

NFPA® 1901

Standard for Automotive Fire Apparatus

2016



IMPORTANT NOTICES AND DISCLAIMERS CONCERNING NFPA® STANDARDS

NOTICE AND DISCLAIMER OF LIABILITY CONCERNING THE USE OF NFPA STANDARDS

NFPA® codes, standards, recommended practices, and guides (“NFPA Standards”), of which the document contained herein is one, are developed through a consensus standards development process approved by the American National Standards Institute. This process brings together volunteers representing varied viewpoints and interests to achieve consensus on fire and other safety issues. While the NFPA administers the process and establishes rules to promote fairness in the development of consensus, it does not independently test, evaluate, or verify the accuracy of any information or the soundness of any judgments contained in NFPA Standards.

The NFPA disclaims liability for any personal injury, property or other damages of any nature whatsoever, whether special, indirect, consequential or compensatory, directly or indirectly resulting from the publication, use of, or reliance on NFPA Standards. The NFPA also makes no guaranty or warranty as to the accuracy or completeness of any information published herein.

In issuing and making NFPA Standards available, the NFPA is not undertaking to render professional or other services for or on behalf of any person or entity. Nor is the NFPA undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances.

The NFPA has no power, nor does it undertake, to police or enforce compliance with the contents of NFPA Standards. Nor does the NFPA list, certify, test, or inspect products, designs, or installations for compliance with this document. Any certification or other statement of compliance with the requirements of this document shall not be attributable to the NFPA and is solely the responsibility of the certifier or maker of the statement.



ALERT: THIS STANDARD HAS BEEN MODIFIED BY A TIA OR ERRATA

Users of NFPA codes, standards, recommended practices, and guides (“NFPA Standards”) should be aware that NFPA Standards may be amended from time to time through the issuance of Tentative Interim Amendments or corrected by Errata. An official NFPA Standard at any point in time consists of the current edition of the document together with any Tentative Interim Amendment and any Errata then in effect.

In order to determine whether an NFPA Standard has been amended through the issuance of Tentative Interim Amendments or corrected by Errata, visit the “Codes & Standards” section on NFPA’s website. There, the document information pages located at the “List of NFPA Codes & Standards” provide up-to-date, document-specific information including any issued Tentative Interim Amendments and Errata.

To view the document information page for a specific NFPA Standard, go to <http://www.nfpa.org/docinfo> to choose from the list of NFPA Standards or use the search feature to select the NFPA Standard number (e.g., NFPA 101). The document information page includes postings of all existing Tentative Interim Amendments and Errata. It also includes the option to register for an “Alert” feature to receive an automatic email notification when new updates and other information are posted regarding the document.

IMPORTANT NOTICES AND DISCLAIMERS CONCERNING NFPA® STANDARDS

ADDITIONAL NOTICES AND DISCLAIMERS

Updating of NFPA Standards

Users of NFPA codes, standards, recommended practices, and guides (“NFPA Standards”) should be aware that these documents may be superseded at any time by the issuance of new editions or may be amended from time to time through the issuance of Tentative Interim Amendments or corrected by Errata. An official NFPA Standard at any point in time consists of the current edition of the document together with any Tentative Interim Amendments and any Errata then in effect. In order to determine whether a given document is the current edition and whether it has been amended through the issuance of Tentative Interim Amendments or corrected through the issuance of Errata, consult appropriate NFPA publications such as the National Fire Codes® Subscription Service, visit the NFPA website at www.nfpa.org, or contact the NFPA at the address listed below.

Interpretations of NFPA Standards

A statement, written or oral, that is not processed in accordance with Section 6 of the Regulations Governing the Development of NFPA Standards shall not be considered the official position of NFPA or any of its Committees and shall not be considered to be, nor be relied upon as, a Formal Interpretation.

Patents

The NFPA does not take any position with respect to the validity of any patent rights referenced in, related to, or asserted in connection with an NFPA Standard. The users of NFPA Standards bear the sole responsibility for determining the validity of any such patent rights, as well as the risk of infringement of such rights, and the NFPA disclaims liability for the infringement of any patent resulting from the use of or reliance on NFPA Standards.

NFPA adheres to the policy of the American National Standards Institute (ANSI) regarding the inclusion of patents in American National Standards (“the ANSI Patent Policy”), and hereby gives the following notice pursuant to that policy:

NOTICE: The user’s attention is called to the possibility that compliance with an NFPA Standard may require use of an invention covered by patent rights. NFPA takes no position as to the validity of any such patent rights or as to whether such patent rights constitute or include essential patent claims under the ANSI Patent Policy. If, in connection with the ANSI Patent Policy, a patent holder has filed a statement of willingness to grant licenses under these rights on reasonable and nondiscriminatory terms and conditions to applicants desiring to obtain such a license, copies of such filed statements can be obtained, on request, from NFPA. For further information, contact the NFPA at the address listed below.

Law and Regulations

Users of NFPA Standards should consult applicable federal, state, and local laws and regulations. NFPA does not, by the publication of its codes, standards, recommended practices, and guides, intend to urge action that is not in compliance with applicable laws, and these documents may not be construed as doing so.

Copyrights

NFPA Standards are copyrighted. They are made available for a wide variety of both public and private uses. These include both use, by reference, in laws and regulations, and use in private self-regulation, standardization, and the promotion of safe practices and methods. By making these documents available for use and adoption by public authorities and private users, the NFPA does not waive any rights in copyright to these documents.

Use of NFPA Standards for regulatory purposes should be accomplished through adoption by reference. The term “adoption by reference” means the citing of title, edition, and publishing information only. Any deletions, additions, and changes desired by the adopting authority should be noted separately in the adopting instrument. In order to assist NFPA in following the uses made of its documents, adopting authorities are requested to notify the NFPA (Attention: Secretary, Standards Council) in writing of such use. For technical assistance and questions concerning adoption of NFPA Standards, contact NFPA at the address below.

For Further Information

All questions or other communications relating to NFPA Standards and all requests for information on NFPA procedures governing its codes and standards development process, including information on the procedures for requesting Formal Interpretations, for proposing Tentative Interim Amendments, and for proposing revisions to NFPA standards during regular revision cycles, should be sent to NFPA headquarters, addressed to the attention of the Secretary, Standards Council, NFPA, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101; email: stds_admin@nfpa.org

For more information about NFPA, visit the NFPA website at www.nfpa.org. All NFPA codes and standards can be viewed at no cost at www.nfpa.org/docinfo.

Copyright © 2015 National Fire Protection Association®. All Rights Reserved.

NFPA® 1901

Standard for

Automotive Fire Apparatus

2016 Edition

This edition of NFPA 1901, *Standard for Automotive Fire Apparatus*, was prepared by the Technical Committee on Fire Department Apparatus and acted on by NFPA at its June Association Technical Meeting held June 22–25, 2015, in Chicago, IL. It was issued by the Standards Council on August 18, 2015, with an effective date of September 7, 2015, and supersedes all previous editions.

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

This edition of NFPA 1901 was approved as an American National Standard on September 7, 2015.

Origin and Development of NFPA 1901

The 2009 edition of NFPA 1901 was a general update of the 2003 edition. The text was reorganized to present the requirements better, text was added to clarify requirements, and the requirements for delivery of documentation and test results with the apparatus were standardized. Annex material was added throughout to assist the user in understanding and meeting the requirements.

A new chapter on trailers transporting equipment or other vehicles under emergency response conditions was added, and changes were made throughout the document where necessary to address the requirements for the vehicle that is to tow the trailer. A requirement was added for a vehicle data recorder to capture data that can be used to promote safe driving and riding practices. The requirements for vehicle stability were changed to require tilt table testing, a calculated center of gravity no higher than 80 percent of vehicle height, or a vehicle stability system.

The 2009 edition introduced the concept of estimated in-service weight as a basis for designing the apparatus and measuring certain stability requirements and links the maximum top speed of the apparatus to the GVWR and agent tank capacity or the tire manufacturer's ratings. A “Statement of Exceptions” required the manufacturer to deliver either a certification that the apparatus meets the standard or a statement that describes specifically what is not fully compliant and identifies who is responsible for achieving compliance.

Because of diesel particulate filters being installed on fire apparatus, requirements for operation and performance of those devices were added.

Requirements for the minimum length of seat belts were established, together with instruction for how they are measured. A seat belt warning device to indicate when seat belts are not being properly used was required. Those new requirements also allowed seat belts to be bright orange in addition to red.

The cabs on apparatus with a GVWR over 26,000 lb (11,800 kg) had to meet standards on occupant protection during crashes. In addition, the document discouraged the wearing of fire helmets in the cab and required provisions for proper storage of helmets while the vehicle is moving.

More specific requirements for the retroreflective material used for striping apparatus were added, and striping on the rear of the apparatus was changed to require retroreflective striping in a chevron pattern sloping downward and away from the centerline of the vehicle at an angle of 45 degrees.

The chapter on industrial supply pumps [rated over 3000 gpm (12,000 L/min)] was integrated with the chapter on fire pumps [rated 3000 gpm (12,000 L/min) or less], and differences in requirements based on rated capacity were spelled out in the revised fire pump chapter. A requirement was added for testing the accuracy of the gauges and flowmeters during the pump certification testing.

A change to the aerial ladder and elevating platform requirements allowed for electronic envelope control, with electronics and interlocks used to prevent an aerial device from moving into an area where it cannot support its rated capacity.

Foam systems are required to be type tested for accuracy and certified by the system manufacturer and, after installation, to be tested and certified by the final installer for proper operation.

In addition to reorganization of material in the line voltage electrical system chapter for clarification, changes included requiring the protective ground from a shoreline inlet to be bonded to the vehicle frame, requiring the neutral conductor to be switched through the transfer switch if there are multiple power sources, establishing a minimum wire size for cord on permanently mounted reels, requiring fixed scene lighting devices to be tested and listed, and additional testing.

In Chapter 24, Air Systems, requirements for who is to train fire department personnel were revised. A high-temperature alarm is required in the compressor compartment together with a label cautioning users not to obstruct the airflow. Compressors are required to be equipped with an air quality-monitoring system. If a compressor is driven by an electric motor, a shoreline connection to the electric motor is required. High-pressure air hose and couplings are to have a pressure rating equal to or greater than the highest pressure expected to be encountered, with a safety factor of 4 to 1. Requirements for the testing and certification of breathing air fill stations were changed to add systems filling SCUBA, the section on system testing was changed to be specific to breathing air systems, and a new was added for testing utility air systems.

The 2016 edition of NFPA 1901 includes a new chapter on ultra-high pressure (UHP) fire pumps and associated equipment due to the increased use of UHP fire pumps. This edition provides guidance to manufacturers and purchasers as to the design, testing, and performance of UHP fire pumps with a rated discharge pressure of 1100 psi (7600 kPa) or greater. The Committee also clarified the requirements within Chapter 16 for pump controls and added updated tables to the body of the chapter for the engine speed advancement interlock test. Additional changes have been made throughout the document to remove redundant language and to clarify requirements.

See Annex E for a complete history of the standard.

Technical Committee on Fire Department Apparatus

Donald Frazeur, *Chair*
Los Angeles Fire Department, CA [U]

Elden L. Alexander, U.S. Department of the Interior, ID [E]
Rep. National Wildfire Coordinating Group

Walter C. Caldwell, Charlotte Fire Department, NC [U]

Wesley D. Chestnut, Spartan Motors, Inc., MI [M]

Jeff Cranfill, California Department of Forestry and Fire Protection - CAL FIRE, CA [U]

Peter F. Darley, W. S. Darley & Company, IL [M]
Rep. National Truck Equipment Association

Ralph Dorio, Insurance Services Office, Inc., NJ [I]

David Durstine, Akron Brass Company, OH [M]
Rep. Fire Apparatus Manufacturers Association

Clayton W. Fenwick, Sugar Land Fire Department, TX [U]
Rep. International Association of Fire Chiefs

David V. Haston, U.S. Department of Agriculture, ID [RT]

Thomas Hillenbrand, UL LLC, IL [RT]

James J. Juneau, Juneau, Boll, Stacy, & Ucherek, PLLC, TX [SE]

James L. Kelker, Mistras Group Inc., OH [RT]

J. Roger Lackore, Oshkosh Corporation, WI [M]

Thomas H. McCullough, II, Glatfelter Claims Management, Inc., PA [I]

John W. McDonald, U.S. General Services Administration, MD [E]

J. Allen Metheny, Sr., Hartly Volunteer Fire Company, DE [U]
Rep. National Volunteer Fire Council

Tom Mettler, Waterous Company, MN [M]

William C. Peters, WC Peters Fire Apparatus Consulting Services, LLC, NJ [SE]

Jeff Piechura, Stockton Fire Department, CA [U]

W. Michael Pietsch, Mike Pietsch, P.E. Consulting Services, Inc., TX [SE]

Gary R. Pope, John H. Enders Fire Company, Inc. & Rescue Squad, VA [U]

Edward C. Rice, Jr., District of Columbia Fire Dept, MD [U]

James A. Salmi, E-One, Inc., PA [M]

Jason Shivers, Forsyth County Fire Department, GA [U]

Thomas A. Stalnaker, Goshen Fire Company, PA [U]

Thomas G. Stites, Sutphen Corporation, OH [M]

John M. Terefinko, KME Fire Apparatus, PA [M]

Richard Tull, Hale Products Inc., PA [M]

Stephen Wilde, Certified Fleet Services, Inc., IL [IM]
Rep. EVT Certification Commission, Inc.

Alternates

Kirk Bradley, Michigan Dept of Natural Resources (DNR), MI [U]
(Alt. to J. Cranfill)

James T. Currin, KME Fire Apparatus, VA [M]
(Alt. to J. M. Terefinko)

Jason Darley, W.S. Darley, WI [M]
(Alt. to P. F. Darley)

Wayne Travis Fister, National Testing/Mistras Group, FL [RT]
(Alt. to J. L. Kelker)

James R. Garver, Sutphen Corporation, OH [M]
(Alt. to T. G. Stites)

Stanley "Chip" Goodson, Jr., E-One, Inc., FL [M]
(Alt. to J. A. Salmi)

Mark Haider, Waterous Company, MN [M]
(Alt. to T. Mettler)

Stuart D. Insley, Arlington County VA Fire Department, VA [U]
(Alt. to C. W. Fenwick)

William F. Jenaway, Volunteer Firemen's Insurance Services, Inc., PA [I]
(Alt. to T. H. McCullough, II)

James E. Johannessen, UL LLC, PA [RT]
(Alt. to T. Hillenbrand)

Kevin P. Kuntz, Insurance Services Office, Inc., NJ [I]
(Alt. to R. Dorio)

Dan W. McKenzie, U.S. Department of Agriculture, CA [RT]
(Alt. to D. V. Haston)

Michael R. Moore, Pierce Manufacturing, Inc., WI [M]
(Alt. to J. R. Lackore)

Homer K. Robertson, Fort Worth Fire Department, TX [U]
(Alt. to W. C. Caldwell)

Mike Schoenberger, Rosenbauer America, MN [M]
(Alt. to D. Durstine)

Michael L. Thorn, Oregon Apparatus Repair, Inc., OR [IM]
(Alt. to S. Wilde)

Robert L. Upchurch, Fairfax County Fire & Rescue Department, VA [U]
(Alt. to G. R. Pope)

William H. Yohn, U.S. Department of the Interior, ID [E]
(Alt. to E. L. Alexander)

Nonvoting

Howard L. McMillen, Fort Worth, TX [SE]
(Member Emeritus)

Ryan Depew, NFPA Staff Liaison

This list represents the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of the document.

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

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

Contents

Chapter 1 Administration	1901- 7	Chapter 7 Mobile Water Supply Fire Apparatus	1901- 25
1.1 Scope.	1901- 7	7.1 General.	1901- 25
1.2 Purpose.	1901- 7	7.2 Fire Pump.	1901- 25
1.3 Application.	1901- 7	7.3 Aerial Device. (Reserved)	1901- 25
1.4 Retroactivity.	1901- 7	7.4 Foam Proportioning System.	1901- 25
1.5 Equivalency.	1901- 7	7.5 Water Tank.	1901- 25
1.6 Units of Measure.	1901- 7	7.6 Equipment Storage.	1901- 25
Chapter 2 Referenced Publications	1901- 7	7.7 Hose Storage.	1901- 25
2.1 General.	1901- 7	7.8 Equipment Supplied by the Contractor.	1901- 26
2.2 NFPA Publications.	1901- 7	7.9 Minor Equipment.	1901- 26
2.3 Other Publications.	1901- 7	Chapter 8 Aerial Fire Apparatus	1901- 26
2.4 References for Extracts in Mandatory Sections.	1901- 9	8.1 General.	1901- 26
Chapter 3 Definitions	1901- 9	8.2 Fire Pump.	1901- 26
3.1 General.	1901- 9	8.3 Aerial Device.	1901- 27
3.2 NFPA Official Definitions.	1901- 9	8.4 Foam Proportioning System.	1901- 27
3.3 General Definitions.	1901- 10	8.5 Water Tank.	1901- 27
Chapter 4 General Requirements	1901- 16	8.6 Equipment Storage.	1901- 27
4.1 General.	1901- 16	8.7 Hose Storage.	1901- 27
4.2 Requirements by Apparatus Type.	1901- 16	8.8 Equipment Supplied by the Contractor.	1901- 27
4.3 Responsibility of the Purchaser.	1901- 16	8.9 Minor Equipment.	1901- 27
4.4 Responsibility of the Contractor.	1901- 16	Chapter 9 Quint Fire Apparatus	1901- 28
4.5 Fire Apparatus Components.	1901- 16	9.1 General.	1901- 28
4.6 Legal Requirements.	1901- 16	9.2 Fire Pump.	1901- 28
4.7 Third-Party Certification of Test Results.	1901- 16	9.3 Aerial Device.	1901- 28
4.8 Manufacturer Certification of Test Results.	1901- 18	9.4 Foam Proportioning System.	1901- 28
4.9 Personnel Protection.	1901- 18	9.5 Water Tank.	1901- 28
4.10 Controls and Instructions.	1901- 18	9.6 Equipment Storage.	1901- 28
4.11 Vehicle Data Recorder.	1901- 18	9.7 Hose Storage.	1901- 28
4.12 Component Protection.	1901- 19	9.8 Equipment Supplied by the Contractor.	1901- 28
4.13 Vehicle Stability.	1901- 19	9.9 Minor Equipment.	1901- 29
4.14 Fire Apparatus Performance.	1901- 20	Chapter 10 Special Service Fire Apparatus	1901- 30
4.15 Highway Performance.	1901- 20	10.1 General.	1901- 30
4.16 Serviceability.	1901- 20	10.2 Fire Pump.	1901- 30
4.17 General Pre-Delivery Tests.	1901- 20	10.3 Reserved.	1901- 30
4.18 Tests on Delivery.	1901- 20	10.4 Reserved.	1901- 30
4.19 Documentation.	1901- 21	10.5 Reserved.	1901- 30
4.20 Data Required of the Contractor.	1901- 21	10.6 Equipment Storage.	1901- 30
4.21 Statement of Exceptions.	1901- 22	10.7 Reserved.	1901- 30
Chapter 5 Pumper Fire Apparatus	1901- 23	10.8 Equipment Supplied by the Contractor.	1901- 30
5.1 General.	1901- 23	10.9 Minor Equipment.	1901- 30
5.2 Fire Pump.	1901- 23	Chapter 11 Mobile Foam Fire Apparatus	1901- 30
5.3 Aerial Device.	1901- 23	11.1 General.	1901- 30
5.4 Foam Proportioning System.	1901- 23	11.2 Fire Pump.	1901- 30
5.5 Water Tank.	1901- 23	11.3 Aerial Device.	1901- 30
5.6 Equipment Storage.	1901- 23	11.4 Foam Proportioning System.	1901- 31
5.7 Hose Storage.	1901- 23	11.5 Foam Tank.	1901- 31
5.8 Equipment Supplied by the Contractor.	1901- 23	11.6 Equipment Storage.	1901- 31
5.9 Minor Equipment.	1901- 23	11.7 Hose Storage.	1901- 31
Chapter 6 Initial Attack Fire Apparatus	1901- 24	11.8 Equipment Supplied by the Contractor.	1901- 31
6.1 General.	1901- 24	11.9 Minor Equipment.	1901- 31
6.2 Fire Pump.	1901- 24	Chapter 12 Chassis and Vehicle Components	1901- 32
6.3 Aerial Device. (Reserved)	1901- 24	12.1 Carrying Capacity.	1901- 32
6.4 Foam Proportioning System.	1901- 24	12.2 Engine and Engine System Design.	1901- 32
6.5 Water Tank.	1901- 24	12.3 Vehicle Components.	1901- 34
6.6 Equipment Storage.	1901- 24	Chapter 13 Low Voltage Electrical Systems and Warning Devices	1901- 36
6.7 Hose Storage.	1901- 24	13.1 General.	1901- 36
6.8 Equipment Supplied by the Contractor.	1901- 24	13.2 Wiring.	1901- 36
6.9 Minor Equipment.	1901- 25	13.3 Power Supply.	1901- 36
		13.4 Batteries.	1901- 37

