

NFPA®

414

**Standard for Aircraft Rescue
and Fire-Fighting Vehicles**

2017



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NFPA® 414

Standard for

Aircraft Rescue and Fire-Fighting Vehicles

2017 Edition

This edition of NFPA 414, *Standard for Aircraft Rescue and Fire-Fighting Vehicles*, was prepared by the Technical Committee on Aircraft Rescue and Fire Fighting. It was issued by the Standards Council on May 13, 2016, with an effective date of June 2, 2016, and supersedes all previous editions.

This edition of NFPA 414 was approved as an American National Standard on June 2, 2016.

Origin and Development of NFPA 414

In 1960, a tentative edition of this standard was adopted by the Association. The original document was further revised in 1962, 1963, 1964, 1965, 1967, 1968, 1969, 1970, 1975, and 1978.

In 1984, the standard was revised completely to identify three types of vehicles and to make the document easier to use. The text also was rewritten to conform with the NFPA *Manual of Style*.

The standard was revised again in 1990, and a chapter was added to provide a test method to verify the design requirements.

Notable revisions to the 1995 edition included the removal of requirements for a separate category of rapid intervention vehicle.

The major change for the 2001 edition was the combination of major fire-fighting vehicles and combined agent vehicles. Additionally, a table concisely provided many requirements that previously were covered by numerous paragraphs.

The 2007 revision included minor changes to the document plus the addition of a new chapter on interior access vehicles.

For the 2012 edition of NFPA 414, the committee went through the entire document and made a multitude of changes to the requirements. Those changes included the addition of an equivalency statement, to provide the AHJ or purchaser some flexibility when it comes to meeting the requirements. There was also a new emphasis placed on Chapter 5, which deals with aircraft interior access vehicles. This was due largely to the increase in need for these vehicles based on the increased size of aircraft as well as some limitations to traditional aircraft rescue and fire-fighting (ARFF) vehicles, whose primary function is fire fighting. These vehicles assist in the evacuation of passengers from aircraft in addition to the use of evacuation slides or if the slides are not appropriate for use and deployment. Another important item addressed in the 2012 edition was that many ARFF vehicles are operated by a single person and that many of the devices and warnings/alarms are now designed with a single user/operator in mind. Generally speaking, many of the changes or enhancements that were introduced into the 2012 edition revolved around the development and use of larger aircraft, such as the A-380 and the Boeing Dreamliner, as well as the composite materials from which they are manufactured. The capacities for ARFF vehicles have to be increased to address this change in aircraft as well as to ensure that the vehicles are still able to meet prescribed response time standards. The committee has also addressed the environmental impact some extinguishing agents pose and have either limited them or removed them from the document and replaced them with acceptable alternatives. The committee also reviewed the entire document to ensure that it is consistent with the source documents, with commonly accepted practices as they relate to the ARFF industry, and with the *Manual of Style for NFPA Technical Committee Documents*.

The 2017 edition revisions include updates to referenced publications and definitions and a rewrite of Chapter 5, Aircraft Interior Access Vehicles. This rewrite includes the addition of language to address cab visibility, cab construction, equipment, AIAV body, docking platform, acceptance criteria, and testing. Revisions also include extracted language from NFPA 1901 on SCBA mounting and a full extract of NFPA 1901 language for Chapter 6, Electrical System Performance Tests.

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Committee Scope: This Committee shall have primary responsibility for documents on aircraft rescue and fire-fighting services and equipment, for procedures for handling aircraft fire emergencies, and for specialized vehicles used to perform these functions at airports, with particular emphasis on saving lives and reducing injuries coincident with aircraft fires following impact or aircraft ground fires. This Committee also shall have responsibility for documents on aircraft hand fire extinguishers and accident prevention and the saving of lives in future aircraft accidents involving fire.

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NFPA 414

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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.

1.1.1* This standard specifies the minimum design, performance, and acceptance criteria for aircraft rescue and fire-fighting (ARFF) vehicles intended to transport personnel and equipment to the scene of an aircraft emergency for the purpose of rescuing occupants and conducting rescue and fire-fighting operations.

1.1.2 Vehicles without wheels, such as track, amphibious, or air-cushion types, are not covered by this standard.

1.2 Purpose.

1.2.1 The purpose of this standard is to specify features and components that, when assembled, produce an efficient and capable fire-fighting vehicle for both on-pavement and off-pavement performance. Off-pavement capability is important to ensure timely and effective response of these vehicles to aircraft accident sites located off paved surfaces.

1.2.2 It is not the purpose of this standard to serve as a detailed purchase specification. Drafting of complete specifications for bidding purposes is the responsibility of the purchaser.

1.3 Equivalency.

1.3.1 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.

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

1.3.3 The system, method, or device employed shall be demonstrated to meet the acceptance criteria for the intended purpose to the authority having jurisdiction.

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 412, *Standard for Evaluating Aircraft Rescue and Fire-Fighting Foam Equipment*, 2014 edition.

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

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

NFPA 1964, *Standard for Spray Nozzles*, 2013 edition.

2.3 Other Publications.

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

ANSI S1.4, *Specification for Sound Level Meters*, 1983.

2.3.2 ASME Publications. ASME Technical Publishing Office, Two Park Avenue, New York, NY 10016-5990.

Boiler and Pressure Vessel Code, 1992.

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*, 1994.

2.3.4 Federal Aviation Administration Publications. Available from Department of Transportation, Distribution Unit, M-494.3, Washington, DC 20590.

FAA Advisory Circular No. 150/5210-19A - *Driver's Enhanced Vision System (DEVS)*.

2.3.5 NATO Publications. Global Engineering Documents, An IHS Company, 15 Inverness Way East, Englewood, CO 80112.

NATO Document, *Dynamic Stability Report—Allied Vehicle Test-ing Publication (AVTP)*, 03–16W.

2.3.6 SAE Publications. Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.

SAE J156, *Fusible Links*, 1997.

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*, 1996.

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

SAE J994, *Standard on Alarm-Backup-Electric Laboratory Performance Testing*, 1993.

SAE J1127, *Low Voltage Battery Cable*, 1995.

SAE J1128, *Low Voltage Primary Cable*, 1995.

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

SAE J1908, *Electrical Grounding Practice*, 1996.

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

SAE J2174, *Heavy-Duty Wiring Systems for Trailers 2032 mm or More in Width*, 2009.

SAE J2180, *A Tilt Table Procedure for Measuring the Static Roll-over Threshold for Heavy Trucks*, 1993.

SAE J2181, *Steady State Circular Test Procedures for Trucks and Buses*, 1993.

SAE J2202, *Heavy-Duty Wiring Systems for On-Highway Trucks*, 2003.

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

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

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

2.3.7 UNECE Publications. UN Economic Commission for Europe, Palais des Nations, CH-1211, Geneva 10 Switzerland.

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*, 2007.

2.3.8 U.S. Government Publications. U.S. Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.

Federal Motor Carrier Safety Administration: *FMVSS 121 Brake Performance and Stability Testing*.

2.3.9 Other Publications.

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

2.4 References for Extracts in Mandatory Sections.

NFPA 402, *Guide for Aircraft Rescue and Fire-Fighting Operations*, 2013 edition.

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

3.2.4 Shall. Indicates a mandatory requirement.

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

3.2.6 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 Aggressive Tire Tread. See 3.3.61.1.

3.3.2* Aircraft Rescue and Fire Fighting (ARFF). The fire-fighting action taken to prevent, control, or extinguish fire involved or adjacent to an aircraft for the purpose of maintaining maximum escape routes for occupants using normal and emergency routes for egress. [402, 2013]

3.3.3 Air-Mechanical Brakes. See 3.3.13.1.

3.3.4 Air-Over-Hydraulic Brakes. See 3.3.13.2.

3.3.5 All-Wheel Drive. A vehicle with the ability to apply tractive power to all wheels.

3.3.6 Ambient Temperature. The temperature of the surrounding medium; usually used to refer to the temperature of the air in which a structure is situated or a device operates.

3.3.7* Angle of Approach. The measure of the steepest ramp that a fully loaded vehicle can approach.

3.3.8* Angle of Departure. The measure of the steepest ramp from which the fully loaded vehicle can depart.

3.3.9 ARFF Chassis. The assembled frame, engine, drivetrain, and tires of an ARFF vehicle.

3.3.10 Automatic Locking Differential. A type of nonslip differential that operates automatically.

3.3.11 Axle Tread. See 3.3.61.2.

3.3.12* Bogie. A combination of two axles used to support the end of a vehicle.

3.3.13 Brakes.

3.3.13.1 Air-Mechanical Brakes. Brakes in which the force from an individual air chamber is applied directly to the friction surfaces through a mechanical linkage.

3.3.13.2 Air-Over-Hydraulic Brakes. Brakes in which the force of a master air cylinder is applied to the friction surfaces through an intervening hydraulic system.

3.3.13.3 Service Brake. A system capable of decelerating the vehicle at a controlled rate to a desired, reduced speed or complete stop.

3.3.14* Center of Gravity. The point within a vehicle at which all of its weight can be considered to be concentrated.

3.3.15* Complementary Agent. Agents that provide unique extinguishing capability beyond the primary chosen agent.

3.3.16 Component Manufacturer's Certification. A signed application approval furnished by the vehicle manufacturer certifying that the components are approved as being installed in the vehicle for their intended use, or that the components comply with the criteria required by the standard.

3.3.17* Cooling Preheater Device. A device for heating the engine coolant so that the engine is maintained at a constant temperature.

3.3.18* Diagonal Opposite Wheel Motion. The measurement of the vertical movement relationship of the wheel and suspension travel.

3.3.19 Differential Global Positioning System (DGPS). See 3.3.59.3.1.

3.3.20 Driver's Enhanced Vision System (DEVS). See 3.3.59.1.

3.3.21 Dynamic Balance. A physical condition that exists when a vehicle is driven into a turn at high speed and the vehicle displays no tendencies to pitch weight forward on the front steering wheels nor exhibits any understeer or oversteer conditions that could make the vehicle unstable.

3.3.22 Equipment Allowance. Any equipment added to the vehicle that is not directly required for the vehicle to discharge water or other fire-fighting agent(s) on the initial attack.

3.3.23 Extendable Turret. See 3.3.62.1.

3.3.24 Fluid Coupling. A turbine-like device that transmits power solely through the action of a fluid in a closed circuit without direct mechanical connection between input and output shafts and without producing torque multiplication.

3.3.25 Foam Concentrate. A concentrated liquid foaming agent as received from the manufacturer.

3.3.26 Foam Expansion. The ratio between the volume of foam produced and the volume of solution used in its production.

3.3.27 Foam-Liquid Concentration. The quantity of foam-liquid concentrate in water identified in percentage.

3.3.28* Forward-Looking Infrared (FLIR). The detection of heat energy radiated by objects to produce a "thermal image." This thermal image is converted by electronics and signal processing into a visual image that can be viewed by the operator.

3.3.29 Fully Loaded Vehicle. See 3.3.69.1.

3.3.30 Global Positioning System (GPS). See 3.3.59.3.

3.3.31 Ground Sweep Nozzle. See 3.3.40.1.

3.3.32 Halogenated Agents. A liquefied gas extinguishing agent that extinguishes fire by chemically interrupting the combustion reaction between fuel and oxygen.

3.3.33 In-Service Condition. A state or condition of readiness for intended duty; usually an emergency vehicle properly serviced with all equipment properly loaded and ready for immediate response.

3.3.34* Intended Airport Service. All aspects of aircraft rescue and fire-fighting services as provided by this standard.

