

NFPA®

1906

Standard for Wildland Fire Apparatus

2016



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NFPA® 1906

Standard for

Wildland Fire Apparatus

2016 Edition

This edition of NFPA 1906, *Standard for Wildland Fire Apparatus*, was prepared by the Technical Committee on Fire Department Apparatus. It was issued by the Standards Council on May 26, 2015, with an effective date of June 15, 2015, and supersedes all previous editions.

This document has been amended by one or more Tentative Interim Amendments (TIAs) and/or Errata. See “Codes & Standards” at www.nfpa.org for more information.

This edition of NFPA 1906 was approved as an American National Standard on June 15, 2015.

Origin and Development of NFPA 1906

The first edition of NFPA 1906, *Standard for Wildland Fire Apparatus*, was published in 1995 to provide a standard for apparatus that are basically designed and deployed to combat fires in wildland. The document covered apparatus with pumps ranging in size from 20 gpm to 250 gpm (76 L/min to 950 L/min) and water tanks with a capacity of 125 gal (473 L) or more.

Requirements were also provided for the first time for foam proportioning systems using Class A foam as a fire suppressant agent and for compressed air foam systems (CAFS). The apparatus covered in the standard included built-to-specification apparatus and fire-fighting packages designed to be slipped onto a vehicle chassis.

In the 2001 edition, the requirements for low-voltage electrical systems, including the emergency warning systems, were brought in line with the requirements in NFPA 1901, *Standard for Automotive Fire Apparatus*. The chapter on pumps was reorganized to provide requirements for four types of pumps, with the range of sizes changed to include pumps from 10 gpm (38 L/min) to 500 gpm (1900 L/min). The allowable minimum size on water tanks was lowered to 50 gal (190 L), and the chapter on line-voltage systems was removed. The document was also updated in other areas where appropriate to make the requirements consistent with those in NFPA 1901.

The 2006 edition was a general updating of the document, including making requirements consistent with those in NFPA 1901 where appropriate. It added requirements for what the manufacturer certification of test results must include and for better illumination and signage for controls, switches, instruction plates, gauges, and instruments. This edition also introduced the concept of estimated in-service weight as a basis for measuring certain stability requirements and linked the maximum top speed of the apparatus to the tire manufacturer's ratings. It also required more head height at seating positions and the use of red seat belts if available.

The 2006 edition also reorganized the requirements for water pumps installed on the wildland fire apparatus into seven categories and updated the requirements for baffling water tanks to better address smaller water tanks. The standard required type testing of foam systems followed by individualized testing of each installation. Two annexes were added, one to provide an equipment size and weight chart, the other to provide guidelines for first-line and reserve fire apparatus. Finally, the document was reorganized according to the *Manual of Style for NFPA Technical Committee Documents*.

The 2012 edition was a complete reorganization of the document, to follow the same format and style as NFPA 1901, *Standard for Automotive Fire Apparatus*. It included a new category of wildland fire apparatus titled Wildland Mobile Water Supply Apparatus, giving specific requirements for vehicles equipped with a minimum of 1000 gal (4000 L) water tanks designed to operate off-road. This revision also included appropriate updates consistent with those requirements in NFPA 1901.

The 2016 edition of NFPA 1906 includes a new chapter on the design of wildland fire crew carriers specifically for the purpose of transporting wildland fire crews. It also includes a new chapter

on ultra-high pressure (UHP) fire pumps and associated equipment due to the increased use of UHP fire pumps. This edition provides guidance to manufacturers and purchasers as to the design, testing, and performance of UHP fire pumps with a rated discharge pressure of 1100 psi (7600 kPa) or greater. The 2016 edition of NFPA 1906 also introduces a new design concept of the on-board pump-and-roll firefighting position in Chapter 14. This is a seated, belted, and protected position that allows for safe and effective use of pump-and-roll operations in situations where walk along-side pump-and-roll operations are not practical. The Committee also has clarified the requirements within Chapter 16 for pump controls and has added updated tables to the chapter for the engine speed advancement interlock test. Additional changes have been made throughout the document to remove redundant language and to clarify requirements.

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Committee Scope: This Committee shall have primary responsibility for documents on the design and performance of fire apparatus for use by the fire service.

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A reference in brackets [] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex E. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced publications can be found in Chapter 2 and Annex E.

Chapter 1 Administration

1.1* Scope. This standard shall define the minimum requirements for the design, performance, and testing of new automotive fire apparatus that are designed primarily to support wildland fire suppression operations.

1.2 Purpose. The purpose of this standard shall be to establish the minimum requirements for new automotive wildland fire apparatus that will be safe and reliable when properly maintained and used within design parameters.

1.3 Application.

1.3.1* This standard shall apply to new fire apparatus that meet the following criteria:

- (1) Rated at minimum 10,001 lb (4501 kg) gross vehicle weight rating (GVWR)

- (2) Designed specifically for supporting wildland fire suppression operations
- (3) Contracted for on or after January 1, 2016

1.3.2 Nothing shall prevent the use of the standard prior to January 1, 2016, if the purchaser and the contractor agree.

1.3.3 This standard shall not apply to fire apparatus designed to support structural fire fighting or associated fire department operations, which are covered by the requirements of NFPA 1901.

1.4* Retroactivity. The standard is not intended to be applied retroactively.

1.5 Equivalency. Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard.

1.5.1 Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency.

1.5.2 The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

1.6 Units of Measure.

1.6.1* In this standard, values for measurement in U.S. customary units shall be followed by an equivalent in SI units.

1.6.2 Either set of values can be used, but the same set of values (either U.S. customary units or SI units) shall be used consistently.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 1901, *Standard for Automotive Fire Apparatus*, 2016 edition.

NFPA 1963, *Standard for Fire Hose Connections*, 2014 edition.

2.3 Other Publications.

2.3.1 ANSI Publications. American National Standards Institute, 25 West 43rd Street, 4th floor, New York, NY 10036.

ANSI/NEMA Z535.4, *Product Safety Signs and Labels*, 2011.

2.3.2 ASME Publications. American Society of Mechanical Engineers, Two Park Avenue, New York, NY 10016-5990.

ANSI/ASME B1.20.7, *Hose Coupling Screw Threads, Inch*, 1991 (R2003).

ASME B40.100, *Pressure Gauges and Gauge Attachments*, 2005.

Boiler and Pressure Vessel Code, Section VIII, Division 1, 2013.

2.3.3 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM D4956, *Standard Specification for Retroreflective Sheeting for Traffic Control*, 2013.

2.3.4 FAMA Publications. Fire Apparatus Manufacturers Association, P.O. Box 397, Lynnfield, MA 01940-0397.

FAMA TC008, *Graphical Symbols for Automotive Fire Apparatus*, 2013.

FAMA TC010, *Standard Product Safety Sign Catalog for Automotive Fire Apparatus*, 2014.

2.3.5 ISEA Publications. International Safety Equipment Association, 1901 North Moore Street, Arlington, VA 22209-1762, www.safetysignequipment.org.

ANSI/ISEA 207, *Standard for High-Visibility Public Safety Vests*, 2011.

2.3.6 ISO Publications. International Standards Organization, 1 rue de Varembe, Case Postale 56, CH-1211 Genève 20, Switzerland.

ISO 9244, *Earth-moving machinery — Machine safety labels — General principles*, 2008.

ISO/IEC 17020, *General criteria for the operation of various types of bodies performing inspection*, 1998.

ISO/IEC 17065, *Conformity Assessment: Requirements for bodies certifying products, processes and services*, 2012.

2.3.7 Parker Hannifin, Racor Division Publication. Parker Hannifin, Racor Division, Attn: Dan Haggard, 805 West Street, Holly Springs, MS 38634.

LF 1093-90, *Ember Separation Test Procedure*, January 2003.

2.3.8 SAE Publications. Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J156, *Fusible Links*, 2012.

SAE J541, *Voltage Drop for Starting Motor Circuits*, 1996.

SAE J551/1, *Performance Levels and Methods of Measurement of Electromagnetic Compatibility of Vehicles, Boats (up to 15 m), and Machines (16.6 Hz to 18 GHz)*, 2010.

SAE J553, *Circuit Breakers*, 2004.

SAE J554, *Electric Fuses (Cartridge Type)*, 1987.

SAE J575, *Test Methods and Equipment for Lighting Devices and Components for Use on Vehicles Less Than 2032 mm in Overall Width*, 2012.

SAE J578, *Color Specification*, 2012.

SAE J595, *Directional Flashing Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles*, 2008.

SAE J683, *Tire Chain Clearance — Trucks, Buses (Except Suburban, Intercity, and Transit Buses), and Combinations of Vehicles*, 2011.

SAE J845, *Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles*, 2007.

SAE J994, *Alarm — Backup — Electric, Laboratory Performance Testing*, 2009.

SAE J1127, *Low Voltage Battery Cable*, 2012.

SAE J1128, *Low Voltage Primary Cable*, 2012.

SAE J1194, *Rollover Protective Structures (ROPS) for Wheeled Agricultural Tractors*, 2009.

SAE J1330, *Photometry Laboratory Accuracy Guidelines*, 2007.

SAE J1690, *Flashers*, 1996.

SAE J1849, *Emergency Vehicle Sirens*, 2012.

SAE J1888, *High Current Time Lag Electric Fuses*, 1990.

SAE J1889, *L.E.D. Signal and Marking Lighting Devices*, 2011.

SAE J2077, *Miniature Blade Type Electrical Fuses*, 1990.

SAE J2180, *A Tilt Table Procedure for Measuring the Static Roll-over Threshold for Heavy Trucks*, 2011.

SAE J2202, *Heavy-Duty Wiring Systems for On-Highway Trucks*, 2008.

SAE J2418, *Occupant Restraint System Evaluation — Frontal Impact Component-Level Heavy Trucks*, 1998, reaffirmed 2003.

SAE J2420, *COE Frontal Strength Evaluation — Dynamic Loading Heavy Trucks*, 2010.

SAE J2422, *Cab Roof Strength Evaluation — Quasi-Static Loading Heavy Trucks*, 2010.

2.3.9 TRA Publications. Tire and Rim Association, Inc., 175 Montrose West Ave., Suite 150, Copley, OH 44321.

Tire and Rim Association — Year Book, 2015.

2.3.10 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

ANSI/UL 969, *Standard for Marking and Labeling Systems*, 1995, with revisions through November 24, 2008.

2.3.11 UNECE Publications. UN Economic Commission for Europe, Palais des Nations, CH – 1211, Geneva 10 Switzerland, www.UNECE.org.

ECE Regulation number 29, *Uniform Provisions Concerning the Approval of Vehicles with Regard to the Protection of the Occupants of the Cab of a Commercial Vehicle*, 2011.

2.3.12 U.S. Department of Agriculture Publications. USDA Forest Service, San Dimas Technology and Development Center, 444 East Bonita Avenue, San Dimas, CA 91773.

USDA - Forest Service Standard 5100-1.

2.3.13 U.S. Government Publications. U.S. Government Printing Office, Washington, DC 20402.

Public Law 89-563.

Title 29, Code of Federal Regulations, Part 1910.169, "Air receivers." 29 CFR 1910.169.

Title 49, Code of Federal Regulations, Part 178.37, "Specification 3AA and 3AAX seamless steel cylinders." 49 CFR 178.37.

Title 49, Code of Federal Regulations, Part 393.94(c), "Interior noise levels in power units." 49 CFR 393.94(c).

2.3.14 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Mandatory Sections.

NFPA 10, *Standard for Portable Fire Extinguishers*, 2013 edition.

NFPA 70®, *National Electrical Code®*, 2014 edition.

NFPA 414, *Standard for Aircraft Rescue and Fire-Fighting Vehicles*, 2012 edition.

NFPA 1150, *Standard on Foam Chemicals for Fires in Class A Fuels*, 2010 edition.

NFPA 1901, *Standard for Automotive Fire Apparatus*, 2016 edition.

NFPA 1917, *Standard for Automotive Ambulances*, 2016 edition.

NFPA 1961, *Standard on Fire Hose*, 2013 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is 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.

3.2.4* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.5 Shall. Indicates a mandatory requirement.

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

3.2.7 Standard. An NFPA Standard, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA Manuals of Style. When used in a generic sense, such as in the phrase "standards development process" or "standards development activities," the term "standards" includes all NFPA Standards, including Codes, Standards, Recommended Practices, and Guides.

3.3 General Definitions.

3.3.1 Acceptance. An agreement between the purchasing authority and the contractor that the terms and conditions of the contract have been met. [1901, 2016]

3.3.2 Acceptance Tests. Tests performed on behalf of or by the purchaser at the time of delivery to determine compliance with the specifications for the fire apparatus. [1901, 2016]

3.3.3 Access Ladder. One or more rungs (of any shape) for climbing that have a degree of inclination between 60 and 90 degrees. [1901, 2016]

3.3.4 Active Horizontal Angles of Light Emission. The angles, measured in a horizontal plane passing through the optical center of the optical source, as specified by the manufacturer of the optical device, between which the optical source contributes optical power. [1901, 2016]

3.3.5 Angle of Approach. The smallest angle made between the road surface and a line drawn from the front point of ground contact of the front tire to any projection of the apparatus in front of the front axle. [1901, 2016]

3.3.6 Angle of Departure. The smallest angle made between the road surface and a line drawn from the rear point of ground contact of the rear tire to any projection of the apparatus behind the rear axle. [1901, 2016]

3.3.7 ASME Pressure Vessel. A pressure vessel used for the storage or accumulation of air or gas under pressure that is constructed and tested in accordance with the *ASME Boiler and Pressure Vessel Code*. [1901, 2016]

3.3.8 Automatic Electrical Load Management System. A device that continuously monitors the electrical system voltage and automatically sheds predetermined loads in a selected order to prevent overdischarging of the apparatus' batteries. [1901, 2016]

3.3.9* Automatic Regulating Foam Proportioning System. A foam proportioning system that automatically adjusts the flow of foam concentrate into the water stream to maintain the desired proportioning ratio.

3.3.10 Auxiliary Braking System. A braking system in addition to the service brakes, such as an engine retarder, transmission retarder, driveline retarder, or exhaust retarder. [1901, 2016]

3.3.11 Auxiliary Engine-Driven Pumps. Pumps whose power is provided by engines that are independent of the vehicle engine.

3.3.12 Back-Up Alarm. An audible device designed to warn that the fire apparatus is in reverse gear. [1901, 2016]

3.3.13 Battery Disconnect Switch. A switch that disconnects the battery from all of the vehicle's wiring.

3.3.14 Bubble (Foam). A thin-walled, roughly spherical film of liquid inflated with air. [1901, 2016]

3.3.15 Center of Gravity. The point at which the entire weight of the fire apparatus is considered to be concentrated so that, if supported at this point, the apparatus would remain in equilibrium in any position. [1901, 2016]

3.3.16 Chassis. The basic operating motor vehicle including the engine, frame, and other essential structural and mechanical parts, but exclusive of the body and all appurtenances for

the accommodation of driver, property, passengers, appliances, or equipment related to other than control. Common usage might, but need not, include a cab (or cowl). [1901, 2016]

3.3.17 Class A Fires. Class A fires are fires in ordinary combustible materials, such as wood, cloth, paper, rubber, and many plastics. [10, 2013]

3.3.18 Class A Foam. Foam for use on fires in Class A fuels. [1150, 2010]

3.3.19 Class A Fuel. Materials such as vegetation, wood, cloth, paper, rubber, and some plastics in which combustion can occur at or below the surface of the material. [1150, 2010]

3.3.20* Compound Gauge. A gauge that indicates pressure both above and below atmospheric pressure. [1901, 2016]

3.3.21* Compressed Air Foam System (CAFS). A foam system that combines air under pressure with foam solution to create foam. [1901, 2016]

3.3.22 Continuous Duty. Operation at a substantially constant load for an indefinitely long time. [70:100]

3.3.23* Contractor. The person or company responsible for fulfilling an agreed-upon contract. [1901, 2016]

3.3.24 Convenient Reach. The ability of the operator to manipulate the controls from a driving/riding position without excessive movement away from the seat back or without excessive loss of eye contact with the roadway. [1901, 2016]

3.3.25 Curb Weight. The total weight of the complete vehicle less the payload. [1901, 2016]

3.3.26 Defect. A discontinuity in a part or a failure to function that interferes with the service or reliability for which the part was intended. [1901, 2016]

3.3.27 Discharge Outlet Size. The nominal size of the first fire hose connection from the pump on a discharge. [1901, 2016]

3.3.28 Documentation. Any data or information supplied by the manufacturer or contractor relative to the apparatus, including information on its operation, service, and maintenance. [1901, 2016]

3.3.29 DOT Cylinder. A pressure vessel constructed and tested in accordance with Title 49 CFR 178.37 that is used for the storage and transportation of air under pressure. [1901, 2016]

3.3.30 Dry Location. A location not normally exposed to moisture such as in the interior of the driving or crew compartment, the interior of a fully enclosed walk-in fire apparatus body, or a watertight compartment opened only for maintenance operations. [1901, 2016]

3.3.31* Eductor. A device placed in a hose line or a discharge pipe that incorporates a venturi and proportions foam concentrate or other fire fighting agents into the water stream. [1901, 2016]

3.3.32* Ejector. An appliance used to fill a fire engine's tank when the water source is below or beyond the engine's drafting capability.

3.3.33* Electric Siren (Electromechanical). An audible warning device that produces sound by the use of an electric motor

with an attached rotating slotted or perforated disc. [1901, 2016]

3.3.34* Electronic Siren. An audible warning device that produces sound electronically through the use of amplifiers and electromagnetic speakers. [1901, 2016]

3.3.35 Emergency Vehicle. A fire apparatus or other vehicle that is permitted by law to call for the right of way while responding to an incident affecting the public safety and to block the public road while at the scene of such an incident.

3.3.36 Enclosed Compartment. An area designed to protect stored items from environmental damage (weather resistant) that is confined on six sides and equipped with an access opening(s) that can be closed and latched. [1901, 2016]

3.3.37 Estimated In-Service Weight. The amount that the fire apparatus manufacturer estimates the apparatus will weigh when it is placed in service with all fixed and portable equipment installed, all tanks full, and all personnel seating positions occupied.

3.3.38 Expansion Ratio. The ratio of the volume of foam in its aerated state to the original volume of nonaerated foam solution. [1901, 2016]

3.3.39 Final-Stage Manufacturer. An entity that performs such manufacturing operations on an incomplete vehicle that it becomes a complete vehicle.

3.3.40 Fire Pump. A water pump with a rated capacity of at least 250 gpm (1000 L/min) but less than 3000 gpm (12,000 L/min) at 150 psi (1000 kPa) net pump pressure, or a water pump with a rated capacity over 3000 gpm (12,000 L/min) or greater at 100 psi (700 kPa) net pump pressure that is mounted on a fire apparatus and used for fire fighting.

3.3.41 FMVSS. Abbreviation for Federal Motor Vehicle Safety Standards. Regulations promulgated by the National Highway Transportation Safety Administration (NHTSA) of the United States under Public Law 89-563, which are mandatory and must be complied with when motor vehicles or items of motor vehicle equipment are manufactured and certified thereto. [1901, 2016]

3.3.42 Foam. An aerated fire-extinguishing solution created by mixing air into foam solution to form bubbles. [1901, 2016]

3.3.43 Foam Concentrate. Foam fire-fighting agent as received from the manufacturer that must be diluted with water to make foam solution. [1901, 2016]

3.3.44 Foam Proportioner. A device or method to add foam concentrate to water to make foam solution. [1901, 2016]

3.3.45 Foam Proportioning System. The apparatus and techniques used to mix concentrate with water to make foam solution. [1901, 2016]

3.3.46 Foam Solution. A homogeneous mixture of water and foam concentrate in the proper proportions. [1901, 2016]

3.3.47 Fully Enclosed Personnel Area. A driver or passenger compartment on the fire apparatus that provides total enclosure on all sides, top, and bottom and has positive latching on all access doors. [1901, 2016]

3.3.48 Gallon. United States gallon [231 in.³ (3.785 L)].

3.3.49 Gauge. A visual device that indicates a measurement.

3.3.50 Gauge Pressure. Pressure measured by an instrument where the pressure indicated is relative to atmospheric pressure. [1901, 2016]

3.3.51* GAWR (Gross Axle Weight Rating). The final-stage manufacturer's specified maximum load-carrying capacity of an axle system, as measured at the tire-ground interfaces. [1901, 2016]

3.3.52* Grade. A measurement of the angle used in road design and expressed as a percentage of elevation change over distance. [1901, 2016]

3.3.53 Ground Clearance. The vertical distance from the vehicle component to the ground. [1901, 2016]

3.3.54* GVWR (Gross Vehicle Weight Rating). The final-stage manufacturer's specified maximum load-carrying capacity of a single vehicle. [1901, 2016]

3.3.55 Instruction Plate. A visual indication whether in pictorial or word format that provides instruction to the operator in the use of a component on the apparatus. [1901, 2016]

3.3.56 Intake Connection Size. The nominal size of the first fire hose connection from the pump on an intake. [1901, 2016]

3.3.57 Intake Relief Valve. A relief valve piped to the intake manifold of a pump and designed to automatically relieve excessive pressure from the incoming flow of water by discharging water to the environment. [1901, 2016]

3.3.58 Interior. A sheltered location not exposed to the environment. [1901, 2016]

3.3.59 Interlock. A device or arrangement by means of which the functioning of one part is controlled by the functioning of another. [1901, 2016]

3.3.60 ISO. Insurance Services Office.

3.3.61 Label. A visual indication whether in pictorial or word format that provides for the identification of a control, switch, indicator, or gauge, or the display of information useful to the operator. [1901, 2016]

3.3.62 Lift. Pump lift is the vertical distance from the water surface to the centerline or eye of the impeller of the pump.

3.3.63 Line Voltage Circuit, Equipment, or System. An ac or dc electrical circuit, equipment, or system where the voltage to ground or from line to line is greater than 30 V rms (ac), 42.4 V peak (ac), or 60 V dc.

3.3.64 Low-Voltage Circuit, Equipment, or System. An electrical circuit, equipment, or system where the voltage does not exceed 30 V rms (ac), 42.4 V peak (ac), or 60 V dc; usually 12 V dc in fire apparatus. [1901, 2016]

3.3.65 Manually Regulated Foam Proportioning System. A foam proportioning system that requires manual adjustment to maintain the proportioning ratio when there is a change of flow or pressure through the foam proportioner.

3.3.66 Manufacturer. The person or persons, company, firm, corporation, partnership, or other organization responsible for turning raw materials or components into a finished product. [1901, 2016]

3.3.67* Maximum Pump Close-Off Pressure. The maximum pump discharge pressure obtained with all discharge outlets closed, with the pump primed and running, with the pump drive engine operating at maximum obtainable speed, and with the pump intake pressure at atmospheric pressure or less. [1901, 2016]

3.3.68 Minimum Continuous Electrical Load. The electrical current required to continuously operate a defined set of electrical devices. [1901, 2016]

3.3.69 Miscellaneous Equipment. Portable tools and equipment carried on a fire apparatus not including suction hose, fire hose, ground ladders, fixed power sources, hose reels, cord reels, breathing air systems, or other major equipment or components permanently mounted on the apparatus. [1901, 2016]

3.3.70 Miscellaneous Equipment Allowance. That portion of the GVWR allocated for the weight of miscellaneous equipment and its mounting brackets, boards, or trays.

