter 15, page 342, IFSFI, Ashland, Mass 1986




NOTE:
6" NST, 6" STORTZ OR 6" BELL CAP WITH QUICK LOCK LUGS OR OTHER QUICK CONNECT COUPLING RECOMMENDED.

TOP VIEW

Figure C-1-12.4(a).




SIDE VIEW

Figure C-1-12.4(b).

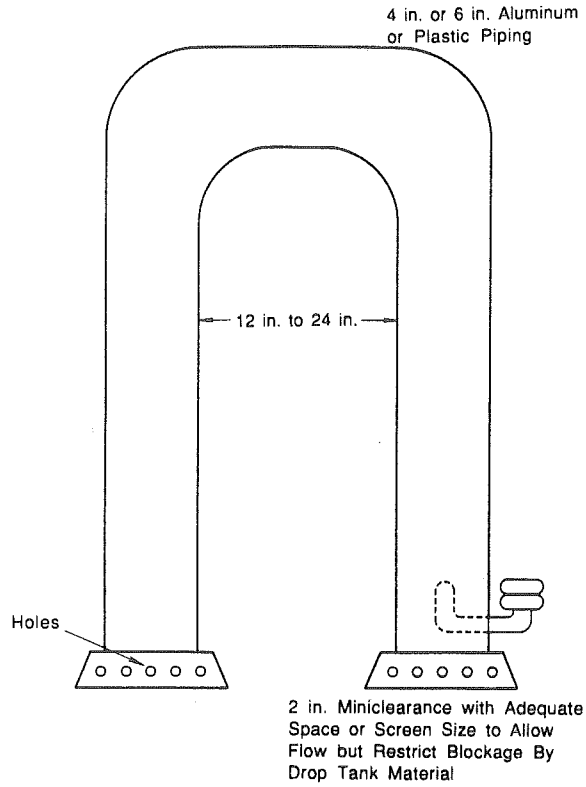



**Figure C-1-12.5(a) Jet-assisted transfer syphon.**

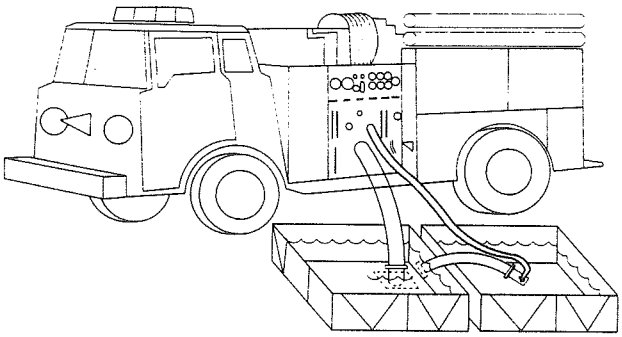


**Figure C-1-12.5(b) Modified hard suction jet syphon.**

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-1-14 Use of Portable Drop Tanks and Mobile Water Supply Vehicles (Tankers).** The development of the portable drop tank or portable folding tank and the jet assisted dump or large gravity dump 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:

**Figure C-1-13(a) Portable drop tanks should be simple to set up. Note the portable tank compartment (door open) on the tanker.** *(Photo by Nahunta Volunteer Fire Department, North Carolina)*

**Figure C-1-13(b) Each tanker should carry a portable tank that is 40 percent greater than the capacity of the tanker. Note the strainer that minimizes whirlpooling and allows departments to draft to a depth of 1-2 in. in the portable tank.**

When an alarm of fire is received, equipment is dispatched on a preplanned basis determined by such factors 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 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 pumping unit 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 preplanned, 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 supply 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 supply 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 that 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. Automatic 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.

It is desirable that each tanker carry a portable drop tank with a capacity in excess of the tanker capacity.

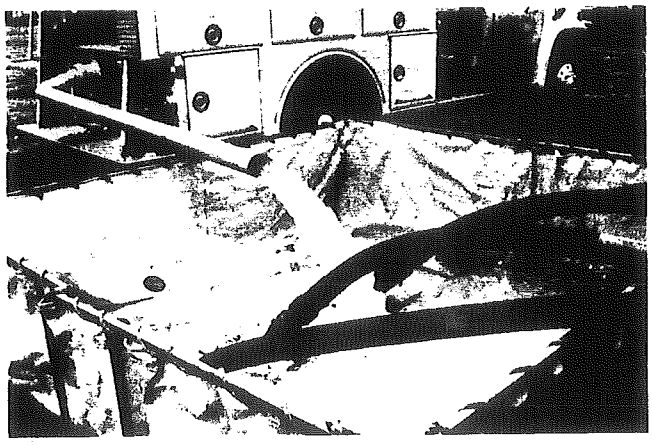


**Figure C-1-14 The aluminum irrigation discharge pipe, in the shape of an "L," allows discharge from either side or rear of the tanker. Four hard suction hose lines are used to minimize any clogging of the strainers.**

## C-1-15 Chemical Additive and Water Supply.

**C-1-15.1 General.** Fire departments are using chemicals to increase their fire fighting capacity. This is important to the rural fire fighter working with a limited water supply because these chemicals can give more extinguishing capability per gallon of water. Since the chemical additives will create an additional expense, it becomes very important to be aware of the various capabilities and characteristics of chemical additives, as well as their advantages and disadvantages, relating to the types of fires encountered by each fire department.

**C-1-15.2 Foam.** The need for fire fighting foams occurs on surfaces when the cooling effect of water is needed and whenever continuous film-coating characteristics of a light, opaque form of water, capable of sealing vapors, are needed. The most important use of foam is in fighting fires involving flammable or combustible liquids; foam becomes the only permanent extinguishing agent used on fires of this type. Fire fighting foam is lighter than the aqueous solution from which it is formed and lighter than flammable liquids; therefore, it floats on all flammable or combustible liquids, producing an air-excluding, cooling, continuous layer of vapor-sealing, water bearing material for purposes of halting or preventing combustion. (*See NFPA 11, Standard for Low Expansion Foam and Combined Agent Systems.*)

The appropriate listings on the label should be consulted to determine proper application rates and methods. If there are no listings for application rates and methods, do not assume any. However, the word "foam" appears in the usage of wetting agent instructions as well as in the use of water expansion system (WES) units.

**C-1-15.3 Other Water Additives (Wetting Agents).** A wetting agent is a chemical compound that, when added to water in amounts indicated by the manufacturer, will materially reduce the water's surface tension, increase its penetrating and spreading abilities, and may also provide emulsification and foaming characteristics. Decreased surface tension disrupts the forces holding the film of water together, thereby allowing it to flow and spread uniformly over solid surfaces, also allowing it to penetrate openings and recesses that it would normally flow over. Water treated in this manner not only spreads and penetrates, but displays increased absorptive speed and superior adhesion to solid surfaces. Because of the above, leaks in plumbing and pump packing may occur that would not have occurred if the additive had not been used. Visual inspection should be made during wet water operations.

Wet water should be applied directly to the surface of the combustible. These agents do not increase the heat absorption capacity of water, but the greater spread and penetration of the wet water increase the efficiency of the extinguishing properties of water as more water surface is available for heat absorption and run-off is decreased.

Wetting agents are broadly defined as being surfactants (surface acting agents). All wetting agents are concentrated and are mixed with a liquid at varying percentages. The wetting agent can be liquid or powder. The liquid into which it is mixed for fire fighting purposes is water. However, the primary sales for some wetting agents are for use as a carrier for liquid fertilizers, fungicides, insecticides, and herbicides. Thse wetting agents can be, and are, used for fire fighting purposes. They don't have additives that will protect tanks, pumps, valves and bushings, etc., and it is recommended that unused mixtures be drained out of the tank and a flush of all parts be made with plain water. With all wetting agents, hard water usually does require a greater amount of additive to produce the same results.

Wetting agents designed for fire department use will normally contain rust inhibitors to protect the tank, pump, piping, and valves. Generally, the mixture will lose some of its rust-inhibiting characteristics if left in the tank.

Wetting agents are available in both liquid and powder form. Both forms will result in the same extinguishment characteristics.

The use of wetting agents is as a soaking or penetrating agent into forest fuels, sawdust, cotton (bales, bedding, upholstery), rags, paper, etc. These agents are used very effectively on smoldering or glowing combustibles. All of the commercially available products that fall into the above category will satisfactorily suppress Class A type fires.

Many of the wet water additive products will have instructions that make note of the production of a foam material through increasing the amount of the product.

No additional equipment is needed for the production of this foam. Caution should be exercised, as well as actual on-site testing performed, in order to determine what the resultant foam will display in terms of extinguishment and fire fighter safety.

Additionally, a few wet water additives will produce a foam through the use of a foam gun (generally a tube-type aerator and some nozzles. The instructions will indicate this is generally a Class A fire extinguishing agent. As above, local on-site testing should be performed to determine the product's capabilities.

There is commercially available a water additive that will suppress Class A and B fires. The product accomplishes the extinguishment of Class B fires by altering the water properties in such a manner that the increasing heat converts the water to a vapor, rather than steam, thereby cooling the fire.

## 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 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 Diameter 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-1-3(a) 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.

**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

**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**

**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 that 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. (152-mm) hose is used. Therefore, the department should consider using 6-in. (152-mm) 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.