13.5	Starting Device.	1901– 37	18.2	Tank Construction.	1901– 69
13.6	Temperature Exposure.	1901– 37	18.3	Tank-to-Pump Intake Line.	1901– 70
13.7	Electromagnetic Interference.	1901– 38	18.4	Filling and Venting.	1901– 70
13.8	Optical Warning Devices.	1901– 38	18.5	Mobile Water Supply Apparatus.	1901– 70
13.9	Audible Warning Devices.	1901– 41	18.6	Water Tank Capacity Certification.	1901– 70
13.10	Work Lighting.	1901– 41	Chapter 19	Aerial Devices	1901– 70
13.11	Hazard Light.	1901– 42	19.1	General Requirements.	1901– 70
13.12	Backup Alarm.	1901– 42	19.2	Aerial Ladder Requirements.	1901– 71
13.13	Stop, Tail, and Directional Lights.	1901– 42	19.3	Aerial Ladder Rated Capacity.	1901– 72
13.14	Electrical System Performance Tests.	1901– 42	19.4	Aerial Ladder Operating Position.	1901– 72
13.15	Documentation.	1901– 43	19.5	Aerial Ladder Operating Mechanisms.	1901– 72
Chapter 14	Driving and Crew Areas	1901– 43	19.6	Aerial Ladder Water Delivery System.	1901– 73
14.1	General.	1901– 43	19.7	Elevating Platform Requirements.	1901– 73
14.2	Cab Tilt Systems.	1901– 46	19.8	Elevating Platform Rated Capacity.	1901– 74
14.3	Driving Compartment.	1901– 46	19.9	Elevating Platform Operating Positions.	1901– 75
14.4	Tractor-Drawn Vehicles.	1901– 46	19.10	Elevating Platform Operating Mechanisms. ...	1901– 75
Chapter 15	Body, Compartments, and Equipment		19.11	Ladders on the Elevating Platform.	1901– 75
	Mounting	1901– 47	19.12	Elevating Platform Water Delivery System.	1901– 75
15.1	Compartmentation.	1901– 47	19.13	Water Tower Requirements.	1901– 76
15.2	Radio Space.	1901– 47	19.14	Water Tower Rated Capacity.	1901– 76
15.3	Equipment Containment.	1901– 47	19.15	Water Tower Operating Mechanisms.	1901– 76
15.4	Powered Equipment Racks.	1901– 47	19.16	Water Tower Water Delivery System.	1901– 76
15.5	SCBA Storage.	1901– 47	19.17	Control Devices.	1901– 77
15.6	Pump and Plumbing Access.	1901– 47	19.18	Safety.	1901– 77
15.7	Stepping, Standing, and Walking Surfaces.	1901– 48	19.19	Hydraulic System.	1901– 78
15.8	Access Handrails or Handholds.	1901– 48	19.20	Structure.	1901– 78
15.9	Metal Finish.	1901– 49	19.21	Stabilization.	1901– 78
15.10	Hose Storage.	1901– 49	19.22	Quality Control.	1901– 79
15.11	Requirements for Mounting of Ground Ladders.	1901– 49	19.23	Instruction Plates and Signs.	1901– 80
15.12	Receivers and Anchors for Rope and Removable Winches.	1901– 50	19.24	Certification Tests.	1901– 80
15.13	Slip-On Fire-Fighting Module.	1901– 50	19.25	Manufacturer's Predelivery Test.	1901– 81
Chapter 16	Fire Pumps and Associated Equipment .	1901– 50	Chapter 20	Foam Proportioning Systems	1901– 82
16.1	Application.	1901– 50	20.1	Application.	1901– 82
16.2	Design and Performance Requirements.	1901– 50	20.2	Requirements by Type of Foam Proportioning System.	1901– 82
16.3	Pumping Engine Requirements.	1901– 51	20.3	Design and Performance Requirements of a Foam Proportioning System.	1901– 82
16.4	Power Train Capability.	1901– 54	20.4	Controls for Foam Proportioning Systems.	1901– 82
16.5	Construction Requirements.	1901– 54	20.5	Foam Proportioning System Pressure Gauges, Flowmeters, and Indicators.	1901– 82
16.6	Pump Intake Connections.	1901– 54	20.6	Atmospheric Foam Concentrate Tank.	1901– 83
16.7	Pump Discharge Outlets.	1901– 55	20.7	Foam Concentrate Pump.	1901– 83
16.8	Pump Drains.	1901– 56	20.8	Pressure Vessel Foam Concentrate or Foam Solution Tanks.	1901– 84
16.9	Pump Operator's Panel.	1901– 56	20.9	Labels and Instruction Plates.	1901– 84
16.10	Pump Controls.	1901– 56	20.10	Foam Proportioning System Accuracy.	1901– 84
16.11	Pump Engine Controls.	1901– 57	20.11	Testing and Documentation.	1901– 85
16.12	Instrumentation.	1901– 58	Chapter 21	Compressed Air Foam Systems (CAFS) .	1901– 85
16.13	Required Testing.	1901– 59	21.1	Application.	1901– 85
Chapter 17	Auxiliary Pumps and Associated Equipment	1901– 67	21.2	General Requirements.	1901– 85
17.1	Application.	1901– 67	21.3	Compressed Air System.	1901– 85
17.2	Pump Performance.	1901– 67	21.4	Air Mixing.	1901– 86
17.3	Pump Rating Label.	1901– 67	21.5	Compressed Air System Piping.	1901– 86
17.4	Power Train Capability.	1901– 67	21.6	Air System Controls.	1901– 86
17.5	Construction Requirements.	1901– 67	21.7	Foam System Pressure Gauges, Flowmeters, and Indicators.	1901– 86
17.6	Pump Intakes.	1901– 67	21.8	Labels and Instruction Plates.	1901– 86
17.7	Pump Discharges.	1901– 67	21.9	Manufacturer's Predelivery Tests.	1901– 87
17.8	Pump Operator's Panel.	1901– 68	Chapter 22	Line Voltage Electrical Systems	1901– 87
17.9	Pump Controls.	1901– 68	22.1	Application.	1901– 87
17.10	Pump Drive Systems.	1901– 68	22.2	General Requirements.	1901– 87
17.11	Engine Controls.	1901– 68	22.3	Grounding and Bonding.	1901– 88
17.12	Gauges and Instruments.	1901– 68	22.4	Power Source General Requirements.	1901– 88
17.13	Testing.	1901– 69	22.5	Power Source Type Specific Requirements. ...	1901– 89
Chapter 18	Water Tanks	1901– 69			
18.1	Application.	1901– 69			

22.6	Portable Generator Installations.	1901– 90	25.5	Hydraulically Driven Winches.	1901– 105
22.7	Line Voltage Supplied from an External Source.	1901– 91	Chapter 26 Trailers		1901– 105
22.8	Power Supply Assembly.	1901– 91	26.1	General.	1901– 105
22.9	Overcurrent Protection.	1901– 91	26.2	Classification of Trailers.	1901– 105
22.10	Wiring Methods.	1901– 92	26.3	Carrying Capacity.	1901– 105
22.11	Wiring System Components.	1901– 92	26.4	Information Labels and Instruction Plates.	1901– 105
22.12	Cord Reels.	1901– 93	26.5	Fluids and Pressures Specific to the Trailer Chassis.	1901– 105
22.13	Scene Lighting Systems.	1901– 93	26.6	Braking System.	1901– 105
22.14	Power-Operated Light Mast.	1901– 94	26.7	Suspension and Wheels.	1901– 105
22.15	Electrical System Testing.	1901– 94	26.8	Trailer Hitch.	1901– 106
Chapter 23 Command and Communications		1901– 95	26.9	Wheel Chocks.	1901– 106
23.1	General.	1901– 95	26.10	Low Voltage Electrical Systems and Warning Devices.	1901– 106
23.2	Location.	1901– 95	26.11	Reflective Markings.	1901– 107
23.3	Climate Control.	1901– 95	Chapter 27 Reserved		1901– 107
23.4	Noise Levels.	1901– 95	Chapter 28 Ultra-High Pressure Fire Pumps and Associated Equipment		1901– 107
23.5	Lighting Levels.	1901– 95	28.1	Application.	1901– 107
23.6	Command Working Surfaces and Countertop.	1901– 95	28.2	Pump Performance.	1901– 107
23.7	Seating in Command Center.	1901– 95	28.3	Power Train Capability.	1901– 107
23.8	Cabinets and Equipment Storage.	1901– 95	28.4	Construction Requirements.	1901– 107
23.9	Wall, Ceiling, and Floor Surfaces.	1901– 96	28.5	Pump Intakes.	1901– 108
23.10	Communications and Electrical Consoles.	1901– 96	28.6	Pump Discharges.	1901– 108
23.11	Computer Equipment and Installation.	1901– 96	28.7	Pump Operator's Panel.	1901– 108
23.12	Video Equipment and Installation.	1901– 96	28.8	Pump Controls.	1901– 108
23.13	Power Operated Masts.	1901– 96	28.9	Pump Drive Systems.	1901– 109
Chapter 24 Air Systems		1901– 96	28.10	Engine Controls.	1901– 109
24.1	Application.	1901– 96	28.11	Gauges and Instruments.	1901– 109
24.2	Provisions Applying to All Air Systems.	1901– 96	28.12	Required Testing.	1901– 109
24.3	Breathing Air Compressor.	1901– 98	Annex A Explanatory Material		1901– 113
24.4	Purification System.	1901– 99	Annex B Specifying and Procuring Fire Apparatus		1901– 163
24.5	Air Storage Systems.	1901– 100	Annex C Weights and Dimensions for Common Equipment		1901– 195
24.6	Air Booster Systems.	1901– 100	Annex D Guidelines for First-Line and Reserve Fire Apparatus		1901– 195
24.7	Air Supply Regulation.	1901– 100	Annex E History of NFPA 1901		1901– 196
24.8	Air Control Panel.	1901– 101	Annex F Informational References		1901– 198
24.9	SCBA or SCUBA Air Cylinder Fill Station.	1901– 101	Index		1901– 200
24.10	Air Hose Reels.	1901– 101			
24.11	Air Hose.	1901– 102			
24.12	Low Pressure Utility Air Supply.	1901– 103			
24.13	Remote Breathing Air Systems.	1901– 103			
24.14	Breathing Air System Testing and Delivery.	1901– 103			
24.15	Utility Air System Testing.	1901– 104			
Chapter 25 Winches		1901– 104			
25.1	General.	1901– 104			
25.2	Winch Wire or Synthetic Rope.	1901– 104			
25.3	Clutch.	1901– 104			
25.4	Electric Powered Winches.	1901– 104			

NFPA 1901

Standard for

Automotive Fire Apparatus

2016 Edition

IMPORTANT NOTE: This NFPA document is made available for use subject to important notices and legal disclaimers. These notices and disclaimers appear in all publications containing this document and may be found under the heading "Important Notices and Disclaimers Concerning NFPA Standards." They can also be viewed at www.nfpa.org/disclaimers or obtained on request from NFPA.

UPDATES, ALERTS, AND FUTURE EDITIONS: New editions of NFPA codes, standards, recommended practices, and guides (i.e., NFPA Standards) are released on scheduled revision cycles. This edition may be superseded by a later one, or it may be amended outside of its scheduled revision cycle through the issuance of Tentative Interim Amendments (TIAs). An official NFPA Standard at any point in time consists of the current edition of the document, together with all TIAs and Errata in effect. To verify that this document is the current edition or to determine if it has been amended by TIAs or Errata, please consult the National Fire Codes® Subscription Service or the "List of NFPA Codes & Standards" at www.nfpa.org/docinfo. In addition to TIAs and Errata, the document information pages also include the option to sign up for alerts for individual documents and to be involved in the development of the next edition.

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

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

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

Chapter 1 Administration

1.1* Scope. This standard defines the requirements for new automotive fire apparatus and trailers designed to be used under emergency conditions to transport personnel and equipment and to support the suppression of fires and mitigation of other hazardous situations.

1.2 Purpose. This standard specifies the minimum requirements for new automotive fire apparatus and trailers.

1.3 Application.

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

- (1) Have 10,000 lb (4,500 kg) or greater gross vehicle weight rating (GVWR) or are trailers intended to be towed by fire apparatus under emergency response conditions

- (2) Are designed for use under emergency conditions to transport personnel and equipment and to support the suppression of fires and mitigation of other hazardous situations
- (3) Are contracted for on or after January 1, 2016

1.3.2 Nothing shall prevent the use of the standard prior to January 1, 2016, or for vehicles with less than 10,000 lb (4,500 kg) gross vehicle weight rating (GVWR), if the purchaser and the contractor both agree.

1.3.3 This standard shall not apply to wildland fire apparatus, which are covered by NFPA 1906.

1.4* Retroactivity. This standard shall not be applied retroactively.

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

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

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

1.6 Units of Measure.

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

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

Chapter 2 Referenced Publications

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

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

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

NFPA 1906, *Standard for Wildland Fire Apparatus*, 2016 edition.

NFPA 1911, *Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus*, 2012 edition.

NFPA 1931, *Standard for Manufacturer's Design of Fire Department Ground Ladders*, 2015 edition.

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

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

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services*, 2013 edition.

NFPA 1983, *Standard on Life Safety Rope and Equipment for Emergency Services*, 2012 edition.

NFPA 1989, *Standard on Breathing Air Quality for Emergency Services Respiratory Protection*, 2013 edition.

2.3 Other Publications.

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

ANSI A14.2, *Ladders — Portable Metal — Safety Requirements*, 2007.

ANSI A14.5, *Ladders — Portable Reinforced Plastic — Safety Requirements*, 2007.

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

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

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

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

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

ANSI/ASNT CP-189, *Standard for Qualification and Certification of Nondestructive Testing Personnel*, 2011.

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*, 2010.

ASTM B648, *Standard Test Method for Indentation Hardness of Aluminum Alloys by Means of a Barcol Impressor*, 2010.

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

ASTM E6, *Standard Terminology Relating to Methods of Mechanical Testing*, 2009be1.

ASTM E10, *Standard Test Method for Brinell Hardness of Metallic Materials*, 2012.

ASTM E18, *Standard Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials*, 2014.

ASTM E114, *Standard Practice for Ultrasonic Pulse-Echo Straight-Beam Examination by the Contact Method*, 2010.

ASTM E165/E165M, *Standard Test Method for Liquid Penetrant Examinations*, 2012.

ASTM E384, *Standard Test Method for Knoop and Vickers Hardness of Metallic Materials*, 2011e1.

ASTM E569/E569M, *Standard Practice for Acoustic Emission Monitoring of Structures During Controlled Stimulation*, 2013.

ASTM E650, *Standard Guide for Mounting Piezoelectric Acoustic Emission Sensors*, 2012.

ASTM E709, *Standard Guide for Magnetic Particle Testing*, 2014.

ASTM E797, *Standard Practice for Measuring Thickness by Manual Ultrasonic Pulse-Echo Contact Method*, 2010.

ASTM E1004, *Standard Practice for Determining Electrical Conductivity Using the Electromagnetic (Eddy-Current) Method*, 2009.

2.3.5 AWS Publications. American Welding Society, 550 NW LeJeune Road, Miami, FL 33126, www.aws.org.

AWS B1.10, *Guide for the Nondestructive Examination of Welds*, 1999.

AWS D1.1, *Structural Welding Code — Steel*, 2006.

AWS D1.2, *Structural Welding Code — Aluminum*, 2003.

AWS D1.3, *Structural Welding Code — Sheet Steel*, 2008.

2.3.6 CGA Publications. Compressed Gas Association, 14501 George Carter Way, Suite 103, Chantilly, VA 20151-2923, www.cganet.com.

G-7, *Compressed Air for Human Respiration*, 2008.

G-7.1, *Commodity Specification for Air*, 2011.