3.3.71 Momentary Switch. A switch that returns to the neutral position (off) when released. [1901, 2016]

3.3.72 National Hose Thread (NH). A standard screw thread that has dimensions for inside (female) and outside (male) fire hose connections as defined in NFPA 1963. [1901, 2016]

3.3.73* Net Pump Pressure. The sum of the discharge pressure and the suction lift converted to psi or kPa when pumping at draft, or the difference between the discharge pressure and the intake pressure when pumping from a hydrant or other source of water under positive pressure. [1901, 2016]

3.3.74 Nozzle Reaction. Force that occurs when a water stream is discharged from the nozzle. [1901, 2016]

3.3.75 NPSH (National Pipe Straight Hose Thread). National pipe straight hose coupling thread as specified in ASME B1.20.7, *Hose Coupling Screw Threads, Inch*.

3.3.76 NWCG. National Wildfire Coordinating Group.

3.3.77* Off-Road Use Vehicle. A vehicle designed to be used on other than paved or improved roads, especially in areas where no roads, poor roads, and steep grades exist and where natural hazards, such as rocks, stumps, and logs, protrude from the ground.

3.3.78 Operator's Panel. A panel containing gauges, switches, instruments, or controls where an operator can visually monitor the applicable functions. [1901, 2016]

3.3.79 Optical Center. The point specified by the optical warning device manufacturer of highest intensity when measuring the output of an optical warning device. [1901, 2016]

3.3.80 Optical Element. Any individual lamp or other light emitter within an optical source. [1901, 2016]

3.3.81 Optical Power. A unit of measure designated as candela-seconds/minute that combines the flash energy and flash rate of an optical source into one power measurement representing the true visual effectiveness of the emitted light. [1901, 2016]

3.3.82* Optical Source. Any single, independently mounted, light-emitting component in a lighting system. [1901, 2016]

3.3.83 Optical Warning Device. A manufactured assembly of one or more optical sources. [1901, 2016]

3.3.84 Personal Equipment Weight. A weight allowance for personal gear that is carried on the apparatus by each fire-fighting crew member.

3.3.85 Powered Equipment Rack. A power-operated device that is intended to provide storage of suction hoses, ground ladders, or other equipment, generally in a location above apparatus compartments. [1901, 2016]

3.3.86* Preconnected Hose Line. A hose line that is stored on the apparatus already connected to an outlet on a pump and that can be charged by the activation of one discharge valve. [1901, 2016]

3.3.87 Proper(ly). In accordance with the manufacturer's specifications or as recommended by the manufacturer. [1901, 2016]

3.3.88 psi. Pounds per square inch. [1901, 2016]

3.3.89 PTO. Power takeoff. [1901, 2016]

3.3.90 Pump Discharge Pressure Classification.

3.3.90.1 High Pressure. Pump discharge pressure from 500 psi (3500 kPa) to less than 1100 psi (7600 kPa). [1901, 2016]

3.3.90.2 Normal Pressure. Pump discharge pressure less than 500 psi (3500 kPa). [1901, 2016]

3.3.90.3 Ultra-High Pressure. Pump discharge pressure of 1100 psi (7600 kPa) or greater. [1901, 2016]

3.3.91 Pump and Roll. Process of discharging water while the vehicle is in motion.

3.3.92 Pump Operator's Panel. The area on a fire apparatus that contains the gauges, controls, and other instruments used for operating the pump. [1901, 2016]

3.3.93 Pump Operator's Position. The location from which the pump operator operates the pump. [1901, 2016]

3.3.94 Purchaser. The authority having responsibility for the specification and acceptance of the apparatus. [1901, 2016]

3.3.95 Purchasing Authority. The agency that has the sole responsibility and authority for negotiating, placing, and, where necessary, modifying each and every solicitation, purchase order, or other award issued by a governing body. [1901, 2016]

3.3.96 Qualified Person. A person who, by possession of a recognized degree, certificate, professional standing, or skill, and who, by virtue of education, training, experience, or other special attributes possesses expertise regarding a particular subject matter, work, or project.

3.3.97 Ramp Breakover Angle. The angle measured between two lines tangent to the front and rear tire static loaded radius, and intersecting at a point on the underside of the vehicle that defines the largest ramp over which the vehicle can roll.

3.3.98 Rated Capacity (Water Pump). The flow rate to which the pump manufacturer certifies compliance of the pump when it is new. [1901, 2016]

3.3.99 Readily Accessible. Able to be located, reached, serviced, or removed without removing other components or parts of the apparatus and without the need to use special tools to open enclosures. [1901, 2016]

3.3.100 Rear Axle Track Width. The lateral distance between the centerlines of the tires at ground; if there are dual rear wheels, the lateral distance from the midway points between the inner and outer tires at ground. [1901, 2016]

3.3.101 Removable Winch. A winch with quick disconnects for power and controls that can be temporarily mounted on the apparatus at a permanently installed mounting receiver. [1901, 2016]

3.3.102 Reserve Capacity. The ability of a battery to sustain a minimum electrical load in the event of a charging system failure or a prolonged charging system deficit. [1901, 2016]

3.3.103 Reserved. The contents that would go in this section are not applicable to this document, but for consistency with other NFPA documents, the chapter, section, or subsection number is maintained.

3.3.104 Road Spray Location. Any underbody or underchassis location that is subject to road spray. [1901, 2016]

3.3.105 Sign. A visual indication whether in pictorial or word format that provides a warning to the operator or other persons near the apparatus. [1901, 2016]

3.3.106* Slip-On Fire-Fighting Module. A self-contained unit that includes an auxiliary-driven pump, piping, a tank, and hose storage and that is designed to be placed on a truck chassis, utility bed, flatbed, or trailer of sufficient carrying capacity.

3.3.107 Slow-Operating Valve. A valve that has a mechanism to prevent movement of the flow-regulating element from the fully closed position to the fully opened position or vice versa in less than 3 seconds. [1901, 2016]

3.3.108 Split Shaft PTO. A power takeoff (PTO) drive system that is inserted between the chassis transmission and the chassis drive axle and that has the shift mechanism necessary to direct the chassis engine power either to the drive axle or to a fire pump or other accessory. [1901, 2016]

3.3.109 Standard Cubic Feet per Minute (SCFM). An expression of airflow rate in which the airflow rate is corrected to standard temperature and pressure. Standard temperature is 60°F (15°C) and standard pressure is 14.696 psi (101.33 kPa) or 29.92 in. Hg (760 mm Hg).

3.3.110 Suction Hose. A hose that is designed to prevent collapse under vacuum conditions so that it can be used for drafting water from below the pump (lakes, rivers, wells, etc.). [1961, 2013]

3.3.111 Suction Lift. The sum of the vertical lift and the friction and entrance loss caused by the flow through the intake strainers and hose expressed in feet of water (meters of water) head. [1901, 2016]

3.3.112 Sump. A recessed area of a tank assembly designed primarily to entrap sludge or debris for removal and to serve as a central liquid collection point. [1901, 2016]

3.3.113 Supply Hose. Hose designed for the purpose of moving water between a pressurized water source and a pump that is supplying attack lines. [1961, 2013]

3.3.114 Swash Partition. A vertical wall within a tank structure designed to control the unwanted movement of the fluid within that tank. [1901, 2016]

3.3.115 Switch. Any set of contacts that interrupts or controls current flow through an electrical circuit. [1901, 2016]

3.3.116 Total Continuous Electrical Load. The total current required to operate all of the devices permanently connected to the apparatus that can be simultaneously energized excluding intermittent-type loads such as primers and booster reel rewind motors. [1901, 2016]

3.3.117 Tow Vehicle. A motor vehicle used to tow a trailer under emergency response conditions whether the tow vehicle-trailer combination is designed to remain together as a single unit or to be separated at the incident to allow the trailer to be used independently of the tow vehicle. [1901, 2016]

3.3.118 Trailer. A vehicle designed to be pulled by a tow vehicle and used to transport equipment or other vehicles under emergency response conditions. [1901, 2016]

3.3.119 Turning Clearance Radius. One-half the larger of the left or right full circle wall-to-wall turning diameter. [1901, 2016]

3.3.120 Ultimate Strength. The strength of a material in tension, compression, or shear, respectively, that is the maximum tensile, compressive, or shear stress that the material can sustain, calculated on the basis of the ultimate load and the original or unrestrained dimensions. [1901, 2016]

3.3.121 Unequipped Fire Apparatus. The completed fire apparatus excluding personnel, agent(s), and any equipment removable without the use of tools. [1901, 2016]

3.3.122 Vibration Isolation. Isolation materials used to prevent structure-borne vibrations from reaching attached surfaces. [1901, 2016]

3.3.123 Wet Location. A location on fire apparatus subject to saturation with water or other liquids and in unprotected locations exposed to the weather. (See also 3.3.104, *Road Spray Location*.) [1901, 2016]

3.3.124 Wildland Fire Crew Carrier Apparatus. Fire apparatus designed for transporting 10 or fewer personnel in the cab and crew compartment for the purpose of wildland fire suppression.

3.3.125 Wildland Fire Pump. A water pump that meets the requirements of Section 16.2 of NFPA 1906.

3.3.126 Wildland Fire Suppression Apparatus. A fire apparatus designed for fighting wildland fires that is equipped with a pump, a water tank, limited hose and equipment, and pump-and-roll capability.

3.3.127 Wildland Mobile Water Supply Apparatus (Wildland Water Tender). A fire apparatus designed for transporting water (pickup, transporting, and delivering) and fighting wildland fires on and off road that is equipped with a wildland fire pump, a water tank with minimum capacity of 1000 gal (4000 L), limited hose and equipment, and pump-and-roll capability.

Chapter 4 General Requirements

4.1 General.

4.1.1 All wildland fire apparatus shall meet the requirements of Chapters 1 through 4 and 12 through 15.

4.1.2 If a tow vehicle is to respond while calling for right-of-way under emergency conditions, it shall meet the requirements of 4.1.1. [1901:4.1.2]

4.2 Requirements by Apparatus Type. Certain chapters of this standard shall apply to the construction of each listed type of wildland apparatus, as shown in Table 4.2.

4.3 Responsibility of the Purchaser.

4.3.1* It shall be the responsibility of the purchaser to specify the details of the apparatus in addition to the requirements in NFPA 1906 needed by the manufacturer to build the apparatus, including:

- (1) Requirements not uniquely specified in NFPA 1906, such as the type of apparatus desired.
- (2) Any features of the apparatus desired in addition to, or in excess of, the requirements in NFPA 1906.

[1901:4.3.1]

4.4 Reserved.

4.5 Reserved.

4.6 Legal Requirements. The apparatus shall comply with all applicable federal and state or provincial laws and regulations. [1901:4.6]

4.7 Third-Party Certification of Test Results. Where this standard requires the results of tests to be certified by an independent third-party certification organization, that organization shall meet the requirements of this section. [1901:4.7]

4.7.1 All certification shall be performed by a certification organization that is accredited for inspection and testing systems on fire apparatus in accordance with ISO/IEC 17020, *General criteria for the operation of various types of bodies performing inspection*, or ISO/IEC 17065, *Conformity Assessment: Requirements for bodies certifying products, processes and services*. [1901:4.7.1]

4.7.2 The certification organization shall not be owned or controlled by manufacturers or vendors of the product that is being tested. [1901:4.7.2]

4.7.3 The certification organization shall be primarily engaged in certification work and shall not have a monetary interest in the product's ultimate profitability. [1901:4.7.3]

4.7.4* The independent third-party organization shall witness all required tests by an in-person representative(s) at the test site or by use of verifiable automated data collection and image recording equipment. The third-party organization shall refuse to certify any test results for a system if all components of that system requiring testing do not pass the testing required by this standard. [1901:4.7.4]

4.7.5 There shall be no conditional, temporary, or partial certification of test results. [1901:4.7.5]

4.7.6* Forms or data sheets shall be provided and used during the testing. [1901:4.7.6]

Table 4.2 Chapter Requirements by Wildland Apparatus

Chapter	Wildland Fire Suppression Apparatus	Wildland Mobile Water Supply Fire Apparatus	Wildland Fire Crew Carrier Apparatus
1. Administration	Required	Required	Required
2. Referenced Publications	Required	Required	Required
3. Definitions	Required	Required	Required
4. General Requirements	Required	Required	Required
5. Wildland Fire Suppression Apparatus	Required	N/A	N/A
6. Reserved	N/A	N/A	N/A
7. Wildland Mobile Water Supply Fire Apparatus	N/A	Required	N/A
8. Reserved	N/A	N/A	N/A
9. Reserved	N/A	N/A	N/A
10. Wildland Fire Crew Carrier Apparatus	N/A	N/A	Required
11. Reserved	N/A	N/A	N/A
12. Chassis and Vehicle Components	Required	Required	Required
13. Low Voltage Electrical Systems and Warning Devices	Required	Required	Required
14. Driving and Crew Areas	Required	Required	Required
15. Body, Compartments, and Equipment Mounting	Required	Required	Required
16. Pumps for Wildland Fire Fighting and Associated Equipment	Required	Required	N/A
17. Reserved	N/A	N/A	N/A
18. Water Tanks	Required	Required	N/A
19. Reserved	N/A	N/A	N/A
20. Foam Proportioning Systems for Class A Foam Concentrate	If specified	If specified	N/A
21. Compressed Air Foam Systems (CAFS)	If specified	If specified	N/A
22. Line Voltage Electrical Systems	If specified	If specified	If specified
23. Reserved	N/A	N/A	N/A
24. Reserved	N/A	N/A	N/A
25. Winches	If specified	If specified	If specified
26. Reserved	N/A	N/A	N/A
27. Vehicle Protection Systems	If specified	If specified	If specified
28. Ultra-High Pressure	If specified	If specified	N/A

4.7.7 Programs shall be in place for training, proficiency testing, and performance verification of any staff involved with certification. [1901:4.7.7]

4.7.8 The certification organization's operating procedures shall provide a mechanism for the manufacturer to appeal decisions. The procedures shall include provisions for the presentation of information from representatives of both sides of a controversy to a designated appeals panel. [1901:4.7.8]

4.8 Manufacturer Certification of Test Results. Where this standard requires the results of tests or the performance of a component to be certified by the manufacturer, the manufacturer shall meet the requirements of this section. [1901:4.8]

4.8.1 A representative of the manufacturer shall witness all tests and shall refuse to certify any test results for a system unless all components of that system requiring testing pass the testing required by this standard. [1901:4.8.1]

4.8.2 There shall be no conditional, temporary, or partial certification of test results. [1901:4.8.2]

4.8.3 The manufacturer shall have the facilities and equipment necessary to conduct the required testing, a program for

the calibration of all instruments, and procedures to ensure the proper control of all testing. [1901:4.8.3]

4.8.4* Forms or data sheets shall be provided and used during the testing. [1901:4.8.4]

4.8.5 Programs shall be in place for training, proficiency testing, and performance verification of any personnel involved with certification. [1901:4.8.5]

4.8.6 An official of the company that manufactures or installs the product shall designate in writing who is qualified to witness tests and certify results. [1901:4.8.6]

4.8.7 Certification documentation shall be delivered with the apparatus, including results of the certification tests. [1901:4.8.7]

4.9 Personnel Protection.

4.9.1* Guards, shields, or other protection shall be provided where necessary in order to prevent injury of personnel by hot, moving, or rotating parts during nonmaintenance operations. [1901:4.9.1]

4.9.2 Electrical insulation or isolation shall be provided where necessary in order to prevent electrical shock from onboard electrical systems. [1901:4.9.2]

4.9.3 Vehicular workmanship shall ensure an operating environment free of accessible sharp projections and edges. [1901:4.9.3]

4.9.4* Safety signs with text shall conform to the general principles of ANSI/NEMA Z535.4, *Product Safety Signs and Labels*. Safety signs without text shall conform to the general principles for two-panel safety signs of ISO 9244, *Earth-moving machinery — Machine safety labels — General principles*. [1901:4.9.4]

4.9.4.1 Apparatus built for sale in the United States shall employ safety signage that complies with ANSI/NEMA Z535.4. [1901:4.9.4.1]

4.9.4.2 Apparatus built for sale outside the United States shall employ safety signage that complies with either ANSI/NEMA Z535.4 or ISO 9244. [1901:4.9.4.2]

4.9.4.3* Safety signs referenced in this standard beginning with the letters FAMA shall conform to the text and graphics of the referenced safety sign number found in FAMA TC010, *Standard Product Safety Sign Catalog for Automotive Fire Apparatus*. [1901:4.9.4.3]

4.10 Controls and Instructions.

4.10.1 Illumination shall be provided for controls, switches, instruction plates, labels, gauges, and instruments necessary for the operation of the apparatus and the equipment provided on it. [1901:4.10.1]

4.10.1.1 If external illumination is provided, it shall be a minimum of 5 fc (50 lx) on the face of the device. [1901:4.10.1.1]

4.10.1.2 If internal illumination is provided, it shall be a minimum of 4 footlamberts (14 candela/m²). [1901:4.10.1.2]

4.10.2* All required signs, instruction plates, and labels shall be permanent in nature and securely attached and shall meet the requirements of 4.9.4 and ANSI/UL 969, *Standard for Marking and Labeling Systems*. [1901:4.10.2]

4.10.2.1 The signs, instruction plates, and labels shall have resistance to damage from temperatures between -30°F and 176°F (-35°C and 80°C) and exposure to oil, fuel, water, hydraulic fluids, or other fluids used on the apparatus. [1901:4.10.2.1]

4.10.2.2 The exterior mounted labels relating to safety or critical operational instructions shall be reflective or illuminated as required by 4.10.1. [1901:4.10.2.2]

4.10.3 The centerline of any gauge or visual display required by this standard shall be no more than 84 in. (2130 mm) above the level where the operator stands to read the instrument. [1901:4.10.3]

4.10.4 The central midpoint or centerline of any control shall be no more than 72 in. (1830 mm) vertically above the ground (with vehicle at estimated in-service weight) or the platform that is designed to serve as the operator's standing position. [1901:4.10.4]

4.10.5 Controls Labeling. Where controls will be labeled using graphical symbols, they shall conform to the common graphical symbols found in FAMA TC008, *Graphical Symbols for Automotive Fire Apparatus*. [1901:4.10.5]

4.11 Reserved.

4.12 Component Protection.

4.12.1* Hydraulic hose lines, air system tubing, control cords, and electrical harnesses shall be mechanically attached to the frame or body structure of the apparatus. [1901:4.12.1]

4.12.2 The type of equipment described in 4.12.1 shall be furnished with protective looms, grommets, or other devices at each point where they pass through body panels or structural members or wherever they lie against a sharp metal edge. [1901:4.12.2]

4.12.3 A through-the-frame connector shall be permitted to be used in place of metal protective looms or grommets. [1901:4.12.3]

4.13 Vehicle Stability.

4.13.1* Rollover Stability. The apparatus shall meet the criteria defined in 4.13.1.1.

4.13.1.1 The apparatus shall meet the criterion defined in either of the following:

- (1)* The apparatus shall remain stable in both directions in accordance with Table 4.13.1.1 when tested on a tilt table in accordance with SAE J2180, *A Tilt Table Procedure for Measuring the Static Rollover Threshold for Heavy Trucks*.
- (2) The calculated or measured vertical center of gravity (VCG) divided by the rear axle track width shall not exceed the applicable criterion in Table 4.13.1.1.

4.13.1.1.1 Compliance shall be certified by testing, calculating, or measuring the apparatus or by comparing the apparatus to a compliant, substantially similar example apparatus, and the certification shall be delivered with the fire apparatus. [1901:4.13.1.1.1]

4.13.1.1.2 The example apparatus shall be considered substantially similar if it includes a chassis with the same or higher center of gravity (CG) height, the same or narrower rear axle track width, the same or greater water tank size and CG height, and the same type of front and rear suspension.

4.13.1.1.3 For purposes of 4.13.1.1, the apparatus shall be loaded with fuel, fire-fighting agents, hose, ladders, a weight of 250 lb (114 kg) in each seating position, and weight equivalent to the miscellaneous equipment allowance as defined in Table 12.1.2. [1901:4.13.1.1.3]

4.13.1.1.3.1 If the apparatus is designed to meet a specified higher equipment loading (e.g., a larger hose bed capacity) or to carry ground ladders or additional equipment, these greater loads shall be included in the testing, calculating, or measuring.

4.13.1.1.3.2 The weight added to the fire apparatus for the purpose of test, calculation, or measurement shall be distributed to approximate typical in-service use of the fire apparatus

Table 4.13.1.1 Vehicle GVWR

Vehicle GVWR	Tilt Criteria (degrees)	VCG/Track (percentage)
≤33,000 lb (15,000 kg)	30	75
>33,000 lb (15,000 kg)	27	80

while not exceeding the manufacturer's published individual compartment weight ratings. [1901:4.13.1.1.3.2]

4.13.2 Weight Distribution.

4.13.2.1* When the fire apparatus is loaded to its estimated in-service weight, the front-to-rear weight distribution shall be within the limits set by the chassis manufacturer. [1901:4.13.2.1]

4.13.2.2 The front axle loads shall not be less than the minimum axle loads specified by the chassis manufacturer, under full load and all other loading conditions. [1901:4.13.2.2]

4.13.3 Load Distribution.

4.13.3.1* The apparatus manufacturer shall calculate the load distribution for the apparatus and that load distribution plan shall be delivered with the fire apparatus. [1901:4.13.3.1]

4.13.3.2 The manufacturer shall engineer the fire apparatus to comply with the gross axle weight ratings (GAWR), the overall gross vehicle weight rating (GVWR), and the chassis manufacturer's load balance guidelines. [1901:4.13.3.2]

4.13.3.3* The fire apparatus, when loaded to its estimated in-service weight, shall have a side-to-side tire load variation of no more than 7 percent of the total tire load for that axle. [1901:4.13.3.3]

4.13.4* Each tire shall be equipped with a visual indicator or monitoring system that indicates tire pressure. [1901:4.13.4]

4.14 Fire Apparatus Performance.

4.14.1* The fire apparatus shall meet the requirements of this standard at elevations of 2000 ft (600 m) above sea level. [1901:4.14.1]

4.14.2* The fire apparatus shall meet all the requirements of this standard while stationary on a grade of 10 percent in any direction.

4.14.3* The fire apparatus shall meet the requirements of this standard in ambient temperature conditions between 32°F (0°C) and 110°F (43°C). [1901:4.14.3]

4.15 Highway Performance.

4.15.1 The apparatus, when loaded to its estimated in-service weight, shall be capable of the following performance while on dry, paved roads that are in good condition:

- (1) Accelerating from 0 to 35 mph (55 km/hr) within 25 seconds on a 0 percent grade
 - (2)* Attaining a speed of 50 mph (80 km/hr) on a 0 percent grade
 - (3)* Maintaining a speed of at least 20 mph (32 km/hr) on any grade up to and including 6 percent.
- [1901:4.15.1]

4.15.2* The maximum top speed of fire apparatus with a GVWR over 33,000 lb (11,800 kg) shall not exceed 68 mph (105 km/hr) or the manufacturer's maximum fire service speed rating for the tires installed on the apparatus, whichever is lower.

