

NFPA®

1900

Standard for
Aircraft Rescue and Firefighting
Vehicles, Automotive Fire Apparatus,
Wildland Fire Apparatus, and
Automotive Ambulances

2024

Includes

NFPA 414 | NFPA 1901 | NFPA 1906 | NFPA 1917



NFPA® 1900

Standard for Aircraft Rescue and Firefighting Vehicles, Automotive Fire Apparatus, Wildland Fire Apparatus, and Automotive Ambulances

2024 Edition



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NFPA® 1900

Standard for

Aircraft Rescue and Firefighting Vehicles, Automotive Fire Apparatus, Wildland Fire Apparatus, and Automotive Ambulances

2024 Edition

This edition of NFPA 1900, *Standard for Aircraft Rescue and Firefighting Vehicles, Automotive Fire Apparatus, Wildland Fire Apparatus, and Automotive Ambulance*, was prepared by the Technical Committees on Fire Department Apparatus, Aircraft Rescue and Firefighting, and Ambulances. It was issued by the Standards Council on October 7, 2022, with an effective date of October 27, 2022.

This edition of NFPA 1900 was approved as an American National Standard on October 27, 2022.

Origin and Development of NFPA 1900

For the first edition of NFPA 1900, *Standard for Aircraft Rescue and Firefighting Vehicles, Automotive Fire Apparatus, Wildland Fire Apparatus, and Automotive Ambulances*, the single legacy standards NFPA 414, NFPA 1901, NFPA 1906, and NFPA 1917 were all part of a document consolidation plan that was approved during the April 2019 Standards Council meeting that affects all documents in the Emergency Response and Responder Safety (ERRS) project.

Many of the changes made for this edition were related to the consolidation of the legacy documents NFPA 414, NFPA 1901, NFPA 1906, and NFPA 1917 into NFPA 1900. In addition to those changes that were made to make the document consolidation possible, each of the committees made significant changes to the areas of the document they are responsible for. For the aircraft rescue and firefighting (ARFF) vehicles requirements within NFPA 1900, the ARFF committee made changes to further explain the equivalency statement to better assist the AHJ. The ARFF committee also made changes to the lettering, numbering, and striping requirements for ARFF vehicles, and they included requirements for the use of hybrid electric or electric ARFF vehicles given the increased use and demand for these types of ARFF vehicles.

For the portions of NFPA 1900 that are made up of the legacy documents NFPA 1901 and NFPA 1906, some of the changes included the deletion of duplicative material and duplicative chapters, resulting in a further consolidation of the material relative to structural apparatus or wildland apparatus. Another change was the moving of the equipment requirements from the main body of the document to the annex. The fire department apparatus committee also included new requirements that address the various types of engines that might be used on new apparatus, they updated the requirements around lettering, striping, and the use of colors and retro-reflective materials, which gives the AHJ increased flexibility, and they made changes to the optical warning systems on the apparatus.

For the portions of NFPA 1900 that are made up of the legacy document NFPA 1917, many of the changes made related to the consolidation of the document. One of the most significant changes made by the ambulance committee was to remove the requirement on seatbelt warning systems. The committee provided a detailed substantiation for this change and included annex material relating to the change. The ambulance committee also made changes to the requirements to the optical warning systems.

For more information about the ERRS consolidation project, see nfpa.org/errs.



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

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NFPA 1900

Standard for

Aircraft Rescue and Firefighting Vehicles, Automotive Fire Apparatus, Wildland Fire Apparatus, and Automotive Ambulances

2024 Edition

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

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

Chapter 1 Administration

1.1 Scope.

1.1.1 This standard defines the minimum requirements for the design, performance, acceptance criteria, and testing of aircraft rescue and firefighting apparatus, new automotive fire apparatus and trailers, wildland fire apparatus, and automotive and remounted ambulances.

1.1.2* Vehicles without wheels are not covered by this standard.

1.2 Purpose. The purpose of this standard is to specify minimum requirements for the following:

- (1) Aircraft rescue and firefighting vehicles with on- and off-pavement performance capabilities
- (2) New automotive fire apparatus and trailers
- (3) New automotive wildland fire apparatus
- (4) New and remounted automotive ambulances

1.3* Application. This standard can be applied as follows:

- (1) Chapters 1 through 3, 4 through 6, and Annexes A, B, C, and I constitute NFPA 414.
- (2) Chapters 1 through 3, 7 through 14, 16 through 25, and Annexes A, D, E, F, G, and I constitute NFPA 1901.
- (3) Chapters 1 through 3, 7 through 12, 15 through 19, 24, 26, 27, and Annexes A, F, G and I constitute NFPA 1906.
- (4) Chapters 1 through 3, 28 through 34, and Annexes A, H, and I constitute NFPA 1917.

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, www.NFPA.org.

NFPA 70®, *National Electrical Code*®, 2023 edition.

NFPA 460, *Standard for Aircraft Rescue and Firefighting Services at Airports*, 2024 edition.

NFPA 950, *Standard for Data Development and Exchange for the Fire Service*, 2020 edition.

NFPA 1910, *Standard for the Inspection, Maintenance, Refurbishment, Testing, and Retirement of In-Service Emergency Vehicles and Marine Firefighting Vessels*, 2024 edition.

NFPA 1931, *Standard for Manufacturer's Design of Fire Department Ground Ladders*, 2020 edition.

NFPA 1932, *Standard on Use, Maintenance, and Service Testing of In-Service Fire Department Ground Ladders*, 2020 edition.

NFPA 1961, *Standard on Fire Hose*, 2020 edition.

NFPA 1963, *Standard for Fire Hose Connections*, 2019 edition.

NFPA 1964, *Standard for Spray Nozzles*, 2018 edition.

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services*, 2019 edition.

NFPA 1989, *Standard on Breathing Air Quality for Emergency Services Respiratory Protection*, 2019 edition.

NFPA 2500, *Standard for Operations and Training for Technical Search and Rescue Incidents and Life Safety Rope and Equipment for Emergency Services*, 2022 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 A14.2, *Ladders — Portable Metal — Safety Requirements*, 2017.

ANSI A14.5, *Ladders — Portable Reinforced Plastic — Safety Requirements*, 2017.

ANSI S1.4, *Specification for Sound Level Meters*, 2014.

ANSI/NEMA Z535.4, *Product Safety Signs and Labels*, 2017.

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

ASME B40.100, *Pressure Gauges and Gauge Attachments*, 2013.

Boiler and Pressure Vessel Code, 2021.

Boiler and Pressure Vessel Code, Section VIII, Division 1, 2021.

2.3.3 ASNT Publications. American Society for Nondestructive Testing, Inc., P.O. Box 28518, 1711 Arlingate Lane, Columbus, OH 43228-0518. www.asnt.org.

ANSI/ASNT CP-189, *Standard for Qualification and Certification of Nondestructive Testing Personnel*, 2020.

2.3.4 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, www.astm.org.

ASTM B647, *Standard Test Method for Indentation Hardness of Aluminum Alloys by Means of a Webster Hardness Gage*, 2016.

ASTM B648, *Standard Test Method for Indentation Hardness of Aluminum Alloys by Means of a Barcol Impressor*, 2015.

ASTM D4956, *Standard Specification for Retroreflective Sheeting for Traffic Control*, 2019.

ASTM E6, *Standard Terminology Relating to Methods of Mechanical Testing*, 2015.

ASTM E10, *Standard Test Method for Brinell Hardness of Metallic Materials*, 2018.

ASTM E18, *Standard Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials*, 2020.

ASTM E114, *Standard Practice for Ultrasonic Pulse-Echo Straight-Beam Examination by the Contact Method*, 2020.

ASTM E165/E165M, *Standard Test Method for Liquid Penetrant Examinations*, 2018.

ASTM E384, *Standard Test Method for Microindentation Hardness of Materials*, 2017.

ASTM E569/E569M, *Standard Practice for Acoustic Emission Monitoring of Structures During Controlled Stimulation*, 2020.

ASTM E650, *Standard Guide for Mounting Piezoelectric Acoustic Emission Sensors*, 2017.

ASTM E661, *Standard Test Method for Performance of Wood and Wood-Based Floor and Roof Sheathing Under Concentrated Static and Impact Loads*, 2003 (2015).

ASTM E709, *Standard Guide for Magnetic Particle Testing*, 2021.

ASTM E797, *Standard Practice for Measuring Thickness by Manual Ultrasonic Pulse-Echo Contact Method*, 2021.

ASTM E1004, *Standard Practice for Determining Electrical Conductivity Using the Electromagnetic (Eddy-Current) Method*, 2017.

2.3.5 AWS Publications. American Welding Society, 8669 NW 36 Street, #130, Miami, FL 33166-6672, www.aws.org/w/a.

AWS B1.10M/B1.10, *Guide for the Nondestructive Examination of Welds*, 2016.

AWS D1.1/D1.1M, *Structural Welding Code — Steel*, 2020.

AWS D1.2/D1.2M, *Structural Welding Code — Aluminum*, 2014.

AWS D1.3/D1.3M, *Structural Welding Code — Sheet Steel*, 2018.

2.3.6 CGA Publications. Compressed Gas Association, 8484 Westpark Drive, Suite 220, McLean, VA 22102, www.cganet.com.

G-7, *Compressed Air for Human Respiration*, 2019.

G-7.1, *Commodity Specification for Air*, 2018.

2.3.7 CSA Publications. CSA Group, 178 Rexdale Blvd., Toronto, ON M9W 1R3, Canada, www.csagroup.org.

CSA W47.1, *Certification of Companies for Fusion Welding of Steel*, 2019.

CSA W47.2, *Certification of Companies for Fusion Welding of Aluminum*, 2015.

2.3.8 FAA Publications. Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 2059, www.faa.gov/airports/resources/advisory_circulars/.

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

2.3.9 FAMA Publications. Fire Apparatus Manufacturers Association, P.O. Box 3065, Ocala, FL 34478, www.fama.org.

FAMA TC008, *Graphical Symbols for Automotive Fire Apparatus*, 2014

FAMA TC010, *Standard Product Safety Sign Catalog for Automotive Fire Apparatus*, 2019.

FAMA TC079, *Ember Separator Test*, 2021.

Fire Apparatus Safety Guide, 2020.

2.3.10 IPC Publications. IPC, 3000 Lakeside Drive, 309 S, Bannockburn, IL 60015, www.ipc.org.

IPC A-610H, *Acceptability of Electronic Assemblies*, 2020.

2.3.11 ISEA Publications. International Safety Equipment Association, 1101 Wilson Blvd, Suite #1425, Arlington, VA 22209-1762, www.safetysystem.org.

ANSI/ISEA 107, *American National Standard for High-Visibility Safety Apparel and Accessories*, 2020.

2.3.12 ISO Publications. International Organization for Standardization, ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, www.iso.org.

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

ISO/IEC 17020, *Conformity Assessment: Requirements for the operation of various types of bodies performing inspection*, 2012.

ISO/IEC 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*, 2017.

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

ISO 17840-4, *Road Vehicles — Information for first and second responders — Part 4: Propulsion energy identification*, 2018.

IEC 62477-1, *Safety Requirements for Power Electronic Converter Systems and Equipment*, 2012.