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

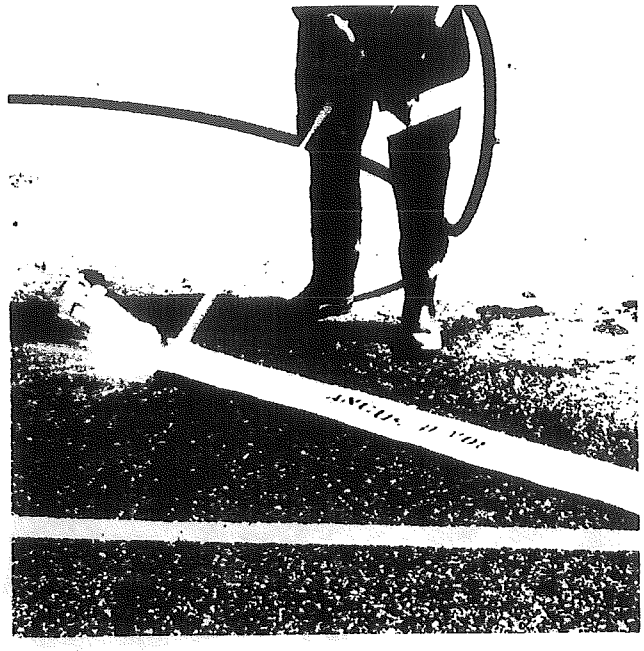


Figure D-1-6(a) Field cleaning large diameter hose.

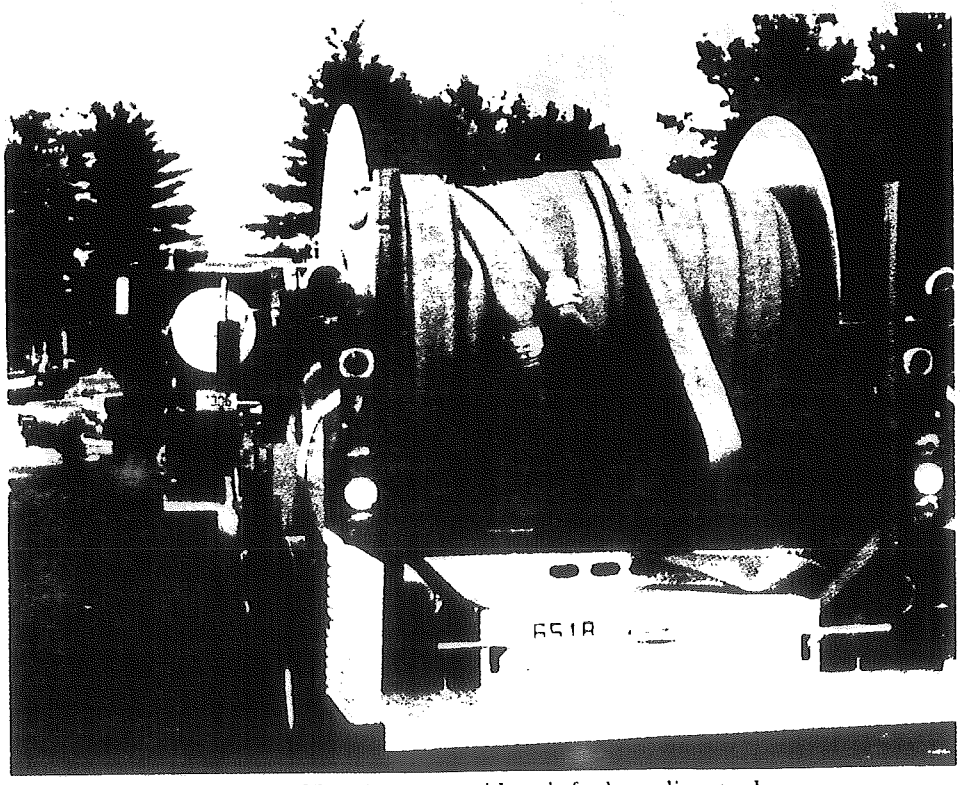


Figure D-1-6(b) Apparatus with reels for large diameter hose.

municipal water supplies that 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 that 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.

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.

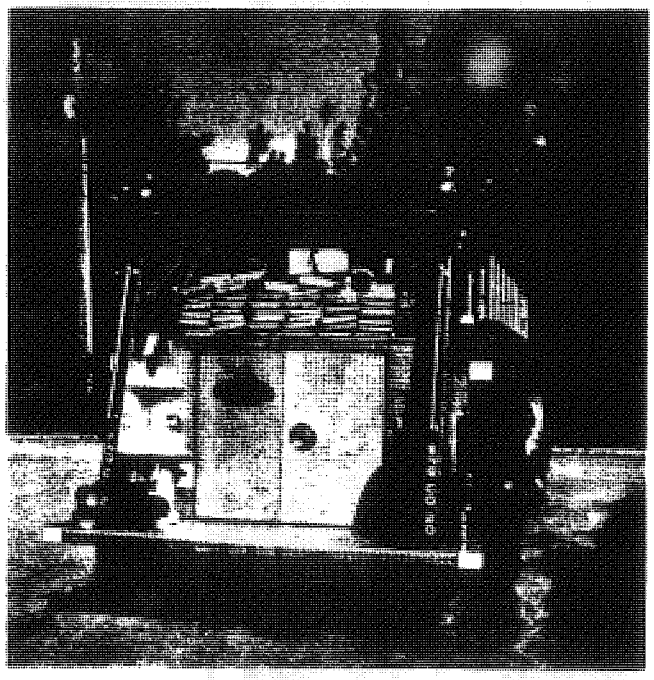


**Figure D-1-6(c) Many departments have installed large diameter hose with a flat lay in the hose bed.**

**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 (described below) have been developed to be used with large diameter hose.

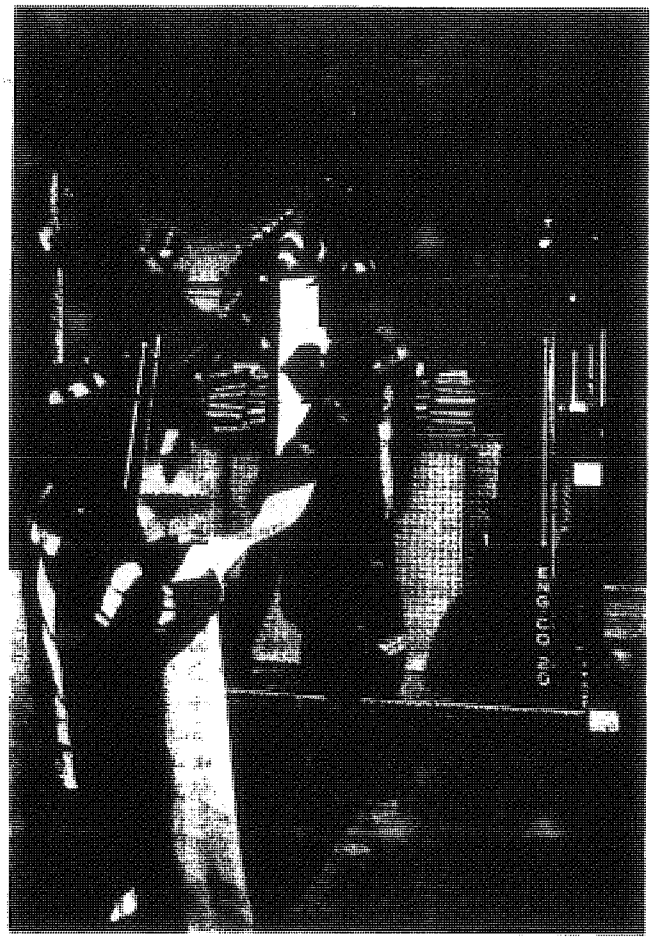


**Figure D-1-6(d) Fire fighters quickly reload 5-in. hose as the driver straddles the hose. Note that the hose is loaded over the bar between the stanchions.**

**D-1-7.1 Clappered Siamese with Indicator.** (*See Figure D-1-7.1.*) This valve is added to the supply line one length from the hydrant or pumper at draft and allows for the addition of a second pumper without shutting down the flow of water. The indicator shows the position of the single clapper.

**D-1-7.2 Line Relay Valve.** (*See Figure D-1-7.2.*) Should relay pumping be required, a line relay valve is inserted during the hose lay. This valve has a straight-through waterway so water delivery can be started upon completion of the lay. The valve contains a gated outlet and a clappered inlet. Upon arrival of the relay pumper, a line is attached from the gated outlet to the suction of the pump, with a discharge line connected from the pump discharge into the clappered inlet. The pump pressure closes the clapper, and the full flow is relayed to the fireground or another relay pumper. In addition, this valve contains an automatic air bleeder and a pressure dump valve set at 150 psi (1034 kPa). It is important to note that the relay pumper can be added to or removed from the line without shutting down the flow of water to the fireground.

**D-1-7.3 Hydrassist Valve.** This versatile valve can be utilized on a hydrant when water is available but pressure

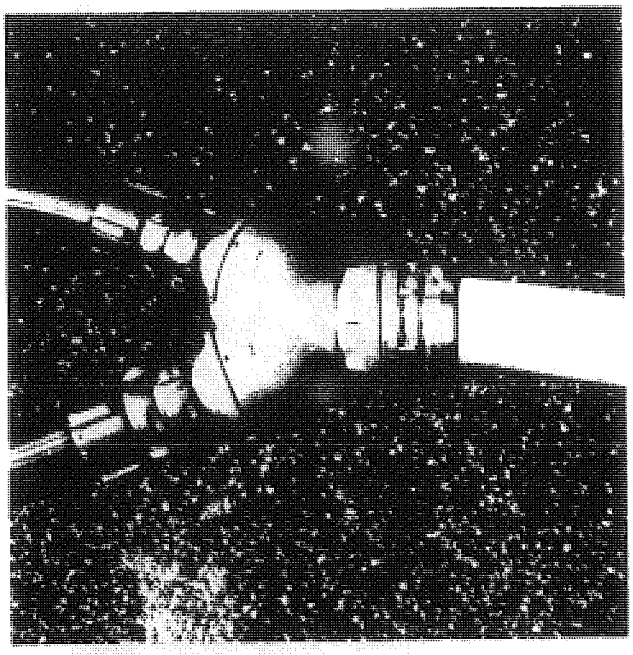


Figure D-1-7.1.