3.3.35* Interaxle Clearance Angle (Ramp Angle). The measure of the ability of a fully loaded vehicle to negotiate a ramp without encountering interference between the vehicle and the ramp between any two axles.

3.3.36 Interaxle Differential. A differential in the line of drive between any two axles.

3.3.37 "J" Turn Test. The measure of a vehicle's ability to traverse a 90 degree turn at a prescribed speed.

3.3.38 Lightweight Construction. Lightweight materials or advanced engineering or both practices resulting in a weight saving without sacrifice of strength or efficiency.

3.3.39 No-Load Condition. The status of an engine with standard accessories operating without an imposed load, with the vehicle drive clutches and any special accessory clutches in a disengaged or neutral condition.

3.3.40 Nozzle.

3.3.40.1 Ground Sweep Nozzle. A small nozzle(s) mounted in front of the vehicle that disperses foam solution in front to provide protection.

3.3.40.2 Undertruck Nozzle. A small nozzle device that hangs below the vehicle and disperses foam solution in a manner that provides protection for the vehicles from ground or grass proximity fires; these devices spray agent from wheel and front to back of the underside of the truck.

3.3.41* Off-Pavement Performance. A vehicle's ability to perform or operate on other than paved surfaces.

3.3.42 Operational Tests. An all-vehicle test conducted by the manufacturer to ensure that each vehicle is fully operational when it is delivered and to ensure that the original level of performance of the prototype vehicle has been maintained.

3.3.43* Overall Height, Length, and Width. The dimensions determined with the vehicle fully loaded and equipped, unless otherwise specified.

3.3.44* Percent Grade. The ratio of the change in elevation to the horizontal distance traveled multiplied by 100.

3.3.45 Power-Assist Steering. A system using hydraulic or air power to aid in the steering assist. This system is supplementary to the mechanical system in order to maintain steering ability in the event of power failure.

3.3.46 Primary Turret. See 3.3.62.2.

3.3.47* Propellant Gas. A gas pressurizing an agent container.

3.3.48 Prototype Vehicle. See 3.3.69.2.

3.3.49 Radio Suppression. Suppression of the ignition and electrical system noises that normally interfere with radio transmission and reception.

3.3.50 Ramp Angle. See 3.3.35, Interaxle Clearance Angle (Ramp Angle).

3.3.51 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]

3.3.52 Reserve Capacity Rating. The number of minutes a new, fully charged battery at 26.7°C (80°F) can be discharged at 25 amperes while maintaining 1.75 volts per cell or higher.

3.3.53* Rubber-Gasketed Fitting. A device for providing a leakproof connection between two pieces of pipe while allowing moderate movement of one pipe relative to the other.

3.3.54 Seat Belt. A two-point lap belt, a three-point lap/shoulder belt, or a four-point lap/shoulder harness for vehicle occupants designed to limit their movement in the event of an accident, rapid acceleration, or rapid deceleration by securing individuals safely to a vehicle in a seated position.

3.3.55 Service Brake. See 3.3.13.3.

3.3.56 Side Slope. This angle is measured as either the percent of slope or the tilt angle at which the vehicle would become unstable should the vehicle be placed on the side of a steep, angled hill or sloped surface.

3.3.57* Steering Drive Ends. In the front wheel spindle in a driving-steering axle as used at the front of an all-wheel drive vehicle.

3.3.58 Surfaces.

3.3.58.1 Improved Surfaces. Surfaces that are classed as main thoroughfares, paved roadways, runways, taxiways, parking aprons, and secondary routes of vehicle travel including mediums that are normally of paved, asphalted, or concrete construction.

3.3.58.2 Unimproved Surfaces. Surfaces that are not paved or surface coated for heavy automotive travel and include dirt, clay, shale, or crushed rock that is not maintained on a regular basis.

3.3.59 System.

3.3.59.1* Driver's Enhanced Vision System (DEVS). An enhanced vision and navigation system for guiding aircraft rescue and fire-fighting vehicles at night and during certain low-visibility conditions.

3.3.59.2* Electronic Stability Control System. A closed-loop stability-control system that relies on proven antilock brake system and traction control system components.

3.3.59.3* Global Positioning System (GPS). A satellite-based radio navigation system comprised of three segments: space, control, and user.

3.3.59.3.1* Differential Global Positioning System (DGPS). A technique applied to a global positioning system (GPS) solution that improves the accuracy of that solution.

3.3.60 Torque Converter. A device that is similar to a fluid coupling but that produces, by means of additional turbine blades, variable torque multiplication.

3.3.61 Tread.

3.3.61.1 Aggressive Tire Tread. Tread designed to provide maximum traction for all types of surfaces, including sand, mud, snow, ice, and hard surfaces, wet or dry.

3.3.61.2* Axle Tread. The distance between the center of two tires or wheels on one axle.

3.3.62 Turret.

3.3.62.1* Extendable Turret. A device, permanently mounted with a power-operated boom or booms, designed to supply a large-capacity, mobile, elevatable water stream or other fire-extinguishing agents, or both.

3.3.62.2* Primary Turret. The largest capacity foam turret used to apply primary extinguishing agent.

3.3.63* Twenty-Five Percent Drainage Time. The time in minutes that it takes for 25 percent of the total liquid contained in the foam collected in a specified manner to drain.

3.3.64 Underaxle Clearance. The clearance distance between the ground and the center drive train of the vehicle; generally this measurement is taken at the low point bottom of the drive differentials.

3.3.65* Underbody Clearance Dimensions. The dimensions determined with the vehicle fully loaded and fully equipped, unless otherwise specified.

3.3.66 Undertruck Nozzle. See 3.3.40.2.

3.3.67 Unitized Rigid Body and Frame Structure. A structure in which parts that generally comprise a separate body are inte-

grated with the chassis frame to form a single, rigid, load-carrying structure.

3.3.68 Unsprung Weight. The total weight of all vehicle components that are not supported completely by the suspension system.

3.3.69 Vehicle.

3.3.69.1* Fully Loaded Vehicle. Consists of the fully assembled vehicle, complete with a full complement of crew, fuel, and fire-fighting agents.

3.3.69.2* Prototype Vehicle. The first vehicle of a unique vehicle configuration built to establish its performance capability and the performance capability of all subsequent vehicles manufactured from its drawings and parts list.

3.3.70* Vehicle Types. Vehicle types are designated as 4 × 4, and so forth, and these designations are used to indicate the number of wheels on the vehicle and the number of wheels that propel or drive the vehicle.

3.3.71* Wall-to-Wall Turning Diameter. A measurement of the space that completely contains a vehicle as it is being turned.

3.3.72* Weather Resistant. Sufficiently protected to prevent the penetration of rain, snow, and wind-driven sand, dirt, or dust under all operating conditions.

3.3.73 Weight Scale Measurement. The accurate measurement of vehicle weight by means of a scale to verify or check a stated or estimated weight.

3.3.74 Where Specified. Options selected by the purchaser beyond the minimum requirements of the standard.

Chapter 4 Aircraft Rescue and Fire-Fighting Vehicles

4.1* General.

4.1.1* The design criteria for the standard vehicles described by this document consider temperature extremes ranging from 0°C to 43.3°C (32°F to 110°F). For cold weather operation where temperatures range from -40°C to 0°C (-40°F to 32°F) or lower, some type of winterization system shall be specified by the purchaser. Vehicles shall comply with Table 4.1.1(a), Table 4.1.1(b), Table 4.1.1(c), Table 4.1.1(d), and other requirements in this chapter.

4.1.2 The category of vehicles shall encompass a range of water capacity commencing at 454 L (120 gal) and extending to over 6000 L (1585 gal).

4.1.3* Certain vehicles shall be required to carry complementary agents in addition to carrying foam as the primary agent.

4.1.4 Because the same performance cannot be expected of all vehicles within this range, vehicles shall be classified by water capacity as listed in Table 4.1.1(a) and Table 4.1.1(b).

4.1.5* Additional vehicle options, where needed, shall be selected by the purchaser.

4.2 Requirements for All Aircraft Rescue and Fire-Fighting Vehicles — Responsibility of Contractors/Suppliers.

4.2.1* Certification. The aircraft rescue and fire-fighting vehicle manufacturer shall assume responsibility for the design,

construction, and performance of all component parts of the complete vehicle, even if major portions are subcontracted, and shall certify that the completed vehicle meets the requirements of this standard.

4.2.2 Manuals. The manufacturer shall supply at the time of delivery the following manuals in electronic format:

- (1) Operator's manual
- (2) Service manual
- (3) Parts manual

These manuals shall cover the entire vehicle and shall be in accordance with 4.2.2.1 through 4.2.2.3.9.

4.2.2.1 Operator's Manual.

4.2.2.1.1 Operating instructions shall include all information required for operation of the vehicle, vehicle components, fire-fighting systems, and integral vehicular options.

4.2.2.1.2 The location and function of all controls and instruments shall be covered by illustrations and descriptions.

4.2.2.1.3 These instructions, as a minimum, also shall include the following:

- (1) Complete description of the vehicle and special equipment
- (2) Preparation for use of the vehicle upon receipt
- (3) Daily maintenance and mission readiness checks to be performed by the operator
- (4) Periodic operator inspection

4.2.2.2 Service Manual. The service manual shall contain the regular maintenance schedule including operating hours, mileage, and cycle time.

4.2.2.2.1 The repair and overhaul instructions shall be factual, specific, concise, and clearly worded.

4.2.2.2.2 The instructions shall cover such typical maintenance and repair operations as troubleshooting, adjustment procedures, minor and major repairs and overhaul, removal and replacement of units, assemblies and subassemblies, and complete instructions for disassembly and reassembly of components.

4.2.2.2.3 The instructions also shall include data that include tolerances, specifications, and capacities.

4.2.2.2.4 Illustrations, wiring diagrams, and exploded views shall be used to clarify text and shall appear as close to the related text as possible.

4.2.2.2.5 Special tools needed for the repair and overhaul of the equipment shall be specified and illustrated.

4.2.2.2.6 The service manual shall contain a suitable index.

4.2.2.3 Parts Manual.

4.2.2.3.1 The parts list shall include illustrations and exploded views necessary for the proper identification of all parts, assemblies, and subassemblies.

4.2.2.3.2 Assemblies or components shall be shown in illustrations and shall be identified by reference numbers that correspond to the reference numbers in the parts list.

4.2.2.3.3 The size, thread dimensions, and special characteristics shall be given on all nonstandard nuts, bolts, washers, grease fittings, and similar items.

Table 4.1.1(a) Fully Loaded Vehicle Performance Parameters (SI Units)

Performance Parameters	Minimum Usable Capacity		
	Vehicle Water Tank Capacity ≥454 to ≤1999 L	Vehicle Water Tank Capacity >1999 to ≤6000 L	Vehicle Water Tank Capacity >6000 L
Side slope stability (degrees)	30	30	30
Dynamic balance (kph), minimum speed on a (30 m) radius circle	40	35.5	35.5
Angle of approach (degrees)	25	30	30
Angle of departure (degrees)	30	30	30
Interaxle clearance (degrees)	12	12	12
Underbody clearance (cm)	33	46	46
Underaxle clearance at differential housing bowl (cm)	26.7	33.0 (26.7)	33
Diagonal opposite wheel motion (cm)	25.4	36	36
Wall-to-wall turning diameter	<Three times the vehicle's overall length	<Three times the vehicle's overall length	<Three times the vehicle's overall length
Maximum acceleration time from 0 to 80.5 kph (sec)	30	25	35
Top speed (kph)	≥113	≥113	≥113
Service brake: Stopping distance from 33 kph (m) from 64 kph (m) Percent grade holding of fully loaded vehicle: Ascending Descending	≤11 ≤40 m ≥50 percent ≥50 percent	≤11 ≤40 m ≥50 percent ≥50 percent	≤12 ≤49 m ≥50 percent ≥50 percent
Emergency brake stopping distance at 64 kph (m)	≤88	≤88	≤88
Parking brake: Percent grade holding for the parking brake Ascending Descending	≥20 percent ≥20 percent	≥20 percent ≥20 percent	≥20 percent ≥20 percent
Evasive maneuver test, NATO Document AVTP 03-16W (kph)	40	40	40
“J” turn test at 46 m radius (kph)	48	48	48

4.2.2.3.4 The parts identification manual shall provide the description and quantity of each item used per vehicle.

4.2.2.3.5 The parts identification manual shall contain a numerical index.

4.2.2.3.6 The vehicle manufacturer shall ensure that parts critical to the mission of the vehicle are shipped to the purchaser within 48 hours.