2.3.13 National Truck Equipment Association (NTEA) Publications. NTEA The Association for the Work Truck Industry, 37400 Hills Tech Drive, Farmington Hills, MI 48331-3414, www.ntea.com

AMD 005, *Low Voltage Electrical System Test*, 2019.

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- AMD 008, *Handrail Static Load Test*, 2019.
- AMD 010, *Water Leak Test*, 2019.
- AMD 011, *Equipment Temperature Test*, 2019.
- AMD 012, *Interior Climate Control Test*, 2019.
- AMD 013, *Weight Distribution Measurements*, 2019.
- AMD 015, *Ambulance Main Medical Gas System Test*, 2019.
- AMD 016, *Patient Compartment Lighting Level Test*, 2019.
- AMD 018, *Rear Stepping Surface Load Test*, 2019.
- AMD 021, *Aspirator System Test*, 2019.
- AMD 024, *Perimeter Illumination Test*, 2019.
- AMD 025, *Occupant Head Clearance Zones Test*, 2019.
- AMD 027, *Line Voltage Electrical Systems Test*, 2019.
- AMD 028, *Vertical Component Retention — Static Test*, 2019.
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- NATO Document, *Dynamic Stability Report—Allied Vehicle Testing Publication (AVTP)*, 03–16W.
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- 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)*, 2020.
- SAE J553, *Circuit Breakers*, 2016.
- SAE J554, *Electric Fuses (Cartridge Type)*, 1987.
- SAE J560, *Primary and Auxiliary Seven Conductor Electrical Connector for Truck-Trailer Jumper Cable*, 2020.
- SAE J575, *Test Methods and Equipment for Lighting Devices and Components for Use on Vehicles Less Than 2032 mm in Overall Width*, 2018.
- SAE J578, *Chromaticity Requirements of Ground Vehicle Lamps and Lighting Equipment*, 2020.
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- SAE J994, *Alarm — Backup — Electric, Laboratory Performance Testing*, 2014.
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- SAE J1128, *Low Voltage Primary Cable*, 2020.
- SAE J1673, *High Voltage Automotive Wiring Assembly Design*, 2012.
- SAE J1849, *Emergency Vehicle Sirens, Stabilized*, 2020.
- SAE J1888, *High Current Time Lag Electric Fuses*, 1990.
- SAE J1889, *L.E.D. Signal and Marking Lighting Devices*, 2019.
- SAE J1908, *Electrical Grounding Practice*, 2013.
- SAE J2077, *Miniature Blade Type Electrical Fuses*, 1990.
- SAE J2174, *Heavy-Duty Wiring Systems for Trailers 2032 mm or More in Width*, 2020.
- SAE J2180, *A Tilt Table Procedure for Measuring the Static Roll-over Threshold for Heavy Trucks*, 2011.
- SAE J2181, *Steady State Circular Test Procedures for Trucks and Buses*, 2011.
- SAE J2202, *Heavy-Duty Wiring Systems for On-Highway Trucks*, 2019.
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- SAE J2394, *Seven-Conductor Cable for ABS Power — Truck and Bus*, 2020.
- SAE J2418, *Occupant Restraint System Evaluation — Frontal Impact Component-Level Heavy Trucks*, 2020.
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- SAE J2578, *Recommended Practice for General Fuel Cell Vehicle Safety*, 2014.
- SAE J2863, *Automotive Trailer Tow Connector*, 2016.
- SAE J2910, *Recommended Practice for the Design and Test of Hybrid Electric and Electric Trucks and Buses for Electrical Safety*, 2014.
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- SAE J3026, *Ambulance Patient Compartment Seating Integrity and Occupant Restraint*, 2016.
- SAE J3027, *Ambulance Litter Integrity, Retention, and Patient Restraint*, 2016.
- SAE J3043, *Ambulance Equipment Mounts*, 2014.
- SAE J3057, *Ambulance Modular Body Evaluation-Quasi-Static Loading For Type I and Type III Modular Ambulance Bodies*, 2017.
- SAE J3058, *Ambulance Interior Storage Compartment Integrity*, 2016.
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UL 2034, *Standard for Single and Multiple Station Carbon Monoxide Alarms*, 2018.

UL 2231-1, *Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits: General Requirements*, 2021.

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UL 8750, *Light Emitting Diode (LED) Equipment for Use in Lighting Products*, 2021.

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UN 38.3, *Certification for Lithium Batteries*, 2019.

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

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

USDA Forest Service Standard 5100-1, 2013.

2.3.20 US Government Publications. US Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.

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

Public Law 89-563.

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

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

Title 49, Code of Federal Regulations, Part 393.94, "Interior noise levels in power units, test procedure."

Title 49, Code of Federal Regulations, Part 567, "Certification."

Title 49, Code of Federal Regulations, Part 571, Federal Motor Vehicle Safety Standards (FMVSS).

Title 49, Code of Federal Regulations, Part 571.121, "Air Brake Systems."

Title 49, Code of Federal Regulations, Part 571, Subpart B, "Federal Motor Vehicle Safety Standards," No. 108, "Lamps, reflective devices, and associated equipment."

Title 49, Code of Federal Regulations, Part 571, Subpart B, "Federal Motor Vehicle Safety Standards," No. 302, "Flammability of interior materials."

Title 49, Code of Federal Regulations, Part 571 Subpart B, "Federal Motor Vehicle Safety Standards," No. 305, "Electric Powered Vehicles: Electrolyte Spillage and Electrical Shock Protection."

2.3.21 Other Publications.

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

2.4 References for Extracts in Mandatory Sections.

NFPA 10, *Standard for Portable Fire Extinguishers*, 2022 edition. NFPA 70®, *National Electrical Code®*, 2023 edition.

NFPA 440, *Guide for Aircraft Rescue and Firefighting Operations and Airport/Community Emergency Planning*, 2024 edition.

NFPA 1150, *Standard on Foam Chemicals for Fires in Class A Fuels*, 2022 edition.

NFPA 1451, *Standard for a Fire and Emergency Service Vehicle Operations Training Program*, 2022 edition.

NFPA 1932, *Standard on Use, Maintenance, and Service Testing of In-Service Fire Department Ground Ladders*, 2020 edition.

NFPA 1961, *Standard on Fire Hose*, 2020 edition.

NFPA 1989, *Standard on Breathing Air Quality for Emergency Services Respiratory Protection*, 2019 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 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

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

standards or has been tested and found suitable for a specified purpose.

3.2.5 Shall. Indicates a mandatory requirement.

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

3.2.7 Standard. An NFPA standard, the main text of which contains only mandatory provisions using the word “shall” to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA manuals of style. When used in a generic sense, such as in the phrases “standards development process” or “standards development activities,” the term “standards” includes all NFPA standards, including codes, standards, recommended practices, and guides.

3.3 General Definitions.

3.3.1 Acceptance. An agreement between the purchasing authority and the contractor that the terms and conditions of the contract have been met.

3.3.2 Acceptance Tests. Tests performed on behalf of or by the purchaser at the time of delivery to determine compliance with the specifications for the vehicle.

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

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

3.3.5 Aerial Device. An aerial ladder, elevating platform, or water tower that is designed to position personnel, handle materials, provide continuous egress, or discharge water.

3.3.6 Aerial Fire Apparatus. A vehicle equipped with an aerial ladder, elevating platform, or water tower that is designed and equipped to support firefighting and rescue operations by positioning personnel, handling materials, providing continuous egress, or discharging water at positions elevated from the ground.

3.3.7 Aerial Ladder. A self-supporting, turntable-mounted, power-operated ladder of two or more sections permanently attached to a self-propelled automotive fire apparatus and designed to provide a continuous egress route from an elevated position to the ground.

3.3.8 Air Control Panel. A consolidated arrangement of valves, regulators, gauges, and air system piping at a location that allows the operator to monitor and control the airflow and pressure within the air system from a centralized location.

3.3.9* Aircraft Rescue and Firefighting (ARFF). The firefighting 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. [440, 2024]

3.3.10 Air-Mechanical Brakes. See 3.3.38.1, Air-Mechanical Brakes.

3.3.11 Air-Over-Hydraulic Brakes. See 3.3.38.2, Air-Over-Hydraulic Brakes.

3.3.12 Air Quality Monitors. Electronic instruments that monitor the air for such elements as carbon monoxide levels and moisture levels and that are capable of sending a signal to automatically shut down the air system.

3.3.13* Air Tank. A storage vessel meeting the requirements of either U.S. Department of Transportation (DOT) or American Society of Mechanical Engineers (ASME) and used to store an accumulation of air under pressure.

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

3.3.15 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.

3.3.16 Ambulance. A vehicle used for out-of-hospital medical care and patient transport that provides a driver's compartment; a patient compartment to accommodate an emergency medical services provider (EMSP) and at least one patient located on the primary cot positioned so that the primary patient can be given emergency care during transit; equipment and supplies for emergency care at the scene as well as during transport; safety, comfort, and avoidance of aggravation of the patient's injury or illness; two-way radio communication; and audible and visual traffic warning devices.

3.3.16.1* Substantially Similar Ambulance. An ambulance in which the relevant area or component that is being compared or considered is comparable. Applicable to the test being considered for an ambulance in which like areas are compared.

3.3.16.2 Type I Ambulance. An ambulance with a 10,001 lb (4536 kg) to 14,000 lb (6350 kg) gross vehicle weight rating (GVWR) constructed on a cab chassis with a modular ambulance body.

3.3.16.3 Type I-AD (Additional Duty) Ambulance. An ambulance with a 14,001 lb (6351 kg) or more GVWR constructed on a cab chassis with a modular ambulance body.

3.3.16.4 Type II Ambulance. An ambulance constructed on a van.

3.3.16.5 Type III Ambulance. An ambulance with a 10,001 lb to 14,000 lb GVWR constructed on a cutaway van chassis with integrated modular ambulance body.

3.3.16.6 Type III-AD (Additional Duty) Ambulance. An ambulance with a 14,001 lb or more GVWR constructed on a cutaway van chassis with integrated modular body.

3.3.17 Angle.

3.3.17.1* Angle of Approach. The smallest angle made between the road surface and a line drawn from the front point of ground contact of the front tire to any projection of the vehicle in front of the front axle.

3.3.17.2* Angle of Departure. The smallest angle made between the road surface and a line drawn from the rear point of ground contact of the rear tire to any projection of the vehicle behind the rear axle.

3.3.18 Apparatus Operator Manual. Document(s) provided by the chassis or apparatus manufacturer that covers how the complete apparatus should be safely operated and serviced.

3.3.19 Articulating Boom. An aerial device consisting of two or more folding boom sections whose extension and retraction modes are accomplished by adjusting the angle of the knuckle joints.

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

3.3.21 Authorized Person. A person approved or assigned to perform specific types of duties or to be at a specific location at the job site.

3.3.22 Automatic Electrical Load Management System. A device that continuously monitors the electrical system voltage and automatically sheds predetermined loads in a selected order to prevent overdischarging of the vehicle's batteries.

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

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

3.3.25 Auxiliary Braking System. A braking system in addition to the service brakes, such as an engine retarder, transmission retarder, driveline retarder, or exhaust retarder.