4.15.3 If the combined water tank and foam agent tank capacities on the fire apparatus exceed 1250 gal (4732 L), or the GVWR of the vehicle is over 50,000 lb (22,680 kg), the maximum top speed of the apparatus shall not exceed either 60 mph (85 km/hr) or the manufacturer's maximum fire serv-

ice speed rating for the tires installed on the apparatus, whichever is lower. [1901:4.15.3]

4.15.4* The vehicle shall be capable of maneuvering across a 20 percent grade and up and down a 25 percent grade.

4.16 Serviceability.

4.16.1* The fire apparatus shall be designed so that all the manufacturer's recommended routine maintenance checks of lubricant and fluid levels can be performed by the operator without lifting the cab of a tilt-cab apparatus and without the need for hand tools. [1901:4.16.1]

4.16.2 Where special tools are required for routine service on any component of the apparatus, such tools shall be provided with the apparatus. [1901:4.16.2]

4.16.3 Apparatus components that interfere with repair or removal of other major components shall be attached with fasteners, such as cap screws and nuts, so that the components can be removed and installed with ordinary hand tools. These components shall not be welded or otherwise permanently secured into place. [1901:4.16.3]

4.17 General Pre-Delivery Tests.

4.17.1 Each apparatus shall be tested before delivery to verify that it meets the criteria in this section. [1901:4.17.1]

4.17.1.1 The tests shall be conducted at a location and in a manner that does not violate local, state or provincial, or federal traffic laws. [1901:4.17.1.1]

4.17.1.2 Tests shall be conducted on a dry, level, paved surface that is free of loose material, oil, or grease. [1901:4.17.1.2]

4.17.1.3 Tests shall be conducted with the water and foam tanks full (water or product). [1901:4.17.1.3]

4.17.2 The apparatus shall accelerate from 0 to 35 mph (55 km/hr) within 25 seconds. [1901:4.17.2]

4.17.3 The apparatus shall attain a speed of 50 mph (80 km/hr). [1901:4.17.3]

4.17.4 The auxiliary braking system, if so equipped, shall function as intended by the auxiliary braking system manufacturer. [1901:4.17.4]

4.17.5* The air service brakes shall bring the apparatus to a complete stop from a speed of 20 mph (32.2 km/hr) in a distance not exceeding 35 ft (10.7 m). [1901:4.17.5]

4.17.6 The hydraulic service brakes shall bring the apparatus to a complete stop from a speed of 30 mph (48.2 km/hr) in a distance not exceeding 88 ft (26.8 m). [1901:4.17.6]

4.18* Tests on Delivery. If acceptance tests are performed at the point of delivery, the tests shall not be performed in a manner that requires the apparatus or a component to operate outside its designed operating range.

4.19* Documentation. Any documentation delivered with the apparatus shall be permitted to be in printed format, electronic format, audiovisual format, or a combination thereof. [1901:4.19]

4.20 Data Required of the Contractor.

4.20.1 Fire Apparatus Documentation. The contractor shall supply, at the time of delivery, at least one copy of the following documents:

- (1) The manufacturer's record of apparatus construction details, including the following information:
 - (a) Owner's name and address
 - (b) Apparatus manufacturer, model, and serial number
 - (c) Chassis make, model, and serial number
 - (d) GAWR of front and rear axles and GVWR
 - (e) Front tire size and total rated capacity in pounds (kilograms)
 - (f) Rear tire size and total rated capacity in pounds (kilograms)
 - (g) Chassis weight distribution in pounds (kilograms) with water and manufacturer-mounted equipment (front and rear)
 - (h) For each engine: make, model, serial number, rated horsepower and related speed, and governed speed; and if so equipped, engine transmission PTO(s) make, model, and gear ratio
 - (i) Type of fuel and fuel tank capacity
 - (j) Electrical system voltage and alternator output in amps
 - (k) Battery make, model, and capacity in cold cranking amps (CCA)
 - (l) Chassis transmission make, model, and serial number; and if so equipped, chassis transmission PTO(s) make, model, and gear ratio
 - (m) Ratios of all driving axles
 - (n) Maximum governed road speed
 - (o) For each pump: make, model, rated capacity in gallons per minute (liters per minute where applicable), and serial number
 - (p) For each pump transmission: make, model, serial number, and gear ratio
 - (q) Reserved
 - (r) Water tank certified capacity in gallons or liters
 - (s) Reserved
 - (t) Paint manufacturer and paint number(s)
 - (u) Company name and signature of responsible company representative
 - (v) Weight documents from a certified scale showing actual loading on the front axle, rear axle(s), and overall fire apparatus (with water tank full but without personnel, equipment, and hose)
- (2) Reserved
- (3) Certification of compliance of the optical warning system (*see 13.8.16*)
- (4) Siren manufacturer's certification of siren (*see 13.9.1.1*)
- (5) Written load analysis and results of the electrical system performance tests (*see 13.14.1 and Section 13.15*)
- (6) Certification of slip resistance of all stepping, standing, and walking surfaces (*see 15.7.4.5*)
- (7) The wildland fire pump manufacturer's certification of suction capability (*see 16.2.4.1*)
- (8) If special conditions are specified by the purchaser of the wildland fire pump, the pump manufacturer's certification of suction capacity under the special conditions (*see 16.2.4.2*)
- (9) A copy of the apparatus manufacturer's approval for stationary pumping applications of the wildland fire pump (*see 16.3.1*)
- (10) Reserved
- (11) For each pump, the pump manufacturer's certification of the hydrostatic test (*see 16.5.2.2*)
- (12) For each pump, the certification of inspection and test for the pump (*see 16.13.1.2.4*)
- (13) Reserved
- (14) The certification of water tank capacity (*see Section 18.6*)
- (15) Reserved
- (16) Reserved
- (17) If the apparatus has a foam proportioning system, the foam proportioning system manufacturer's certification of accuracy (*see 20.10.4.2*) and the final installer's certification that the foam proportioning system meets this standard (*see 20.11.2*)
- (18) If the system has a CAFS, the documentation of the manufacturer's predelivery tests (*see Section 21.9*)
- (19) If the apparatus has a line voltage power source, the certification of the test for the power source (*see NFPA 1901*)
- (20) If the apparatus is equipped with an air system, air tank certificates (*see NFPA 1901, 24.5.1.2*), the SCBA fill station certification (*see NFPA 1901, 24.9.7*), and the results of the testing of the air system installation (*see NFPA 1901, 24.14.5 and NFPA 1901, 24.15.4*)
- (21) Certification of vehicle side slope stability, including the weight distribution assumed for the calculations or as loaded on the vehicle for the tilt table test (*see 4.9.1*)
- (22) Any other required manufacturer test data or reports

4.20.2 Operations and Service Documentation.

4.20.2.1 The contractor shall deliver with the fire apparatus at least two sets of complete operation and service documentation covering the completed apparatus as delivered and accepted. [1901:4.20.2.1]

4.20.2.2 The documentation shall address at least the inspection, service, and operations of the fire apparatus and all major components thereof. [1901:4.20.2.2]

4.20.2.3 The contractor shall also provide the following documentation for the entire apparatus and each major operating system or major component of the apparatus:

- (1) Manufacturer's name and address
- (2) Country of manufacture
- (3) Source for service and technical information
- (4) Parts replacement information
- (5) Descriptions, specifications, and ratings of the chassis and pump
- (6) Wiring diagrams for low-voltage and line voltage systems to include the following information:
 - (a) Pictorial representations of circuit logic for all electrical components and wiring
 - (b) Circuit identification
 - (c) Connector pin identification
 - (d) Zone location of electrical components
 - (e) Safety interlocks
 - (f) Alternator-battery power distribution circuits
 - (g)* Input/output assignment sheets or equivalent circuit logic implemented in multiplexing systems
- (7) Lubrication charts

- (8) Operating instructions for the chassis and any major components such as the pump, and any auxiliary systems
- (9) Reserved
- (10) Instructions regarding the frequency and procedure for recommended maintenance
- (11) Overall apparatus operating instructions
- (12) Safety considerations
- (13) Limitations of use
- (14) Inspection procedures
- (15) Recommended service procedures
- (16) Troubleshooting guide
- (17) Apparatus body, chassis, and other component manufacturer's warranties
- (18) Special data required by this standard
- (19) A material safety data sheet (MSDS) for any fluid that is specified for use on the apparatus

4.20.2.4* The contractor shall deliver with the apparatus all manufacturers' operations and service documents supplied with components and equipment that are installed or supplied by the contractor. [1901:4.20.2.4]

4.21 Statement of Exceptions. The entity responsible for final assembly of the apparatus shall deliver with the fire apparatus either a certification that the apparatus fully complies with all requirements of this standard or, alternatively, a Statement of Exceptions specifically describing each aspect of the completed apparatus that is not fully compliant with the requirements of this standard at the time of delivery. [1901:4.21]

4.21.1 The Statement of Exceptions shall contain, for each noncompliant aspect of the apparatus or missing required item, the following information:

- (1) A separate specification of the section of the applicable standard for which compliance is lacking
- (2) A description of the particular aspect of the apparatus that is not in compliance therewith or required equipment that is missing
- (3) A description of the further changes or modifications to the delivered apparatus that must be completed to achieve full compliance
- (4) Identification of the entity that will be responsible for making the necessary postdelivery changes or modifications or for supplying and installing any missing required equipment to the apparatus to achieve full compliance with this standard

[1901:4.21.1]

4.21.2 Prior to, or at the time of, delivery of the apparatus, the Statement of Exceptions shall be signed by an authorized agent of the entity responsible for final assembly of the apparatus and by an authorized agent of the purchasing entity, indicating mutual understanding and agreement between the parties regarding the substance thereof. [1901:4.21.2]

4.21.3* An apparatus that is delivered subject to a Statement of Exceptions shall be recognized as noncompliant by the purchaser. The purchaser either accepts the vehicle as noncompliant or accepts responsibility that the apparatus will not be placed in emergency service until the apparatus has been modified as necessary to be in full compliance with this standard.

Chapter 5 Wildland Fire Suppression Apparatus

5.1 General. If the apparatus is to function as a wildland fire suppression apparatus, it shall meet the requirements of this chapter.

5.2 Pump. The apparatus shall be equipped with a pump for wildland fire fighting that meets the requirements of Chapter 16 or a fire pump that meets the requirements of NFPA 1901.

5.3 Reserved.

5.4 Water Tank. The apparatus shall be equipped with a water tank(s) that meets the requirements of Chapter 18 and that has a minimum certified capacity (combined, if applicable) of 150 gal (600 L).

5.5* Equipment Storage. A minimum volume as shown in Table 5.5 of enclosed weather-resistant compartmentation that meets the requirements of Section 15.1 shall be provided for the storage of equipment.

5.6* Hose Storage. If the apparatus is equipped with a dedicated hose storage area(s), such area(s) shall comply with Section 15.10.

5.7 Equipment.

5.7.1 The following equipment shall be furnished by the contractor:

- (1)* Two solid bottom wheel chocks, mounted in readily accessible locations, each designed to hold the apparatus, when loaded to its GVWR, on a 15 percent grade with the transmission in neutral and the parking brake released
- (2) One set of tire tools, including a jack and a lug wrench, if a spare tire is carried on the apparatus

5.7.2* The following additional equipment shall be carried on the apparatus:

- (1) One of the following traffic warning devices:
 - (a) Five fluorescent orange traffic cones not less than 28 in. (711 mm) in height, each equipped with a 6 in. (152 mm) retroreflective white band no more than 4 in. (102 mm) from the top of the cone, and an additional 4 in. (102 mm) retroreflective white band 2 in. (51 mm) below the 6 in. (152 mm) band
 - (b) One reflective triangle kit
- (2) Five illuminated warning devices such as highway flares, unless the traffic cones or reflective triangles specified in 5.7.2(1) have illuminating capabilities
- (3) One traffic vest for each seating position, each vest to comply with ANSI/ISEA 207, *Standard for High-Visibility Public Safety Vests*, and to have a five-point breakaway feature that includes two at the shoulders, two at the sides, and one at the front

Table 5.5 Equipment Storage Requirements

Chassis GVWR		Storage Area	
lb	kg	ft ³	m ³
10,001–15,000	4,501–7,000	20	0.56
15,001–20,000	7,001–9,000	50	1.42
20,001–26,000	9,001–12,000	50	1.42
>26,000	>12,000	75	2.12

- (4) One approved, dry chemical portable fire extinguisher with a minimum capacity in accordance with the following:
 - (a) For a GVWR below 33,000 lb (15,000 kg), a 2A-10-B:C extinguisher
 - (b) For a GVWR 33,000 lb (15,000 kg) and above, a 3A-40-B:C extinguisher
- (5) One first-aid kit

5.7.3 A detailed list of who is to furnish the items and the method for organizing and mounting these items shall be supplied by the purchasing authority.

Chapter 6 Reserved

Chapter 7 Wildland Mobile Water Supply Fire Apparatus

7.1* General. If the apparatus is to function as a wildland mobile water supply apparatus, it shall meet the requirements of this chapter.

7.2 Pump. The apparatus shall be equipped with a pump for wildland fire fighting that meets the requirements of Chapter 16 or a fire pump that meets the requirements of NFPA 1901.

7.3 Reserved.

7.4 Water Tank. The apparatus shall be equipped with a water tank(s) that meets the requirements of Chapter 18 and that has a minimum certified capacity (combined, if applicable) of 1000 gal (4000 L).

7.5* Equipment Storage. A minimum of 20 ft³ (0.57 m³) of enclosed weather-resistant compartmentation that meets the requirements of Section 15.1 shall be provided for the storage of equipment.

7.6* Hose Storage.

7.6.1* The apparatus shall be equipped with a hose storage area that complies with Section 15.10.

7.6.2 Storage shall be provided to accommodate a minimum of 20 ft (6 m) of suction hose and 15 ft (4.5 m) of supply hose.

7.7 Equipment.

7.7.1 The following equipment shall be furnished by the contractor:

- (1)* Two solid bottom wheel chocks, mounted in readily accessible locations, each designed to hold the apparatus, when loaded to its GVWR, on a 15 percent grade with the transmission in neutral and the parking brake released
- (2) One set of tire tools, including a jack and a lug wrench, if a spare tire is carried on the apparatus

7.7.2* The following additional equipment shall be carried on the apparatus:

- (1) One of the following traffic warning devices:
 - (a) Five fluorescent orange traffic cones not less than 28 in. (711 mm) in height, each equipped with a 6 in. (152 mm) retroreflective white band no more than 4 in. (102 mm) from the top of the cone, and an additional 4 in. (102 mm) retroreflective white band 2 in. (51 mm) below the 6 in. (152 mm) band

- (b) One reflective triangle kit
- (2) Five illuminated warning devices such as highway flares, unless the traffic cones or reflective triangles specified in 7.7.2(1) have illuminating capabilities
- (3) One traffic vest for each seating position, each vest to comply with ANSI/ISEA 207, *Standard for High-Visibility Public Safety Vests*, and to have a five-point breakaway feature that includes two at the shoulders, two at the sides, and one at the front
- (4) One approved, dry chemical portable fire extinguisher with a minimum capacity in accordance with the following:
 - (a) For a GVWR below 33,000 lb (15,000 kg), a 2A-10-B:C extinguisher
 - (b) For a GVWR 33,000 lb (15,000 kg) and above, a 3A-40-B:C extinguisher
- (5) One first-aid kit

7.7.3 A detailed list of who is to furnish the items and the method for organizing and mounting these items shall be supplied by the purchasing authority.

Chapter 8 Reserved

Chapter 9 Reserved

Chapter 10 Wildland Fire Crew Carrier Apparatus

10.1 General.

10.1.1 If the apparatus is to function as a wildland fire crew carrier apparatus, it shall meet the requirements of this chapter.

10.2 Equipment.

10.2.1 The following equipment shall be furnished by the contractor:

- (1)* Two solid-bottom wheel chocks, mounted in readily accessible locations, each designed to hold the apparatus loaded to its GVWR, on a 15 percent grade, with the transmission in neutral, and the parking brake released
- (2) One set of tire tools, including a jack and a lug wrench, if a spare tire is carried on the apparatus

10.2.2 The following additional equipment shall be carried on the apparatus:

- (1) One of the following traffic warning devices:
 - (a) Five fluorescent orange traffic cones not less than 28 in. (711 mm) in height, each equipped with a 6 in. (152 mm) retroreflective white band no more than 4 in. (102 mm) from the top of the cone, and an additional 4 in. (102 mm) retroreflective white band 2 in. (51 mm) below the 6 in. (152 mm) band
 - (b) One reflective triangle kit
- (2) Five illuminated warning devices, such as highway flares, unless the traffic cones or reflective triangles specified in 10.2.2(1) have illuminating capabilities
- (3) For each seating position, a traffic vest that complies with ANSI/ISEA 207, *Standard for High-Visibility Public Safety Vests*, and has a five-point breakaway feature that includes two at the shoulders, two at the sides, and one at the front

- (4) One approved, dry-chemical portable fire extinguisher with a minimum capacity in accordance with the following:
 - (a) For a GVWR less than 33,000 lb (15,000 kg), a 2A-10-B:C extinguisher
 - (b) For a GVWR of 33,000 lb (15,000 kg) or more, a 3A-40-B:C extinguisher
- (5) One first-aid kit

10.2.3 A detailed list of who is to furnish the items and the method for organizing and mounting these items shall be supplied by the purchasing authority.

10.3* Crew Compartment. A crew compartment body separate from the main cab shall be utilized for transportation of wildland fire fighters.

10.3.1 Body Mounting. The crew compartment body shall be mounted per the allowed and/or recommended methods of the chassis manufacturer for off-highway use.

10.3.1.1 Body mounting shall allow independent movement between the body and the chassis frame.

10.3.1.2 An independent secondary retention system shall be furnished to prevent the crew compartment body from completely separating from the chassis frame if the primary retention system fails.

10.3.2 A minimum of 12 in. (300 mm) width of clear aisle walkway shall be provided.

10.3.3 Each internal storage compartment shall be permanently labeled with the load capacity. [414:4.13.10]

10.3.4 If separated, the cab and the crew compartment body bulkheads shall have an aligned opening of at least 150 in.² (96,780 mm²).

10.3.5 The body interior shall be free of all sharp projections and sharp corners.

10.4 Crew Compartment Body Structural Integrity.

10.4.1 Structural Integrity — Roof Loading.

10.4.1.1 The crew compartment body shall withstand a force equal to 2.5 times the curb weight of the vehicle applied to the roof of the vehicle's body structure, validated by testing a substantially similar crew compartment in accordance with 10.4.2.

10.4.1.2 The downward vertical movement at any point on the roof application plate shall not exceed 5.12 in. (130 mm). [1917:6.3.4]

10.4.1.3 Each exterior door of the vehicle and emergency escape windows shall be capable of opening and closing during the full application of the force and after release of the force.

10.4.1.4 No structural damage to any load bearing or supporting members (e.g., torn or broken material, broken welds, popped or sheared body rivets, bolts, and/or fasteners) shall be evident during the application of the force and after the release of the force. [1917:6.3.6]

10.4.2 Test Method – Roof Loading.

10.4.2.1 The following steps shall be performed during the roof crush test:

- (1) Support the crew compartment on a rigid fixture independent of the vehicle suspension.
- (2) Remove any components that extend upward from the vehicle roof.
- (3) Measure and record the distance from the mounting surface to each of the four corners of the roof.
- (4) Employ a rectangular force application plate fitted as near as possible to the contour of the crew compartment roof.
- (5) Position the force application plate so that it is centered on the roof.
- (6) Close all crew compartment doors.
- (7) Load the application plate to 500 lb (227 kg) at a deflection rate less than 0.5 in. (13 mm) per second.
- (8) Record elevation readings of all four corners of the roof.
- (9) Load the application plate to 50 percent of the final load at a deflection rate less than 0.5 in. (13 mm) per second.
- (10) Record elevation readings of all four corners of the roof.
- (11) Load the application plate to 100 percent of the final load at a deflection rate less than 0.5 in. (13 mm) per second.
- (12) Record elevation readings of all four corners of the roof.
- (13) Verify that crew compartment doors and any emergency escape windows remain closed during the application of the load and are capable of being opened and closed.
- (14) Remove load.
- (15) Verify that crew compartment doors and any emergency escape windows remain closed after the application of the load and are capable of being opened and closed.

10.4.2.2 The application plate required in 10.4.2.1(4) shall be a minimum of 5 in. (127 mm) longer and 5 in. (127 mm) wider than the vehicle roof of the crew's compartment.

10.4.2.3 For the purposes of the measurements in 10.4.2.2, the crew compartment roof shall be that structure, seen in the top projected view, that coincides with the crew riding area, as shown in Figure 10.4.2.3.

10.4.3 Structural Integrity — Side Loading.

10.4.3.1 The crew compartment body shall withstand a force equal to 2.5 times the curb weight of the vehicle applied to either the driver or passenger side of the vehicle's body structure, validated by testing a substantially similar crew compartment in accordance with 10.4.4.

10.4.3.2 If so equipped, rear exterior doors and roof emergency escape hatches shall be capable of opening and closing during the full application of the force and after release of the force.

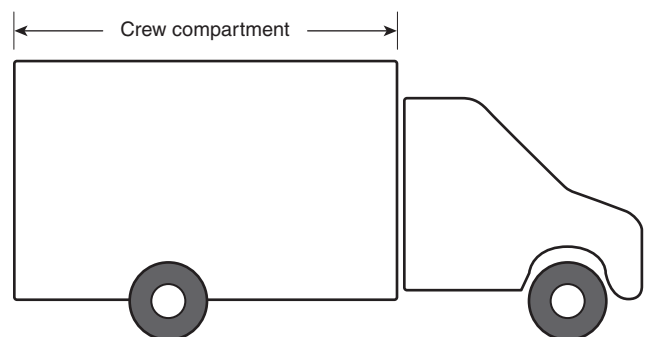


FIGURE 10.4.2.3 Crew Compartment Roof Measurement.

10.4.3.3 No structural damage to any load bearing or supporting members (e.g., torn or broken material, broken welds, popped or sheared body rivets, bolts, and/or fasteners) shall be evident during the application of the force and after the release of the force. [1917:6.3.6]

10.4.4 Test Method — Side Loading.

10.4.4.1 The following steps shall be performed during the side crush test:

- (1) Place either side of the body of the crew carrier on a rigid horizontal surface so that the body of the crew compartment is entirely supported.
- (2) Measure and record the distance from the mounting surface to each of the four top corners of the body side.
- (3) Employ a rigid, rectangular force application plate fitted as near as possible to the contour of the crew compartment side.
- (4) Position the force application plate so that it is centered on the crew compartment side.
- (5) Close all crew compartment doors.
- (6) Load the application plate to 500 lb (227 kg) at a deflection rate less than 0.5 in. (13 mm) per second.
- (7) Record elevation readings of all four corners of the body side.
- (8) Load the application plate to 50 percent of the final load at a deflection rate less than 0.5 in. (13 mm) per second.
- (9) Record elevation readings of all four corners of the body side.
- (10) Load the application plate to 100 percent of the final load at a deflection rate less than 0.5 in. (13 mm) per second.
- (11) Record elevation readings of all four corners of the body side.
- (12) Verify that rear exterior doors and any emergency roof escape hatches remain closed during the application of the load and are capable of being opened and closed.
- (13) Remove load.
- (14) Verify that rear exterior doors and any emergency roof escape hatches remain closed after the application of the load and are capable of being opened and closed.