4.2.2.3.7 The original equipment manufacturers shall be disclosed to the owner if the vendor is unable to supply the necessary parts within 48 hours to allow local purchase of an equivalent part.

4.2.2.3.8 A qualified and responsible representative of the contractor shall instruct personnel specified by the purchaser in the operation, care, and maintenance of the vehicle delivered.

4.2.2.3.9 The purchasers shall specify provisions for training, including the location and duration, and shall agree on suitable training aids such as video tapes and training manuals.

4.2.2.3.10* Parts manuals shall not be required for commercial chassis vehicles supplied to a component manufacturer. Parts manuals shall be required for upfit components added to the commercial chassis.

Table 4.1.1(b) Fully Loaded Vehicle Performance Parameters (U.S. Customary Units)

Performance Parameters	Minimum Usable Capacity		
	Vehicle Water Tank Capacity ≥120 to ≤528 gal	Vehicle Water Tank Capacity >528 to ≤1585 gal	Vehicle Water Tank Capacity >1585 gal
Side slope stability (degrees)	30	30	30
Dynamic balance (mph) minimum speed on a (100 ft) radius circle	25	22	22
Angle of approach (degrees)	25	30	30
Angle of departure (degrees)	30	30	30
Interaxle clearance (degrees)	9	12	12
Underbody clearance (in.)	13	18	18
Underaxle clearance at differential housing bowl (in.)	8.5	13 (10.5)	13
Diagonal opposite wheel motion (in.)	10	14	14
Wall-to-wall turning diameter	<Three times the vehicle's overall length	<Three times the vehicle's overall length	<Three times the vehicle's overall length
Maximum acceleration time from 0 to 50 mph (sec)	30	25	35
Top speed (mph)	≥70	≥70	≥70
Service brake: Stopping distance from 20 mph (ft)	≤35	≤35	≤40
from 40 mph (ft)	≤131	≤131	≤160
Percent grade holding of fully loaded vehicle:			
Ascending	≥50 percent	≥50 percent	≥50 percent
Descending	≥50 percent	≥50 percent	≥50 percent
Emergency brake stopping distance at 40 mph (ft)	≤288	≤288	≤288
Parking brake: Percent grade holding for the parking brake			
Ascending	≥20 percent	≥20 percent	≥20 percent
Descending	≥20 percent	≥20 percent	≥20 percent
Evasive maneuver test, NATO Document AVTP 03-16W (mph)	25	25	25
"J" turn test at 150 ft radius (mph)	30	30	30

4.2.3 Metal Finish.

4.2.3.1 All exposed ferrous metal surfaces that are not plated or of stainless steel or that are not otherwise treated to resist corrosion shall be cleaned thoroughly and prepared and shall be painted in the color(s) specified by the purchaser.

4.2.3.2 If nonferrous body components are furnished, the purchaser shall specify which surfaces are to be painted.

4.2.3.3 The paint, including the primer, shall be applied in accordance with the paint manufacturer's recommendation.

4.2.3.4 Paint finish shall be selected for maximum visibility and shall be resistant to damage from fire-fighting agents.

4.2.3.5 Dissimilar metals shall not be in contact with each other.

4.2.3.5.1 Metal plating or metal spraying of metals of dissimilar base to provide electromotively compatible abutting surfaces shall be permitted.

4.2.3.5.2 The use of dissimilar metals separated by suitable insulating material shall be permitted.

4.2.3.5.3 In systems where bridging of insulation materials by an electrically conductive fluid can occur, dissimilar metals shall not be permitted.

Table 4.1.1(c) Agent System Performance Parameters (SI Units)

Performance Parameters	Minimum Usable Capacity		
	Vehicle Water Tank Capacity ≥454 to ≤1999 L	Vehicle Water Tank Capacity >1999 to ≤6000 L	Vehicle Water Tank Capacity >6000 L
1. Water tank percent of deliverable water			
a. On level ground	100 percent	100 percent	100 percent
b. On 20 percent side slope	85 percent	85 percent	85 percent
c. 30 percent ascending/ descending grade	85 percent	85 percent	85 percent
2. Turret(s) discharge	Total flow rate can be achieved with handlines	Total flow rate can be achieved using a roof turret, extendable turret, bumper turret, or a combination thereof	Total flow rate can be achieved using a roof turret, extendable turret, bumper turret, or a combination thereof
2a. Roof turret:			
a. Total minimum flow rate (L/min) OR	≥227	≥2839	≥4731
Individual flow rate of the roof turret, if used in combination with a bumper turret (L/min)	N/A	≥1892	≥3785
b. Stream pattern/distances:			
i. Straight/far point (m)	≥46	≥58	≥70
ii. Dispersed/far point (m)	≥15	≥20	≥21
iii. Dispersed/width (m)	≥9	≥11	≥11
2b. Extendable turret:			
a. Individual flow rate of the extendable turret if used in combination with a bumper turret (L/min)	N/A	≥1892	≥3785
b. Stream pattern/distances:			
i. Straight/far point (m)	N/A	≥58	≥58
ii. Dispersed/far point (m)	N/A	≥20	≥21
iii. Dispersed/width (m)	N/A	≥11	≥11
2c. Bumper turret:	Can be used as the primary turret and must follow roof turret flows and ranges	Can be used as the primary turret and must follow roof turret flows and ranges	Can be used as the primary turret and must follow roof turret flows and ranges
a. Flow rate (L/min)	≥227	≥946	≥946
b. Straight stream distance (m)	≥46	≥46	≥46
c. Dispersed pattern distances:			
i. Far point (m)	≥15	≥15	≥15
ii. Width (m)	≥9	≥9	≥9
iii. Near point (m)	Within 9 m of front bumper	Within 9 m of front bumper	Within 9 m of front bumper
2d. Ground sweep nozzle:	Where specified	Where specified	Where specified

(continues)

Table 4.1.1(c) Continued

Performance Parameters	Minimum Usable Capacity		
	Vehicle Water Tank Capacity ≥454 to ≤1999 L	Vehicle Water Tank Capacity >1999 to ≤6000 L	Vehicle Water Tank Capacity >6000 L
a. Flow rate (L/min)	N/A	≥378 to ≤1135	≥378 to ≤1135
b. Dispersed pattern distances:			
i. Far point (m)	N/A	≥9	≥9
ii. Width (m)	N/A	≥3.5	≥3.5
2e. Undertruck nozzle flow rate (L/min)	Where specified >57	Where specified >57	Where specified >57
2f. Piercing nozzle flow rate (L/min)	Where specified ≥946	Where specified ≥946	Where specified ≥946
3. Number of water-foam handlines required per vehicle (select from following)	1	2	2
3a. Woven jacket water-foam handline:			
a. Nozzle flow rate (L/min)	≥360	≥360	≥360
b. Straight stream distance (m)	≥20	≥20	≥20
c. Dispersed stream pattern:			
i. Range (m)	≥6	≥6	≥6
ii. Width (m)	≥4.5	≥4.5	≥4.5
d. Hose inside diameter (mm)	≥38	≥38	≥38
e. Hose length (m)	≥46	≥46	≥46
3b. Reeled water-foam handline:			
a. Nozzle flow rate (L/min)	360 (≥227 for dual agent lines)	360 (≥227 for dual agent lines)	360 (≥227 for dual agent lines)
b. Straight stream distance (m)	≥20	≥20	≥20
c. Dispersed stream pattern:			
i. Range (m)	≥6	≥6	≥6
ii. Width (m)	≥4.5	≥4.5	≥4.5
d. Hose length (m)	≥46 (≥30 for dual agent lines)	≥46 (≥30 for dual agent lines)	≥46 (≥30 for dual agent lines)
4. Complementary agent			
a. Capacity (kg)	≥45	≥45	≥45
4a. Dry chemical handline:	Where specified	Where specified	Where specified
a. Discharge rate (kg/sec)	≥2.3	≥2.3	≥2.3
b. Range (m)	≥7.5	≥7.5	≥7.5
c. Hose length (m)	≥30	≥30	≥30
4b. Dry chemical turret:	Where specified	Where specified	Where specified
a. Discharge rate (kg/sec)	≥7 and ≤10	≥7 and ≤10	≥7 and ≤10
b. Range (m)	≥30	≥30	≥30
c. Width (m)	≥5	≥5	≥5

(continues)

Table 4.1.1(c) *Continued*

Performance Parameters	Minimum Usable Capacity		
	Vehicle Water Tank Capacity ≥454 to ≤1999 L	Vehicle Water Tank Capacity >1999 to ≤6000 L	Vehicle Water Tank Capacity >6000 L
4c. Dry chemical extendable turret	Where specified	Where specified	Where specified
a. Discharge rate (kg/sec)	≥5.5	≥5.5 and ≤10	≥5.5 and ≤10
b. Range (m)	≥30	≥30	≥30
c. Width (m)	≥5	≥5	≥5
4d. Halogenated agent handline:	Where specified	Where specified	Where specified
a. Discharge rate (kg/sec)	≥2.3	≥2.3	≥2.3
b. Range (m)	≥7.5	≥7.5	≥7.5
c. Hose inside diameter (mm)	≥25.4	≥25.4	≥25.4
d. Hose length (m)	≥30	≥30	≥30

4.2.3.6 Materials that deteriorate when exposed to sunlight, weather, or operational conditions normally encountered during service shall not be used or shall have a means of protection against such deterioration that does not prevent compliance with performance requirements.

4.2.3.7 Protective coatings that chip, crack, or scale with age or extremes of climatic conditions or when exposed to heat shall not be used.

4.2.3.8 The use of proven, nonmetallic materials in lieu of metal shall be permitted, provided such use contributes to reduced weight, lower cost, or less maintenance and there is no degradation in performance or increase in long-term operations and maintenance costs.

4.2.4 Lettering, Numbering, and Striping.

4.2.4.1 Vehicle numbering, lettering, and minimum 0.2 m (8 in.) wide reflective striping shall be provided in accordance with ASTM D4956.

4.2.4.2 Striping shall be placed horizontally on the sides of the vehicle below the body centerline.

4.2.4.3 Vehicles shall display an identification number on each side and roof.

4.2.4.3.1 Side numbers shall be a minimum of 0.4 m (16 in.) in height.

4.2.4.3.2 Primary numbers shall be a minimum of 0.6 m (24 in.) in height and affixed with their base toward the front of the vehicle.

4.2.4.4 Numbering, lettering, and striping shall be in sharp contrast to the vehicle color.

4.2.5 Vehicle Information Data Plate. A data plate that contains, as a minimum, all the information presented in Figure 4.2.5 shall be installed in the cab of the vehicle.