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

3.3.27 Auxiliary Hydraulic Power. A small gasoline engine, diesel engine, or electric motor-driven hydraulic pump used to operate an aerial device in an emergency or in lieu of the main hydraulic system.

3.3.28 Auxiliary Pump. A water pump mounted on the fire apparatus in addition to a fire pump and used for firefighting either in conjunction with or independent of the fire pump.

3.3.29 Back-Up Alarm. An audible device designed to warn that the fire apparatus is in reverse gear.

3.3.30 Base Rail. The lower chord (rail) of an aerial ladder to which rungs and reinforcements are attached.

3.3.31 Base Section. The first or bottom section of an aerial device.

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

3.3.33 Bonded (Bonding). Connected to establish electrical continuity and conductivity.

3.3.34* Boom. The structural member of an apparatus, other than an aerial ladder, which can be elevated, rotated, or extended.

3.3.35 Booster Hose. Thick-walled flexible hose that retains its round cross-section when it is not under pressure.

3.3.36 Booster Pump. See 3.3.28, *Auxiliary Pump*.

3.3.37 Booster Supplied Air System. A system that is capable of increasing air pressure from an air storage system or a compressor system.

3.3.38 Brakes.

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

3.3.38.2 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.

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

3.3.39 Breathing Air System. The complete assembly of equipment such as compressors, a purification system, pressure regulators, safety devices, manifolds, air tanks or receivers, and interconnected piping required to deliver breathing air.

3.3.40 Bubble (Foam). A thin-walled, roughly spherical film of liquid inflated with air.

3.3.41 Bulk Air System. A method of piping air tanks together to allow air to be supplied to an air system or SCBA fill station, using one or more tanks where all tanks are used simultaneously and are at the same pressure.

3.3.42 Bulkhead. The partition dividing the driver compartment from the patient compartment.

3.3.43 Burst Pressure. The pressure at which a hydraulic component fails due to stresses induced as a result of the pressure.

3.3.44 Carbon Monoxide Monitor. A monitoring device that samples a purified air stream for trace elements of carbon monoxide (CO).

3.3.45 Cascade System. A method of piping air tanks together to allow air to be supplied to the SCBA fill station using a progressive selection of tanks each with a higher pressure level.

3.3.46* Center of Gravity. The point at which the entire weight of the vehicle is considered to be concentrated so that, if supported at this point, the apparatus would remain in equilibrium in any position.

3.3.47* Chassis. The basic operating motor vehicle including the engine, frame, and other essential structural and mechanical parts, but exclusive of the body and all appurtenances for the accommodation of driver, property, passengers, appliances, or equipment related to other than control.

3.3.48 Child Restraint Seat. See 3.3.250.1.

3.3.49 Class A Fires. Class A fires are fires in ordinary combustible materials, such as wood, cloth, paper, rubber, and many plastics. [10, 2018]

3.3.50 Class A Foam. Foam for use on fires in Class A fuels. [1150, 2022]

3.3.51 Class A Fuel. Materials such as vegetation, wood, cloth, paper, rubber, and some plastics in which combustion can occur at or below the surface of the material. [1150, 2022]

3.3.52 Class B Fire. A fire in flammable liquids, combustible liquids, petroleum greases, tars, oils, oil-based paints, solvents, lacquers, alcohols, and flammable gases.

3.3.53 Class B Foam. Foam intended for use on Class B fires.

3.3.54 Combination Vehicle. A vehicle consisting of a towing vehicle and one or more towed units.

3.3.55 Command and Communications Apparatus. A fire apparatus used primarily for communications and incident command.

3.3.56 Compartment.

3.3.56.1 Exterior Compartment. A weather-resistant area designed to protect stored items from environmental damage that is confined on six sides and equipped with an access opening(s) that can be closed and latched.

3.3.56.2 Interior Storage Compartment. A cabinet, drawer, pouch style system, or other means used to contain and secure EMS supplies, tools, medical devices, or other equipment within an enclosed area.

3.3.56.3 Patient Compartment. The enclosed portion of an ambulance intended for transporting patients.

3.3.57* Complementary Extinguishing Agent. An agent that provides unique extinguishing capability beyond the primary chosen agent.

3.3.58 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.

3.3.59* Compound Gauge. A gauge that indicates pressure both above and below atmospheric pressure.

3.3.60* Compressed Air Foam System (CAFS). A foam system that combines air under pressure with foam solution to create foam.

3.3.61 Compressed Breathing Air. A respirable gas mixture derived from either normal atmospheric air or from manufactured synthetic air, stored in a compressed state in storage cylinders and respirator breathing air cylinders, and supplied to the user in gaseous form. [1989, 2019]

3.3.62 Conductor.

3.3.62.1 Grounding Conductor. A non-current-carrying conductor used to connect equipment or the ground circuit of a wiring system to the power source grounding system.

3.3.62.2 Line Voltage Conductor. An ungrounded current-carrying conductor of a line voltage circuit.

3.3.62.3 Neutral Conductor. The conductor connected to the neutral point of a system that is intended to carry current under normal conditions.

3.3.63 Continuous Duty. Operation at a substantially constant load for an indefinitely long time.

3.3.64 Continuous Egress. A continuous exit or rescue path down an aerial device from an elevated position to the ground.

3.3.65* Contractor. The person or company responsible for fulfilling an agreed upon contract.

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

3.3.67 Curb Weight. The total weight of the complete vehicle less the payload.

3.3.68 Dead Load. The weight of the aerial device structure and all materials, components, mechanisms, or equipment permanently fastened thereto.

3.3.69 Defect. A discontinuity in a part or a failure to function that interferes with the service or reliability for which the part was intended.

3.3.70 Designated Primary Seating Position. Front driver and officer seats and any additional seating positions designated by the purchaser to be used by firefighters wearing personal protective clothing and equipment as the apparatus is used in regular service.

3.3.71 Designated Secondary Seating Position. Any seating position other than a designated primary seating position that is not intended to be occupied as the vehicle is used in regular service and not intended to be used by firefighters wearing protective clothing.

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

3.3.73 Discharge Outlet Size. The nominal size of the first fire hose connection from the pump on a discharge.

3.3.74 Documentation. Any written data or information supplied by the manufacturer or contractor relative to the vehicle and its components and systems, including information on its operation, service, and maintenance.

3.3.75 DOT Cylinder. A pressure vessel constructed and tested in accordance with Title 49 CFR 178.37 that is used for the storage and transportation of air under pressure.

3.3.76 Drain Time (Foam). The time period it takes for a specified percent of the total solution contained in the foam to revert to liquid and to drain out of the bubble structure.

3.3.77 Driver's Enhanced Vision System (DEVS). See 3.3.274.1.

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

3.3.79 Dump Valve. A large opening from the water tank of a mobile water supply apparatus for unloading purposes.

3.3.80 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.

3.3.81* Eductor. A device placed in a hose line or a discharge pipe that incorporates a venturi and proportions foam concentrate or other firefighting agents into the water stream.

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

3.3.83* Electric Siren (Electromechanical). An audible warning device that produces sound by the use of an electric motor with an attached rotating slotted or perforated disc.

3.3.84 Electric Vehicle. A vehicle made up of a propulsion system using only power from the rechargeable energy storage system to operate the vehicle drive.

3.3.85 Electrical Appliance. An electrical device or instrument designed to perform a specific function, such as scene lights, battery charger, medical equipment, and so forth.

3.3.86 Electrical Equipment. See 3.3.102, Fixed Electrical Equipment, and 3.3.209, Portable Electrical Equipment.

3.3.87* Electronic Siren. An audible warning device that produces sound electronically through the use of amplifiers and electromagnetic speakers.

3.3.88 Electronic Stability Control System. See 3.3.274.2.

3.3.89 Elevating Platform. A self-supporting, turntable-mounted device consisting of a personnel-carrying platform attached to the uppermost boom of a series of power-operated booms that articulate, telescope, or both and that are sometimes arranged to provide the continuous egress capabilities of an aerial ladder.

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

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

3.3.92* Engine. A machine that provides mechanical power for the vehicle or vehicle system.

3.3.92.1 Electrical Vehicle (EV) Motor. An electrical machine that converts electrical energy into mechanical energy.

3.3.92.2 Fuel Cell. A device for converting a chemical fuel to electrical power without combustion.

3.3.92.3 Internal Combustion (IC) Engine. A machine that converts combustible fuel directly into mechanical energy.

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

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

3.3.95 Expansion Ratio. The ratio of the volume of foam in its aerated state to the original volume of nonaerated foam solution.

3.3.96 Exterior. A nonsheltered location exposed to the environment, either continuously or intermittently.

3.3.97 Exterior Compartment. See 3.3.56.1.

3.3.98 Federal Motor Vehicle Safety Standards (FMVSS). Regulations promulgated by the National Highway Traffic Safety Administration (NHTSA) of the United States under Public Law 89-563 that are mandatory and must be complied with when motor vehicles or items of motor vehicle equipment are manufactured and certified thereto.

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

3.3.100 Fire Apparatus. A vehicle designed to be used under emergency conditions to transport personnel and equipment or to support the suppression of fires or mitigation of other hazardous situations.

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

3.3.102 Fixed Electrical Equipment. Any electrical equipment that is not removable without the use of tools or is hard wired to the vehicle's electrical system.

3.3.103 Fixed Power Source. Any line voltage power source except a portable generator.

3.3.104 Fly Section. Any section of an aerial telescoping device beyond the base section.

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

3.3.106 Foam. An aerated fire-extinguishing solution created by mixing air into foam solution to form bubbles.

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

3.3.108 Foam Concentration. The quantity of foam liquid concentrate in water identified in percentage.

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

3.3.110 Foam Proportioner. A device or method to add foam concentrate to water to make foam solution.

3.3.111 Foam Proportioning System. The apparatus and techniques used to mix concentrate with water to make foam solution.

3.3.112 Foam Solution. A homogeneous mixture of water and foam concentrate in the proper proportions.

3.3.113* 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.

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

3.3.115 Fully Loaded Vehicle. See 3.3.301.1, Fully Loaded Vehicle.

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

3.3.117 Gauge. A visual device that indicates a measurement.

3.3.118 Gauge Pressure. Pressure measured by an instrument where the pressure indicated is relative to atmospheric pressure.

3.3.119 GAWR. Gross axle weight rating. See 3.3.306.1.

3.3.120 GCWR. Gross combination weight rating. See 3.3.306.2.

3.3.121 Generator. An electromechanical device for the production of electricity.

3.3.122 Global Positioning System (GPS). See 3.3.274.3, Global Positioning System (GPS).

3.3.123* Grade. A measurement of the angle used in road design and expressed as a percentage of elevation change over distance.

3.3.124 Ground Clearance. The vertical distance from the vehicle component to the ground.

3.3.125 Ground Sweep Nozzle. See 3.3.185.1, Ground Sweep Nozzle.

3.3.126* Ground-Fault Circuit Interrupter (GFCI). A device intended for the protection of personnel that functions to de-energize a circuit or portion thereof within an established period of time when a ground-fault current exceeds the values established for a Class A device. [70, 2023]

3.3.127 Grounding Conductor. See 3.3.62.1.

3.3.128 GVWR. Gross vehicle weight rating. See 3.3.306.3.

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

3.3.130 High Pressure. See 3.3.226.1.

3.3.131 High-Idle Speed Control. A control or switch system that provides a means to increase the engine operating speed from an idle condition to a higher preset operating speed.