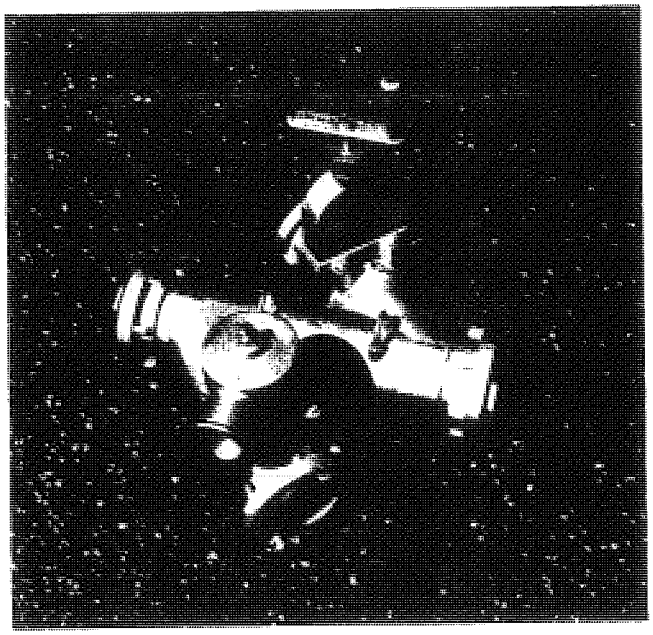


Figure D-1-7.2.

is limited. The valve is attached to the hydrant and the normal lay of supply line is initiated. When additional pressure is required, a pumper is attached to the valve and begins boosting pressure to the fire scene without interrupting the flow of water from hydrant to fire. In rural applications this valve can be equipped to lay in a line during hose lay and to allow a pumper to hook into the line and boost pressure without interrupting flow to the fire scene.

**D-1-7.4 Manifold Valve.** This valve contains a 4-in. (102-mm) or 5-in. (127-mm) inlet and four 2½-in. (65-mm) gated, threaded male or female outlets as well as a gated

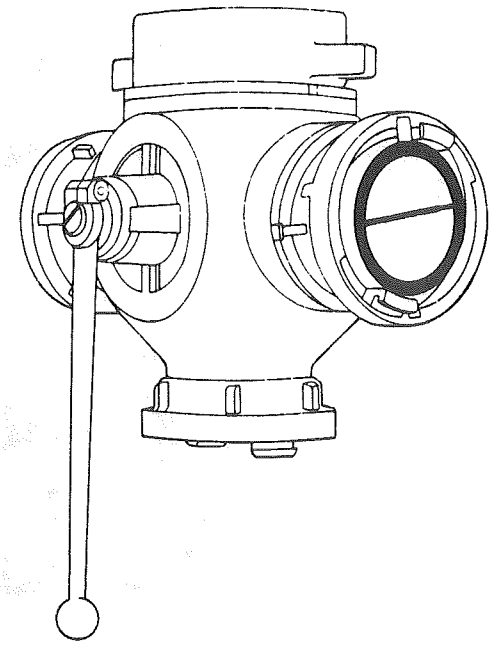


Figure D-1-7.3 Hydrassist valve.

4-in. (102-mm) or 5-in. (127-mm) outlet. The manifold is available with relief valve adjustable from 50 to 200 psi (345 to 1379 kPa). A pressure gauge is optional. The manifold is portable, allowing the fire department to establish its own portable hydrant.

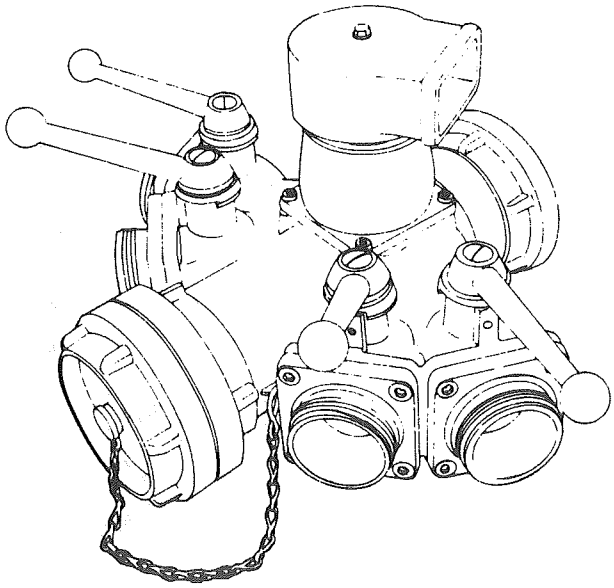


Figure D-1-7.4 Manifold valve.

**D-1-7.5 Distributor Valve.** (*See Figure D-1-7.5.*) This valve contains a 4-in. (102-mm) opening and waterway with two 2½-in. (65-mm) threaded male outlets. It is placed at the end of the supply line at the fireground allowing distribution of water to one or more attack pumpers. The valve utilizes ball shutoffs plus an adjustable dump valve.

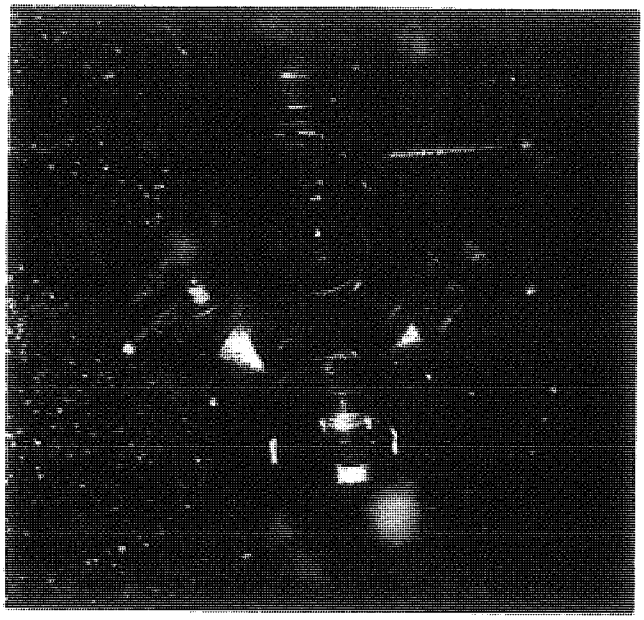


Figure D-1-7.5 Distributor valve.

**D-1-7.6 Incoming Gated Relief Valve.** (*See Figure D-1-7.6.*) This valve is attached to the large suction inlet of the pumper. The supply line is connected directly to the valve. It is equipped with a fine-threaded, slow-acting gate valve, an automatic air bleeder, and an adjustable dump valve. The gate valve allows connection to the supply line while utilizing the booster tank water. It is also used to control the volume of water from the supply line to the pump. The dump valve helps protect the pumper and supply line against sudden pressure surges and water hammer.

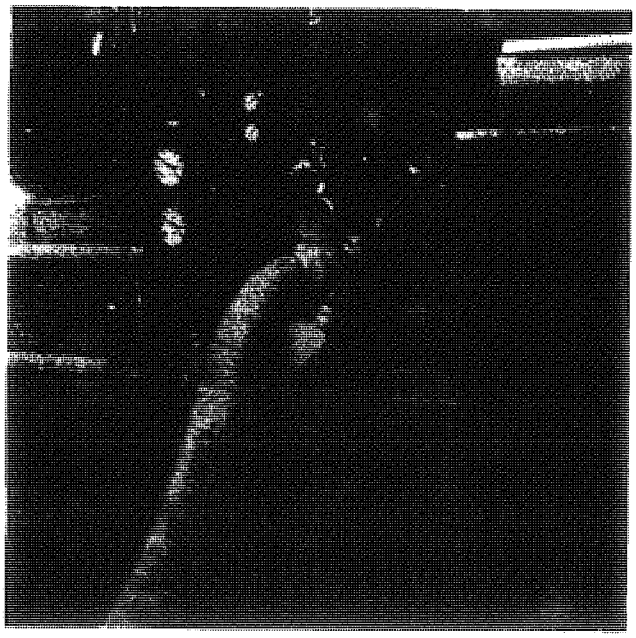


Figure D-1-7.6 Incoming gated relief valve.

**D-1-7.7 Automatic Air Bleeder.** (*See Figure D-1-7.7.*) Required at all points where a large diameter hose is connected to an engine inlet or at any distribution point.

