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NFPA 1901 Automotive Fire Apparatus 1985 Edition

National Fire Protection Association Batterymarch Park, Quincy, MA 02269

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

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

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

Statement on NFPA Procedures

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

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NFPA 1901

Standard on

Automotive Fire Apparatus

1985 Edition

This edition of NFPA 1901, *Standard on Automotive Fire Apparatus*, was prepared by the Technical Committee on Fire Department Equipment, and acted on by the National Fire Protection Association, Inc. at its Annual Meeting held May 13-17, 1985 in Chicago, Illinois. It was issued by the Standards Council on June 6, 1985, with an effective date of June 26, 1985, and supersedes all previous editions.

The 1985 edition of this standard has been approved by the American National Standards Institute.

Origin and Development of NFPA 1901

A detailed history of this standard is included in Appendix B.

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

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

Contents

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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 12.

Chapter 1 Administration

1-1 Scope. This standard shall apply to self-propelled automotive fire apparatus of the various types commonly utilized by public fire departments in structural and associated fire fighting. The standard is prepared on a performance basis by the Committee on Fire Department Equipment of the National Fire Protection Association.

1-2 Purpose. This standard specifies minimum requirements for automotive fire apparatus and is presented in a form which may serve as the technical section of a complete specification for purchasing fire apparatus.

1-3 Application. Each purchaser shall evaluate the individual need, and use Special Provisions to adapt the basic standards to the intended class of service and operating conditions.

1-4 General.

1-4.1 This standard is prepared on a performance basis by the Committee on Fire Department Equipment of the National Fire Protection Association. The standard is subject to review and revision as necessary, with all proposals for revision being considered by the entire committee.

1-4.2 Officials shall plan for systematic replacement of fire apparatus as necessary to combat obsolescence, parts replacement difficulties, increased maintenance costs, and to take advantage of improvements in fire department equipment.

1-5 Definitions.

1-5.1 Aerial Ladder Truck. A ladder truck equipped with a permanently mounted, power operated aerial ladder.

1-5.2 Angle of Departure. The smallest angle made between the road surface and the line drawn from the rear point of ground contact of the rear tire to any sprung projection of the truck behind the rear axle.

1-5.3* Approved. Acceptable to the "authority having jurisdiction."

1-5.4* Authority Having Jurisdiction. The "authority having jurisdiction" is the organization, office, or individual responsible for "approving" equipment, an installation, or a procedure.

1-5.5 Compound Gage. A gage reading pressure from 0 to maximum in lb per sq in. and vacuum from 0 to 30 in. of mercury (Hg).

1-5.6 Elevating Platform Apparatus. A ladder truck equipped with permanently mounted, power operated booms of articulating construction or telescoping construction; or a combination of articulating and telescoping construction; and with a passenger carrying platform attached to the uppermost boom.

1-5.7 Fire Apparatus. The emergency vehicles of the fire department or fire brigade used for fire suppression.

1-5.8 Gallons. United States gallons.

1-5.9 GPM. Gallons per minute (1 gpm = 3.785 liters per minute, L/min).

1-5.10 Gross Axle Weight Rating or "GAWR." The value specified by the vehicle manufacturer as the load-carrying rating of a single axle system, as measured at the tire ground interfaces.

1-5.11 Gross Combination Weight Rating or "GCWR." The value specified by the manufacturer as the loaded weight of a combination vehicle.

1-5.12 Gross Vehicle Weight Rating or "GVWR." The value specified by the manufacturer as loaded weight rating of a single vehicle.

1-5.13 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.

1-5.14 Ladder Truck. A piece of fire apparatus carrying at least the standard complement of ground ladders.

1-5.15 Light Attack Vehicle. A unit equipped with only a booster pump, with no more than three designated seating positions, carrying a limited amount of equipment.

1-5.16* 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.

1-5.17 May. This term is used to state a permissive use or an alternative method to a specified requirement.

1-5.18 Mobile Water Supply Apparatus. A piece of fire apparatus whose primary purpose is transporting

water with a water tank 1000-gal capacity or larger. Truck should include a pump and have a limited hose body capacity.

1-5.19 PSI. Pounds pressure per square inch (6.895 kPa).

1-5.20 PSIG. Gage pressure in pounds per square inch (pressure above atmospheric pressure).

1-5.21 Pumper. A piece of fire apparatus with a permanently mounted fire pump with a rated discharge capacity of 500 gpm or greater and complying with Chapter 3 of this standard; and may also include a water tank and hose body.

1-5.22 Pumper-Ladder Truck. A ladder truck plus the addition of a fire pump; and may also include a water tank and hose body.

1-5.23 Quadruple Ladder Truck. A service ladder truck with the addition of a fire pump, water tank, and hose body.

1-5.24 Quintuple Ladder Truck. A quadruple ladder truck with the addition of an aerial device.

1-5.25 Service Ladder Truck. A ladder truck carrying at least the standard complement of ground ladders, but neither an aerial ladder nor an elevating platform.

1-5.26 Shall. This term indicates a mandatory requirement.

Chapter 2 Provisions Applying to All Types of Apparatus

2-1 General.

2-1.1 Responsibility of Contractor.

2-1.1.1 The manufacturer shall supply at time of delivery at least two copies of a complete operation and maintenance manual covering the completed apparatus as delivered, including but not limited to the truck, pump, wiring and piping diagrams, lubrication charts, and fire fighting equipment.

2-1.1.2 Responsibility for the apparatus and equipment shall remain with the manufacturer until the satisfactory completion of acceptance tests and formal acceptance by the purchaser.

2-1.1.3 A qualified and responsible representative of the manufacturer shall deliver the apparatus and remain in the community purchasing the equipment for a sufficient time, normally three days, to instruct fire department personnel in the operation, care and maintenance of the equipment delivered. Method of delivery shall be specified by purchaser in Special Provisions.

2-1.2 Responsibility of Purchaser.

2-1.2.1 It shall be the responsibility of the purchaser to indicate in Special Provisions details of product and performance which depart from, or are in addition to, the basic provisions of this standard.

2-1.3* Design.

2-1.3.1 The apparatus shall be constructed with due consideration to the nature and distribution of the load to be sustained and to the general character of the service to which the apparatus is to be subjected when placed in service. All parts of the apparatus shall be strong enough to withstand the general service under full load. The apparatus shall be so designed that the various parts are readily accessible for lubrication, inspection, adjustment and repair.

2-1.3.2* Where fire apparatus may have to operate off paved roadways and special drive train components are desired, purchaser shall indicate in the Special Provisions.

2-1.3.3* Where the apparatus is required to operate on any grade in excess of ten percent, the purchaser shall indicate the maximum percent of grade in Special Provisions.

2-1.3.4 The apparatus shall comply with all applicable motor vehicle laws in effect at date of contract for purchase.

2-1.3.5 Where special tools, which are not normally used or available, are required to service any components of the apparatus built or supplied by the manufacturer, such tools shall be provided with the apparatus.

2-1.3.6 Each bid shall be accompanied by a detailed description of the apparatus and equipment which it is proposed to furnish and to which the apparatus furnished under the contract shall conform. The purpose of these specifications is to cover the furnishing and delivering to the purchaser of a complete and soundly engineered apparatus equipped as hereinafter specified. Minor details of construction and materials where not otherwise specified shall be left to the discretion of the contractor who shall be solely responsible for the design and construction of all features.

2-1.3.7 Each bidder shall provide accurate written specifications on the vehicle bid, including but not limited to weight, wheelbase, principal dimensions, transmission and axle ratios and a certified brake horsepower curve showing maximum no-load governed speed.

2-1.4 Carrying Capacity.

2-1.4.1* It shall be the responsibility of the manufacturer to provide GAWR, GCWR, and GVWR adequate to carry a full water tank, the specified hose load, and a personnel weight and miscellaneous equipment allowance as shown in Table 2-1.4.1.

2-1.4.1.1 GAWR, GCWR, and GVWR adequate to carry higher equipment loads shall be provided when the purchaser so specifies in Special Provisions.

Table 2-1.4.1

	Personnel	Miscellaneous Equipment
Pumpers	1200 lb	2000 lb
Water Towers	1200 lb	1500 lb
Aerials and Elevating Platforms—Ground Ladders Plus	1200 lb	2500 lb
Light Attack Vehicles	600 lb	900 lb

2-1.4.1.2 Apparatus shall be weighed to determine compliance with 2-1.4.1.

2-1.4.2 Apparatus and chassis manufacturers shall furnish certification of GVWR, GCWR, and GAWR on a nameplate affixed to the vehicle.

2-1.5 Engine Designs.

2-1.5.1* The engine supplied shall be of the type specified by the purchaser in Special Provisions.

2-1.5.2* When the maximum elevation at which the apparatus is expected to perform exceeds 2000 ft above sea level, the purchaser shall state this elevation in Special Provisions.

2-1.5.3* An engine governor shall be installed which will limit the speed of the engine under all conditions of operation to that speed established by the engine manufacturer; this shall be the maximum no-load governed speed. A tachometer shall be provided on the instrument panel in the driving compartment for indicating engine speed.

2-1.5.4* Automatic engine shutdown systems shall not be provided.

2-1.6 Cooling System, Gasoline or Diesel.

2-1.6.1* The cooling system of the engine shall be pressurized and shall be adequate to maintain a temperature of the coolant in the engine not in excess of the engine manufacturer's maximum temperature rating. (*See 3-3.3.2 and 5-3.3.2.*)

2-1.6.1.1 A coolant conditioner of a type approved by the engine manufacturer shall be supplied when specified by the purchaser in Special Provisions.

2-1.6.1.2 Radiator sight gages shall be provided when specified by the purchaser in Special Provisions.

2-1.6.2 Where automatic radiator shutters are provided, fail-safe features, or manual controls, or both, shall be incorporated.

2-1.6.3 Adequate and readily accessible drain cocks shall be installed at the lowest point of the cooling system, and at other such points as are necessary to permit complete removal of the coolant from the system. Drain cocks shall not open accidentally due to vibration.

2-1.6.4 The radiator shall be so mounted as not to develop leaks due to ordinary running and operating nor be twisted or strained when the apparatus operates over uneven ground. Radiator cores shall be compatible with commercial anti-freeze solutions and of straight tube construction for easy mechanical maintenance.

2-1.7 Lubrication System, Gasoline or Diesel.

2-1.7.1* The engine shall be provided with a replaceable element oil filter of the type approved by the engine manufacturer.

2-1.7.2 The engine oil fill pipe shall be large enough and so located as to permit easy filling.

2-1.8 Fuel System, Gasoline or Diesel.

2-1.8.1 Gasoline Engines Only. A dry type or oil bath air filter shall be provided. Air inlet restrictions shall meet the engine manufacturer's recommendations. Air inlet shall be protected as to prevent entry of water.

2-1.8.2 Diesel Engines Only. A dry type air filter shall be provided. Air inlet restrictions shall meet the engine manufacturer's recommendations. Air inlet shall be protected to prevent water and burning embers from entering the air intake system. The manufacturer shall provide an air restriction indicator, mounted in the cab, visible to the driver.

2-1.8.3* Gasoline Engines Only. Fuel lines and filters and/or strainers of an accessible and serviceable type, as recommended by the engine manufacturer, shall be provided. The filters or strainers shall be of a type which can be serviced without disconnecting the fuel line. Where two or more fuel lines are installed, separate fuel pumps operating in parallel with suitable check valves and filtering devices shall be provided. The fuel line(s) shall be so located or protected as not to be subjected to excessive heating from any portion of a vehicle exhaust system. The line(s) shall be protected from mechanical injury. Suitable valves and drains shall be installed. The carburetor(s) of a gasoline engine shall be nonadjustable, with the exception of the idle setting, of sufficient size to develop the rated power, and so located as not to be subjected to pocketing of vapor or excessive heating. A manual or automatic choke shall be provided. The gasoline feed system shall include an electrically operated fuel pump located within or adjacent to the fuel tank.

2-1.8.4* Diesel Engines Only. The fuel system shall be of the injector type, supplied by the engine manufacturer and shall be of sufficient size to develop the rated power. The manufacturer shall supply fuel lines and fuel filters in accordance with the engine manufacturer's recommendations. To prevent engine shutdown due to fuel contamination, dual filters in parallel, with proper valving so that each filter can be used separately, may be desired. If dual filters are desired, purchaser shall specify in Special Provisions.

2-1.8.4.1 An electric fuel pump shall be provided when purchaser so specifies in Special Provisions.

2-1.8.4.2 When specified by the purchaser in the Special Provisions, an emergency engine shut-off shall be provided, in addition to the normal engine shut-off switch to be used when control of the engine fuel supply

does not control engine speed. This emergency shut-off may be of the type that will shut off either the air supply, or the exhaust gas flow of the engine. This shut-off shall be provided with a guard and marked "Emergency Shut-off." This emergency shut-off shall include a provision to prevent restarting of the engine without a special reset procedure. If an emergency air or exhaust gas shut-off is desired, the purchaser shall specify in the Special Provisions.

2-1.8.5 For other than light attack vehicles, the fuel tank shall be not less than 20-gal capacity. The capacity for apparatus with pumping equipment shall be of a size which shall permit the operation of the pumping engine for not less than 2 hr when operating at rated pump capacity. A suitable method of venting and means for draining directly from the tank shall be provided. The tank fill opening shall be conspicuously labeled as to the type of fuel used.

Exception: For light attack vehicles the fuel tank shall be not less than 15-gal capacity and the 2-hr requirement shall be waived.

2-1.8.6 When a large capacity fuel tank is desired, as in the case of apparatus designed for rural service, the capacity specified by purchaser in Special Provisions shall be supplied.

2-1.8.7* Only one fuel tank is to be furnished where rated rank capacity is 50 gal or less. The fuel gage shall indicate the proportionate amount of fuel in the tank system at any time.

2-1.8.8 Tank and fill piping shall be so placed as to be protected from mechanical injury, and not be exposed to heat from exhaust or other source of ignition. Tank shall be so placed as to be easily removable for repairs.

2-1.9 Exhaust System, Gasoline or Diesel.

2-1.9.1* The exhaust piping and discharge outlet shall be so located as to not expose any portion of the apparatus or equipment to excessive heating. Exhaust pipe discharge shall not be directed toward the pump operator's position. Silencing devices shall be provided. Exhaust back pressure shall not exceed the limits specified by the engine manufacturer. Where parts of the exhaust system are exposed so that they are likely to cause injury to operating personnel, suitable protective guards shall be provided.

2-2 Electrical System and Devices.

2-2.1 General.

2-2.1.1 Alternator, starting device, ignition, distributors, ignition coils, and magneto shall be of moisture-resistant type, accessibly mounted and protected against excessive heat.

2-2.1.2 All electrical circuit wiring shall be made with stranded conductors of a carrying capacity commensurate with the anticipated maximum circuit loading. Insulation shall be in accordance with or superior to the recommended standards of the Society of Automotive Engineers for such loading at the potential employed. Overall covering of conductors shall be of moisture-resistant type. All connections shall be made with lugs or terminals mechanically secured to the conductors. Wiring shall be thoroughly secured in place and suitably protected against heat, oil, and physical injury where required. Wiring shall be colored or otherwise coded.

2-2.1.3 Circuits shall be provided with suitable overload protective devices. Such devices shall be readily accessible and protected against excessive heat, physical injury and water spray.

2-2.2 Power Supply.

2-2.2.1* An electric alternator shall be provided. It shall have an outlet adequate to meet the anticipated electrical load and be provided with full automatic regulation.

2-2.2.2* Where 110-volt power generating capacity is required, the purchaser shall specify the generating capacity and type of system desired. The purchaser shall also specify the number and location of outlets to be provided.

2-2.2.2.1 The generating system shall be installed in accordance with the grounding requirements of Section 250-6, Portable and Vehicle-Mounted Generators, of NFPA 70, *National Electrical Code®*.

2-2.2.3 When receptacle on other facilities providing 110 V AC or DC power are installed, such receptacles and other facilities shall be of weatherproof type and all circuits or associated wiring shall have at the source of 110 V supply, overload protection rated at the carrying capacity of the conductor. Circuits shall be 3-wire and installed in accordance with Section 250-6 of NFPA 70, *National Electrical Code*. These receptacles shall conform to the appropriate NEMA configuration for the voltage and capacity of the circuit.

2-2.3 Batteries.

2-2.3.1* Batteries shall be securely mounted and adequately protected against physical injury and vibration, water spray, and engine and exhaust heat. When an enclosed battery compartment is provided, it shall be adequately ventilated and the batteries shall be readily accessible for examination, test and maintenance.

2-2.3.2* Battery capacity shall be commensurate with the size of the engine and the anticipated electrical load. In any event the minimum capacity shall be not less than 520 cold cranking amps for gasoline engines. One or more polarized receptacles shall be provided for charging all batteries.

2-2.3.3 The battery capacity and wiring circuits provided, including the starter switch and circuit and the starter to battery connections, shall meet or exceed the engine manufacturer's recommendations.

2-2.4 Starting Device.

2-2.4.1 An electrical starting device shall be provided for the engine. Its characteristics shall be such that, when operating under maximum load, the current draw does

not introduce a voltage drop sufficient to adversely affect function of the ignition system.

2-2.5 Ignition System, Gasoline Engine.

2-2.5.1 Ignition shall be of the battery supplied distributor and coil type.

2-2.5.2 A dual ignition system, with two sets of spark plugs and a switching arrangement which shall permit either or both sets of plugs to be fired, shall be provided when so specified by the purchaser in Special Provisions.

2-2.5.3 The ignition switch shall be provided with a pilot light. The ignition key, if any, shall not be removable.

2-2.5.4 Ignition distributors or magnetos, if not fully automatic for proper spark advance, shall be provided with manual control.

2-2.6 Lights and Warning Devices.

2-2.6.1 The rear stop, tail, and directional lights shall be so mounted that they will not be obscured by equipment and personnel normally carried on the rear step. Turn signals shall be visible from front, sides, and rear. A red flashing light, or lights visible through 360 degrees in a horizontal plane, shall be installed. Lights shall comply with federal standards as a minimum.

2-2.6.2* Apparatus shall have hooded lights, with individual switches, providing illumination of the pump operating panel, tool and equipment compartments, steps and walkways. Switches shall be conveniently located.

2-2.6.3 Two universally mounted sealed beam rear lights shall be provided. A universally mounted floodlight system shall be provided when specified by purchaser in Special Provisions.

2-2.6.4 Audible warning equipment in the form of one automotive horn and one electric or electronic siren shall be provided. Control for operating the siren shall be provided for the right and left front seat positions. Other signal devices, such as additional siren, bell, air horn, buzzer, back-up alarm, or lights, shall be provided when so specified by purchaser in Special Provisions.

2-3 Vehicle Components.

2-3.1 Braking System.

2-3.1.1* Service and parking brakes shall be independent and separate systems. All brakes shall be readily accessible for adjustment.

Exception: Air released, spring-actuated parking brakes, on non-steering axles only, shall be acceptable.

2-3.1.2 The service brake application valve, when applied, shall operate all the service brakes on the vehicle or combination of vehicles.

2-3.1.3* Air-actuated brakes and automatic moisture ejectors shall be provided when each is specified by purchaser in Special Provisions.