3.3.132 High-Voltage Interlock. A means to control the high-voltage battery such that all HV connections and serviceable components must be secure before energizing the rechargeable energy storage system; an electrical circuit or loop that proves all HV connections are secure.

3.3.133 High-Voltage Isolation Monitor. A system to monitor the high-voltage system to ensure the high-voltage system, including the rechargeable energy storage system, the hybrid propulsion unit, and any other devices connected to the high-voltage system, is isolated electrically from the vehicle chassis.

3.3.134 Hybrid Propulsion Unit. A device or system capable of providing mechanical power from two sources such as electrical power from a rechargeable energy storage system or an

internal combustion engine, or from both sources simultaneously.

3.3.135 Hybrid Vehicle. A vehicle made up of a propulsion system having sufficient mechanical power available from a rechargeable energy storage system and from the engine to operate the vehicle drive from either source without the aid of the other source.

3.3.136 Hydrodynamic Test. A test performed by operating a fire pump to develop pump discharge pressure to pressurize the pump discharge structure and connected discharge piping and valves to a prescribed value while the intake piping, intake valves, and intake structure of the pump are not subjected to the prescribed pump discharge pressure.

3.3.137 Hydrostatic Test. A test performed by filling pressure-containing components completely with water or other incompressible fluid while expelling all contained air, closing or capping all open ports of the pressure-containing components, and then raising and maintaining the contained pressure to pressurize the pressure-containing components to a prescribed value through an externally supplied pressure-generating device.

3.3.138 Improved Surface. See 3.3.271.1.

3.3.139 Indicator. A device that provides a visual signal or annunciation regarding the operating condition or status of electrical circuits, systems, or equipment.

3.3.140 Infant Restraint Seat. See 3.3.250.2.

3.3.141 Initial Attack Apparatus. Fire apparatus with a fire pump of at least 250 gpm (1000 L/min) capacity, water tank, and hose body whose primary purpose is to initiate a fire suppression attack on structural, vehicular, or vegetation fires, and to support associated fire department operations.

3.3.142 In-Service Fire Apparatus. Any fire apparatus, including reserve apparatus, that is available for use under emergency conditions to transport personnel and equipment and to support suppression of fires and mitigation of other hazardous conditions.

3.3.143 In-Service Weight. The maximum actual vehicle weight under any conditions of mobile operation, sometimes referred to as gross vehicle weight.

3.3.144 Instability. A condition of a mobile unit in which the sum of the moments tending to overturn the unit exceeds the sum of the moments tending to resist overturning.

3.3.145 Instruction Plate. A visual indication whether in pictorial or word format that provides instruction to the operator in the use of a component.

3.3.146 Intake Connection Size. The nominal size of the first fire hose connection from the pump on an intake.

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

3.3.148* Intended Airport Service. All aspects of aircraft rescue and firefighting services as provided by this standard.

3.3.149* Interaxle Clearance (Ramp Breakover 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.

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

3.3.151 Interior. A sheltered location not exposed to the environment.

3.3.152 Interior Storage Compartment. See 3.3.56.2.

3.3.153 Interlock. A device or arrangement by means of which the functioning of one part is controlled by the functioning of another.

3.3.154 ISO. Insurance Services Office.

3.3.155 “J” Turn Test. The measure of a vehicle’s ability to traverse a 90 degree turn at a prescribed speed.

3.3.156 Knuckle. A point of connection between upper and lower booms of an articulating device; the point at which lower and upper booms are hinged together.

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

3.3.158 Ladder Section. A structural member normally of an open “U” truss-type design that includes the rungs and comprises the base or fly section of an aerial ladder.

3.3.159 Latch. A mechanical device used to position the door in a closed position relative to the body framework with provision for controlled release or operation.

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

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

3.3.162 Line Voltage Conductor. See 3.3.62.2.

3.3.163 Live Load. Forces acting on the aerial device from personnel, portable equipment, water, wind, and nozzle reaction.

3.3.164 Load Distribution Plan. A drawing or spreadsheet of shelves, cabinets, drawers, compartment, or otherwise storage with a maximum weight attached to each location.

3.3.165* Loose Equipment. Equipment other than the occupants and the cot that is intended to be stored on the ambulance.

3.3.166 Low-Voltage Circuit, Equipment, or System. An electrical circuit, equipment, or system where the voltage does not exceed 30 V rms (ac), 42.4 V peak (ac), or 60 V dc; usually 12 V dc in vehicles.

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

3.3.168 Manufacturer. The person(s) or entity responsible for turning raw materials or components into a finished product.

3.3.169 Material Yield Strength. See 3.3.315, Yield Strength.

3.3.170 Maximum Discharge Pressure Capability Rating. The maximum permissible discharge gauge pressure at which the fire pump can be operated.

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

3.3.172 Minimum Continuous Electrical Load. The electrical current required to continuously operate a defined set of electrical devices.

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

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

3.3.175 Mobile Foam Fire Apparatus. Fire apparatus with a permanently mounted fire pump, foam proportioning system, and foam concentrate tank(s) whose primary purpose is the control and extinguishment of flammable and combustible liquid fires in storage tanks and spills.

3.3.176 Mobile Water Supply Apparatus (Tanker, Tender). A vehicle designed primarily for transporting (pickup, transporting, and delivering) water to fire emergency scenes to be applied by other vehicles or pumping equipment.

3.3.177 Momentary Switch. A switch that returns to the neutral position (off) when released.

3.3.178 Multiple Configuration. Variable configurations or positions of the aerial device (e.g., elevation, extension) in which a manufacturer's different rated load capacities are allowed.

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

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

3.3.181 Neutral Conductor. See 3.3.62.3.

3.3.182* Neutral Point. The common point on a wye-connection in a polyphase system or midpoint on a single-phase, 3-wire system, or midpoint of a single-phase portion of a 3-phase delta system, or midpoint of a 3-wire, direct current system.

3.3.183 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.

3.3.184 Normal Pressure. See 3.3.226.2.

3.3.185 Nozzle.

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

3.3.185.2 Piercing Nozzle. A nozzle designed to penetrate into an aircraft to discharge fire extinguishing agent(s).

3.3.185.3 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 to wheel and front to back of the underside of the truck.

3.3.186 Nozzle Reaction. Force that occurs when a water stream is discharged from the nozzle.

3.3.187 NWCG. National Wildfire Coordinating Group.

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

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

3.3.190 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.

3.3.191 Operator's Panel. A panel containing gauges, switches, instruments, or controls where an operator can visually monitor the applicable functions.

3.3.192 Optical Center. The point specified by the optical warning device manufacturer of highest intensity when measuring the output of an optical warning device.

3.3.193 Optical Element. Any individual lamp or other light emitter within an optical source.

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

3.3.195 Optical Signaling Characteristics. The specific classification of the flash pattern, color, location, and optical power for optical warning devices.

3.3.196* Optical Source. Any single, independently mounted, light-emitting component in a lighting system.

3.3.197 Optical Warning Device. A manufactured assembly of one or more optical sources.

3.3.198 Optical Warning System. The optical warning devices along with automatic or manual sensors, switches, or other devices used to activate, alter, or deactivate optical warning devices.

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

3.3.200 Override. A system or device used to neutralize a given action or motion.

3.3.201 Override (Aerial Device). The takeover of all aerial device movement control functions by an operator at a second control station.

3.3.202 Panelboard. A single panel or group of panel units designed for assembly in the form of a single panel, including buses and automatic overcurrent devices, and equipped with or without switches for the control of light, heat, or power circuits; designed to be placed in a cabinet or cutout box placed in or against a wall, partition, or other support; and accessible only from the front. [70:100]

3.3.203 Patient Compartment. See 3.3.56.3.

3.3.204 Patient Cot. An elevating patient conveyance device upon which the primary patient is transported, and which is also known as a stretcher, transporter, gurney, and carrier.

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

3.3.206 Personal Gear. The weight of personal clothing and items for personal hygiene carried on the fire apparatus by each crew member when they expect the response to be of long duration.

3.3.207 Photometric Measurement Point. The defined geometric point of an optical measurement within the horizontal and vertical axial planes originating from the optical center of the optical source or optical device.

3.3.208 Piercing Nozzle. See 3.3.185.2.

3.3.209 Portable Electrical Equipment. Any electrical equipment that is not fixed. (See 3.3.102, *Fixed Electrical Equipment*.)

3.3.210* Portable Generator. A mechanically driven power source that can be removed from the fire apparatus and operated at a location that is remote from the fire apparatus.

3.3.211 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.

3.3.212 Power Source. A device that produces line voltage electricity.

3.3.213 Power Supply Assembly. Any cord or distribution assembly that is partly comprised of the neutral conductor, grounding conductor, and line voltage conductors connected from the output terminals of the power source to the first main overcurrent protection device.

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

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

3.3.216 Pressure Relief System. A device or method for reducing pressure in vessels, stages, or equipment when pressure has increased above a particular limit.

3.3.217 Primary Patient Care Seat. The seating position designated by the AHJ from which the EMSP is expected to provide primary patient care.

3.3.218 Primary Turret. See 3.3.282.2, Primary Turret.

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

3.3.220 Proper(ly). In accordance with the manufacturer's specifications or as recommended by the manufacturer.

3.3.221 Propulsion System. A vehicle system made up of a combination of multiple elements, including engine(s), transmission(s), hybrid propulsion unit(s), and rechargeable energy storage system(s), representing the source of propulsion power to the vehicle drive.

3.3.222 Prototype Vehicle. See 3.3.301.2, Prototype Vehicle.

3.3.223 psi. Pounds per square inch.

3.3.224 PTO. Power takeoff.

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

3.3.226 Pump Discharge Pressure Classification.

3.3.226.1 High Pressure. Pump discharge pressure from 500 psi (3500 kPa) to less than 1100 psi (7600 kPa).

3.3.226.2 Normal Pressure. Pump discharge pressure less than 500 psi (3500 kPa).

3.3.226.3 Ultra-High Pressure. Pump discharge pressure of 1100 psi (7600 kPa) or greater.

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

3.3.228 Pump Operator's Position. The location from which the pump operator operates the pump.

3.3.229 Pumper. Fire apparatus with a permanently mounted fire pump of at least 750 gpm (3000 L/min) capacity, water tank, and hose body whose primary purpose is to combat structural and associated fires.

3.3.230 Purchaser. The authority having responsibility for the specification and acceptance of the vehicle.

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

3.3.232 Purification System. A combination of mechanical, chemical, and physical devices such as separators, filters, adsorbents, and catalysts designed to remove or alter contaminants within the compressed air stream to produce effluent air that is breathable.

3.3.233 Qualified Person. A person who, by possession of a recognized degree, certificate, professional standing, or skill, and who, by knowledge, training, and experience, has demonstrated the ability to deal with problems related to the subject matter, the work, or the project. [1451, 2022]

3.3.234* Quint. Fire apparatus with a permanently mounted fire pump, a water tank, a hose storage area, an aerial ladder or elevating platform with a permanently mounted waterway, and a complement of ground ladders.