4.3 Weights and Dimensions.

4.3.1* Weights.

4.3.1.1 The actual gross vehicle weight of a fully staffed, loaded, and equipped vehicle for service shall not exceed the manufacturer's tested weight rating as recorded on the vehicle information data plate.

4.3.1.2* The weight shall be distributed over the axles and tires of the fully loaded vehicle.

4.3.1.2.1 The difference in weight between tires on any axle shall not exceed 5 percent of the average tire weight for that axle.

4.3.1.2.2 The difference in weight between any two axles shall not exceed 10 percent of the weight of the heaviest axle if the heavy axle is a rear axle. This requirement shall not apply to vehicles with a capacity of <1999 L (528 gal).

4.3.1.2.3 If the heavy axle is a front axle, the weight difference between that axle and any other axle shall not exceed 5 percent of the heavy axle weight.

4.3.1.2.4 Under no circumstances shall the axle and tire manufacturers' ratings be exceeded.

4.3.1.3 The center of gravity of every vehicle shall be tested at the time of manufacture and kept as low as possible under all conditions of loading.

4.3.1.4 If a commercial chassis is utilized, the chassis manufacturer's recommended center of gravity shall not be exceeded.

4.3.1.5 It shall be the end user's responsibility to ensure that vehicles modified by the end user comply with performance requirements.

4.3.1.6 The vehicle shall not exhibit oversteer characteristics. (See 6.3.2.3 for test requirements.)

Table 4.1.1(d) Agent System Performance Parameters (U.S. Customary Units)

Performance Parameters	Minimum Usable Capacity		
	Vehicle Water Tank Capacity ≥120 to ≤528 gal	Vehicle Water Tank Capacity >528 to ≤1585 gal	Vehicle Water Tank Capacity >1585 gal
1. Water tank percent of deliverable water			
a. On level ground	100 percent	100 percent	100 percent
b. On 20 percent side slope	85 percent	85 percent	85 percent
c. 30 percent ascending/ descending grade	85 percent	85 percent	85 percent
2. Turret(s) discharge	Total flow rate can be achieved with handlines	Total flow rate can be achieved using a roof turret, extendable turret, bumper turret, or a combination thereof	Total flow rate can be achieved using a roof turret, extendable turret, bumper turret, or a combination thereof
2a. Roof turret:			
a. Total minimum flow rate (gpm) OR	≥60	≥750	≥1250
Individual flow rate of the roof turret, if used in combination with a bumper turret (gpm)	N/A	≥500	≥1000
b. Stream pattern/distances:			
i. Straight/far point (ft)	≥65	≥190	≥230
ii. Dispersed/far point (ft)	≥20	≥65	≥70
iii. Dispersed/width (ft)	≥15	≥35	≥35
2b. Extendable turret:			
a. Individual flow rate of the extendable turret if used in combination with a bumper turret (gpm)	N/A	≥500	≥1000
b. Stream pattern/distances:			
i. Straight/far point (ft)	N/A	≥190	≥190
ii. Dispersed/far point (ft)	N/A	≥65	≥70
iii. Dispersed/width (ft)	N/A	≥35	≥35
2c. Bumper turret:	Can be used as the primary turret and must follow roof turret flows and ranges	Can be used as the primary turret and must follow roof turret flows and ranges	Can be used as the primary turret and must follow roof turret flows and ranges
a. Flow rate (gpm)	≥60	≥250	≥250
b. Straight stream distance (ft)	≥65	≥150	≥150
c. Dispersed pattern distances:			
i. Far point (ft)	≥20	≥50	≥50
ii. Width (ft)	≥15	≥30	≥30
iii. Near point (ft)	Within 30 ft of front bumper	Within 30 ft of front bumper	Within 30 ft of front bumper
2d. Ground sweep nozzle:	Where specified	Where specified	Where specified

(continues)

Table 4.1.1(d) Continued

Performance Parameters	Minimum Usable Capacity		
	Vehicle Water Tank Capacity ≥120 to ≤528 gal	Vehicle Water Tank Capacity >528 to ≤1585 gal	Vehicle Water Tank Capacity >1585 gal
a. Flow rate (gpm)	N/A	≥100 to ≤300	≥100 to ≤300
b. Dispersed pattern distances:			
i. Far point (ft)	N/A	≥30	≥30
ii. Width (ft)	N/A	≥12	≥12
2e. Undertruck nozzle flow rate (gpm)	Where specified >15	Where specified >15	Where specified >15
2f. Piercing nozzle flow rate (gpm)	Where specified ≥250	Where specified ≥250	Where specified ≥250
3. Number of water-foam handlines required per vehicle (select from following)	1	2	2
3a. Woven jacket water-foam handline:			
a. Nozzle flow rate (gpm)	≥95	≥95	≥95
b. Straight stream distance (ft)	≥65	≥65	≥65
c. Dispersed stream pattern:			
i. Range (ft)	≥20	≥20	≥20
ii. Width (ft)	≥15	≥15	≥15
d. Hose inside diameter (in.)	≥1.50	≥1.50	≥1.50
e. Hose length (ft)	≥150	≥150	≥150
3b. Reeled water-foam handline:			
a. Nozzle flow rate (gpm)	95 (≥60 for dual agent lines)	95 (≥60 for dual agent lines)	95 (≥60 for dual agent lines)
b. Straight stream distance (ft)	≥65	≥65	≥65
c. Dispersed stream pattern:			
i. Range (ft)	≥20	≥20	≥20
ii. Width (ft)	≥15	≥15	≥15
d. Hose length (ft)	≥150 (≥100 for dual agent lines)	≥150 (≥100 for dual agent lines)	≥150 (≥100 for dual agent lines)
4. Complementary agent			
a. Capacity (lb)	≥100	≥100	≥100
4a. Dry chemical handline:	Where specified	Where specified	Where specified
a. Discharge rate (lb/sec)	≥5	≥5	≥5
b. Range (ft)	≥25	≥25	≥25
c. Hose length (ft)	≥100	≥100	≥100
4b. Dry chemical turret:	Where specified	Where specified	Where specified
a. Discharge rate (lb/sec)	≥16 and ≤22 (>7)	≥16 and ≤22	≥16 and ≤22
b. Range (ft)	≥100	≥100	≥100
c. Width (ft)	≥17	≥17	≥17

(continues)

Table 4.1.1(d) Continued

Performance Parameters	Minimum Usable Capacity		
	Vehicle Water Tank Capacity ≥120 to ≤528 gal	Vehicle Water Tank Capacity >528 to ≤1585 gal	Vehicle Water Tank Capacity >1585 gal
4c. Dry chemical extendable turret:	Where specified	Where specified	Where specified
a. Discharge rate (lb/sec)	≥12	≥12 and ≤22	≥12 and ≤22
b. Range (ft)	≥100	≥100	≥100
c. Width (ft)	≥17	≥17	≥17
4d. Halogenated agent handline:	Where specified	Where specified	Where specified
a. Discharge rate (lb/sec)	≥5	≥5	≥5
b. Range (ft)	≥25	≥25	≥25
c. Hose inside diameter (in.)	≥1.00	≥1.00	≥1.00
d. Hose length (ft)	≥100	≥100	≥100

4.3.2 Dimensions.

4.3.2.1* The axle clearances in Table 4.1.1(a) and Table 4.1.1(b) shall be measured with vehicle tires inflated to high-way inflation pressure.

4.3.2.1.1 The dimensions in Table 4.1.1(a) and Table 4.1.1(b) shall be permitted to be reduced to give more stable performance on hard pavement if the suspension is designed to raise the vehicle to these clearances when vehicle is traveling off pavement.

4.3.2.1.2 Where an active suspension provides vehicle leveling and maintenance of the underbody clearance of the lower underaxle, clearances shown in the parentheses in Table 4.1.1(a) and Table 4.1.1(b) shall be used.

4.3.2.1.3 If this option is used, the vehicle shall be tested in accordance with Table 4.1.1(a) and Table 4.1.1(b).

4.3.2.2 Field of Vision.

4.3.2.2.1 The vehicle shall be constructed so that a seated driver, having an eye reference point of 80.7 cm (31¾ in.) above the seat cushion and 30.5 cm (12 in.) forward from the seat back, shall be capable of the following::

- (1) To see the ground 6.1 m (20 ft) ahead of the vehicle
- (2) To have a field of vision of at least 5 degrees above the horizontal plane
- (3) To have a field of vision in the horizontal plane of at least 90 degrees on each side from the straight ahead position
- (4) Not to have his or her vision obstructed by more than 7 degrees per obstruction

4.3.2.3 Adjustable rearview mirrors with a glass area of not less than 387.1 cm² (60 in.²) shall be provided on each side of the vehicle.

4.3.2.3.1 Each side shall be provided with a minimum 45.2 cm² (7 in.²) wide-angle (convex) mirror.

4.3.2.3.2 Rearview outside mirrors shall be motorized and controlled from the driver's position.

Manufacturer _____	
Vehicle (make and model year) _____ and _____	
Drive type: ☐ 4 × 4 ☐ 6 × 6 ☐ 8 × 8 ☐ 10 × 10	
The vehicle was tested to _____ degrees in both directions (table angle)	
Was a trip/slip rail used? ☐ No ☐ Yes	
If yes, height of rail [maximum 50 mm (2 in.)] _____ [mm (in.)]	
Date of test: _____	
Front axle loading*	_____ [kg (lb)]
Second axle loading*	_____ [kg (lb)]
3rd axle loading* (if applicable)	_____ [kg (lb)]
4th axle loading* (if applicable)	_____ [kg (lb)]
5th axle loading* (if applicable)	_____ [kg (lb)]
Tire manufacturer	_____
Tire model	_____
Tire pressure	_____ [kPa (psi)]
Front wheel track	_____ [cm (in.)]
Rear wheel track	_____ [cm (in.)]
Crew capacity	_____ (Number of personnel)
Fuel tank capacity	_____ [L (gal)]
Equipment allowance	_____ [kg (lb)]
Water tank capacity	_____ [L (gal)]
Foam tank capacity	_____ [L (gal)]
Auxiliary agent capacity (if applicable)	_____ [kg (lb)]
*The "loading" shall be in accordance with the definition of a fully loaded vehicle as presented in NFPA 414.	

FIGURE 4.2.5 Aircraft Rescue and Fire-Fighting Vehicle Tilt Table Certification per NFPA 414.

4.3.2.3.3 Convex mirrors shall not be required to be motorized.

4.3.2.3.4 In lieu of mirrors, audiovisual devices that meet or exceed the field of vision provided by the wide-angle mirrors shall be permitted.

4.4 Engine.

4.4.1 Performance Requirements.

4.4.1.1 Engine Characteristics.

4.4.1.1.1 The vehicle engine(s) shall have the horsepower, torque, and speed characteristics to meet and maintain all vehicular performance characteristics specified in this standard.

4.4.1.1.2 The engine manufacturer shall certify that the installed engine is approved for this application.

4.4.1.2* The fully loaded vehicle shall be able to accelerate consistently from 0 kph to 80.5 kph (0 mph to 50 mph) on dry, level concrete pavement at the operational airport within the times specified in Table 4.1.1(a) and Table 4.1.1(b).

4.4.1.2.1 The maximum speed shall not be less than 112 kph (70 mph).

4.4.1.2.2 The acceleration times provided in Table 4.1.1(a) and Table 4.1.1(b) shall be achieved with the engine(s) and transmission(s) at the component manufacturers' recommended operating temperatures at any ambient temperature from -17.8°C to 43.3°C (0°F to 110°F) and at elevations up to 609.6 m (2000 ft) above sea level, unless a higher elevation is specified.