10.4.4.2 The application plate required in 10.4.4.1(3) shall be a minimum of 5 in. (127 mm) longer and 5 in. (127 mm) wider than the vehicle side of the crew's compartment.

10.5 Crew Compartment Entry Doors.

10.5.1 The crew compartment shall be equipped with at least one primary access door opening with minimum dimensions of 28 in (710 mm) wide by 60 in. (1500 mm) high.

10.5.2 Door handles shall be designed and installed to protect against accidental or inadvertent opening. [1917:6.9.2]

10.5.3 Entry doors and door openings shall be designed to minimize inadvertent snagging of apparel. [1917:6.9.3]

10.5.4 When doors are open, the hinges and latches shall not protrude into the access area. [1917:6.9.5]

10.5.5 Doors shall be equipped with a hold-open device. [1917:6.9.6]

10.5.6 One externally operated lock for each door opening shall be provided. [1917:6.9.7]

10.5.7 An internal lock on each crew compartment primary entry door shall be provided.

10.5.8 All crew compartment entry door locks shall be identically keyed.

10.5.9 Doors shall be equipped with not less than 250 in.² (160,000 mm²) of safety glass area per door.

10.5.10 Doors and windows shall be designed to prevent leakage of exhaust fumes, dust, water, and air into the crew compartment.

10.6 Crew Compartment Body Means of Escape.

10.6.1 The crew compartment area shall have a minimum of four means of escape with at least one on the left side, right side, roof, and rear of the crew compartment.

10.7 Crew Compartment Seats.

10.7.1* All seats shall face fore or aft.

10.7.2 SCBA Storage. SCBA packs shall not be stored in the seat backs of seats in the crew compartment.

10.8 Crew Compartment Seat Head Height. The minimum vertical dimension from the seat H-point shall be 40 in. (1016 mm) to the ceiling for each belted seating position.

Chapter 11 Reserved

Chapter 12 Chassis and Vehicle Components

12.1* Carrying Capacity. The GAWR or GVWR of the chassis shall be adequate to carry the weight of the fire apparatus when loaded to its estimated in-service weight as defined in 12.1.2.

12.1.1 The manufacturer shall establish the estimated in-service weight during the design of the fire apparatus. [1901:12.1.1]

12.1.2 The estimated in-service weight shall include the following:

- (1) Chassis, body, and tank(s)
- (2) Full fuel, lubricant, and other chassis or component fluid tanks or reservoirs
- (3) Full water and other agent tanks, if equipped
- (4)* 250 lb (114 kg) in each seating position
- (5)* Fixed equipment such as pumps, generators, reels, and air systems as installed
- (6) Ground ladders, suction hose, designed hose load in their hose beds and on their reels
- (7)* An allowance for miscellaneous equipment that is at least as great as the values shown in Table 12.1.2
- (8)* If the apparatus is designed to accommodate SCBA, an additional 25 lb (11.4 kg) per seating position to the miscellaneous equipment allowance.

12.1.3 The manufacturer shall engineer and design the fire apparatus such that the completed apparatus, when loaded to its estimated in-service weight, with all movable weights distributed as close as is practical to their intended in-service configuration, does not exceed the GVWR. [1901:12.1.3]

12.1.4* A final manufacturer's certification of the GVWR or GCWR, along with a certification of the GAWR, shall be supplied on a label affixed to the vehicle. [1901:12.1.4]

Table 12.1.2 Minimum Miscellaneous Equipment Allowance

	Chassis GVWR		Equipment Weight	
	lb	kg	lb	kg
Wildland fire suppression apparatus	10,001–15,000	4,501– 7,000	200	90
	15,001–20,000	7,001–9,000	500	225
	20,001–26,000	9,001–12,000	500	225
	>26,000	>12,000	750	340
Wildland mobile water supply fire apparatus	All	All	200	90
Wildland fire crew carrier apparatus	≤19,500	≤8,845	500	225
	>19,500	>8,845	750	340

12.1.5 The fire apparatus manufacturer shall permanently affix a high-visibility label in a location visible to the driver while seated. [1901:12.1.5]

12.1.5.1* The label shall show the unladen height of the completed unequipped fire apparatus in feet and inches or in meters, the length of the completed fire apparatus in feet and inches or in meters, and the GVWR in tons or metric tons. [1901:12.1.5.1]

12.1.5.2 Wording on the label shall indicate that the information shown was current when the apparatus was manufactured and that, if the overall height changes while the vehicle is in service, the fire department must revise that dimension on the label.

12.2 Engine and Engine System Design.

12.2.1 Chassis Engine.

12.2.1.1* An engine governor or electronic fuel control system shall be installed that will limit the speed of the engine under all conditions of operation to that speed established by the engine manufacturer, which shall be the maximum governed speed. [1901:12.2.1.1]

12.2.1.2 Audible and visual warning devices that are visible from the driver's position shall be provided to alert the driver to high engine temperature or low oil pressure conditions. [1901:12.2.1.2]

12.2.1.3* Automatic engine shutdown systems shall not be permitted unless they are an integral part of the standard engine management system. [1901:12.2.1.3]

12.2.1.4 Engine derate programming shall be permitted to be used to protect the engine. [1901:12.2.1.4]

12.2.1.5 Engine Speed Auxiliary Control Device.

12.2.1.5.1* If the apparatus is equipped with an engine speed auxiliary control device, it shall comply with 12.2.1.5.2 and 12.2.1.5.3.

12.2.1.5.2* An interlock shall prevent the operation of the engine speed auxiliary control device unless the parking brake is engaged and the transmission is in neutral or park, or the parking brake is engaged and the engine is disengaged from the drive wheels. [1901:12.2.1.5.2]

12.2.1.5.3 The engine shall be prevented from regulating its own engine speed during times when engine rpm control is critical for consistent apparatus functions such as a generator or a water pump.

12.2.1.6 The installation of the engine, transmission, and engine- and transmission-driven accessories [power takeoffs (PTOs), etc.] shall meet the engine and transmission manufacturers' installation recommendations for the service intended. [1901:12.2.1.6]

12.2.2 Cooling System.

12.2.2.1* The engine's cooling system shall maintain a temperature in the engine at or below the engine manufacturer's maximum temperature rating under all conditions for which the apparatus is designed. [1901:12.2.2.1]

12.2.2.2 Drain Valves.

12.2.2.2.1 Readily accessible drain valves shall be installed at the lowest point of the cooling system and at such other points as are necessary to permit complete removal of the coolant from the system. [1901:12.2.2.2.1]

12.2.2.2.2* Drain valves shall be designed or positioned such that they will not open accidentally. [1901:12.2.2.2.2]

12.2.2.3 The radiator shall be mounted to prevent the development of leaks caused by twisting or straining where the apparatus operates over uneven ground. [1901:12.2.2.3]

12.2.3 Lubrication System.

12.2.3.1* The engine shall be provided with an oil filter of the type approved by the engine manufacturer. [1901:12.2.3.1]

12.2.3.2 The engine oil fill pipe shall be large enough and located so as to allow easy filling. [1901:12.2.3.2]

12.2.3.3 A permanent label in the driving compartment shall specify the quantity and type of the following fluids used in the vehicle and tire information:

- (1) Engine oil
- (2) Engine coolant
- (3) Chassis transmission fluid
- (4) Pump transmission lubrication fluid
- (5) Pump priming system fluid, if applicable
- (6) Drive axle(s) lubrication fluid
- (7) Air-conditioning refrigerant

- (8) Air-conditioning lubrication oil
 - (9) Power steering fluid
 - (10) Cab tilt mechanism fluid
 - (11) Transfer case fluid
 - (12) Equipment rack fluid
 - (13) CAFS air compressor system lubricant
 - (14) Generator system lubricant
 - (15)* Front tire cold pressure
 - (16)* Rear tire cold pressure
 - (17) Maximum tire speed ratings
- [1901:12.2.3.3]

12.2.4* Air Intake System.

12.2.4.1* An air filter shall be provided in the engine's air intake system. [1901:12.2.4.1]

12.2.4.2 Air inlet restrictions shall not exceed the engine manufacturer's recommendations. [1901:12.2.4.2]

12.2.4.3* The air inlet shall be equipped with a means of separating water and burning embers from the air intake system. [1901:12.2.4.3]

12.2.4.4 The requirement in 12.2.4.3 shall be permitted to be achieved by either of the following methods:

- (1) Provision of a device such that burning particulate matter larger than 0.039 in. (1.0 mm) in diameter cannot reach the air filter element
 - (2) Provision of a multiscreen ember separator capable of meeting the test requirements defined in the Parker Hannafin, Racor Division, publication LF 1093-90, *Ember Separation Test Procedure*, or an equivalent test
- [1901:12.2.4.4]

12.2.4.5 An air restriction indicator shall be mounted in the driving compartment and visible to the driver. [1901:12.2.4.5]

12.2.5 Fuel System.

12.2.5.1 Diesel Engines.

12.2.5.1.1* The fuel supply lines and fuel filters shall meet the engine manufacturer's recommendations. [1901:12.2.5.1.1]

12.2.5.1.2 The filters or strainers shall be of a serviceable type and mounted in an accessible location. [1901:12.2.5.1.2]

12.2.5.1.3 Where two or more fuel lines are installed, separate fuel pumps operating in parallel with check valves and filtering devices shall be provided. [1901:12.2.5.1.3]

12.2.5.1.4 The fuel line(s) shall be located or protected so as not to be subjected to excessive heating from any portion of an exhaust system. [1901:12.2.5.1.4]

12.2.5.1.5 The line(s) shall be protected from mechanical damage. [1901:12.2.5.1.5]

12.2.5.1.6 Electric Fuel Priming System.

12.2.5.1.6.1* Where an electric fuel priming system is furnished, the valving and piping shall be arranged so that the priming system can be operated only to reprime the fuel system. [1901:12.2.5.1.6.1]

12.2.5.1.6.2 When the priming system is not being intentionally operated, it shall be isolated from the fuel system and inoperable. [1901:12.2.5.1.6.2]

12.2.5.1.6.3 The priming system shall be marked with a label to indicate proper operation. [1901:12.2.5.1.6.3]

12.2.5.2 Gasoline Engines.

12.2.5.2.1 Fuel lines and filters or strainers that meet the engine manufacturer's recommendations shall be provided. [1901:12.2.5.2.1]

12.2.5.2.2 The filters or strainers shall be of a serviceable type and mounted in an accessible location. [1901:12.2.5.2.2]

12.2.5.2.3 Where two or more fuel lines are installed, separate fuel pumps operating in parallel with check valves and filtering devices shall be provided. [1901:12.2.5.2.3]

12.2.5.2.4 The fuel line(s) shall be located or protected so as not to be subjected to excessive heating from any portion of an exhaust system. [1901:12.2.5.2.4]

12.2.5.2.5 The line(s) shall be protected from mechanical damage. [1901:12.2.5.2.5]

12.2.5.2.6 A gasoline feed system shall include an electric-powered fuel pump located within or adjacent to the fuel tank. [1901:12.2.5.2.6]

12.2.6 Exhaust System.

12.2.6.1* The exhaust piping and discharge outlet shall be located or shielded so as not to expose any portion of the apparatus or equipment to excessive heating. [1901:12.2.6.1]

12.2.6.2 Exhaust pipe discharge shall be directed away from the pump operator's position. [1901:12.2.6.2]

12.2.6.3 Reserved.

12.2.6.4 Silencing devices shall be provided. [1901:12.2.6.4]

12.2.6.5 Exhaust backpressure shall not exceed the limits specified by the engine manufacturer. [1901:12.2.6.5]

12.2.6.6 Where parts of the exhaust system are exposed so that they are likely to cause injury to operating personnel, protective guards shall be provided. [1901:12.2.6.6]

12.2.6.7* Diesel Particulate Filter. If the apparatus is driven by a diesel engine equipped with a diesel particulate filter (DPF), the requirements of 12.2.6.7.1 through 12.2.6.7.6 shall apply. [1901:12.2.6.7]

12.2.6.7.1 The regeneration process shall be activated by two methods:

- (1)* Automatically by the engine system but only when the transmission is in gear and the speedometer indicates a speed above 5 mph (8 km/hr), whether the apparatus is in motion or is operating in stationary pump mode with an engine rpm sufficient to register 5 mph (8 km/hr) on the speedometer
 - (2) Manually when initiated by activation of a switch located in the driver's area of the driving compartment
- [1901:12.2.6.7.1]

12.2.6.7.2 Instructions for initiating the manual regeneration process shall be explained in the apparatus operator's manual. [1901:12.2.6.7.2]

12.2.6.7.3* A switch shall be provided at the driver's area that will inhibit DPF regeneration until the switch is reset or the engine is shut down and restarted. [1901:12.2.6.7.3]

12.2.6.7.4 A DPF icon visible to the driver when seated in the driver's seat shall be illuminated to indicate that the DPF requires active regeneration. [1901:12.2.6.7.4]

12.2.6.7.5 A high exhaust system temperature (HEST) icon visible to the driver when seated in the driver's seat shall be illuminated to indicate that an active regeneration process has been initiated. [1901:12.2.6.7.5]

12.2.6.7.6* Engine exhaust gas temperature shall not exceed 851°F (455°C) when measured at the exit of the exhaust pipe during normal DPF regeneration. [1901:12.2.6.7.6]

12.3 Vehicle Components.

12.3.1 Braking System.

12.3.1.1 All brakes shall be readily accessible for adjustment. [1901:12.3.1.1]

12.3.1.2* Where air-actuated braking systems are provided, they shall include the following:

- (1) An automatic moisture ejector
- (2) An air drier
- (3) A pressure protection valve to prevent air-operated accessories from drawing air from the air brake system when the air system's pressure drops below 80 psi (550 kPa)

12.3.1.3* Parking Brakes.

12.3.1.3.1 Parking brakes shall control the rear wheels, or all wheels, and shall be of the positive, mechanically actuated type. [1901:12.3.1.3.1]

12.3.1.3.2 A lockup device to retain applied pressure on hydraulically actuated service brake systems or the use of the "park" position on an automatic transmission shall not be substituted for a separate parking brake system. [1901:12.3.1.3.2]

12.3.1.4* Auxiliary Brake.

12.3.1.4.1 All apparatus with a GVWR of 36,000 lb (16,330 kg) or greater shall be equipped with an auxiliary braking system. [1901:12.3.1.4.1]

12.3.1.4.2* Auxiliary brakes shall have a switch to turn them off during adverse road conditions. [1901:12.3.1.4.2]

12.3.1.4.3 The DOT brake lights shall illuminate when the auxiliary brake is applied. [1901:12.3.1.4.3]

12.3.2 Suspension and Wheels.

12.3.2.1* Each load-bearing tire and rim of the fire apparatus shall not carry a weight in excess of the recommended load for the operation of truck tires of the size used, as published in *Tire and Rim Association — Year Book*, or as recommended by the tire manufacturer, when the apparatus is loaded to its GVWR. [1901:12.3.2.1]

12.3.2.2* Axle housings and any components other than wheels, tires, automatic tire chains, and items designed to swing clear shall clear the road surface by at least the ground clearance specified in Table 12.3.2.2.

12.3.2.3* An angle of approach and an angle of departure of at least 20 degrees shall be maintained at the front and the rear of the vehicle when it is loaded to the estimated in-service weight.

Table 12.3.2.2 Under-Vehicle Clearance

Chassis GVWR		Ground Clearance	
lb	kg	in.	mm
10,001–15,000	4,501–7,000	12	300
15,001–20,000	7,001–9,000	13	330
>20,000	>9,000	15	380

12.3.2.4 Clearance for tire chains shall be provided in accordance with SAE J683, *Tire Chain Clearance — Trucks, Buses (Except Suburban, Intercity, and Transit Buses), and Combinations of Vehicles*. [1901:12.3.2.4]

12.3.2.5 Steering.

12.3.2.5.1 The steering mechanism shall be capable of turning the front wheels to an angle of at least 30 degrees to either the right or left for nondriving front axles and at least 28 degrees for driving front axles. [1901:12.3.2.5.1]

12.3.2.5.2 Power steering or power-assisted steering shall be provided. [1901:12.3.2.5.2]

12.3.2.6 Reserved.

12.3.3* Transmission.

12.3.3.1 The transmission shall be rated for heavy-duty service and shall be designed to match engine torque and speed to the load demand. [1901:12.3.3.1]

12.3.3.2 The transmission shall provide the driver with the selection of individual gears or ranges of gears necessary to meet the performance requirements of this standard. [1901:12.3.3.2]

12.3.3.3* The power train shall allow the vehicle to function and operate smoothly at 2 mph (3.2 km/hr).

12.3.3.4* Apparatus with a front drive axle (4 × 4 or 6 × 6 configuration) shall include a visual indicator that is illuminated whenever the front drive axle is engaged.

12.3.4 Fuel Tanks.

12.3.4.1* The fuel capacity shall allow the engine to operate at 60 percent of gross engine horsepower for 2½ hours.

12.3.4.2 The tank fill opening shall be marked with a label indicating the type of fuel to be used. [1901:12.3.4.2]

12.3.4.3 Reserved.

12.3.4.4 The tank fill piping shall be placed so it is protected from mechanical damage during the normal use of the fire apparatus. [1901:12.3.4.4]

12.3.4.5 The tank and the fill piping shall be located or shielded so that they are not exposed to heat from an exhaust system or other source of ignition on the fire apparatus. [1901:12.3.4.5]

12.3.4.6 The tank shall be placed so it is removable for repairs. [1901:12.3.4.6]

12.3.4.7 Reserved.

12.3.4.8 Gasoline-fueled chassis shall have fuel withdrawal fittings above the normal fuel level.

12.3.5* Tow Hooks. Front and rear tow hooks or tow eyes shall be attached to the frame structure to allow towing (not lifting) of the apparatus without damage. [1901:12.3.5]

12.3.6 Towing Capability. If the apparatus is equipped for towing a trailer, the provisions of 12.3.6.1 through 12.3.6.5 shall apply. [1901:12.3.6]

12.3.6.1 For hydraulic brake-equipped, electric brake-equipped, or non-brake-equipped trailer towing capability, a primary electrical receptacle shall be provided near the hitch point and shall match the umbilical cable specified in 26.10.4.5 of NFPA 1901. [1901:12.3.6.1]

12.3.6.2 For air brake-equipped trailer towing capability, the following shall apply:

- (1) A primary electrical receptacle shall be provided near the hitch point and shall match the umbilical cable specified in 26.10.4.4 of NFPA 1901.
- (2) Gladhands shall be provided for air brake connections. [1901:12.3.6.2]

12.3.6.3 An auxiliary electrical receptacle shall be provided near the hitch point and shall match the umbilical cable specified in 26.10.4.6 of NFPA 1901. [1901:12.3.6.3]

12.3.6.4 A label shall be provided in a location in which it is visible to an operator making trailer connections. The label shall state the maximum GVWR and tongue weight of the trailer that can be safely towed with the hitch system. [1901:12.3.6.4]

12.3.6.5 Two safety chain attachment points shall be provided near the hitch point for hitches designed to use safety chains, each designed with an ultimate strength of not less than the maximum GVWR specified on the label required in 12.3.6.4. [1901:12.3.6.5]

Chapter 13 Low-Voltage Electrical Systems and Warning Devices

13.1* General. Any low-voltage electrical systems or warning devices installed on the fire apparatus shall be appropriate for the mounting location and intended electrical load and shall meet the specific requirements of Chapter 13. [1901:13.1]

13.2 Wiring. All electrical circuit feeder wiring supplied and installed by the fire apparatus manufacturer shall meet the requirements of 13.2.1 through 13.2.8. [1901:13.2]

13.2.1* The circuit feeder wire shall be stranded copper or copper alloy conductors of a gauge rated to carry 125 percent of the maximum current for which the circuit is protected. [1901:13.2.1]

13.2.1.1 Voltage drops in all wiring from the power source to the using device shall not exceed 10 percent. [1901:13.2.1.1]

13.2.1.2 The use of star washers for circuit ground connections shall not be permitted. [1901:13.2.1.2]

13.2.1.3 All circuits shall otherwise be wired in conformance with SAE J2202, *Heavy-Duty Wiring Systems for On Highway Trucks*.

13.2.2 Wiring and Wire Harness Construction.

13.2.2.1 All insulated wire and cable shall conform to SAE J1127, *Low Voltage Battery Cable*, or SAE J1128, *Low Voltage Primary Cable*, type SXL, GXL, or TXL. [1901:13.2.2.1]

13.2.2.1.1 All conductors shall be constructed in accordance with SAE J1127 or SAE J1128, except where good engineering practice dictates special strand construction. [1901:13.2.2.1.1]

13.2.2.1.2 Conductor materials and stranding, other than copper, shall be permitted if all applicable requirements for physical, electrical, and environmental conditions are met as dictated by the end application. [1901:13.2.2.1.2]

13.2.2.1.3 Physical and dimensional values of conductor insulation shall be in conformance with the requirements of SAE J1127 or SAE J1128, except where good engineering practice dictates special conductor insulation. [1901:13.2.2.1.3]

13.2.2.2 The overall covering of conductors shall be moisture-resistant loom or braid that has a minimum continuous rating of 194°F (90°C) except where good engineering practice dictates special consideration for loom installations exposed to higher temperatures. [1901:13.2.2.2]

13.2.3 The overall covering of jacketed cables shall be moisture resistant and have a minimum continuous temperature rating of 194°F (90°C), except where good engineering practice dictates special consideration for cable installations exposed to higher temperatures. [1901:13.2.3]

13.2.4 All wiring connections and terminations shall use a method that provides a positive mechanical and electrical connection. [1901:13.2.4]

13.2.4.1 The wiring connections and terminations shall be installed in accordance with the device manufacturer's instructions. [1901:13.2.4.1]

13.2.4.2 All ungrounded electrical terminals shall have protective covers or be in enclosures. [1901:13.2.4.2]

13.2.4.3 Wire nut, insulation displacement, and insulation piercing connections shall not be used. [1901:13.2.4.3]

13.2.5 Wiring shall be restrained to prevent damage caused by chafing or ice buildup, and protected against heat, liquid contaminants, or other environmental factors. [1901:13.2.5]

13.2.6* Wiring shall be uniquely identified at least every 2 ft (0.6 m) by color coding or permanent marking with a circuit function code. The identification shall reference a wiring diagram. [See 4.20.2.3(6).] [1901:13.2.6]

13.2.7 Circuits shall be provided with properly rated low voltage overcurrent protective devices. [1901:13.2.7]

13.2.7.1 Such devices shall be readily accessible and protected against heat in excess of the overcurrent device's design range, mechanical damage, and water spray. [1901:13.2.7.1]

13.2.7.2 Circuit protection shall be accomplished by utilizing fuses, circuit breakers, fusible links, or solid state equivalent devices. [1901:13.2.7.2]

13.2.7.3 If a mechanical-type device is used, it shall conform to one of the following SAE standards:

- (1) SAE J156, *Fusible Links*
 - (2) SAE J553, *Circuit Breakers*
 - (3) SAE J554, *Electric Fuses (Cartridge Type)*
 - (4) SAE J1888, *High Current Time Lag Electric Fuses*
 - (5) SAE J2077, *Miniature Blade Type Electrical Fuses*
- [1901:13.2.7.3]

13.2.8 Switches, relays, terminals, and connectors shall have a direct current (dc) rating of 125 percent of maximum current for which the circuit is protected. [1901:13.2.8]

13.3 Power Supply.

13.3.1 A 12 V or greater electrical alternator shall be provided. [1901:13.3.1]

13.3.2* The alternator shall have a minimum output at idle to meet the minimum continuous electrical load of the fire apparatus as defined in 13.3.3, at 200°F (93°C) ambient temperature within the engine compartment, and shall be provided with full automatic regulation. [1901:13.3.2]

13.3.3 Minimum Continuous Electrical Load. The minimum continuous electrical load shall consist of the total amperage required to simultaneously operate the following in a stationary mode during emergency operations:

- (1) The propulsion engine and transmission
- (2) All legally required clearance and marker lights, headlights, and other electrical devices except windshield wipers and four-way hazard flashers
- (3) The radio(s) at a duty cycle of 10 percent transmit and 90 percent receive (for calculation and testing purposes, a default value of 5 A continuous)
- (4) The lighting necessary to produce 5 fc (50 lx) of illumination on all control and instrument panels
- (5) The minimum optical warning system required in Section 13.8, where the apparatus is designed to call for or block the right-of-way
- (6) The continuous electrical current required to simultaneously operate any water pumps and hydraulic pumps
- (7)* Other warning devices and electrical loads that are designated as critical to the mission of the apparatus

13.3.4* The condition of the low-voltage electrical system shall be monitored by a warning system that provides both an audible and a visual signal to persons on, in, or near the apparatus of an impending electrical system failure caused by the excessive discharge of the battery set. [1901:13.3.4]

13.3.4.1 The charge status of the battery shall be determined either by direct measurement of the battery charge or indirectly by monitoring the electrical system voltage. [1901:13.3.4.1]

13.3.4.2 If electrical system voltage is monitored, the alarm shall sound if the system voltage at the battery drops below 11.8 V for 12 V nominal systems, 23.6 V for 24 V nominal systems, or 35.4 V for 42 V nominal systems for more than 120 seconds.