2-3.1.4 Parking brakes shall control the rear wheels, or all wheels, and shall be of positive, mechanically actuated type with provision for securely holding in position when applied. Neither a lock-up device to retain applied pressure on hydraulic-actuated service brake systems, nor a "park" position on an automatic transmission as a substitute for a separate parking brake system is acceptable. The purchaser shall specify maximum grade requirement for the parking brake system in Special Provisions.

2-3.1.5 Brake performance shall comply with applicable regulations including all state and federal requirements for apparatus type at date of manufacture. As a minimum requirement, service brakes shall be capable of bringing the fully laden apparatus to a complete stop from an initial speed of 20 mph in a distance not exceeding 30 ft by actual measurement on a substantially hard surface road that is free from loose material, oil, or grease.

2-3.2 Suspension and Wheels.

2-3.2.1 Wheels shall be of the metal spoke or disc type.

2-3.2.2 Front wheels shall be single, and rear wheels single or dual. All tires shall be of pneumatic truck type.

2-3.2.3 Each load-bearing tire and rim of the apparatus shall carry a weight not in excess of the recommended load for intermittent operation for truck tires or the size used, as published by the Tire and Rim Association, Inc., Akron, Ohio or the tire manufacturer's published rating, when apparatus is loaded as indicated in 2-1.4. Compliance shall be determined by weighing of the load supported by the tires or each axle, all movable load to be located as it would be in service.

2-3.2.4 Axle housings shall clear road surface at least 8 in.

2-3.2.5* An angle of departure of at least 8 degrees shall be maintained at the rear of the vehicle when normally loaded as indicated in 2-1.4.1. Where road inclinations are such that a greater angle of departure is necessary, purchaser shall specify in Special Provisions.

2-3.2.6* Fenders and guards shall be braced and firmly secured. Proper clearance shall be provided for chains. Chains shall be provided when specified by the purchaser in Special Provisions.

2-3.2.7 The steering mechanism for nondriving front axles shall be capable of turning the front wheels to an angle of at least 30 degrees to either right or left. Power or power assist steering shall be provided on all fire apparatus with a front axle rating (GAWR) over 9000 lb.

2-3.2.8* The transmission and clutch shall be of such type as to operate smoothly and effectively under all conditions of service. When automatic transmission is desired purchaser shall specify in Special Provisions.

2-3.3 Body.

2-3.3.1 The apparatus body design shall be rugged with

suitable ventilation and drains where needed and with good visibility to front, sides, and rear. Bodies shall provide readily accessible facilities for carrying hose, appliances and equipment and riding space for the personnel.

2-3.3.2 Front and rear hooks or rings shall be attached to the frame structure to permit towing of the apparatus. When purchaser specifies in Special Provisions, hooks and rings shall be located so that their use does not require opening compartment doors.

2-3.3.3 A heavy-duty bumper shall be provided on the front of the chassis and the bumper mounting brackets shall be attached to the frame.

2-3.3.4 Suitable holders, boxes, compartments, or other attachments shall be provided for all tools, equipment, play-pipes, and other items which the purchaser desires to carry on the apparatus. Equipment holders shall be firmly attached, and designed so that equipment will remain in place under all running conditions, but be quickly removable for use. When equipment other than that purchased with the vehicle must be mounted, the purchaser shall indicate in Special Provisions. (*See also 10-1.1.3.*)

2-3.3.5 The purchaser shall indicate, in Special Provisions, the space or compartment desired for the installation of radio equipment. Suitable shielding shall be provided where necessary to permit radio operation without undue interference.

2-3.3.6* All steps shall be suitably braced and be of heavy gage metal with nonskid safety surface. Minimum width of rear steps shall be 18 in. measuring from the back of the body.

Exception: Rear steps shall not be required on aerial ladder, elevating platforms, and pumper-ladder trucks.

2-3.3.7 Handrails shall be between 1 in. and 1⅝ in. in outside diameter. They shall be constructed of chrome plated metal, or stainless steel tubing, and shall be so arranged as to avoid snagging of the hose or equipment. A rear handrail shall be provided where a rear step is furnished. The minimum clearance between handrails and any surface shall not be less than 2 in.

2-3.4 Driving Compartment.

2-3.4.1 An enclosed driving compartment with seating capacity for not less than two persons shall be provided; when seating for more than two persons is to be provided the purchaser shall specify seating capacity in Special Provisions.

Exception: A semi-cab shall be provided when specified in Special Provisions.

2-3.4.2 Driver's seat shall be readily adjustable by the driver, adjustment range to be not less than 3 in. front to rear. A separate seat shall be provided for the driver when specified by the purchaser in the Special Provisions.

2-3.4.3 A speedometer/odometer shall be provided. An odometer or recording device shall be provided to register total engine operation.

2-4 Metal Finish.

2-4.1* All exposed ferrous metal surfaces not chrome plated or stainless steel shall be thoroughly cleaned and prepared and shall be painted fire department red, Munsell No. 7.5R3.5/14.0. All irregularities in painted surfaces shall be rubbed down before the application of the finishing coats.

Exception: When a different color or colors are desired, purchaser shall specify in Special Provisions.

2-4.2 Undercoating shall be provided when specified by the purchaser in Special Provisions.

2-4.3 Striping, decorating, and lettering shall be provided as specified by the purchaser in Special Provisions.

Chapter 3 Provisions Applying to Apparatus Equipped with a Fire Pump

3-1 Design and Performance Requirements.

3-1.1 Capacity.

3-1.1.1* The rated capacity of the fire pump shall be 500, 750, 1000, 1250, 1500, 1750, or 2000 gpm, as specified by the purchaser in Special Provisions.

3-1.1.2 The pump provided shall deliver the percentage of the rated capacity shown below at the pressures indicated:

100 percent of rated capacity at 150 psi net pump pressure

70 percent of rated capacity at 200 psi net pump pressure

50 percent of rated capacity at 250 psi net pump pressure.

3-1.2 Suction Capability.

3-1.2.1 When dry, the pump in both parallel and series operation (where pumps are of parallel-series type) shall be capable of taking suction and discharging water with a lift of 10 ft in not more than 30 sec through 20 ft of suction hose of appropriate size, and not over 45 sec for pumps of 1500 gpm or larger capacity.

3-1.2.2 The pump manufacturer shall certify that the fire pump is capable of pumping rated capacity of 150 psi net pump pressure, from draft, through 20 ft of suction hose with strainer attached, under conditions as stipulated below.

(a) An altitude of 2000 ft above sea level.

(b) Atmospheric pressure of 29.9 in. (760 mm) Hg (corrected to sea level).

NOTE: At an altitude of 2000 ft the actual (uncorrected) atmospheric pressure equivalent to the sea level reading of 29.9 in. (760 mm) Hg is 27.8 (707 mm) Hg.

(c) Water temperature of 60°F (15.6°C).

(d) Suction hose size and lift as indicated in Table 3-1.2.2(d).

(e) Friction and entrance loss in section hose as given in Table 3-1.2.2(e).

Exception No. 1: The pump manufacturer shall certify that the pump is capable of pumping rated capacity and pressure at an elevation over 2000 ft when purchaser specified such higher elevation in Special Provisions.

Exception No. 2: The pump manufacturer shall certify that the pump is capable of pumping rated capacity and pressure at lifts higher than those listed in 3-1.2.2, or through more than 20 ft of suction hose, or both, when purchaser specifies such special conditions in Special Provisions.

Exception No. 3: The pump manufacturer shall certify that a 1500 gpm or larger pump is capable of pumping rated capacity and pressure through a single suction hose or through two suction hoses attached to one side of the apparatus only, when purchaser so specifies in Special Provisions.

Table 3-1.2.2(d)

Rated Capacity (gpm)	Suction Hose Size (in.)	No. of Suction Lines	Lift (ft)
500	4	1	10
750	4½	1	10
1000	5	1	10
1250	6	1	10
1500	6	1 or 2	10
1750	6	2	8
2000	6	2	6

3-1.3 Engine Capability.

3-1.3.1 The engine shall be capable of performing the pumping tests herein specified without exceeding the maximum no-load governed speed of the engine as shown on a certified brake horsepower curve of the type of engine used without accessories; the certification shall be by a responsible official of the engine manufacturer.

3-1.3.2 The engine shall demonstrate its ability to deliver rated pump capacity at 165 psi net pump pressure. (*See 2-1.5.3.*)

3-2 Construction Requirements.

3-2.1 Pump.

3-2.1.1* The fire pump shall be of the centrifugal type, and shall be constructed of cast iron with stainless steel shaft and bronze impellers and other trim.

Exception No. 1: The pump may be of another type when the purchaser specifies in Special Provisions.

Exception No. 2: The pump, and all piping, fittings, and valves connected to it shall be all-bronze, or constructed of materials having corrosion resistance equal to or superior to bronze, when purchaser specifies in Special Provisions.

3-2.1.2 The fire pump shall be one of the following types, as specified by the purchaser in Special Provisions:

(a) Single-stage.

(b) Multi-stage, series only.

(c) Multi-stage, series/parallel.

Table 3-1.2.2(e) Friction and Entrance Loss in 20 ft of Suction Hose, Including Strainers

Flow Rate GPM	Suction Hose Size (Inside Diameter)													
	4 in.		4½ in.		5 in.		6 in.		2 — 4½ in.		2 — 5 in.		2 — 6 in.	
	ft water	in. Hg	ft water	in. Hg	ft water	in. Hg	ft water	in. Hg	ft water	in. Hg	ft water	in. Hg	ft water	in. Hg
500	5.0 (1.3)	4.4	3.6 (0.8)	3.2	2.1 (0.4)	1.9	0.9 (0.2)	0.8						
350	2.5 (0.7)	2.1	1.8 (0.4)	1.6	1.0 (0.2)	1.0	0.4 (0.1)	0.4						
250	1.3 (0.4)	1.1	0.9 (0.3)	0.8	0.5 (0.1)	0.5	0.2 (0.1)	0.2						
750	11.4 (2.9)	9.8	8.0 (1.6)	7.1	4.7 (0.9)	4.2	1.9 (0.4)	1.7						
525	5.5 (1.5)	4.9	3.9 (0.8)	3.4	2.3 (0.5)	2.0	0.9 (0.2)	0.8						
375	2.8 (0.7)	2.5	2.0 (0.4)	1.8	1.2 (0.2)	1.1	0.5 (0.1)	0.5						
1000			14.5 (2.8)	2.5	8.4 (1.6)	7.4	3.4 (0.6)	3.0						
700			7.0 (1.4)	6.2	4.1 (0.8)	3.7	1.7 (0.3)	1.5						
500			3.6 (0.8)	3.2	2.1 (0.4)	1.9	0.9 (0.2)	0.8						
1250					13.0 (2.4)	11.5	5.2 (0.9)	4.7	5.5 (1.2)	4.9				
875					6.5 (1.2)	5.7	2.6 (0.5)	2.3	2.8 (0.7)	2.5				
625					3.3 (0.7)	2.9	1.3 (0.3)	1.1	1.4 (0.3)	1.2				
1500							7.6 (1.4)	6.7	8.0 (1.6)	7.1	4.7 (0.9)	4.2	1.9 (0.4)	1.7
1050							3.7 (0.7)	3.3	3.9 (0.8)	3.4	2.3 (0.5)	2.0	0.9 (0.3)	0.8
750							1.9 (0.4)	1.7	2.0 (0.4)	1.8	1.2 (0.2)	1.1	0.5 (0.1)	0.5
1750							10.4 (1.8)	9.3	11.0 (2.2)	9.7	6.5 (1.2)	5.7	2.6 (0.5)	2.3
1225							5.0 (0.9)	4.6	5.3 (1.1)	4.7	3.1 (0.7)	2.7	1.2 (0.3)	1.1
875							2.6 (0.5)	2.3	2.8 (0.6)	2.5	1.6 (0.3)	1.4	0.7 (0.2)	0.6
2000									14.5 (2.8)	12.5	8.4 (1.6)	7.4	3.4 (0.6)	3.0
1400									7.0 (1.4)	6.2	4.1 (0.8)	3.7	1.7 (0.3)	1.5
1000									3.6 (0.8)	3.2	2.1 (0.4)	1.9	0.9 (0.2)	0.8

NOTE: Figures in parentheses indicate increment to be added or subtracted for each 10 ft of hose less than or greater than 20 ft.

3-2.1.3 Power to drive the fire pump shall be provided by the same engine used to propel the apparatus. The pump shall be located near the middle of the chassis ("midship mounted") and driven through an integral transmission including means for connecting power selectively to the driving axle or to the pump.

Exception No. 1: The pump shall be located at the front of the chassis and driven from the front of the engine when purchaser specifies in Special Provisions.

Exception No. 2: The pump shall be located at such other position and driven by such other means as specified by the purchaser in Special Provisions.

3-2.2 Pump Connections.

3-2.2.1 Two suction inlets of the same size as the suction hose specified in 3-1.2.2 shall be provided.

Exception No. 1: Where a front-mounted pump is furnished, or otherwise when specified by the purchaser in Special Provisions, a single large suction inlet shall be provided.

Exception No. 2: Suction inlets shall be larger than the size of the suction hose specified in 3-1.2.2 when such larger size is specified by the purchaser in Special Provisions.

3-2.2.1.1 The suction inlets specified in 3-2.2.1 shall have male National (American) Standard threads as specified in NFPA 1963, *Standard for Screw Threads and Gaskets for Fire Hose Connections*.

3-2.2.1.2* Additional suction inlets of the same size as those specified in 3-2.2.1 shall be provided at the front or rear of the apparatus, or elsewhere, when purchaser specifies in Special Provisions.

3-2.2.1.3 Where the suction hose specified in 10-2.1 is different in size than the suction inlets specified in 3-2.2.1, suitable adapter couplings shall be attached to all such inlets.

3-2.2.1.4* One or more of the suction inlets specified in 3-2.2.1 shall be gated when specified by the purchaser in Special Provisions.

3-2.2.2 Suction inlets shall have a removable or accessible strainer provided inside each external inlet.

3-2.2.3* One auxiliary gated suction inlet shall be provided. It shall be of 2½ in. nominal size, and shall be equipped with a swivel coupling with 2½ in. female National (American) Standard threads, as specified in NFPA 1963, *Standard for Screw Threads and Gaskets for Fire Hose Connections*.

Exception No. 1: Where one of the large suction inlets specified in 3-2.2.1 is gated, the auxiliary 2½ in. gated inlet shall be provided only when specified by the purchaser in Special Provisions.

Exception No. 2: Where one of the large suction inlets specified in 3-2.2.1 is equipped with a two-way or three-way 2½-in. or 3-in. gated suction siamese, the auxiliary 2½-in. gated inlet shall be provided only when specified by the purchaser in Special Provisions.

3-2.2.3.1* Additional auxiliary gated suction inlets shall be provided when purchaser specifies in Special Provisions.

3-2.2.3.2 The auxiliary gated suction inlet specified in 3-2.2.3 shall be of a size larger than 2½ in., when specified by the purchaser in Special Provisions. When furnished, it shall be equipped as specified by the purchaser in Special Provisions, with male or female National (American) Standard threads, as specified in NFPA 1963, *Standard for Screw Threads and Gaskets for Fire Hose Connections*.

3-2.2.3.3 A gated suction inlet shall be equipped with a bleed-off connection when specified by the purchaser in Special Provisions.

3-2.2.3.4 All suction inlets shall be provided with suitable closures. Inlets having male threads shall be equipped with caps; inlets having female threads shall be equipped with plugs.

Caps and plugs for 3½-in. and smaller suction inlets shall be secured to the apparatus with suitable chains or cables.

Exception No. 1: When specified by the purchaser in Special Provisions, adapters for special threads or other means for hose attachment shall be furnished in lieu of caps or plugs; in such cases closures shall be provided for the adapters.

Exception No. 2: When specified by the purchaser in Special Provisions, chains or cables shall be omitted.

Exception No. 3: When specified by the purchaser in Special Provisions, protective caps may be omitted on suction inlet(s) to which preconnected suction line(s) may be attached and the inlet(s) will be equipped with a valve.

3-2.2.4* Where a water tank is installed it shall be connected to the suction side of the pump with valve controllable at the pump operator's position. When specified by the purchaser in Special Provisions, a check valve shall be provided in the tank-to-pump line.

3-2.2.5 One 2½-in. outlet shall be provided for each 250 gpm of rated capacity. All outlets shall be equipped with male National (American) Standard threads as specified in NFPA 1963, *Standard for Screw Threads and Gaskets for Fire Hose Connections*.

Exception No. 1: Where specified by the purchaser in Special Provisions, all but one of the outlets may be larger than 2½ in.; the purchaser shall specify sizes for such larger outlets.

Exception No. 2: Where specified by the purchaser in Special Provisions, pumps rated 1250 gpm or more may be equipped with only four outlets, provided that:

(a) at least one 2½-in. outlet is provided, and

(b) one or more outlets are larger than 2½ in., and

(c) the rated capacity of the pump may be discharged at the flow rates listed at the top of page 13:

Outlet Size, in.	*Flow Rates, gpm*
2½	*250*
3	*375*
3½	*500*
4	*625*
4½	*750*
5	*1000*

3-2.2.5.1 Adapter couplings with special threads or other means for hose attachment, as specified by the purchaser, shall be furnished on all outlets when specified by the purchaser in Special Provisions.

3-2.2.5.2 All 2½-in. or larger outlets shall be equipped with valves which can be opened and closed smoothly and readily at any rated pressure. The flow regulating element of each valve shall not change its position under any condition of operation involving discharge pressures to 250 psig; the means to prevent a change in position shall be incorporated in the operating mechanism and may be manually controlled or automatic. Each discharge valve shall be equipped with a drain or bleed-off valve with a minimum ¾-in. pipe thread connection for draining or bleeding off pressure from a hose connected to the valve.

3-2.2.5.3 When specified by the purchaser in Special Provisions, additional 2½-in., or larger, outlets shall be provided at the locations specified.

3-2.2.5.4 The connections to the pumps shall allow the rated capacity of the pump to be discharged at the flow rates listed below, with each discharge valve fully open, with the pressure at all outlets at least equal to the pump discharge pressure less 8 psi.

Size, in.	**Max. Flow Rate, gpm**
2½	275
3	400
3½	525
4	650
4½	775
5	1025

Exception No. 1: When the rated capacity of the pump is 1000 gpm or higher, any combination of outlets whose total flow is 1000 gpm shall have the pressure loss limited as stated above.

Exception No. 2: If an outlet is connected to the pump through a foam liquid (or other additive) proportioning device, the pressure at that outlet shall be at least equal to the pump discharge pressure less 28 psi.

Exception No. 3: When one or more of the outlets are located at the front or rear of the apparatus when a midship pump is furnished, or at the rear when a front-mounted pump is furnished, as specified by the purchaser in Special Provisions, the pressure at such outlets shall be at least equal to the pump discharge pressure less 14 psi. If such outlets are connected to the pump through a foam liquid (or other additive) proportioning device, the pressure at those outlets shall be at least equal to the pump discharge pressure less 34 psi.