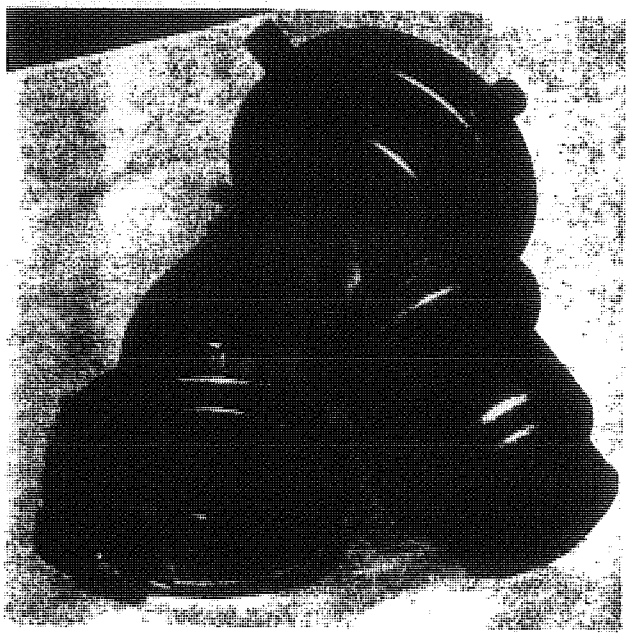


Figure D-1-7.7.

## D-1-8 Irrigation Piping.

**D-1-8.1 General.** While certainly not large diameter hose, the topic of this section of the appendix, irrigation piping, shares many of its characteristics of low friction loss and capability of transferring large volumes of water. Irrigation is increasing throughout the country, which has resulted in much lightweight aluminum pipe being available to the fire service. It may be carried on vehicles or found on the fireground in farming areas. The fire department should know which of its potential hazards may be served by such a system.

The pipe can be coupled, but usually the couplings are not a type that permits drafting. The pipe has the advantage of being a relatively permanent installation for long duration fire fighting jobs and is not susceptible to the rupture problems of fire hose. Generally, it is an excellent tool for major disaster situations but is less often used for conventional fire fighting evolutions, especially since the introduction of large diameter fire hose.

Departments working in an area in which piped irrigation systems are used should be alert to the adapters, etc., that may be necessary to turn the conventional agricultural fittings into useful fireground fittings. Adapters from the pipe coupling to fire department threads may be required and can be easily fabricated in local machine shops. They are not offered by either pipe or fire hose manufacturers. Minimum requirements are for one supply adapter; for instance, four 2½-in. (65-mm) NH (American National Fire Hose Connection Screw Thread) thread female inlets x pipe section, and one discharge adapter; or, four 2½-in. (65-mm) NH thread gated male outlets x pipe section.

Additional fittings to provide discharge gates at 100- to 300-ft (30- to 90-m) intervals [one or more 2½-in. (65-mm)

NH x pipe section] may be desirable. In areas where large diameter hose is available, adapters permitting its integration with the pipe are highly recommended.

## Appendix E Portable Pumps

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

### E-1 Portable Pumps.

**E-1-1 General.** Both diesel and gasoline driven portable pumps are available. The use of portable pumps is a common method for moving water by the rural fire department. The rural fire fighter should not be required to be a pump expert; however, the fire fighter should have the skill to place all portable pumps used by the department in operation, obtain draft, and perform each procedure in a minimum amount of time.

**E-1-1.1 Evaluating Portable Pump Needs.** In order to get the maximum benefit from portable pumps, the officers of the rural fire department must carefully study the needs of the department, taking into consideration the potential fire hazard, available water supplies, and the capabilities of the department to use portable pumps. The accessibility and the reliability of water supplies are determining factors in the need for and use of portable pumps. Many rural fire departments have found that both a low pressure pump and a high pressure pump are required to fill their needs.

Portable pump selection should fit the fire fighting system of which it is to be a component; if direct hose streams are to be taken from a portable pump, the nozzles and hose size determine the required pump discharge vs. pressure characteristics.

**E-1-1.2 Portable Pumps.** A portable pump in the fire service means a pump that can be carried to a source by fire fighters, sometimes over difficult terrain. In general, two people should be able to conveniently carry the pump. It should not weigh over 150 to 175 lb (68 to 79 kg), and should have carrying handles, be so constructed as to be easily carried in a compartment on the apparatus, and be capable of supplying at least two 1½-in. (38-mm) hand lines. Heavier pumps, perhaps trailer or truck-mounted or otherwise made mobile, are valuable but used less commonly.

Although a number of rural fire departments have used portable-type pumps that are securely mounted on their apparatus as the sole means of pumping, few fire departments consider this to be a permanent arrangement and plan to buy a fire department pumper, in addition to the portable pump(s), when finances permit.

**E-1-2 Classification for Portable Pumps.** Portable pumps for the fire service are covered under NFPA 1921, *Standard for Fire Department Portable Pumping Units*, which sets forth specifications to be followed when obtaining portable pumps. This standard classifies portable pumps by capacity and operating pressure.

**E-1-2.1 Rating of Portable Pumps.**

(a) *Small Volume — Relatively High Pressure.* This pumping unit should be capable of pumping 20 gpm (76 L/min) at 200 psi (1380 kPa) net pressure through a 1-in. (25.4-mm) discharge outlet while taking suction through a 1½-in. (38-mm) suction inlet. This class of portable pumps is especially useful to fire departments for forest fire fighting, which frequently requires long ¾-in. (19-mm) to 1½-in. (38-mm) hose lines and pumping uphill in rugged terrain. Such an arrangement will provide good nozzle reach.

(b) *Medium Volume — Medium Pressure.* This pumping unit shall be capable of discharging 60 gpm (227 L/min) at 90 psi (621 kPa) net pressure and 125 gpm (473 L/min) at 60 psi (414 kPa) net pressure through a 1½-in. (38-mm) discharge outlet while taking suction through a 2½-in. (65-mm) suction inlet. This class of portable pump has limited utility for small structural fires and may supply a 60-gpm (227-L/min) fog nozzle through 250 ft (76 m) of 1¾-in. (44-mm) hose. It can be used to fill booster tanks or be used with 2½-in. (65-mm) hose to move water a long distance.

(c) *Large Volume — Relatively Low Pressure.* This pumping unit shall be capable of supplying 125 gpm (473 L/min) at 60 psi (414 kPa) net pressure and 300 gpm (1136 L/min) at 20 psi (138 kPa) net pressure through a 2½-in. (65-mm) discharge outlet while taking suction through a 3-in. (76-mm) or 4-in. (102-mm) suction inlet. This class of portable pumping unit is frequently used for tank filling when a pumper cannot get close to a source of water. It is also suitable for draining cellars, manholes, and other areas where water has accumulated. It may be used to supply two 1½-in. (38-mm) or 1¾-in. (44-mm) hose lines of short length with 60-gpm (227-L/min) fog nozzles. This may result in fire streams of reduced quality and quantity that may not be suitable flows for interior fire fighting.

Among the common types of pumps used are:

**E-1-2.2 Gear Pumps.** Gear pumps (high pressure, low volume) are of positive displacement type with gears having very close tolerances between gears and case. They may be used safely in clear water only. Dirty water will cause damage to gears and case. They are not very useful for tank filling or relay work as they are generally of low capacity in the lighter models.

They are very good for fire fighting where high pressures are desired. These pumps have a shorter life span than the centrifugal type, are widely used by the U.S. Forest Service, and are easily packed on the back. They should never be operated without water and must be equipped with a relief valve.

**E-1-2.3 Piston Pumps.** Piston pumps (high pressure, low volume) are operated by a piston, sleeve, or cylinder with two check valves. They can be either single or double action with one or more cylinders. They are positive displacement type and must be operated with clean water. They are usually high pressure pumps. Piston-type pumps are limited to small capacities and weigh more than centrifugal or gear pumps. They are capable of very high lift and must be equipped with a relief valve.

**E-1-2.4 Low Pressure Centrifugal Pumps.** The low pressure centrifugal portable pumps (high volume) gener-

ally are rated at 200 to 300 gpm (757 to 1136 L/min) and are capable of discharge at pressures of 50 to 80 psi (345 to 552 kPa). Usually these pumps will not discharge rated capacities when operating with suction lift in excess of 5 ft (1.5 m).

Some of these pumps do not use running rings or seal rings. These types do not have close tolerances so they may be used in dirty water where some debris or abrasives are encountered. These pumps require little maintenance.

Other types of portable pumps in this category do have water or seal rings, which will not hold up as long when pumping water containing substantial amounts of abrasive materials.

At lower discharge pressures this type pump may deliver larger volumes, which at times have been metered at from 400 gpm (1514 L/min) to 600 gpm (2272 L/min) with adequate size hard suction hose at very low discharge pressures and high pump rpms. (Example: Relay from portable pump into fire pump on apparatus or portable drop tank; or relay from water source to drop tank where tanker is filled for relay to fire site.)

Operation of these pumps depends on centrifugal force to move water, and they are very effective for relay operations to pumper or for booster tank or tanker filling. There are no special operating problems to watch out for, and the pump will not heat up as rapidly as others if run without water.

**E-1-2.5 High Pressure Centrifugal Pumps.** High pressure portable pumps (small volume) generally have a small capacity, with an average of 30 to 40 gpm (114 to 151 L/min) discharge and operating pressures in the 125 to 150 psi (862 to 1030 kPa) range.

The impeller is usually geared twice as fast as the engine to get the pressure at single stage. This type uses running rings or seal rings the same as larger fire pumpers and usually incorporates closed volutes in the impeller.

**E-1-2.6 Floating Pumps.** Pressure and volume floating pumps are available. A more recent development in portable pumps is the floating pump that primes and pumps automatically when placed in water. This type of pump is constructed to set inside a float that resists breakage and needs no maintenance. Some entire units weigh under 50 lb (23 kg), including fuel, and provide from 60 to 90 minutes of operating time from the 5-qt (4.73-L) fuel tank.