2.3.7 CSA Publications. Canadian Standards Association, 5060 Spectrum Way, Mississauga, ON L4W 5N6, Canada, www.csa.ca.

CSA W47.1, *Certification of Companies for Fusion Welding of Steel*, 2012.

CSA W47.2, *Certification of Companies for Fusion Welding of Aluminum*, 2012.

2.3.8 FAMA Publications. Fire Apparatus Manufacturers Association, P.O. Box 397, Lynnfield, MA 01940-0397, www.fama.org.

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

FAMA TC010, *Standard Product Safety Sign Catalog for Automotive Fire Apparatus*, 2012.

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

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

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

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.

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

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

2.3.12 SAE Publications. Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096, www.SAE.org.

SAE J156, *Fusible Links*, 2012.

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

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

SAE J553, *Circuit Breakers*, 2004.

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

SAE J560, *Primary and Auxiliary Seven Conductor Electrical Connector for Truck-Trailer Jumper Cable*, 2009.

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

SAE J578, *Color Specification*, 2012.

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

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

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

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

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

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

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

SAE J1690, *Flashers*, 1996.

SAE J1849, *Emergency Vehicle Sirens*, Stabilized 2012.

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

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

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

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

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

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

SAE J2394, *Seven-Conductor Cable for ABS Power — Truck and Bus*, 2013.

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

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

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

SAE J2863, *Automotive Trailer Tow Connector*, 2013.

2.3.13 TRA Publications. Tire and Rim Association, Inc., 175 Montrose West Ave., Copley, OH 44321, www.US-TRA.org.

Tire and Rim Association — Year Book, 2015.

2.3.14 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096, www.ul.com.

ANSI/UL 153, *Standard for Portable Electric Luminaires*, 2002, with revisions through March 15, 2013.

ANSI/UL 498, *Standard for Safety Attachment Plugs and Receptacles*, 2013 with revisions through November 16, 2012.

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

ANSI/UL 1598, *Standard for Luminaires*, 2008, with revisions through October 17, 2012.

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

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

2.3.16 U.S. Government Publications. U.S. Government Printing Office, Washington, DC 20402, www.gpo.gov.

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

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

Title 49, Code of Federal Regulations, Part 393.94, “Interior noise levels in power units, paragraph (c), Test procedure.” 49 CFR 393.94.

Title 49, Code of Federal Regulations, Part 567, “Certification.” 49 CFR 567.

Title 49, Code of Federal Regulations, Part 571, Subpart B, “Federal Motor Vehicle Safety Standards,” No. 108, “Lamps, reflective devices, and associated equipment.” 49 CFR 571.108.

Title 49, Code of Federal Regulations, Part 571, Subpart B, “Federal Motor Vehicle Safety Standards,” No. 302, “Flammability of interior materials.” 49 CFR 571.302.

2.3.17 Other Publications.

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

2.4 References for Extracts in Mandatory Sections.

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

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

NFPA 1932, *Standard on Use, Maintenance, and Service Testing of In-Service Fire Department Ground Ladders*, 2015 edition.

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

NFPA 1989, *Standard on Breathing Air Quality for Emergency Services Respiratory Protection*, 2013 edition.

Chapter 3 Definitions

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

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

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

3.2.3 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

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

3.2.5 Shall. Indicates a mandatory requirement.

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

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

3.3 General Definitions.

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

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

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

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 fire fighting 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 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.

3.3.10* 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.

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

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

3.3.13 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.

3.3.14 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*.

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

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

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

3.3.18 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.

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

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

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

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

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

3.3.24 Boom. An assembled section of an aerial device. The boom construction can be of the stressed skin box beam-type, the trussed lattice-type, or the open "U" truss-type design.

3.3.25 Booster Pump. See 3.3.19, *Auxiliary Pump*.

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

3.3.27 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.

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

3.3.29 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.

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

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

3.3.32 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.

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

3.3.34 Chassis. The basic operating motor vehicle including the engine, frame, and other essential structural and mechanical parts, but exclusive of the body and all appurtenances for the accommodation of driver, property, passengers, appliances, or equipment related to other than control. Common usage might, but need not, include a cab (or cowl).

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

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

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

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

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

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

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

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

3.3.43 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, 2013]

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

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

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

3.3.47 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.

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

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

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

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

3.3.52 Documentation. Any data or information supplied by the manufacturer or contractor relative to the apparatus, including information on its operation, service, and maintenance.

3.3.53 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.

3.3.54 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.

3.3.55 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.

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

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

3.3.58* 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.

3.3.59 Electrical Equipment. See 3.3.68, Fixed Electrical Equipment, and 3.3.134, Portable Electrical Equipment.

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

3.3.61 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.

3.3.62 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.

3.3.63 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.

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

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

3.3.66 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.

3.3.67 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 fire fighting.

3.3.68 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.

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

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

3.3.71 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.

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

3.3.73 Foam Concentrate. Foam fire-fighting agent as received from the manufacturer that must be diluted with water to make foam solution.

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

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

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

3.3.77 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.

3.3.78 Gallon. United States gallon.

3.3.79 Gauge. A visual device that indicates a measurement.

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

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

3.3.82* GCWR (Gross Combination Weight Rating). 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.

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

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

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

3.3.86* Ground-Fault Circuit Interrupter (GFCI). A device intended for the protection of personnel that functions to deenergize a circuit or portion thereof within an established period of time when a current to ground exceeds the values established for a Class A device. [70:100]

3.3.87 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.

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

3.3.89 Hazardous Material Response Fire Apparatus. An emergency vehicle designed to carry various support equipment and personnel to a scene of a hazardous material incident.

3.3.90 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.

3.3.91 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.

3.3.92 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.

3.3.93 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.

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

3.3.95 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.

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

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

3.3.98 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.

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

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

3.3.101 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.

3.3.102 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.

3.3.103 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.

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

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

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

3.3.107 Load Limit Indicator. A load indicator or a label, visible at the operator's position, that shows the recommended safe load at any condition of an aerial device's elevation and extension.

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

3.3.109 Manufacturer. The entity responsible for the assembly of a finished product from materials or components.

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

3.3.111* 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.

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

3.3.113 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.

3.3.114 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.

3.3.115 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.

3.3.116 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.

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

3.3.118 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.

3.3.119 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.

3.3.120* 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.

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

3.3.122* 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.

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

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

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

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

3.3.127 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.

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

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

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

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

3.3.132 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]

3.3.133 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.

3.3.134 Portable Electrical Equipment. Any electrical equipment that is not fixed. (See 3.3.68, *Fixed Electrical Equipment*.)

3.3.135* 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.

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

3.3.137 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.

3.3.138 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.

3.3.139* 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.

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

3.3.141 psi. Pounds per square inch.

3.3.142 PTO. Power takeoff.

3.3.143 Pump Discharge Pressure Classification.

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

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

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

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

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

3.3.146 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.

3.3.147 Purchaser. The authority having responsibility for the specification and acceptance of the apparatus.

3.3.148 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.

3.3.149 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.

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

3.3.151* 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.

3.3.152 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.

3.3.153 Rated Capacity (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 on the platform of an elevating platform with the aerial device placed in the horizontal position at its maximum horizontal extension when the stabilizers are fully deployed.

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

3.3.155 Readily Accessible. Able to be located, reached, serviced, or removed without removing other components or parts

of the apparatus and without the need to use special tools to open enclosures.

3.3.156 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.

3.3.157 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.

3.3.158 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.

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

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

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

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

3.3.163 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.

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

3.3.165 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.

3.3.166 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.

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

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

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

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

3.3.171 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.

3.3.172 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.

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

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

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

3.3.176 Synthetic Breathing Air. A manufactured breathing air that is produced by blending nitrogen and oxygen. [1989, 2013]

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

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

3.3.179 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.

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

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

3.3.182* 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.

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

3.3.184* 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.

3.3.185 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.

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

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

3.3.188 Vibration Isolation. Isolation materials used to prevent structure-borne vibrations from reaching attached surfaces.

3.3.189 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.

3.3.190 Wet Location. A location on fire apparatus subject to saturation with water or other liquids and in unprotected locations exposed to the weather. (See also 3.3.159, *Road Spray Location*.)

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

Chapter 4 General Requirements

4.1 General.

4.1.1 All fire apparatus shall comply with the following chapters:

- (1) Chapter 1, "Administration"
- (2) Chapter 2, "Referenced Publications"
- (3) Chapter 3, "Definitions"
- (4) Chapter 4, "General Requirements"
- (5) Chapter 12, "Chassis and Vehicle Components"
- (6) Chapter 13, "Low Voltage Electrical Systems and Warning Devices"
- (7) Chapter 14, "Driving and Crew Areas"
- (8) Chapter 15, "Body, Compartments, and Equipment Mounting"

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

4.2 Requirements by Apparatus Type.

4.2.1 In addition to the requirements in Section 4.1, the following also shall apply:

- (1) Pumper fire apparatus shall comply with Chapter 5.
- (2) Initial attack fire apparatus shall comply with Chapter 6.
- (3) Mobile water supply fire apparatus shall comply with Chapter 7.
- (4) Aerial fire apparatus shall comply with Chapter 8.
- (5) Quint fire apparatus shall comply with Chapter 9.
- (6) Special service fire apparatus shall comply with Chapter 10.
- (7) Mobile foam fire apparatus shall comply with Chapter 11.

4.2.2 Table 4.2.2 shows the required chapters that shall apply to the construction of the types of fire apparatus in 4.2.1.

4.2.3 In addition to the types of fire apparatus listed in 4.2.1, other types of fire apparatus shall be permitted by combining the requirements for the components to be used in the apparatus as defined in Section 4.5 with the requirements listed in Section 4.1.

4.3 Responsibility of the Purchaser.

4.3.1* It shall be the responsibility of the purchaser to specify the details of the apparatus in addition to the requirements in NFPA 1901 needed by the manufacturer to build the apparatus, including:

- (1) Requirements not uniquely specified in NFPA 1901, such as the type of apparatus desired.
- (2) Any features of the apparatus desired in addition to, or in excess of, the requirements in NFPA 1901.

4.3.2 After acceptance of the fire apparatus, the purchaser shall be responsible for ongoing training of personnel to develop and maintain proficiency regarding the proper and safe use of the apparatus and the associated equipment.

4.4 Responsibility of the Contractor.

4.4.1 The contractor shall provide a detailed description of the apparatus, a list of equipment to be furnished, and other construction and performance details to which the apparatus shall conform.

4.4.1.1 The detailed description of the apparatus shall include, but shall not be limited to, estimated in-service weight, wheelbase, turning clearance radius, principal dimensions, angle of approach, angle of departure, transmission, axle ratios, and, if applicable, the rated capacity of the aerial device.

4.4.1.2 The contractor's detailed description shall include a statement specifically describing each aspect of the delivered apparatus that will not be fully compliant with the requirements of this standard.

4.4.1.3 The purpose of these contractor specifications shall be to define what the contractor intends to furnish and deliver to the purchaser.

4.4.2 Responsibility for the apparatus and equipment shall remain with the contractor until they are accepted by the purchaser.

4.5 Fire Apparatus Components. All components shall be installed in accordance with the applicable manufacturer's installation instructions.

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

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

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

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

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

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

Table 4.2.2 Chapter Requirements by Apparatus

Chapter	Pumper Fire Apparatus	Initial Attack Fire Apparatus	Mobile Water Supply Fire Apparatus	Aerial Fire Apparatus	Quint Fire Apparatus	Special Service Fire Apparatus	Mobile Foam Fire Apparatus
1. Administration	Required	Required	Required	Required	Required	Required	Required
2. Referenced Publications	Required	Required	Required	Required	Required	Required	Required
3. Definitions	Required	Required	Required	Required	Required	Required	Required
4. General Requirements	Required	Required	Required	Required	Required	Required	Required
5. Pumper Fire Apparatus	Required	N/A	N/A	N/A	N/A	N/A	N/A
6. Initial Attack Fire Apparatus	N/A	Required	N/A	N/A	N/A	N/A	N/A
7. Mobile Water Supply Fire Apparatus	N/A	N/A	Required	N/A	N/A	N/A	N/A
8. Aerial Fire Apparatus	N/A	N/A	N/A	Required	N/A	N/A	N/A
9. Quint Fire Apparatus	N/A	N/A	N/A	N/A	Required	N/A	N/A
10. Special Service Fire Apparatus	N/A	N/A	N/A	N/A	N/A	Required	N/A
11. Mobile Foam Fire Apparatus	N/A	N/A	N/A	N/A	N/A	N/A	Required
12. Chassis and Vehicle Components	Required	Required	Required	Required	Required	Required	Required
13. Low Voltage Electrical Systems and Warning Devices	Required	Required	Required	Required	Required	Required	Required
14. Driving and Crew Areas	Required	Required	Required	Required	Required	Required	Required
15. Body, Compartments, and Equipment Mounting	Required	Required	Required	Required	Required	Required	Required
16. Fire Pumps and Associated Equipment	Required	Required	If specified	If specified	Required	If specified	Required
17. Auxiliary Pumps and Associated Equipment	If specified	If specified	If specified	If specified	If specified	If specified	If specified
18. Water Tanks	Required	Required	Required	If specified	Required	If specified	If specified
19. Aerial Devices	If specified	If specified	N/A	Required	Required	If specified	If specified
20. Foam Proportioning Systems	If specified	If specified	If specified	If specified	If specified	If specified	Required
21. Compressed Air Foam Systems (CAFS)	If specified	If specified	If specified	If specified	If specified	If specified	If specified
22. Line Voltage Electrical Systems	If specified	If specified	If specified	If specified	If specified	If specified	If specified
23. Command and Communications	If specified	If specified	If specified	If specified	If specified	If specified	If specified
24. Air Systems	If specified	If specified	If specified	If specified	If specified	If specified	If specified
25. Winches	If specified	If specified	If specified	If specified	If specified	If specified	If specified
26. Trailers	If specified	If specified	If specified	If specified	If specified	If specified	If specified
28. Ultra-High Pressure	If specified	If specified	If specified	If specified	If specified	If specified	If specified

4.7.5 There shall be no conditional, temporary, or partial certification of test results.

4.7.6* Forms or data sheets shall be provided and used during the testing.

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

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

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

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

4.8.2 There shall be no conditional, temporary, or partial certification of test results.

4.8.3 The manufacturer shall have the facilities and equipment necessary to conduct the required testing, a program for the calibration of all instruments, and procedures to ensure the proper control of all testing.

4.8.4* Forms or data sheets shall be provided and used during the testing.

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

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

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

4.9 Personnel Protection.

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

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

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

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

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

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

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

4.10 Controls and Instructions.

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

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

4.10.1.2 If internal illumination is provided, it shall be a minimum of 4 fl (14 cd/m²).

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

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

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

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

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

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

4.11 Vehicle Data Recorder.

4.11.1 All apparatus shall be equipped with an on-board vehicle data recorder (VDR).

4.11.2 The VDR shall be capable of recording the data shown in Table 4.11.2 in that order at least once per second.

4.11.3 Data shall be stored at the sampling rate in a 48-hour loop.

4.11.4 Memory shall be sufficient to record 100 engine hours' worth of minute-by-minute summary showing the data in Table 4.11.4.

4.11.5 When the memory capacity is reached, the system shall erase the oldest data first.

4.11.6 All data stored in the VDR shall be uploadable by the user to a computer and importable into a data management software package.

Table 4.11.2 VDR Data

Data	Unit of Measure
Vehicle speed	mph
Acceleration (from speedometer)	mph/sec
Deceleration (from speedometer)	mph/sec
Engine speed	rpm
Engine throttle position	% of full throttle
Anti-lock braking system event	On/off
Seat occupied status	Occupied: Yes/No by position
Seat belt status	Buckled: Yes/No by position
Master optical warning device switch	On/off
Time	24-hour clock
Date	Year/month/day

Table 4.11.4 VDR Summary Data

Data	Unit of Measure
Maximum vehicle speed	mph
Maximum acceleration (from speedometer)	mph/sec
Maximum deceleration (from speedometer)	mph/sec
Maximum engine speed	rpm
Maximum engine throttle position	% of full throttle
Anti-lock braking system event	On/off
Seat occupied with seat belt unbuckled	Yes/no by position at 30 sec into minute
Master optical warning device switch	On/off at 30 sec into minute
Time	24-hour clock
Date	Year/month/day

4.11.7 Data shall be password protected with access controlled by the purchaser.

4.11.8 Software shall be delivered with the apparatus that will run on both Windows® and Apple® operating systems and produce the following formatted reports from the uploaded data:

- (1) Raw second-by-second data over a specified data/time range
- (2) Daily log for the time the engine is running for a given date (minute-by-minute output of all values)
- (3) Weekly summary (maximum values each hour for each day of the week)
- (4) Monthly summary (maximum values each day for each day of the month)

4.12 Component Protection.

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

4.12.2 The types of equipment described in 4.12.1 shall be furnished with protective looms, grommets, or other devices at

each point where they pass through body panels or structural members or wherever they lie against a sharp metal edge.

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

4.13 Vehicle Stability.

4.13.1* Rollover Stability. The apparatus shall meet the criteria defined in 4.13.1.1, or it shall be equipped with a stability control system in accordance with 4.13.1.2.

4.13.1.1 The apparatus shall not exceed the chassis manufacturer's maximum allowable vertical center of gravity for a completed vehicle, if specified, and meet the criteria defined in either of the following:

- (1)* The apparatus remains stable to 26.5 degrees in both directions when tested on a tilt table in accordance with SAE J2180, *A Tilt Table Procedure for Measuring the Static Rollover Threshold for Heavy Trucks*.
- (2) The calculated or measured center of gravity (CG) is no higher than 80 percent of the rear axle track width.

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

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

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

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

4.13.1.1.3.2 The weight added to the fire apparatus for the purpose of test, calculation, or measurement shall be distributed to approximate typical in-service use of the fire apparatus while not exceeding the manufacturer's published individual compartment weight ratings.

4.13.1.2 If the apparatus is equipped with a stability control system, the system shall have, at a minimum, a steering wheel position sensor, a vehicle yaw sensor, a lateral accelerometer, and individual wheel brake controls.

4.13.2 Weight Distribution.

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

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

4.13.3 Load Distribution.

4.13.3.1* The apparatus manufacturer shall calculate the load distribution for the apparatus, and that load distribution plan shall be delivered with the fire apparatus.

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

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

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

4.14 Fire Apparatus Performance.

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

4.14.2* The fire apparatus shall meet all the requirements of this standard while stationary on a grade of 6 percent in any direction.