3-2.2.5.5 All discharge outlets shall be equipped with suitable caps. When adapters are furnished (*see 3-2.2.5.1*) the caps shall fit on the adapters. Caps for outlets 3½ in. and smaller shall be secured to the apparatus with suitable chains or cables.

Exception No. 1: Outlets to which hose will be preconnected shall not be equipped with caps.

Exception No. 2: When specified by purchaser in Special Provisions, chains or cables shall be omitted.

3-2.2.6* When specified by the purchaser in Special Provisions, additional outlets for preconnected lines shall be provided. Unless otherwise specified, piping between pump discharge manifold and outlets shall be 1½ in. minimum size.

3-2.2.7 Discharge valves or gated suction inlets, or both, shall be controllable at the pump operator's position when specified by the purchaser in Special Provisions.

3-2.2.8* When specified by the purchaser in Special Provisions, a tank fill line from the pump to the water tank shall be provided. Such line shall be connected from the pump discharge manifold directly to the water tank with a valve suitable for throttling service and controllable at the pump operator's position.

3-2.2.9 Suitable and readily accessible drain cocks, arranged so that either the open or the closed position is clearly indicated, shall be provided to permit draining the pump and all water-carrying lines.

3-2.2.10 Where a booster pump is specified in combination with a fire pump and where the pumps are interconnected such that pressure from one pump may be transmitted to the other pump, suitable check valves or other automatic means shall be provided to avoid pressurizing either pump beyond its maximum rated hydrostatic pressure.

3-2.2.11 Where a tank is furnished but a tank fill line is not (*see 3-2.2.8*), a by-pass line shall be installed from the pump discharge manifold directly to the tank. Where a tank is not furnished, a by-pass line shall be installed from the pump discharge manifold directly to the ground. The by-pass line shall be at least ½ in. in diameter and shall include a valve suitable for throttling service and controllable at the pump operator's position. (*See A-3-2.2.8.*)

3-2.2.12 When specified by the purchaser in Special Provisions, a warning light actuated when the temperature of the water in the pump reaches a dangerous level (175°-190°F), or a pump temperature indicator shall be provided.

3-3 Operating Controls and Devices.

3-3.1 Pump Operator's Position.

3-3.1.1 The area in which pump controls, gages, and other instruments are located shall be known as the pump operator's position.

3-3.1.2 Adequate illumination shall be provided for all gages and controls located at the pump operator's position.

3-3.1.3 All required marking shall be of a type permanent in nature, capable of withstanding the effects of extremes of weather and temperature and shall be securely attached.

3-3.2 Pump Controls.

3-3.2.1 Provisions shall be made for quickly and easily placing the pump in operation. The lever or other device shall be marked to indicate when in pumping position.

3-3.2.2 Any control device used in the power train between the engine and pump shall be arranged so that it cannot be unintentionally knocked out of the desired position.

3-3.2.3* Where the pump is driven with the chassis transmission in neutral, in that propelling power can be applied to the wheels while pumping, a device shall be provided by which the chassis transmission can be positively held in neutral.

3-3.2.4 A nameplate indicating the chassis transmission control lever position to be used for pumping shall be provided in the cab and located so that it can be easily read from the driver's position.

3-3.2.5 Where an automatic chassis transmission is furnished, means shall be provided to maintain the transmission in the designed engine/pump gear ratio.

3-3.2.6 With parallel-series centrifugal pumps, the positions for parallel operation (volume) and series operation (pressure) shall be clearly indicated. The control for changing the pump from series to parallel and vice versa shall be controllable at the pump operator's position.

3-3.2.7 Means shall be provided for controlling pressure at the pump either through an automatic relief valve or a pressure regulator controlling the speed of the pump. The device shall be capable of operation over a range of 90 to 300 psig discharge pressure. The means provided shall be controllable by one person in the pump operator's position. (*See 11-2.2.3.*)

3-3.2.8* When specified by the purchaser in Special Provisions, means for limiting the pressure on the suction side of the pump shall be provided.

3-3.2.9 A priming device shall be provided. It shall be capable of meeting the requirements of 3-1.2 and 11-2.2.4, and of developing a vacuum of 22 in. Hg at an altitude of 1000 ft. It shall function at engine speeds not exceeding the maximum no-load governed speed.

3-3.2.9.1* Where the priming device utilizes engine manifold vacuum, two distinct means or a single device with a suitable back up shall be provided to prevent induction of water into the manifold.

3-3.2.9.2 The priming device shall be controllable at the pump operator's position.

3-3.2.9.3 A positive displacement primer (gear or vane pump) shall be provided when specified by the purchaser in Special Provisions.

3-3.2.10 All pump controls and devices shall be installed so as to be protected against mechanical injury, or the effects of adverse weather conditions upon their operation.

3-3.2.11 If the pump is of the positive displacement type, at least two gear ratios or an equivalent device shall be provided between the pump and the engine; gear shift positions shall be marked "Capacity" and "Pressure."

3-3.3 Engine Controls.

3-3.3.1 A hand throttle, controlling the fuel supply to the engine and of a type that will hold its set position, shall be so located that it can be manipulated from the operator's position with all gages in full view.

3-3.3.2 When a supplementary heat exchange cooling system is provided, proper valving shall be so installed as to permit use of water from the discharge side of the fire pump for the cooling of coolant circulating through the engine cooling system without intermixing.

3-3.4 Gages and Instruments.

3-3.4.1 A pump suction gage shall be provided on the left hand side of the gage panel. It shall be not less than 4½ in. in diameter, and it shall read from 30 in. Hg vacuum to not less than 300 psi but not more than 600 psi pressure.

3-3.4.2 A pump discharge pressure gage shall be provided located to the right of the suction gage specified in 3-3.4.1. It shall be not less than 4½ in. in diameter of a type not subject to damage by vacuum, and shall read from zero to not less than 300 psi but not more than 600 psi pressure.

Exception: Where the maximum pump working pressure is above 600 psig, the gage shall read to a pressure higher than the maximum pump working pressure.

3-3.4.3 A pressure gage shall be provided for each pump outlet of 2½ in. or larger size and shall be labeled as to the outlet to which it is connected. Each shall be connected to the outlet downstream of the valve at the outlet.

Exception: When specified by the purchaser in Special Provisions, flow meters shall be provided in lieu of gages at the outlets.

3-3.4.4 When specified by the purchaser in Special Provisions, gages shall be connected to outlets smaller than 2½ in. Such gages shall be at least 2½ in. in diameter and shall be connected to the outlet downstream of any valve which can control flow through the outlet.

3-3.4.5 All gages shall have ¼ in. pipe thread connections and shall be mounted so that they are readily visible at the pump operator's position, and so that they are not subject to excessive vibration. They shall be suitably enclosed or otherwise protected.

Exception: Gages or flow meters connected to outlets remote from the operator's panel need not be visible from the pump operator's position unless purchaser specifies in Special Provisions.

3-3.4.6 Connections for test gages shall be provided at the pump operator's position. One shall be connected to the suction side of the pump, and the other shall be connected to the discharge manifold of the pump. They shall have ¼ in. standard pipe thread, shall be plugged, and shall be suitably identified.

3-3.4.7 A weatherproof tachometer shall be installed at the pump operator's position, and shall indicate the speed of the engine when it is driving the pump.

3-3.4.8 Means shall be provided whereby the reading of the tachometer specified in 3-3.4.7 can be checked with a hand revolution counter. Such means shall be readily and conveniently accessible and its use shall not require disconnecting the tachometer. A plate indicating the ratio of the checking shaft speed to the engine speed shall be permanently attached adjacent to the checking shaft.

3-3.4.9 An oil pressure gage and an engine-coolant temperature gage shall be provided at the pump operator's position and shall be grouped together, in addition to the indicators on the vehicle instrument panel.

3-3.4.10 Where the pump is driven by the vehicle engine and an automatic transmission is furnished, two green indicator lights shall be provided. One indicator light shall be installed at the pump operator's position immediately adjacent to and preferably above the throttle control with a legend reading: "Warning: Do not open throttle unless light is on." The second indicator light shall be installed in the cab of the vehicle in plain view from the driver's normal position, with a legend reading: "OK to pump."

Exception No. 1: This requirement shall not apply where the only pump operator's position is also the driver's position and the pump can be operated while the vehicle is moving under power.

Exception No. 2: Where a booster pump is installed in accordance with the provisions of Chapter 5, and is driven by a transmission mounted (SAE) PTO or otherwise with the transmission in neutral, the indicator lights shall be energized when the pump transmission is in the pumping position and also when the chassis transmission is in neutral.

3-3.4.10.1 Where the pump has a split-shaft PTO and is installed between the chassis transmission and the driving axle, the indicator lights specified in 3-3.4.10 shall be energized only when the pump transmission is in the pumping position.

3-3.4.10.2 Where the pump is driven by a transmission mounted (SAE) PTO, or front-of-engine crankshaft PTO with the transmission in neutral, the indicator lights specified in 3-3.4.10 shall be energized only when the chassis transmission is in neutral.

3-3.4.11 Where the pump can be operated while the vehicle is moving under power, a visual indicator at the driver's position shall be provided to advise the driver when the pump is engaged.

3-4 Hose.

3-4.1 Suction Hose.

3-4.1.1 Hard suction hose when furnished shall comply with the requirements of NFPA 1961, *Standard for Fire Hose*, and be equipped with expansion ring type couplings that comply with the requirements of NFPA 1963, *Standard for Screw Threads and Gaskets for Fire Hose Connections*.

3-4.2 Booster Hose.

3-4.2.1 Conventional booster hose shall comply with the requirements of ANSI/UL 92, *Standard for Fire Extinguisher and Booster Hose*.

Exception: Where working pressure will exceed 250 psig, high pressure hose with couplings attached, rated at 800 psig, complying with the requirements of RMA IP 12, Standard for High Pressure Fire Engine Booster and Fire Extinguisher Hose, shall be provided.

Chapter 4 Provisions Applying to Apparatus Equipped with a Hose Body

4-1 Hose Compartment.

4-1.1 General.

4-1.1.1* A hose compartment, or compartments, of at least 55 cu ft shall be provided on apparatus which is designed to carry 2½ in. and 1½ in. hose, and shall have a capacity for double jacket, rubber-lined fire hose of not less than 1,500 ft of 2½ in. hose on pumpers and hose trucks and 400 ft of 1½ in. hose. The hose compartment for 2½ in. hose shall not be less than 72 in. in length. A partition shall be provided to separate the 2½ in. and 1½ in. hose.

Exception No. 1: Pumper-ladder trucks shall have a hose compartment, or compartments, of at least 40 cu ft and shall have a capacity for double jacket, rubber-lined fire hose of not less than 1000 ft of 2½ in. hose and 400 ft of 1½ in. hose. The 72-in. minimum length for the hose compartment shall not apply.

Exception No. 2: Light attack vehicles shall have a hose compartment, or compartments, of at least 12 cu ft, and shall have a capacity for double jacket, rubber-lined fire hose of not less than 300 ft of 2½ in. hose and 400 ft of 1½ in. hose. The 72-in. minimum length for the hose compartment shall not apply.

Exception No. 3: Mobile water supply apparatus shall have a hose compartment, or compartments, of sufficient capacity to permit compliance with 6-3.3 of this standard.

4-1.1.1.1 Larger compartments shall be provided necessary to accommodate different hose loads when specified by the purchaser in Special Provisions.

4-1.1.2 Hose compartments shall be divided to permit two or more lines to be laid simultaneously, as specified in 4-1.1.1, when specified by the purchaser in Special Provisions.

4-1.1.3* The hose compartments shall be reinforced at the corners. The bottom shall be in removable sections fabricated from wood or other noncorrosive materials. The interior shall be smooth and free from all projections such as nuts, sharp angles, or brackets which might injure the hose. Baskets, reels, rear handrails, and equipment holders shall not be placed as to obstruct the placing of hose in the compartments.

4-1.1.4 Removable covers to protect the hose shall be provided when specified by the purchaser in Special Provisions.

4-2 Reel for Booster Hose.

4-2.1 Where apparatus is provided with a water tank and a fire pump or a booster pump, a hose reel, together with all necessary piping and hose connections, shall be provided. Booster hose reels shall have a capacity of not less than 200 ft of 1 in. booster hose.

Exception: Mobile water supply apparatus may comply with the provisions of 6-3.3.1.1 of this standard.

4-2.1.1 When specified by the purchaser in Special Provisions a power rewind for reel shall be provided.

4-2.1.2 Piping, valves, and space for preconnected 1½ in. hose shall be provided in lieu of booster hose when specified in Special Provisions.

Chapter 5 Provisions Applying to Apparatus Equipped with a Booster Pump

5-1 Design Requirements.

5-1.1 General.

5-1.1.1* Any pump mounted permanently on an apparatus and rated less than 500 gpm shall be called a booster pump. A portable pump shall not be considered a booster pump within the meaning of this chapter.

5-1.1.2* The rated capacity and pressure shall be specified by the purchaser in the Special Provisions. The pump shall be capable of delivering rated capacity when taking suction from the water tank.

Exception: Light attack vehicles shall have a minimum rated capacity of either 250 gpm at 150 psi, or 100 gpm at 250 psi.

5-1.1.3 Where pump is to deliver rated capacity from draft, purchaser shall indicate in Special Provisions, stipulating the maximum lift, suction hose size, and maximum altitude at which the apparatus will be used.

5-1.1.4 Purchaser shall indicate the type of pump drive desired in Special Provisions.

5-1.1.5* When specified by the purchaser in Special Provisions, the pump shall be capable of being operated while the vehicle is moving under power. Where such is required, purchaser shall indicate the desired pump performance at given vehicle speed in Special Provisions.

5-1.2 Engine Capability.

5-1.2.1 The engine shall be capable of performing the pumping tests herein specified without exceeding the maximum no-load governed speed of the engine as shown on a certified brake horsepower curve of the type of engine used without accessories; the certification shall be by a responsible official of the engine manufacturer.

5-1.3 Power Train Capability.

5-1.3.1 All components in the power train from the engine to the pump shall be capable of transmitting the power required by the pump at maximum rated capacity and pressure. (*See 5-1.1.2.*)

5-1.3.2* When pumping rated capacity and pressure, lubricant temperatures shall not exceed component manufacturer's published limits.

5-1.3.3 Duration of operation shall not exceed component manufacturer's published limits for the level of power utilized.

5-2 Construction Requirements.

5-2.1 Pump.

5-2.1.1 The booster pump shall be of the centrifugal type, and shall be constructed of cast iron with stainless steel shaft and bronze impeller(s) and other trim.

Exception No. 1: The pump may be of another type if so specified by the purchaser in Special Provisions.

Exception No. 2: The pump and all piping, fittings, and valves connected to it shall be all-bronze or constructed of materials having corrosion resistance equal to or superior to bronze when the purchaser specifies in Special Provisions.

5-2.2 Pump Connections.

5-2.2.1 External suction inlets shall be of such size and number, and in such locations, as specified by the purchaser in Special Provisions. Purchaser shall specify suction inlets which are commensurate with the specified pump capacity. (*See 5-1.1.2.*)

5-2.2.2 All discharge outlets shall have National (American) Standard fire hose coupling threads. Adapter couplings, securely attached, shall be provided on each outlet if local couplings are not National (American) Standard as specified in NFPA 1963, *Standard for Screw Threads and Gaskets for Fire Hose Connections.*

5-2.2.3 Discharge outlets shall be of such size and number, and in such locations, as specified by the purchaser in Special Provisions. Each discharge outlet shall be equipped with a valve which can be operated smoothly and readily under all rated pressures. Any outlet to which hose is not preconnected shall be equipped with a protective cap. Purchaser shall specify a sufficient number of outlets of appropriate size so that the rated capacity of the pump can be discharged and conducted through hose lines connected to the outlets without excessive friction loss.

5-2.2.4 A tank fill line shall be provided when specified by the purchaser in Special Provisions. The line shall be

connected from the pump discharge manifold directly to the water tank, and shall include a valve controllable at the pump operator's position.

5-2.2.5 Suitable provisions shall be made to drain the pump and all water-carrying lines.

5-2.2.6 A by-pass line of not less than ¼-in. diameter, with a manual control valve at the pump operator's position, shall be installed from the discharge manifold directly to the water tank, where a tank is furnished; or to the ground, where a tank is not furnished.

Exception: This requirement shall not apply where a positive displacement pump with a relief valve which discharges to the tank or to the ground is furnished.

5-2.2.7 A warning light, actuated when the temperature of the water in the pump reaches a dangerous level (175°-190°F), or a pump temperature indicator shall be provided when specified by the purchaser in Special Provisions.

5-3 Operating Controls and Devices.

5-3.1 Pump Operator's Position.

5-3.1.1 The area in which pump controls, gages and other instruments are located shall be known as the pump operator's position.

5-3.1.2 Adequate illumination shall be provided for all gages and controls located at the pump operator's position.

5-3.2 Pump Controls.

5-3.2.1 Provisions shall be made for quickly and easily placing the pump in operation. The lever or other device shall be marked to indicate when in pumping position.

5-3.2.2 With parallel-series centrifugal pumps, the positions for parallel operation (volume) and series operation (pressure) shall be clearly indicated. The control for changing the pump from series to parallel and vice versa shall be located at the pump operator's position.

5-3.2.3 A relief valve, or other pressure control device, shall be provided when specified by the purchaser in Special Provisions. The device shall be capable of limiting the pump discharge pressure as indicated by the purchaser in Special Provisions.

Exception: Where a positive displacement pump is furnished, a relief valve shall be provided.

5-3.2.4 A priming device shall be provided when purchaser has specified that the pump shall be capable of operating from draft (*see 5-1.1.3*), or otherwise if specified by the purchaser in Special Provisions. The priming device shall be capable of priming the pump from the maximum lift specified, with the specified size suction hose connected, at the maximum altitude specified, so as to permit discharge from the pump within 30 sec after start of the priming operation. In addition, the priming device shall be capable of developing a vacuum of 22 in. Hg at an altitude of 1000 ft above sea level. The priming device shall be controllable at the pump operator's position.

5-3.2.5 All pump controls and devices shall be installed so as to be protected against mechanical injury or the effects of adverse weather conditions upon their operation. All required markings shall be of a type permanent in nature, capable of withstanding the effects of extremes of weather and temperature and shall be securely attached.

5-3.3 Engine Controls.

5-3.3.1 A hand throttle, controlling the fuel supply to the engine and of a type that will hold its set position, shall be so located that it can be manipulated from the operator's position with all gages in full view.

5-3.3.2 A supplementary heat exchange cooling system shall be provided when specified by the purchaser in Special Provisions. The system shall be properly valved and shall permit the use of water from the discharge side of the pump flowing through the exchanger to the suction side of the pump to cool the engine coolant without intermixing.

5-3.4 Gages and Instruments.

5-3.4.1 All gages and instruments shall be so mounted and attached that they are not subjected to excessive vibration. They shall be suitably enclosed or protected.

5-3.4.2 A discharge pressure gage and a suction pressure gage shall be provided at the pump operator's position. Unless otherwise specified by the purchaser in Special Provisions, the discharge pressure gage shall read from zero to at least 300 psig, but not less than 100 psi higher than the maximum pressure which can be developed by the pump when it is operating with zero suction pressure, and the suction pressure gage shall read from 30 in. Hg vacuum to not less than 300 psig, but not more than 600 psig.