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

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

3.3.237 Rated Capacity (Aerial Device). Operational capacity for each condition of extension, elevation, and rotation as indicated on the load chart.

3.3.237.1 Rated Horizontal Capacity — Dry (Aerial Device).

The total amount of weight of all personnel and equipment that can be supported at the outermost rung of an aerial ladder or in the platform of an elevating platform under the following conditions: (1) aerial device placed in the horizontal position; (2) stabilizers fully deployed; (3) apparatus on firm and level ground; and (4) aerial device extended and rotated to any position the control system will allow that produces the lowest capacity.

3.3.237.2 Rated Horizontal Capacity — Wet (Aerial Device).

The total amount of weight of all personnel and equipment that can be supported at the outermost rung of an aerial ladder or in the platform of an elevating platform under the following conditions: (1) aerial device placed in the horizontal position; (2) stabilizers fully deployed; (3) apparatus on firm and level ground; (4) aerial device extended and rotated to any position the control system will allow that produces the lowest capacity; (5) monitor or water pipe flowing maximum rated water capacity; and (6) monitor pointed in the direction that produces the greatest overturning moment.

3.3.238 Rated Capacity (Water Pump). The flow rate to which the pump manufacturer certifies compliance of the pump when it is new.

3.3.239 Readily Accessible. Able to be located, reached, serviced, or removed without removing other components or parts of the vehicle and without the need to use special tools to open enclosures.

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

3.3.241* Rechargeable Energy Storage System. An energy storage system that has the capability to be charged and discharged.

3.3.242 Remounted Ambulance Patient Compartment. An ambulance patient compartment that has been removed from its original chassis and installed on a different chassis.

3.3.243 Removable Winch. A winch with quick disconnects for power and controls that can be temporarily mounted on the apparatus at a permanently installed mounting receiver.

3.3.244 Reserve Capacity. The ability of a battery to sustain a minimum electrical load in the event of a charging system failure or a prolonged charging system deficit.

3.3.245 Reserved. The contents that would go in this section are not applicable to this document, but for consistency with

other NFPA documents, the chapter, section, or subsection number is maintained.

3.3.246 Road Spray Location. Any underbody or underchassis location that is subject to road spray.

3.3.247* 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.

3.3.248 SCBA Fill Hose. Flexible hose plumbed to connect SCBA cylinders to the compressed air supply for filling purposes.

3.3.249 SCBA Fill Station. A containment enclosure for refilling self-contained breathing cylinders to guard personnel from fragments due to accidental cylinder rupture.

3.3.250 Seat.

3.3.250.1 Child Restraint Seat. A seat capable of transporting a child 66 lb (30 kg) or less in accordance with 49 CFR 571, FMVSS 213 and mounted in accordance with the seat manufacturer's recommendation.

3.3.250.2 Infant Restraint Seat. A seat capable of transporting an infant 22 lb (10 kg) or less in accordance with 49 CFR 571, FMVSS 213 and mounted in accordance with the seat manufacturer's recommendation.

3.3.251 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.

3.3.252 Service Brake. See 3.3.38.3.

3.3.253 Side Entry Door. The body door on the side of the ambulance body that provides entry into the patient compartment and through which patients can be loaded and unloaded.

3.3.254 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.

3.3.255 Sign. A visual indication whether in pictorial or word format that provides a warning to the operator or other persons nearby.

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

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

3.3.258* Special Services Fire Apparatus. A multipurpose vehicle that primarily provides support services at emergency scenes.

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

3.3.260 Stabilizer. A device integral with or separately attached to the chassis of a fire apparatus with an aerial device that is used to increase the moments tending to resist overturning the apparatus.

3.3.261 Stabilizer Pad. A plate inserted beneath a stabilizer shoe to give greater surface bearing area.

3.3.262 Stabilizer Shoe. A permanently mounted shoe on a stabilizer to provide a ground surface area.

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

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

3.3.265* Structural Fire Apparatus. Fire apparatus other than wildland fire apparatus, whether used to respond to structural incidents or other non-wildland incidents.

3.3.266 Substantially Similar Ambulance. See 3.3.16.1.

3.3.267 Suction Hose. A hose that is designed to prevent collapse under vacuum conditions so that it can be used for drafting water from below the pump (lakes, rivers, wells, etc.). [1961, 2020]

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

3.3.269 Sump. A recessed area of a tank assembly designed primarily to entrap sludge or debris for removal and to serve as a central liquid collection point.

3.3.270 Supply Hose. Hose designed for the purpose of moving water between a pressurized water source and a pump that is supplying attack lines. [1961, 2020]

3.3.271 Surface.

3.3.271.1 Improved Surface. 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.

3.3.271.2 Unimproved Surface. 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.

3.3.272 Swash Partition. A vertical wall within a tank structure designed to control the unwanted movement of the fluid within that tank.

3.3.273 Switch. Any set of contacts that interrupts or controls current flow through an electrical circuit.

3.3.274 System.

3.3.274.1* Driver's Enhanced Vision System (DEVS). An enhanced vision and navigation system for guiding aircraft

rescue and firefighting vehicles at night and during certain low-visibility conditions.

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

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

3.3.275 Top Rail. The top chord (rail) of an aerial ladder to which reinforcements are attached.

3.3.276 Total Continuous Electrical Load. The total current required to operate all the devices permanently connected to the vehicle that can be simultaneously energized, excluding intermittent-type loads such as primers, reel rewind motors, and starters.

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

3.3.278 Trailer. A vehicle designed to be pulled by a tow vehicle and used to transport equipment or other vehicles under emergency response conditions.

3.3.279* Turning Clearance Radius. One-half the larger of the left or right full circle wall-to-wall turning diameter.

3.3.280* Turntable. A structural component that connects the aerial device to the chassis and stabilization system through a rotating bearing that permits 360-degree continuous rotation of the aerial device.

3.3.281 Turntable Alignment Indicator. An indicator that facilitates alignment of the aerial device with the boom support for bedding purposes.

3.3.282 Turret. A vehicle-mounted device for directing a stream of water or agent that has a nozzle attached to it and provides vertical and horizontal movement.

3.3.282.1* *Boom-Mounted Turret.* An elevated device permanently mounted on the top of the vehicle.

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

3.3.283* 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.

3.3.284 Type I Ambulance. See 3.3.16.2.

3.3.285 Type I-AD (Additional Duty) Ambulance. See 3.3.16.3.

3.3.286 Type II Ambulance. See 3.3.16.4.

3.3.287 Type III Ambulance. See 3.3.16.5.

3.3.288 Type III-AD (Additional Duty) Ambulance. See 3.3.16.6.

3.3.289 Type A Aircraft Door. A floor-level exit door with a rectangular opening not less than 1067 mm (42 in.) wide by 1829 mm (72 in.) high, with corner radii not greater than 178 mm (7 in.).

3.3.290* Type 4 Rating. A rating for electrical equipment that is intended for outdoor use because it provides a degree of protection from falling rain, splashing water, and hose-directed water.

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

3.3.292 Ultra-High Pressure. See 3.3.226.3.

3.3.293 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.

3.3.294* Underbody Clearance. The vertical distance from the ground to the lowest part of the vehicle except axle assemblies and items designed to swing clear, measured with the vehicle loaded and equipped.

3.3.295 Undertruck Nozzle. See 3.3.185.3, Undertruck Nozzle.

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

3.3.297 Unimproved Surface. See 3.3.271.2.

3.3.298 Unitized Rigid Body and Frame Structure. A structure in which parts that generally comprise a separate body are integrated with the chassis frame to form a single, rigid, load-carrying structure.

3.3.299 Usable Payload. The weight of the loose equipment, occupants, and cot that can be carried in the ambulance without exceeding the GVWR.

3.3.300 Utility Air. Air used for purposes other than human respiration.

3.3.301 Vehicle.

3.3.301.1* *Fully Loaded Vehicle.* Consists of the fully assembled vehicle, complete with a full complement of crew, fuel, equipment, and firefighting agents.

3.3.301.2* *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.

3.3.302* 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.

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

3.3.304 Water Tower. An aerial device consisting of permanently mounted power-operated booms that articulate, telescope, or both, and a waterway designed to supply a large capacity mobile elevated water stream.

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

3.3.306 Weight Rating.

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

3.3.306.2* Gross Combination Weight Rating (GCWR). The final-stage manufacturer's specified maximum loaded weight for a combination (articulated) vehicle consisting of a tow vehicle and one or more towed units.

3.3.306.3* Gross Vehicle Weight Rating (GVWR). The final-stage manufacturer's specified maximum load-carrying capacity of a single vehicle.

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

3.3.308 Wet Location. A location subject to saturation with water or other liquids, or a location exposed to the weather. (See also 3.3.246, *Road Spray Location*.)

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

3.3.310* Wildland Fire Apparatus. Fire apparatus primarily used for wildland fire response.

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

3.3.312 Wildland Fire Pump. A water pump that meets the requirements of Section 15.2 of this standard.

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

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

3.3.315 Yield Strength. The stress at which a material exhibits a specified permanent deformation or set.

agency for the purpose of rescuing occupants and conducting rescue and firefighting operations.

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

4.1.2 Purpose.

4.1.2.1 The purpose of Chapters 4 through 6 is to specify features and components that, when assembled, produce an efficient and capable firefighting 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.

4.1.2.2 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.

4.1.3* Equivalency. Nothing in Chapters 4 through 6 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.

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

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

4.1.4 Units of Measure.

4.1.4.1 The units of measure in Chapters 4 through 6 shall be presented in the International System (SI) of units followed by US customary units (inch-pound units) in parentheses.

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

4.2* General.

4.2.1* The design criteria for the standard vehicles described by this document shall consider temperature extremes ranging from 0°C to 43.3°C (32°F to 110°F).

4.2.1.1 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.

4.2.1.2 Vehicles shall comply with Table 4.2.1.2(a), Table 4.2.1.2(b), Table 4.2.1.2(c), Table 4.2.1.2(d), and other requirements in this chapter.

4.2.2 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).

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

4.2.4 Because the same performance cannot be expected of all vehicles within this range, vehicles shall be classified by water capacity as listed in Table 4.2.1.2(a) and Table 4.2.1.2(b).