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

4.15 Highway Performance.

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

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

4.15.2* The maximum top speed of fire apparatus with a GVWR over 26,000 lb (11,800 kg) shall not exceed either 68 mph (109 km/hr) or the manufacturer's maximum fire service speed rating for the tires installed on the apparatus, whichever is lower.

4.15.3 If the combined water tank and foam agent tank capacities on the fire apparatus exceed 1250 gal (4732 L), or the GVWR of the vehicle is over 50,000 lb (22,680 kg), the maximum top speed of the apparatus shall not exceed either 60 mph (95 km/hr) or the manufacturer's maximum fire service speed rating for the tires installed on the apparatus, whichever is lower.

4.16 Serviceability.

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

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

4.16.3 Apparatus components that interfere with repair or removal of other major components shall be attached with

fasteners, such as cap screws and nuts, so that the components can be removed and installed with ordinary hand tools. These components shall not be welded or otherwise permanently secured into place.

4.17 General Pre-Delivery Tests.

4.17.1 Each apparatus shall be tested by the manufacturer before delivery to verify that it meets the criteria in this section.

4.17.1.1 Tests shall be conducted at a location and in a manner that does not violate local, state or provincial, or federal traffic laws.

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

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

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

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

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

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

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

4.18 Tests on Delivery.

4.18.1* If acceptance tests are required at the point of delivery, the purchaser shall specify the details of the tests to be performed, and they shall not be performed in a manner that requires the apparatus or a component to operate outside its designed operating range.

4.18.2 Aerial device stability tests shall not be run other than at the manufacturer's facility.

4.18.3 An official of the company that manufactures the apparatus and, if applicable, the aerial device shall designate in writing who is qualified to provide operational instructions and apparatus familiarization to the final customer.

4.18.4 Programs shall be in place for training, proficiency testing, and performance verification of the qualified person in 4.18.3

4.18.5 The authority having jurisdiction shall appoint a person(s) to receive operational instructions and apparatus familiarization.

4.18.6 Operational instructions shall be provided on new apparatus by the contractor in accordance with 4.18.6.1 through 4.18.6.2.

4.18.6.1 Review with the authorized person(s) as defined by the authority having jurisdiction all service, maintenance, operational, and instruction manuals, including the entire vehicle, chassis, major components, and auxiliary equipment provided.

4.18.6.2 Familiarization and demonstration of the vehicle shall be by a competent and qualified person as defined in 3.3.148 of this standard.

4.18.6.2.1 The familiarization and demonstration shall not include driving training or any fire-fighting training operations.

4.18.6.2.2 Familiarization of the vehicle shall include the following:

- (1) How to locate gauges or indicators and check all fluid levels and operational issues of the vehicle
- (2) How to tilt the chassis cab or hood assembly for access to the engine, fire pump, or aerial control, or any other device to allow access to fluids or for required maintenance
- (3) Interior cab controls, instruments, mirrors, safety devices or alarms, brake operations, transmission control, pump controls, exhaust regeneration (if provided), seat adjustments, warning light engagement, and other operational equipment
- (4) If the apparatus is provided with a fire pump system, the following minimum instructions:
 - (a) Setting of parking brake, proper transmission gear, and fire pump engagement operations
 - (b) Throttle control
 - (c) Primer and tank-to-pump operation
 - (d) Use of pressure control devices
 - (e) Tank refilling operations
 - (f) Proper operation of discharge controls
 - (g) Proper shutdown and draining of system
- (5) If the apparatus is provided with a generator, the following minimum instructions:
 - (a) Proper engagement if driven by the chassis
 - (b) Startup, operation, and shutdown of generator
 - (c) Monitoring of controls and instruments
- (6) If the apparatus is provided with a foam system, the following minimum instructions:
 - (a) Startup, operation, and shutdown of foam system
 - (b) Setting of foam percentages and other operational settings
 - (c) Proper flushing and draining of the system
- (7) If the apparatus is provided with a water tower or aerial device, the following minimum instructions:
 - (a) Positioning and locating the vehicle for safe operations
 - (b) Chassis parking brakes and engagement of hydraulic system
 - (c) Deployment of stabilization devices and use of ground pads
 - (d) Operation of elevation, extension, and rotation of the aerial device
 - (e) Operation of waterway, nozzle, and other fire-fighting devices of aerial device
 - (f) Operation and use of breathing air system
 - (g) Specific aerial device maintenance and service areas for operators
 - (h) Shutdown and return to service operations
 - (i) Operation of tip controls and platform controls
 - (j) General familiarization and demonstration of aerial device
 - (k) Review of all safety devices, interlocks, and operational hazards

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

4.20 Data Required of the Contractor.

4.20.1 Fire Apparatus Documentation. The contractor shall deliver with the fire apparatus at least one copy of the following documents:

- (1) The manufacturer's record of apparatus construction details, including the following information:
 - (a) Owner's name and address
 - (b) Apparatus manufacturer, model, and serial number
 - (c) Chassis make, model, and serial number
 - (d) GAWR of front and rear axles and GVWR
 - (e) Front tire size and total rated capacity in pounds (kilograms)
 - (f) Rear tire size and total rated capacity in pounds (kilograms)
 - (g) Chassis weight distribution in pounds (kilograms) with water and manufacturer-mounted equipment (front and rear)
 - (h) Engine make, model, serial number, rated horsepower and related speed, and governed speed; and if so equipped, engine transmission PTO(s) make, model, and gear ratio
 - (i) Type of fuel and fuel tank capacity
 - (j) Electrical system voltage and alternator output in amps
 - (k) Battery make, model, and capacity in cold cranking amps (CCA)
 - (l) Chassis transmission make, model, and serial number; and if so equipped, chassis transmission PTO(s) make, model, and gear ratio
 - (m) Ratios of all driving axles
 - (n) Maximum governed road speed
 - (o) Pump make, model, rated capacity in gallons per minute (liters per minute where applicable), maximum discharge pressure capability rating, and serial number
 - (p) Pump transmission make, model, serial number, and gear ratio
 - (q) Auxiliary pump make, model, rated capacity in gallons per minute (liters per minute where applicable), and serial number
 - (r) Water tank certified capacity in gallons or liters
 - (s) Foam tank (if provided) certified capacity in gallons (liters)
 - (t) Aerial device type, rated vertical height in feet (meters), rated horizontal reach in feet (meters), and rated capacity in pounds (kilograms)
 - (u) Paint manufacturer and paint number(s)
 - (v) Company name and signature of responsible company representative
 - (w) Weight documents from a certified scale showing actual loading on the front axle, rear axle(s), and overall fire apparatus (with the water tank full but without personnel, equipment, and hose)
- (2) Certification of compliance of the optical warning system (*see 13.8.16*)
- (3) Siren manufacturer's certification of the siren (*see 13.9.1.1*)

- (4) Written load analysis and results of the electrical system performance tests (*see 13.14.1 and Section 13.15*)
 - (5) Certification of slip resistance of all stepping, standing, and walking surfaces (*see 15.7.4.5*)
 - (6) If the apparatus has a fire pump, the pump manufacturer's certification of suction capability (*see 16.2.4.1*)
 - (7) If the apparatus is equipped with a fire pump and special conditions are specified by the purchaser, the pump manufacturer's certification of suction capacity under the special conditions (*see 16.2.4.2*)
 - (8) If the apparatus has a fire pump, a copy of the apparatus manufacturer's approval for stationary pumping applications (*see 16.3.1*)
 - (9) If the apparatus has a fire pump, the engine manufacturer's certified brake horsepower curve for the engine furnished, showing the maximum governed speed (*see 16.3.2.2*)
 - (10) If the apparatus has a fire pump, the pump manufacturer's certification of the hydrostatic test (*see 16.5.2.2*)
 - (11) If the apparatus has a fire pump with a maximum discharge pressure capability rating that exceeds the hydrostatic test pressure of 16.5.2.1, the pump manufacturer's certification of the hydrodynamic test
 - (12) If the apparatus has a fire pump, the certification of inspection and test for the fire pump (*see 16.13.1.1.5 or 16.13.1.2.4 as applicable*)
 - (13) If the apparatus is equipped with an auxiliary pump, the apparatus manufacturer's certification of the hydrostatic test (*see Section 17.13*)
 - (14) When the apparatus is equipped with a water tank, the certification of water tank capacity (*see Section 18.6*)
 - (15) If the apparatus has an aerial device, the certification of inspection and test for the aerial device (*see Section 19.24*)
 - (16) If the apparatus has an aerial device, all the technical information required for inspections to comply with NFPA 1911
 - (17) If the apparatus has a foam proportioning system, the foam proportioning system manufacturer's certification of accuracy (*see 20.10.4.2*) and the final installer's certification the foam proportioning system meets this standard (*see 20.11.2*)
 - (18) If the system has a CAFS, the documentation of the manufacturer's predelivery tests (*see Section 21.9*)
 - (19) If the apparatus has a line voltage power source, the certification of the test for the power source (*see 22.15.7.2*)
 - (20) If the apparatus is equipped with an air system, air tank certificates (*see 24.5.1.2*), the SCBA fill station certification (*see 24.9.6*), and the results of the testing of the air system installation (*see 24.14.5 and 24.15.4*)
 - (21) Any other required manufacturer test data or reports
- (1) Manufacturer's name and address
 - (2) Country of manufacture
 - (3) Source for service and technical information
 - (4) Parts replacement information
 - (5) Descriptions, specifications, and ratings of the chassis, pump (if applicable), and aerial device (if applicable)
 - (6) Wiring diagrams for low-voltage and line-voltage systems to include the following information:
 - (a) Pictorial representations of circuit logic for all electrical components and wiring
 - (b) Circuit identification
 - (c) Connector pin identification
 - (d) Zone location of electrical components
 - (e) Safety interlocks
 - (f) Alternator-battery power distribution circuits
 - (g)* Input/output assignment sheets or equivalent circuit logic implemented in multiplexing systems
 - (7) Lubrication charts
 - (8) Operating instructions for the chassis, any major components such as a pump or aerial device, and any auxiliary systems
 - (9) Precautions related to multiple configurations of aerial devices, if applicable
 - (10) Instructions regarding the frequency and procedure for recommended maintenance
 - (11) Overall apparatus operating instructions
 - (12) Safety considerations
 - (13) Limitations of use
 - (14) Inspection procedures
 - (15) Recommended service procedures
 - (16) Troubleshooting guide
 - (17) Apparatus body, chassis, and other component manufacturer's warranties
 - (18) Special data required by this standard
 - (19) A material safety data sheet (MSDS) for any fluid that is specified for use on the apparatus
 - (20) One copy of the latest edition of FAMA's *Fire Apparatus Safety Guide*

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

4.21* Statement of Exceptions. The final-stage manufacturer shall deliver with the fire apparatus either a certification that the apparatus fully complies with all requirements of this standard or, alternatively, a Statement of Exceptions specifically describing each aspect of the completed apparatus that is not fully compliant with the requirements of this standard at the time of delivery.

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

- (1) A separate specification of the section of the applicable standard for which compliance is lacking
- (2) A description of the particular aspect of the apparatus that is not in compliance therewith or required equipment that is missing
- (3) A description of the further changes or modifications to the delivered apparatus that must be completed to achieve full compliance

4.20.2 Operations and Service Documentation.

4.20.2.1 The contractor shall deliver with the fire apparatus complete operation and service documentation covering the completed apparatus as delivered and accepted.

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

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

- (4) Identification of the entity that will be responsible for making the necessary postdelivery changes or modifications or for supplying and installing any missing required equipment to the apparatus to achieve full compliance with this standard

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

Chapter 5 Pumper Fire Apparatus

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

5.2 Fire Pump. The apparatus shall be equipped with a fire pump that meets the requirements of Chapter 16 and that has a minimum rated capacity of 750 gpm (3000 L/min).

5.3 Aerial Device.

5.3.1 Where a pumper fire apparatus is equipped with an aerial device, the aerial device shall meet the requirements of Chapter 19.

5.3.2 Provisions shall be made to ensure that the pump operator is not in contact with the ground.

5.4 Foam Proportioning System. If the pumper is equipped with a foam proportioning system, it shall meet the requirements of Chapter 20.

5.5* Water Tank. The pumper shall be equipped with a water tank(s) that meets the requirements of Chapter 18 and that has a minimum certified capacity (combined, if applicable) of 300 gal (1100 L).

5.6* Equipment Storage. A minimum of 40 ft³ (1.1 m³) of enclosed weather-resistant compartmentation that meets the requirements of Section 15.1 shall be provided for the storage of equipment.

5.7* Hose Storage. Hose bed area(s), compartments, or reels that comply with Section 15.10 shall be provided to accommodate the following:

- (1) A minimum hose storage area of 30 ft³ (0.8 m³) for 2½ in. (65 mm) or larger fire hose
- (2) Two areas, each a minimum of 3.5 ft³ (0.1 m³), to accommodate 1½ in. (38 mm) or larger preconnected fire hose lines

5.8* Equipment Supplied by the Contractor. The contractor shall supply the equipment listed in 5.8.1 and 5.8.2 and shall provide and install such brackets or compartments as are necessary to mount the equipment.

5.8.1 Ground Ladders.

5.8.1.1 All fire department ground ladders carried on the apparatus shall meet the requirements of NFPA 1931, except as permitted by 5.8.1.3 and 5.8.1.4.

5.8.1.2* At a minimum, the following fire department ground ladders shall be carried on the apparatus:

- (1) One straight ladder equipped with roof hooks

- (2) One extension ladder
- (3) One folding ladder

5.8.1.3 Stepladders and other types of multipurpose ladders meeting ANSI A14.2, *Ladders — Portable Metal — Safety Requirements*, or ANSI A14.5, *Ladders — Portable Reinforced Plastic — Safety Requirements*, with duty ratings of Type 1A or 1AA shall be permitted to be substituted for the folding ladder required in 5.8.1.2(3).

5.8.1.4 Stepladders and other types of multipurpose ladders shall be permitted to be carried in addition to the minimum fire department ground ladders specified in 5.8.1.2 provided they meet either ANSI A14.2 or ANSI A14.5 with duty ratings of Type 1A or 1AA.

5.8.2 Suction Hose or Supply Hose.

5.8.2.1 A minimum of 20 ft (6 m) of suction hose or 15 ft (4.5 m) of supply hose shall be carried.

5.8.2.1.1 Where suction hose is provided, a suction strainer shall be furnished.

5.8.2.1.2 Where suction hose is provided, the friction and entrance loss of the combination suction hose and strainer shall not exceed the losses listed in Table 16.2.4.1(b) or Table 16.2.4.1(c).

5.8.2.1.3 Where supply hose is provided, it shall have couplings compatible with the local hydrant outlet connection on one end and the pump intake connection on the other end.

5.8.2.2 Suction hose and supply hose shall meet the requirements of NFPA 1961.

5.8.2.3* The purchaser shall specify whether suction hose or supply hose is to be provided, the length and size of the hose, the type and size of the couplings, the manner in which the hose is to be carried on the apparatus, and the style of brackets desired.

5.9* Minor Equipment.

5.9.1 General. The equipment listed in 5.9.3 and 5.9.4 shall be available on the pumper fire apparatus before the apparatus is placed in service.

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

5.9.3* Fire Hose and Nozzles. The following fire hose and nozzles shall be carried on the apparatus:

- (1) 800 ft (240 m) of 2½ in. (65 mm) or larger fire hose
- (2) 400 ft (120 m) of 1½ in. (38 mm), 1¾ in. (45 mm), or 2 in. (52 mm) fire hose
- (3) One handline nozzle, 200 gpm (750 L/min) minimum
- (4) Two handline nozzles, 95 gpm (360 L/min) minimum
- (5) One smoothbore or combination nozzle with 2½ in. shut-off that flows a minimum of 250 gpm

5.9.4* Miscellaneous Equipment. The following additional equipment shall be carried on the apparatus:

- (1) One 6 lb (2.7 kg) flathead axe
- (2) One 6 lb (2.7 kg) pickhead axe
- (3) One 6 ft (2 m) pike pole or plaster hook
- (4) One 8 ft (2.4 m) or longer pike pole
- (5) Two portable hand lights

- (6) One approved dry chemical portable fire extinguisher with a minimum 80-B:C rating
- (7) One 2½ gal (9.5 L) or larger water extinguisher
- (8) One self-contained breathing apparatus (SCBA) complying with NFPA 1981 for each assigned seating position, but not fewer than four, mounted in brackets fastened to the apparatus or stored in containers supplied by the SCBA manufacturer
- (9) One spare SCBA cylinder for each SCBA carried, each mounted in a bracket fastened to the apparatus or stored in a specially designed storage space
- (10) One first aid kit
- (11) Four combination spanner wrenches
- (12) Two hydrant wrenches
- (13) One double female 2½ in. (65 mm) adapter with National Hose (NH) threads
- (14) One double male 2½ in. (65 mm) adapter with NH threads
- (15) One rubber mallet, suitable for use on suction hose connections
- (16) Two salvage covers each a minimum size of 12 ft × 14 ft (3.7 m × 4.3 m)
- (17) Two or more wheel chocks, mounted in readily accessible locations, that together will hold the apparatus, when loaded to its GVWR or GCWR, on a hard surface with a 20 percent grade with the transmission in neutral and the parking brake released
- (18) One traffic vest for each seating position, each vest to comply with ANSI/ISEA 207, *Standard for High-Visibility Public Safety Vests*, and have a five-point breakaway feature that includes two at the shoulders, two at the sides, and one at the front
- (19) Five fluorescent orange traffic cones not less than 28 in. (711 mm) in height, each equipped with a 6 in. (152 mm) retroreflective white band no more than 4 in. (102 mm) from the top of the cone, and an additional 4 in. (102 mm) retroreflective white band 2 in. (51 mm) below the 6 in. (152 mm) band
- (20) Five illuminated warning devices such as highway flares, unless the five fluorescent orange traffic cones have illuminating capabilities
- (21) One automatic external defibrillator (AED)

5.9.4.1 If the supply hose carried does not use sexless couplings, an additional double female adapter and double male adapter, sized to fit the supply hose carried, shall be carried mounted in brackets fastened to the apparatus.

5.9.4.2 If none of the pump intakes are valved, a hose appliance that is equipped with one or more gated intakes with female swivel connection(s) compatible with the supply hose used on one side and a swivel connection with pump intake threads on the other side shall be carried. Any intake connection larger than 3 in. (75 mm) shall include a pressure relief device that meets the requirements of 16.6.6.