5-3.4.3 Where the pump is driven by the vehicle engine and an automatic transmission is furnished, two green indicator lights shall be provided. One indicator light shall be installed at the pump operator's position immediately adjacent to and preferably above the throttle control with a legend reading: "Warning: Do not open throttle unless light is on." The second indicator light shall be installed in the cab of the vehicle in plain view from the driver's normal position, with a legend reading: "OK to pump."

Exception: This requirement shall not apply where the only pump operator's position is also the driver's position and the pump can be operated while the vehicle is moving under power.

5-3.4.3.1 Where the pump has a split-shaft PTO and is installed between the chassis transmission and the driving axle, the indicator lights specified in 5-3.4.3 shall be energized only when the pump transmission is in the pumping position.

5-3.4.3.2 Where the pump is driven by a transmission mounted (SAE) PTO, or front-of-engine crankshaft PTO with the transmission in neutral, the indicator lights

specified in 5-3.4.3 shall be energized only when the chassis transmission is in neutral.

Exception: Where a fire pump with a split-shaft PTO is installed between the chassis transmission and the driving axle, in accordance with the provisions of Chapter 3, the indicator lights shall be energized when the chassis transmission is in neutral and also when the pump transmission is in the pumping position.

5-3.4.4 Where the pump can be operated while the vehicle is moving under power, a visual indicator at the driver's position shall be provided to advise the driver when the pump is engaged.

5-3.4.5 Visible or audible warning devices shall be provided which are actuated when the temperature of the lubricant in any power train component that provides power to the pumps exceeds the manufacturer's published limit.

Exception: If lubricant temperature indicators are provided on the pump operator's panel, warning devices shall not be required.

5-4 Hose.

5-4.1 Suction Hose.

5-4.1.1 Hard suction hose of the specified size and length shall be provided, when specified by the purchaser in Special Provisions. Hard suction hose shall comply with the requirements of NFPA 1961, *Standard for Fire Hose*, and be equipped with expansion ring type couplings that comply with the requirements of NFPA 1963, *Standard for Screw Threads and Gaskets for Fire Hose Connections*.

5-4.2 Booster Hose.

5-4.2.1 Conventional booster hose shall comply with the requirements of ANSI/UL 92, *Standard for Fire Extinguisher and Booster Hose.*

Exception: Where working pressures will exceed 250 psig, high pressure hose with couplings attached, rated at 800 psig, complying with the requirements of RMA IP 12, Standard for High Pressure Fire Engine Booster and Fire Extinguisher Hose, shall be provided.

Chapter 6 Provisions Applying to Apparatus Equipped with a Water Tank

6-1 General.

6-1.1 Tank Construction.

6-1.1.1 All water tanks shall be of noncorrosive material or steel suitably protected against corrosion and deterioration; readily accessible clean-out holes or other means to permit complete cleaning of the tank shall be provided.

6-1.1.2 All water tanks shall be constructed to be independent of the body or compartments and shall be equipped with suitable method for lifting tank out of body.

6-1.1.3* The water tank shall be provided with at least one swash partition. Any water tank shall have a sufficient number of swash partitions so that the maximum dimension of any spaces in the tank, either transverse or longitudinal, shall not exceed 46 in., and shall not be less than 23 in.

6-1.1.4 Swash partitions shall have suitable vents or openings at both top and bottom to permit movement of air and water between spaces as required to meet the flow requirements as specified in 6-1.2.3 of this chapter.

6-1.1.5 Connections or outlets from tank to pump shall be suitable designed to prevent air from being entrained while pumping water from the tank.

6-1.2 Tank Connections.

6-1.2.1 A convenient, capped fill opening of not less than 5 in. in diameter and designed to prevent spillage shall be provided. An easily removable, readily cleaned screen shall be installed.

6-1.2.2* Provisions shall be made for necessary overflow and venting of tanks. Vents shall be not less than 3 in. in diameter to permit use of 2½-in. hydrant fill lines. The overflow outlet shall be designed so that the effect of a spill on rear tire traction will be minimized.

6-1.2.3* If equipped with other than a portable pump, connections between the water tank and the pump shall permit the tank to pump flow rates specified below, and these flow rates shall be maintained for not less than 80 percent of the rated capacity of the tank.

(a) For tanks of 300 to and including 750 gal capacity and with a pump as specified in Chapter 3 of this standard, the flow rate shall be 250 gpm.

(b) For tanks of over 750 gal capacity and with a pump as specified in Chapter 3 of this standard, the flow rate shall be 500 gpm.

(c) For all tank capacities, and with a pump as specified in Chapter 5 of this standard, the flow rate shall be the same as the rated pump capacity if such rated pump capacity is less than the flows specified above [in (a) and (b)].

6-1.2.3.1 A different tank to pump flow rate shall be provided when specified by the purchaser in Special Provisions.

6-1.2.3.2 When more than one pump is provided, the purchaser shall specify in Special Provisions to which pump or pumps the tank shall be connected.

6-1.2.4 All valves shall be operable from the pump operator's position or other accessible location where necessary controls are concentrated.

6-1.2.5 All connections to which hose can be attached shall have National (American) Standard fire hose threads as specified in NFPA 1963, *Standard for Screw Threads and Gaskets for Fire Hose Connections*, for the size of outlet and inlet provided. Adapters shall be provided when purchaser so specifies in Special Provisions.

6-1.3 Special Agents.

6-1.3.1* Tanks for wetting agents or mechanical foam shall be provided if specified. The purchaser shall also specify size of the tank, and the type of proportioning equipment desired to control the flow of these agents into hose lines. Swash partitions shall not be required in special agent tanks with a capacity of 100 gal or less. Larger special agent tanks shall be provided with swash partitions in the same manner as water tanks. (*See 6-1.1.3.*)

6-2 Water Tanks on Apparatus Other than Mobile Water Supply Apparatus.

6-2.1 Tank Capacity.

6-2.1.1* Water tanks shall have a minimum capacity of 300 gal.

Exception No. 1: For apparatus equipped with an aerial ladder, an elevating platform, or for light attack vehicles, the water tank capacity shall be a minimum of 150 gal.

Exception No. 2: When greater water tank capacity is desired, the purchaser shall specify in the Special Provisions.

6-2.1.1.1 Water level gage shall be provided when specified by the purchaser in Special Provisions.

6-3* Mobile Water Supply Apparatus.

6-3.1 General.

6-3.1.1 Mobile water supply apparatus, as defined, shall comply with the requirements of Chapter 2, Provisions Applying to All Types of Apparatus, and to the provisions of this section.

6-3.1.1.1 It shall be the responsibility of the manufacturer to provide GAWR and GVWR adequate to carry a full water tank, the specified hose load, and a personnel and equipment weight as follows:

Personnel: 600 lb
Equipment: 1000 lb.

6-3.1.2 The vehicle shall comply with any additional requirements in this standard when specified by the purchaser in the Special Provisions.

6-3.2 Pump.

6-3.2.1 A pump of at least 250 gpm at 150 psi shall be provided conforming to the requirements of either Chapter 3 or Chapter 5 of this standard.

6-3.2.2 When a portable pump in addition to a booster pump or fire pump is desired, purchaser shall specify in Special Provisions.

6-3.2.3 Portable pumps, when specified for pumping from the water tank, shall be installed with flexible, semi-permanent connections properly valved so they may be quickly disconnected to permit easy removal of the portable pump.

6-3.3 Hose Capacity.

6-3.3.1 Space shall be provided to carry at least 400 ft of 2½-in. double jacketed, rubber-lined fire hose and at least 200 ft of preconnected 1½-in. hose.

Exception No. 1: When a different hose capacity is desired, it shall be specified by the purchaser in Special Provisions.

Exception No. 2: When a booster hose is desired in lieu of 1½-in. hose, 200 ft of booster hose shall be provided. A reel will be provided to carry the hose.

6-3.4 Tank.

6-3.4.1* The water tank shall have a minimum of 1500 gal capacity. Tank may be independent of body or integral as desired. Tank provisions of Chapter 6 shall apply.

Exception: When tank capacity other than 1500 gal is desired, purchaser shall specify in Special Provisions.

6-3.4.2 A single outlet capable of allowing water to be transferred from the tank, at an average rate of 1000 gpm, shall be supplied. Purchaser shall indicate its desired location and the type of fitting desired.

6-3.4.3 For apparatus not equipped with a pump providing a 500-gpm transfer capacity, a 4-in. or larger dump valve connection shall be installed in a convenient location.

6-3.4.3.1 An external filler connection directly to the tank shall be provided. This connection shall permit a minimum filling rate of 1000 gpm from sources external to the unit.

6-3.4.3.2 Venting and overflow devices shall be provided. These devices shall permit a minimum filling rate of 1000 gpm without damaging or overpressurization of the tank. Purchaser shall specify if a higher rate is desired.

6-3.4.4 A water level gage shall be provided. It shall be of a type that has no interacting mechanical parts immersed in the tank. Purchaser shall indicate gage location in the Special Provisions.

Chapter 7 Provisions Applying to Apparatus Equipped with an Aerial Ladder

7-1* Aerial Ladder.

7-1.1 Length.

7-1.1.1 A metal aerial ladder of two or more sections shall be provided. Length shall be as specified by the purchaser in the Special Provisions.

7-1.1.2 The length of an aerial ladder shall be measured by a plumb line from the top rung of the ladder to the ground with the ladder raised to its maximum angle of elevation and fully extended.

7-1.1.3 There shall be a minimum of 18 in. width between the rails of an aerial ladder measured at the narrowest point, between the rails or the trussing.

7-1.2 Operating Mechanism.

7-1.2.1 A power-operated raising device shall be provided, so arranged that the upward movement of the ladder is rapid, smooth and without undue swaying or vibration.

Cables used to extend and to lower the fly section shall be securely attached and arranged with sufficient compensation so as to avoid undue stresses and strains.

Where the raising device includes moving cylinders or other moving parts, these shall be so arranged as to provide adequate hand clearance with the sides of the ladder or suitable hand guards shall be provided to prevent injury to the operator.

7-1.2.2 A power-operated turntable shall be provided for revolving the aerial ladder, so arranged that it will rotate with little resistance. The mechanism of the turntable shall be constructed so that the platform and the aerial ladder can be operated in a complete circle, clockwise and counterclockwise, to enable the ladder to be put in any position.

7-1.3 Aerial Ladder Equipment.

7-1.3.1* The horizontal traverse of the detachable ladder pipe specified in Section 10-4 shall not exceed 15 degrees on either side of center.

7-1.3.1.1 Where pulleys and cables for vertical control of the stream from the turntable are desired, the purchaser shall specify in Special Provisions.

7-1.3.2 Brackets for carrying the detachable ladder pipe specified in Section 10-4 shall be provided on the truck near the upper end of the ladder. These brackets shall have two metal rungs of the same spacing as the ladder rungs so that the ladder pipe brackets will not have to be readjusted to secure the pipe to the aerial ladder.

7-1.3.3 Folding steps shall be placed near the top of the aerial ladder for the use of the ladder pipe operator.

7-1.3.4* If the top rung of the fly section is too wide to attach the hook of a pompier or life belt, provisions shall be made so that the nozzle operator may tie in.

7-1.3.4.1 Where an axe, plaster hook, or both, mounted inside of the fly section of the aerial ladder are desired, purchaser shall indicate in Special Provisions.

7-1.3.5 Suitable lighting shall be provided at the base of the ladder arranged to illuminate the ladder in any position of operation.

7-1.3.5.1* Where an additional spotlight attached to the top of the aerial is desired, purchaser shall specify in Special Provisions.

7-1.3.5.2 Where reflective material or other special treatment is desired to make the top of the aerial ladder, extendible ground jacks, and the sides of the ladder turntable more visible at night, purchaser shall specify in Special Provisions.

7-2 Control Devices and Mechanisms.

7-2.1 General.

7-2.1.1* There shall be a place to be known as the operator's position where the operator of the aerial ladder shall stand. Aerial ladder operational controls shall be operable from that position. The position shall be such that the operator's line of sight is parallel or coincides with the axis of the ladder when in any position. Control devices shall be grouped in a convenient manner on a pedestal or panel.

7-2.1.1.1 Where an intercom system between operator position on turntable and top of ladder is desired, purchaser shall indicate in the Special Provisions.

7-2.1.2 Control devices, mounted on a pedestal or panel, shall be clearly marked, suitably lighted, and arranged so that they cannot be moved accidentally. Control devices shall be provided to:

(a) immobilize the vehicle;

(b) transfer power application to the ladder mechanism;

(c) stabilize the vehicle;

(d) lock in and release the ladder from its bed;

(e) control elevation, rotation and extension of the ladder;

(f) indicate the angle of elevation and the load limit of the ladder;

(g) control the engine from the operator's position.

7-2.1.3 Adequate steps and suitable hand holds or rails shall be provided to reach the turntable of the aerial ladder from either side.

7-2.1.4 The turntable platform shall be provided with a safety railing of chrome-plated or stainless steel tubing at least 30 in. high, extending along the outside of the turntable in back of the operator's position.

7-2.2 Immobilization Controls.

7-2.2.1 A suitable control shall be provided at the driver's position to lock driving wheels at the wheel brake drums. Brake performance shall comply with the requirements of 2-3.1.

7-2.2.2 When the aerial ladder is mounted on a tractor-trailer chassis, a suitable device shall be installed which will prevent transmission of the load on the aerial ladder to the rear springs of the tractor.

7-2.2.3 Four wheel chocks shall be provided.

7-2.3 Power Transfer Control.

7-2.3.1 Controls shall be provided at the driver's position to transfer the power from the road drive to the aerial ladder mechanism. A visual or audible signaling device shall be provided at the driver's position so as to indicate when the power take-off (PTO) mechanism is engaged.

7-2.4 Ladder Bed Lock.

7-2.4.1 A lock shall be provided which will prevent action and movement of the aerial ladder in its bed when the vehicle is in motion.

7-2.4.2 The lock release or control shall be located at the driver's or tillerman's position or at the turntable or may be automatically performed when actuating the controls required in 7-2.3 or 7-2.5.

7-2.5 Stabilization Controls.

7-2.5.1 At least two ground jacks shall be provided, one on each side of the apparatus at the turntable location and with the widest practicable spread between their feet when in operating position. Where extendible ground jacks are provided, these shall be arranged so that jacks may be used simultaneously on both sides of the apparatus. Positive safety stops shall be provided to prevent overextension.

7-2.5.2 The ground contact area of each jack shall not be less than 140 sq in. and, in addition, foot plates of ample strength shall be provided with each jack capable of increasing the ground contact area of each jack to not less than 320 sq in. The jack foot pad shall be capable of swiveling in at least one direction. If foot pad swivels in one direction only, it shall be in a plane normal to the axis of the apparatus.

7-2.5.3 Where jacks depend upon an I-beam or other structural member to carry the weight of the ladder, portions of the truck, and live loads incident to fire fighting operations, the I-beam or structural member shall be of ample strength to carry the load without bending, twisting, or other failure. Where axle jacks or locks are also provided to secure the tractor frame to the tractor rear axle below the ladder turntable, the jacks or locks shall be of a positive type which will operate on all types of terrain or gradients on which the truck may be called upon to perform.

7-2.6 Elevation, Rotation, and Extension Controls.

7-2.6.1 A control for elevating the ladder out of its bed to the maximum angle of elevation and returning it shall be provided at the operator's position. This control shall be arranged to permit the operator to regulate the speed of elevation within safe limits determined by the manufacturer. A manual or other positive locking device shall be provided so that the desired angle of elevation can be maintained indefinitely without dependence upon engine power.

7-2.6.2 Controls for rotating the turntable 360 degrees in either direction shall be arranged to permit the operator to regulate the speed of rotation within limits determined by the manufacturer. The turntable shall be fitted with strong friction or other positive locking device so as to retain it in any desired position. Suitable indicators, clearly visible at night, shall be provided to facilitate correct alignment of the turntable with the ladder bed.

7-2.6.3 Controls shall be installed at the operator's position for extending the fly sections of the aerial ladder to any desired height between the fully retracted and fully extended positions; the same control may also be used to retract the sections. Safety provisions shall prevent damage at full retraction or extension. Provisions shall be made so that, in the event of failure of extension mechanism during operation, the descent of the ladder shall be kept at a speed which will prevent damage to the ladder structure or danger to personnel. Stops shall be provided to properly align the sections without damage to the ladder or the cable mechanism when the ladder is retracted.

7-2.6.4 A lock that controls ladder rung locks or pawls shall be provided at the base of the ladder adjacent to the operator's position to prevent movement of the sections when the power is shut off or in the event of loss of pressure in hydraulic circuits. This lock shall be arranged for use when aligning rungs. The control for the pawls shall be such that the on and off position may be clearly determined by the operator without it being necessary to see the pawls. To prevent damage to the ladder due to application of power when the pawls are locked, an automatic device shall be provided to prevent retraction of the ladder sections until the pawls have been released.

7-2.6.5 Auxiliary or supplemental controls shall include a hand wheel or crank with which the operator can manually rotate the ladder. If this is of a design that might cause injury if left in operating position when power is applied, a locking device shall be included which will prevent power operation of the turntable when the manual control is engaged. Manual controls shall be provided which will permit releasing of the pawls and retraction of the ladder in the event of power failure.

7-2.7 Angle of Elevation Indicator and Load Limit.

7-2.7.1 A device, clearly visible from the operator's position, shall be provided to indicate the angle of elevation of the ladder at all times. Either a load indicator or an instruction plate, visible from the operator's position, shall show the recommended safe load under existing conditions of ladder elevation and extension when the ladder is supported at the top, and when the ladder is supported at the base only (as with water tower operation). If automatic load limit controls are installed, provision shall be made for overriding the controls to obtain required extension in an emergency.

7-2.8 Engine Controls.

7-2.8.1 The engine speed shall be automatically regulated. A suitable engine throttle shall be provided and shall be governed to prevent operation of the ladder at excessive speeds.

7-2.8.2 Where hydraulic power is used for ladder operations, an oil pressure gage shall be provided at the ladder operator's position indicating the hydraulic pressure. The oil reservoir filler shall be so located as to be readily accessible for checking, conspicuously marked "Hydraulic Oil," and shall have a cap suitably secured.

7-3 Chassis.

7-3.1 General.

7-3.1.1 Either a single-chassis vehicle, i.e., a ladder

truck and engine on a common chassis, or a tractor-drawn vehicle shall be furnished.

7-3.2 Single Chassis.

7-3.2.1 On a single chassis, the aerial ladder turntable shall either be located immediately to the rear of the cab compartment or to the rear of the rear axle.

7-3.3 Tractor-Drawn Vehicles.

7-3.3.1 A tractor-drawn vehicle shall consist of a 4-wheel tractor with a suitable "fifth wheel" mounted upon the rear of the chassis to carry the forward end of the aerial ladder trailer unit.

7-3.3.2 A tiller wheel shall be provided to steer the rear wheels of the trailer unit. A windshield shall be provided for the tillerman and equipped with a power-operated constant speed windshield wiper.