13.3.5 A voltmeter shall be mounted on the driver's instrument panel to allow direct observation of the system voltage. [1901:13.3.5]

13.3.6 Load Management.

13.3.6.1* If the total continuous electrical load exceeds the minimum continuous electrical output rating of the installed alternator(s) operating under the conditions specified in 13.3.2, an automatic electrical load management system shall be required. [1901:13.3.6.1]

13.3.6.2 The minimum continuous electrical loads defined in 13.3.3 shall not be subject to automatic load management. [1901:13.3.6.2]

13.4* Batteries.

13.4.1 Batteries shall be of the high-cycle type. [1901:13.4.1]

13.4.2 With the engine off, the battery system shall be able to provide the minimum continuous electrical load for 10 minutes without discharging more than 50 percent of the reserve capacity and then to restart the engine. [1901:13.4.2]

13.4.3 The battery system cold cranking amps (CCA) rating shall meet or exceed the minimum CCA recommendations of the engine manufacturer. [1901:13.4.3]

13.4.4 The batteries shall be mounted to prevent movement during fire apparatus operation and shall be protected against accumulations of road spray, snow, and road debris. [1901:13.4.4]

13.4.4.1 The batteries shall be readily accessible for examination, testing, and maintenance. [1901:13.4.4.1]

13.4.4.2 A means shall be provided for jump-starting the engine if the batteries are not accessible without lifting the cab of a tilt-cab apparatus. [1901:13.4.4.2]

13.4.4.3 Where an enclosed battery compartment is provided, it shall be ventilated to the exterior to prevent the buildup of heat and explosive fumes. [1901:13.4.4.3]

13.4.4.4* The batteries shall be protected against vibration and temperatures that exceed the battery manufacturer's recommendation. [1901:13.4.4.4]

13.4.5* If an onboard conditioner or charger is supplied, the associated line voltage electrical power system shall be installed in accordance with Chapter 22 of NFPA 1901.

13.4.6* One of the following master disconnect switches shall be provided:

- (1) A master body disconnect switch that disconnects all electrical loads not provided by the chassis manufacturer
- (2) A master load disconnect switch that disconnects all electrical loads on the apparatus except the starter

[1901:13.4.6]

13.4.6.1 The starter solenoids shall be connected directly to the batteries. [1901:13.4.6.1]

13.4.6.2 Electronic control systems and similar devices shall be permitted to be otherwise connected if so specified by their manufacturer. [1901:13.4.6.2]

13.4.6.3 The alternator shall be wired directly to the batteries through the ammeter shunt(s), if one is provided, and not through the master disconnect switch. [1901:13.4.6.3]

13.4.6.4* A green "master disconnect on" indicator that is visible from the driver's position shall be provided. [1901:13.4.6.4]

13.4.6.5 Rechargeable handlights, radios, and other similar devices shall be permitted to be connected to the electrical system ahead of the master load disconnect switch. [1901:13.4.6.5]

13.4.7* A sequential switching device shall be permitted to energize the optical warning devices required in 13.3.3 and other high current devices, provided the switching device shall first energize the electrical devices required in 13.3.3 within 5 seconds. [1901:13.4.7]

13.5 Starting Device.

13.5.1 An electrical starting device shall be provided for the engine. [1901:13.5.1]

13.5.2 When the electrical starting device is operating under maximum load, the voltage drop of the conductors between the battery and the starting device shall be in accordance with SAE J541, *Voltage Drop for Starting Motor Circuits*. [1901:13.5.2]

13.6 Temperature Exposure. Any alternator, electrical starting device, ignition wiring, distributor, or ignition coil shall be moisture resistant and protected such that it is not exposed to a temperature that exceeds the component manufacturer's recommendations. [1901:13.6]

13.7* Electromagnetic Interference. Electromagnetic interference suppression shall be provided, as required, to satisfy the radiation limits specified in SAE J551/1, *Performance Levels and Methods of Measurement of Electromagnetic Compatibility of Vehicles, Boats (up to 15 m), and Machines (16.6 Hz to 18 GHz)*. [1901:13.7]

13.8* Optical Warning Devices. Each apparatus that responds on public roads as an emergency vehicle by calling for or blocking the right-of-way from other traffic shall have a system of optical warning devices that meets or exceeds the requirements of this section; if the vehicle is not equipped to call for or block the right-of-way on a public highway, a sign shall be affixed on the dashboard that reads as follows: "This apparatus is not equipped to call for or block right-of-way on public highways."

13.8.1* The optical warning system shall consist of an upper and a lower warning level. [1901:13.8.1]

13.8.2 The requirements for each level shall be met by the warning devices in that particular level without consideration of the warning devices in the other level. [1901:13.8.2]

13.8.3 For the purposes of defining and measuring the required optical performance, the upper and lower warning levels shall be divided into four warning zones. [1901:13.8.3]

13.8.3.1 The four zones shall be determined by lines drawn through the geometric center of the apparatus at 45 degrees to a line drawn lengthwise through the geometric center of the apparatus. [1901:13.8.3.1]

13.8.3.2 The four zones shall be designated A, B, C, and D in a clockwise direction, with zone A to the front of the apparatus. (See Figure 13.8.3.2.) [1901:13.8.3.2]

13.8.4 Each optical warning device shall be installed on the apparatus and connected to the apparatus's electrical system in accordance with the requirements of this standard and the requirements of the manufacturer of the device. [1901:13.8.4]

13.8.5 A master optical warning system switch that energizes all the optical warning devices shall be provided. [1901:13.8.5]

13.8.6 The optical warning system on the fire apparatus shall be capable of two separate signaling modes during emergency operations. [1901:13.8.6]

13.8.6.1 One mode shall signal to drivers and pedestrians that the apparatus is responding to an emergency and is calling for the right-of-way. [1901:13.8.6.1]

13.8.6.2 One mode shall signal that the apparatus is stopped and is blocking the right-of-way. [1901:13.8.6.2]

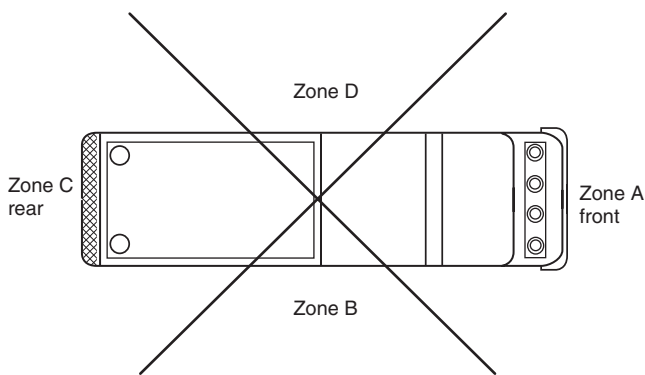


FIGURE 13.8.3.2 Warning Zones for Optical Warning Devices. [1901: Figure 13.8.3.2]

13.8.6.3 The use of some or all of the same warning lights shall be permitted for both modes, provided the other requirements of this chapter are met. [1901:13.8.6.3]

13.8.7 A switching system shall be provided that senses the position of the parking brake or the park position of an automatic transmission. [1901:13.8.7]

13.8.7.1 When the master optical warning system switch is on and the parking brake is released or the automatic transmission is not in park, the warning devices signaling the call for the right-of-way shall be energized. [1901:13.8.7.1]

13.8.7.2 When the master optical warning system switch is on and the parking brake is on or the automatic transmission is in park, the warning devices signaling the blockage of the right-of-way shall be energized. [1901:13.8.7.2]

13.8.7.3* The system shall be permitted to have a method of modifying the two signaling modes. [1901:13.8.7.3]

13.8.8 The optical warning devices shall be constructed or arranged so as to avoid the projection of light, either directly or through mirrors, into any driving or crew compartment(s). [1901:13.8.8]

13.8.9 The front optical warning devices shall be placed so as to maintain the maximum possible separation from the headlights. [1901:13.8.9]

13.8.10 The optical sources on each level shall be of sufficient number and arranged so that failure of a single optical source does not create a measurement point in any zone on the same level as the failed optical source without a warning signal at a distance of 100 ft (30 m) from the geometric center of the apparatus. [1901:13.8.10]

13.8.11 Flash Rate.

13.8.11.1 The minimum flash rate of any optical source shall be 75 flashes per minute, and the minimum number of flashes at any measurement point shall be 150 flashes per minute. [1901:13.8.11.1]

13.8.11.1.1 Steadily burning, nonflashing optical sources shall be permitted to be used. [1901:13.8.11.1.1]

13.8.11.1.2 The optical energy provided by nonflashing optical sources shall not be included in the calculations of the zone's total optical power. [1901:13.8.11.1.2]

13.8.11.2 The flasher of any current-interrupted flashing device shall otherwise meet the requirements of SAE J1690, *Flashers*. [1901:13.8.11.2]

13.8.12* Color of Warning Lights.

13.8.12.1 Permissible colors or combinations of colors in each zone, within the constraints imposed by applicable laws and regulations, shall be as shown in Table 13.8.12.1. [1901:13.8.12.1]

13.8.12.2 All colors shall be as specified in SAE J578, *Color Specification*, for red, blue, yellow, or white. [1901:13.8.12.2]

13.8.13* Requirements for Large Apparatus.

13.8.13.1 If the apparatus has a bumper-to-bumper length of 25 ft (7.6 m) or more or has an optical center on any optical warning device greater than 8 ft (2.4 m) above level ground, the requirements of 13.8.13.2 through 13.8.13.6 shall apply. [1901:13.8.13.1]

13.8.13.2 Upper-Level Optical Warning Devices.

13.8.13.2.1 The upper-level optical warning devices shall be mounted as high and as close to the corner points of the apparatus as is practical to define the clearance lines of the apparatus. [1901:13.8.13.2.1]

13.8.13.2.2 The upper-level optical warning devices shall not be mounted above the maximum height, specified by the device manufacturer, that gives an intensity value at 4 ft (1.2 m) above level ground and at 100 ft (30.5 m) from the optical warning device of less than 50 percent of that required at the optical center. [1901:13.8.13.2.2]

13.8.13.3 Lower-Level Optical Warning Devices.

13.8.13.3.1 To define the clearance lines of the apparatus, the optical center of the lower-level optical warning devices in the front of the vehicle shall be mounted on or forward of the front axle centerline and as close to the front corner points of the apparatus as is practical. [1901:13.8.13.3.1]

13.8.13.3.2 The optical center of the lower-level optical warning devices at the rear of the vehicle shall be mounted on or behind the rear axle centerline and as close to the rear corners of the apparatus as is practical. [1901:13.8.13.3.2]

13.8.13.3.3 The optical center of any lower-level device shall be between 18 in. and 62 in. (460 mm and 1600 mm) above level ground. [1901:13.8.13.3.3]

13.8.13.4 Midship Optical Warning Devices.

13.8.13.4.1 A midship optical warning device shall be mounted on both the right and left sides of the apparatus if the distance between the front and rear lower-level optical devices exceeds 25 ft (7.6 m) at the optical center. [1901:13.8.13.4.1]

13.8.13.4.2 Additional midship optical warning devices shall be required, where necessary, to maintain a horizontal distance between the centers of adjacent lower-level optical warning devices of 25 ft (7.6 m) or less. [1901:13.8.13.4.2]

13.8.13.4.3 The optical center of any midship mounted optical warning device shall be between 18 in. and 62 in. (460 mm and 1600 mm) above level ground. [1901:13.8.13.4.3]

13.8.13.5* For each operating mode, the combined optical power of all the optical sources shall meet or exceed the zone total optical power requirements shown in Table 13.8.13.5. [1901:13.8.13.5]

13.8.13.6 No individual measurement point shall be less than that shown in Table 13.8.13.5. [1901:13.8.13.6]

13.8.14* Requirements for Small Apparatus.

13.8.14.1 If the apparatus has a bumper-to-bumper length of less than 25 ft (7.6 m) and has the optical center of all optical warning devices at 8 ft (2.4 m) or less above level ground, the requirements of 13.8.14.2 through 13.8.14.5 shall apply. [1901:13.8.14.1]

13.8.14.2 Upper-Level Optical Warning Devices.

13.8.14.2.1 The upper-level optical warning devices shall be mounted as high as practical, but not over 8 ft (2.4 m), at the optical center. [1901:13.8.14.2.1]

13.8.14.2.2 The upper-level optical warning devices shall be permitted to be combined in one or more enclosures and shall be permitted to be mounted on the cab roof or any other convenient point. [1901:13.8.14.2.2]

13.8.14.3 Lower-Level Optical Warning Devices.

13.8.14.3.1 One or more lower-level optical warning devices shall be visible from the front and the side of the apparatus. [1901:13.8.14.3.1]

13.8.14.3.2 The optical center of the lower-level optical warning devices in the front of the vehicle shall be mounted on or forward of the front wheel centerline and as close to the front corner points of the apparatus as is practical. [1901:13.8.14.3.2]

13.8.14.3.3 The optical center of the device(s) shall be between 18 in. and 48 in. (460 mm and 1220 mm) above level ground. [1901:13.8.14.3.3]

13.8.14.4 For each operating mode, the combined optical power of all the optical sources mounted on both the upper and lower levels shall meet or exceed the zone's total optical power requirements shown in Table 13.8.14.4. [1901:13.8.14.4]

13.8.14.5 No individual measurement point shall be less than that shown in Table 13.8.14.4. [1901:13.8.14.5]

13.8.15 Tests of Optical Warning Devices.

13.8.15.1 Mechanical and Environmental Tests.

13.8.15.1.1 All optical warning devices shall be tested to the requirements of SAE J595, *Directional Flashing Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles*; SAE J845, *Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles*; or SAE J1889, *L.E.D. Signal and Marking Lighting Devices*. [1901:13.8.15.1.1]

Table 13.8.12.1 Zone Colors

Color	Calling for Right-of-Way	Blocking Right-of-Way
Red	Any zone	Any zone
Blue	Any zone	Any zone
Yellow	Any zone except A	Any zone
White	Any zone except C	Not permitted

[1901: Table 13.8.12.1]

Table 13.8.13.5 Minimum Optical Power Requirements for Large Apparatus

Zone	Level	Mode of Operation					
		Calling for Right-of-Way			Blocking Right-of-Way		
		<i>H</i> Total	At any <i>H</i> Point	At any Point 5 Degrees Up or 5 Degrees Down from <i>H</i>	<i>H</i> Total	At any <i>H</i> Point	At any Point 5 Degrees Up or 5 Degrees Down from <i>H</i>
A	Upper	1,000,000	10,000	3,500	400,000	10,000	3,500
B	Upper	400,000	10,000	3,500	400,000	10,000	3,500
C	Upper	400,000	10,000	3,500	800,000	10,000	3,500
D	Upper	400,000	10,000	3,500	400,000	10,000	3,500
A	Lower	150,000	3,750	1,300	150,000	3,750	1,300
B	Lower	150,000	3,750	1,300	150,000	3,750	1,300
C	Lower	150,000	3,750	1,300	150,000	3,750	1,300
D	Lower	150,000	3,750	1,300	150,000	3,750	1,300

Notes:

(1) All values are in candela-seconds/minute.

(2) *H* = Horizontal plane passing through the optical center.(3) The values in the *H* Total columns are the total 19 data point values for each light, with data points on the boundary between zones counted in both zones.

[1901:Table 13.8.13.5]

Table 13.8.14.4 Minimum Optical Power Requirements for Small Apparatus

Zone	Mode of Operation					
	Calling for Right-of-Way			Blocking Right-of-Way		
	<i>H</i> Total	At any <i>H</i> Point	At Any Point 5 Degrees Up or 5 Degrees Down from <i>H</i>	<i>H</i> Total	At any <i>H</i> Point	At any Point 5 Degrees Up or 5 Degrees Down from <i>H</i>
A	1,000,000	10,000	3,500	400,000	10,000	3,500
B	200,000	8,000	3,500	200,000	8,000	3,500
C	400,000	10,000	3,500	800,000	10,000	3,500
D	200,000	8,000	3,500	200,000	8,000	3,500

Notes:

(1) All values are in candela-seconds/minute.

(2) *H* = horizontal plane passing through the optical center.(3) The values in the *H* Total columns are the total 19 data point values for each light, with data points on the boundary between zones counted in both zones.

[1901:Table 13.8.14.4]

13.8.15.1.2 Optical devices and components designed for mounting only in weatherproof, interior spaces shall be tested in conformance with the applicable SAE standard listed in 13.8.15.1.1 and shall comply with the vibration test and the warpage test for plastic components. [1901:13.8.15.1.2]

13.8.15.1.3 Optical devices and components designed for mounting on the exterior of the apparatus or in nonweatherproof interior spaces shall be tested in conformance with SAE J845 and shall comply with the following performance requirements of that standard:

- (1) Vibration
- (2) Moisture
- (3) Dust
- (4) Corrosion
- (5) High temperature
- (6) Low temperature
- (7) Durability
- (8) Warpage

[1901:13.8.15.1.3]

13.8.15.2 Photometric Test Procedures for Optical Devices.

13.8.15.2.1 Testing shall be performed by, or on behalf of, the device manufacturer to ensure compliance with the requirements of 13.8.15.2.2 through 13.8.15.2.5.2. [1901:13.8.15.2.1]

13.8.15.2.1.1 The results of the testing, and all required photometric data shall be available, upon request, from the optical warning device manufacturer.

13.8.15.2.1.2 The goniometer, integrating photometer, and other equipment used to take the test measurements shall meet the requirements of SAE J1330, *Photometry Laboratory Accuracy Guidelines*. [1901:13.8.15.2.1.2]

13.8.15.2.2 The optical source shall be mounted in a goniometer and operated as it would be in a normal system application. [1901:13.8.15.2.2]

13.8.15.2.2.1 The minimum distance between the light-emitting surface of the source being tested and the front face of the photometer detector shall be 59 ft (18 m). [1901:13.8.15.2.2.1]

13.8.15.2.2.2 The goniometer shall be oriented and the integrating photometer shall be set to integrate light pulses from the source for 20 seconds. [1901:13.8.15.2.2.2]

13.8.15.2.3 For all tests performed with the power applied, the lighting system, or component thereof, shall be operated at $12.8\text{ V} \pm 0.1\text{ V}$ for 12 V nominal equipment, $25.6\text{ V} \pm 0.2\text{ V}$ for 24 V nominal equipment, and $38.4\text{ V} \pm 0.3\text{ V}$ for 42 V nominal equipment. [1901:13.8.15.2.3]

13.8.15.2.3.1 If the equipment is rated for operation on multiple voltages, the tests shall be performed at each of the rated voltages used by the equipment. [1901:13.8.15.2.3.1]

13.8.15.2.3.2 Voltage shall be measured at a point 12 in. ± 1 in. (300 mm ± 25 mm) from the entry into the component. [1901:13.8.15.2.3.2]

13.8.15.2.4 The technique described in 13.8.15.2.2 through 13.8.15.2.2.2 shall be performed along the horizontal plane that passes through the optical center, beginning at the optical center and repeated at 5-degree intervals to the left and to the right of the optical center throughout the active horizontal angle of light emission of the optical source. [1901:13.8.15.2.4]

13.8.15.2.5 Measurements shall be repeated at 5 degrees up and 5 degrees down from the horizontal plane that passes through the optical center, beginning at a point on the vertical plane passing through the optical center. [1901:13.8.15.2.5]

13.8.15.2.5.1 The measurements shall be repeated at 5 degree intervals to the left and to the right of this vertical plane throughout the active horizontal angle of light emission of the optical source. [1901:13.8.15.2.5.1]

13.8.15.2.5.2 If the optical warning device contains more than one optical source, the test shall be repeated for each optical source. [1901:13.8.15.2.5.2]

13.8.16* Compliance Documentation. The apparatus manufacturer shall demonstrate compliance of the warning system by one of the following methods:

- (1) Certification that the system was installed within the geometric parameters specified by the manufacturer of the system, referencing the optical source test reports provided by the manufacturer of the system

- (2) Certification that a mathematical calculation based on test reports for individual optical sources provided by the manufacturer of the devices and performed by a qualified person demonstrates that the combination of individual devices as installed meets the requirements of this standard

- (3) Actual measurement of the lighting system after installation on the apparatus

[1901:13.8.16]

13.9 Audible Warning Devices.

13.9.1 Audible warning devices shall be provided.

13.9.1.1 At least one automotive traffic horn shall be provided.

13.9.1.2 If the apparatus responds as an emergency vehicle on public roads, one electric or electronic siren shall be provided.

13.9.1.2.1 The siren manufacturer shall certify the siren as meeting the requirements of SAE J1849, *Emergency Vehicle Sirens*. [1901:13.9.1.1]

13.9.1.2.2* A means shall be provided to allow the activation of the siren within convenient reach of the driver. [1901:13.9.1.2]

13.9.2 Where furnished, air horns, electric siren(s), and electronic siren speaker(s) shall be mounted as low and as far forward on the apparatus as is practical. [1901:13.9.2]

13.9.3 Audible warning equipment shall not be mounted on the roof of the apparatus. [1901:13.9.3]

13.10* Work Lighting. Any ground lighting, hose bed lighting, surface lighting, interior lighting, and compartment lighting shall meet the requirements of this section.