4.4.1.2.3 For airports above 609.6 m (2000 ft), the elevation at which the vehicle shall operate in order to ensure the necessary performance shall be specified.

4.4.1.3 The vehicle also shall be capable of ascending, stopping, starting, and continuing ascent on a 40 percent grade on dry pavement at a speed up to at least 1.6 kph (1 mph) with extinguishing agents being discharged from the primary turret nozzle(s).

4.4.2 Engine Cooling Systems.

4.4.2.1 An engine coolant preheating device shall be provided as an aid to rapid starting and high initial engine performance.

4.4.2.2 This device shall be fitted with an automatic thermostat.

4.4.2.3 If the engine coolant preheating device requires electrical power from an outside source to operate, a grounded ac receptacle shall be provided to allow a pull-away connection from the local electric power supply to the engine coolant preheating device.

4.4.2.3.1 The cooling system shall be designed so that the stabilized engine coolant temperature remains within the engine manufacturer's prescribed limits under all operational conditions and at all ambient temperatures encountered at the operational airport.

4.4.2.3.2 The cooling system shall be provided with an automatic thermostat for rapid engine warming.

4.4.2.3.3 Where specified, radiator shutters, where furnished for cold climates, shall be of the automatic type and shall be designed to open automatically upon failure.

4.4.3 Fuel System.

4.4.3.1 A complete fuel system shall be installed with the engine manufacturer's approval.

4.4.3.2 The fuel system shall be protected from the following:

- (1) Damage
- (2) Exhaust heat
- (3) Exposure to ground fires
- (4) Vapor lock

4.4.3.3 Accessible filtration for each fuel supply line and a drain shall be provided at the bottom of the fuel tank.

4.4.3.3.1 A fuel-water separator equipped with a manual drain shall be supplied where the vehicle is equipped with a diesel-fueled engine.

4.4.3.3.2 The fuel-water separator shall meet the engine manufacturer's requirements.

4.4.3.4 Fuel tanks shall not be installed in a manner that allows gravity feed.

4.4.3.5 Fuel Capacity.

4.4.3.5.1 For vehicles with a water tank capacity <1999 L (<528 gal), the fuel tank shall have the capacity to provide for a minimum of 48.3 km (30 mi) of highway travel at 88.5 kph (55 mph), plus 2 hours of pumping at the full rated discharge.

4.4.3.5.2 For vehicles with a water tank capacity <1999 L (<528 gal), additional fuel capacity shall be provided for a minimum of 4 hours of operation of each accessory item (such as a generator or fuel-fired heaters) that uses the common fuel tank as a source.

4.4.4 Exhaust System.

4.4.4.1 The exhaust system shall be constructed in such a manner that exhaust discharge is directed away from any operators.

4.4.4.1.1 The exhaust system shall be of high-grade, rust-resistant materials.

4.4.4.1.2 The exhaust system shall include a muffler to reduce engine noise.

4.4.4.2 The exhaust system shall be protected from damage that could result from traversing rough terrain.

4.4.4.3 The tailpipe shall not be directed toward the ground.

4.5 Vehicle Electrical System.

4.5.1 Electrical Systems and Warning Devices.

4.5.1.1 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 this section. [1901:13.1]

4.5.1.1.1 Wiring. All electrical circuit feeder wiring supplied and installed by the fire apparatus manufacturer shall meet the requirements of 4.4.1.1.2 through 4.5.1.1.23. [1901:13.2]

4.5.1.1.2 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]

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

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

4.5.1.1.5 All circuits shall otherwise be wired in conformance with SAE J2202, *Heavy-Duty Wiring Systems for On-Highway Trucks*, or for trailer wiring, SAE J2174, *Heavy-Duty Wiring Systems for Trailers 2032 mm or More in Width*. [1901:13.2.1.3]

4.5.1.1.6 Wiring and Wire Harness Construction. [1901:13.2.2]

4.5.1.1.7 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]

4.5.1.1.8 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]

4.5.1.1.9 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]

4.5.1.1.10 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]

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

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

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

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

4.5.1.1.15 All ungrounded electrical terminals shall have protective covers, enclosures, or a means to protect from accidental shorting. [1901:13.2.4.2]

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

4.5.1.1.17 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]

4.5.1.1.18 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 NFPA 1901.] [1901:13.2.6]

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

4.5.1.1.20 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]

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

4.5.1.1.22 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]

4.5.1.1.23 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]

4.5.1.2 Line Voltage Electrical Systems. The line voltage electrical systems shall be in accordance with Chapter 22 of NFPA 1901.

4.5.2 Battery Chargers.

4.5.2.1 A built-in battery charger shall be provided on the vehicle to maintain a full charge on all batteries.

4.5.2.2 A grounded ac receptacle shall be provided to allow a pull-away connection from the local electric power supply to the battery charger.

4.5.3 The electrical grounding procedures used on the vehicle shall be in accordance with SAE J1908 or an equivalent electrical grounding standard.

4.5.4 Where specified, an onboard battery charger/conditioner shall have a minimum output rating of 0.5 percent of the cold-cranking ampere rating at 0°C (32°F) of the engine-starting battery system.

4.5.4.1 The battery charger shall be supplied from an external power source of 115 volts or 220 volts ac.

4.5.4.2 This battery charger/conditioner shall be the type that can be connected to the batteries at all times and yet maintain a charge to the batteries without causing any damage.

4.5.4.3 The unit shall reduce its charging output level to a point where a small amount of charge is allowed to the batteries continuously or it shall shut off completely.

4.5.4.4 The charger/conditioner shall have protection built into it to protect it from damage during high current demands such as those caused by starting the engine.

4.5.4.5 The unit shall be provided with a grounded ac receptacle to allow a pull-away connection from the local electrical power supply to the battery charger/conditioner.

4.5.5 The electrical system and its components shall be weatherproof, insulated, and protected from chafing, damage from road debris, and exposure to ground fires.

4.5.5.1 All wiring shall be coded to correspond with the wiring diagram provided with the vehicle.

4.5.5.2 Circuit protection shall be provided to protect the vehicle in the event of electrical overload.

4.5.6 Radio suppression of the electrical system shall be in accordance with SAE J551/1 or an equivalent radio suppression standard.

4.6 Vehicle Drive. Transmission of power from the engine to the wheels of the vehicle shall be through an automatic or a semiautomatic gearbox.

4.6.1 The entire drivetrain shall be designed and rated by the component manufacturer as having the strength to slip the wheels of the static-loaded vehicle on a surface having a coefficient of friction of 0.8.

4.6.2 The transmission shall be approved by its manufacturer for the application.

4.6.3 A transmission cooling system shall be provided and designed so that the stabilized transmission oil temperature remains within the transmission manufacturer's prescribed limits under all operational conditions and at all ambient temperatures encountered at the operational airport.

4.6.4 A positive drive shall be provided to each wheel by means of a fully locked driveline in order to maximize traction on low-friction surfaces.

4.6.4.1 Positive drive either shall be permitted to be achieved by the use of automatic locking and torque proportioning differentials or shall be permitted to be selected manually by the seated driver by use of a single control while the vehicle is in motion.

4.6.4.2 Where a 10 × 8 vehicle is used, only 8 of the 10 wheels shall be required to be powered.

4.6.5 All-Wheel Drive.

4.6.5.1 All-wheel drive on these vehicles shall incorporate a drive to the front and rear axles that is engaged at all times during the intended airport service.

4.6.5.2 An interaxle differential shall be installed with automatic means or driver-selected means of differential locking.

4.6.6 All traction-increasing devices shall be operated by a single control for driving simplicity.

4.6.6.1 This requirement shall not apply to vehicles with a capacity of <1999 L (<528 gal).

4.6.7 Axle Capacity.

4.6.7.1 Front and rear axles shall have the gross axle weight rating (GAWR) capacity to carry the maximum imposed load under all intended operating conditions.

4.6.7.2 The variations in axle track shall not exceed 20 percent of the tire(s) sectional width at rated load.

4.7* Suspension. The suspension system shall be designed to allow the loaded vehicle to perform as follows:

- (1) Travel at the specified speeds over improved surface
- (2) Travel at moderate speeds over unimproved surface
- (3) Provide diagonally opposite wheel motion above ground obstacles without raising the remaining wheels from the ground, in accordance with Table 4.1.1(a) and Table 4.1.1(b)
- (4) Prevent damage to the vehicle caused by wheel movement

4.8 Rims, Tires, and Wheels.

4.8.1 Vehicles shall be required to meet the specified paved surface performance while still providing off-pavement performance compatible with the conditions encountered at the operational airport.

4.8.2* A tire selection shall be made that reflects the off-pavement performance requirements necessitated by the soil conditions encountered at the operational airport.

4.8.3* Only new tires shall be mounted on the vehicles.

4.8.4 All wheels on vehicles of more than 1999 L (528 gal) capacity shall be of the single-wheel type, with all rims, tires, and wheels of an identical size and the same tire tread design.

4.8.5 Rims, tires, and wheels shall be certified by their respective manufacturers as having the capacity to meet the specified performance.

4.8.6 Tires shall be certified by their respective manufacturers for not less than 42.9 km (25 mi) of continuous operation at 96.5 kph (60 mph) when inflated at the operational pressure.

4.9* Towing Connections. At least two large tow eyes or tow hooks (one at the front and one at the rear), capable of towing the vehicle on level ground without damage, shall be mounted on the truck and attached directly to the frame structure or where recommended by the vehicle manufacturer.

4.10 Brakes.

4.10.1* The braking system shall comply with FMVSS 121:

- (1) No part of the brake chamber shall project below the axle bowls.
- (2) The air system shall have the capacity for quick buildup from 0 kPa (0 psi) to release of spring brakes within 15 seconds.

4.10.2* Service brakes shall be of the all-wheel type with split circuits so that failure of one circuit shall not cause total service brake failure.

4.10.2.1 The service brakes shall be capable of holding the fully loaded vehicle on a 50 percent grade.

4.10.2.2 For vehicles less than 6000 L (1585 gal), the service brakes shall stop the vehicle within 10.7 m (35 ft) at 32.2 kph (20 mph) and within 39.9 m (131 ft) at 64.4 kph (40 mph).

4.10.2.3 For vehicles greater than 6000 L (1585 gal), the service brakes shall stop the vehicle within 12.2 m (40 ft) at 32.2 kph (20 mph) and within 48.8 m (160 ft) at 64.4 kph (40 mph).

4.10.2.4 Stopping distances shall be accomplished on a dry, hard, approximately level roadway that is free from loose material and that has a roadway width equal to the vehicle width plus 1.2 m (4 ft) without any part of the vehicle leaving the roadway.

4.10.2.5 For each vehicle, the service brakes shall provide one power-assisted stop while the vehicle engine is inoperative for the stopping distances specified in 4.10.2.2 through 4.10.2.4.

4.10.3 The parking brake shall be capable of holding the fully loaded vehicle on a 20 percent grade without air or hydraulic assistance.

4.10.4 Brakes — Air System.

4.10.4.1 Reservoirs shall be equipped with drain valves and safety valves.

4.10.4.2 Provision shall be made for charging of air tanks with either a pull-away electrical connection used to power a vehicle-mounted complementary compressor or a pull-away air connection for charging of air tanks from an external air source.

4.10.4.3 Visual and audible low-air pressure warning devices that are visible and audible to the driver from inside the cab of the vehicle shall be provided.