The pump serves a need for a lightweight, easy-to-operate, portable fire pump that may be placed in the water and does not need suction hose or strainers. However, such pumps tend to pick up leaves and other trash that may stop up nozzles and strainers of a pump being supplied by the floating pump. (*See Figure E-1-2.6.*)

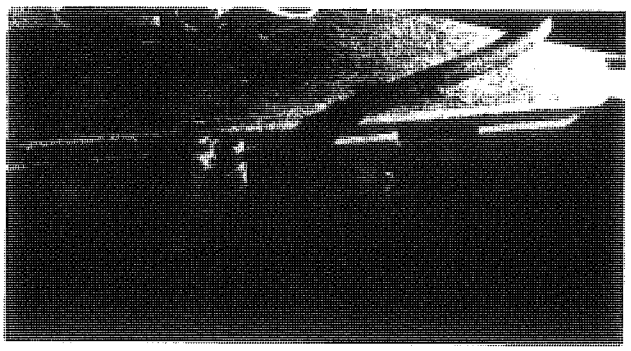


**Figure E-1-2.6 Floating 500-gpm pump in swimming pool supplying the department pumper through large diameter hose.**

**E-1-2.7 High-lift Pumps.** The high-lift pump is a small, portable pump that uses water to drive a water motor, which in turn drives an impeller and pumps water to high elevations into a fire pumper for relay into hose lines for fire fighting.

The high-lift pump is designed to obtain a water supply from a river, lake, stream, swimming pool, etc., when not accessible by a pumper or conventional portable pump for drafting operations.

The water used to power the water motor of a high-lift pump is taken from the booster tank of the pumper and discharged at high pressure through the fire pump into the hose to the high-lift pump water motor. This, in turn, drives the water motor, which is connected to the high-lift pump impeller, thus forcing volumes of water back into the intake side of the fire pump and on into the fire fighting hose lines.

High-lift pumps may be hooked into hose lines and lowered or tossed into water sources at the lower levels without fire fighting personnel having to go down to set the pump.

**E-1-2.8 Dewatering-type Pumps.** Dewatering pumps, also known as trash pumps, are pumps specifically designed to handle muddy, sandy, or otherwise contaminated water. Some are built to handle spherical solids up to 1½ in. (38 mm) in diameter. These pumps could be used in the fire service to pump water out of basements, tubs, or catchalls during salvage operations.

**E-1-2.9 Diaphragm Pump.** The diaphragm pump uses a piston-type action employing a diaphragm that moves water with each stroke and is capable of handling trashy water without damaging the pump.

**E-1-3 Methods of Using Portable Pumps.**

**E-1-3.1 General.** Some of the many problems of supplying water in rural areas can frequently be overcome through the use of the proper portable pump. Many departments, through area prefire planning, locate water sources where portable pumps are the only suitable means of using the water supply for filling tankers or for supplying fire fighting hose lines.

Departments should, when locating pumping sites for portable pumps, determine whether the site is available year-round or whether it can be used certain times of the year only. Further determination should be made as to availability under weather conditions anticipated and, if such conditions may make their use difficult, how to prepare the sites for all-weather utilization.

Centrifugal pumps are usually preferred over other types because of their ability to handle dirt and abrasives with less damage and because of their desirable volume-pressure ratio. Similarly, four-cycle engines are considered more suitable for fire service use, although two-cycle or the new turbine driven pumps may be used. However, four-cycle engines must be used with the engine in a level position or the engine will be damaged, whereas two-cycle engines

can be used with the engine in any position (as long as gasoline is available to the engine) without damage to the engine.

A wood pallet or other firm base can be useful under soft ground conditions.

**E-1-3.2 Uses of Pumps.** Portable pumps can be used in single or multiple combinations to accomplish many of the following:

(a) Filling truck tanks when no fire pumper is available;

(b) Supplying fire fighting hose lines;

(c) Relaying water from a source in a variety of combinations or hook-ups;

(d) Dewatering operations;

(e) Pump and roll operations.

**E-1-3.3** Under conditions where a fire department pumper cannot get to a source of water and there is considerable distance between the source and the fire (several miles), low pressure portable pumps of larger gallonage have proved to be very satisfactory when used to relay water to a tanker fleet that shuttles water to a portable drop tank at the fire. A fire department pumper takes suction from the portable drop tank for discharge onto a fire. (*See C-1-13.*)

A few of the ways in which a fire department may make use of portable pumps are:

**E-1-3.4 Pumping Directly onto the Fire.** The portable pump may be used to pump water into hose lines directly onto a fire. They may be carried to nearby sources of water, say, a swimming pool, out of reach of regular fire apparatus. Where these water sources are close to the fire, only small amounts of hose are needed and may be quickly carried into position for rapid attack on the fire.

An effective portable pump for this purpose would need to be of at least a medium volume type with enough discharge pressure to give an effective fire fighting stream.

An example of this type of operation is:

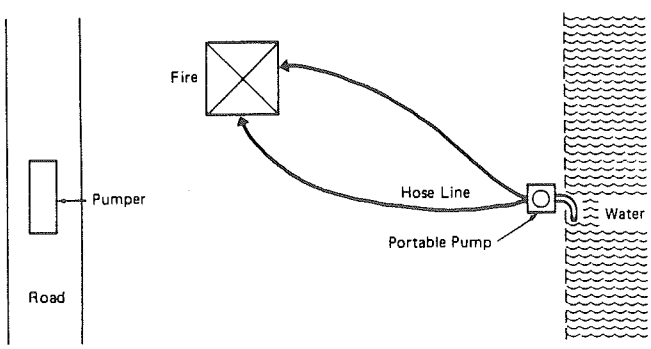



**Figure E-1-3.4 Pumping directly onto the fire.**

**E-1-3.5 Single Relay from Portable Pump to Pumpers.** Under conditions when a normal fire truck cannot get to a source of water, low pressure portable pumps of larger gallonage have proved to be very satisfactory when used to relay water to pumpers. This becomes feasible at a greater distance from water, as large diameter hose, for instance, is used.

A single portable pump often can supply enough water to keep a pumper supplied with good fire streams. The portable pump may be at the water source and a line (lines) laid from the portable pump to the pumper.

One of the big advantages of the portable pump is that it can be placed close to the water supply for operation at minimum lift and minimum friction loss in the suction hose, provided adequate size suction hose is used. Regular pumpers can accept water from portable pumps and increase water pressure for fire streams or use the water in a combination of fire streams and booster tank filling.

A method commonly used is for a pumper to lay hose lines from the fire to the water supply and start pumping from the booster tank into the hose line and onto the fire while the portable pump is being placed and water supply and hose lines from the portable to the regular pumper are being hooked up.

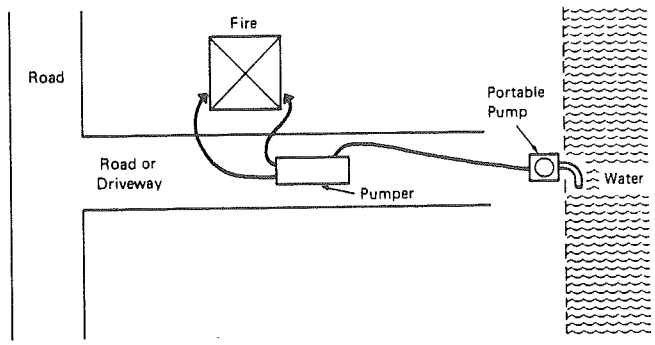



**Figure E-1-3.5 Single relay from portable pump to pumper.**

**E-1-3.6 Use of Portable Pumps to Fill Tankers or Booster Tanks.** Many rural fire departments are overcoming problems of limited water supply by using tankers to relay water to pumpers working at a fire. Should the water supply be a stream with a small flow, for instance 150 gpm (568 L/min), or inaccessible by fire apparatus, the water may be obtained with a portable pump placed at the water supply. This pump supplies a portable folding tank that is used to stockpile water, and tankers are filled from the portable folding tank for shuttle to the fire. At the fire, the tanker will discharge its water into another portable folding tank that is used to stockpile water from which the pumper (pumpers) takes suction and discharges water onto the fire. (*See C-1-13.*)

It is not prudent to put the discharge line from portable pumps into the tops of booster tanks or tankers unless no other way is possible or a special filling device is provided. Placing lines into tops of tankers or booster tanks is a slow way of filling the tank and may be dangerous to those working on apparatus. Hooking the portable pump discharge line directly into intake piping of large pumpers or tankers has proven to be the quickest and safest method of filling tanks.

Any of the portable pumps may be used for filling tankers in place of a pumper; however, the low pressure, high volume type pumps will do the job more quickly than others. When pumping into tanks, strainers should be used to prevent passage of trash and debris. Floating strainers have proved to be very effective.

Where the water supply has the capacity, multiple por-

table pumps for filling tankers are suggested. A 200- to 300-gpm (757- to 1136-L/min) rate results in a slow filling time; therefore, two or three portable pumps should be moved into the operation as mutual aid tankers arrive for a 500-gpm (1893-L/min) filling rate. Multiple portable pumps also act as a backup in case of engine failure.