13.10.1 Reserved.

13.10.2 Reserved.

13.10.3 Reserved.

13.10.4 Reserved.

13.10.5 Reserved.

13.10.6 Reserved.

13.10.7 Reserved.

13.10.8 Testing. All work lights mounted in wet locations shall be tested in conformance with SAE J575, *Test Methods and Equipment for Lighting Devices and Components for Use on Vehicles Less Than 2032 mm in Overall Width*, and shall comply with the following performance requirements of that standard:

- (1) Vibration
 - (2) Moisture
 - (3) Dust
 - (4) Corrosion
 - (5) High temperature
 - (6) Low temperature
 - (7) Durability
 - (8) Warpage
- [1901:13.10.8]

13.11 Reserved.

13.12* Backup Alarm. An electric or electronic backup alarm shall be provided that meets the Type D (87 dBA) requirements of SAE J994, *Alarm — Backup — Electric, Laboratory Performance Testing*. [1901:13.12]

13.13 Stop, Tail, and Directional Lights.

13.13.1 The apparatus shall be equipped with all legally required stop, tail, and directional lights. [1901:13.13.1]

13.13.2 Directional lights shall be visible from the front, sides, and rear of the apparatus. [1901:13.13.2]

13.13.3 On apparatus 30 ft (10 m) or longer in length, a turn signal shall be mounted approximately midway along the apparatus at approximately running board height. [1901:13.13.3]

13.13.4 Equipment shall not be mounted in a manner that obscures the stop, tail, or directional lights. [1901:13.13.4]

13.14 Electrical System Performance Tests.

13.14.1* The fire apparatus low-voltage electrical system shall be tested as required by Section 13.14 and its subsections.

13.14.1.1 The test results shall be certified by the apparatus manufacturer.

13.14.1.2 The certification shall be delivered with the apparatus.

13.14.2 Tests shall be performed when the air temperature is between 0°F and 110°F (-18°C and 43°C). [1901:13.14.2]

13.14.3 Test Sequence.

13.14.3.1 The three tests defined in 13.14.3.2 through 13.14.3.4 shall be performed in the order in which they appear. [1901:13.14.3.1]

13.14.3.1.1 Before each test, the batteries shall be fully charged until the voltage stabilizes at the voltage regulator set point and the lowest charge current is maintained for 10 minutes. [1901:13.14.3.1.1]

13.14.3.1.2 Failure of any of these tests shall require a repeat of the sequence. [1901:13.14.3.1.2]

13.14.3.2 Reserve Capacity Test.

13.14.3.2.1 The engine shall be started and kept running until the engine and engine compartment temperatures are stabilized at normal operating temperatures and the battery system is fully charged. [1901:13.14.3.2.1]

13.14.3.2.2 The engine shall be shut off, and the minimum continuous electrical load shall be activated for 10 minutes. [1901:13.14.3.2.2]

13.14.3.2.3 All electrical loads shall be turned off prior to attempting to restart the engine. [1901:13.14.3.2.3]

13.14.3.2.4 The battery system shall then be capable of restarting the engine. [1901:13.14.3.2.4]

13.14.3.2.5 Failure to restart the engine shall be considered a test failure of the battery system. [1901:13.14.3.2.5]

13.14.3.3 Alternator Performance Test at Idle.

13.14.3.3.1 The minimum continuous electrical load shall be activated with the engine running at idle speed. [1901:13.14.3.3.1]

13.14.3.3.2 The engine temperature shall be stabilized at normal operating temperature. [1901:13.14.3.3.2]

13.14.3.3.3 The battery system shall be tested to detect the presence of battery discharge current. [1901:13.14.3.3.3]

13.14.3.3.4 The detection of battery discharge current shall be considered a test failure. [1901:13.14.3.3.4]

13.14.3.4 Alternator Performance Test at Full Load.

13.14.3.4.1 The total continuous electrical load shall be activated with the engine running up to the engine manufacturer's governed speed. [1901:13.14.3.4.1]

13.14.3.4.2 The test duration shall be a minimum of 2 hours. [1901:13.14.3.4.2]

13.14.3.4.3 Activation of the load management system shall be permitted during this test. [1901:13.14.3.4.3]

13.14.3.4.4 An alarm sounded by excessive battery discharge as detected by the warning system required in 13.3.4, or a system voltage of less than 11.8 V dc for a 12 V nominal system, 23.6 V dc for a 24 V nominal system, or 35.4 V dc for a 42 V nominal system for more than 120 seconds, shall be considered a test failure. [1901:13.14.3.4.4]

13.14.4 Low-Voltage Alarm Test.

13.14.4.1 The following test shall be started with the engine off and the battery voltage at or above 12 V for a 12 V nominal system, 24 V for a 24 V nominal system, or 36 V for a 42 V nominal system. [1901:13.14.4.1]

13.14.4.2 With the engine shut off, the total continuous electrical load shall be activated and shall continue to be applied until the excessive battery discharge alarm activates. [1901:13.14.4.2]

13.14.4.3 The battery voltage shall be measured at the battery terminals. [1901:13.14.4.3]

13.14.4.4 The test shall be considered a failure if the alarm does not sound in less than 140 seconds after the voltage drops to 11.70 V for a 12 V nominal system, 23.4 V for a 24 V nominal system, or 35.1 V for a 42 V nominal system. [1901:13.14.4.4]

13.14.4.5 The battery system shall then be able to restart the engine. [1901:13.14.4.5]

13.14.4.6 Failure to restart the engine shall be considered a test failure. [1901:13.14.4.6]

13.15 Documentation. The manufacturer shall deliver the following with the fire apparatus:

- (1) Documentation of the electrical system performance tests
- (2) A written electrical load analysis, including the following:
 - (a) The nameplate rating of the alternator
 - (b) The alternator rating under the conditions specified in 13.3.2
 - (c) Each of the component loads specified in 13.3.3 that make up the minimum continuous electrical load
 - (d) Additional electrical loads that, when added to the minimum continuous electrical load, determine the total continuous electrical load
 - (e) Each individual intermittent electrical load

[1901:13.15]

Chapter 14 Driving and Crew Areas

14.1 General.

14.1.1 Each crew riding position shall be within a fully enclosed personnel area except as provided in Section 14.4.

14.1.2 A label that states the number of personnel the vehicle is designed to carry shall be located in an area visible to the driver. [1901:14.1.2]

14.1.3* Each crew riding position shall be provided with a seat and an approved seat belt designed to accommodate a person with and without heavy clothing. [1901:14.1.3]

14.1.3.1* The effective seat belt web length for a Type 1 lap belt for pelvic restraint shall be a minimum of 60 in. (1525 mm) with the seat adjusted all the way back and down when measured using the following procedure:

- (1) Locate an imaginary line where the plane of the center of the seat back surface intersects the plane of the center of the seat cushion surface (line 1 in Figure 14.1.3.1). For seats with an SCBA seat back, use a plane that simulates the position of an SCBA back pad installed in the SCBA holder.
- (2) Locate point A on line 1 at the outside of the seat on the retractor side of the seat.
- (3) Locate point C on line 1 at the outside of the seat on the receiver buckle side of the seat.
- (4) Locate point D at the tip of the buckle.
- (5) Pull the seat belt webbing entirely out of the retractor and measure along the webbing between point A and the seat belt bucklatch plate (tongue). Record this length as AD.
- (6) Measure from point C to point D and record this length as CD.
- (7) The effective seat belt web length equals $AD + CD$. [1901:14.1.3.1]

14.1.3.2* A Type 2 seat belt shall have either a single retractor or dual retractors. A single retractor Type 2 pelvic and upper torso restraint-style seat belt assembly shall have a minimum effective seat belt web length of 110 in. (2800 mm) with the

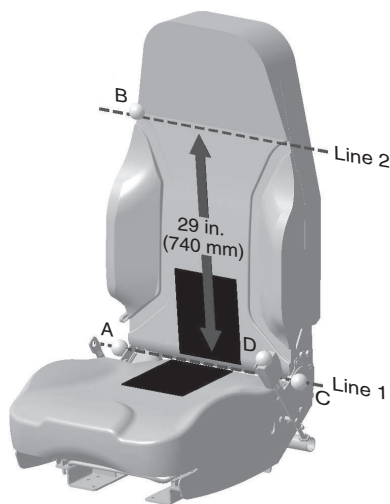


FIGURE 14.1.3.1 Dimension Lines for Measuring Seat Belt Effective Length. [1901: Figure 14.1.3.2]

seat adjusted all the way back and down and when measured in accordance with 14.1.3.2.1. A dual retractor Type 2 pelvic and upper torso restraint-style seat belt assembly shall have a minimum effective shoulder belt web length of 50 in. (1270 mm) and a minimum effective lap belt web length of 60 in. (1530 mm) with the seat all the way back and down and as measured in 14.1.3.2.2. [1901:14.1.3.2]

14.1.3.2.1 Effective seat belt web length for a single retractor Type 2 seat belt shall be measured according to the following procedure:

- (1) Locate an imaginary line where the plane of the center of the seat back surface intersects the plane of the center of the seat cushion surface (line 1 in Figure 14.1.3.1). For seats with an SCBA seat back, use a plane that simulates the position of an SCBA back pad installed in the SCBA holder.
- (2) Locate an imaginary line parallel with line 1 and lying on the center of the seat back surface 29 in. (740 mm) from line 1 (line 2 in Figure 14.1.3.1).
- (3) Locate point A on line 1 at the outside of the seat on the retractor side of the seat.
- (4) Locate point B on line 2 at the shoulder strap edge of the seat back.
- (5) Locate point C on line 1 at the outside of the seat on the buckle side of the seat.
- (6) Locate point D at the tip of the buckle.
- (7) Pull the seat belt webbing entirely out of the retractor and measure along the webbing between points A and B. Record this length as AB.
- (8) Measure from point C to point D and record this length as CD.
- (9) The effective seat belt web length equals $AB + 2CD$. [1901:14.1.3.2.1]

14.1.3.2.2 Effective seat belt web length for a dual retractor Type 2 seat belt shall be measured according to the following procedure:

- (1) Locate an imaginary line where the plane of the center of the seat back surface intersects the plane of the center of the seat cushion surface (line 1 in Figure 14.1.3.1). For seats with an SCBA seat back, use a plane that simulates the position of an SCBA back pad installed in the SCBA holder.
- (2) Locate point A on line 1 at the outside of the seat on the retractor side of the seat.
- (3) Locate point C on line 1 at the outside of the seat on the buckle side of the seat.
- (4) Locate point D at the tip of the buckle.
- (5) Pull the lap belt webbing entirely out of the lap belt retractor and measure along the webbing between point A and the seat belt latch plate (tongue). Record this length as AD.
- (6) Locate an imaginary line parallel with line 1 and lying on the center of the seat back surface 29 in. (740 mm) from line 1 (line 2 in Figure 14.1.3.1).
- (7) Locate point B on line 2 at the shoulder strap edge of the seat back.
- (8) Pull the shoulder belt webbing entirely out of the shoulder belt retractor and measure along the webbing between point B and the seat belt latch plate (tongue). Record this length as BD.
- (9) Measure from point C to Point D and record this length as CD.
- (10) The effective lap belt web length equals $AD + CD$

(11) The effective shoulder belt web length equals $BD + CD$ [1901:14.1.3.2.2]

14.1.3.2.3* In the case of a Type 2 seat belt, the distance from the buckle anchorage (point E in Figure 14.1.3.2.3) to the buckle tip (point D in Figure 14.1.3.2.3) shall be no more than 4 in. (102 mm) longer than the perpendicular distance from the buckle anchorage to a lateral axis through the H-point of the seat (line 3 in Figure 14.1.3.2.3) when the seat is adjusted to its lowest and most rearward position. [1901:14.1.3.2.3]

14.1.3.3 The seat belt webbing shall be bright red or bright orange in color, and the buckle portion of the seat belt shall be mounted on a rigid or semirigid stalk such that the buckle remains positioned in an accessible location. [1901:14.1.3.3]

14.1.3.4* The seat belt webbing color requirement of 14.1.3.3 shall not apply to vehicles with a GVWR of 19,500 lb (8,845 kg) or less. [1901:14.1.3.4]

14.1.3.5 All forward-facing seats adjacent to a side wall shall be provided with a Type 2 pelvic and upper torso restraint-style seat belt assembly. [1901:14.1.3.5]

14.1.3.6 Reserved.

14.1.3.7 Safety sign FAMA07, which warns of the importance of seat belt use shall be visible from each seat that is intended to be occupied while the vehicle is in motion. [1901:14.1.3.7]

14.1.3.8 Safety sign FAMA06 shall be visible from each seat that is not equipped with occupant restraint and therefore not intended to be occupied while the vehicle is in motion. [1901:14.1.3.8]

14.1.4 All interior crew and driving compartment door handles shall be designed and installed to protect against accidental or inadvertent opening. [1901:14.1.4]

14.1.5 Any door of the apparatus designed to allow persons to enter or exit the apparatus shall have at least 96 in.² (62,000 mm²) of retroreflective material affixed to the inside of the door. [1901:14.1.5]

14.1.6 At any seat location, the maximum noise level shall be 90 dBA without any warning devices in operation, as measured

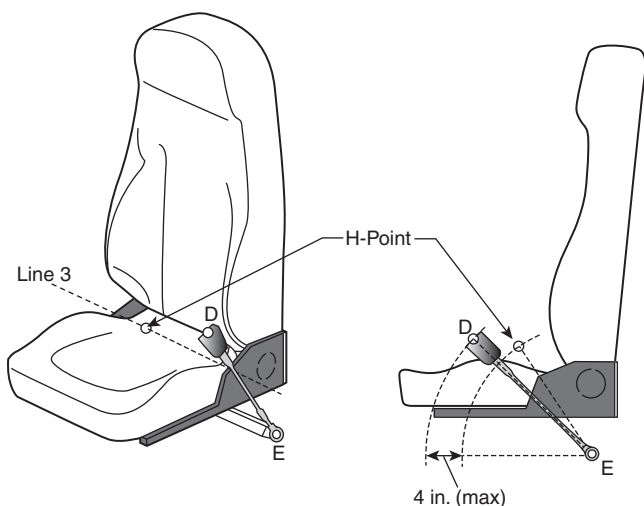


FIGURE 14.1.3.2.3 Dimension Lines for Measuring Buckle Length. [1901: Figure 14.1.3.2.3]

by the test procedure defined in 49 CFR 393.94(c), "Interior noise levels in power units test procedure," except that the test shall be performed with the vehicle traveling at a steady speed of 45 mph (72 km/hr) on a level, paved, smooth-surface road. [1901:14.1.6]

14.1.7 Seat Head Height.

14.1.7.1* The minimum vertical dimension from the seat H-point to the ceiling for each belted seating position shall be as follows:

- (1) For suspension-style seats with independent height adjustment, the minimum vertical dimension shall be 37 in. (940 mm) measured with the height adjustment in its lowest position and the suspension inflated and/or raised to the upper limit of its travel.
- (2) For suspension-style seats without independent height adjustment, the minimum vertical dimension shall be 37 in. (940 mm) measured with the suspension inflated and/or raised to the upper limit of its travel.
- (3) For nonsuspension-style seats, the minimum vertical dimension shall be 35 in. (889 mm) measured with the seat adjusted to its lowest position.

[1901:14.1.8.1]

14.1.7.2 When independent vertical and/or horizontal seat adjustment is provided, it shall be fully adjustable within 10 seconds. [1901:14.1.8.2]

14.1.7.3 The seat-to-ceiling height shall be measured at the lowest surface in the area immediately above the projected area of the seat as it is moved through its horizontal travel with any soft headliner material depressed by hand. [1901:14.1.8.3]

14.1.7.4* The following statement shall be included in the operator's manual: "Warning: Serious head/neck injury can result from helmet use in cab. Do not wear helmet while seated unless necessary during suppression operations. Fire helmets are not designed for crash protection and they will interfere with the protection provided by head rests. Reduction of head clearance can increase the risk of spinal compression injury from roof contact. The use of seat belts is essential to protecting fire fighters during driving."

14.1.7.5 Safety sign FAMA43, which warns not to wear helmets while the vehicle is in motion, shall be visible from each seat that is intended to be occupied while the vehicle is in motion.

14.1.8 Seat Arrangement.

14.1.8.1 Each seating space shall have a minimum width of 22 in. (560 mm) at the shoulder level. [1901:14.1.9.1]

14.1.8.2 Seat cushions shall be a minimum of 18 in. (460 mm) in width and 15 in. (380 mm) from the front of the cushion to the face of the seat back. [1901:14.1.9.2]

14.1.8.3 A back cushion that extends from the face of the seat vertically at least 18 in. (460 mm) and that is a minimum of 18 in. (460 mm) wide at the base shall be provided. [1901:14.1.9.3]

14.1.8.3.1 The back cushion shall be permitted to be split to accommodate a fully recessed SCBA and bracket. [1901:14.1.9.3.1]

14.1.8.3.2 Where the back cushion is split to accommodate an SCBA, a headrest shall be supplied. [1901:14.1.9.3.2]

14.1.9 SCBA Mounting.

14.1.9.1* Where SCBA holders are mounted within a driving or crew compartment, they shall comply with the following:

- (1) The SCBA holder shall retain a pack and bottle combination for the published weight rating of the holder when subjected to the dynamic force pulse per SAE J2418, *Occupant Restraint System Evaluation — Frontal Impact Component-Level Heavy Trucks*.
- (2) If the SCBA unit is mounted in a seatback, the release mechanism shall be accessible to the user while seated.
- (3) Brackets that lock automatically either in the event of impact or when the parking brake is released, but are not locked at other times, shall be permitted.
- (4)* The SCBA holder shall retain the bottle when subjected to the deceleration pulse at 0, 30, 90, and 180 degrees with respect to the direction of bottle extraction and in the horizontal plane.
- (5) The SCBA holder shall retain the bottle when subjected to a deceleration pulse that exceeds 2 *g* for at least 60 ms in the vertical direction.
- (6) The deceleration pulse shall meet the SAE J2418 deceleration profile with an accuracy of $\pm 10\%$ within the 35 to 95 ms range.
- (7) The deceleration pulse shall be measured on a rigid portion of the base of the test fixture.
- (8) The test component shall be retained in the holder during and after the dynamic test.
- (9) The force required to extract the bottle after each test shall be no more than 125 percent of the initial extraction force.
- (10) The SCBA holder shall be attached to the fixture in the same manner that it will be fastened to the seat or vehicle.
- (11) The test bottle shall not move more than 3 in. relative to the frame of the holder during each test.
- (12) The test fixture shall not allow the holder frame to move more than 3 in. relative to the base of the test sled.
- (13) Each holder shall bear a label affixed by the holder manufacturer certifying compliance to these specifications.
[1901:14.1.9.1]

14.1.10 Equipment Mounting.

14.1.10.1 All equipment required to be used during an emergency response shall be securely fastened. [1901:14.1.11.1]

14.1.10.2 All equipment not required to be used during an emergency response, with the exception of SCBA units, shall not be mounted in a driving or crew area unless it is contained in an area capable of containing all contents when a 9 *g* force is applied in the longitudinal axis of the vehicle or a 3 *g* force is applied in any other direction, or the equipment is mounted in a bracket(s) that can contain the equipment when the equipment is subjected to those same forces.

14.1.10.3 Cab Equipment Mounting. Safety sign FAMA10, which warns of the need to secure items in the cab, shall be visible inside the cab. [1901:14.1.10.3]

14.1.11 Steps and access handrails that comply with 15.7.1 through 15.7.4.6, and Section 15.8 shall be provided as necessary for access to all driving and crew compartments. [1901:14.1.12]

14.1.12 Where the crew compartment and the driving compartment are separated, prohibiting direct voice communication, a two-way buzzer or two-way voice intercom system shall be provided. [1901:14.1.13]

14.1.13 Means of Escape.

14.1.13.1 Any interior area to be occupied by personnel shall have a minimum of two means of escape. [1901:14.1.14.1]

14.1.13.2 Each opening shall be a minimum of 24 in. $\times$ 24 in. (610 mm $\times$ 610 mm). [1901:14.1.14.2]

14.1.14 Fresh Air Intake. Fresh air intake for the HVAC system of an enclosed crew compartment shall be equipped with a means of separating burning embers from the air intake system such that burning particulate matter larger than 0.039 in. (1.0 mm) in diameter cannot reach the inside of the crew compartment.

14.2 Cab Tilt Systems. If the fire apparatus has a cab tilt system, the system shall meet the requirements of 14.2.1 through 14.2.3.2. [1901:14.2]

14.2.1 If the operation of the cab tilt system is accomplished by hydraulic means, the system shall be equipped with devices to prevent the motion of the cab in the event of any hydraulic hose failure. [1901:14.2.1]

14.2.2 If the cab has a powered tilting system, the system shall be interlocked to operate only when the parking brake is engaged and shall be configured so that the failure of a single component will not result in unintentional tilting of the cab. [1901:14.2.2]

14.2.3 The control of the cab tilt mechanism shall be accomplished clear of the cab travel area while still having the travel area in clear view. [1901:14.2.3]

14.2.3.1 A mechanical means shall be provided to hold the cab in a fully raised position. [1901:14.2.3.1]

14.2.3.2 If the cab is able to be raised to a defined intermediate position, a mechanical means shall also be provided to hold the cab in that intermediate position. [1901:14.2.3.2]

14.3 Driving Compartment.

14.3.1* A fully enclosed driving compartment with seating capacity for not fewer than two persons shall be provided.

14.3.2* Cabs on apparatus with a GVWR greater than 26,000 lb (11,800 kg) shall meet the requirements of one of the following sets of standards:

- (1) SAE J2420, *COE Frontal Strength Evaluation — Dynamic Loading Heavy Trucks*, and SAE J2422, *Cab Roof Strength Evaluation — Quasi-Static Loading Heavy Trucks*
- (2) ECE Regulation number 29, *Uniform Provisions Concerning the Approval of Vehicles with Regard to the Protection of the Occupants of the Cab of a Commercial Vehicle*
[1901:14.3.2]

14.3.3 Driver's Seat.

14.3.3.1 The driver's seat shall be readily adjustable by the driver. [1901:14.3.3.1]

14.3.4* The passenger side mirror shall be so mounted that the driver has a clear view of the mirror when the passengers are in their normal seated positions. [1901:14.3.4]

14.3.5 All primary rearview mirrors used by the driver shall be adjustable from the driver's position. [1901:14.3.5]

14.3.6 Instrumentation and Controls.

14.3.6.1 The following instrumentation and controls shall be mounted in the driving compartment and shall be identified and visible to the driver while seated:

- (1) Speedometer
- (2) Tachometer
- (3) Odometer
- (4) Oil pressure indicator or gauge
- (5) Coolant temperature indicator or gauge
- (6) Automatic transmission temperature indicator or gauge, if applicable and available
- (7) Voltmeter
- (8) Reserved
- (9) Air pressure gauge(s), if applicable
- (10) Turn signal control and indicator lights
- (11) Headlight/DOT light switch
- (12) High-beam headlight switch and indicator
- (13) Fuel level gauge(s)
- (14) Master ignition switch
- (15) Heater/defroster controls
- (16) Warning lights and siren switches
- (17) Master disconnect switch
- (18) "Master disconnect on" indicator light
- (19) Windshield wipers and windshield washer control
- (20) PTO-engaged indicator, if applicable
- (21) Pump engagement controls, if applicable

14.3.6.2 Controls and switches that are expected to be operated by the driver while the apparatus is in motion shall be within convenient reach for the driver. [1901:14.3.6.2]

14.4* On-Board Pump-and-Roll Fire-Fighting Position.