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

Chapter 4 Aircraft Rescue and Firefighting Vehicles (NFPA 414)

4.1 Administration.

4.1.1 Scope.

4.1.1.1* Chapters 4 through 6 shall specify the minimum design, performance, and acceptance criteria for aircraft rescue and firefighting (ARFF) vehicles intended to transport personnel and equipment to the scene of an aircraft emer-

Table 4.2.1.2(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)	≤11 ≤40 m	≤11 ≤40 m	≤12 ≤49 m
Percent grade holding of fully loaded vehicle:			
Ascending	≥50 %	≥50 %	≥50 %
Descending	≥50 %	≥50 %	≥50 %
Emergency brake stopping distance at 64 kph (m)	≤88	≤88	≤88
Parking brake: Percent grade holding for the parking brake			
Ascending	≥20 %	≥20 %	≥20 %
Descending	≥20 %	≥20 %	≥20 %
Evasive maneuver test, NATO Document AVTP 03-16W (kph)	56	56	56
“J” turn test at 46 m radius (kph)	48	48	48

Table 4.2.1.2(b) Fully Loaded Vehicle Performance Parameters (US 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) from 40 mph (ft)	≤ 35 ≤ 131	≤ 35 ≤ 131	≤ 40 ≤ 160
Percent grade holding of fully loaded vehicle:			
Ascending	≥ 50 %	≥ 50 %	≥ 50 %
Descending	≥ 50 %	≥ 50 %	≥ 50 %
Emergency brake stopping distance at 40 mph (ft)	≤ 288	≤ 288	≤ 288
Parking brake: Percent grade holding for the parking brake			
Ascending	≥ 20 %	≥ 20 %	≥ 20 %
Descending	≥ 20 %	≥ 20 %	≥ 20 %
Evasive maneuver test, NATO Document AVTP 03-16W (mph)	35	35	35
"J" turn test at 150 ft radius (mph)	30	30	30

Table 4.2.1.2(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 %	100 %	100 %
b. On 20 % side slope	85 %	85 %	85 %
c. 30 % ascending/descending grade	85 %	85 %	85 %
2. Turret(s) discharge	Total flow rate can be achieved with handlines	Total flow rate can be achieved using a roof turret, boom-mounted turret, bumper turret, or a combination thereof	Total flow rate can be achieved using a roof turret, boom-mounted turret, bumper turret, or a combination thereof
2a. Roof turret:			
a. Total minimum flow rate (L/min) OR	≥ 227 (–0%/+10%)	≥ 2839 (–0%/+10%)	≥ 4731 (–0%/+10%)
Individual flow rate of the roof turret, if used in combination with a bumper turret (L/min)	N/A	≥ 1892 (–0%/+10%)	≥ 3785 (–0%/+10%)
b. Entrained 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. Boom-mounted turret:			
a. Individual flow rate of the boom-mounted turret if used in combination with a bumper turret (L/min)	N/A	≥ 1892 (–0%/+10%)	≥ 3785 (–0%/+10%)
b. Entrained 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 (–0%/+10%)	≥ 946 (–0%/+10%)	≥ 946 (–0%/+10%)
b. Straight entrained stream distance (m)	≥ 46	≥ 46	≥ 46
c. Dispersed pattern distances:			

(continues)

Table 4.2.1.2(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
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
a. Flow rate (L/min)	N/A	≥ 378 to ≤ 1135 (-0%/+10%)	≥ 378 to ≤ 1135 (-0%/+10%)
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 (-0%/+10%)	Where specified > 57 (-0%/+10%)	Where specified > 57 (-0%/+10%)
2f. Piercing nozzle flow rate (L/min)	Where specified ≥ 946 (-0%/+10%)	Where specified ≥ 946 (-0%/+10%)	Where specified ≥ 946 (-0%/+10%)
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 (-0%/+10%)	≥ 360 (-0%/+10%)	≥ 360 (-0%/+10%)
b. Straight entrained stream distance (m)	≥ 20	≥ 20	≥ 20
c. Dispersed entrained 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 (-0%/+10%) (≥ 227 for dual agent lines)	360 (-0%/+10%) (≥ 227 for dual agent lines)	360 (-0%/+10%) (≥ 227 for dual agent lines)
b. Straight entrained stream distance (m)	≥ 20	≥ 20	≥ 20
c. Dispersed entrained 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			

(continues)

Table 4.2.1.2(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. 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. Hose length (m)	≥ 30	≥ 30	≥ 30
4b. Dry chemical turret:	≥ 454 and ≤ 1999 L	> 1999 and ≤ 6000 L	Above > 6000 L
a. Powder discharge rate (kg/sec)	≥ 7 and ≤ 10	≥ 7 and ≤ 10	≥ 7 and ≤ 10
b. Stream range (m)	See 2a/2c	See 2a/2c	See 2a/2c
c. Stream width (m)	≥ 5	≥ 5	≥ 5
4c. Dry chemical boom-mounted turret	Where specified	Where specified	Where specified
a. Discharge rate (kg/sec)	≥ 5.5	≥ 5.5 and ≤ 10	≥ 5.5 and ≤ 10
4d. Halogenated agent handline:	Where specified	Where specified	Where specified
a. Discharge rate (kg/sec)	≥ 2.3	≥ 2.3	≥ 2.3
b. Hose inside diameter (mm)	≥ 25.4	≥ 25.4	≥ 25.4
c. Hose length (m)	≥ 30	≥ 30	≥ 30

4.3 Requirements for All Aircraft Rescue and Firefighting Vehicles — Responsibility of Contractors/Suppliers.

4.3.1* Certification. The aircraft rescue and firefighting 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 certify that the completed vehicle meets the requirements of this standard.

4.3.1.1 The manufacturer shall supply at the time of delivery the following documents in electronic format:

- (1) Component manufacturers certificates per Section 6.2
- (2) Operational test data sheets per Section 6.4
- (3) Product warranties

4.3.2 Manuals.

4.3.2.1 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

4.3.2.2 These manuals shall cover the entire vehicle and be in accordance with 4.3.2.3 through 4.3.2.5.9.

4.3.2.3 Operator's Manual.

4.3.2.3.1 Operating instructions shall include all information required for operation of the vehicle, vehicle components, firefighting systems, and integral vehicular options.

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

4.3.2.3.3 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

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

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

4.3.2.4.2 The instructions shall cover such typical maintenance and repair operations as troubleshooting and adjustment procedures.

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

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

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

4.3.2.4.6 The service manual shall contain a suitable index.

Table 4.2.1.2(d) Agent System Performance Parameters (US 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 %	100 %	100 %
b. On 20 % side slope	85 %	85 %	85 %
c. 30 % ascending/descending grade	85 %	85 %	85 %
2. Turret(s) discharge	Total flow rate can be achieved with handlines	Total flow rate can be achieved using a roof turret, boom-mounted turret, bumper turret, or a combination thereof	Total flow rate can be achieved using a roof turret, boom-mounted turret, bumper turret, or a combination thereof
2a. Roof turret:			
a. Total minimum flow rate (gpm) OR	≥ 60 (–0%/+10%)	≥ 750 (–0%/+10%)	≥ 1250 (–0%/+10%)
Individual flow rate of the roof turret, if used in combination with a bumper turret (gpm)	N/A	≥ 500 (–0%/+10%)	≥ 1000 (–0%/+10%)
b. Entrained 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. Boom-mounted turret:			
a. Individual flow rate of the boom-mounted turret if used in combination with a bumper turret (gpm)	N/A	≥ 500 (–0%/+10%)	≥ 1000 (–0%/+10%)
b. Entrained 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 (–0%/+10%)	≥ 250 (–0%/+10%)	≥ 250 (–0%/+10%)
b. Straight entrained stream distance (ft)	≥ 65	≥ 150	≥ 150
c. Dispersed pattern distances:			

(continues)

Table 4.2.1.2(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
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
a. Flow rate (gpm)	N/A	≥ 100 to ≤ 300 ($-0\%/+10\%$)	≥ 100 to ≤ 300 ($-0\%/+10\%$)
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 ($-0\%/+10\%$)	Where specified > 15 ($-0\%/+10\%$)	Where specified > 15 ($-0\%/+10\%$)
2f. Piercing nozzle flow rate (gpm)	Where specified ≥ 250 ($-0\%/+10\%$)	Where specified ≥ 250 ($-0\%/+10\%$)	Where specified ≥ 250 ($-0\%/+10\%$)
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 ($-0\%/+10\%$)	≥ 95 ($-0\%/+10\%$)	≥ 95 ($-0\%/+10\%$)
b. Straight entrained stream distance (ft)	≥ 65	≥ 65	≥ 65
c. Dispersed entrained 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 ($-0\%/+10\%$) (≥ 60 for dual agent lines)	95 ($-0\%/+10\%$) (≥ 60 for dual agent lines)	95 ($-0\%/+10\%$) (≥ 60 for dual agent lines)
b. Straight entrained stream distance (ft)	≥ 65	≥ 65	≥ 65
c. Dispersed entrained 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			

(continues)

Table 4.2.1.2(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. Capacity (lb)	≥ 100	≥ 100	≥ 100
4a. Dry chemical handline:	Where specified	Where specified	Where specified
a. Discharge rate (lb/sec)	≥ 5	≥ 5	≥ 5
b. Hose length (ft)	≥ 100	≥ 100	≥ 100
4b. Dry chemical turret:	≥ 120 and ≤ 528 gal	> 528 and ≤ 1585 gal	Above > 1585 gal
a. Powder discharge rate (lb/sec)	≥ 16 and ≤ 22 (> 7)	≥ 16 and ≤ 22	≥ 16 and ≤ 22
b. Stream range (ft)	See 2a/2c	See 2a/2c	See 2a/2c
c. Stream width (ft)	≥ 17	≥ 17	≥ 17
4c. Dry chemical boom-mounted turret:	Where specified	Where specified	Where specified
a. Discharge rate (lb/sec)	≥ 12	≥ 12 and ≤ 22	≥ 12 and ≤ 22
4d. Halogenated agent handline:	Where specified	Where specified	Where specified
a. Discharge rate (lb/sec)	≥ 5	≥ 5	≥ 5
b. Hose inside diameter (in.)	≥ 1.00	≥ 1.00	≥ 1.00
c. Hose length (ft)	≥ 100	≥ 100	≥ 100

4.3.2.5 Parts Manual.

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

4.3.2.5.2 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.

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

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

4.3.2.5.5 The parts identification manual shall contain a numerical index.

4.3.2.5.6 The vehicle manufacturer shall ensure that in-stock parts critical to the mission of the vehicle are shipped to the purchaser within 48 hours (business days).

4.3.2.5.7 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.

4.3.2.5.8 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.

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

4.3.2.5.10* Parts manuals shall not be required for commercial chassis vehicles supplied to a component manufacturer.

4.3.2.5.11 Parts manuals shall be required for upfit components added to the commercial chassis.

4.3.3 Metal Finish.

4.3.3.1 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, prepared, and painted in the color(s) specified by the purchaser.

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

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

4.3.3.4 Paint finish shall be selected for maximum visibility and be resistant to damage from firefighting agents.

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

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

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

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

4.3.3.6 Materials that deteriorate when exposed to sunlight, weather, or operational conditions normally encountered during service shall comply with one of the following:

- (1) Not be used
- (2) Have a means of protection against such deterioration that does not prevent compliance with performance requirements

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

4.3.3.8 The use of proven, nonmetallic materials in lieu of metal shall be permitted, provided such use contributes to reduced weight or less maintenance and there is no degradation in performance.

4.3.4 Lettering, Numbering, and Striping.

4.3.4.1 All retroreflective materials used shall conform at minimum to the requirements of ASTM D4956, *Standard Specification for Retroreflective Sheeting for Traffic Control*, Section 6.1.1, for Type I sheeting.

4.3.4.2 Colors that are not listed in ASTM D4956, *Standard Specification for Retroreflective Sheeting for Traffic Control*, Section 6.1.1, shall have a minimum coefficient of retroreflection of 10 with an observation angle of 0.2 degrees and an entrance angle of -4 degrees.