7-3.3.3 Suitable seating shall be provided for the tillerman with adequate foot rest to provide leverage for steering. The tiller seat shall be so located as to provide good visibility and permit the tillerman to closely judge clearances on each side of the ladder trailer. There shall be a suitable signal, horn, or buzzer with control at the tiller seat to permit the tillerman to signal the driver.

7-3.3.3.1 Where an intercom system between tillerman and driver is desired, purchaser shall specify in the Special Provisions.

7-3.3.4 Where the tiller wheel arrangement is such that the wheel and spindle must be removed to raise the aerial or remove ground ladders, provisions shall be made that will prevent the replacement of the steering wheel and tiller seat until the spindle has been inserted.

Chapter 8 Provisions Applying to Apparatus Equipped with an Elevating Platform

8-1* Elevating Platform.

8-1.1 General.

8-1.1.1 A metal elevating platform device consisting of two or more booms or sections with a passenger carrying platform assembly shall be provided.

8-1.2 Height.

8-1.2.1 The nominal height of an elevating platform assembly shall be measured by a plumb line from the top surface of the platform to the ground, with the platform raised to its position of maximum elevation.

8-1.2.1.1 Purchaser shall specify the height desired in Special Provisions.

8-1.3 Operating Mechanism and Functions.

8-1.3.1 A power-operated raising and extending device shall be provided, so arranged that movement of the platform is rapid, smooth, and without undue sway or vibration. It shall be so designed, and provided with adequate power, to allow multiple movements of the elevating booms or sections simultaneously. All cables, if and where used, shall be securely attached and arranged with sufficient compensation to avoid undue stresses and strains.

8-1.3.2 A platform-leveling system shall be provided and so designed that the platform, together with its rated load, can be supported and maintained level in relation to the turntable regardless of the position of the booms or sections. Where the raising device includes moving cylinders or other external moving parts, these shall be arranged to provide adequate hand clearance or guards so as to prevent injury to operators or occupants of the platform.

8-1.3.3 A power-operated turntable shall be provided for revolving the platform and booms or sections, so arranged that it will rotate with little resistance. The mechanism of the turntable shall be so constructed that the booms or sections and platform can be rotated continuously clockwise and counterclockwise to enable the platform to be faced in any direction through 360 degrees.

8-1.3.4 The rotating mechanism shall provide sufficient power to rotate the platform in either direction while carrying the manufacturer's rated load and with the turret nozzle in operation at its rated capacity in any normal position of use.

8-1.4 Platform and Equipment.

8-1.4.1 The platform shall have a minimum floor area of 14 sq ft and shall be provided with a guard railing between 42 and 45 in. high on all sides. The railing shall be constructed so that there is no opening below it greater than 24 in. There shall be two gates below the top railing, each of which shall be provided with suitable safety latches. A kick plate not less than 4 in. high shall be provided around the floor of the platform. Drain openings shall be provided to prevent water accumulation on the platform. A heat-protective shield shall be provided on the platform for the protection of the operator. For elevating platform apparatus equipped with a ladder, either aerial or on a boom, the use of a parallelogram, vertical closing, gravity-type gate for ladder access to and from the platform may be considered as meeting the continuous railing intent of this section.

8-1.4.2 A permanently installed turret nozzle shall be provided on the platform, supplied by a water system incorporated with the booms or sections. The nozzle shall be equipped so as to allow the platform operator to control its rotation and elevation. The nozzle shall provide for rotation through at least 45 degrees either side of center, and for elevation and depression through at least 45 degrees above and below horizontal. A stop shall be provided to limit movement to 45 degrees above horizontal.

8-1.4.3* The water supply system shall be capable of delivering 750 gpm at the turret nozzle with a pressure loss of not more than 75 psi with the platform at max-

imum elevation. The system shall have a capability of withstanding 100 psig nozzle pressure while delivering the rated capacity of the turret nozzle. If a shut-off valve is provided at the basket, it shall be of a screw-operated type. The water supply shall be supplied at ground level through suitable piping with provision for at least three 2½-in. hose connections, or other sizes with equivalent capacity, with clappers in each inlet; a suitable pressure gage shall be provided at this point. Nozzle tips provided shall be 1⅜, 1½ and 1¾ in., and a spray nozzle of at least 500 gpm capacity. Tips shall have 2½-in. National (American) Standard fire hose coupling thread as specified in NFPA 1963, *Standard for Screw Threads and Gaskets for Fire Hose Connections.*

8-1.4.3.1 Where gated inlets are desired, purchaser shall specify in Special Provisions.

8-1.4.3.2 Where manually operated dump valve is desired, purchaser shall specify in Special Provisions.

8-1.4.3.3 Where outlets for hand hose lines are desired on the platform, the purchaser shall specify in Special Provisions. Where outlets for hand hose lines are provided, a screw-operated shut-off valve shall be installed on the turret nozzle.

8-1.4.4 A spotlight, of not less than 100,000 candlepower, shall be provided on the platform for the use of the operator. Suitable lighting shall be provided to illuminate the platform in any position of operation, affording visibility for the lower operator.

8-1.4.5 A two-way voice communication system shall be provided between the platform and the lower control station.

8-1.4.6 Where a plaster hook, or axe, or both, mounted accessible to the platform are desirable, purchaser shall specify in Special Provisions.

8-1.4.7 Where reflective material or other special treatment to make the platform, ground jacks, and the sides of the booms or sections more readily visible at night is desired, purchaser shall specify in Special Provisions.

8-2 Control Devices and Mechanisms.

8-2.1 General.

8-2.1.1 There shall be two control stations, one to be known as the platform control station, and the other as the lower control station where the lower operator shall stand. All elevation, extension, and rotation operational controls shall be operable from both of these positions. The control devices shall be grouped in a convenient manner on a pedestal or panel in both cases. The lower control station shall be such that the operator can easily observe the platform while operating the controls.

8-2.1.2 Control devices shall be clearly marked, suitably lighted, and arranged so that they cannot be moved accidentally.

8-2.2 Immobilization of Vehicle.

8-2.2.1 A suitable device shall be provided at the driver's position to lock driving wheels of the chassis at the wheel brake drums. Brake performance shall comply with the requirements of 2-3.1.

8-2.2.2 Four wheel chocks shall be provided.

8-2.3 Platform Boom or Section Bed Lock.

8-2.3.1 A lock shall be provided which will prevent action and movement of the retracted elevating platform booms or sections in their bed until the ground jacks are placed in position to stabilize the vehicle. The lock release or control shall be located at the driver's position or at the lower control station, or the release may be automatically performed when the controls required to transfer power from road drive to boom or section operation are activated, or when the ground jacks are lowered. A spring-return override control for the lock release shall be provided at the lower control station.

8-2.4 Stabilization of Vehicle.

8-2.4.1 Ground jacks shall be provided on each side of the apparatus with the widest practicable spread between their feet when in operating position. When extendible ground jacks are provided, these shall be arranged so that they may be used simultaneously on both sides of the apparatus. Positive safety stops shall be provided to prevent overextension.

8-2.4.2 The ground contact area of each jack shall be not less than 140 sq in. and, in addition, foot plates of ample strength shall be provided with each jack, capable of increasing the ground contact area of each jack to not less than 575 sq in. The jack foot pad shall be capable of swiveling in at least one direction. If foot pad swivels in one direction only, it shall be in a plane normal to the axis of the apparatus.

8-2.4.3 Any I-beam or other structural member through which the jacks carry the weight of the booms or sections, portions of the truck, and live loads incident to fire fighting operations shall be of ample strength to carry these loads without evidence of bending, twisting, or other failure.

8-2.5 Platform Operating Controls.

8-2.5.1 Controls for elevation of the platform booms or sections out of their bed, extending them to their maximum elevation and returning them to their bed, shall be provided at both the lower control station and the platform control station. These controls shall be arranged to permit the operator to regulate the speed of these operations within safe limits as determined by the manufacturer. A manual or other positive locking device shall be provided so that the desired angle of elevation can be maintained indefinitely without dependence upon engine power.

8-2.5.2 Provisions shall be made to prevent damage at full retraction or extension. Provisions shall be made that, in the event of failure of any extending mechanism during operation, the gravity descent of the platform shall be kept at a speed which will prevent damage to the equipment or danger to personnel. Stops shall be provided, if necessary, to properly align the booms or sec-

tions without damage to the equipment when the platform is retracted.

8-2.5.3 Controls for rotating the turntable 360 degrees in either direction shall be provided and arranged so as to permit either the platform control operator or the lower control operator to regulate the speed of rotation within safe limits as determined by the manufacturer.

8-2.5.4 The turntable shall be so designed that it may be retained in any position while the turret nozzle is in operation.

8-2.5.5 Suitable indicators, clearly visible at all times, shall be provided to facilitate correct alignment of the turntable with the bed of the booms or sections.

8-2.5.6 Provision shall be made so that, in the event of failure of the normal operating power source, an auxiliary source of power shall be readily available.

8-2.5.7 A control or device shall be provided at both the lower control station and the platform control station to allow either operator to completely deactivate the platform controls. During deactivation of the platform controls, the lower controls shall remain operable.

8-2.6 Engine Controls.

8-2.6.1 If the engine speed is not automatically regulated or predetermined, a suitable engine throttle shall be provided at the lower control station, but shall be limited so as to prevent operation of the platform at excessive speeds.

8-2.6.2 Where hydraulic power is used, a pressure gage shall be provided in the hydraulic system. The oil reservoir filler shall be so located as to be readily accessible for checking, conspicuously marked "Hydraulic Oil," and shall have a cap suitably secured.

8-2.6.3 A visual or audible signaling device shall be provided at the driver's position to indicate when the power take-off (PTO) mechanism is engaged.

8-3 Load Limitations.

8-3.1 General.

8-3.1.1 Either load indicators or instruction plates located at both control stations shall show the recommended safe load of the platform.

8-3.1.2* The platform shall be capable of carrying its rated load safely in any position of operation. Positive stops shall be provided to limit platform travel to those positions of operation recommended by the manufacturer. The minimum payload capacity of the platform shall be 700 lb. The weight of the turret nozzle and tips shall not be considered part of the rated payload.

8-3.2 Turret Nozzle Operation.

8-3.2.1 The apparatus shall be so designed that when using the turret nozzle with a 1¾-in. tip, regardless of the position of the platform and the direction of the stream, the equipment can be safely operated while discharging water at the rate of 750 gpm.

Chapter 9 Provisions Applying to Apparatus Equipped with a Water Tower

9-1* Water Tower Apparatus.

9-1.1 General.

9-1.1.1 A water tower shall consist of a metal elevating tower of two or more beams or sections equipped with a water tower nozzle capable of providing a large capacity mobile and elevated stream.

9-1.2 Height and Horizontal Reach.

9-1.2.1 The nominal height of a water tower assembly shall be measured by a plumb line from the discharge end of the nozzle to the ground, with the nozzle raised to its position of maximum elevation. The horizontal reach of the water tower nozzle shall be the distance from the center of the turntable or pedestal to the end of the nozzle with the assembly fully extended at right angles to the apparatus.

9-1.2.1.1 Purchaser shall specify the height and reach desired in Special Provisions.

9-1.3 Operating Mechanism and Functions.

9-1.3.1 A power-operated raising and extending device shall be provided, arranged so that movement of the assembly and nozzle is rapid, smooth, and without undue sway or vibration. It shall be designed, and provided with adequate power, to allow multiple movements of the elevating booms or sections. All cables and hydraulic circuits, if and where used, shall be securely attached and arranged with sufficient compensation to avoid undue stresses and strains. Where provided for controlling the nozzle, hydraulic circuits shall be protected or shielded against the effect of extremes in temperatures encountered in fire fighting.

9-1.3.2 A power-operated turntable or pedestal shall be provided for revolving the booms or sections to direct the nozzle in the desired direction, and arranged so that it will rotate with little resistance. The mechanism of the turntable or pedestal shall be constructed so that the booms or sections carrying the nozzle can be rotated continuously clockwise and counterclockwise to enable the nozzle to be faced in any direction through 360 degrees.

9-1.3.3 The mechanism shall be provided with sufficient power and stability to rotate the tower with the turret nozzle in operation at its rated capacity in any normal position of use.

9-1.3.4 The apparatus shall be designed so that, when discharging water at the rated capacity of the unit, the equipment can be operated safety regardless of the position of the tower and the direction of the stream.

9-1.4 Tower and Equipment.

9-1.4.1 A permanently installed nozzle shall be provided at the top of the tower and supplied by a permanent water system. The nozzle shall be equipped so as to allow the operator to control its rotation and elevation. The nozzle, as distinct from the supporting boom, shall

provide for rotation through at least 45 degrees either side of center. The nozzle and boom shall provide for elevation and depression of the nozzle through at least 45 degrees above and below horizontal. If a variable flow and variable pattern spray nozzle is provided on the tower, a control shall be provided at the operator's pedestal to permit selection of the desired stream pattern and flow.

9-1.4.1.1 Where facilities for discharging foam from the tower are desired, purchaser shall specify in Special Provisions.

9-1.4.1.2 If salt water is to be used in the system, purchaser shall specify in Special Provisions.

9-1.4.2 The water supply system shall be capable of delivering 750 gpm to the tower nozzle with a pressure loss of not more than 75 psi with the tower at maximum elevation. The system shall have a capability of withstanding 100 psig pressure at the nozzle while delivering the rated capacity of the water tower. The water supply system shall be supplied by suitable piping with sufficient capacity to handle the specified flow. Not less than three 2½-in. hose connections, or other sizes with equivalent capacity, with clappers in each inlet shall be provided for supplying the apparatus. If apparatus is equipped with a fire pump, it shall be connected to the water tower and be capable of discharging 750 gpm through the tower nozzle.

9-1.4.2.1 Where gated inlets are desired, purchaser shall specify in Special Provisions.

9-1.4.3 A suitable pressure gage shall be installed at the control pedestal to indicate the water pressure at the base of the tower or the lower boom section.

9-1.4.4 Nozzle tips provided shall be 1⅜, 1½, and 1¾ in., and a spray nozzle of at least 500 gpm capacity. Where a variable flow spray nozzle capable of discharge range of between 500 and 1000 gpm is provided, these additional tips need not be furnished.

9-1.4.5 A spotlight, of not less than 100,000 candlepower, shall be provided on the apparatus by which the operator may observe the effect of the stream.

9-2 Control Devices and Mechanisms.

9-2.1 General.

9-2.1.1 A control station shall be provided for the water tower operator at or adjacent to the turntable. The control devices shall be grouped in a convenient manner on a pedestal or panel. The control station shall be such that the operator easily can observe the boom and nozzle while operating the controls.

A platform shall be provided at the control station as part of the apparatus, for the operator to stand on while operating the tower, to help avoid possible electric shock in case of apparatus contact with live electrical lines.

9-2.1.2 Control devices shall be clearly marked, suitably lighted, and arranged so that they may not be moved accidentally.

9-2.1.3 A suitable device shall be provided at the driver's position to lock driving wheels of the chassis at the wheel brake drums. Brake performance shall comply with the requirements of 2-3.1.

9-2.1.4 Four wheel chocks shall be provided.

9-2.1.5 Ground jacks shall be provided on each side of the apparatus with widest practicable spread when in operating position. Ground jacks shall be arranged so that they may be used simultaneously on both sides of the apparatus with due compensation for normal differences in ground level. Positive safety stops shall be provided to prevent overextension. The ground contact area of each jack shall not be less than 140 sq in. and, in addition, foot plates of ample strength shall be provided with each jack capable of increasing the ground contact area of each jack to not less than 320 sq in. The jack foot pad shall be capable of swiveling in at least one direction. If foot pad swivels in one direction only, it shall be in a plane normal to the axis of the apparatus.

9-2.1.6 Any structural member through which the jacks carry the weight of the booms or sections, portions of the truck, and live loads incident to fire fighting operations shall be of ample strength to carry these loads without evidence of bending, twisting, or other failure.

9-2.2 Water Tower Operating Controls.

9-2.2.1 Controls for elevation of the water tower booms or sections out of their bed, extending them to their maximum elevation and vertical reach, and returning them to their bed shall be provided at the control station. These controls shall be arranged to permit the operator to regulate the speed of these operations within safe limits as determined by the manufacturer. A manual or other positive locking device shall be provided so that the desired angle of elevation can be maintained indefinitely without dependence upon engine power.

9-2.2.2 Provision shall be made to prevent damage at full extension or retraction. Provision shall be made, that, in the event of failure of any extending mechanism, the gravity descent of the water tower shall be kept at a speed which will prevent damage to the equipment or danger to personnel. Stops shall be provided to properly align the booms or sections without damage to the equipment when the water tower is retracted.

9-2.2.3 Controls for rotating the turntable 360 degrees in either direction shall be provided and arranged so as to permit the operator to regulate the speed of rotation within safe limits as determined by the manufacturer.

9-2.2.4 The turntable shall be so designed that it may be retained in any position unattended when the turret nozzle is in operation.

9-2.2.5 Suitable indicators, clearly visible at all times, shall be provided to facilitate correct alignment of the turntable with the bed of the booms or sections.

9-2.2.6 Provision shall be made so that, in the event of failure of the normal operating power source, an aux-

iliary source of power shall be available to permit operation of the water tower in any of its normal operating positions.

9-2.3 Engine Controls.

9-2.3.1 If the engine speed is not automatically regulated or predetermined, a suitable engine throttle shall be provided at the control station. It shall be governed to prevent operation of the water tower at excessive speeds.

9-2.3.2 Where hydraulic power is used, the oil reservoir filler shall be located so as to be readily accessible for checking, conspicuously marked "Hydraulic Oil," and shall have a cap suitably secured.

9-2.3.3 Positive stops shall be provided to limit boom or section travel to those positions of operation determined as safe by the manufacturer.

9-2.3.4 A visual or audible signaling device shall be provided at the driver's position so as to indicate when the power take-off (PTO) mechanism is engaged.

Chapter 10 Equipment for Various Types of Apparatus

10-1 General.

10-1.1* Each section of this chapter lists that equipment which shall be provided with each piece of apparatus, and additional equipment that may be carried.

10-1.2 If no list of equipment is attached by the purchaser, the manufacturer shall supply that equipment listed in Category A or the basic equipment for the particular type of apparatus being purchased.

10-1.3 The manufacturer shall provide such brackets and compartments as are necessary for the basic equipment and other equipment specified in Special Provisions. (*See also 2-3.3.4.*)

10-2* Equipment Carried on Pumpers.

10-2.1* Categories A and B list that equipment which shall be available on each piece of pumping apparatus. Equipment in Category A shall be supplied and mounted by the apparatus manufacturer unless otherwise directed by the purchaser.

Equipment in Category B shall be available on all pumpers before being placed in service. It may be supplied by the apparatus builder or it may be supplied by the fire department. In either case, a detailed listing of who is to supply items in Category B shall be supplied by the purchasing authority.

Category C lists additional equipment which the fire department may require to meet local conditions.

Category A:

Axe — flat head, 6 lb.

Axe — pick head, 6 lb.

Hose — booster, 200 ft of 1 in. on reel-equipped apparatus only.

Exception: Where different hose dimensions are desired, purchaser shall specify this in Special Provisions.

Hose — suction, hard or soft; type, size, and length to be specified.

Ladder — 14 ft with folding hooks.

Ladder — 24 ft 2-section extension ladder.