5.9.4.3 If the pumper is equipped with an aerial device with a permanently mounted ladder, four ladder belts meeting the requirements of NFPA 1983, shall be provided.

5.9.4.4 If the apparatus does not have a 2½ in. intake with NH threads, an adapter from 2½ in. NH female to a pump intake shall be carried, mounted in a bracket fastened to the apparatus if not already mounted directly to the intake.

5.9.4.5 If the supply hose carried has other than 2½ in. NH threads, adapters shall be carried to allow feeding the supply

hose from a 2½ in. NH thread male discharge and to allow the hose to connect to a 2½ in. NH female intake, mounted in brackets fastened to the apparatus if not already mounted directly to the discharge or intake.

Chapter 6 Initial Attack Fire Apparatus

6.1 General. If the apparatus is to function as an initial attack fire apparatus, it shall meet the requirements of this chapter.

6.2 Fire Pump. The apparatus shall be equipped with a fire pump that meets the requirements of Chapter 16 and that has a minimum rated capacity of 250 gpm (1000 L/min).

6.3 Aerial Device. (Reserved)

6.4 Foam Proportioning System. If the initial attack apparatus is equipped with a foam proportioning system, it shall meet the requirements of Chapter 20.

6.5 Water Tank. Initial attack apparatus shall be equipped with a water tank(s) that meets the requirements of Chapter 18 and that has a minimum certified capacity (combined, if applicable) of 200 gal (750 L).

6.6* Equipment Storage. A minimum of 22 ft³ (0.62 m³) of enclosed weather-resistant compartmentation that meets the requirements of Section 15.1 shall be provided for the storage of equipment.

6.7* Hose Storage. Hose bed area(s), compartments, or reels that meet the requirements of Section 15.10 shall be provided to accommodate the following:

- (1) A minimum hose storage area of 10 ft³ (0.3 m³) for 2½ in. (65 mm) or larger fire hose
- (2) Two areas, each a minimum of 3.5 ft³ (0.1 m³), to accommodate 1½ in. (38 mm) or larger preconnected fire hose lines

6.8* Equipment Supplied by the Contractor. The contractor shall supply the equipment listed in 6.8.1 and 6.8.2 and shall provide and install such brackets or compartments as are necessary to mount the equipment.

6.8.1 Ground Ladders.

6.8.1.1 A 12 ft (3.7 m) or longer combination or extension-type fire department ground ladder shall be carried on the apparatus.

6.8.1.2 All fire department ground ladders on the apparatus shall meet the requirements of NFPA 1931, except as permitted by 6.8.1.3.

6.8.1.3 Stepladders and other types of multipurpose ladders shall be permitted to be carried in addition to the minimum fire department ground ladders specified in 6.8.1.1 provided they meet either ANSI A14.2 or ANSI A14.5 with duty ratings of Type 1A or 1AA.

6.8.2 Suction Hose or Supply Hose.

6.8.2.1 A minimum of 20 ft (6 m) of suction hose or 15 ft (4.5 m) of supply hose shall be carried.

6.8.2.1.1 Where suction hose is provided, a suction strainer shall be furnished.

6.8.2.1.2 Where suction hose is provided, the friction and entrance loss of the combination suction hose and strainer shall not exceed the losses listed in Table 16.2.4.1(b) or Table 16.2.4.1(c).

6.8.2.1.3 Where supply hose is provided, it shall have couplings compatible with the local hydrant outlet connection on one end and the pump intake connection on the other end.

6.8.2.2 Suction hose and supply hose shall meet the requirements of NFPA 1961.

6.8.2.3* The purchaser shall specify whether suction hose or supply hose is to be provided, the length and size of the hose, the type and size of the couplings, the manner in which the hose is to be carried on the apparatus, and the style of brackets desired.

6.9* Minor Equipment.

6.9.1 General. The equipment listed in 6.9.3 and 6.9.4 shall be available on the initial attack fire apparatus before the apparatus is placed in service.

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

6.9.3 Fire Hose and Nozzles. The following fire hose and nozzles shall be carried on the apparatus:

- (1) 300 ft (90 m) of 2½ in. (65 mm) or larger fire hose
- (2) 400 ft (120 m) of 1½ in. (38 mm), 1¾ in. (45 mm), or 2 in. (52 mm) fire hose
- (3) Two handline nozzles, 95 gpm (360 L/min) minimum

6.9.4* Miscellaneous Equipment. The following additional equipment shall be carried on the apparatus:

- (1) One 6 lb (2.7 kg) pickhead axe
- (2) One 6 ft (2 m) pike pole or plaster hook
- (3) Two portable hand lights
- (4) One approved dry chemical portable fire extinguisher with a minimum 80-B:C rating
- (5) One 2½ gal (9.5 L) or larger water extinguisher
- (6) One SCBA complying with NFPA 1981 for each assigned seating position, but not fewer than two, mounted in brackets fastened to the apparatus or stored in containers supplied by the SCBA manufacturer
- (7) One spare SCBA cylinder for each SCBA carried, each mounted in a bracket fastened to the apparatus or stored in a specially designed storage space(s)
- (8) One first aid kit
- (9) Two combination spanner wrenches
- (10) One hydrant wrench
- (11) One double female adapter, sized to fit 2½ in. (65 mm) or larger fire hose
- (12) One double male adapter, sized to fit 2½ in. (65 mm) or larger fire hose
- (13) One rubber mallet, for use on suction hose connections,
- (14) Two or more wheel chocks, mounted in readily accessible locations, that together will hold the apparatus, when loaded to its GVWR or GCWR, on a hard surface with a 20 percent grade with the transmission in neutral and the parking brake released
- (15) One traffic vest for each seating position, each vest to comply with ANSI/ISEA 207, *Standard for High-Visibility Public Safety Vests*, and have a five-point breakaway feature

that includes two at the shoulders, two at the sides, and one at the front

- (16) Five fluorescent orange traffic cones not less than 28 in. (711 mm) in height, each equipped with a 6 in. (152 mm) retroreflective white band no more than 4 in. (102 mm) from the top of the cone, and an additional 4 in. (102 mm) retroreflective white band 2 in. (51 mm) below the 6 in. (152 mm) band
- (17) Five illuminated warning devices such as highway flares, unless the five fluorescent orange traffic cones have illuminating capabilities
- (18) One automatic external defibrillator (AED)

6.9.4.1 Reserved.

6.9.4.2 If none of the pump intakes are valved, a hose appliance that is equipped with one or more gated intakes with female swivel connection(s) compatible with the supply hose used on one side and a swivel connection with pump intake threads on the other side shall be carried. Any intake connection larger than 3 in. (75 mm) shall include a pressure relief device that meets the requirements of 16.6.6.

6.9.4.3 Reserved.

6.9.4.4 If the apparatus does not have a 2½ in. intake with NH threads, an adapter from 2½ in. NH female to a pump intake shall be carried, mounted in a bracket fastened to the apparatus if not already mounted directly to the intake.

6.9.4.5 If the supply hose carried has other than 2½ in. NH threads, adapters shall be carried to allow feeding the supply hose from a 2½ in. NH thread male discharge and to allow the hose to connect to a 2½ in. NH female intake, mounted in brackets fastened to the apparatus if not already mounted directly to the discharge or intake.

Chapter 7 Mobile Water Supply Fire Apparatus

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

7.2 Fire Pump. If the apparatus is equipped with a fire pump, the pump shall meet the requirements of Chapter 16.

7.3 Aerial Device. (Reserved)

7.4 Foam Proportioning System. If the apparatus is equipped with a foam proportioning system, it shall meet the requirements of Chapter 20.

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

7.6* Equipment Storage. A minimum of 10 ft³ (0.0.3 m³) of enclosed weather-resistant compartmentation meeting the requirements of Section 15.1 shall be provided for the storage of equipment.

7.7* Hose Storage.

7.7.1 Hose bed area(s), compartments, or reels that comply with Section 15.10 shall be provided to accommodate a minimum hose storage area of 6 ft³ (0.8 m³) for 2½ in. (65 mm) or larger fire hose.

7.7.2 If the apparatus is equipped with a pump, storage for a minimum of 100 ft (30 m) of 1½ in. (38 mm) or larger fire hose for a protection line shall be provided.

7.8* Equipment Supplied by the Contractor. The contractor shall supply the equipment listed in 7.8.1 and 7.8.2 and shall provide and install such brackets or compartments as are necessary to mount the equipment.

7.8.1 Ground Ladders. Not required unless specified by the purchaser.

7.8.2 Suction Hose or Supply Hose. If the mobile water supply fire apparatus is equipped with a pump, the requirements in 7.9.1 through 7.9.3 shall apply.

7.8.2.1 A minimum of 20 ft (6 m) of suction hose or 15 ft (4.5 m) of supply hose shall be carried.

7.8.2.1.1 Where suction hose is provided, a suction strainer shall be furnished.

7.8.2.1.2 Where suction hose is provided, the friction and entrance loss of the combination suction hose and strainer shall not exceed the losses listed in Table 16.2.4.1(b) or Table 16.2.4.1(c).

7.8.2.1.3 Where supply hose is provided, it shall have couplings compatible with the local hydrant outlet connection on one end and the pump intake connection on the other end.

7.8.2.2 Suction hose and supply hose shall meet the requirements of NFPA 1961.

7.8.2.3* The purchaser shall specify whether suction hose or supply hose is to be provided, the length and size of the hose, the type and size of the couplings, the manner in which the hose is to be carried on the apparatus, and the style of brackets desired.

7.9* Minor Equipment.

7.9.1 General. The equipment listed in 7.9.3 and 7.9.4 shall be available on the mobile water supply apparatus before the apparatus is placed in service.

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

7.9.3 Fire Hose and Nozzles.

7.9.3.1 The mobile water supply apparatus shall be equipped with at least 200 ft (60 m) of 2½ in. (65 mm) or larger fire hose.

7.9.3.2* If the mobile water supply apparatus is equipped with a fire pump, the following shall be provided:

- (1) 100 ft (30 m) of 1½ in. (38 mm), 1¾ in. (45 mm), or 2 in. (52 mm) fire hose
- (2) One handline nozzle, 95 gpm (360 L/min) minimum

7.9.4* Miscellaneous Equipment. Mobile water supply fire apparatus shall be equipped with at least the following equipment:

- (1) Two portable hand lights
- (2) One approved dry chemical portable fire extinguisher with a minimum 3A-40B:C rating
- (3) One first aid kit
- (4) Two combination spanner wrenches

- (5) One hydrant wrench
- (6) One double female adapter, sized to fit 2½ in. (65 mm) or larger fire hose
- (7) One double male adapter, sized to fit 2½ in. (65 mm) or larger fire hose
- (8) Two or more wheel chocks, mounted in readily accessible locations, that together will hold the apparatus, when loaded to its GVWR or GCWR, on a hard surface with a 20 percent grade with the transmission in neutral and the parking brake released
- (9) One traffic vest for each seating position, each vest to comply with ANSI/ISEA 207, *Standard for High-Visibility Public Safety Vests*, and have a five-point breakaway feature that includes two at the shoulders, two at the sides, and one at the front
- (10) Five fluorescent orange traffic cones not less than 28 in. (711 mm) in height, each equipped with a 6 in. (152 mm) retroreflective white band no more than 4 in. (102 mm) from the top of the cone, and an additional 4 in. (102 mm) retroreflective white band 2 in. (51 mm) below the 6 in. (152 mm) band
- (11) Five illuminated warning devices such as highway flares, unless the five fluorescent orange traffic cones have illuminating capabilities
- (12) One automatic external defibrillator (AED)

7.9.4.1 Reserved.

7.9.4.2 If the mobile water supply apparatus is equipped with a fire pump and none of the pump intakes are valved, a hose appliance that is equipped with one or more gated intakes with female swivel connection(s) compatible with the supply hose used on one side and a swivel connection with pump intake threads on the other side shall be carried. Any intake connection larger than 3 in. (75 mm) shall include a pressure relief device that meets the requirements of 16.6.6.

7.9.4.3 If the mobile water supply apparatus is equipped with a fire pump, a rubber mallet for use on suction hose connections shall be carried.

7.9.4.4 If the apparatus does not have a 2½ in. intake with NH threads, an adapter from 2½ in. NH female to a pump intake shall be carried, mounted in a bracket fastened to the apparatus if not already mounted directly to the intake.

7.9.4.5 If the supply hose carried has other than 2½ in. NH threads, adapters shall be carried to allow feeding the supply hose from a 2½ in. NH thread male discharge and to allow the hose to connect to a 2½ in. NH female intake, mounted in brackets fastened to the apparatus if not already mounted directly to the discharge or intake.

Chapter 8 Aerial Fire Apparatus

8.1 General.

8.1.1 If the apparatus is to function as an aerial fire apparatus, it shall meet the requirements of this chapter.

8.1.2 If the apparatus is to function as a pumper with an aerial device, it shall meet all the requirements of Chapter 5 instead of Chapter 8.

8.2* Fire Pump. If the apparatus is equipped with a fire pump, the pump shall meet the requirements of Chapter 16.

8.2.1 Provisions shall be made to ensure that the pump operator is not in contact with the ground.

8.2.2 If the aerial fire apparatus is equipped with a fire pump that is intended to supply water to a permanently mounted waterway, the fire pump shall be capable of supplying the flow requirements of 19.6.1, 19.12.1, or 19.16.1 with a maximum intake gauge pressure of 20 psi (138 kPa).

8.3 Aerial Device. The apparatus shall be equipped with an aerial ladder, elevating platform, or water tower that meets the requirements of Chapter 19.

8.4 Foam Proportioning System. If the aerial fire apparatus is equipped with a foam proportioning system, it shall meet the requirements of Chapter 20.

8.5 Water Tank. If the aerial fire apparatus is equipped with a water tank, it shall meet the requirements of Chapter 18.

8.6* Equipment Storage. A minimum of 40 ft³ (1.1 m³) of enclosed weather-resistant compartmentation meeting the requirements of Section 15.1 shall be provided for the storage of equipment.

8.7 Hose Storage.

8.7.1* Any space on the aerial fire apparatus designed to carry fire hose shall meet the requirements of Section 15.10.

8.7.2 If the apparatus is equipped with a fire pump and a water tank, two areas, each a minimum of 3.5 ft³ (0.1 m³), to accommodate 1½ in. (38 mm) or larger preconnected fire hose lines shall be provided.

8.8* Equipment Supplied by the Contractor. The contractor shall supply the equipment listed in 8.8.1 and shall provide and install such brackets or compartments as are necessary to mount the equipment.

8.8.1 Ground Ladders.

8.8.1.1 All fire department ground ladders carried on the apparatus shall meet the requirements of NFPA 1931, except as permitted by 8.8.1.4 and 8.8.1.5.

8.8.1.2* A minimum of 115 ft (35 m) of fire department ground ladders shall be supplied and installed by the contractor.

8.8.1.3* As a minimum, the following types of ladders shall be provided:

- (1) One folding ladder
- (2) Two straight ladders (with folding roof hooks)
- (3) Two extension ladders

8.8.1.4 Stepladders and other types of multipurpose ladders meeting ANSI A14.2, *Ladders — Portable Metal — Safety Requirements*, or ANSI A14.5, *Ladders — Portable Reinforced Plastic — Safety Requirements*, with duty ratings of Type 1A or 1AA shall be permitted to be substituted for the folding ladder required in 8.8.1.3(1).

8.8.1.5 Stepladders and other types of multipurpose ladders shall be permitted to be carried in addition to the minimum fire department ground ladders specified in 8.8.1.3 provided they meet either ANSI A14.2 or ANSI A14.5 with duty ratings of Type 1A or 1AA.

8.8.2 Reserved.

8.9* Minor Equipment.

8.9.1 The equipment listed in 8.9.3 and 8.9.4 shall be available on the aerial fire apparatus before the apparatus is placed in service.

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

8.9.3* Aerial fire apparatus shall be equipped with at least the following equipment:

- (1) Two 6 lb (2.7 kg) flathead axes
- (2) Three 6 lb (2.7 kg) pickhead axes
- (3) Four pike poles
- (4) Two 3 ft to 4 ft (1 m to 1.2 m) plaster hooks with D handles
- (5) Two crowbars
- (6) Two claw tools
- (7) Two 12 lb (5 kg) sledgehammers
- (8) Four portable hand lights
- (9) One approved dry chemical portable fire extinguisher with a minimum 80-B:C rating
- (10) One 2½ gal (9.5 L) or larger water extinguisher
- (11) One SCBA complying with NFPA 1981 for each assigned seating position, but not fewer than four, mounted in brackets fastened to the apparatus or stored in containers supplied by the SCBA manufacturer
- (12) One spare SCBA cylinder for each SCBA carried, each mounted in a bracket fastened to the apparatus or stored in a specially designed storage space(s)
- (13) One first aid kit
- (14) Six salvage covers, each a minimum size of 12 ft × 18 ft (3.6 m × 5.5 m)
- (15) Four combination spanner wrenches
- (16) Two scoop shovels
- (17) One pair of bolt cutters, 24 in. (0.6 m) minimum
- (18) Four ladder belts meeting the requirements of NFPA 1983
- (19) One 150 ft (45 m) light-use life safety rope meeting the requirements of NFPA 1983
- (20) One 150 ft (45 m) general-use life safety rope meeting the requirements of NFPA 1983
- (21) Two 150 ft (45 m) utility ropes having a breaking strength of at least 5000 lb (2300 kg)
- (22) One box of tools to include the following:
 - (a) One hacksaw with three blades
 - (b) One keyhole saw
 - (c) One 12 in. (0.3 m) pipe wrench
 - (d) One 24 in. (0.6 m) pipe wrench
 - (e) One ballpeen hammer
 - (f) One pair of tin snips
 - (g) One pair of pliers
 - (h) One pair of lineman's pliers
 - (i) Assorted types and sizes of screwdrivers
 - (j) Assorted adjustable wrenches
 - (k) Assorted combination wrenches
- (23) Two or more wheel chocks, mounted in readily accessible locations, that together will hold the apparatus, when loaded to its GVWR or GCWR, on a hard surface with a 20 percent grade with the transmission in neutral and the parking brake released

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

8.9.4 If the aerial fire apparatus is equipped with a fire pump, the requirements of 8.9.4.1 through 8.9.4.3 shall apply.