4.11 Steering.

4.11.1 The chassis shall be equipped with power-assisted steering with direct mechanical linkage from the steering wheel to the steered axle(s) to allow manual control in the event of power-assist failure.

4.11.2 The power steering system shall have the capacity so that no more than 66.7 N (15 lbf) pull is needed on the steering wheel rim to turn the steering linkage from stop to stop with the fully loaded vehicle stationary on a dry, level, paved surface with the engine at idle.

4.11.3* The wall-to-wall turning diameter of the fully loaded vehicle shall be less than three times the vehicle length.

4.12 Cab. All interior crew and driving compartment door handles shall be designed and installed to protect against accidental or inadvertent opening.

4.12.1 Cab Interior.

4.12.1.1 The cab shall be fully enclosed (i.e., floor, roof, and four sides).

4.12.1.2 Seating for the crew shall be restricted to the cab.

4.12.1.3 The maximum number of crew seat positions provided in the cab designated by the manufacturer shall be labeled in the cab.

4.12.1.4 As a minimum, seat positions shall be provided, for the driver and for an additional crew member.

4.12.1.5 Three-point seat belts equipped with a single hand hookup shall be provided for each of the designated seating positions.

4.12.1.6 Space shall be provided for all instrument controls and equipment specified without hindering the crew.

4.12.1.7 Doors shall be provided on each side of the cab with steps and handrails to allow rapid entrance and exit from the cab while wearing full protective equipment.

4.12.1.8 Each door shall be equipped with a restraint device(s) to prevent the door from being sprung open by wind or jet blast.

4.12.2 Cab Visibility.

4.12.2.1 The cab shall meet the visibility requirements of 4.3.2.2.

4.12.2.2 Interior cab reflections from exterior and interior lighting shall be minimized.

4.12.2.3 The windshield shall be shatterproof safety glass.

4.12.2.4 All other windows shall be constructed of safety glass.

4.12.2.5 Where equipped with a primary turret having manual controls above the cab roof, the cab roof shall be designed with a quick access to the primary turret(s).

4.12.3 Cab Construction.

4.12.3.1 The cab shall be weatherproof.

4.12.3.2 The cab shall be fully insulated thermally and acoustically with a fire-resistant material.

4.12.3.3 The cab interior noise level at any seated position shall not exceed 85 dBA while the vehicle is being driven at 80.5 kph (50 mph) on a level, hard surface without warning devices operating.

4.12.3.4 While stationary and discharging water or foam from the high-volume turrets with exterior warning devices operating, the maximum noise level inside the cab shall be 90 dBA.

4.12.3.5 The cab shall be permitted to be of the unitized rigid body and frame structure type or a separate unit that is flexibly mounted on the main vehicle frame.

4.12.3.6* Cabs on apparatus with a GVWR greater than 11,800 kg (26,000 lb) 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]

4.12.4 Instruments, Warning Lights, and Controls.

4.12.4.1 The minimum number of instruments, warning lights, and controls consistent with the operation of the vehicle, chassis, and fire-fighting system shall be provided.

4.12.4.1.1 All chassis instruments and warning lights shall be grouped on a panel in front of the driver.

4.12.4.1.2 All fire-fighting system instruments, warning lights, and controls shall be grouped by function to provide ready accessibility and high visibility for the driver as well as crew members.

4.12.4.2* All instruments and controls shall be illuminated.

4.12.4.3 Groupings of both the chassis and the fire-fighting system instruments, warning lights, and controls shall be easily removable as a unit or shall be accessible for servicing.

4.12.4.4 The following instruments and warning lights shall be provided as a minimum:

- (1) Speedometer/odometer
- (2) Engine tachometer(s)
- (3) Fuel level
- (4) Air pressure
- (5) Engine(s) temperature
- (6) Fire system pressure
- (7) Water tank level
- (8) Foam or tank level
- (9) Low-air pressure warning
- (10) Headlight beam indicator
- (11) Engine(s) oil pressure
- (12) Voltmeter(s)
- (13) Transmission oil temperature
- (14) Forward-looking infrared (FLIR) monitor

4.12.4.4.1 The components in 4.12.4.4(4), 4.12.4.4(6), 4.12.4.4(7), 4.12.4.4(8), and 4.12.4.4(9) shall not be applicable to a small commercial chassis.

4.12.4.5 The cab shall have all the following controls within reach of the driver for operation of the vehicle and the pumping system:

- (1) Accelerator pedal
- (2) Brake pedal
- (3) Parking brake control
- (4) Steering wheel, with directional signal control and horn
- (5) Transmission range selector
- (6) Pump control or selector
- (7) Foam control
- (8) Siren switch(es)
- (9) Bumper turret controls or ground sweep valve control, where specified
- (10) Undertruck valve control, where specified
- (11) Remote turret controls, where remote turret is provided
- (12) Light switches
- (13) Windshield wipers with delayed and multispeed capability and washer controls
- (14) Heater/defroster controls
- (15) Master electrical switch
- (16) Means of starting and stopping engine
- (17) Complementary agent pressurization control, where specified
- (18) Windshield deluge system switch, where specified

4.12.4.6* Where specified, a windshield deluge system shall be designed to flood the windshield with clear water and to be energized automatically whenever the system is operated.

4.12.4.7* Where specified, vehicles shall be equipped with the navigation system of a driver's enhanced vision system (DEVS).

4.12.4.7.1 The DEVS system shall meet or exceed the following requirements as outlined in FAA Advisory Circular AC No. 150/5210-19A:

- (1) Chapter 1, Section 2, Subsection b, Part (2) Navigation
- (2) Chapter 2, Full Sections 5–7, 16–19, 21
- (3) Chapter 2, Full Sections 16–19

4.12.4.7.2 Where specified, the DEVS navigation system as described in 4.12.4.7.1 shall include a tracking and onboard information system that meets or exceeds the following requirements as outlined in FAA Advisory Circular No. 150/5210-19A:

- (1) Chapter 1, Section 2, Subsection b, Part (3) Tracking
- (2)* Chapter 2, All

4.12.4.8* A low-visibility enhanced vision system shall be installed in the vehicle consisting of an FLIR system that meets or exceeds the following requirements as outlined in FAA Advisory Circular No. 150/5210-19A:

- (1) Chapter 1, Section 2, Subsection b, Part (1) Vision Enhancement
- (2) Chapter 2, Full Sections 6, 7, 10, 11, and 12

4.12.5 Equipment.

4.12.5.1 The following equipment shall be provided in or on the cab, as applicable:

- (1) Heater/defroster
- (2) Driver's suspension seat with vertical, fore, and aft adjustment, with seat belt [The use of a nonsuspension driver's seat shall be permitted where recommended by the manufacturer; the vertical adjustment shall not apply to commercial vehicles with a capacity of <1999 L (528 gal).]
- (3) Crew seats with individual retractable seat belts
- (4) Windshield washers appropriate for removing foam
- (5) Windshield wipers appropriate for removing foam
- (6) Siren
- (7) Horn
- (8) A means or provision that is designed to protect driver and crew from overhead glare and light from the sun
- (9) Outside rearview mirrors, as specified in 4.3.2.3
- (10) Interior lighting
- (11) Provisions for mounting at each crew seat position self-contained breathing apparatus (SCBA) of the type specified by the purchaser
- (12) Low-visibility FLIR meeting suggested specifications contained in Section D.4 or equivalent

4.12.5.2* SCBA Mounting. 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 ± 10 percent 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]

4.12.5.3 Equipment Mounting.

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

4.12.5.3.2 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 a fully enclosed and latched compartment capable of containing the 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. [1901:14.1.10.2]

4.12.6 Signs visible from each seated position that state "Occupants must be seated and wearing a seat belt when apparatus is in motion" shall be provided.

4.12.7* Where specified, a monitoring and data acquisition system (MADAS) shall be installed for the collection of various performance measurements to monitor, as a minimum, the following:

- (1) Vehicle speed
- (2) Vehicle heading
- (3) Lateral acceleration
- (4) Vertical acceleration
- (5) Longitudinal acceleration and deceleration
- (6) Engine rpm
- (7) Throttle position
- (8) Steering input
- (9) Vehicle braking input (pedal position and brake pressure)
- (10) Date, time, and location for all data collected

4.12.7.1 The data acquisition system shall be capable of storing the measurements and the time intervals, starting at least 120 seconds before and ending at least 15 seconds after any serious incident.

4.12.7.2 The data acquisition system shall be designed so that the data being recorded will not be lost or overwritten immediately after the incident due to the use of an emergency shutoff or a master electrical disconnect switch.

4.12.8* If a lateral acceleration indicator is provided, it shall be adjustable for sensitivity and provide both visual and audio warning signals and warnings to the driver.

4.13 Body.

4.13.1 The body shall be constructed of materials that are of the lightest weight consistent with the strength necessary for off-pavement operation over rough terrain and exposure to excess heat, and body panels shall be removable where necessary to provide access to the interior of the vehicle.

4.13.2 Access doors shall be provided for those areas of the interior of the vehicle that are inspected frequently, including, but not limited to, the following:

- (1) Engine
- (2) Pump
- (3) Foam-proportioning system
- (4) Battery storage
- (5) Fluid reservoirs

4.13.3 Compartments for storage of equipment and tools to be carried on the vehicle shall have the following characteristics:

- (1) Be weather resistant
- (2) Be self-draining
- (3) Be lighted

4.13.4 A working deck that is reinforced and constructed of, or covered with, a slip-resistant material shall be provided and shall be reinforced adequately to allow the crew to perform its duties in the primary turret area, cab hatch area, water tank top fill area and foam-liquid top fill area, and in other areas where access to complementary or installed equipment is necessary.

4.13.5 Handrails or bulwarks shall be provided where necessary for the safety and convenience of the crew.

4.13.5.1 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]

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

4.13.5.3 Exterior access handrails shall be between 25.4 mm and 41.275 mm (1 in. and 1 5/8 in.).

4.13.6 Steps or ladders shall be provided for access to the top fill area.

4.13.6.1 The lowermost step(s) shall be permitted to extend below the angle of approach or departure or ground clearance limits if it is designed to swing clear.

4.13.6.2 All other steps shall be rigidly constructed and constructed of, or covered with, a slip-resistant material.

4.13.6.3 The lowermost step(s) shall be no more than 558.8 mm (22 in.) above level ground when the vehicle is fully loaded.

4.13.6.4 Lighting shall be provided to illuminate steps and walkways.

4.13.7 A front bumper shall be mounted on the vehicle and secured to the frame structure.

4.13.8 Vehicle numbering, lettering, and minimum 20.3 cm (8 in.) wide reflective striping shall be provided in accordance with ASTM D4956.

4.13.8.1 A graphic design meeting the reflectivity requirements of this subsection shall be permitted to replace all or part of the required striping, provided the design or combination thereof covers a minimum of the same perimeter length required in 4.13.8.

4.13.8.2 Striping shall be placed on at least 60 percent of the perimeter length of each side, width, and rear.

4.13.8.3 At least 40 percent of the perimeter width of the front of the vehicle shall have reflective striping.

4.13.9 Attachments shall be provided for all tools, equipment, and other items that the purchaser specifies to be furnished on the vehicle.

4.13.9.1 Equipment holders shall be attached and designed so that equipment remains in place under all operating conditions.

4.13.9.2 The equipment holders shall allow the equipment to be readily accessible and removable for use.

4.13.10* Each storage compartment identified by the vehicle manufacturer for use by the purchaser shall be labeled with tested weight.