14.4.1 If an on-board pump-and-roll fire fighting position as described in this section is provided it shall be on a wildland fire apparatus with a GVWR of no more than 19,500 lbs.

14.4.2 If an on-board pump-and-roll fire fighting position is provided, it shall include the following:

- (1) A seat with an approved Type 1 seat belt for each fire-fighting position
- (2) Controls required by the operator within reach without removing the seat belt
- (3) A means of communication with the driver
- (4) Safety sign FAMA44, which warns of riding safety procedures, and the maximum speed of 10 mph visible from the pump-and-roll fire-fighting position
- (5) Safety sign FAMA45, which warns of driving safety procedures, and the maximum speed of 10 mph visible from the driver's position or visible to the driver while entering the cab

14.4.3 If the seating position is located outside the cab, it shall meet the requirements in 14.4.3.1 through 14.4.3.6.

14.4.3.1 The seating position shall be located behind the cab and ahead of the rear axle.

14.4.3.2 A protective structure shall be provided in compliance with the side impact and crush criteria from SAE J1194, *Rollover Protective Structures (ROPS) for Wheeled Agricultural Tractors*.

14.4.3.3 A protective structure shall be designed to allow exit out of either side of the vehicle.

14.4.3.4* The protective structure shall include a perforated plate or mesh with openings no larger than 1.5 in. (3.8 cm) × 1.5 in. (3.8 cm) or other solid guard to protect from brush hazards at the front, the back, and the roof.

14.4.3.5 A door or gate with a latching mechanism shall be provided on each side of the vehicle designed to allow exit out of either side of the vehicle.

14.4.3.5.1 The door or gate shall be designed to prevent outward swing even in the event of failure of the latching mechanism.

14.4.3.5.2 The door or gate shall be at least 48 in. (1200 mm) high from the walking surface below the firefighter's feet.

14.4.3.5.3 The door or gate shall be constructed so there are no horizontal or vertical openings below the 48 in. (1200 mm) minimum height greater than 24 in. (610 mm) in either direction.

14.4.3.6 Equipment located within the protective structure shall meet the requirements of 14.1.10.

Chapter 15 Body, Compartments, and Equipment Mounting

15.1* Compartmentation.

15.1.1* Any enclosed external compartments shall be weather resistant and ventilated and have provisions for drainage.

15.1.2 All electrical junctions or wiring within compartments shall be protected from mechanical damage resulting from equipment stored in the compartment. [1901:15.1.2]

15.2 Reserved.

15.3 Equipment Containment.

15.3.1* Equipment holders or compartments shall be provided for all tools, equipment, and other items that are on the fire apparatus. [1901:15.3.1]

15.3.2* Equipment holders shall be attached and shall be designed so that equipment remains in place under all vehicle operating conditions. [1901:15.3.2]

15.3.3 All tools and equipment shall be readily accessible. [1901:15.3.3]

15.4 Powered Equipment Racks. When a powered equipment rack is provided, it shall meet the requirements of this section. [1901:15.4]

15.4.1 The equipment rack shall be constructed of materials that are capable of carrying the equipment that is intended to be mounted on the equipment rack. [1901:15.4.1]

15.4.2 A lock shall be provided that will retain the equipment rack in the road travel position when the vehicle is in motion.

15.4.3 An interlock shall be provided to prevent operation of the equipment rack unless the apparatus parking brake has been activated. [1901:15.4.3]

15.4.4 Controls shall be provided in a position where the operator can visually follow the travel of the equipment rack. [1901:15.4.4]

15.4.5 A visual signal shall be provided at the driver's position to indicate that the equipment rack is in motion, or in the down position, and that the parking brake is not engaged. [1901:15.4.5]

15.4.6 Flashing lights facing the front and rear of the apparatus shall be provided on the equipment rack and shall be illuminated whenever the equipment rack is in the down position. [1901:15.4.6]

15.4.7 The outward ends of the equipment rack that protrude beyond the body of the apparatus shall have retroreflective material to indicate a hazard or obstruction. [1901:15.4.7]

15.5* SCBA Storage. Storage of complete SCBA units or SCBA cylinders shall be arranged so as to prevent damage, injury, or abrasion to the SCBA from other equipment stored in the general area. [1901:15.5]

15.5.1 If an SCBA unit or cylinder is stored within a driving or crew compartment, the mounting shall comply with the requirements of Section 15.5 and 14.1.9. [1901:15.5.1]

15.5.2 If an SCBA cylinder is mounted in a vertical position with the valve down, it shall be supported with a brace or yoke under the cylinder or valve area to prevent downward movement. [1901:15.5.2]

15.5.3 The holding or clamping device shall not injure, wear, scrape, or otherwise affect the SCBA unit or cylinder, including damage to the paint or reflective finish, while the cylinder is being placed in, stored in, or removed from the holder. [1901:15.5.3]

15.5.4 The SCBA storage area shall be a ventilated, dry area away from all heat sources that could damage the SCBA (e.g., mufflers, engines). [1901:15.5.4]

15.5.5* Vertical Storage of SCBA Cylinders in Tubes.

15.5.5.1 The base of the storage tube shall have a rubber, plastic, or similar device to prevent wear on the cylinder and to prevent damage if the cylinder is accidentally dropped into the storage position. [1901:15.5.5.1]

15.5.5.2 Each storage tube shall have a drain to prevent accumulation of moisture. [1901:15.5.5.2]

15.5.6* Horizontal Storage of SCBA Cylinders.

15.5.6.1 The storage rack or tube assembly shall be designed to prevent the cylinder from accidentally sliding out of the storage rack or tube and shall be installed so as to keep the cylinder from hitting or rubbing on compartment doors, by preventing movement or shifting when in transit. [1901:15.5.6.1]

15.5.6.2 The rear wall of each SCBA storage area or tube shall be covered with a rubber, plastic, or similar material to prevent wear on cylinders. [1901:15.5.6.2]

15.6 Pump and Plumbing Access. If the water pump on the wildland fire apparatus is in an enclosed space, the requirements of 15.6.4 shall apply.

15.6.1 Reserved.

15.6.2 Reserved.

15.6.3 Reserved.

15.6.4 All valves, gauges, controls, pump, and other plumbing equipment shall be accessible for service and replacement.

15.7 Stepping, Standing, and Walking Surfaces.

15.7.1* Steps, platforms, or permanently attached access ladders shall be provided so that fire fighters have access to all working and storage areas of the fire apparatus. [1901:15.7.1]

15.7.1.1 The maximum stepping height shall not exceed 18 in. (460 mm), with the exception of the ground to first step, which shall not exceed 24 in. (610 mm) when the vehicle is loaded to its estimated in-service weight. [1901:15.7.1.1]

15.7.1.1.1 The maximum horizontal offset between steps shall not exceed 18 in. (460 mm). [1901:15.7.1.1.1]

15.7.1.1.2 Any step that decreases the specified approach or departure angle shall be designed to be movable so as not to be damaged when the vehicle traverses terrain that requires the full angle of approach or departure.

15.7.1.1.3 Reserved.

15.7.1.1.4 The ground-to-first-step height shall be determined with the apparatus on level ground. [1901:15.7.1.1.4]

15.7.1.2* All steps shall have a minimum area of 35 in.² (22,580 mm²), shall be of such a shape that a 5 in. (125 mm) diameter disk does not overlap any side when placed on the step, and shall be arranged to provide at least 6 in. (150 mm) of clearance between the leading edge of the step and any obstruction. [1901:15.7.1.2]

15.7.1.3 All platforms shall have a minimum depth of 8 in. (200 mm) from the leading edge of the platform to any obstruction. [1901:15.7.1.3]

15.7.1.4 All access ladders shall have at least 8 in. (200 mm) of clearance between the leading edge of any rung and the body of the fire apparatus or other obstruction. [1901:15.7.1.4]

15.7.1.5 Climbing Method Instruction. Safety sign FAMA23, which warns of the proper climbing method, shall be visible to personnel entering the cab and at each designated climbing location on the body. [1901:15.7.1.5]

15.7.1.6 Designated horizontal standing or walking surfaces higher than 48 in. (1220 mm) from the ground and not guarded by a railing or structure at least 12 in. (300 mm) high when measured with the apparatus at curb weight, shall have at least a 1 in. (25 mm) wide safety yellow or orange line delineation that contrasts with the background to mark the outside perimeter of the designated standing or walking surface area, excluding steps and ladders. [1901:15.7.1.6]

15.7.2 All steps, platforms, or access ladders shall be designed and installed to sustain a minimum static load of 500 lb (227 kg) without deformation. [1901:15.7.2]

15.7.3 Ladder rungs on access ladders shall have a skid-resistant surface or covering, but that surface or covering shall not be required to meet the slip resistance performance requirements of 15.7.4. [1901:15.7.3]

15.7.4* Slip Resistance.

15.7.4.1* All materials used for exterior surfaces designated as stepping, standing, and walking areas and all interior steps shall have a minimum slip resistance in any orientation of 0.68 when tested wet using the English XL tester in accordance with the manufacturer's instructions, or 0.52 when tested wet using the Brungraber Mark II tester in accordance with the manufacturer's instructions. [1901:15.7.4.1]

15.7.4.2 All materials used for interior floors shall have a minimum slip resistance in any orientation of 0.58 when tested dry using the English XL tester in accordance with the manufacturer's instructions or 0.47 when tested dry using the Brungraber Mark II tester in accordance with the manufacturer's instructions. [1901:15.7.4.2]

15.7.4.3 A standard Neolite® test sensor shall be used with both the English XL tester and the Brungraber Mark II tester. [1901:15.7.4.3]

15.7.4.4 Sampling Strategy.

15.7.4.4.1 For uniformly patterned materials, at least 16 readings shall be taken on each sample. [1901:15.7.4.4.1]

15.7.4.4.1.1 Each reading shall be taken 90 degrees clockwise from the previous orientation, resulting in at least four readings in each orientation. [1901:15.7.4.4.1.1]

15.7.4.4.1.2 The readings shall be averaged and reported as the slip resistance for the material. [1901:15.7.4.4.1.2]

15.7.4.4.2 For directionally patterned materials, at least 32 readings shall be taken on each sample. [1901:15.7.4.4.2]

15.7.4.4.2.1 Each reading shall be taken 45 degrees clockwise from the previous orientation, resulting in at least four readings in each orientation. [1901:15.7.4.4.2.1]

15.7.4.4.2.2 The four readings in each direction shall be averaged and reported as the slip resistance for the material in that orientation. [1901:15.7.4.4.2.2]

15.7.4.5 The contractor shall deliver with the fire apparatus a certification that all materials used for exterior surfaces designated as stepping, standing, and walking areas, all interior steps, and all interior floors meet the requirements of 15.7.4. [1901:15.7.4.5]

15.7.4.6 Where the fuel fill is located at or near a stepping surface, the surface shall be constructed of an open grate-type material to facilitate draining of accidentally spilled fuel to lessen any slipping hazard. [1901:15.7.4.6]

15.7.5 Safety sign FAMA24, which warns personnel not to ride on the vehicle, shall be located at the rear step areas and at any cross walkways. [1901:15.7.5]

15.8 Access Handrails or Handholds.

15.8.1 Access handrails or handholds shall be provided at each entrance to a driving or crew compartment and at each position where steps or ladders for climbing are located. [1901:15.8.1]

15.8.2 Exterior access handrails shall be constructed of or covered with a slip-resistant, noncorrosive material. [1901:15.8.2]

15.8.3 Exterior access handrails shall be between 1 in. and 1½ in. (25 mm and 42 mm) in diameter and have a minimum clearance between the handrails and any surface of at least 2 in. (50 mm). [1901:15.8.3]

15.8.4* All exterior access handrails shall be designed and mounted to reduce the possibility of hand slippage and to avoid snagging of hose, equipment, or clothing. [1901:15.8.4]

15.8.5 Handrails and handholds shall be constructed so that three points of contact (two hands and one foot, or one hand and two feet) can be maintained at all times while ascending and descending. [1901:15.8.5]

15.8.6* Access handrails supplied by the chassis manufacturer on a commercial chassis shall be permitted to be used to meet the requirements of this section. [1901:15.8.6]

15.9 Metal Finish.

15.9.1 Where dissimilar metals that pose a galvanic corrosion or reactive threat are to be mounted together, the mounting base material shall have an isolation barrier prior to assembly to prevent dissimilar metal reaction. [1901:15.9.1]

15.9.2* Painting.

15.9.2.1* All exposed ferrous metal surfaces that are not plated or stainless steel shall be cleaned and prepared and shall be painted or coated. [1901:15.9.2.1]

15.9.2.2 The paint or coating, including any primer, shall be applied in accordance with the paint or coating manufacturer's recommendation. [1901:15.9.2.2]

15.9.3* Reflective Striping.

15.9.3.1* A retroreflective stripe(s) shall be affixed to all of the following:

- (1) The side of the apparatus covering at least 50 percent of the cab and 50 percent of the body on each side, excluding the pump panel areas
- (2) At least 25 percent of the width of the front of the apparatus (measured at the front of the vehicle, not including mirrors or other protrusions)
- (3) At least 50 percent of the width of the rear-facing vertical surface of the apparatus calculated by considering any vertical surface within 36 in. (91 cm) forward of the rear bumper, visible from the rear of the apparatus, excluding any pump panel areas not covered by a door

15.9.3.1.1* The stripe or combination of stripes shall be a minimum of 4 in. (100 mm) in total width or as wide as possible if 4 inches (100 mm) of flat surface is not available.

15.9.3.1.2 The 4 in. (100 mm) wide stripe or combination of stripes shall be permitted to be interrupted by objects (e.g., receptacles, cracks between slats in roll-up doors) provided the full stripe is seen as conspicuous when the apparatus is being approached.

15.9.3.1.3 A graphic design shall be permitted to replace all or part of the required striping material if the design or combination thereof covers at least the same perimeter length(s) required by 15.9.3.1. [1901:15.9.3.1.3]

15.9.3.2 Reserved.

15.9.3.3 All retroreflective materials required by 15.9.3.1 shall conform to the requirements of ASTM D4956, *Standard Specification for Retroreflective Sheeting for Traffic Control*, Section 6.1.1, for Type I Sheeting.

15.9.3.3.1 All retroreflective materials used to satisfy the requirements of 15.9.3.1 that are colors not listed in ASTM D4956, Section 6.1.1, shall have a minimum coefficient of retroreflection of 10 with observation angle of 0.2 degrees and entrance angle of -4 degrees. [1901:15.9.3.3.1]

15.9.3.3.2 Reserved.

15.9.3.3.3 Any printed or processed retroreflective film construction used to meet the requirements of 15.9.3.1 shall conform to the standards required of an integral colored film as specified in ASTM D4956, Section 6.1.1.

15.10* Hose Storage. If a hose storage area(s) is provided, it shall comply with this section. [1901:15.10]

15.10.1 The hose storage area shall be made from noncorrosive materials.

15.10.2* The bottom shall be constructed to prevent the accumulation of water and allow for ventilation to aid in drying hose. [1901:15.10.1]

15.10.3 The interior shall be smooth and free from all projections, such as nuts, sharp angles, or brackets, that might cause damage to the hose. [1901:15.10.2]

15.10.4 The interior of a hose storage area shall not be required to meet the slip resistance requirements given in 15.7.4. [1901:15.10.3]

15.10.5 Reels, handrails, ladders, and equipment holders shall be placed so as not to obstruct the laying or removal of hose from the storage area. [1901:15.10.4]

15.10.6* Any hose storage area shall be equipped with a positive means to prevent unintentional deployment of the hose from the top, sides, front, and rear of the hose storage area while the apparatus is underway in normal operations. [1901:15.10.5]

15.10.7 Hose Restraint Safety Sign. Safety sign FAMA22, which warns of the need to secure hose, shall be visible to personnel at each hose storage area. [1901:15.10.6]

15.10.8* If a hose reel is provided, it shall be equipped with a brake.

15.10.8.1 The hose reel shall have a capacity of not less than 100 ft (30 m) of $\frac{3}{4}$ in. (19 mm) booster hose.

15.10.8.2 When the reel is equipped with over 100 ft (30 m) of hose, the reel shall have power rewind capability.

15.11 Requirements for Mounting of Ground Ladders. If the apparatus is equipped with ground ladders, the mounting shall meet the requirements of 15.11.1 through 15.11.4.

15.11.1 Ground ladders shall be mounted and protected to prevent movement, abrasion, or other damage to the ground ladder while they are on the fire apparatus. [1901:15.11.1]

15.11.2 When mounted on the apparatus, ground ladders shall not be subject to exposure to heat sources (such as engine heat) of 212°F (100°C) or greater. [1901:15.11.2]

15.11.3 Ground ladders shall be supported to prevent any sagging or distortion while they are mounted on the fire apparatus. [1901:15.11.3]

15.11.4 The rollers and other moving parts of the frame holding the ground ladders on the apparatus shall be readily accessible to permit lubrication. [1901:15.11.4]

15.12* Receivers and Anchors for Rope and Removable Winches.

15.12.1 Receivers or anchors installed at any location on the apparatus for use as removable winch anchors shall be designed and affixed to provide at least a 2.0-to-1 straight line pull no-yield safety factor over the load rating of the removable winch. [1901:15.12.1]

15.12.2 Receivers or anchors installed at any location on the apparatus for use with rope operations shall be designed and affixed to the apparatus to provide at least a 9000 lbf (40,000 N) no-yield condition with a straight line pull. [1901:15.12.2]

15.12.3 Safety sign FAMA28 shall be located on or near each receiver or anchor stating the maximum straight line pull rating. [1901:15.12.3]

15.13 Slip-On Fire-Fighting Module. If the pump, piping, and tank are built as a slip-on, self-contained unit, it shall meet the requirements of 15.13.1 through 15.13.3 and shall be mounted on the fire apparatus in accordance with 15.13.4. [1901:15.13]

15.13.1 The major components of the slip-on module, including the pump, pumping engine, water and agent tank(s), plumbing system, and electrical system, shall meet the requirements of the applicable chapters of this standard covering those components. [1901:15.13.1]

15.13.2 Intake and discharge piping shall not interfere with the routine maintenance of the pump, engine, or auxiliary systems and shall not unduly restrict the servicing of these components. [1901:15.13.2]

15.13.3 The manufacturer of a slip-on fire-fighting module shall provide the following data with the module:

- (1) Weight without water but with all other tanks or reservoirs for liquids full
 - (2) Weight full with water and other liquids, including foam concentrate, fuel, and lubricants
 - (3) Horizontal center of gravity when full with water and other liquids
 - (4) Overall dimensions
- [1901:15.13.3]

15.13.4 Mounting.

15.13.4.1 The slip-on module shall be mounted in a manner that allows access to the engine, pump, and auxiliary systems for routine maintenance. [1901:15.13.4.1]

15.13.4.2 The slip-on module shall be removable using common hand tools. [1901:15.13.4.2]

15.13.4.3 The slip-on module shall be mounted in a manner that prevents damage by vibration. [1901:15.13.4.3]

15.13.4.4* Special anchorage shall be provided on the vehicle chassis and on the slip-on fire-fighting module to secure the fire-fighting module to the vehicle chassis. [1901:15.13.4.4]

15.13.4.5 The anchorage described in 15.13.4.4 shall be designed to prevent movement of the slip-on module during rapid acceleration, deceleration, or side-hill operations. [1901:15.13.4.5]

15.13.4.6 Drilling on chassis frame flanges or welding to chassis frame shall not be permitted. [1901:15.13.4.6]

Chapter 16 Pumps for Wildland Fire Fighting and Associated Equipment

16.1 Application.

16.1.1 If the apparatus is equipped with a pump, the wildland fire apparatus shall include a wildland fire pump as defined in Section 16.2 through 16.13.11.4.4 or a fire pump as defined in NFPA 1901.

16.1.2 The purchaser shall refer to the standards applicable to the pump selected.

16.2 Design and Performance Requirements.

16.2.1* One or more wildland fire pumps shall be mounted on the apparatus and rated at one or more of the ratings in Table 16.2.1.

16.2.2 The apparatus shall be designed for pump and roll operations.

16.2.2.1* The vehicle drive engine and drive train shall be arranged so that the pump can deliver at least 20 gpm (80 L/min) at a gauge pressure of 80 psi (550 kPa), while the fire apparatus is moving at 2 mph (3.2 km/hr) or less.

16.2.3 Pumping System Capability.

16.2.3.1 Reserved.

16.2.3.2 Reserved.

16.2.3.3* When dry, the pump system in both parallel and series operation where pumps are of the parallel/series type shall be capable of taking suction under the conditions specified in 16.2.4.1 through 20 ft (6 m) of suction hose of the size specified in Table 16.2.4.1(a) and a strainer and discharging water in not more than 30 seconds.

Table 16.2.1 Wildland Fire Apparatus Pump Rating Chart

Minimum Pump Pressure		Minimum Rated Capacity or Flow Rate	
psi	kPa	gpm	L/min
100	700	50	200
		150	600
150	1000	50	200
		250	1000
250	1700	50	200
		150	600
300	2000	200	800
400	2800	30	120

16.2.3.4 Vacuum.

16.2.3.4.1 The completed pumping system shall be capable of developing a vacuum of 17 in. Hg (57.4 kPa) at altitudes up to 2000 ft (600 m) by means of the pump priming system and sustaining the vacuum for at least 5 minutes with a loss not to exceed 10 in. Hg (34 kPa).

16.2.3.4.2 The requirement in 16.2.3.4.1 shall be met with all intake valves open, with all intakes capped or plugged, with all discharge caps removed and valves closed, and without the use of the pump primer during the 5-minute period. [1901:16.2.3.4.2]

16.2.3.4.3 The requirement in 16.2.3.4.1 shall also be met with the intake valves closed and caps or plugs removed.

16.2.3.4.4 An automatic method shall be provided to prevent the loss of vacuum through the priming system when the priming device is not being operated.

16.2.3.4.4.1 A manual method shall be provided to shut off the priming system to prevent loss of vacuum, to prevent back-flow, and to prevent outflow when the priming device is not in use.

16.2.3.4.4.2 If the automatic method to shut off the priming system prevents flow in both directions, a separate manual method shall not be required.

16.2.3.4.4.3 The method used to shut off the priming device shall be permitted to be a separate device controlled by the primary control.

16.2.3.4.5 Pump intake plumbing shall be capable of withstanding a minimum vacuum of 30 in. Hg (101.6 kPa) without becoming deformed.

16.2.4 Pumping Suction Capability.

16.2.4.1 The pump manufacturer shall certify that the pump can deliver its rated capacity at rated net pump pressure from draft, under the following conditions:

- (1) At an altitude of 2000 ft (600 m) above sea level
- (2) Through a single intake with 20 ft (6 m) of suction hose of the size specified in Table 16.2.4.1(a) and equipped with a suction hose strainer
- (3) With a lift of 10 ft (3 m)
- (4) At 29.9 in. Hg (101 kPa) atmospheric pressure (corrected to sea level)
- (5) At a water temperature of 60°F (16°C)
- (6) At the entrance and friction loss for the 20 ft (6 m) of suction hose and strainer listed in Table 16.2.4.1(b) or at the entrance and friction loss for the 6 m of suction hose and strainer listed in Table 16.2.4.1(c).