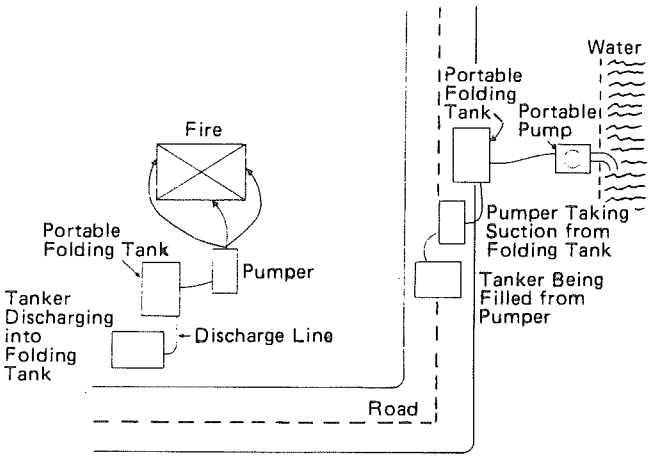



Figure E-1-3.6.

**E-1-3.7 Fire Fighting from Tanker in Motion.** Some departments have installed pipes or hard suction lines from their tankers to portable pumps on the apparatus so they can pump from the tank into discharge lines while the tanker is in motion. The portable pump may be quickly disconnected and taken off the tanker for use in other locations. This use is particularly effective for grain, grass, and brush fires, as it provides uniform pressures regardless of the gear the vehicle may require to negotiate the terrain. Since rigging a hard suction line from a pump to the vehicle carrying that pump is frequently awkward, it may be essential to carry a specially prepared length of hard suction hose for this purpose or to otherwise prepare the vehicle or the pump to make the evolution rapid and practical.

**E-1-3.8 Summary of Portable Pump Evolutions.** There are many choices that a fire department may make in deciding what size and type of portable pump will best fill its needs.

Consideration must be given to the capabilities of the pump and the uses to which the pump will be put.

## Appendix F Automatic Sprinkler Protection

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

### F-1 Automatic Sprinkler Protection.

### F-1-1 Sprinkler Protection of Rural Buildings.

**F-1-1.1 General.** Farsighted rural fire departments are big boosters of automatic sprinkler protection. With more sprinklered buildings being constructed in rural areas, many rural fire departments are just beginning to learn what a friend the fire service has in automatic sprinkler protection. The sprinkler system provides the fire department with built-in hose line protection. The sprinkler heads and piping are in place and ready to put water (other extinguishing agents may be used) on any unfriendly fire. Also, the record of the sprinkler system is enviable. NFPA records show that 96 percent of all fires in sprinklered buildings are controlled or extinguished by the sprinkler system with a large percentage of these fires controlled by no more than two or three heads. In the 3 to 4 percent with unsatisfactory performance, the following human failures have been noted:

1. Sprinkler system was shut off and not in service.
2. Fire department shut off water to sprinkler heads before fire was completely extinguished.
3. Fire department robbed sprinkler system of water supply.
4. Fire department did not use fire department connection.

### F-2 Water Supply for Automatic Sprinkler System.

**F-2-1 Sprinklered Building a Possible Water Source.** Sprinklered buildings are usually provided with a water supply such as an elevated tank or a ground level suction tank or pond equipped with a fire pump. In a number of cases, a distribution system with hydrants is also provided.

Ground level tanks, as well as elevated tanks, can be used by the fire department to supply water-hauling operations. Adequate provisions should be made by the fire department so as not to deplete the tank supply without also making provisions for refilling the tank at the conclusion of water-hauling operations.

When building and sprinkler plans are being reviewed, the fire department has an excellent opportunity to make contact with the property owner for permission to use the water supply in the elevated tank in water-hauling operations. In case a certain quantity of water must be reserved for the sprinkler system, a riser, serving a hydrant available to the fire department, may be installed that extends into the tank and allows the fire department to use the water above that which is reserved for the sprinkler system.

In some municipalities (as well as some states), certain types of occupancies may be required by law to install sprinkler systems. In a number of cases, very limited water supplies, such as pressure tanks, have been provided as the sole water supply for these systems. Such properties should not be considered as a water source for a water-hauling operation for a rural fire department.

### F-3 Supervision for Sprinkler System.

**F-3-1** In rural areas where sprinklered properties may be isolated with good possibility that the outside sprinkler alarm will not be heard in case of fire, it is desirable that automatic sprinkler systems referred to in Section 5-7 be fully supervised by either a competent guard on premises or by an alarm system with all signals transmitted directly to a central station or a fire alarm center.

**F-3-1.1** Where guard service is provided, it should meet the requirements of NFPA 601, *Standard for Guard Service in Fire Loss Prevention.*

**F-3-1.2** It is desirable that the alarm system include supervision of sprinkler water flow, sprinkler control valve tamper, building temperature, low air pressure on dry sprinkler systems, fire pump operation, fire pump electric power, fire pump battery charger, temperature of water in tanks, and level of water in tanks where any of these items exist.

**F-3-1.3** The central station should meet the requirements of NFPA 71, *Standard for the Installation, Maintenance, and Use of Signaling Systems for Central Station Service.*

**F-3-1.4** Fire alarm centers should meet the requirements of NFPA 1221, *Standard for the Installation, Maintenance, and Use of Public Fire Service Communications* (formerly NFPA 73).

**F-3-1.5** Where not specified in NFPA 71 or NFPA 1221, on-premises components of the alarm system should meet the requirements of NFPA 72B, *Standard for the Installation, Maintenance, and Use of Auxiliary Protective Signaling Systems*; NFPA 72C, *Standard for the Installation, Maintenance, and Use of Remote Station Protective Signaling Systems*; or NFPA 72D, *Standard for the Installation, Maintenance, and Use of Proprietary Protective Signaling Systems*, whichever is applicable.

**F-3-1.6** In some situations, guard service or fire alarm centers referred to in F-3-1.2 and F-3-1.5 may not be feasible due to unavailability, economic considerations, or both. It is, however, very important that sprinkler alarms be supervised and signal transmitted rapidly to the fire department. In some rural areas where public telephone lines are the primary means of alarm transmittal, some sprinkler systems are "supervised" by using combinations of water flow indicators, microswitches, and the like, with direct telephone lines or automatic phone dialers. Typically, the signal or prerecorded alarm message is sent to a "fire phone" location, police dispatch, or similar location where alarms are handled. In no case should automatic phone dialers be allowed on the circuit used by the public to report emergency messages (fire, police, or ambulance).

### F-4 Fire Department and the Sprinkler System.

**F-4-1** Water supplies for the automatic sprinkler system referred to in 5-7, which consist of pumps and tank combinations feeding yard mains and a hydrant system, should be installed in accordance with NFPA 20, *Standard for the Installation of Centrifugal Fire Pumps*; NFPA 22, *Standard for Water Tanks for Private Fire Protection*; and NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances.*

**F-4-1.1** In addition to NFPA 13, *Standard for the Installation of Sprinkler Systems*, referred to in 5-7, the following NFPA standards may apply where applicable: NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*; NFPA 16, *Standard on Deluge Foam-Water Sprinkler and Foam-Water Spray Systems*; NFPA 231, *Standard for General Storage*; and NFPA 231C, *Standard for Rack Storage of Materials.*

**F-4-1.2 Use of Fire Department Connection.** The standard operating procedures (SOP) of each rural fire department should call for one of the first due pumpers to pump to the fire department connection of the sprinkler system. In this way, water pressure and volume to the system may be increased, making the sprinklers more effective. Also, the fire department connection ties into the system beyond all valves that might be shut off; therefore, even with the valve controlling the water supply to the sprinkler system shut off, sprinkler heads may always be supplied with water through the fire department connection. After size-up by the officer in charge, the word to charge the system may be warranted. The pressure available from the fire department pumper will not burst the piping or heads of the sprinkler system as all parts of the system are designed and tested to withstand at least 200 psi (1380 kPa).

**F-4-1.3 Shutting Off Sprinkler System in Case of Fire.** The sprinkler system should not be shut down until the chief officer is convinced that the fire is extinguished or controlled and hand lines are in place for overhauling operations. Even then, the fire department pumper should not be disconnected from the fire department connection to the sprinkler system. Make sure that the fire is out. Station a person at the control valve of the sprinkler system, ready to reopen the valve in case of a flare-up during fire department mop-up operations.

## Appendix G Secondary Water Supply

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

### G-1 Secondary Water Supply.

**G-1-1 General.** The water supply for fire fighting purposes, as specified in Chapter 5, are considered the minimum water supply. They presuppose water is available to the fire department from a single water point, often using a tanker shuttle or tanker relay and in conjunction with a portable folding tank or dry hydrant, etc.

The authority having jurisdiction may determine that an additional, secondary water supply is warranted. This determination may be made as a result of on-site survey of buildings by the fire department having jurisdiction or by review of architectural plans of proposed construction and/or planned development.

**G-1-2 Determination of Secondary Water Supply.** The determination of a secondary water supply anticipates a large-scale fire situation. Where such conditions exist, this would require a water supply delivery system consisting of multiple water points. Generally this can best be achieved by a water system that would include hydrants, a distribution system, storage, and a source of supply capable of delivering a minimum flow of 250 gpm (946 L/min) at 20 psi (139 kPa) residual pressure for a two-hour duration.

**G-1-3 Procedure for Developing Secondary Water Requirement.** Construction and occupancy hazard classification tables have been compiled from equation information derived from the formula discussed under paragraph G-1-4. These are tables printed in this Appendix as Tables G-1-3(a), Wood Frame Construction, Table G-1-3(b), Ordinary Construction, Table G-1-3(c), Noncombustible

Construction, and Table G-1-3(d), Fire Resistive Construction.