4.13.11 Compartment loading shall not be exceeded as identified at the time of vehicle manufacture.

4.13.12 Provisions shall be made for mounting tools and equipment, as specified by the purchaser, on the truck.

4.13.13 Special tools for servicing the vehicle, fire suppression system, and any of the auxiliary equipment shall be identified specifically by the vehicle manufacturer and furnished as necessary by the vehicle manufacturer.

4.14 Fire-Fighting Systems and Agents.

4.14.1 For ARFF purposes, vehicles using primary extinguishing agents shall be tested in accordance with all requirements of NFPA 412.

4.14.2 Vehicles designed to discharge complementary agents shall require the use of complementary agents that are compatible with the primary agent.

4.14.3* All components of the agent systems shall be made of materials resistant to corrosion by the primary agent, primary agent/water solution, water, and, where specified, the complementary agent.

4.14.4 Combinations of high-pressure lines, valves, and quick disconnect fittings that allow for the in-service refilling of propellants without requiring the removal of the high-pressure vessels from the truck shall be permitted.

4.15 Agent Pump(s) and Pump Drive.

4.15.1 Agent Pump(s).

4.15.1.1 The water pump(s) shall be constructed of corrosion-resistant metals of the single-stage or multiple-stage centrifugal type agreed upon by the end user and manufacturer, and designed for emergency service.

4.15.1.1.1 Pumps shall be gravity primed from the vehicle tank.

4.15.1.1.2 The pump and piping system shall be designed to eliminate the entrapment of air.

4.15.1.2 All proportioning system components shall be made of materials resistant to corrosion by all primary agents.

4.15.1.3 Where discharging foam solution, the pumping system shall be capable of discharging at a rate equal to or exceeding the total requirements of the roof or extendable turret(s), bumper turret or ground sweep nozzles, handline nozzles, and undertruck nozzles, where specified, discharging simultaneously at designed pressures.

4.15.2 Pump Drive.

4.15.2.1 The pump(s) drive shall allow operation of the pump(s) and simultaneous operation of the vehicle.

4.15.2.1.1 The pump(s) shall not be affected by changes in transmission ratios or the actuation of clutches in the vehicle drive.

4.15.2.1.2 The design of the drive system and controls shall prevent damage to the drive and minimize lurching of the vehicle when the vehicle drive is engaged during pumping operations.

4.15.2.1.3 The pump(s) drive system shall be capable of absorbing the maximum torque delivered by the engine to the pump(s) and withstanding the engagement of the pump(s) at all engine and vehicle speeds and under all operating conditions.

4.15.2.1.4 The operation of the pump(s) shall not, under any conditions, cause the engine to stall or cause more than a slight and momentary reduction in engine speed and consequent drop in pump pressure.

4.15.2.2 While pumping at rated capacity, the drive shall allow controlled vehicle operation at speeds from 0 kph to a maximum of 16.1 kph (0 mph to a maximum of 10 mph) in forward direction and 0 kph to a maximum of 8 kph (0 mph to a maximum of 5 mph) in rearward direction.

4.15.2.2.1 During shifting from forward to rearward drive, the pumping system shall maintain the preset discharge pressure.

4.15.2.2.2 The pump(s) drive shall have the power capacity to provide the pump(s) discharge requirements of 4.15.1.3 while the vehicle is being propelled under all operating conditions where fire-fighting capability is needed.

4.15.2.3 If an independent engine is used to drive the pump(s), it shall operate with the same fuel and electrical system as the chassis engine.

4.15.3 Tank-to-Pump Connections.

4.15.3.1 The tank-to-pump system shall be designed for flow at the pumping rates required by 4.15.1.3.

4.15.3.2 A drain shall be at the lowest point with a valve for draining all the liquid from the pumping system.

4.15.4 Discharge Connections. All couplings shall be specified by the purchaser to the standard for the airport.

4.15.5 Piping, Couplings, and Valves.

4.15.5.1 Union or rubber-gasketed fittings shall be provided where necessary to facilitate removal of piping.

4.15.5.2 Piping shall be provided with flexible couplings to minimize stress.

4.15.5.3 All valves shall be of the quarter-turn type and shall be selected for ease of operation and freedom from leakage.

4.15.5.4 The tank-to-pump side of the pump piping shall be leak free.

4.15.5.5 All water and foam solution discharge piping, together with the agent pump(s), shall be tested at 50 percent above the system operating pressure.

4.15.6 Overheat Protection. An automatic system with a visual alarm shall be provided to prevent overheating of the pumps while they are engaged and operating at zero discharge.

4.15.7 Pressure Relief Valves. A pressure relief system shall be provided to protect and ensure optimum performance of the system.

4.15.8 Drains. A drainage system shall be provided appropriate for the design of the vehicle.

4.16 Water Tank.

4.16.1 Capacity.

4.16.1.1 A water tank shall have a usable capacity as specified in Table 4.1.1(a) and Table 4.1.1(b).

4.16.1.2 The rated capacity of the tank shall be equal to the usable capacity that can be pumped from the tank while the vehicle is parked on level ground.

4.16.1.3 The tank outlets shall be arranged to allow the use of at least 85 percent of the rated capacity with the vehicle positioned as follows:

- (1) On a 20 percent side slope
- (2) On a 30 percent ascending grade
- (3) On a 30 percent descending grade

4.16.2 Construction.

4.16.2.1 The tank shall be constructed to resist all forms of deterioration that could be caused by the water and the foam concentrate while affording the structural integrity necessary for off-road operation.

4.16.2.2 The tank shall have the following characteristics:

- (1) Be equipped with removable manhole covers over the tank discharge
- (2) Be designed to allow for internal and external inspection and service
- (3) Have longitudinal and transverse baffles
- (4) Have a minimum 63.5 mm (2½ in.) capacity drain connection installed at the bottom of the sump

4.16.2.3 Provisions shall be made for necessary overflow and venting.

4.16.2.3.1 Venting shall be sized to allow agent discharge at the maximum design flow rate without danger of tank collapse.

4.16.2.3.2 Vents shall be sized to allow rapid and complete filling without exceeding the internal pressure design limit of the tank.

4.16.2.3.3 Overflows shall be designed to prevent loss of water from the tank during maneuvering and to direct the discharge of overflow water directly to the ground.

4.16.2.3.4 Water tank shall be full at start of tilt-table test.

4.16.2.3.5 Water loss shall be prevented during tilt-table testing.

4.16.2.4 The water tank shall have the following characteristics:

- (1) Be mounted in a manner that limits the transfer of the torsional strains from the chassis frame to the tank during off-pavement driving
- (2) Be separate and distinct from the crew compartment, engine compartment, and chassis
- (3) Be able to be removed as a unit
- (4) Be permitted to be an integral part of unitized rigid body construction

4.16.2.5 The water tank shall be equipped with at least one top fill opening of not less than 20.3 cm (8 in.) internal diameter.

4.16.2.5.1 The water tank top fill shall be equipped with an easily removable strainer of 6.4 mm (¼ in.) mesh construction.

4.16.2.5.2 The water tank top fill opening shall be equipped with a cap designed to prevent spillage.

4.16.2.6 For vehicles less than 1999 L (528 gal), the water tank shall be equipped with at least one top fill opening of not less than 127 mm (5 in.) internal diameter.

4.16.3 Tank Fill Connection(s).

4.16.3.1 A tank fill connection(s) shall be provided in a position where it can be reached easily from the ground.

4.16.3.2 All couplings shall be specified by the purchaser to the standard for the airport.

4.16.3.3 The connection(s) shall be provided with strainers of 6.4 mm (¼ in.) mesh.

4.16.3.4 The tank fill connection(s) shall be sized to allow filling of the water tank in 2 minutes at a pressure of 551.6 kPa (80 psi) at the tank intake connection.

4.16.3.5 The tank connections shall have check valves or shall be constructed so that water is not lost from the tank when a connection or disconnection is made.

4.17* Foam System.

4.17.1 Foam-Liquid Concentrate Tank(s).

4.17.1.1 The purchaser shall specify the percent concentrate foam system to be provided and that it have a working capacity sufficient for two tanks of water at the maximum tolerance specified in NFPA 412, Section 5.2.

4.17.1.2 The tank(s) shall be designed for compatibility with the foam concentrate being used.

4.17.1.3 Tanks shall be designed to allow for internal and external inspection and service.

4.17.1.4 The tank outlets shall be located above the bottom of the sump and shall provide continuous foam-liquid concentrate to the foam proportioning system, with that system operating as specified in 4.17.4 and with the vehicle discharging two tank loads of usable water as specified in 4.16.1.

4.17.1.5 If separate from the water tank, the foam-liquid tank shall be mounted in a manner that limits the transfer of the torsional strains from the chassis frame to the tank during off-pavement driving.

4.17.1.5.1 The foam-liquid concentrate tank shall be removable as a unit.

4.17.1.5.2 Foam-liquid concentrate tanks used as an integral part of unitized rigid body construction shall be permitted.

4.17.1.5.3 A flexible tank shall be structurally supported to resist tearing independently of the fluid levels in either the water or foam tanks.

4.17.1.5.4 The structural support shall not be dependent on the fluid level in either the water tank or the foam tank.

4.17.1.6 A top fill trough shall have the following characteristics:

- (1) Be equipped with a mesh screen constructed of noncorrosive materials and container openers to allow emptying 18.9 L (5 gal) foam-liquid concentrate containers into the storage tank(s)
- (2) Be connected to the foam-liquid storage tank(s) with a fill line designed to introduce foam-liquid concentrate to minimize foaming within the storage tank

4.17.1.7 The tank fill connection(s) shall have the following characteristics:

- (1) Be provided in a position where it can be reached, but not exceed 1.5 m (5 ft), from the ground to allow the pumping of foam-liquid concentrate into the storage tank(s)
- (2) Be provided with strainers of 6.4 mm ($\frac{1}{4}$ in.) mesh and have check valves or be constructed so that foam is not lost from the tank when a connection or disconnection is made

4.17.1.8 Where flexible tanks are used, the supply system shall have the following characteristics:

- (1) Be designed so that the flexible tanks are not subject to excess pressure
- (2) Be capable of delivering foam-liquid at a rate at least equal to or greater than the maximum discharge rate of the foam system

4.17.1.9 The tank(s) shall have the following characteristics:

- (1) Be vented to allow for filling without the buildup of pressure
- (2) Allow emptying of the tank at the maximum design flow rate without danger of collapse
- (3) Have the vent outlets directed to the ground to prevent spillage of foam-liquid concentrate on vehicle components

4.17.2 Foam Proportioning System Flushing. The foam-liquid concentrate system shall be arranged so that the entire piping system can be flushed readily with clear water.

4.17.3 Foam-Liquid Concentrate Piping.

4.17.3.1* The foam-liquid concentrate piping shall be of material resistant to corrosion by foam-liquid concentrates addressed in this standard.

4.17.3.1.1 Care shall be taken that combinations of dissimilar metals that produce galvanic corrosion are not selected or that such dissimilar metals are electrically insulated.

4.17.3.1.2 Where plastic piping is used, it shall be fabricated from unplasticized resins, unless it has been demonstrated that the stipulated plasticizer does not adversely affect the performance characteristics of the foam-liquid concentrates addressed in this standard.

4.17.3.1.3 The plastic pipe shall be permitted to be reinforced with glass fibers.

4.17.3.2 The foam-liquid concentrate piping shall be sized to allow the maximum required flow rate.

4.17.3.3 The foam-liquid concentrate piping shall be arranged to prevent water from entering the foam tank.

4.17.4 Foam Proportioning Systems.

4.17.4.1 The foam concentrate proportioning system shall provide a means of controlling the ratio of foam concentrate to the quantity of water in the foam solution being discharged from all orifices used for aircraft fire-fighting operations.