4.3.4.3 Lettering, numbering, and striping shall be in contrast to the vehicle color.

4.3.4.3.1 Reflective striping shall be placed horizontally on the sides of the vehicle below the body centerline.

4.3.4.3.2 The striping shall be at a minimum 20.3 cm (8 in.) in height and be at least 60 percent of the overall vehicle length.

4.3.4.3.3 Reflective striping shall be placed horizontally on the rear of the vehicle below the body centerline.

4.3.4.3.4 The striping shall be at a minimum 20.3 cm (8 in.) in height and be at least 60 percent of the overall vehicle width.

4.3.4.4 Vehicles shall display a unique reflective identification number on each side and on their roof.

4.3.4.4.1 Roof "primary" numbers shall be 61 cm (24 in.) in height and placed so that the base of the number is facing the front of the vehicle.

4.3.4.4.2 Side "secondary" numbers shall be 40.6 cm (16 in.) in height and placed above the vehicle centerline.

4.3.4.5 A graphical design shall be permitted, provided the design covers the minimum height and width requirements listed in 4.3.4.3.2 and 4.3.4.3.4.

4.3.5 Vehicle Information Data Plate. A data plate that contains, as a minimum, all the information presented in Figure 4.3.5 shall be installed in the cab of the vehicle.

4.4 Weights and Dimensions.

4.4.1* Weights.

4.4.1.1 The actual gross vehicle weight of a fully loaded vehicle shall not exceed the manufacturer's gross vehicle weight rating as recorded on the vehicle information data plate.

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" is to be in accordance with the definition of a fully loaded vehicle as presented in Chapters 1 through 6 of NFPA 1900.	

FIGURE 4.3.5 Aircraft Rescue and Firefighting Vehicle Tilt Table Certification per Chapters 1 through 6.

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

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

4.4.1.2.2 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.

4.4.1.2.3 The requirement in 4.4.1.2.2 shall not apply to vehicles with a capacity of less than 1999 L (528 gal).

4.4.1.2.4 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.

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

4.4.1.3 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.

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

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

4.4.1.6 The vehicle shall not exhibit oversteer characteristics. (See 6.3.7.3 for test requirements.)

4.4.2 Dimensions.

4.4.2.1* The axle clearances in Table 4.2.1.2(a) and Table 4.2.1.2(b) shall be measured with vehicle tires inflated to high-way inflation pressure.

4.4.2.1.1 The dimensions in Table 4.2.1.2(a) and Table 4.2.1.2(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.

4.4.2.1.2 Where an active suspension provides vehicle leveling and maintenance of the underbody clearance of the lower underaxle, clearances shown in the parentheses in Table 4.2.1.2(a) and Table 4.2.1.2(b) shall be used.

4.4.2.1.3 If this option is used, the vehicle shall be tested in accordance with Table 4.2.1.2(a) and Table 4.2.1.2(b).

4.4.2.2 Field of Vision.

4.4.2.2.1 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

4.4.2.3 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.

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

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

4.4.2.3.3 Convex mirrors shall not be required to be motorized.

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

4.5 Propulsion System.

4.5.1 Performance Requirements.

4.5.1.1 Propulsion System Characteristics.

4.5.1.1.1 The vehicle's propulsion system shall have the horsepower, torque, and speed characteristics to meet and maintain all vehicular performance characteristics specified in Chapters 4 through 6.

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

4.5.1.2* 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 4.2.1.2(a) and Table 4.2.1.2(b).

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

4.5.1.2.2 The acceleration times provided in Table 4.2.1.2(a) and Table 4.2.1.2(b) shall be achieved with the propulsion system at the component manufacturers' recommended operating temperatures and state of charge if applicable 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.

4.5.1.2.3 For airports above 609.6 m (2000 ft), the elevation at which the vehicle operates shall be specified to ensure the necessary performance.

4.5.1.3 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).

4.5.2 Engine Cooling Systems.

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

4.5.2.2 This device shall be fitted with an automatic thermostat.

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

4.5.2.3.1 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 identified in 4.2.1 that might be encountered at the operational airport.

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

4.5.2.3.3 Where specified, radiator shutters, where furnished for cold climates, shall be both of the following:

- (1) Automatic
- (2) Designed to open automatically upon failure

4.5.3 Fuel System.

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

4.5.3.2 The fuel system shall be protected from the following:

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

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

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

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

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

4.5.3.5 Fuel Capacity.

4.5.3.5.1 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.

4.5.3.5.2 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.

4.5.4 Exhaust System.

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

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

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

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

4.5.4.3 The tailpipe shall not be directed toward the ground.

4.6 Vehicle Electrical System.

4.6.1 Electrical Systems and Warning Devices.

4.6.1.1 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 meet the specific requirements of this section.

4.6.1.1.1 Wiring. All electrical circuit feeder wiring supplied and installed by the fire apparatus manufacturer shall meet the requirements of 4.5.1.1.2 through 4.6.1.1.23.

4.6.1.1.2 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.

4.6.1.1.3 Voltage drops in all wiring from the power source to the using device shall not exceed 10 percent.

4.6.1.1.4 The use of star washers for circuit ground connections shall not be permitted.

4.6.1.1.5 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*.

4.6.1.1.6 Wiring and Wire Harness Construction.

4.6.1.1.7 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.

4.6.1.1.8 All conductors shall be constructed in accordance with SAE J1127 or SAE J1128, except where good engineering practice dictates special strand construction.

4.6.1.1.9 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.

4.6.1.1.10 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.

4.6.1.1.11 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.

4.6.1.1.12 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.

4.6.1.1.13 All wiring connections and terminations shall use a method that provides a positive mechanical and electrical connection.

4.6.1.1.14 The wiring connections and terminations shall be installed in accordance with the device manufacturer's instructions.

4.6.1.1.15 All ungrounded electrical terminals shall have protective covers, enclosures, or a means to protect from accidental shorting.

4.6.1.1.16 Wire nut, insulation displacement, and insulation piercing connections shall not be used.

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

4.6.1.1.18 Wiring shall be uniquely identified at least every 2 ft (0.6 m) by color coding or permanent marking with a circuit function code and reference a wiring diagram.

4.6.1.1.19 Circuits shall be provided with properly rated low-voltage overcurrent protective devices.

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

4.6.1.1.21 Circuit protection shall be accomplished by utilizing fuses, circuit breakers, fusible links, or solid state equivalent devices.

4.6.1.1.22 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*

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

4.6.1.2 Line Voltage Electrical Systems. The line voltage electrical systems shall be in accordance with Chapter 21.

4.6.1.3 High-Voltage Electrical System.

4.6.1.3.1 Where specified, high-voltage wiring between propulsion system components exceeding 50V shall meet the requirements of SAE J1673, *High Voltage Automotive Wiring Assembly Design*.

4.6.1.3.2 Where specified, a rechargeable energy storage system shall meet the requirements of UN 38.3, *Certification for Lithium Batteries*, and SAE J2929, *Electric and Hybrid Vehicle Propulsion Battery System Safety Standard — Lithium-based Rechargeable Cells*.

4.6.1.3.3 Where specified, high-voltage systems shall be labeled in accordance with SAE J2910, *Recommended Practice for the Design and Test of Hybrid Electric and Electric Trucks and Buses for Electrical Safety*.

4.6.1.3.4 Where specified, high-voltage systems shall meet high-voltage isolation requirements of SAE J2578, *Recommended Practice for General Fuel Cell Vehicle Safety*, and SAE J2344, *Guidelines for Electric Vehicle Safety*.

4.6.1.3.5 High-voltage electrical energy storage devices shall be marked with a warning symbol.

4.6.1.3.5.1 The symbol shall be visible on electrical protection barriers that, when removed, expose live parts of high-voltage sources.

4.6.1.3.5.2 The symbol shall be yellow, and the bordering and the arrow shall be black.

4.6.1.3.6 Cables for high-voltage sources that are not located within electrical protection barriers shall be identified by having an outer covering with the color orange.

4.6.1.3.7 Hybrid electric or electric vehicles shall include a high-voltage isolation monitor that meets the requirements of SAE J2578, *Recommended Practice for General Fuel Cell Vehicle Safety*; UL 2231-1, *Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits: General Requirements*; and UL 2231-2, *Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits: Particular Requirements for Protection Devices for Use in Charging Systems*.

4.6.1.3.8 Hybrid electric or electric vehicle rechargeable energy storage system shall have a high-voltage interlock in accordance with SAE J2578, *Recommended Practice for General Fuel Cell Vehicle Safety*, and SAE J2344, *Guidelines for Electric Vehicle Safety*.

4.6.1.3.9 Hybrid electric or electric vehicles shall meet the bonding requirements of IEC 62477-1, *Safety Requirements for Power Electronic Converter Systems and Equipment*.

4.6.2 Battery Chargers.

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

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

4.6.3 The electrical grounding procedures used on the vehicle shall be in accordance with SAE J1908, *Electrical Grounding Practice*, or an equivalent electrical grounding standard.

4.6.4 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.

4.6.4.1 The battery charger shall be supplied from an external power source with a voltage as specified by the end user.

4.6.4.2 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.

4.6.4.3 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.

4.6.4.4 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.

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

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

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

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

4.6.6 Radio suppression of the electrical system shall be in accordance with 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)*, or an equivalent radio suppression standard.

4.7 Vehicle Drive. Transmission of power from the power source(s) to the wheels of the vehicle shall be through an automatic or a semiautomatic gearbox.

4.7.1 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.

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

4.7.3 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.

4.7.4 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.

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

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

4.7.5 All-Wheel Drive.

4.7.5.1 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.

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

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

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

4.7.7 Axle Capacity.

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

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

4.8* 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 4.2.1.2(a) and Table 4.2.1.2(b)
- (4) Prevent damage to the vehicle caused by wheel movement

4.9 Rims, Tires, and Wheels.

4.9.1 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.

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

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

4.9.4 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.

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

4.9.6 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.

4.10* 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.

4.11 Brakes.

4.11.1* The braking system shall comply with FMVSS 121, *Brake Performance and Stability Testing* as follows:

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

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

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

4.11.2.2 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).

4.11.2.3 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).

4.11.2.4 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.

4.11.2.5 For each vehicle, the service brakes shall provide one power-assisted stop while the vehicle engine is inoperative for the stopping distances specified in 4.11.2.2 through 4.11.2.4.

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

4.11.4 Brakes — Air System.

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

4.11.4.2 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.

4.11.4.3 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.

4.12 Steering.

4.12.1 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.

4.12.2 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.

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

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

4.13.1 Cab Interior.

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

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

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

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

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

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

4.13.1.7 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.

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

4.13.2 Cab Visibility.

4.13.2.1 The cab shall meet the visibility requirements of 4.4.2.2.

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

4.13.2.3 The windshield shall be shatterproof safety glass.

4.13.2.4 All other windows shall be constructed of safety glass.

4.13.2.5 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).

4.13.3 Cab Construction.

4.13.3.1 The cab shall be weatherproof.

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

4.13.3.3 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.

4.13.3.4 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.

4.13.3.5 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.

4.13.3.6* 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*

4.13.4 Instruments, Warning Lights, and Controls.

4.13.4.1 The minimum number of instruments, warning lights, and controls consistent with the operation of the vehicle, chassis, and firefighting system shall be provided.