Nozzle — 1 in. shut-off, variable gallonage; 100 psi (reel-equipped only).

Pike Pole — or plaster hook, 6 ft.

Pike Pole — 8 ft or 10 ft; specify length.

Strainer — for hard suction hose size, if specified.

Category B:

Two portable hand lights with mounting brackets.

Two approved portable fire extinguishers with mounting brackets. The variety shall be suitable for use on Class B and C fires. The minimum sizes shall be 20 BC rating in dry chemical or 10 BC rating in CO_2. The number and type of portable fire extinguishers desired shall be specified by the purchaser in Special Provisions.

One 2½-gal or larger water extinguisher with bracket.

10-ft folding ladder with feet and mounting brackets.

One swivel connection with suction hose thread on one end and local large hydrant thread on the other.

Exception: Where large (over 4 in.) soft suction hose will be carried and where the ends mate with both apparatus and local hydrant threads, no adaptor will be required.

One swivel connection with pump suction threads on one end and local 2½-in. hose thread on the other.

Exception: Where a 4-in. or larger suction siamese, 2-or 3-way, is to be carried, this swivel connection is not required.

Four self-contained breathing apparatus (SCBA), positive pressure, NIOSH/MSHA approved, 30 minute or longer rated service life.

Four SCBA cylinders, spare, to fit current SCBA.

One first aid kit, minimum 24 units, mounted, fire department assortment.

Four combination spanners; two on each side of apparatus, with brackets.

Two hydrant wrenches, with brackets.

One double-gated reducing Leader wye, sized to fit hose used in department.

One double female, sized to fit hose used in department.

One double male, sized to fit hose used in department.

1200 ft 2½-in. or larger fire hose.

400 ft 1½-in., 1¾-in., or 2-in. fire hose.

Two combination fog nozzles, 200 gpm minimum.

Two combination fog nozzles, 95 gpm minimum. Two playpipes, each with shutoffs and 1-in., 1⅛-in., and 1¼-in. tips.

One rubber mallet, suitable for use on suction connections.

Category C:

Additional equipment that may be required to be carried on pumpers by the authority having jurisdiction in addition to that specified in Categories A and B.

One fire service claw tool.

One 16-in. or larger (5000 cfm or larger) smoke ejector. If electric driven, suitable adapter cord shall be sup-

plied to fit standard house "U" ground outlets and extension cords and outlets on generators used in fire department.

One crowbar (36 in. minimum) with brackets.

One pair, insulated bolt cutters with 7/16 in. minimum cut.

One Haligan type tool with brackets.

One 2½-in. hydrant valve (screw-type gate).

Four salvage covers.

Two shovels (1 square end and 1 scoop).

Four hose straps.

One 125-ft utility rope (not for lifeline work).

One 3000-watt (minimum) portable generator.

Two 500-watt portable lights.

Two cord reels with minimum 200-ft cord on each, connections compatible with lights, generator, and smoke ejector.

Two metal containers, minimum 5-gal capacity.

One portable pump.

Toolbox with hammers, wrenches, screwdrivers, and other assorted tools.

Master stream appliance; 1000 gpm minimum.

Foam equipment; 95 gpm minimum. Type of foam to be determined by local authorities.

One hose clamp.

10-3 Equipment Carried on Mobile Water Supply Apparatus.

10-3.1 Categories A and B list that equipment which shall be available on each mobile water supply apparatus. Equipment in Category A must be supplied and mounted by the apparatus manufacturer unless otherwise directed by the purchaser.

Equipment in Category B shall be available on all mobile water supply apparatus before being placed in service. It may be supplied by the apparatus builder or it may be supplied by the fire department. In either case, a detailed listing of who is to supply items in Category B shall be supplied by the purchasing authority.

Category C lists additional equipment which the fire department may require to meet local conditions.

Category A:

Axe — pick head, 6 lb.

Hose — suction, hard or soft; type, size and length to be specified. If hard suction hose is specified a minimum of 30 ft shall be carried on the vehicle.

Strainer — for hard suction hose size,if specified.

Category B:

One rubber mallet, 3 lb minimum, suitable for large suction connections.

One hydrant wrench with bracket.

Four combination spanners.

Four hundred ft 2½-in., or larger fire hose.

Four hundred ft 1½-in., 1¾-in., or 2-in. fire hose.

One double male connection.

One double female connection.

One combination fog nozzle, minimum 200 gpm.

One combination fog nozzle, minimum 95 gpm.

Two approved portable fire extinguishers with mounting brackets. The variety shall be suitable for use on Class B and C fires. The minimum sizes shall be 20 BC rating in dry chemical or 10 BC rating in CO_2. The number and type of portable fire extinguishers desired shall be specified by the purchaser in Special Provisions.

Two SCBA, positive pressure NIOSH/MSHA approved, 30 minute or longer rated service life.

Two SCBA cylinders, spare for current SCBA.

Two portable hand lights with mounting brackets.

One first aid kit, minimum 24 unit mounted, fire department assortment.

Category C:

Ground ladder or ladders.

Pike pole.

Portable tank, 1000 gal minimum.

Two shovels.

One 125-ft utility rope, not for lifeline work.

Tool box with hammers, wrenches, screwdrivers, and assorted other tools.

Double-gated reducing wye, sized to fit hose used in the department.

Low level strainer, designed for use with portable tanks.

10-4* Equipment Carried on Ladder Trucks.

10-4.1* Basic equipment shall be provided as follows unless otherwise specified by purchaser.

Four SCBA, positive pressure, NIOSH/MSHA approved, 30 minute or longer rated service life.

Four SCBA cylinders, spare for current SCBA.

2 pick-head axes (6 lb).

2 flat-head axes (6 lb).

2 crowbars, 50-in. minimum.

1 claw tool.

2 approved portable fire extinguishers. The variety shall be suitable for use on Class A, B, and C fires. The minimum sizes shall be 20 BC rating in dry chemicals, 10 BC rating in CO_2, and 2 A rating in water-type extinguishers. The number and type of portable fire extinguishers desired shall be specified by the purchaser in the Special Provisions. (*See NFPA 10, Standard for Portable Fire Extinguishers.*)

4 electric hand lights, 6-volt dry cell or 4-volt wet cell minimums.

2 6-ft pike poles.

2 8-ft pike poles.

2 12-ft pike poles.

2 scoop shovels.

2 shovels, plain.

125 ft rope, ⅝-in. diameter, the grade to be specified by the purchaser in Special Provisions.

125 ft rope, ¾-in. diameter, the grade to be specified by the purchaser in Special Provisions.

4 pompier belts.

10-4.1.1 The following list of metal ladders shall apply in addition to the requirements of 10-4.1. Ladders shall conform to the requirements of NFPA 1931, *Standard on Design, and Design Verification Tests for Fire Department Ground Ladders*. Ladders over 20 ft shall be truss type. Lengths shall be measured when extended and shall not be the simple sum of the lengths of the sections. Widths shall be consistent with lengths, and extension ladders shall have pawls.

1 40-ft extension ladder.

1 35-ft extension ladder.

1 28-ft extension ladder.

1 20-ft single ladder with folding roof hooks.
1 16-ft single ladder with folding roof hooks.
1 14-ft extension ladder.
1 10-ft collapsible ladder.

Exception No. 1: Where wood ladders are desired, purchaser shall specify in Special Provisions.

Exception No. 2: Where ladders over 20 ft are to be solid side type, purchaser shall specify in Special Provisions.

10-4.1.2 If apparatus is equipped with an aerial ladder, the following equipment shall be provided in addition to the requirements of 10-4.1.1:

1 ladder pipe suitable for quickly attaching to ladder with 1¼-, 1⅜-, 1½-in. tips.
100 ft of 3-in. double jacket, rubber lined fire hose, coupled.
1 2-inlet valved siamese with ⅜-in. minimum diameter drain (2 female, 1 male connections).
1 gated shut-off valve for male outlet on siamese.

Exception No. 1: Where 3 inlet clappered siamese or different size is desired, purchaser shall indicate in Special Provisions.

Exception No. 2: Where other size and length of lead hose is desired, purchaser shall indicate in Special Provisions.

10-5 Equipment Carried on Pumper-Ladder Trucks.

10-5.1 Basic equipment which shall be provided, unless otherwise specified by purchaser in Special Provisions, shall be that specified in both 10-2.1 and 10-4.1. Where number of items of equipment differ, the larger number shall be required.

10-6 Equipment Carried on Salvage Trucks.

10-6.1 The following is a list of basic tools and equipment which shall be carried on salvage trucks:

1 box sprinkler equipment containing:
12 standard sprinkler heads (assorted temperatures and types).
6 sprinkler stoppers or wedges.
1 set sprinkler head wrenches for the types of heads carried.
1 box assorted pipe plugs and caps.
3 stillson wrenches, 10-, 14-, 16-in. sizes.
2 monkey wrenches.
20 salvage covers.
2 floor runners, 3 by 18 ft.
1 roll 15-lb tar paper or plastic sheeting, at least 8 mil.
4 brooms.
4 mops.
2 mop wringers, with buckets.
1 water vacuum cleaner.
6 18-in. squeegees with handles.
3 scoop shovels.
1 submersible pump.
2 10-ft metal ladders with folding roof hooks.
2 8-ft pike poles.
125 ft rope, ½-in. diameter, the grade to be specified by the purchaser in Special Provisions.
125 ft rope, ⅝-in. diameter, the grade to be specified by the purchaser in Special Provisions.
2 axes (6 lb).
1 crowbar, 36-in. minimum.
2 pinch bars.
2 sledge hammers.
3 claw hammers.
1 box of assorted nails.
2 padlocks, keys and hasps.
1 heavy-duty stapler.
4 assorted hand saws.
1 power saw (chain or heavy-duty rotary type).
1 smoke ejector, 5000 cfm minimum capacity.
1 electric generator of at least 2500 watt rating.

Exception: Where generator is not portable, additional wire cable is desirable. If built-in wire connections are made to receptacles on the truck, a 3-wire system is recommended with either portable or fixed generator.

3 portable floodlights (500 watt).
5 50-ft lengths of cable with locking-type connectors 14-3 gage or heavier.
3 pigtail ground adapters, 2-wire to 3-wire 14-3 gage or heavier with 12-in. minimum length.
2 100-ft lengths of cable with locking-type connectors.
2 electric hand lights, 6-volt dry cell or 4-volt wet cell minimums.
1 first aid kit (24-unit fire department assortment).
2 approved portable fire extinguishers. The variety shall be suitable for use on Class A, B, and C fires. The minimum sizes shall be 20 BC rating in dry chemicals, 10 BC rating in CO_2 and 2 A rating in water-type extinguishers. (*See NFPA 10, Standard for Portable Fire Extinguishers.*)
1 roll heavy-duty cellophane tape, 2-in. width.
1 deodorizer unit, power operated.
2 SCBA, positive pressure, NIOSH/MSHA approved, 30 minute or longer rated service life.
2 SCBA cylinders, spare for current SCBA.

10-7 Equipment Carried on Light Attack Vehicles.

10-7.1 Basic equipment for light attack vehicles shall be provided as follows unless otherwise specified by purchaser:

1 pick-head axe, 6 lb.
1 electric hand light, 6-volt dry cell or 4-volt wet cell minimum.
1 approved portable fire extinguisher, Class ABC, 10 lb or equal rating.
1 pike pole or plaster hook (6 ft minimum).
2 SCBA, positive pressure, NIOSH/MSHA approved, 30 minute or longer rated service life.
2 SCBA cylinders, spare for current SCBA.

Chapter 11 Acceptance Tests and Requirements

11-1 Road Tests — All Apparatus.

11-1.1 Acceptance Procedure.

11-1.1.1 Acceptance tests, on behalf of the purchaser, shall be as prescribed and conducted prior to delivery, or within ten days after delivery, by the manufacturer's representative in the presence of such person or persons as

the purchaser may designate in the requirements for delivery.

11-1.1.2* The apparatus loaded with a full complement of hose and men, a full water tank, and equipment allowances as specified in 2-1.4 shall meet the tests on dry paved roads in good condition. The tests shall consist of two runs, in opposite directions over the same route; and the engine shall not be operating in excess of the maximum no load-governed speed.

11-1.2 Tests.

11-1.2.1 From a standing start, through the gears, the vehicle shall attain a true speed of 35 mph within 25 sec in the case of pumpers, and a true speed of 35 mph in 30 sec in the case of apparatus carrying over 800 gal of water or apparatus equipped with aerial ladders or elevating platforms.

11-1.2.2* From a steady speed of 15 mph the vehicle shall accelerate to a true speed of 35 mph within 30 sec. This shall be accomplished without moving gear selector.

Exception: Where apparatus is designed for service involving long runs at steady speed or is a mobile water supply apparatus, this requirement may be waived or modified.

11-1.2.3 The vehicle shall attain a top speed of not less than 50 mph, or a higher speed as may be specified by the purchaser in the Special Provisions.

11-1.2.4 The vehicle shall demonstrate ability to comply with the requirements of 2-3.1.5.

11-2 Acceptance Requirements. This section applies only to apparatus equipped with a fire pump as specified in Chapter 3 of this standard.

11-2.1 Tests Performed by the Manufacturer.

11-2.1.1 The fire pump on the completed vehicle shall be thoroughly run in by the manufacturer before being delivered, by operating for a minimum of 2 hr at draft delivering rated capacity of 150 psi net pump pressure for at least 1 hr, 70 percent of rated capacity at 200 psi net pump pressure for at least ½ hr and 50 percent of rated capacity at 250 psi net pump pressure for at least ½ hr.

11-2.1.2 All pumps shall be hydrostatically tested by the pump manufacturer for 10 min at a pressure not less than 350 psig.

11-2.1.2.1 Two-stage series-parallel pumps shall be tested either hydrostatically or hydrodynamically by the pump manufacturer at a discharge pressure of 500 psig.

11-2.2 Certification Tests.

11-2.2.1 Conditions for Test.

11-2.2.1.1 The test site shall be adjacent to a supply of clear water at least 4 ft deep, with the water level not more than 10 ft below the center of the pump suction inlet, and close enough to allow the suction strainer to be submerged at least 2 ft below the surface of the water when connected to the pump by 20 ft of suction hose.

11-2.2.1.2 Pumper tests shall be performed when conditions are as follows:

Air Temperature:	0°F to 100°F
Water Temperature:	35°F to 90°F
Barometric Pressure:	(corrected to sea level) 29 in. Hg, minimum

11-2.2.1.3 Engine driven accessories shall not be functionally disconnected or otherwise rendered inoperative during the tests.

11-2.2.1.4 All structural enclosures such as floorboards, gratings, grills, heat shields, etc. not furnished with a means for opening them in normal service shall be kept in place during the tests.

11-2.2.2 Equipment.

11-2.2.2.1 Suction hose shall be of the appropriate size for the rated capacity of the pumper (*see 3-1.2.2*).

11-2.2.2.2 A suction strainer which will allow flow with total friction and entrance loss not greater than that specified in 3-1.2.2 of this standard shall be provided.

11-2.2.2.3 Sufficient fire hose shall be provided to allow discharge of rated capacity to the nozzles or other flow measuring equipment without exceeding a flow velocity of 35 ft per sec (approximately 500 gpm for 2½-in. hose).

11-2.2.2.4 Where nozzles are used they shall be smoothbore; inside diameters shall be from ¾ in. to 2½ in. Pitot tubes if used shall be approved by the authority having jurisdiction. Other equipment such as flow meters, volumetric tanks or weigh tanks used for measuring the flow shall be approved by the authority having jurisdiction.

11-2.2.2.5 All gages shall conform with ANSI B40.1, Grade A, and shall be at least 3½ in. in diameter. The suction gage shall have a range of 30 in. Hg vacuum to zero for a vacuum gage, or 30 in. Hg vacuum to 150 psig for a compound gage. The discharge pressure gage shall have a range of zero to 400 psig. Pitot gages shall have a range of zero to 160 psig. A mercury manometer may be used in lieu of a suction gage. All gages shall have been calibrated within the week preceding tests. Calibrating equipment shall consist of a dead weight gage tester or a master gage meeting ANSI B40.1 or B40.1M Grade 3A or 4A calibrated by its manufacturer within the preceding year.

11-2.2.2.6 All gage connections shall include "snubbing" means, such as needle valves to damp out rapid needle movements.

11-2.2.2.7 Speed measuring equipment shall consist of either a tachometer, measuring revolutions per minute, or a revolution counter and stop watch. When a tachometer is used, it shall be of a type approved by the authority having jurisdiction. When a revolution counter and stop watch are used, the stop watch shall be equipped with a full sweep second hand or shall be of a digital reading type. All speed measurements shall be taken at the checking shaft outlet (*see 3-3.4.8*).

11-2.2.2.8 Where tests are performed inside a structure or elsewhere having limited air circulation, carbon monoxide monitoring equipment shall be used. Such equipment shall be checked and calibrated regularly and shall include a suitable warning device.

11-2.2.3* Procedure.

11-2.2.3.1* The ambient air temperature, water temperature, vertical lift, elevation of test site, and atmospheric pressure (corrected to sea level) shall be determined and recorded prior to and after each pumper test. The engine, pump, transmission and all parts of the apparatus shall exhibit no undue heating, loss of power, overspeed, or other defect during the entire test.

11-2.2.3.2* With the pumper set up for the pumping test the primer shall be operated in accordance with the manufacturer's instruction until the main pump has been primed and is discharging water, and the interval from the time the primer was started until the time the main pump is discharging water noted.

The time required to prime the main pump if rated capacity is 1250 gpm or less as determined by the priming time test shall not exceed 30 sec; if rated capacity is 1500 gpm or more the time to prime shall not exceed 45 sec.

The pumper shall be subjected to a 3-hr pumping test consisting of 2 hr of continuous pumping at rated capacity at 150 psi net pump pressure, followed by ½ hr pumping 70 percent of rated capacity at 200 psi net pump pressure and ½ hr pumping 50 percent of rated capacity at 250 psi net pump pressure. The pump shall not be stopped until after the 2-hr test at rated capacity unless it becomes necessary to clean the suction strainer. The pump may be stopped between tests to allow changing hose and/or nozzles, and to clean strainer, and once during the 3-hr period, preferably immediately following the 2-hr test at rated capacity, to add fuel.

The capacity, discharge pressure, suction pressure, and engine speed shall be recorded at least every 15 min. Average net pump pressure shall be calculated and recorded based on average values for discharge and suction pressure.

11-2.2.3.3 The pumper shall be subjected to an overload test consisting of pumping rated capacity at 165 psi net pump pressure for at least 10 min. If desired, this test may be performed immediately following the 2-hr segment of the pumping test of rated capacity at 150 psi.

The capacity, discharge pressure, suction pressure, and engine speed shall be recorded once during the overload test.

11-2.2.3.4 The pressure control device shall be tested as follows:

(a) Pump shall be operated at draft.

(b) With pump delivering rated capacity at 150 psig discharge pressure, the pressure control device shall be set in accordance with the manufacturer's instructions to maintain discharge pressure at 150 psig.

(c) All outlet (discharge) valves shall be closed no more rapidly than in five sec time and the rise in discharge pressure noted.