The factors considered in developing the secondary water requirement for a building are as follows:

(a) *Type of Construction (Ci).* Combustibility and fire resistance of the building itself greatly influence the development and spread of a fire and, to a large extent, will determine the amount of water needed to control and extinguish a fire.

(b) *Size of Building (Ai).* The greater the story height and larger the undivided floor area, without walls or other fire separation, the greater is the potential for a large fire and the greater is the secondary water requirement.

(c) *Occupancy (Oi).* A fire in a building having highly combustible contents will require a higher rate of water application than a fire in a building with low-combustible contents. Examples would be a wastepaper warehouse at one end of the scale, and a steel pipe warehouse at the other, with many variations in between.

(d) *Exposures (Xi) and Communications (Pi).* Besides the water needed on the fire in the building under consideration, additional water may be needed to prevent the fire from spreading to nearby buildings. The amount of this extra water will depend on such factors as the distance between buildings and the type of construction and size of the exposed and/or communicating buildings.

The method of determining secondary water requirement is not intended to provide details for calculating an adequate amount of water for large, special fire protection problems such as lumber yards, petroleum storage, refineries, grain elevators, and large chemical plants. For suggested protection, see appropriate NFPA standards.

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

**G-1-4 Calculation.** The calculation of a secondary water supply for a subject building in gallons per minute (gpm) considers the construction (Ci), Occupancy (Oi), Exposure (Xi), and Communication (Pi) factors of each selected building or fire division and is done as outlined below:

1. Construction Factor (Ci):

NOTE: There follows a brief digest of the calculation of the secondary water requirement for a given facility. An example of an actual calculation is included in the paragraph on Examples. That portion of the secondary water requirement attributed to the type of construction and area of the selected building or fire division is determined by the following formula:

$$Ci = 18F(Ai)0.5$$

F = Coefficient related to the class of construction:

F = 1.5 for wood frame construction
= 1.0 for ordinary construction
= 0.8 for noncombustible construction
= 0.6 for fire resistive construction

Ai = Effective Area

The effective area is the total square-foot area of the largest floor in the building plus the following percentage of the other floors:

(a) Buildings of Constructon Type II, III, IV, and V, 50 percent of all other floors.

(b) Buildings of Construction Type I.

1. If all vertical openings in the building have 1½-hour or more protection, 25 percent of the area not exceeding the two other largest floors.

2. In other buildings, 50 percent of the area of not exceeding other floors.*

NOTE: Do not include basements and subbasement areas that are vacant or are used for building maintenance, or that are occupied by light-hazard or low-hazard occupancies. (*See below.*)

The maximum value of (Ci) is limited by the following:

8,000 gpm (30,280 L/min) for wood frame and ordinary construction;

6,000 gpm (22,710 L/min) for noncombustible and fire resistive construction;

6,000 gpm (22,710 L/min) for a 1-story building of any type of construction.

The minimum value of (Ci) is 250 gpm (945 L/min). The calculated value of (Ci) shall be rounded to the nearest 250 gpm (945 L/min).

2. Occupancy Factor (Oi).

The factors below reflect the influence of the occupancy in the selected building on the secondary water requirement.

| Occupancy Hazard Classification Number | Occupancy Factor (Oi) |
|---|---|
| No. 7 Light Hazard | 0.75 |
| No. 6 Low Hazard | 0.85 |
| No. 5 Moderate Hazard | 1.00 |
| No. 4 High Hazard | 1.15 |
| No. 3 Severe Hazard | 1.25 |

Representative lists of occupancies by classification of occupancy hazard are given in Chapter 3 of this standard.

NOTE: Tables G-1-3(a) through G-1-3(d) are printed with the occupancy factors (Oi) applied for each type of construction.

3. Exposure (Xi) and Communication (Pi) Factors.

The factors developed in this item reflect the influence of exposed and communicating buildings on the secondary water requirement. A value of (Xi + Pi) shall be developed for each side of the building:

$$(X + P)i = 1.0 + \frac{n}{i = 1}(Xi + Pi), \text{ maximum } 1.55, \text{ where}$$

n = number of sides of subject building.

NOTE: The exposure factor shall apply to only one side of the subject building. It is determined by the following method.

(a) Factor for Exposure (Xi):

*If division walls are rated 1-hour or more with labeled Class B fire doors on openings, subdivide a floor. The maximum area on any one floor used shall be the largest undivided area plus 50 percent of the second largest undivided area on that floor.

The factor for (Xi) depends upon the construction and the length-height value (length of wall in feet times height in stories) of the exposed building and the distance between facing walls of the subject building and the exposed building, and shall be selected from Table G-1-3(e).

NOTE: The following buildings shall not be charged as exposures:

- Buildings fully protected by automatic sprinklers;
- Buildings with a residential occupancy;
- Building that are Type I Construction;
- Buildings with a blank masonry wall.

(b) Factor for Communications (Pi):

The factor for (Pi) depends upon the protection for the communicating party-wall openings and the length and construction of communications between fire divisions and shall be selected from Table G-1-3(f). When more than one communication type exists in any one side wall, apply only the largest factor (Pi) for that side. When there is no communication on a side, (Pi) = 0.

(c) Calculation of Secondary Water Supply (SWSi):

$$SWSi = (Ci)(Oi)(X + P)i$$

Where wood shingles as a roof covering are permitted by the authority having jurisdiction (on the building being considered or on the exposed buildings) 500 gpm is added to the secondary water requirements unless such shingles are listed Class C or better.

The secondary water requirement shall not exceed 12,000 gpm (45 420 L/min) nor less than 250 gpm (945 L/min).

The secondary water requirement shall be rounded off to the nearest 250 gpm (945 L/min) if less than 2,500 gpm (9462 L/min) and to the nearest 500 gpm (1892 L/min) if greater than 2,500 gpm (9462 L/min).

**Table G-1-3(a) Wood Frame Construction Occupancy Hazard Classification**

| AREA (sq ft) | 7 | 6 | 5 | 4 | 3 |
|---|---|---|---|---|---|
| | Oi = 0.75 | Oi = 0.85 | Oi = 1.00 | Oi = 1.15 | Oi = 1.25 |
| 500 | 250 gpm | 500 gpm | 500 gpm | 500 gpm | 500 gpm |
| 1,100 | 500 | 750 | 750 | 750 | 1,000 |
| 1,700 | 750 | 750 | 1,000 | 1,250 | 1,250 |
| 2,600 | 1,000 | 1,000 | 1,250 | 1,500 | 1,500 |
| 3,600 | 1,250 | 1,250 | 1,500 | 1,725 | 2,000 |
| 4,800 | 1,250 | 1,500 | 1,750 | 2,000 | 2,250 |
| 6,200 | 1,500 | 1,750 | 2,000 | 2,250 | 2,500 |
| 7,700 | 1,750 | 2,000 | 2,250 | 2,500 | 2,750 |
| 9,400 | 2,000 | 2,250 | 2,500 | 2,750 | 3,000 |
| 11,300 | 2,000 | 2,250 | 2,750 | 3,250 | 3,500 |
| 13,400 | 2,250 | 2,500 | 3,000 | 3,500 | 3,750 |
| 15,600 | 2,500 | 2,750 | 3,250 | 3,750 | 4,000 |
| 18,000 | 2,750 | 3,000 | 3,500 | 4,000 | 4,500 |
| 20,600 | 2,750 | 3,250 | 3,750 | 4,250 | 4,750 |
| 23,300 | 3,000 | 3,500 | 4,000 | 4,500 | 5,000 |
| 26,300 | 3,250 | 3,500 | 4,250 | 5,000 | 5,250 |
| 29,300 | 3,500 | 3,750 | 4,500 | 5,250 | 5,500 |
| 32,600 | 3,500 | 4,000 | 4,750 | 5,500 | 6,000 |
| 36,000 | 3,750 | 4,250 | 5,000 | 5,750 | 6,250 |
| 39,600 | 4,000 | 4,500 | 5,250 | 6,000 | 6,500 |
| 43,400 | 4,250 | 4,500 | 5,500 | 6,250 | 6,750 |
| 47,400 | 4,250 | 5,000 | 5,750 | 6,500 | 7,250 |
| 51,500 | 4,500 | 5,000 | 6,000 | 7,000 | 7,500 |
| 55,700 | 4,750 | 5,250 | 6,250 | 7,250 | 7,725 |
| 60,200 | 4,750 | 5,500 | 6,500 | 7,500 | 8,000 |
| 64,800 | 5,000 | 5,750 | 6,750 | 7,750 | 8,000 |
| 69,600 | 5,250 | 6,000 | 7,000 | 8,000 | 8,000 |
| 74,600 | 5,500 | 6,250 | 7,250 | 8,000 | 8,000 |
| 79,800 | 5,750 | 6,250 | 7,500 | 8,000 | 8,000 |
| 85,100 | 5,750 | 6,500 | 7,750 | 8,000 | 8,000 |
| Over | 6,000 | 6,750 | 8,000 | 8,000 | 8,000 |