Table 16.2.4.1(a) Suction Hose Size by Pump Capacity Rating

Flow Rate		Suction Hose Size	
gpm	L/min	in.	mm
30	120	1½	38
50	200	2	52
150	600	2½	65
200	800	2½	65
250	1000	3	75

Table 16.2.4.1(b) Entrance and Friction Loss in 20 ft of Suction Hose, Including Strainer (inch-pound units)

Flow Rate (gpm)	Suction Hose Size (in.)									
	1½		2		2½		3		4	
	ft water	in. Hg	ft water	in. Hg	ft water	in. Hg	ft water	in. Hg	ft water	in. Hg
30	2.7	2.38	0.75	0.66						
50			1.7	1.50	0.5	0.44				
150					4.5	3.97	1.9	1.64		
200					8.0	7.06	3.3	2.91	0.8	0.71
250					13.0	11.47	5.2	4.59	1.3	1.1

Table 16.2.4.1(c) Entrance and Friction Loss in 6 m of Suction Hose, Including Strainer (SI Units)

Flow Rate (L/ min)	Suction Hose Size (mm)									
	38		52		65		75		100	
	m water	kPa	m water	kPa	m water	kPa	m water	kPa	m water	kPa
120	0.82	8.1	0.23	2.2						
200			0.52	5.1	0.15	1.5				
600			2.83	27.8	0.91	9.0				
800					2.44	23.9	1.01	9.9	0.24	2.4
1000					3.96	38.9	1.58	15.5	0.4	4

16.2.4.2* The pump manufacturer shall certify that the pump is capable of pumping rated capacity at rated net pump pressure from draft at any of the following special conditions when these conditions are specified by the purchaser:

- (1) At an elevation above 2000 ft (600 m)
- (2) At lifts higher than 10 ft (3 m), through more than 20 ft (6 m) of suction hose, or both

16.3 Pump Engine Requirements.

16.3.1 The apparatus manufacturer shall approve the use of the pumping engine for stationary pumping applications based on the size of the fire apparatus and the rating of the pump being furnished. [1901:16.3.1]

16.3.2 Reserved.

16.3.3 Reserved.

16.3.4 Reserved.

16.3.5 Reserved.

16.3.6 Reserved.

16.3.7 Engine and Engine System Design. If a separate pump engine drives the pump, that engine shall meet the requirements of 16.3.7.1 through 16.3.7.3.

16.3.7.1* An engine governor or electronic fuel control system shall be installed that will limit the speed of the engine under all conditions of operation to that speed established by the engine manufacturer, which shall be the maximum governed speed.

16.3.7.2* Automatic engine shutdown systems shall be permitted if they are an integral part of the standard engine management system.

16.3.7.3 Automatic engine shutdown systems shall be permitted to automatically shut down the pump drive engine when the pump is out of water, provided the system is manually armed.

16.3.8 Cooling System.

16.3.8.1 The engine shall be air cooled or liquid cooled with a self-contained cooling system.

16.3.8.2 The engine's cooling system shall maintain a temperature in the engine at or below the engine manufacturer's maximum temperature rating under all conditions for which the fire apparatus is designed.

16.3.8.3 If the engine is liquid cooled, the cooling system shall meet the requirements of 16.3.8.3.1 through 16.3.8.3.4.

16.3.8.3.1 If the cooling system is equipped with drain valves, they shall be installed at the lowest point of the cooling system.

16.3.8.3.2* Drain valves shall be designed or positioned such that they will not open accidentally.

16.3.8.3.3 The radiator shall be mounted to prevent the development of leaks caused by twisting or straining where the apparatus operates over uneven ground.

16.3.8.3.4 A coolant temperature gauge or high-temperature indicator light shall be provided.

16.3.9 Lubrication System.

16.3.9.1 The engine oil fill-pipe shall be large enough and located so as to allow easy filling.

16.3.9.2 If the pump drive engine has a positive pressure lubrication system, a low-oil pressure indicator or oil pressure

gauge shall be provided that is visible from the pump operator's position.

16.3.9.3 Clearance or an extension shall be provided so the engine oil can be drained and captured.

16.3.10 Fuel and Air System.

16.3.10.1 Diesel Engines.

16.3.10.1.1 Air Intake System.

16.3.10.1.1.1* An air filter shall be provided in the engine's air intake system.

16.3.10.1.1.2 Air inlet restrictions shall not exceed the engine manufacturer's recommendations.

16.3.10.1.1.3 For engines greater than 35 hp (26 kW), if approved by the engine manufacturer, the air inlet shall be equipped with a means of separating water and burning embers from the air intake system such that burning particulate matter larger than 0.039 in. (1.0 mm) in diameter cannot reach the air filter element.

16.3.10.1.2* The fuel supply lines and fuel filters shall meet the engine manufacturer's recommendations.

16.3.10.1.3 Electric Fuel Priming System.

16.3.10.1.3.1* Where an electric fuel priming system is furnished, the valving and piping shall be arranged and marked with a label so that it can be operated only to reprime the fuel system.

16.3.10.1.3.2 When the electric fuel priming system is not being intentionally operated, it shall be isolated from the fuel system and inoperable.

16.3.10.1.3.3 The priming system shall be marked with a label to indicate proper operation.

16.3.10.2 Gasoline Engines.

16.3.10.2.1 Air Intake System.

16.3.10.2.1.1* An air filter shall be provided in the engine's intake air system.

16.3.10.2.1.2 Air inlet restrictions shall not exceed the engine manufacturer's recommendations.

16.3.10.2.1.3 For engines greater than 35 hp (26 kW), if approved by the engine manufacturer, the air inlet shall be equipped with a means of separating water and burning embers from the air intake system such that burning particulate matter larger than 0.039 in. (1.0 mm) in diameter cannot reach the air filter element.

16.3.10.2.2 Fuel System.

16.3.10.2.2.1 All fuel lines and all filters or strainers shall meet the engine manufacturer's recommendations.

16.3.10.2.2.2 The fuel line(s) shall be located or protected so as not to be subjected to excessive heating from any portion of a vehicle exhaust system.

16.3.10.2.2.3 The line(s) shall be protected from mechanical damage.

16.3.11 Exhaust System.

16.3.11.1 The exhaust piping and its discharge shall be located so as not to expose any portion of the apparatus to excessive heating.

16.3.11.2* Exhaust pipe discharge shall be directed away from the pump operator's position.

16.3.11.3 The exhaust system shall meet the requirements of USDA Forest Service specifications 5100-1 unless 100 percent of the exhaust gases pass through a turbo charger.

16.3.11.4 Exhaust backpressure shall not exceed the limits specified by the engine manufacturer.

16.3.12 Engine Controls.

16.3.12.1* A nonkeyed switch to start or stop the pump engine shall be furnished and shall be located at the pump operator's position.

16.3.12.2 The engine speed shall be permitted to be controlled by an automatic speed controller or a manually adjustable throttle.

16.3.12.2.1 A hand throttle of a type that holds its set position shall be provided where the pump drive engine is not equipped with an automatic throttle control system to control the engine speed.

16.3.12.2.2 Where provided, the throttle shall be located so that it can be manipulated from the pump operator's position with all instrumentation in full view.

16.3.13 Electrical System and Devices.

16.3.13.1 The electrical system on the pump engine shall meet the requirements of Section 13.2.

16.3.13.2 Where a separate battery(s) is provided, the requirements of 16.3.13.2.1 through 16.3.13.2.4 shall apply.

16.3.13.2.1 A built-in means to charge the battery(s) shall be provided.

16.3.13.2.2 The charging system shall have an output adequate to meet the continuous anticipated electrical load of the engine and starting system as manufactured, at 200°F (93°C) operating temperature (within any engine enclosure, if applicable).

16.3.13.2.3 The charging system shall be provided with full automatic regulation.

16.3.13.2.4 The batteries shall meet the requirements of 13.4.4 through 13.4.4.4.

16.3.13.3* Battery power for the separate engine-driven pump shall be permitted to be supplied from the chassis battery(ies).

16.3.14 Starting Device.

16.3.14.1 An electrical starting device shall be provided.

16.3.14.2 The characteristics of the electrical starting device shall be such that, when operating under maximum load, the voltage drop of the conductors shall be in accordance with SAE J541.

16.3.15* Fuel Tanks.

16.3.15.1 The fuel tank(s) shall be of sufficient size to permit operation of the pump at its rated capacity and pressure for at least 1 hour without refilling.

16.3.15.2* The pump engine shall be permitted to draw fuel from the chassis fuel tank, when done in accordance with the chassis manufacturer's recommendation.

16.3.15.3 Each fuel tank shall be labeled near the fill opening to indicate the type of fuel.

16.4 Power Train Capability.

16.4.1 All components in the power train from the engine to the wildland fire pump shall be capable of transmitting the torque necessary to power the pump, as installed in the apparatus, for the pump-rated capacity without exceeding the component manufacturer's continuous-duty torque rating.

16.4.2 When pumping continuously at rated capacity, lubricant temperatures in any power train component installed in the apparatus from the engine to the pump shall not exceed the component manufacturer's recommendation for maximum temperature.

16.4.3* A means shall be provided to limit the nominal net engine output during pumping operation to a torque level equal to the nominal continuous-duty torque rating of the weakest component or, if there are multiple devices to be driven simultaneously, to a level equal to the sum of the nominal continuous-duty torque ratings of multiple components. [1901:16.4.3]

16.5* Construction Requirements.

16.5.1* Wetted moving parts shall be constructed of a corrosion-resistant material. [1901:16.5.1]

16.5.1.1 Where more than one pump is provided, and where the pumps are interconnected so that pressure from one pump can be transmitted to the other pump, check valves, intake or discharge relief valves, pump drive gear ratios, or other automatic means shall be provided to avoid pressurizing either pump beyond the hydrostatic pressure referenced in 16.5.2.1.

16.5.2 Hydrostatic Test.

16.5.2.1 The pump body shall be subjected to a hydrostatic test pressure of 100 psi (700 kPa) above the maximum close-off pressure or to a gauge pressure of 300 psi (2000 kPa), whichever is higher, for 10 minutes.

16.5.2.2 The pump manufacturer shall provide a certificate of completion for the hydrostatic test. [1901:16.5.2.2]

16.5.3 The entire discharge and intake piping system, valves, drain cocks and lines, and intake and outlet closures, excluding the tank-to-pump lines on the tank side of the valve in those lines, shall be subjected to a hydrostatic test pressure of 100 psi (700 kPa) above the maximum close-off pressure or to a gauge pressure of 300 psi (2000 kPa), whichever is higher, for 5 minutes.

16.5.4 The pump shall allow a positive pressure water source to directly add to the pump's discharge pressure. [1901:16.5.5]

16.6* Pump Intake.

16.6.1* Intakes of the same or larger size as specified in Table 16.2.4.1(a) for suction hose size shall be provided.

16.6.1.1* Any intake shall have male threads and any 2½ in. (65 mm) intake or larger shall have National Hose Thread (NH).

16.6.1.2 If the couplings on the suction hose carried on the apparatus are of a different size from that of the pump intake(s) or have means of hose attachment other than that provided on the intake(s), an adapter(s) shall be provided to allow connection of the suction hose to the pump intake(s). [1901:16.6.1.2]

16.6.1.3* Safety sign FAMA25, which warns of the need for training prior to operating the apparatus, shall be located on the pump operator's panel. [1901:16.6.1.3]

16.6.2 Intake Strainer.

16.6.2.1 Each intake shall have a removable or accessible strainer inside the connection. [1901:16.6.2.1]

16.6.2.2* The strainer(s) shall restrict spherical debris that is too large to pass through the pump. [1901:16.6.2.2]

16.6.3 Reserved.

16.6.4 Any 3 in. (76 mm) or larger intake valve except the tank-to-pump valve shall be a slow-operating valve. [1901:16.6.4]

16.6.5 Reserved.

16.6.6 Each valved intake having a connection size larger than 3 in. (75 mm) shall be equipped with an adjustable automatic pressure relief device installed on the supply side of the valve to bleed off pressure from a hose connected to the valved intake. [1901:16.6.6]

16.6.6.1 The pressure relief device shall discharge to atmosphere, and the discharge shall be piped or directed away from the pump operator's position. [1901:16.6.6.1]

16.6.6.2 The automatic pressure relief device shall be adjustable from a minimum of 90 psi (620 kPa) to at least 185 psi (1275 kPa). [1901:16.6.6.2]

16.6.6.3 The pressure relief device, when preset at 125 psi (860 kPa), shall not allow a pressure rise greater than 60 psi (400 kPa) at the device inlet while flowing a minimum of 150 gpm (570 L/min). [1901:16.6.6.3]

16.6.7 If the pump is equipped with one or more intakes larger than 3 in. (75 mm) that are not valved, an adjustable automatic pressure relief device shall be installed on the pump system to bleed off excess pressure from a hose connected to the pump intake. [1901:16.6.7]

16.6.7.1 The automatic pressure relief device shall be adjustable from a minimum of 90 psi (620 kPa) to at least 185 psi (1275 kPa). [1901:16.6.7.1]

16.6.7.2 The pressure relief device, when preset at 125 psi (860 kPa), shall not allow a pressure rise greater than 60 psi (400 kPa) at the device inlet while flowing a minimum of 150 gpm (570 L/min). [1901:16.6.7.2]

16.6.7.3 The pressure relief device shall discharge to atmosphere. [1901:16.6.7.3]

16.6.8 Intake Covers. All intakes shall be provided with caps, plugs, or closures.

16.6.8.1 Intakes having male threads shall be equipped with caps. [1901:16.6.8.1]

16.6.8.2 Intakes having female threads shall be equipped with plugs. [1901:16.6.8.2]

16.6.8.3 Where adapters for special threads or other means for hose attachment are provided on the intakes, closures shall be provided for the adapters in lieu of caps or plugs. [1901:16.6.8.3]

16.6.8.4 Caps, plugs, or closures for 3½ in. (90 mm) and smaller intakes shall remain secured to the apparatus or pumping unit when removed from the intakes. [1901:16.6.8.4]

16.6.9 Reserved.

16.6.10* If the manufacturer or contractor provides a valve, siamese, or adapter on a suction inlet(s) that will remain in place while the apparatus is in motion, that valve, siamese, or adapter shall not project beyond the apparatus running board.

16.7 Pump Discharge Outlets.

16.7.1* Sufficient discharge outlets, including any discharge outlets located in hose storage areas, shall be provided to discharge the rated capacity of the pump at the flow rates as shown in Table 16.7.1.

16.7.2 Discharge Outlet Connections.

16.7.2.1* Each 1½ in. (38 mm) or larger discharge outlet shall be equipped with male National Hose Thread (NH).

16.7.2.2* Adapters with special threads or other means for hose attachment shall be permitted to be furnished on any outlets. [1901:16.7.2.2]

16.7.3 Reserved.

16.7.4 Each discharge outlet, except an outlet to which a hose is to be preconnected, shall be equipped with a cap or closure that is capable of withstanding 100 psi (700 kPa) over the maximum rated pump close-off pressure or 300 psi (2000 kPa) gauge pressure, whichever is higher.

16.7.4.1 Where adapters are provided on the discharge outlet connections, the closures shall fit on the adapters. [1901:16.7.4.1]

16.7.4.2 If a cap or closure is provided, it shall be secured to the pumping unit with a chain or cable.

16.7.4.3 Caps shall automatically release pressure in the discharge outlet before the threads are completely disengaged unless outlet and cap are equipped with drains or bleeder valves. [1901:16.7.4.3]

Table 16.7.1 Flow Rates for Various Outlet Sizes

Outlet Size		Flow Rates	
in.	mm	gpm	L/min
1	25	50	200
1½	38	125	500
2½	65	250	1000

16.7.4.4 The pressure relief shall discharge to atmosphere, and the discharge shall direct away from the operator's position. [1901:16.7.4.4]

16.7.5* Each discharge outlet shall be equipped with a valve that can be opened and closed smoothly at the flows shown in Table 16.7.1 at pump discharge gauge pressures of 250 psi (1700 kPa) or of 100 psi (700 kPa) over the pump rated pressure, whichever is greater.

16.7.5.1 The flow-regulating element of each valve shall not change its position under any condition of operation that involves discharge pressures to the maximum pressure of the pump.

16.7.5.2 The means to prevent a change in position shall be incorporated in the operating mechanism and shall be permitted to be manually or automatically controlled.

16.7.5.3* Any 3 in. (76 mm) or larger discharge valve shall be a slow-operating valve. [1901:16.7.5.2]

16.7.6 Reserved.

16.7.7 Any 2½ in. (65 mm) or larger discharge outlet that is located more than 42 in. (1070 mm) above the ground and to which a hose is to be connected, but that is not in a hose storage area, shall be equipped with a sweep elbow of at least 30 degrees downward.

16.7.8* Valves.

16.7.8.1 Reserved.

16.7.8.2 Reserved.

16.7.8.3* A pump cooling/recirculation line of sufficient size to prevent the pump from overheating when no discharge lines are open shall be provided between the pump discharge and the water tank.

16.7.8.4 All discharge valves 1 in. (25 mm) or over in size shall be quarter-turn types.

16.7.8.5 Where the valve operating mechanism does not indicate the position of the valve, an indicator shall be provided to show when the valve is closed. [1901:16.7.10]

16.7.8.6 Visible quarter-turn valves shall be installed so they are open when the handle is parallel with the run of the pipe and are closed when the handle is perpendicular to the run of the pipe.

16.7.8.7 Blind valves, which are valves behind panels, shall have their open and closed positions marked "Open" and "Closed."

16.7.8.8 Operating mechanisms for valves used on the fire-ground shall be marked as to their function, such as "Intake," "Tank to Pump," "Pump to Tank," and "Discharge."

16.7.8.9 If the apparatus is equipped with a booster reel, the piping, valves, and swivel between the pump and booster reel shall be nominally the same size as or larger than the nominal inside diameter of the hose to be carried on the reel.

16.7.8.9.1 A shutoff valve shall be provided between the pump and the reel.

16.7.8.9.2 High-pressure booster hose of the same nominal size shall be permitted in place of piping.

16.7.9* Location of Discharge Outlets.

16.7.9.1 No discharge outlet larger than 2½ in. (65 mm) shall be located at the pump operator's panel. [1901:16.7.9.1]

16.7.9.2 If the apparatus has a top console-type pump operator's panel, vertical discharge outlets larger than 2½ in. (65 mm) shall be permitted at the top midship position of apparatus where the outlets are used for directly connected deck guns or monitors and no fire hose is used for coupling the components. [1901:16.7.9.2]

16.8 Pump Drains.

16.8.1 A readily accessible drain valve(s) that is marked with a label as to its function shall be provided to allow for draining of the pump and all water-carrying lines and accessories. [1901:16.8.1]

16.8.2 The drain valve(s) shall be operational without the operator having to get under the apparatus, or a label at the operator's location shall indicate the location of drains that need to be operated from under the apparatus.

16.9 Pump Operator's Location.

16.9.1* The pump controls, gauges, and instruments shall be accessed from ground level, a working platform, or a driver's compartment.

16.9.2 All gauges, discharge outlets, pump intakes, and controls shall be illuminated in compliance with 4.10.1. [1901:16.9.2]

16.9.3 Each control, gauge, and instrument shall be marked with a label as to its function.

16.10* Pump Controls.

16.10.1 General Provisions. Provisions shall be made for placing the pump drive system in operation using controls and switches that are identified and within convenient reach of the operator. [1901:16.10.1]

16.10.1.1 Where the pump is driven by the chassis engine and engine compression brakes or engine exhaust brakes are furnished, these engine brakes shall be automatically disengaged for pumping operations. [1901:16.10.1.1]

16.10.1.2* Any control device used in the pumping system power train between the engine and the pump, except a manual pump shift override device if provided, shall be equipped with a means to prevent unintentional movement of the control device from its set position in the pumping mode. [1901:16.10.1.2]

16.10.1.3 Where the pump is driven by the chassis engine, a label indicating the chassis transmission shift selector position to be used for pumping shall be provided in the driving compartment and located so that it can be read from the driver's position. [1901:16.10.1.3]

16.10.1.4 Where the pump is driven by the chassis engine and automatic transmission through a split shaft PTO, an interlock system shall be provided to prevent the pump drive system from being shifted out of the "pump engaged" pumping mode of operation when the chassis transmission is in pump gear. [1901:16.10.1.4]

16.10.1.5 Where the power train from engine to pump includes retarders or other auxiliary braking devices, they shall be automatically disengaged for pumping operations.

16.10.2* Interlocks and Indicators. Where the water pump is driven by the chassis engine, an interlock system shall be provided to ensure that the pump drive system components are engaged in the pumping mode of operation so that the pumping system can be operated from the pump operator's position, with indicators to inform the operators of the status of the controls. [1901:16.10.2]

16.10.2.1 Required Indicators.

16.10.2.1.1 All apparatus shall have "Pump Engaged" and "OK to Pump" indicators in the driver compartment. [1901:16.10.2.1.1]

16.10.2.1.2 All apparatus shall have "Throttle Ready" and "OK to Pump" indicators on the pump operator's panel. [1901:16.10.2.1.2]

16.10.2.1.3 If the apparatus is designed to do pump-and-roll, an "OK to Pump-and-Roll" indicator shall also be in the driver compartment. [1901:16.10.2.1.3]

16.10.2.2* Pump Engaged. A "Pump Engaged" indicator shall be provided in the driving compartment to indicate the pump shift process has been successfully completed. [1901:16.10.2.1]

16.10.2.3 OK to Pump. An "OK to Pump" indicator shall be provided in the driving compartment and on the pump operator's panel to indicate that all of the following conditions have been met to safely operate the pump in stationary mode:

- (1) The pump shift is engaged.
- (2) The parking brake is engaged.
- (3) If the pump is driven from a transfer case PTO or auxiliary transmission PTO, the drive to the wheels is in neutral.
- (4) If the apparatus is equipped with an automatic transmission, the chassis transmission is in the correct pump gear as identified in 16.10.1.3 as follows:
 - (a) If the pump is driven by a PTO after the chassis transmission gearing (e.g., split shaft PTO, transfer case PTO, etc.) the transmission is in the correct forward drive gear.
 - (b) If the pump is driven by a PTO ahead of the chassis transmission gearing (e.g., flywheel PTO, crankshaft PTO, etc.) the transmission is in neutral.
- (5) If the apparatus is equipped with a manual transmission, any gear, including neutral, will allow an "OK to Pump" indicator to come on provided all other conditions are met.

[1901:16.10.2.3]

16.10.2.4* OK to Pump and Roll. If the apparatus is designed to be used in both stationary pumping mode and "pump-and-roll" pumping mode, an "OK to Pump and Roll" indicator shall be provided in the driving compartment to indicate that all of the following conditions have been met to safely operate the pump in pump-and-roll mode.

- (1) The pump shift is engaged.
- (2) The parking brake is released.

[1901:16.10.2.4]