4.17.4.2 The proportioning system shall be accurate to provide for the discharge of finished foam within the range specified in NFPA 412, Chapter 5.

4.17.4.3 Each nozzle shall have minimum foam discharge patterns and meet the discharge parameters described in Table 4.1.1(a).

4.18 Premixed Foam Solutions.

4.18.1 Premixed — Pump System.

4.18.1.1* Where premixed solution in the main water tank is selected as the means of proportioning foam to water, the appropriate foam concentrate shall be used in accordance with the manufacturer specifications.

4.18.1.2 Where premixed solution is used, operation of the vehicle fire-fighting system shall conform to the requirements of Sections 4.15 and 4.16.

4.18.2 Premixed — Pressurized System.

4.18.2.1 Liquid Agent Container(s).

4.18.2.1.1 The storage container(s) for liquid agent(s) shall be marked, designed for pressurization, and constructed in accordance with the ASME *Boiler and Pressure Vessel Code*.

4.18.2.1.2 The material of construction shall be resistant to corrosion by the AFFF agent to be stored, or a lining material shall be provided.

4.18.2.1.3 An ASME-approved pressure relief valve and pressure gauge that indicates the internal pressure of the agent storage container at all times shall be provided on the container and set to prevent pressures in excess of the maximum allowable working pressure.

4.18.2.1.4 A readily accessible fill opening to allow ease in filling, and stirring if necessary, shall be provided.

4.18.2.1.4.1 The fill opening shall be in compliance with ASME or local codes and in no case be less than 76.2 mm (3 in.) in diameter.

4.18.2.1.4.2 Filling shall be accomplished without the removal of any of the extinguisher piping or any major component.

4.18.2.1.5* A means shall be provided to determine the contents of the container as a guide in recharging partial loads.

4.18.2.2 Propellant Gas.

4.18.2.2.1 The propellant gas shall be dry nitrogen or dry compressed air.

4.18.2.2.2 All propellant gas cylinders and valves shall be constructed and marked in accordance with U.S. Department of Transportation (DOT) requirements or regulations.

4.18.2.2.3 The design of the propellant source shall provide for replacement after each use.

4.18.2.2.3.1 Design of the propellant system shall provide for replacement of the high-pressure gas cylinder from the ground by a single person.

4.18.2.2.4 A pressure gauge that indicates the pressure of the propellant gas source at all times shall be provided.

4.18.2.2.5 Cylinder valves, gauges, and piping shall be arranged to preclude accidental mechanical damage.

4.18.2.2.6 The cylinder valve shall be capable of being opened by quick-acting control and permit remote operation.

4.18.2.2.7 The propellant gas supply shall be sized to provide the capability to expel the fire-fighting agent as well as to purge all piping and hose lines after use.

4.18.2.3 Pressure Regulation.

4.18.2.3.1 Pressure regulation shall be designed to reduce the cylinder pressure automatically and to hold the propellant gas pressure at the designed operating pressure of the liquid agent container(s).

4.18.2.3.2 All pressure-regulating devices shall be sealed or pinned at the designed operating pressures after final adjustment by the system manufacturer.

4.18.2.3.3 Pressure-regulating devices shall be equipped with a spring-loaded relief valve that relieves any excess pressure that develops in the regulator.

4.18.2.3.4 The pressure regulator shall be permitted to be of a type without pressure indicating gauges.

4.18.2.4 Piping and Valves.

4.18.2.4.1 All propellant piping and fittings shall have the following characteristics:

- (1) Conform to the appropriate ASME document
- (2) Be designed to withstand the working pressure of the system

4.18.2.4.1.1 The design of the piping and valving shall provide the desired flow of gas into the system and the minimum amount of restriction from the liquid agent container(s) to the hose connection.

4.18.2.4.1.2 Where more than one hose line is provided, piping and fittings shall be sized and designed so that there is equal flow to each line, regardless of the number of lines placed in operation.

4.18.2.4.2 Provisions shall be made for the following:

- (1) Purging of all piping and hose of the liquid after use without discharging the liquid agent remaining in the container(s)
- (2) Depressurization of the liquid agent container(s) without the loss of the remainder of the liquid agent

4.18.2.4.3 Readily accessible drains shall be provided to allow complete draining of the system.

4.18.2.4.4 All valves shall be of the quarter-turn, quick-opening ball type.

4.18.2.4.4.1 A maximum of two operations, exclusive of the nozzle, shall be provided to charge the system.

4.18.2.4.4.2 Controls shall be arranged for simultaneous charging of the liquid agent and dry chemical systems.

4.18.2.4.4.3 Valves on the gas cylinder specified in 4.18.2.2.2 shall not be required to be of the quarter-turn, quick-opening ball type.

4.18.2.4.5 Identical quick-acting controls shall be provided to pressurize the liquid agent system from the cab of the vehicle and the unit.

4.18.2.4.6 All valves and piping shall be resistant to corrosion by the foam-liquid concentrate.

4.18.2.4.7 A check valve shall be provided in the gas piping to prevent the liquid agent from being forced back into the propellant gas line.

4.19 Turret Nozzles.

4.19.1 ARFF vehicles shall have at least one primary turret nozzle with a discharge rate tolerance of +10 percent $\pm$ 0 percent.

4.19.2 Turret nozzles with liquid flow rates of 2839 L/min (750 gpm) or more shall be of the dual discharge type and arranged to allow selection of either 50 percent or 100 percent of the turret's capacity.

4.19.3 If a turret nozzle is visible from the operator's position in all ranges of motion, an elevation and azimuth indication shall not be required.

4.19.4 The purchaser shall specify a manually operated or a power-assisted turret.

4.19.4.1 Where a manually operated turret is specified, the following shall apply:

- (1) Controls shall be in the cab.
- (2) Operation force shall be less than 133.4 N (30 lbf).
- (3) An indicator of turret elevation and azimuth shall be provided.

4.19.4.2 Where a power-assisted turret is specified, the following shall apply:

- (1) Controls shall be in the cab.
- (2) An indicator of roof turret elevation and azimuth shall be provided.
- (3) Where specified, a manual override or secondary control powered by an alternative source of all turret movement functions shall be provided.

- (4) Where specified, secondary controls shall be capable of operating the turret with a failed primary control system.
- (5) Where specified, the manual override for turret operation force shall be less than 133.4 N (30 lbf).

4.19.4.3 Where turret control is at the platform, operation forces shall be less than 222.4 N (50 lbf).

4.19.5 Turrets shall be capable of the following:

- (1) Being elevated at least 45 degrees above the horizontal
- (2) Discharging agent within 9.1 m (30 ft) in front of the vehicle at full output using a dispersed stream
- (3) Where a single turret is used on a vehicle, being rotated not less than 90 degrees to either side, with total traverse not less than 180 degrees
- (4) Where two turrets are used on a vehicle, stopping so that neither turret can interfere with the other turret
- (5) Providing access to turret controls for both foam and dry chemical turrets to the driver and crew members

4.19.6* If the primary turret is of the extendable type, it shall meet the following design and functional requirements:

- (1) The primary turret shall meet the requirements of 4.3.1.3 and 4.3.1.5 while in the stowed position.
- (2) The vehicle shall achieve a 20 percent side slope, with the extendable turret fully elevated and the nozzle rotated uphill at maximum horizontal rotation while discharging at maximum flow rate.
- (3) The vehicle shall be provided with an interlock or warning system and placards in full view of the driver/operator to provide the operational limitations during all phases of operation.
- (4) Flow rates shall be in accordance with Table 4.1.1(c) and Table 4.1.1(d) for major vehicles.
- (5) The primary turret shall meet the primary water-foam agent turret discharge requirements of Table 4.1.1(c) and Table 4.1.1(d) for the applicable vehicle class while in the bedded position.
- (6) The primary turret shall meet the foam-quality standard of NFPA 412 for the applicable foam applicator and foam type.
- (7) The primary turret shall function during ARFF operations without the need for outriggers or other ground contact stabilizers that would render the vehicle immobile or hinder its maneuverability.
- (8) The primary turret shall have a deployment time from the bedded position to the maximum height and start the application of agent within 30 seconds.
- (9) The high rise, telescoping, and/or articulating movement of the boom/tower shall be accomplished with not more than two adjacent lever controls and be permitted to be manual or automated for preselected positioning of the elevation and reach.
- (10) If automated, these functions shall be provided with a manual override positioning capability.
- (11) The primary turret shall be capable of applying agent to any interior area of the most current wide-body jet, so as not to impede evacuation and for safety considerations of the vehicle operator.
- (12) The device shall be capable of positioning the nozzle within 0.6 m (2 ft) of ground level in front of the vehicle and be capable of applying agent to the interior of the aircraft through cargo bay door openings, passenger doorways, and emergency exits on the type of aircraft

being protected while the aircraft is in either the gear-up or gear-down landing position.

- (13) The primary turret shall have a range of motion so as to permit positioning of the nozzle to direct a fire-fighting agent stream at least 90 degrees to the longitudinal axis of the fuselage for interior fire extinguishment.
- (14) The turret/boom mechanism shall be capable of providing for horizontal movement along the aircraft of at least 30 degrees left and right of the vehicle centerline so as not to require repositioning or movement of the ARFF vehicle.
- (15) This horizontal rotation shall be accomplished without the deployment of stabilizers or outriggers that might cause a delay in positioning or emergency movement of the rescue vehicle.
- (16) The primary turret shall have backup systems to allow for override of the single-lever boom control and hydraulic system (or other power source) if the primary system becomes disabled.
- (17) The driver/operator shall be able to see the boom, as it is rising to its maximum height, from a seated position by means of a camera or direct line of sight.

4.19.6.1 If specified by the purchaser as the primary water-foam and dry chemical turret — that is, to function as a dual agent turret system — the device shall also be capable of meeting the agent discharge performance of Table 4.1.1(c) and Table 4.1.1(d) while in the bedded position.

4.19.6.2 An adjustable or dual flow rate nozzle shall be provided that will allow flow rates and patterns for interior aircraft fire fighting [see Table 4.1.1(c) and Table 4.1.1(d)].

4.19.6.3 Where specified, the extendable turret shall be fitted with controls, accessories, and devices needed for a driver or another operator to remotely perform the interior aircraft and highest engine fire-fighting functions.

4.19.6.4 Where auxiliary agent lines are specified, they shall have the following characteristics:

- (1) Be capable of discharging either dry chemical, halocarbon agent, or approved equivalent through the nozzle while the device is extended out and up to its maximum operational reach
- (2) Meet the minimum auxiliary agent flow rate and pattern requirements of Table 4.1.1(c) and Table 4.1.1(d)

4.19.6.5 Where remote color optics are specified:

- (1) They shall be capable of permitting overall fire scene surveillance when fully extended and provide the driver/operator with the detail needed for placement of the penetration device on the aircraft hull for piercing.
- (2) The camera and associated lighting shall be designed and installed for exterior environmental operating conditions encountered by ARFF vehicles.
- (3) A monitor 178 mm (7 in.) or larger shall be cab mounted and viewable from the driver/operator position.

4.19.6.6 Where a skin penetrator/agent applicator is specified, it shall be movable in conjunction with the water-foam nozzle to allow placement of the nozzle control and be capable of the minimum water-foam flow rate and pattern requirements of Table 4.1.1(c) and Table 4.1.1(d).

4.19.6.7* The penetrating nozzle shall be capable of a minimum flow rate of 946 L/min (250 gpm).