(d) After the original conditions have been reestablished, pumping rated capacity at 150 psig, the discharge pressure shall be reduced to 90 psig by throttling the engine fuel supply, with no change to the discharge valve settings, hose, or nozzles.

(e) The pressure control device shall be set according to the manufacturer's instructions to maintain 90 psig discharge pressure.

(f) All discharge valves shall be closed no more rapidly than in five sec time and the rise in discharge pressure noted.

(g) The pump shall be operated at draft pumping 50 percent of rated capacity at 250 psig discharge pressure.

(h) The pressure control device shall be set in accordance with the manufacturer's instructions to maintain 250 psig discharge pressure.

(i) All discharge valves shall be closed no more rapidly than in five sec time and the rise in discharge pressure noted.

The rise in discharge pressure noted for each phase of the pressure control test, at 150 psig, 90 psig, and 250 psig, shall not exceed 30 psi, and shall be recorded.

11-2.2.3.5 Where a water tank of 300 gal or larger capacity is furnished, the flow rate shall be checked as follows (*see 6-1.2.3*).

(a) The water tank shall be filled until it overflows.

(b) All inlets to the pump shall be closed.

(c) The tank fill line and/or by-pass cooling line shall be closed.

(d) Hose lines and nozzles suitable for discharging water at the required tank-to-pump flow rate shall be connected to one or more discharge outlets.

(e) The tank-to-pump valve and the discharge valves leading to the hose lines and nozzles shall be fully opened.

(f) The engine throttle shall be adjusted until the required flow rate -0, + 5 percent is established. The discharge pressure shall be recorded.

(g) The discharge valves shall be closed and the water tank refilled. The by-pass line may be opened temporarily if needed to keep the water temperature within acceptable limits.

(h) The discharge valves shall be reopened fully, and the time noted. If necessary the engine throttle shall be adjusted to maintain the discharge pressure recorded as noted in (f).

(i) When the discharge pressure drops by 5 psi or more, the time shall be noted and the elapsed time from the opening of the discharge valves calculated and recorded.

The required tank-to-pump flow rate shall be maintained until 80 percent of the tank volume has been discharged. The volume discharged shall be calculated by multiplying the rate of discharge in gpm times the time in minutes elapsed from the opening of the discharge valves until the discharge pressure drops by at least 5 percent.

11-2.2.3.6 A test shall be conducted to check the pressure loss in the discharge system (*see 3-2.2.5.4*). The test shall consist of discharging rated capacity through

any combination of outlets so that the rates of flow through any outlet used is not in excess of the values shown below:

Size, in.	Max. Flow Rate, gpm
2½	275
3	400
3½	525
4	650
4½	775
5	1025

The pressure at any outlet shall be above the limit specified in 3-2.2.5.4.

Exception No. 1: When the rated capacity of the pump is 1000 gpm or larger, the pressure shall be checked only at any combination of outlets whose total flow is 1000 gpm.

Exception No. 2: If an outlet is connected to the pump through a foam liquid (or other additive) proportioning device, the pressure at that outlet shall be at least equal to the pump discharge pressure less 28 psi.

Exception No. 3: This test may be omitted if the pump manufacturer has certified that the discharge system furnished will comply with the requirements of 3-2.2.5.4.

11-2.2.3.7 With all openings to the pump closed, the primer shall be operated in accordance with the manufacturer's instructions. The maximum vacuum attained shall be at least 22 in. Hg. At altitudes above 1000 ft, the vacuum attained may be less than 22 in. Hg by 1 in. per 1000 ft altitude above 1000 ft.

11-2.2.3.8* A vacuum test shall be performed and shall consist of subjecting the interior of the pump, with capped suction and uncapped discharge outlets, to a vacuum of 22 in. Hg by means of the pump priming device. The vacuum shall not drop more than 10 in. Hg in 5 min. The primer shall not be used after the 5 min test period has begun. The engine shall not be operated at any speed greater than the no-load governed speed during this test.

11-2.3 Data Required of the Manufacturer.

11-2.3.1 The manufacturer shall supply, at the time of delivery, at least one copy of:

(a) Engine manufacturer's certified brake horsepower curve for the engine furnished showing the maximum no-load governed speed.

(b)* Manufacturer's report of pumper construction details.

(c) Pump manufacturer's certification of suction capability.

(d) Pump manufacturer's certification of hydrostatic test.

(e)* The certification of inspection for fire department pump by a testing organization approved by the authority having jurisdiction.

11-2.3.2 The manufacturer shall supply the pump manufacturer's certification that the discharge system losses meet the requirements of 3-2.2.5.4, if the certification test did not include the discharge system loss test described in 11-2.2.6 of this standard.

11-2.3.3 A test plate shall be provided at the pump operator's position which gives the rated discharges and pressures together with the speed of the engine as determined by the manufacturer's test for each unit, the position of parallel-series pump as used, and the no-load governed speed of the engine as stated by the engine manufacturer on a certified brake horsepower curve. The plate shall be completely stamped with all information at the factory and attached to the vehicle prior to shipping.

11-2.4 Tests on Delivery.

11-2.4.1 If a pump test, conducted by the manufacturer, is desired at the point of delivery, this test shall be run in accordance with those provisions of 11-2.2 that the purchaser specifies.

11-2.4.1.1* Where the point of delivery is over 2000 ft of elevation, the overload test described in 11-2.2.2 may be performed to ensure that the engine will develop adequate power at point of delivery. This test may be performed with the pumper supplied from a suitable fire hydrant, or at draft, with the net pressure maintained at 165 psi. The net pressure, when the pumper is supplied from a hydrant with positive suction pressure, may be calculated by the following formula:

where $P = D - S$
P = net pump pressure, psi
D = discharge pressure, psig
S = suction pressure, psig.

11-2.4.1.2 When a test at delivery is desired, purchaser shall specify in Special Provisions.

11-3 Tests — Booster Pump.

11-3.1 Manufacturer's Tests.

11-3.1.1 Booster pump discharge chamber and discharge connections shall be tested by the pump manufacturer for 10 min at a pressure of 100 psi in excess of the maximum rated pressure.

11-3.2 Tests on Delivery.

11-3.2.1 A pump test, conducted by the manufacturer, may be desired at the point of delivery. Pumping tests shall prove the following: capacity and pressure, 5-1.1.2; engine capability, 5-1.2.1; suitability of pump controls, 5-3.2; engine controls, 5-3.3; and suction capability, 5-1.1.3(i) if applicable.

11-3.2.1.1 When a test at delivery is desired, purchaser shall specify in Special Provisions.

11-4 Tests — Piping and Tank Capacity.

11-4.1 Tank-to-Pump Flow Capability.

11-4.1.1 A tank-to-pump flow test shall be conducted as specified in 11-2.2.8 of this standard.

11-4.2 Tank Capacity.

11-4.2.1 A test shall be conducted to determine if the water tank has at least the capacity specified.

11-5 Tests — Aerial Ladders.

11-5.1 The aerial ladder shall be designed and so powered that from a horizontal position it shall lift a weight of 200 lb on the free end of the main section of the ladder, in addition to any equipment mounted on the aerial ladder for which provision is specified.

11-5.2 The aerial ladder shall be tested in accordance with Chapter 2 of NFPA 1904, *Standard for Testing Fire Department Aerial Ladders and Elevating Platforms*.

11-5.3 A complete cycle of aerial ladder operation shall be carried out after starting the engine, setting the jacks, and transmitting power to the ladder. Elevating the ladder out of the bed, rotating ladder 90 degrees and extending ladder to full specified height shall be completed smoothly and without undue vibration in not over 60 sec. The ladder shall be retracted, the turntable rotation completed and the ladder lowered to its bed, after which a thorough inspection shall be made of all moving parts, with special attention being given to the security and adjustment of the ladder cables. The test shall include successful operation of all ladder controls.

11-6 Tests — Elevating Platforms.

11-6.1 Stability Test.

11-6.1.1 A test of the apparatus shall be performed to demonstrate that the platform and booms, or sections, are so designed and powered that, at maximum horizontal reach, a load representing 150 percent of the manufacturer's rated payload capacity can be placed on the platform and rotated a complete 360 degrees. This test shall be performed on firm level ground with the jacks firmly set.

11-6.2 Operational Tests.

11-6.2.1 After starting the engine, setting the jacks, and transmitting power to the platform booms or sections, a complete cycle of platform operation shall be carried out as follows: With one person operating the machine from the lower control station, raise the platform from a bedded position, extend to full specified height, and rotate through a 90-degree turn. This shall be completed smoothly and without undue vibration in not over 150 sec.

11-6.2.2 The platform shall then be retracted and lowered to its starting position, after which a thorough inspection shall be made of all moving parts, with special attention given to inspection of the platform leveling system.

11-6.2.3 The test specified in 11-6.2.1 shall be repeated, employing the controls at the platform control station.

11-6.2.4 The effectiveness of the lower control station override shall be tested.

11-6.3 Operation of Turret Nozzle and Water System.

11-6.3.1 The apparatus shall be set up to operate the turret nozzle to demonstrate its ability to comply with 8-1.4.2, 8-1.4.3, and 8-3.2.1.

11-7 Tests — Water Towers.

11-7.1 Operational Test.

11-7.1.1 After starting the engine, and transmitting power to the water tower booms or sections, a complete cycle of operation shall be carried out as follows: With one person operating the machine from the control station, raise the water tower, rotate through a 90-degree turn, and extend to full specified height. This shall be completed smoothly and without undue vibration in not over 105 sec. The tower shall then be retracted and lowered to its starting position, after which a thorough inspection shall be made of all moving parts.

11-7.2 Water Tower and System.

11-7.2.1 The apparatus shall be set up to operate the water tower nozzle and tested for its ability to comply with 9-1.3.3, 9-1.4.2 and 9-2.3.4.

11-8 Electrical Systems Testing.

11-8.1 The wiring connected to vehicle mounted generators and associated receptacles shall be subjected to a 1-min, 900-V dielectric voltage withstand test with any switches in the circuit(s) closed between live parts, including neutral and the vehicle frame. Alternatively, the test shall be permitted to be performed at 1080 V for 1 sec. This test shall be conducted after all body work has been completed.

11-8.2 Each fire apparatus vehicle incorporating a vehicle mounted generator, associated wiring, and receptacle(s) shall be subjected to the following:

(a) *Continuity Test.* An electrical continuity test to assure that all exposed electrically conductive parts are properly bonded.

(b) *Polarity Checks.* Electrical polarity checks of permanently wired equipment and receptacles connected to the vehicle mounted generator to determine that connections have been properly made.

Chapter 12 Referenced Publications

12-1* 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 shall be current as of the date of the NFPA issuance of this document.

12-1.1* NFPA Publications.

NFPA 10, *Standard for Portable Fire Extinguishers*, 1984

NFPA 70, *National Electrical Code*, 1984

NFPA 1904, *Standard for Testing Fire Department Aerial Ladders and Elevating Platforms*, 1980

NFPA 1921, *Standard for Fire Department Portable Pumping Units*, 1980

NFPA 1931, *Standard for Design and Design Verification Tests for Fire Department Ground Ladders*, 1984

NFPA 1961, *Standard for Fire Hose*, 1985

NFPA 1963, *Standard for Screw Threads and Gaskets for Fire Hose Connections*, 1985

12-1.2* ANSI Publication.

ANSI/UL 92, *Standard for Fire Extinguisher and Booster Hose*, 1982

12-1.3* Rubber Manufacturers Association (RMA).

RMA IP 12, *Standard for High Pressure Fire Engine Booster and Fire Extinguisher Hose*, 1979.

Appendix to Standard

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

Introduction

General. The purchase of new fire apparatus involves a major investment and should be treated as such. Fire apparatus is complex mechanical equipment which should not be purchased in a haphazard manner. The fire chief should consult the municipal attorney, engineer, and other appropriate officials for information pertaining to other specifications sections. Purchase should be made only after detailed study of the needs, taking into consideration other equipment the department may own or plan to buy.

This standard is designed for use in buying various types of apparatus including pumpers, mobile water supply apparatus, aerial ladders, and elevating platform equipment. The standard is designed to assure sound equipment capable of good performance, without inclusion of restrictive features. The tests are an important feature and should be required to assure that the completed apparatus will meet the specified performance.

Study of Apparatus Needs. An important step in buying apparatus is to study and determine the needs of the department. Competent advice should be obtained from knowledgeable and informed sources including experienced and capable fire chiefs, fire protection engineers, trade journals, training instructors, and maintenance personnel. The fire insurance rating authority should be consulted.

The equipment lists presented in this standard are related to the type of apparatus being considered. Since new apparatus must be fully equipped in order to provide effective service, this standard contemplates the provision of new equipment along with the apparatus. If some suitable equipment is already available within the department, provision of all new equipment may not be justified. Similar judgment is necessary when departmental operations involve auxiliary apparatus and two-piece companies. The Appendix to this standard should be used to assist in the evaluation and determination of a fire department's basic needs.

Compliance with Federal Standards. Since the passage of Public Law 89-563, the National Traffic and Motor Vehicle Safety Act of 1966, the Federal Government has adopted certain Motor Vehicle Safety Standards applicable to all manufacturers of trucks including fire trucks. It is unlawful for a manufacturer to deliver a truck not in compliance with these federal standards. These federal safety standards are frequently changed and their provisions make the incorporation of certain features and devices mandatory. Apparatus manufacturers face heavy penalties for infraction of these rules and therefore cannot accept specifications which would require them to perform unlawfully, or to delete required items or to include any that are illegal.

Additional requirements are placed on apparatus manufacturers and the engine manufacturers (both gasoline and diesel) which are based upon the Clean Air Act and enforced by the Environmental Protection Agency. These standards have resulted in major changes in the performance of many engines. Neither the engine manufacturer nor the apparatus manufacturer may modify engines once they are certified to EPA. The EPA standards often make mandatory the installation of larger engines than may have been previously used, in order to obtain the same apparatus performance.

As some types of fire apparatus are extremely complex and require long production lead times, Chapter 49 CFR, Part 571.8, of the federal regulations makes provision for the standards applicable at the time of contract to be those to which the vehicle shall comply at time of delivery provided delivery takes place within two years of contract. When a federal performance standard precludes practical application of a specification contained in the text of this standard, the former is expected to govern the manufacturer's compliance with this standard.

Writing the Specifications. This standard provides the basic technical section for purchasing fire apparatus. Fire apparatus manufacturers are expected to be familiar with the standard. Usually all that is required is to indicate which chapters or sections are to apply to the apparatus being purchased and to set forth the Special Provisions which will be a part of the specifications. It is recognized that many purchasers will desire additional features of operation over and above this basic standard.

Preparing Specifications. It is important to set a date for the formal opening of bids. This date should be far enough in advance for the engineering departments of apparatus manufacturers to study the specifications and estimate the cost of the apparatus. At least a month is recommended. More time may be required if engineering drawings of the proposed apparatus are required. Bidders should understand that the apparatus will be subjected to the performance tests outlined in this standard.

Many purchasers find it is desirable to provide for an interim inspection at the assembly plant of the successful bidder. The advantages of such a provision include the opportunity to evaluate construction prior to final assembly and painting. The specifications should detail particulars of such an inspection trip.

Studying the Proposals. Look for deviations from your specifications and obtain clarification where necessary. Discuss the financial arrangements. Be sure to have a stipulated delivery date. Obtain a written statement as to method of delivery, whether by rail or over the road.

Where the apparatus is to be equipped with a fire pump, the manufacturer should be required to furnish impartial verification of the capability of meeting purchase pumping specifications. Acceptance tests should be performed before the apparatus is accepted by the purchaser as meeting the specifications.

With a performance specification defining quality, it is usually possible to obtain more favorable bids since there is genuine competition and the specifications are not overly restrictive. Manufacturers' proposals may include amendments and exceptions. Frequently, these changes are offered to meet price requirements or because an individual manufacturer may prefer to build apparatus in a manner more convenient to him. If the intent of the original specification is not changed and the bid is favorable, the purchasing committee may accept these amendments with the approval of the fire chief. On the other hand, extreme care should be taken not to permit exceptions which merely devalue the apparatus and give a bidder an advantage.

If the purchaser has specifically provided for alternates when calling for bids, extra care must be exercised when evaluating proposals — combinations of complicated bid information can become a headache.

Awarding the Contract. Before signing a contract, make certain that the successful bidder has a complete and thorough understanding of the specifications. If any changes are agreed upon, these should be stated in writing and be signed by both parties. Be sure to have a positive understanding of every item since it is much better to reach an agreement in advance of signing the contract. When the chief and the purchasing body are satisfied, the contract should be signed, and not before.

Bidders should also understand that, prior to acceptance following delivery, the apparatus, loaded with water, hose, and equipment, will be weighed to verify compliance with gross vehicle weight rating and axle weight distribution.

Acceptance. Normally, the chief of the fire department (or a designated representative) is the acceptance authority, exercising this authority following satisfactory completion of tests and insepctions for compliance with purchase specifications.

Your Obligation. The fire department, whether paid or volunteer, tax or solicitation supported, has an obligation to the citizens it protects. This fact should be paramount when buying apparatus. The primary obligation is to provide apparatus which will best protect persons and property. A bargain-rate, ill-suited truck can be a waste of taxpayers' money and, if purchased for other than fire fighting utility, may give a false sense of security.

Appendix A

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

Advisory Statements. This Appendix presents advisory information as an assist in the development of the technical section of a complete specification for purchasing fire apparatus. These paragraphs are numbered to correspond with the paragraph numbers of the standard.

A-1-5.3 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.

A-1-5.4 The phrase "authority having jurisdiction" is used in NFPA standards in a broad manner since jurisdictions and "approval" agencies vary as to 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 delegated agent assumes the role of the "authority having jurisdiction"; at government installations, the commanding officer or departmental official may be the "authority having jurisdiction."

A-1-5.16 The means for identifying listed equipment may vary for each testing laboratory, inspection agency or other 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.

A-2-1.3 When local operating conditions necessitate apparatus of unusual design, the purchaser should indicate the requirements in the Special Provisions. Height, width, under-vehicle clearance, wheelbase, turning radius, length, etc., may occasionally need special attention. As an example: A community having many narrow winding streets must have apparatus capable of readily negotiating switchbacks without delay.

A-2-1.3.2 Where fire apparatus may have to operate off paved roads, a two-speed rear axle, an auxiliary transmission or an automatic transmission or combination of these may be desirable, particularly with heavy apparatus. (*See also A-2-1.5.1.*)

A-2-1.3.3 See A-11-1.1.2.

A-2-1.4.1 The carrying capacity of a vehicle is apparently one of the least understood features of design and one of the most important. All vehicles are designed for "rated GVWR" or maximum total weight, which should not be exceeded by the apparatus manufacturer or by the purchaser after the vehicle has been in service. For tractor-drawn vehicles, the design should be adequate for "rated GCWR" weight. There are many factors which make up the rated GVWR, including the design of the springs or suspension system, the rated axle capacity, the rated tire loading, and the distribution of the weight between the front and rear wheels. One of the most critical factors is the size of the water tank; as water

weighs approximately 8⅓ lb per gal, a 500-gal water tank will mean an additional weight of about 2 tons on the vehicle. A value of 10 lb per gal may be used when estimating the weight of the tank and its water, making about 2½ tons for a 500-gal tank.