8.9.4.1 The following equipment shall be provided:

- (1) One double female 2½ in. (65 mm) adapter with National Hose (NH) threads
- (2) One double male 2½ in. (65 mm) adapter with NH threads
- (3) One rubber mallet, for use on suction hose connections
- (4) Two hydrant wrenches

8.9.4.2 If the supply hose carried does not use sexless couplings, an additional double female adapter and double male adapter, sized to fit the supply hose carried, shall be carried mounted in brackets fastened to the apparatus.

8.9.4.3 If none of the pump intakes are valved, a hose appliance that is equipped with one or more gated intakes with female swivel connection(s) compatible with the supply hose used on one side and a swivel connection with pump intake threads on the other side shall be carried. Any intake connection larger than 3 in. (75 mm) shall include a pressure relief device that meets the requirements of 16.6.6.

8.9.4.4 If the apparatus does not have a 2½ in. intake with NH threads, an adapter from 2½ in. NH female to a pump intake shall be carried, mounted in a bracket fastened to the apparatus if not already mounted directly to the intake.

8.9.4.5 If the supply hose carried has other than 2½ in. NH threads, adapters shall be carried to allow feeding the supply hose from a 2½ in. NH thread male discharge and to allow the hose to connect to a 2½ in. NH female intake, mounted in brackets fastened to the apparatus if not already mounted directly to the discharge or intake.

8.9.5* If the aerial fire apparatus does not have a prepiped waterway provided, the following equipment shall be furnished:

- (1) Manual ladder pipe with 1¼ in. (32 mm), 1⅝ in. (35 mm), and 1½ in. (38 mm) tips or electric ladder pipe with automatic nozzle that can be attached to the aerial ladder
- (2) Sufficient length(s) of 3 in. (75 mm) or larger attack hose complying with the requirements of NFPA 1961 to reach between the installed ladder pipe and the ground with at least 10 ft (3 m) of hose available on the ground with the ladder at full extension
- (3) One hose strap for each ladder section
- (4) Halyards to control the ladder pipe from ground level (for manual ladder pipe only)

8.9.5.1 A bracket for carrying the detachable ladder pipe shall be provided on the apparatus and shall be designed so that the ladder pipe clamps will not have to be readjusted to secure the pipe to the aerial ladder.

8.9.5.2 The horizontal traverse of the detachable ladder pipe shall not exceed the aerial ladder manufacturer's recommendations.

8.9.5.3 The ladder pipe shall be capable of swiveling 135 degrees from a line parallel to the ladder and down.

Chapter 9 Quint Fire Apparatus

9.1 General. If the apparatus is to function as a quint, it shall meet the requirements of this chapter.

9.2 Fire Pump.

9.2.1 The apparatus shall be equipped with a fire pump that meets the requirements of Chapter 16 and has a minimum rated capacity of 1000 gpm (4000 L/min).

9.2.2 The fire pump shall be capable of supplying the flow requirements of 19.6.1 or 19.12.1 with a maximum intake gauge pressure of 20 psi (138 kPa).

9.2.3 Provisions shall be made to ensure that the pump operator is not in contact with the ground.

9.3 Aerial Device. The apparatus shall be equipped with an aerial ladder or an elevating platform with a permanently installed waterway that meets the requirements of Chapter 19.

9.4 Foam Proportioning System. If the apparatus is equipped with a foam proportioning system, it shall meet the requirements of Chapter 20.

9.5 Water Tank. The apparatus shall be equipped with a water tank(s) that meets the requirements of Chapter 18 and that has a minimum certified capacity (combined, if applicable) of 300 gal (1100 L).

9.6* Equipment Storage. A minimum of 40 ft³ (1.1 m³) of enclosed weather-resistant compartmentation that meets the requirements of Section 15.1 shall be provided for the storage of equipment.

9.7* Hose Storage. Hose bed area(s), compartments, or reels that comply with Section 15.10 shall be provided to accommodate the following:

- (1) A minimum hose storage area of 30 ft³ (0.8 m³) for 2½ in. (65 mm) or larger fire hose
- (2) Two areas, each a minimum of 3.5 ft³ (0.1 m³), to accommodate 1½ in. (38 mm) or larger preconnected fire hose lines

9.8* Equipment Supplied by the Contractor. The contractor shall supply the equipment listed in 9.8.1 and 9.8.2 and shall provide and install such brackets or compartments as are necessary to mount the equipment.

9.8.1 Ground Ladders.

9.8.1.1 The quint shall carry a minimum of 85 ft (26 m) of fire department ground ladders to include at least one extension ladder, one straight ladder equipped with roof hooks, and one folding ladder.

9.8.1.2 All ground ladders carried on the apparatus shall meet the requirements of NFPA 1931, except as permitted by 9.8.1.3 and 9.8.1.4.

9.8.1.3 Stepladders and other types of multipurpose ladders meeting ANSI A14.2, *Ladders — Portable Metal — Safety Requirements*, or ANSI A14.5, *Ladders — Portable Reinforced Plastic — Safety Requirements*, with duty ratings of Type 1A or 1AA shall be permitted to be substituted for the folding ladder required in 9.8.1.1.

9.8.1.4 Stepladders and other types of multipurpose ladders shall be permitted to be carried in addition to the minimum fire department ground ladders specified in 9.8.1.1 provided they meet either ANSI A14.2 or ANSI A14.5 with duty ratings of Type 1A or 1AA.

9.8.2 Suction Hose or Supply Hose.

9.8.2.1 A minimum of 20 ft (6 m) of suction hose or 15 ft (4.5 m) of supply hose shall be carried.

9.8.2.1.1 Where suction hose is provided, a suction strainer shall be furnished.

9.8.2.1.2 Where suction hose is provided, the friction and entrance loss of the combination suction hose and strainer shall not exceed the losses listed in Table 16.2.4.1(b) or Table 16.2.4.1(c).

9.8.2.1.3 Where supply hose is provided, it shall have couplings compatible with the local hydrant outlet connection on one end and the pump intake connection on the other end.

9.8.2.2 Suction hose and supply hose shall meet the requirements of NFPA 1961.

9.8.2.3* The purchaser shall specify whether suction hose or supply hose is to be provided, the length and size of the hose, the type and size of the couplings, the manner in which the hose is to be carried on the apparatus, and the style of brackets desired.

9.9* Minor Equipment.

9.9.1 The equipment listed in 9.9.3 and 9.9.4 shall be available on the quint fire apparatus before the apparatus is placed in service.

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

9.9.3* Fire Hose and Nozzles. The following fire hose and nozzles shall be carried on the apparatus:

- (1) 800 ft (240 m) of 2½ in. (65 mm) or larger fire hose, in any combination
- (2) 400 ft (120 m) of 1½ in. (38 mm), 1¾ in. (45 mm), or 2 in. (52 mm) fire hose, in any combination
- (3) One handline nozzle, 200 gpm (750 L/min) minimum
- (4) Two handline nozzles, 95 gpm (360 L/min) minimum
- (5) One playpipe with shutoff and 1 in. (25 mm), 1½ in. (29 mm), and 1¾ in. (32 mm) tips

9.9.4* Miscellaneous Equipment. The following additional equipment shall be carried on the apparatus:

- (1) One 6 lb (2.7 kg) flathead axe
- (2) One 6 lb (2.7 kg) pickhead axe
- (3) One 6 ft (2 m) pike pole or plaster hook

- (4) One 8 ft (2.4 m) or longer pike pole
- (5) Two portable hand lights
- (6) One approved dry chemical portable fire extinguisher with a minimum 80-B:C rating
- (7) One 2½ gal (9.5 L) or larger water extinguisher
- (8) One SCBA complying with NFPA 1981 for each assigned seating position, but not fewer than four, mounted in brackets fastened to the apparatus or stored in containers supplied by the SCBA manufacturer
- (9) One spare SCBA cylinder for each SCBA carried, each mounted in a bracket fastened to the apparatus or stored in a specially designed storage space(s)
- (10) One first aid kit
- (11) Four combination spanner wrenches
- (12) Two hydrant wrenches
- (13) One double female 2½ in. (65 mm) adapter with National Hose (NH) threads
- (14) One double male 2½ in. (65 mm) adapter with NH threads
- (15) One rubber mallet, for use on suction hose connections
- (16) Four salvage covers, each a minimum size of 12 ft × 14 ft (3.7 m × 4.3 m)
- (17) Four ladder belts meeting the requirements of NFPA 1983
- (18) One 150 ft (45 m) light-use life safety rope meeting the requirements of NFPA 1983
- (19) One 150 ft (45 m) general-use life safety rope meeting the requirements of NFPA 1983
- (20) Two or more wheel chocks, mounted in readily accessible locations, that together will hold the apparatus, when loaded to its GVWR or GCWR, on a hard surface with a 20 percent grade with the transmission in neutral and the parking brake released
- (21) One traffic vest for each seating position, each vest to comply with ANSI/ISEA 207, *Standard for High-Visibility Public Safety Vests*, and have a five-point breakaway feature that includes two at the shoulders, two at the sides, and one at the front
- (22) Five fluorescent orange traffic cones not less than 28 in. (711 mm) in height, each equipped with a 6 in. (152 mm) retroreflective white band no more than 4 in. (102 mm) from the top of the cone, and an additional 4 in. (102 mm) retroreflective white band 2 in. (51 mm) below the 6 in. (152 mm) band
- (23) Five illuminated warning devices such as highway flares, unless the five fluorescent orange traffic cones have illuminating capabilities
- (24) One automatic external defibrillator (AED)

9.9.4.1 If the supply hose carried does not use sexless couplings, an additional double female adapter and double male adapter, sized to fit the supply hose carried, shall be carried mounted in brackets fastened to the apparatus.

9.9.4.2 If none of the pump intakes are valved, a hose appliance that is equipped with one or more gated intakes with female swivel connection(s) compatible with the supply hose used on one side and a swivel connection with pump intake threads on the other side shall be carried. Any intake connection larger than 3 in. (75 mm) shall include a pressure relief device that meets the requirements of 16.6.6.

9.9.4.3 Reserved.

9.9.4.4 If the apparatus does not have a 2½ in. intake with NH threads, an adapter from 2½ in. NH female to a pump intake

shall be carried, mounted in a bracket fastened to the apparatus if not already mounted directly to the intake.

9.9.4.5 If the supply hose carried has other than 2½ in. NH threads, adapters shall be carried to allow feeding the supply hose from a 2½ in. NH thread male discharge and to allow the hose to connect to a 2½ in. NH female intake, mounted in brackets fastened to the apparatus if not already mounted directly to the discharge or intake.

Chapter 10 Special Service Fire Apparatus

10.1 General. If the apparatus is to function as a special service fire apparatus, it shall meet the requirements of this chapter.

10.2 Fire Pump. If the apparatus is equipped with a fire pump, the pump shall meet the requirements of Chapter 16.

10.3 Reserved.

10.4 Reserved.

10.5 Reserved.

10.6* Equipment Storage. A minimum of 120 ft³ (3.4 m³) of enclosed weather-resistant compartmentation meeting the requirements of Section 15.1 shall be provided for the storage of equipment.

10.7 Reserved.

10.8* Equipment Supplied by the Contractor. If the apparatus is designed to carry ground ladders or has a pump, the contractor shall supply the equipment listed in 10.8.1 and 10.8.2 and shall provide and install such brackets or compartments as are necessary to mount the equipment.

10.8.1 Ground Ladders.

10.8.1.1 If fire department ground ladders are carried on the apparatus, they shall meet the requirements of NFPA 1931 except as permitted by 10.8.1.2.

10.8.1.2 Stepladders and other types of multipurpose ladders shall be permitted to be carried provided they meet either ANSI A14.2, *Ladders — Portable Metal — Safety Requirements*, or ANSI A14.5, *Ladders — Portable Reinforced Plastic — Safety Requirements*, with duty ratings of Type 1A or 1AA.

10.8.2 Suction Hose or Supply Hose. If the special service fire apparatus is equipped with a pump, the requirements in 10.8.2.1 through 10.8.2.3 shall apply.

10.8.2.1 A minimum of 20 ft (6 m) of suction hose or 15 ft (4.5 m) of supply hose shall be carried.

10.8.2.1.1 Where suction hose is provided, a suction strainer shall be furnished.

10.8.2.1.2 Where suction hose is provided, the friction and entrance loss of the combination suction hose and strainer shall not exceed the losses listed in Table 16.2.4.1(b) or Table 16.2.4.1(c).

10.8.2.1.3 Where supply hose is provided, it shall have couplings compatible with the local hydrant outlet connection on one end and the pump intake connection on the other end.

10.8.2.2 Suction and supply hose shall meet the requirements of NFPA 1961.

10.8.2.3* The purchaser shall specify whether suction hose or supply hose is to be provided, the length and size of the hose, the type and size of the couplings, the manner in which the hose is to be carried on the apparatus, and the style of brackets desired.

10.9* Minor Equipment.

10.9.1 General. The equipment listed in 10.9.3 shall be available on the special service fire apparatus before the apparatus is placed in service.

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

10.9.3* The following equipment shall be carried on the apparatus:

- (1) Two portable hand lights
- (2) One approved dry chemical portable fire extinguisher with a minimum 80-B:C rating
- (3) One 2½ gal (9.5 L) or larger water extinguisher
- (4) One SCBA complying with NFPA 1981 for each assigned seating position, but not fewer than two, mounted in brackets fastened to the apparatus or stored in containers supplied by the SCBA manufacturer
- (5) One spare SCBA cylinder for each SCBA carried, each mounted in a bracket fastened to the apparatus or stored in a specially designed storage space(s)
- (6) One first aid kit
- (7) Two or more wheel chocks, mounted in readily accessible locations, that together will hold the apparatus, when loaded to its GVWR or GCWR, on a hard surface with a 20 percent grade with the transmission in neutral and the parking brake released
- (8) One traffic vest for each seating position, each vest to comply with ANSI/ISEA 207, *Standard for High-Visibility Public Safety Vests*, and have a five-point breakaway feature that includes two at the shoulders, two at the sides, and one at the front
- (9) Five fluorescent orange traffic cones not less than 28 in. (711 mm) in height, each equipped with a 6 in. (152 mm) retroreflective white band no more than 4 in. (102 mm) from the top of the cone, and an additional 4 in. (102 mm) retroreflective white band 2 in. (51 mm) below the 6 in. (152 mm) band
- (10) Five illuminated warning devices such as highway flares, unless the five fluorescent orange traffic cones have illuminating capabilities
- (11) One automatic external defibrillator (AED)

Chapter 11 Mobile Foam Fire Apparatus

11.1 General. If the apparatus is to function as a mobile foam fire apparatus, it shall meet the requirements of this chapter.

11.2 Fire Pump. The apparatus shall be equipped with a fire pump that has a minimum rated capacity of 750 gpm (3000 L/min) and meets the requirements of Chapter 16.

11.3 Aerial Device. If the mobile foam fire apparatus is equipped with an aerial device, the requirements of 11.3.1 through 11.3.3 shall apply.

11.3.1 The aerial device shall meet the requirements of Chapter 19.

11.3.2 The aerial device shall be equipped with a permanently mounted waterway, and the fire pump shall be capable of supplying the flow requirements of 19.6.1, 19.12.1, or 19.16.1 with a maximum intake gauge pressure of 20 psi (138 kPa).

11.3.3 Provisions shall be made to ensure that the pump operator is not in contact with the ground.

11.4 Foam Proportioning System. The apparatus shall be equipped with a foam proportioning system that meets the requirements of Chapter 20.

11.5 Foam Tank. The mobile foam fire apparatus shall be equipped with a foam concentrate tank(s) that meets the requirements of Section 20.6 and that has a minimum certified capacity (combined, if applicable) of 500 gal (2000 L).

11.6* Equipment Storage. A minimum of 40 ft³ (1.13 m³) of enclosed weather-resistant compartmentation that meets the requirements of Section 15.1 shall be provided for the storage of equipment.

11.7* Hose Storage. Hose bed area(s), compartments, or reels that comply with Section 15.10 shall be provided to accommodate the following:

- (1) A minimum hose storage area of 30 ft³ (0.8 m³) for 2½ in. (65 mm) or larger fire hose
- (2) Two areas, each a minimum of 3.5 ft³ (0.1 m³), to accommodate 1½ in. (38 mm) or larger preconnected fire hose lines

11.8* Equipment Supplied by the Contractor. The contractor shall supply the equipment listed in 11.8.2 and shall provide and install such brackets or compartments as are necessary to mount the equipment.

11.8.1 Reserved.

11.8.2 Suction Hose or Supply Hose.

11.8.2.1 A minimum of 20 ft (6 m) of suction hose or 15 ft (4.5 m) of supply hose shall be carried.

11.8.2.1.1 Where suction hose is provided, a suction strainer shall be furnished.

11.8.2.1.2 Where suction hose is provided, the friction and entrance loss of the combination suction hose and strainer shall not exceed the losses listed in Table 16.2.4.1(b) or Table 16.2.4.1(c).

11.8.2.1.3 Where supply hose is provided, it shall have couplings compatible with the local hydrant outlet connection on one end and the pump intake connection on the other end.

11.8.2.2 Suction hose and supply hose shall meet the requirements of NFPA 1961.

11.8.2.3* The purchaser shall specify whether suction hose or supply hose is to be provided, the length and size of the hose, the type and size of the couplings, the manner in which the hose is to be carried on the apparatus, and the style of brackets desired.

11.9* Minor Equipment.

11.9.1 General. The equipment listed in 11.9.3 and 11.9.4 shall be available on the mobile foam fire apparatus before the apparatus is placed in service.