**Table G-1-3(b) Ordinary Construction Occupancy Hazard Classification**

F = 1.0

| AREA (sq ft) | 7 | 6 | 5 | 4 | 3 |
|---|---|---|---|---|---|
| | Oi = 0.75 | Oi = 0.85 | Oi = 1.00 | Oi = 1.15 | Oi = 1.25 |
| 1,200 | 250 gpm | 500 gpm | 500 gpm | 500 gpm | 500 gpm |
| 2,400 | 500 | 750 | 750 | 750 | 1,000 |
| 3,900 | 750 | 750 | 1,000 | 1,250 | 1,250 |
| 5,800 | 1,000 | 1,000 | 1,250 | 1,500 | 1,500 |
| 8,200 | 1,250 | 1,250 | 1,500 | 1,725 | 2,000 |
| 10,900 | 1,250 | 1,500 | 1,750 | 2,000 | 2,250 |
| 13,900 | 1,500 | 1,750 | 2,000 | 2,250 | 2,500 |
| 17,400 | 1,750 | 2,000 | 2,250 | 2,500 | 2,750 |
| 21,300 | 2,000 | 2,250 | 2,500 | 2,750 | 3,000 |
| 25,500 | 2,000 | 2,250 | 2,750 | 3,250 | 3,500 |
| 30,100 | 2,250 | 2,500 | 3,000 | 3,500 | 3,750 |
| 35,200 | 2,500 | 2,750 | 3,250 | 3,750 | 4,000 |
| 40,600 | 2,750 | 3,000 | 3,500 | 4,000 | 4,500 |
| 46,400 | 2,750 | 3,250 | 3,750 | 4,250 | 4,750 |
| 52,500 | 3,000 | 3,500 | 4,000 | 4,500 | 5,000 |
| 59,100 | 3,250 | 3,500 | 4,250 | 5,000 | 5,250 |
| 66,000 | 3,500 | 3,750 | 4,500 | 5,250 | 5,500 |
| 73,300 | 3,500 | 4,000 | 4,750 | 5,500 | 6,000 |
| 81,100 | 3,750 | 4,250 | 5,000 | 5,750 | 6,250 |
| 89,200 | 4,000 | 4,500 | 5,250 | 6,000 | 6,500 |
| 97,700 | 4,250 | 4,500 | 5,500 | 6,250 | 6,750 |
| 106,500 | 4,250 | 5,000 | 5,750 | 6,500 | 7,250 |
| 115,800 | 4,500 | 5,000 | 6,000 | 7,000 | 7,500 |
| 125,500 | 4,750 | 5,250 | 6,250 | 7,250 | 7,725 |
| 135,500 | 4,750 | 5,500 | 6,500 | 7,500 | 8,000 |
| 145,800 | 5,000 | 5,750 | 6,750 | 7,750 | 8,000 |
| 156,700 | 5,250 | 6,000 | 7,000 | 8,000 | 8,000 |
| 167,900 | 5,500 | 6,250 | 7,250 | 8,000 | 8,000 |
| 179,400 | 5,750 | 6,250 | 7,500 | 8,000 | 8,000 |
| 191,400 | 5,750 | 6,500 | 7,750 | 8,000 | 8,000 |
| Over | 6,000 | 6,750 | 8,000 | 8,000 | 8,000 |

**Table G-1-3(c) Noncombustible Construction Occupancy Hazard Classification**

F = 0.80

| AREA (sq ft) | 7 | 6 | 5 | 4 | 3 |
|---|---|---|---|---|---|
| | Oi = 0.75 | Oi = 0.85 | Oi = 1.00 | Oi = 1.15 | Oi = 1.25 |
| 1,900 | 250 gpm | 500 gpm | 500 gpm | 500 gpm | 500 gpm |
| 3,700 | 500 | 750 | 750 | 750 | 1,000 |
| 6,100 | 750 | 750 | 1,000 | 1,250 | 1,250 |
| 9,100 | 1,000 | 1,000 | 1,250 | 1,500 | 1,500 |
| 12,700 | 1,250 | 1,250 | 1,500 | 1,725 | 2,000 |
| 17,000 | 1,250 | 1,500 | 1,750 | 2,000 | 2,250 |
| 21,800 | 1,500 | 1,750 | 2,000 | 2,250 | 2,500 |
| 27,200 | 1,750 | 2,000 | 2,250 | 2,500 | 2,750 |
| 33,200 | 2,000 | 2,250 | 2,500 | 2,750 | 3,000 |
| 39,700 | 2,000 | 2,250 | 2,750 | 3,250 | 3,500 |
| 47,100 | 2,250 | 2,500 | 3,000 | 3,500 | 3,750 |
| 54,900 | 2,500 | 2,750 | 3,250 | 3,750 | 4,000 |
| 63,400 | 2,750 | 3,000 | 3,500 | 4,000 | 4,500 |
| 72,400 | 2,750 | 3,250 | 3,750 | 4,250 | 4,750 |
| 82,100 | 3,000 | 3,500 | 4,000 | 4,500 | 5,000 |
| 92,400 | 3,250 | 3,500 | 4,250 | 5,000 | 5,250 |
| 103,100 | 3,500 | 3,750 | 4,500 | 5,250 | 5,500 |
| 114,600 | 3,500 | 4,000 | 4,750 | 5,500 | 6,000 |
| 126,700 | 3,750 | 4,250 | 5,000 | 5,750 | 6,000 |
| 139,400 | 4,000 | 4,500 | 5,250 | 6,000 | 6,000 |
| 152,700 | 4,250 | 4,750 | 5,500 | 6,000 | 6,000 |
| 166,500 | 4,250 | 5,000 | 5,750 | 6,000 | 6,000 |
| Over | 4,500 | 5,000 | 6,000 | 6,000 | 6,000 |

Rounded off to 250 gpm

**Table G-1-3(d) Fire Resistive Construction Occupancy Hazard Classification**

F = 0.60

| AREA (sq ft) | 7 | 6 | 5 | 4 | 3 |
|---|---|---|---|---|---|
| | Oi = 0.75 | Oi = 0.85 | Oi = 1.00 | Oi = 1.15 | Oi = 1.25 |
| 3,300 | 250 gpm | 500 gpm | 500 gpm | 500 gpm | 500 gpm |
| 6,600 | 500 | 750 | 750 | 750 | 1,000 |
| 10,900 | 750 | 750 | 1,000 | 1,250 | 1,250 |
| 16,200 | 1,000 | 1,000 | 1,250 | 1,500 | 1,500 |
| 22,700 | 1,250 | 1,250 | 1,500 | 1,725 | 2,000 |
| 30,200 | 1,250 | 1,500 | 1,750 | 2,000 | 2,250 |
| 38,700 | 1,500 | 1,750 | 2,000 | 2,250 | 2,500 |
| 48,300 | 1,750 | 2,000 | 2,250 | 2,500 | 2,750 |
| 59,000 | 2,000 | 2,250 | 2,500 | 2,750 | 3,000 |
| 70,900 | 2,000 | 2,250 | 2,750 | 3,250 | 3,500 |
| 83,900 | 2,250 | 2,500 | 3,000 | 3,500 | 3,750 |
| 97,700 | 2,500 | 2,750 | 3,250 | 3,750 | 4,000 |
| 112,700 | 2,750 | 3,000 | 3,500 | 4,000 | 4,500 |
| 128,700 | 2,750 | 3,250 | 3,750 | 4,250 | 4,750 |
| 145,900 | 3,000 | 3,500 | 4,000 | 4,500 | 5,000 |
| 164,200 | 3,250 | 3,500 | 4,250 | 5,000 | 5,250 |
| 183,400 | 3,500 | 3,750 | 4,500 | 5,250 | 5,500 |
| 203,700 | 3,500 | 4,000 | 4,750 | 5,500 | 6,000 |
| 225,200 | 3,750 | 4,250 | 5,000 | 5,750 | 6,000 |
| 247,700 | 4,000 | 4,500 | 5,250 | 6,000 | 6,000 |
| 271,200 | 4,250 | 4,750 | 5,500 | 6,000 | 6,000 |
| 295,900 | 4,250 | 5,000 | 5,750 | 6,000 | 6,000 |
| Over | 4,500 | 5,000 | 6,000 | 6,000 | 6,000 |

Rounded off to 250 gpm

## Appendix H Referenced Publications

**H-1** The following documents or portions thereof are referenced within this standard for informational purposes only and thus are not considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

**H-1-1 NFPA Publications.** National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

NFPA 11-1988, *Standard for Low Expansion Foam and Combined Agent Systems*

NFPA 13-1989, *Standard for the Installation of Sprinkler Systems*

NFPA 15-1985, *Standard for Water Spray Fixed Systems for Fire Protection*

NFPA 16-1986, *Standard on Deluge Foam-Water Sprinkler and Foam-Water Spray Systems*

NFPA 20-1987, *Standard for the Installation of Centrifugal Fire Pumps*

NFPA 22-1987, *Standard for Water Tanks for Private Fire Protection*

NFPA 24-1987, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*

NFPA 71-1989, *Standard for the Installation, Maintenance, and Use of Signaling Systems for Central Station Service*

NFPA 72B-1986, *Standard for the Installation, Maintenance, and Use of Auxiliary Protective Signaling Systems for Fire Alarm Service*

NFPA 72C-1986, *Standard for the Installation, Maintenance, and Use of Remote Station Protective Signaling Systems*

NFPA 72D-1986, *Standard for the Installation, Maintenance, and Use of Proprietary Protective Signaling Systems*

NFPA 231-1987, *Standard for General Storage*

NFPA 231C-1986, *Standard for Rack Storage of Materials*

NFPA 601-1986, *Standard for Guard Service in Fire Loss Prevention*

NFPA 1901-1985, *Standard on Automotive Fire Apparatus*

NFPA 1921-1987, *Standard for Fire Department Portable Pumping Units.*

## Index

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