The distribution of the weight between the front and rear wheels is also a factor for major consideration as improper design will seriously affect the handling characteristics. Too little weight on the front wheels may cause a front-end skid and, over bumpy roads, may cause the front of the vehicle to veer from side to side; at the very least it will be difficult to keep the vehicle under control. Too much weight on the front wheels will reduce the traction of the rear wheels and may result in a rear-end skid, or difficulty in traveling over unpaved roads or in mud. Further, overloading of either front or rear wheels might require that the tires be of different sizes.

Overloading the vehicle by the manufacturer through design, or by the purchaser through specifying a small chassis with a large water tank, or by the purchaser adding a great deal of equipment after the vehicle is in service will materially reduce the life of the vehicle and will undoubtedly result in increased maintenance costs, particularly with respect to transmissions, clutches and brakes. Overloading may also seriously affect handling characteristics, making steering particularly difficult.

Fire apparatus must be able to perform its intended service under adverse conditions which may require operation off paved streets or roads. Chassis components should be selected with the rigors of service in mind. It is not good practice to employ underrated or especially rated frames, axles, or transmission even though the finished vehicle may be able to pass the road tests under favorable conditions. When selecting chassis for fire apparatus, it is recommended that optional heavy-duty axle equipment available from chassis manufacturers be specified when necessary to meet the requirements of 2-1.4.

The standard does not contain any minimum for size of engine as the size of the engine must be chosen to correspond with the conditions of design and service. One of the most critical factors is the size of the water tank. As water weighs approximately 8⅓ lb per gal, a value of 10 lb per gal may be used when estimating the weight of the tank and its water; therefore, a 500-gal tank will add about 2½ tons to the vehicle.

A-2-1.5.1 Many fire departments have favored high torque low-speed engines for fire department service because such engines have good performance characteristics both when negotiating city traffic and when driving fire pumps. However, high-speed engines are frequently employed for fire apparatus, particularly in the case of commercial truck chassis. Where high-speed engines are selected for use in fire apparatus which may have to operate off paved highways, it is recommended that one of the following components be specified in the Special Provisions: two-speed rear axle with high numerical ratio in low range; and auxiliary transmission; or an automatic transmission. For most rural fire truck chassis, a two-speed rear axle is recommended.

A-2-1.5.2 The power generated by internal combustion engines may decrease with altitude increase. The loss varies with the type of engine and/or fuel and the amount of air inlet supercharging.

A-2-1.5.3 The maximum no-load governed speed is established by the engine manufacturer as a safe limit of engine speed. The governor will prevent the engine from exceeding the safe speed. Most engine manufacturers allow a plus tolerance of 2 percent for maximum no-load governed speed.

A-2-1.5.4 A shut-down beyond the control of the truck operator during the fire fighting and/or rescue operations can result in loss of water flow from the pump or loss of operation power for an aerial device which could severely endanger personnel.

Automatic fuel line safety shut-off as required by ICC regulations is not considered an automatic engine shutdown.

A-2-1.6.1 When a regular production model commercial chassis is used, it is recommended that the heavy-duty radiator option be included when such is available. Radiators with bolted top and bottom tanks and removable side braces, if available, are considered preferable. Optional features that may be desirable include a coolant conditioner, which should be of a type approved by the engine manufacturer, radiator sight gages and automatic radiator shutters.

A-2-1.7.1 Full flow oil filters are mandatory with some diesel engines.

A-2-1.8.3 Installation of two or more fuel pumps should be designed so that failure of one pump will not nullify the performance of the others. It should be remembered that commercial trucks are designed for over-the-road operation and the fuel system and battery are at least partially cooled by the flow of air resulting from the motion. When a commercial truck is used for fire apparatus, care must be taken that vapor lock does not develop in the fuel system due to the heat developed when the vehicle is standing with the engine driving the pump. Proper ventilation of battery compartment is also important.

A-2-1.8.4 See A-2-1.8.3.

A-2-1.8.7 It is not a recommended practice to add a second tank to a commercial vehicle when the original tank is too small, since such tanks are seldom designed for dual tank use. Where large fuel capacity is required, over 50 gal, dual tanks designed for the purpose are acceptable. In such circumstances, it is undesirable for a pump operator to be required to manually open or close valves to provide additional fuel supply to the engine and, further, there should be a free flow from both tanks so that fuel will not remain unused in any tank for long periods. The tanks should be arranged with check valves in the line with free flow to a mutual feed line. Unfortunate incidents have occurred where operators have used the fuel in one tank, switched to another tank, and neglected to refill the first tank on return to the station. It is also desirable that the fuel gage be so installed that the operator can immediately determine the amount of fuel still remaining in the fuel system without mental addition of various fuel tank capacities.

A-2-1.9.1 Emissions from exhaust discharge pipes should be directed away from any fire fighting tools since such emissions contain an oily substance that could make the tools difficult to handle and possibly dangerous to use.

A-2-2.2.1 An alternator is normally the permanent source of electric power on the fire apparatus. Problems may arise because the purchaser specifies receptacle outlets to provide current for operating lights, power tools or similar equipment.

An alternator produces alternating current varying between 12 and 14 volts; if 110 volts is desired, a transformer must be used. However, the alternator produces 3-phase current and it is essential that the power consumed be balanced on the phases within the limits recommended by the manufacturer. Therefore, either a 3-phase transformer or not more than one transformer on a single phase is necessary; use of two transformers or lack of balance between phases will endanger the alternator.

The alternator begins to produce a usable amount of current at alternator speeds of 800 rpm and produces the maximum current, dependent upon alternator rating, at speeds of 1400 to 1600 rpm. However, the alternating current produced has a frequency (in cycles per sec) of one-tenth the alternator speed (in revolutions per minute) so that it has a frequency which varies from 80 to 160 or more cycles per sec. Therefore, motors designed to operate only on 60 cycle AC current will soon burn out. This means that a rectifier must be installed with the transformer mentioned above and motors of power tools operated from the alternator must be of universal (AC-DC) type, or DC type.

Further, an alternator will produce only a limited amount of current, much of which must be used for charging the battery and operating lights, radio, and other vehicle equipment; the only current available for operating floodlights or power tools is that which is over and above the vehicle requirements.

Another method of producing 110 volts power is through the use of a power inverter which produces 110 volts AC current and can maintain a constant 60 Hz frequency. Depending on alternator capacity, the power inverter can provide as much continuous power as a transformer and in addition has the advantage of surge capacity above the continuous operation capacity. Power inverters take their energy directly from the alternator, at a higher voltage, or directly from battery.

A-2-2.2.2 In view of the increasing use of power-consuming devices on apparatus, the provision of current-producing equipment of sufficient capacity is strongly recommended. Motors of electrical tools used should be compatible with current produced. Where 110-volt equipment use is extensive it is recommended that a separately driven generator, portable or fixed, be used. Caution: Because of non-earthgrounded nature of vehicle mounted 110-V equipment and the wet environment in which it operates, great care should be taken in the use and maintenance of such 110-V circuits and equipment. All installations should be made in accordance with Section 250-6 of NFPA 70, *National Electrical Code*.

A-2-2.3.1 Overheating of a battery will cause rapid deterioration and early failure; evaporation of the water in the battery electrolyte may also be expected. Batteries in commercial truck chassis are often installed to take advantage of the cooling effect of the flow of air from motion in over-the-road operation and may be subject to overheating when the vehicle is stationary, such as during pumping operations.

A-2-2.3.2 The battery capacity is a very important and frequently overlooked factor in vehicle performance. Fire apparatus needs a much higher capacity battery than does a commercial truck because of the large number of lights and other power-consuming devices. When a radio, a large siren, various flashing or rotating lights, spotlights, electric hose reels and other power-consuming devices are installed, the total current needed for short periods may be more than that provided by an alternator, particularly with the engine idling, and the battery must be of ample size to carry the load.

Early lead acid storage batteries served mainly as a source of power for small electric lights, signals, and other low current electrical equipment. The amp-hr capacity at the 20-hr rate was a significant measure of the battery's ability to perform this function. Today, with modern charging systems, the battery is no longer called upon to perform this function, except in rare emergencies.

The prime function of the battery in modern vehicles is to furnish sufficient power to crank the engine. SAE recognized the change of the prime function of the battery in the vehicle and developed a new rating system to enable the user to specify a battery that would meet the cranking requirements of the engine.

A new "Cold Cranking Test" has been established which specifies the minimum amperes available at 0°F and -20°F for cranking. This rating specifies the amperes current the battery will deliver for 30 sec with a minimum voltage of 1.2 volts per cell. The 1.2 volts per cell requirement for new, fully charged batteries represents the voltage required for cranking the vehicle. Thirty sec represents the maximum cranking time for an engine in an acceptable state of tune.

With engine manufacturers specifying the cold cranking amperes for satisfactory cold cranking performance, the user can specify the proper capacity battery for the application. By basing the specification on the old 20-hr rate, the customer could get a battery with good or poor cold cranking performance. The new rating system ensures that the customer will get the performance specified.

Batteries also have a "Reserve Capacity Rating" which represents the approximate time in minutes it is possible to travel at night with an inoperative generator and minimum electrical load. This rating, in minutes, is the time required to discharge a fully charged battery at 25 amp at 80°F to a terminal voltage of 1.7 volts per cell (10.2 volts for a 12-volt battery).

A-2-2.6.2 A light, located in the cab, to indicate an open compartment door may be desirable.

A-2-3.1.1 It is required that service and parking brakes be independent and separate systems so that any failure

of one braking system will not prevent stoppage of the vehicle through use of the other system. Installation of a device which locks in the hydraulic pressure on the service brake system does not constitute a parking brake, nor does a "park" position on an automatic transmission.

A-2-3.1.3 Adequate braking capacity is essential for the safe operation of fire apparatus. While this subject is normally covered in state highway regulations, it should be noted that fire apparatus may have a special problem as compared with normal trucks of the same gross vehicle weight in that fire apparatus may be required to make successive brake applications in a short period of time when attempting to respond to alarms with minimum loss of time. Thus, the problem of brake "fade" and braking capacity may be critical unless the brakes provided take into account the service requirements. Air actuated brakes are recommended for fire service vehicles of over 25,000 GVWR. Where air brakes are provided, it is important that they be of quick build-up type with dual tanks and a pressure regulating valve, and that the rated compressor capacity be not less than 12 cu ft per min for this class of service. Also, air brakes require attention to guard against condensation in the air lines such as may occur in certain areas subject to marked seasonal changes in climate affecting the moisture content of the air. Automatic moisture ejection of suitable nonfreezing type is recommended. Air drop should be limited to normal air losses. ANSI Standard D7-1973, *Inspection, Procedures for Motor Vehicles*, lists as cause for rejection:

(1) Air brake pressure drop of more than 2 psi in 1 min for single vehicles or more than 3 psi in 1 min for vehicle combinations, with engine stopped and service brakes released.

(2) Air pressure drop of more than 3 psi in 1 min for single vehicles or more than 4 psi in 1 min for vehicle combinations, with engine stopped and service brakes fully applied.

A-2-3.2.5 The angle of departure (*see 1-5.1*) affects the road clearance of the vehicle when going over short steep grades such as would be found in a driveway entrance, crossing a high crowned road at right angles, or in off-road service. Too low an angle of departure will result in scraping the rear of the body. In those cases where equipment is stored below the body in the rear, the angle of departure must be measured to a line below the equipment.

A-2-3.2.6 Single chains for outside dual rear wheels are recommended.

A-2-3.2.8 When automatic transmissions are used, the power take-off applications may present problems and especially when dual PTO drives are required. In some instances, the PTO drive can only be engaged in torque converter range with resultant chances of overheating with prolonged use. If high engine rpm occurs, there is the possibility, if the truck is accidentally left in gear, of the output torque overcoming the parking brake and moving the vehicle. Proper operational instructions are essential with automatic transmissions.

A-2-3.3.6 The desirable height of rear steps is normally 20 to 22 in.; however, considering the angle of departure as specified in 2-3.2.5, this dimension is variable.

A-2-4.1 It is recommended that all apparatus in the department be of uniform color and the manufacturer be required to furnish the name and number of the paint used.

It is recommended that the Munsell No. be used to identify other shades of paint that may be used. The following shades can be identified:

(a) Lime Yellow	Munsell No. 2.5GY 8.5/8.0
(b) Yellow	Munsell No. 5.0Y 8.5/12.0
(c) Orange	Munsell No. 5 OYR 6.0/15.0
(d) White	Munsell No. N 8.7/0.1

A-3-1.1.1 Capacities of pumpers recognized as being suitable for structural fire fighting use are 500, 750, 1000, 1250, 1500, 1750 and 2000 gpm. For the department buying its first pumper, a unit rated at not less than 750 gpm, and preferably 1000 gpm, is recommended. Pumps rated in the 1000 gpm range and up permit water delivery in desired quantity at higher pressures for service to powerful stream appliances, and long hose lays. (*See A-5-1.1.1.*)

When the community to which the apparatus is to be delivered is at a considerably higher altitude than the factory or other test location, sufficient excess power must be provided to compensate for the fact that the power of a naturally aspirated internal combustion engine decreases with elevation above sea level.

If the pump must draft rated capacity at high altitudes (over 2000 ft), and/or at lifts over 10 ft, or through more than 20 ft of suction hose, larger hose than is normally needed or a larger pump, or both, may have to be provided.

A-3-2.1.1 Pumps frequently required to pump salt water or other corrosive waters should be bronze. For occasional pumping of such water, iron pumps, bronze fitted, are satisfactory if properly flushed out by fresh water after such use.

The term "all bronze" indicates that the pump main casing, impellers or rotors, suction and discharge manifolds, and other principal components exposed to the water to be pumped, with the exception of the shaft, bearings, and seals, are of a high-copper alloy material.

Corrosion effects are proportional to the mass relationship of bronze to iron. It is, therefore, desirable to use like materials for the pump and piping, and where both iron and bronze are used, to keep the mass of the iron larger than that of the bronze.

While all fire pumps of the same rated capacity must meet the same performance standards, there are sometimes reasons why a fire department prefers a particular type. In such cases, the type of pump should be indicated in the Special Provisions. Some prefer a single stage pump because of its relative simplicity of operation. Others like a multiple stage pump. Any such preference should be indicated with due regard to engine and transmission characteristics.

A-3-2.2.1.2 Suction inlets at the front or rear of the apparatus, or otherwise specially situated, may not permit drafting rated capacity and pressure.

A-3-2.2.1.4 See A-3-2.2.3.

A-3-2.2.3 Two or more auxiliary 2½-in. gated suction inlets, or a suction siamese of the proper size to permit attachment to a gated large suction inlet, are desirable especially where a fire pump is provided on an aerial ladder truck or elevating platform apparatus to boost pressure to a ladder pipe or elevated nozzle. A suction siamese attached to a large suction inlet will usually permit greater flow than two or more auxiliary 2½-in. inlets when the water supply pressure is marginal.

A-3-2.2.3.1 See A-3-2.2.3.

A-3-2.2.4 A check valve is sometimes installed in the tank-to-pump line to prevent water from flowing into the tank at an excessive rate if the pump is being supplied from a hydrant and the tank-to-pump line valve has been inadvertently left in the open position; such condition may result in a pressure build-up in the tank which will cause permanent damage or failure. If a check valve is used, a small hole (approximately ¼ in.) should be provided through the check valve clapper, or other means provided to vent the pump to the tank during booster operations when all outlets may be closed while the pump is operating.

A-3-2.2.6 If flows greater than 120 gpm through preconnected lines are desired, piping from pump to preconnect lines should be larger than 1½ in. in order to keep the friction loss to a reasonable level. The following sizes are suggested.

Max. Flow, gpm	Pipe Size
120	1½ in.
200	2 in.
300	2½ in.

A-3-2.2.8 Where a tank fill line is specified, the fill line should be properly valved and not larger than 1½-in. diameter for larger size tanks and 1-in. diameter for smaller size tanks. It is necessary to design the tank for adequate venting and overflow for the maximum fill rate. A locking-type ball valve, globe valve, needle valve, or other type suitable for throttling service should be used. A gate valve is not recommended.

A-3-3.2.3 Pumpers are normally operated from either the side or the front of the vehicle and the design is such that there is no power applied to the wheels while pumping. Dislocation, through vibration or accidental jarring, of any levers used to prevent power from being applied to the wheels could result in a serious accident. Therefore, it is essential that the lever which changes the vehicle transmission position be locked in place and rigidly fastened so that it cannot be accidentally knocked out of position; this is particularly essential when a front-mount pump is used as the road transmission would be in neutral and the operator would probably be standing in front of the vehicle.

A-3-3.2.8 A "suction relief valve," discharging to the ground, should be used in relay operations. If such operations are frequent, it may be desirable to have such relief valve permanently installed on the pumper rather than to use a portable one connected to the pump suction line.

A-3-3.2.9.1 The usual means of preventing water from entering the intake manifold of an internal combustion engine, when the partial vacuum produced by the action of the engine is utilized to prime a pump, is an automatic float valve which closes the priming line when the water reaches a certain level in the float chamber. A priming device having two separate valves, actuated by separate floats, in series but located in a common chamber is satisfactory.

A-4-1.1.1 It should be recognized that pumpers of 1000-gpm rated capacity or more normally require more than 1200 ft of 2½-in. hose to utilize their pumping capacity and their 2½-in. (or larger) discharge connections. For example, the 1200-ft load provides only 300-ft lines from the four outlets of a 1000-gpm pumper and less than an average of 250 ft per line with a 1250-gpm pumper. Experience has shown that, with large capacity pumpers, 1800 to 2000 ft of hose may be desirable, except where separate hose trucks are provided to utilize available pumping capacity. Additional hose capacity may also be desirable for 750-gpm pumpers. An 1800-ft load will provide three 600-ft lines or two 900-ft lines which are well within the normal performance of this size of pump.

Fire departments serving areas with wide hydrant spacing and nonhydranted areas often find it desirable to have additional space for hose. Even though pump capacities may only be in the 500-750 gpm range, 2½-in. hose bed capacity up to 2000 ft may be beneficial. If scattered suction sources are available to pumpers, hose bed capacity for quantities of 3-in. or larger hose would enable a fire department to lay its own "water main."

A-4-1.1.3 Handrails are required as necessary at the rear of apparatus whenever personnel are expected to ride the rear step. From the safety standpoint, seats for personnel are preferable to riding the step and handrails might be replaced by handholds located as necessary when using the rear step for hose operations.

A-5-1.1.1 The terms "booster pump," "booster tank," and "booster hose," together with such other terms as "fire plug" and "steamer connection," are apparently here to stay in the vocabulary of the fire service. When more efficient equipment was developed to replace the former chemical tanks with attached hose on fire apparatus, the equipment consisted of a small tank with water at zero psig, a permanently connected small pump taking suction from the tank, with no other means of drafting water, and with small diameter hose permanently attached at the pump discharge, with no other discharge connections. The purpose of the equipment was to boost the pressure by a mechanical method, rather than by a chemical reaction, to make possible a small fire stream, hence the term "booster." Later it become common practice to include additional suction and additional discharge connections in the design of the pump, but the term "booster pump" has persisted to designate a