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

11.9.3* Fire Hose and Nozzles. The following fire hose and nozzles shall be carried on the apparatus:

- (1) 800 ft (240 m) of 2½ in. (65 mm) or larger fire hose, in any combination
- (2) 400 ft (120 m) of 1½ in. (38 mm), 1¾ in. (45 mm), or 2 in. (52 mm) fire hose, in any combination
- (3) Four foam or water handline nozzles, 200 gpm (750 L/min) minimum
- (4) Two foam or water handline nozzles, 95 gpm (360 L/min) minimum
- (5) One preconnected monitor, rated to discharge a minimum of 1000 gpm (4000 L/min), mounted on top of the fire apparatus with a spray or foam nozzle rated at a minimum of 1000 gpm (4000 L/min)

11.9.4* Miscellaneous Equipment. The following additional equipment shall be carried on the apparatus:

- (1) One 6 lb (2.7 kg) pickhead axe
- (2) One 6 ft (2 m) pike pole or plaster hook
- (3) Two portable hand lights
- (4) One approved dry chemical portable fire extinguisher with a minimum 80-B:C rating
- (5) One SCBA complying with NFPA 1981 for each assigned seating position, but not fewer than four, mounted in brackets fastened to the apparatus or stored in containers supplied by the SCBA manufacturer
- (6) One spare SCBA cylinder for each SCBA carried, each mounted in a bracket fastened to the apparatus or stored in a specially designed storage space
- (7) One first aid kit
- (8) Four combination spanner wrenches
- (9) Two hydrant wrenches
- (10) One double female 2½ in. (65 mm) adapter with National Hose (NH) threads
- (11) One double male 2½ in. (65 mm) adapter with NH threads
- (12) One rubber mallet, suitable for use on suction hose connections
- (13) Two or more wheel chocks, mounted in readily accessible locations, that together will hold the apparatus, when loaded to its GVWR or GCWR, on a hard surface with a 20 percent grade with the transmission in neutral and the parking brake released
- (14) One traffic vest for each seating position, each vest to comply with ANSI/ISEA 207, *Standard for High-Visibility Public Safety Vests*, and have a five-point breakaway feature that includes two at the shoulders, two at the sides, and one at the front
- (15) Five fluorescent orange traffic cones not less than 28 in. (711 mm) in height, each equipped with a 6 in. (152 mm) retroreflective white band no more than 4 in. (102 mm) from the top of the cone, and an additional 4 in. (102 mm) retroreflective white band 2 in. (51 mm) below the 6 in. (152 mm) band
- (16) Five illuminated warning devices such as highway flares, unless the five fluorescent orange traffic cones have illuminating capabilities
- (17) One automatic external defibrillator (AED)

11.9.4.1 If the supply hose carried does not use sexless couplings, an additional double female adapter and double

male adapter, sized to fit the supply hose carried, shall be carried mounted in brackets fastened to the apparatus.

11.9.4.2 If none of the pump intakes are valved, a hose appliance that is equipped with one or more gated intakes with female swivel connection(s) compatible with the supply hose used on one side and a swivel connection with pump intake threads on the other side shall be carried. Any intake connection larger than 3 in. (75 mm) shall include a pressure relief device that meets the requirements of 16.6.6.

11.9.4.3 If the mobile foam fire apparatus is equipped with an aerial device with a permanently mounted ladder, four ladder belts meeting the requirements of NFPA 1983 shall be provided.

11.9.4.4 If the apparatus does not have a 2½ in. intake with NH threads, an adapter from 2½ in. NH female to a pump intake shall be carried, mounted in a bracket fastened to the apparatus if not already mounted directly to the intake.

11.9.4.5 If the supply hose carried has other than 2½ in. NH threads, adapters shall be carried to allow feeding the supply hose from a 2½ in. NH thread male discharge and to allow the hose to connect to a 2½ in. NH female intake, mounted in brackets fastened to the apparatus if not already mounted directly to the discharge or intake.

Chapter 12 Chassis and Vehicle Components

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

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

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

- (1) The chassis, body, and tank(s)
- (2) Full fuel, lubricant, and other chassis or component fluid tanks or reservoirs
- (3) Full water and other agent tanks
- (4)* 250 lb (114 kg) in each seating position
- (5)* Fixed equipment such as pumps, aerial devices, generators, reels, and air systems as installed
- (6) Ground ladders, suction hose, designed hose load in their hose beds and on their reels
- (7) An allowance for miscellaneous equipment that is the greatest of the the following:
 - (a) The values shown in Table 12.1.2
 - (b) A purchaser-provided list of equipment to be carried with weights
 - (c) A purchaser-specified miscellaneous equipment allowance

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

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

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

12.1.5.1* The label shall show the height of the completed unequipped fire apparatus in feet and inches(meters), the length of the completed fire apparatus in feet and inches (meters), and the GVWR in tons (metric tons).

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

12.2 Engine and Engine System Design.

12.2.1* Chassis Engine.

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

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

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

12.2.1.4 Engine derate programming shall be permitted to be used to protect the engine.

12.2.1.5 Engine Speed Auxiliary Control Device.

12.2.1.5.1* An engine speed auxiliary control device (high idle switch or throttle) shall be installed to allow an increase in the engine speed when the apparatus is parked.

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

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

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

12.2.1.7 An engine hourmeter shall be provided.

12.2.2 Cooling System.

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

12.2.2.2 Drain Valves.

12.2.2.2.1 Readily accessible drain valves shall be installed at the lowest point of the cooling system and at such other points

as are necessary to permit complete removal of the coolant from the system.

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

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

12.2.3 Lubrication System.

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

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

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

- (1) Engine oil
- (2) Engine coolant
- (3) Chassis transmission fluid
- (4) Pump transmission lubrication fluid
- (5) Pump priming system fluid, if applicable
- (6) Drive axle(s) lubrication fluid
- (7) Air conditioning refrigerant
- (8) Air conditioning lubrication oil
- (9) Power steering fluid
- (10) Cab tilt mechanism fluid
- (11) Transfer case fluid
- (12) Equipment rack fluid
- (13) CAFS air compressor system lubricant
- (14) Generator system lubricant
- (15)* Front tire cold pressure
- (16)* Rear tire cold pressure
- (17) Maximum tire speed ratings

12.2.4* Air Intake System.

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

12.2.4.2 Air inlet restrictions shall not exceed the engine manufacturer's recommendations.

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

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

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

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

12.2.5 Fuel System.

12.2.5.1 Diesel Engines.

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

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

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

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

Table 12.1.2 Miscellaneous Equipment Allowance

Apparatus Type	Apparatus Size	Equipment Allowance	
		lb	kg
Pumper fire apparatus	Less than 250 ft ³ (7 m ³) compartment space*	2,000	910
	250 ft ³ (7 m ³) or more of compartment space*	2,500	1,135
Initial attack fire apparatus	10,000 lb to 15,000 lb (4,500 kg to 7,000 kg) GVWR	900	410
	15,001 lb to 20,000 lb (7,001 kg to 9,000 kg) GVWR	1,500	680
	20,001 lb (9,000 kg) and up GVWR	2,000	910
Mobile water supply fire apparatus	All	1,000	455
Aerial fire apparatus	All	2,500	1,135
Quint fire apparatus	All	2,500	1,135
Special service fire apparatus	10,000 lb to 15,000 lb (4,500 kg to 7,000 kg) GVWR	2,000	910
	15,001 lb to 20,000 lb (7,001 kg to 9,000 kg) GVWR	2,500	1,135
	20,001 lb to 30,000 lb (9,001 kg to 14,000 kg) GVWR	3,000	1,350
	30,001 lb to 40,000 lb (14,001 kg to 18,000 kg) GVWR	4,000	1,800
	40,001 lb to 50,000 lb (18,001 kg to 23,000 kg) GVWR	6,000	2,700
	50,001 lb to 60,000 lb (23,001 kg to 27,000 kg) GVWR	8,000	3,600
	60,001 lb (27,001 kg) and up GVWR	10,000	4,500
Mobile foam fire apparatus	All	2,000	910

*Compartment space for pumps is calculated based on the inside dimensions of the enclosed compartment.

12.2.5.1.5 The line(s) shall be protected from mechanical damage.

12.2.5.1.6 Electric Fuel Priming System.

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

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

12.2.5.1.6.3 The priming system shall be marked with a label to indicate proper operation.

12.2.5.2 Gasoline Engines.

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

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

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

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

12.2.5.2.5 The line(s) shall be protected from mechanical damage.

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

12.2.6 Exhaust System.

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

12.2.6.2 Exhaust pipe discharge shall be directed away from any operator's position.

12.2.6.3 If the apparatus is equipped with stabilizers, the exhaust piping discharge shall be directed away from the contact area between the stabilizer and the ground when the stabilizer is deployed.

12.2.6.4 Silencing devices shall be provided.

12.2.6.5 Exhaust backpressure shall not exceed the limits specified by the engine manufacturer.

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

12.2.6.7* Diesel Particulate Filter. If the apparatus is driven by a diesel engine equipped with a diesel particulate filter (DPF), the requirements of 12.2.6.7.1 through 12.2.6.7.7 shall apply.

12.2.6.7.1 The regeneration process shall be activated automatically by the engine system.

12.2.6.7.2 Apparatus having GVWR of 20,000 lb (9,000 kg) or greater shall be equipped with a switch located in the driver's

area of the driving compartment to initiate the regeneration process manually.

12.2.6.7.3 Instructions for initiating the manual regeneration process shall be explained in the apparatus operator's manual.

12.2.6.7.4* For apparatus over 20,000 lb (9,000 kg), a switch shall be provided at the driver's area that will inhibit DPF regeneration until the switch is reset or the engine is shut down and restarted.

12.2.6.7.5 A DPF icon visible to the driver when seated in the driver's seat shall be illuminated to indicate that the DPF requires active regeneration.

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

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

12.3 Vehicle Components.

12.3.1 Braking System.

12.3.1.1 All brakes shall be readily accessible for adjustment.

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

- (1) An automatic moisture ejector
- (2) An air dryer
- (3) A pressure protection valve to prevent all air-operated accessories from drawing air from the air brake system when the air system's pressure drops below 80 psi (550 kPa)
- (4) A quick buildup section in the air reservoir system arranged so that if the apparatus has a completely discharged air system, it is able to move within 60 seconds of startup

12.3.1.2.1 The quick buildup system shall provide sufficient air pressure so that the apparatus has no brake drag and is able to stop under the intended operating conditions following the 60-second buildup time.

12.3.1.2.2* On a chassis that cannot be equipped with a quick buildup air brake system, an onboard automatic electric compressor or a fire station compressed air shoreline hookup shall be permitted in order to maintain full operating air pressure while the vehicle is not running.

12.3.1.3* Parking Brakes.

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

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

12.3.1.4* Auxiliary Brake.

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

12.3.1.4.2 Auxiliary brakes shall have a switch to turn them off during adverse road conditions.

12.3.1.4.3 The DOT brake lights shall illuminate when the auxiliary brake is applied.

12.3.1.5* Any time a secondary braking device such as transmission retarders or exhaust restriction devices are used, they shall have a switch to turn them off during adverse road conditions.

12.3.1.6 All fire apparatus, including those with an axle rated greater than 29,000 lb, shall comply with 49 CFR 571.121.

12.3.2 Suspension and Wheels.

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

12.3.2.1.1 Where the vehicle tires are utilized as part of an aerial device stability system, the maximum loads imposed on the tires shall not exceed the tire manufacturer's maximum static load rating.

12.3.2.1.2* Safety sign FAMA12, which warns of the special requirements for fire service-rated tires, shall be visible to the driver entering the cab of any apparatus so equipped.

12.3.2.2 Axle housings and any components other than wheels, tires, automatic tire chains, and items designed to swing clear shall clear the road surface by at least 8 in. (203 mm).

12.3.2.3* An angle of approach and an angle of departure of at least 8 degrees shall be maintained at the front and the rear of the vehicle when it is loaded to the estimated in-service weight.

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

12.3.2.5 Steering.

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

12.3.2.5.2 Power steering or power-assisted steering shall be provided.

12.3.2.6 Tractor-Drawn Aerial Fire Apparatus.

12.3.2.6.1 If a tractor-drawn vehicle is provided for an aerial fire apparatus, it shall consist of a tractor with a permanent, nonkingpinned "fifth wheel" mounted on the rear of the chassis to carry the forward end of the aerial ladder trailer unit.

12.3.2.6.2 The fifth wheel and body design shall be of a type that allows full 90-degree jackknifing of the tractor trailer combination with the stabilizers in the stored position.

12.3.2.6.3 A steering wheel shall be provided to steer the rear wheels of the trailer unit.

12.3.2.6.3.1 The steering shall be of the power or power-assisted type.

12.3.2.6.3.2 A minimum wheel cramp angle of 20 degrees right and left shall be provided.

12.3.2.6.4 An audible and visual warning system shall be provided to warn both drivers when the jackknife position approaches the manufacturer's maximum allowable position.

12.3.2.6.5 If the manufacturer's design does not permit the load from the aerial device to be transferred to the rear springs of the tractor, a device shall be installed that will prevent such a weight transfer.

12.3.3* Transmission.

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

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

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

12.3.4 Fuel Tank.

12.3.4.1* The fuel capacity shall allow the engine to drive the pump for 2½ hours at rated pump capacity at 150 psi (1000 kPa) net pump pressure and at the suction conditions specified in this standard or to operate at 60 percent of gross engine horsepower for 2½ hours, whichever is greater.

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

12.3.4.3 If two fuel tanks are furnished, the fuel system shall not require manual intervention to provide fuel to the engine. A single fuel gauge shall indicate the proportional amount of fuel in the fuel system.

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

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

12.3.4.6 The tank shall be placed so it is removable for repairs.

12.3.4.7 A means for draining the tank without removing the tank shall be supplied.

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

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

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

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

- (1) A primary electrical receptacle shall be provided near the hitch point and shall match the umbilical cable specified in 26.10.4.4.

(2) Gladhands shall be provided for air brake connections.

12.3.6.3 An auxiliary electrical receptacle shall be provided near the hitch point and shall match the umbilical cable specified in 26.10.4.6.

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

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

Chapter 13 Low Voltage Electrical Systems and Warning Devices

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

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

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

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

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

13.2.1.3 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*.

13.2.2 Wiring and Wire Harness Construction.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

13.3 Power Supply.

13.3.1 A 12 V or greater electrical alternator shall be provided.

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

13.3.3 Minimum Continuous Electrical Load.

13.3.3.1 The minimum continuous electrical load shall consist of the total amperage required to simultaneously operate the following in a stationary mode during emergency operations:

- (1) The propulsion engine and transmission

- (2) All legally required clearance and marker lights, head-lights, and other electrical devices except windshield wipers and four-way hazard flashers
- (3) The radio(s) at a duty cycle of 10 percent transmit and 90 percent receive (for calculation and testing purposes, a default value of 5 A continuous)
- (4) The lighting necessary to produce 2 fc (20 lx) of illumination on all walking surfaces on the apparatus and on the ground at all egress points onto and off the apparatus, 5 fc (50 lx) of illumination on all control and instrument panels, and 50 percent of the total compartment lighting loads
- (5) The minimum optical warning system required in Section 13.8, where the apparatus is blocking the right-of-way
- (6) The continuous electrical current required to simultaneously operate any fire pumps, aerial devices, and hydraulic pumps
- (7)* Other warning devices and electrical loads defined by the purchaser as critical to the mission of the apparatus

13.3.3.2 If the apparatus is equipped to tow a trailer, an additional 45 A shall be added to the minimum continuous electrical load to provide electrical power for the federally required clearance and marker lighting and the optical warning devices mounted on the trailer.

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

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

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

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

13.3.6 Load Management.

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

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

13.4* Batteries.

13.4.1 Batteries shall be of the high-cycle type.

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

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

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

13.4.4.1 The batteries shall be readily accessible for examination, testing, and maintenance.

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

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

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

13.4.5* An onboard battery conditioner or charger or a polarized inlet shall be provided for charging all batteries. Where an onboard conditioner or charger is supplied, the associated line voltage electrical power system shall be installed in accordance with Chapter 22.

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

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

13.4.6.1 The starter solenoids shall be connected directly to the batteries.

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

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

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

13.4.6.5 Rechargeable hand lights, radios, and other similar devices shall be permitted to be connected to the electrical system ahead of the master disconnect switch.

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

13.5 Starting Device.

13.5.1 An electrical starting device shall be provided for the engine.

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

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

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

13.8 Optical Warning Devices. Each apparatus shall have a system of optical warning devices that meets or exceeds the requirements of this section.

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

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

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

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

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

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

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

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

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

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

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

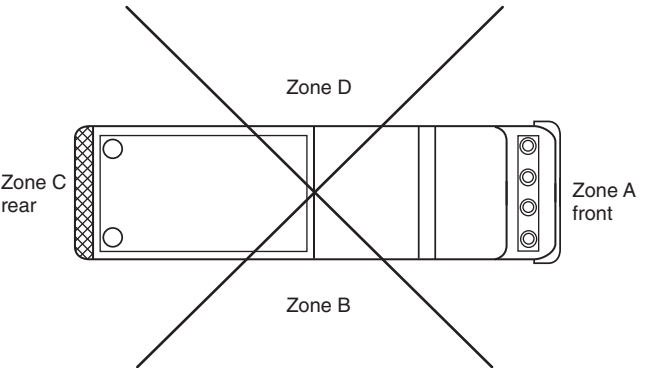


FIGURE 13.8.3.2 Warning Zones for Optical Warning Devices.

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

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

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

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

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

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

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

13.8.11 Flash Rate.

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

13.8.11.1.1 Steadily burning, nonflashing optical sources shall be permitted to be used.

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

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

13.8.12* Color of Warning Lights.

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

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

Table 13.8.12.1 Zone Colors

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

13.8.13* Requirements for Large Apparatus.

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

13.8.13.2 Upper-Level Optical Warning Devices.

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

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

13.8.13.3 Lower-Level Optical Warning Devices.

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

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

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

13.8.13.4 Midship Optical Warning Devices.

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

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

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

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

13.8.13.6 No individual measurement point shall be less than that shown in Table 13.8.13.5.

13.8.14* Requirements for Small Apparatus.

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

13.8.14.2 Upper-Level Optical Warning Devices.

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

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

13.8.14.3 Lower-Level Optical Warning Devices.

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

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

Table 13.8.13.5 Minimum Optical Power Requirements for Large Apparatus

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

Notes:

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

2. H = Horizontal plane passing through the optical center.

3. The values in the H Total columns are the total of 19 data point values for each light, with data points on the boundary between zones counted in both zones.

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

13.8.14.3.4* It shall be permitted for red zone C lower flashing lights to switch to steady-on lights when the service brakes are applied and the optical warning light system is on in the "Clearing Right-of-Way" mode.

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

13.8.14.5 No individual measurement point shall be less than that shown in Table 13.8.14.4.

13.8.15 Tests of Optical Warning Devices.

13.8.15.1 Mechanical and Environmental Test.

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

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

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

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

13.8.15.2 Photometric Test Procedures for Optical Devices.

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

13.8.15.2.1.1 The results of the testing shall be used to determine compliance with this standard, and all required photometric data shall be available, upon request, from the optical warning device manufacturer.

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

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

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

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

13.8.15.2.3 For all tests performed with the power applied, the lighting system, or component thereof, shall be operated at 12.8 V ± 0.1 V for 12 V nominal equipment, 25.6 V ± 0.2 V for 24 V nominal equipment, and 38.4 V ± 0.3 V for 42 V nominal equipment.