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

4.13.4.1.2 All firefighting 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.

4.13.4.2* All instruments and controls shall be illuminated.

4.13.4.3 Groupings of both the chassis and the firefighting system instruments, warning lights, and controls shall be removable as a unit or be accessible for servicing.

4.13.4.4* 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

4.13.4.4.1 The components in 4.13.4.4(4), 4.13.4.4(6), 4.13.4.4(7), 4.13.4.4(8), and 4.13.4.4(9) shall not be applicable to a small commercial chassis.

4.13.4.5 The cab shall have all the following controls within reach of the driver for operation of the vehicle and the pump-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

4.13.4.6* 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.

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

4.13.4.7.1 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

4.13.4.7.2 Where specified, the DEVS navigation system as described in 4.13.4.7.1 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

4.13.4.8* A low-visibility enhanced vision system shall be installed in the vehicle consisting of a 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, and 12

4.13.4.9 FLIR.

4.13.4.9.1 The FLIR sensor shall be able to detect long wave (8 μ m to 12 μ m) infrared (IR) energy.

4.13.4.9.2 The sensor array resolution shall be a minimum of 640 horizontal pixels by 480 vertical pixels.

4.13.4.9.3 The camera shall have a high-contrast filter that will show low-contrast objects in a dynamic thermal scene.

4.13.4.9.4 The camera shall provide an industry standard composite (with automatic gain and level control) or digital video output.

4.13.4.9.5 The camera shall have a minimum horizontal (HFOV) and vertical field of view (VFOV) of 27 degrees (± 4 degrees) and 18 degrees (± 4 degrees), respectively.

4.13.5 Equipment.

4.13.5.1 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 is permitted where recommended by the manufacturer; the vertical adjustment does not apply to commercial vehicles with a capacity of <1999 L (528 gal).]
- (3) Crew seats with individual retractable seat belts
- (4) Windshield washers
- (5) Windshield wipers
- (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 4.4.2.3
- (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

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

- (1) The SCBA holder retains 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 is 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, are permitted.
- (4)* The SCBA holder retains 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 retains 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 meets the SAE J2418 deceleration profile with an accuracy of ± 10 percent within the 35 ms to 95 ms range.
- (7) The deceleration pulse is measured on a rigid portion of the base of the test fixture.
- (8) The test component is retained in the holder during and after the dynamic test.
- (9) The force required to extract the bottle after each test is no more than 125 percent of the initial extraction force.
- (10) The SCBA holder is attached to the fixture in the same manner that it will be fastened to the seat or vehicle.
- (11) The test bottle does not move more than 7.6 m (3 in.) relative to the frame of the holder during each test.
- (12) The test fixture does not allow the holder frame to move more than 7.6 m (3 in.) relative to the base of the test sled.
- (13) Each holder bears a label affixed by the holder manufacturer certifying compliance to these specifications.

4.13.5.3 Equipment Mounting.

4.13.5.3.1 All equipment required to be used during an emergency response shall be securely fastened.

4.13.5.3.2 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.

4.13.6 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.

4.13.7 Onboard Data Management and Communications Equipment. The purchaser shall specify what the contractor needs to provide in terms of onboard data management and communications equipment for the apparatus.

4.13.7.1 For each category of equipment listed in 4.13.7.5, the purchaser shall specify what equipment the contractor is to supply and install.

4.13.7.2 For each category of equipment listed in 4.13.7.5, the purchaser shall specify what purchaser-supplied equipment the contractor is to install.

4.13.7.3* For each category of equipment listed in 4.13.7.5, the purchaser shall specify what accommodations such as space, power, antenna bases, and so on the contractor is to provide to support purchaser-installed equipment.

4.13.7.4 For each category of equipment listed in 4.13.7.5, the purchaser shall specify if no equipment in that category is to be supplied or installed, or have any accommodations provided.

4.13.7.5 The purchaser shall provide the information identified in 4.13.7.1 through 4.13.7.4 for the following:

- (1)* MADAS
- (2) Mobile data terminals or other computer equipment
- (3) Traffic preemption equipment
- (4)* Vehicle data recorder
- (5)* V2X communications

4.13.8* 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.

4.14 Body.

4.14.1 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.

4.14.2 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

4.14.3 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

4.14.4 A working deck that is reinforced and constructed of, or covered with, a slip-resistant material shall be provided and 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.

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

4.14.5.1 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.

4.14.5.2 Exterior access handrails shall be constructed of or covered with a slip-resistant, noncorrosive material.

4.14.5.3 Exterior access handrails shall be between 25.4 mm and 41.275 mm (1 in. and 1⅞ in.).

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

4.14.6.1 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.

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

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

4.14.6.4 Lighting shall be provided to illuminate steps and walkways.

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

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

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

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

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

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

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

4.14.12 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.

4.15 Firefighting Systems and Agents.

4.15.1 For ARFF purposes, vehicles using primary extinguishing agents shall be tested in accordance with all requirements of Chapters 1 through 3, and 27 through 29 of NFPA 460.

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

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

4.15.4 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.

4.16 Agent Pump(s) and Pump Drive.

4.16.1 Agent Pump(s).

4.16.1.1 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.

4.16.1.1.1 Pumps shall be gravity primed from the vehicle tank.

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

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

4.16.1.3 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 boom-mounted turret(s), bumper turret or ground sweep nozzles, handline nozzles, and undertruck nozzles, where specified, discharging simultaneously at designed pressures.

4.16.2 Pump Drive.

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

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

4.16.2.1.2 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.

4.16.2.1.3 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.

4.16.2.1.4 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.

4.16.2.2 While pumping at rated capacity, the drive shall allow controlled vehicle operations at a minimum speed of 16.1 kph (10 mph) in forward direction and minimum speed of 8 kph (5 mph) in rearward direction.

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

4.16.2.2.2 The pump(s) drive shall have the power capacity to provide the pump(s) discharge requirements of 4.16.1.3 while the vehicle is being propelled under all operating conditions where firefighting capability is needed.

4.16.2.3 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

4.16.3 Tank-to-Pump Connections.

4.16.3.1 The tank-to-pump system shall be designed for flow at the pumping rates required by 4.16.1.3.

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

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

4.16.5 Piping, Couplings, and Valves.

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

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

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

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

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

4.16.5.6 Any 3 in. (75 mm) or larger intake valve to the water pump, except the tank-to-pump valve, shall be a slow-operating valve.

4.16.6 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.

4.16.7 Pressure Relief System. A pressure relief system shall be provided to protect the system from damage.

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

4.17 Water Tank.

4.17.1 Capacity.

4.17.1.1 A water tank shall have a usable capacity as specified in Table 4.2.1.2(a) and Table 4.2.1.2(b).

4.17.1.2 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.

4.17.1.3 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

4.17.2 Construction.

4.17.2.1 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.

4.17.2.2 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

4.17.2.3 Provisions shall be made for necessary overflow and venting.

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

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

4.17.2.3.3 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.

4.17.2.4 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

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

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

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

4.17.2.6 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.

4.17.3 Tank Fill Connection(s).

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

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

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

4.17.3.4 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.

4.17.3.5 The tank connections shall comply with the following:

- (1) Have check valves
- (2) Be constructed so that water is not lost from the tank when a connection or disconnection is made

4.18* Foam System.

4.18.1 Foam-Liquid Concentrate Tank(s).

4.18.1.1 The purchaser shall specify the percent concentrate foam system to be provided for it to have a working capacity sufficient for two tanks of water at the maximum tolerance specified in Section 28.2 of NFPA 460.

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

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

4.18.1.4 The tank outlets shall be located above the bottom of the sump and provide continuous foam-liquid concentrate to the foam proportioning system, with that system operating as specified in 4.18.4 and with the vehicle discharging two tank loads of usable water as specified in 4.17.1.

4.18.1.5 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.

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

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

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

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

4.18.1.6 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

4.18.1.7 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 (¼ 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

4.18.1.8 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

4.18.1.9 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

4.18.2 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.

4.18.3 Foam-Liquid Concentrate Piping.

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

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

4.18.3.1.2 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.

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

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

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

4.18.4 Foam Proportioning Systems.

4.18.4.1 The foam concentrate proportioning system shall provide a means of controlling the ratio of end-user-specified foam concentrate to the quantity of water in the foam solution being discharged from all orifices used for aircraft firefighting operations.

4.18.4.2 The proportioning system shall be accurate to provide for the discharge of finished foam within the range specified in Chapter 28 of NFPA 460.

4.18.4.3 Each nozzle shall have minimum foam discharge patterns and meet the discharge parameters described in Table 4.2.1.2(a).

4.18.4.4 If an input-based foam test system is specified with the vehicle it shall be one approved by the AHJ.

4.19 Premixed Foam Solutions.

4.19.1 Premixed — Pump System.

4.19.1.1* 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.

4.19.1.2 Where premixed solution is used, operation of the vehicle firefighting system shall conform to the requirements of Sections 4.16 and 4.17.

4.19.2 Premixed — Pressurized System.

4.19.2.1 Liquid Agent Container(s).

4.19.2.1.1 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*.

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

4.19.2.1.3 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.

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

4.19.2.1.4.1 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.

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

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

4.19.2.2 Propellant Gas.

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

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

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

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

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

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

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

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

4.19.2.3 Pressure Regulation.

4.19.2.3.1 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).

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

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

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

4.19.2.4 Piping and Valves.

4.19.2.4.1 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

4.19.2.4.1.1 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.

4.19.2.4.1.2 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.

4.19.2.4.2 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

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

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

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

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

4.19.2.4.4.3 Valves on the gas cylinder specified in 4.19.2.2.2 shall not be required to be of the quarter-turn, quick-opening ball type.

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

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

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

4.20 Turret Nozzles.

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

4.20.2 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.

4.20.3 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.

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

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

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

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

- (1) Controls are in the cab.
- (2) An indicator of roof turret elevation and azimuth is provided.
- (3) Where specified, a manual override or secondary control powered by an alternative source of all turret movement functions is provided.
- (4) Where specified, secondary controls are capable of operating the turret with a failed primary control system.
- (5) Where specified, the manual override for turret operation force is less than 133.4 N (30 lbf).

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

4.20.5 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

4.20.6 If the boom-mounted turret is on a rotational base, it shall meet the following design and functional requirements:

- (1) The boom-mounted turret meets the requirements of 6.3.22, 6.4.1, and 6.4.12 while in the stowed position.
- (2) The vehicle achieves a 20 percent side slope, with the boom fully elevated and the nozzle rotated uphill at maximum horizontal rotation while discharging at maximum flow rate.
- (3) The vehicle is 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 are in accordance with Table 4.2.1.2(c) and Table 4.2.1.2(d) for major vehicles.
- (5) If the boom-mounted turret is intended to be the primary turret, it meets the primary water-foam agent turret discharge requirements of Table 4.2.1.2(c) and Table 4.2.1.2(d) for the applicable vehicle class while in the stowed position.
- (6) The boom-mounted turret meets the foam-quality standard of Chapters 1 through 3 and 27 through 29 of NFPA 460 for the applicable foam applicator and foam type.