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

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

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

Table 13.8.14.4 Minimum Optical Power Requirements for Small Apparatus

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

Notes:

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

2. *H* = Horizontal plane passing through the optical center.

3. The values in the *H* Total columns are the total of 19 data point values for each light, with data points on the boundary between zones counted in both zones.

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

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

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

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

- (1) Certification that the system was installed within the geometric parameters specified by the manufacturer of the system referencing the optical source test reports provided by the manufacturer of the system
- (2) Certification that a mathematical calculation based on test reports for individual optical sources provided by the manufacturer of the devices and performed by a qualified person demonstrates that the combination of individual devices as installed meets the requirements of this standard
- (3) Actual measurement of the lighting system after installation on the apparatus

13.9 Audible Warning Devices.

13.9.1 Audible warning equipment in the form of at least one automotive traffic horn and one electric or electronic siren shall be provided.

13.9.1.1 The siren manufacturer shall certify the siren as meeting the requirements of SAE J1849, *Emergency Vehicle Sirens*.

13.9.1.2* A means shall be provided to allow the activation of the siren within convenient reach of the driver.

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

13.9.3 Audible warning equipment shall not be mounted on the roof of the apparatus.

13.10 Work Lighting. All light level measurements shall be made with a light meter with a hemispherical light sensor held against the surface, facing perpendicular to the surface, and not deliberately pointed toward the light source.

13.10.1 Ground Lighting.

13.10.1.1* Rear Work Area.

13.10.1.1.1 The work area immediately behind the vehicle shall be illuminated to an average level of at least 3 fc (30 lx), measured at 25 equally spaced points on a 2.5 ft (750 mm) grid within a 10 ft × 10 ft (3 m × 3 m) square to the rear of the vehicle.

13.10.1.1.2 At least 80 percent of the 25 measurements shall meet or exceed 3 fc (30 lx).

13.10.1.1.3 If the apparatus includes an aerial platform stowed over the rear work area, the measurements shall be made with the aerial raised.

13.10.1.2 The fire apparatus shall be equipped with lighting that is capable of providing illumination at a minimum level of 2 fc (20 lx) on ground areas within 30 in. (800 mm) of the edge of the apparatus in areas designed for personnel to climb onto the apparatus or descend from the apparatus to the ground level.

13.10.1.3 Lighting designed to provide illumination on areas under the driver and crew riding area exits shall be switchable but activated automatically when the exit doors are opened.

13.10.1.4 All other ground area lighting shall be switchable.

13.10.2* Hose Bed Lighting.

13.10.2.1 If a hose bed is provided, lighting on the hose bed floor shall be at an average level of 3 fc (30 lx) or higher measured at 30 in. equally spaced intervals along the center of the hose bed floor with all dividers and covers removed.

13.10.2.2 Lateral hose beds (crosslays) that are permanently covered shall not be required to be illuminated.

13.10.3* Surface Lighting. The apparatus shall have sufficient lighting to provide a minimum level of 2 fc (20 lx) on all work surfaces, steps, and walkways.

13.10.4* Interior Lighting. The apparatus shall have sufficient lighting to provide an average level of 2 fc (20 lx) at each seating surface when measured at the center and at each corner of the seat cushion in the driving and crew compartments.

13.10.5 Compartment Lighting.

13.10.5.1 Each engine compartment and pump compartment shall have a light of at least 20 candlepower (250 lumens).

13.10.5.2 The priming lubricant reservoir, if applicable, shall be illuminated.

13.10.5.3 Each enclosed tool and equipment compartment greater than 4 ft³ (0.1 m³) in volume and having an opening greater than 144 in.² (92,900 mm²) shall have sufficient compartment lighting to provide a minimum of 2 fc (20 lx) at any location on the floor of the compartment without any shelves, dividers, or equipment in the compartment.

13.10.5.4 Compartments such as ladder tunnels, pikepole storage tubes, or underbody compartments designed around the volumetric requirements of specific equipment that can be removed without the use of article illumination shall not be required to have compartment lighting.

13.10.6 Switching. Switches for all work lighting shall be readily accessible.

13.10.7 Protection. The lights shall be arranged or protected to minimize accidental breakage.

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

- (1) Vibration
- (2) Moisture
- (3) Dust
- (4) Corrosion
- (5) High temperature

- (6) Low temperature
- (7) Durability
- (8) Warpage

13.11 Hazard Light.

13.11.1 A red flashing or rotating light, located in the driving compartment, shall be illuminated automatically whenever the apparatus's parking brake is not fully engaged and any of the following conditions exist:

- (1) Any driver, passenger, or equipment compartment door is not closed.
- (2) Any ladder or equipment rack is not in the stowed position.
- (3) Stabilizer system is not in its stowed position.
- (4) Powered light tower is not stowed.
- (5) Any other device permanently attached to the apparatus is open, extended, or deployed in a manner that is likely to cause damage to the apparatus if the apparatus is moved.

13.11.2 Compartments meeting all of the following conditions shall be permitted to be exempt from the requirements of 13.11.1.

- (1) The volume is less than or equal to 4 ft³ (0.1 m³).
- (2) The compartment has an opening less than or equal to 144 in.² (92,900 mm²).
- (3) The open door does not extend sideways beyond the mirrors or up above the top of the fire apparatus.
- (4) All equipment in the compartment is restrained so that nothing can fall out if the door is open while the apparatus is moving.

13.11.3* Paragraph 13.11.1 shall not apply to manually raised pole lights with an extension of less than 5 ft (1.5 m).

13.11.4 The hazard light shall be marked with a sign that reads "Do Not Move Apparatus When Light Is On."

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

13.13 Stop, Tail, and Directional Lights.

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

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

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

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

13.14 Electrical System Performance Tests.

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

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

13.14.1.2 The certification shall be delivered with the apparatus.

13.14.2 Tests shall be performed when the air temperature is between 0°F and 110°F (–18°C and 43°C).

13.14.3 Test Sequence.

13.14.3.1 The three tests defined in 13.14.3.2 through 13.14.3.4.4 shall be performed in the order in which they appear.

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

13.14.3.1.2 Failure of any of these tests shall require a repeat of the sequence.

13.14.3.2 Reserve Capacity Test.

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

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

13.14.3.2.3 All electrical loads shall be turned off prior to attempting to restart the engine.

13.14.3.2.4 The battery system shall then be capable of restarting the engine.

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

13.14.3.3 Alternator Performance Test at Idle.

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

13.14.3.3.2 The engine temperature shall be stabilized at normal operating temperature.

13.14.3.3.3 The battery system shall be tested to detect the presence of battery discharge current.

13.14.3.3.4 The detection of battery discharge current shall be considered a test failure.

13.14.3.4* Alternator Performance Test at Full Load.

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

13.14.3.4.2 The test duration shall be a minimum of 2 hours.

13.14.3.4.3 Activation of the load management system shall be permitted during this test.

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

13.14.4 Low Voltage Alarm Test.

13.14.4.1 The following test shall be started with the engine off and the battery voltage at or above 12 V for a 12 V nominal

system, 24 V for a 24 V nominal system, or 36 V for a 42 V nominal system.

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

13.14.4.3 The battery voltage shall be measured at the battery terminals.

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

13.14.4.5 The battery system shall then be able to restart the engine.

13.14.4.6 Failure to restart the engine shall be considered a test failure.

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

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

Chapter 14 Driving and Crew Areas

14.1 General.

14.1.1 Each crew riding position shall be within a fully enclosed personnel area.

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

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

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

- (1) Locate an imaginary line where the plane of the center of the seat back surface intersects the plane of the center of the seat cushion surface (line 1 in Figure 14.1.3.1). For seats with an SCBA seat back, use a plane that simulates the position of an SCBA back pad installed in the SCBA holder.
- (2) Locate point A on line 1 at the outside of the seat on the retractor side of the seat.
- (3) Locate point C on line 1 at the outside of the seat on the buckle side of the seat.
- (4) Locate point D at the tip of the buckle.

- (5) Pull the seat belt webbing entirely out of the retractor and measure along the webbing between point A and the seat belt latch plate (tongue). Record this length as AD.
- (6) Measure from point C to point D and record this length as CD.
- (7) The effective seat belt web length equals AD + CD.

14.1.3.2* A Type 2 seat belt shall have either a single retractor or dual retractors. A single retractor, Type 2 pelvic and upper torso restraint-style seat belt assembly shall have a minimum effective seat belt web length of 110 in. (2800 mm) with the seat adjusted all the way back and down and when measured in accordance with 14.1.3.2.1. A dual retractor Type 2 pelvic and upper torso restraint-style seat belt assembly shall have a minimum effective shoulder belt web length of 50 in. (1270 mm) and a minimum effective lap belt web length of 60 in. (1530 mm) with the seat all the way back and down and as measured in 14.1.3.2.2.

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

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

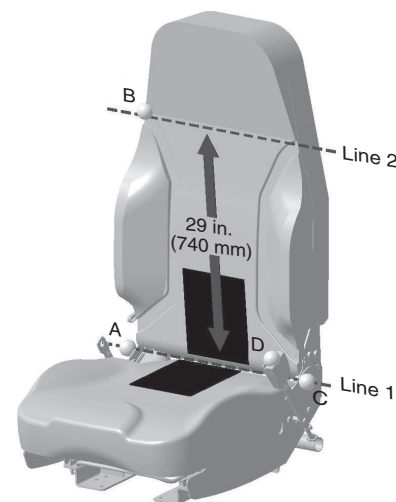


FIGURE 14.1.3.1 Dimension Lines for Measuring Seat Belt Effective Length.

- (8) Measure from point C to Point D and record this length as CD.
- (9) The effective lap belt web length equals $AB + 2CD$.

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

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

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

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

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

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

14.1.3.6 Tiller seats shall have a lap belt.

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

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

14.1.3.9 A seat belt warning system shall be provided.

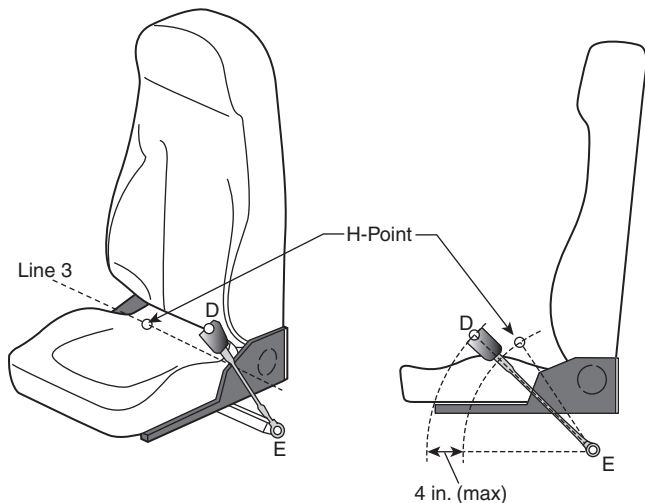


FIGURE 14.1.3.2.3 Dimension Lines for Measuring Buckle Length.

14.1.3.9.1 The warning system shall consist of an audible warning device that can be heard at all seating positions designed to be occupied while the vehicle is in motion and a visual display visible to the driver or the officer showing the condition of each seating position.

14.1.3.9.2 The warning shall be activated anytime the parking brake is released or the automatic transmission is not in park.

14.1.3.9.3 The seat position display shall indicate conditions in accordance with Table 14.1.3.9.3.

14.1.3.9.4 The display indication shall be permitted to consist of lights, text, graphical indicators, digital displays, or other methods.

14.1.3.9.5 The warning system shall not show an affirmative indication unless it has determined that the seat was occupied before the seat belt was buckled.

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

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

14.1.6 At any seat location, the maximum noise level shall be 90 dBA without any warning devices in operation, as measured by the test procedure defined in 49 CFR 393.94(c), "Interior noise levels in power units, test procedure," except that the test shall be performed with the vehicle traveling at a steady speed of 45 mph (72 km/hr) on a level, paved, smooth-surface road.

Table 14.1.3.9.3 Display for Seating System

Display Indication	Seat Belt	Seat Sensor
Affirmative indication	Buckled	Senses occupant
Negative indication	Buckled	No occupant
Negative indication	Unbuckled	Senses occupant
Dark	Unbuckled	No occupant

14.1.7 Seat Head Height.

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

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

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

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

14.1.7.4* The following statement shall be included in the operator's manual: "Fire helmets shall not be worn by persons riding in enclosed driving and crew areas. Fire helmets are not designed for crash protection and they will interfere with the protection provided by head rests. The use of seat belts is essential to protecting fire fighters during driving."

14.1.7.4.1 A location for helmet storage shall be provided.

14.1.7.4.2 If helmets are to be stored in the driving or crew compartment, the helmets shall be secured in compliance with 14.1.10.2.

14.1.7.4.3 Safety sign FAMA15, which warns not to wear helmets while the vehicle is in motion, shall be visible from each seat that is intended to be occupied while the vehicle is in motion.

14.1.8 Seat Arrangement.

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

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

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

14.1.8.3.1 The back cushion shall be permitted to be split to accommodate a fully recessed SCBA and bracket.

14.1.8.3.2 Where the back cushion is split to accommodate a SCBA, a headrest shall be supplied.

14.1.9 SCBA Mounting.

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

- (1) The SCBA holder shall retain a pack and bottle combination for the published weight rating of the holder

when subjected to the dynamic force pulse per SAE J2418, *Occupant Restraint System Evaluation — Frontal Impact Component-Level Heavy Trucks*.

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

14.1.10 Equipment Mounting.

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

14.1.10.2 All equipment not required to be used during an emergency response, with the exception of SCBA units, shall not be mounted in a driving or crew area unless it is contained in 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.

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

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

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

14.1.13 Means of Escape.

14.1.13.1 Any interior area to be occupied by personnel shall have a minimum of two means of escape.

14.1.13.2 Each opening shall be a minimum of 24 in. × 24 in. (610 mm × 610 mm).

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

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

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

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

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

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

14.3 Driving Compartment.

14.3.1* A fully enclosed driving compartment with seating capacity for not fewer than two persons shall be provided except at a tiller operator's driving position. (See 14.4.1.)

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

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

14.3.2.1 Tiller cabs shall meet the requirements of SAE J2422, *Cab Roof Strength Evaluation — Quasi-Static Loading Heavy Trucks*.

14.3.3 Driver's Seat.

14.3.3.1 The driver's seat shall be readily adjustable by the driver.

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

14.3.5 All primary rear view mirrors used by the driver shall be adjustable from the driver's position.

14.3.6 Instrumentation and Controls.

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

- (1) Speedometer
- (2) Tachometer
- (3) Odometer
- (4) Oil-pressure indicator or gauge
- (5) Coolant temperature indicator or gauge

- (6) Automatic transmission temperature indicator or gauge, if applicable
- (7) Voltmeter
- (8) Hazard indicator light (see Section 13.11)
- (9) Air-pressure gauge(s), if applicable
- (10) Turn signal control and indicator lights
- (11) Headlight/DOT light switch
- (12) High-beam headlight switch and indicator
- (13) Fuel level gauge(s)
- (14) Master ignition switch (if a key is provided, it shall be unable to be removed from the driving compartment interior)
- (15) Heater/defroster controls
- (16) Warning lights and siren switches
- (17) Master disconnect switch
- (18) "Master disconnect on" indicator light
- (19) Windshield wipers and windshield washer control
- (20) PTO-engaged indicator, if applicable
- (21) Pump engagement controls, if applicable

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

14.4 Tractor-Drawn Vehicles. Where a tractor-drawn vehicle with tillered steering is provided, the requirements of this section also shall apply.

14.4.1 A fully enclosed tiller operator's compartment with seating for one person shall be provided at the rear wheel's steering position.

14.4.2 No side compartmentation shall be installed that obscures the ability of the tiller operator to see the tiller axle fender area.

14.4.3* Seat Arrangement.

14.4.3.1 The manufacturer shall provide a seat with an approved seat belt within the enclosure.

14.4.3.2 The seating space shall be a minimum of 22 in. (560 mm) in width at the shoulder level.

14.4.3.3 The seat cushion shall be a minimum of 18 in. (460 mm) in width and 15 in. (380 mm) from the front of the cushion to the face of the seat back.

14.4.3.4 A back cushion shall be provided.

14.4.3.5 The seat shall have an adjustment range of at least 3 in. (76 mm) from front to rear and be adjustable by the tiller operator.

14.4.4 A warning indicator in the driving compartment shall activate if the parking brake is released and the tiller operator is not signaling his/her presence.

14.4.5 Communications.

14.4.5.1 A two-way buzzer system or a two-way voice intercom shall be provided for communication between the driver and the tiller operator.

14.4.5.2 The communication system shall be operable without the tiller operator having to take his/her hands off the steering wheel.

14.4.6 A heater or ventilation system and defroster shall be provided.

14.4.7 A windshield wiper and washer fluid system shall be provided.

14.4.8 The following instrumentation and controls shall be mounted in the tiller operator's compartment and shall be identified and visible to the tiller operator while seated:

- (1) Heater/defroster controls
- (2) Turn signal indicator lights
- (3) Two-way buzzer signal switch
- (4) Windshield wiper and washer fluid control

14.4.9 Controls and switches that are expected to be operated by the tiller operator while the apparatus is in motion shall be within convenient reach of that operator.

14.4.10 Exterior rearview mirrors shall be provided at the tiller position.

Chapter 15 Body, Compartments, and Equipment Mounting

15.1* Compartmentation.

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

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

15.2* Radio Space. A protected space or compartment shall be provided for the installation of radio equipment.

15.3 Equipment Containment.

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

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

15.3.3 All tools and equipment shall be readily accessible.

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

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

15.4.2 A means shall be provided that will retain the equipment rack in the road travel position when the vehicle is in motion unless the equipment rack is powered by a self-contained device that will eliminate the system from deploying unintentionally.

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

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

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

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

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

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

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

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

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

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

15.5.5* Vertical Storage of SCBA Cylinders in Tubes.

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

15.5.5.2 Each storage tube shall have a drain to prevent accumulation of moisture.

15.5.6* Horizontal Storage of SCBA Cylinders.

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

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

15.6 Pump and Plumbing Access.

15.6.1 One or more doors or panels that open or are removable without the use of tools shall be provided to allow visual inspection or access for checking the fire pump and plumbing area.

15.6.2 The clear opening shall have no one dimension measure less than 18 in. (460 mm).

15.6.3 Additional door(s) or panel(s) that require no more than standard tools to be opened or removed shall be provided for access to the pump and plumbing area.

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