NFPA 1912

Standard for Fire Apparatus Refurbishing

2006 Edition

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NFPA 1912

Standard for

Fire Apparatus Refurbishing

2006 Edition

This edition of NFPA 1912, *Standard for Fire Apparatus Refurbishing*, was prepared by the Technical Committee on Fire Department Apparatus. It was issued by the Standards Council on January 27, 2006, with an effective date of February 16, 2006, and supersedes all previous editions.

This edition of NFPA 1912 was approved as an American National Standard on February 16, 2006.

Origin and Development of NFPA 1912

The first edition of NFPA 1912, *Standard for Fire Apparatus Refurbishing*, was developed when a need was identified for a document to help both fire service administrators and refurbishing contractors in all phases of the refurbishing process. The first edition specified the requirements for two levels of refurbishing. Level I results in the assembly of a new fire apparatus by the use of a new chassis frame, driving and crew compartments, front axle, steering and suspension components, and for the remainder of the apparatus, the use of either new components or components from an existing apparatus. Level II results in the upgrade of major components or systems of a fire apparatus with components or systems that comply with or exceed the applicable standards in effect at the time the original apparatus was manufactured.

This second edition has been reorganized to conform with the *Manual of Style for NFPA Technical Committee Documents*. It has been updated to reflect changes that have been incorporated in NFPA 1901, *Standard for Automotive Fire Apparatus*. It has also been revised to recognize that refurbishing of wildland fire apparatus must be based on NFPA 1906, *Standard for Wildland Fire Apparatus*, not NFPA 1901, *Standard for Automotive Fire Apparatus*.

The extensive appendix material in the first edition that was designed to assist users with the preparation of specifications for refurbishing a fire apparatus has been further enhanced with the addition of the annex materials from NFPA 1901, *Standard for Automotive Fire Apparatus,* that provide the weights and dimensions of common equipment carried on fire apparatus, and the annex material on guidelines for first-line and reserve fire apparatus.

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Technical Committee on Fire Department Apparatus

Jeffrey Bowman, *Chair*
San Diego Fire Department, CA [U]

Kenneth L. Koch, *Secretary*
Sutphen Corporation, OH [M]

William M. Ballantyne, Hypro LLC, MN [M]
Rep. Fire Apparatus Manufacturers Association
Robert J. Barraclough, Plano, TX [SE]
Gene P. Carlson, VFIS/Glatfelter Insurance Group, PA [I]
Rep. Volunteer Firemen's Insurance Services, Inc.
Peter F. Darley, W. S. Darley & Company, IL [M]
Rep. National Truck Equipment Association
Ralph Dorio, Insurance Services Office, NJ [I]
Donald L. Frazeur, Los Angeles Fire Department, CA [U]
Ron W. French, JDK Management Inc., IL [SE]
Gordon L. Gholson, California Department of Forestry and Fire Protection, CA [U]
Gary Handwerk, Hale Products Inc., FL [M]
Tom Hillenbrand, Underwriters Laboratories Inc., IL [RT]
James J. Juneau, Juneau, Boll & Ward, P.L.L.C., TX [SE]
James L. Kelker, National Testing/Conam Inspection Inc., OH [RT]
William McCombs, Emergency One, Inc., FL [M]
John W. McDonald, U.S. General Services Administration, VA [E]
Dan McKenzie, U.S.D.A. Forest Service, CA [RT]
W. Kenneth Menke, Fire Service Research Institute, MO [SE]
J. Allen Metheny, Sr., Hartly Volunteer Fire Company, DE [U]
Rep. National Volunteer Fire Council
Thomas J. Mettler, Waterous Company, MN [M]
David A. Ogilvie, Pierce Manufacturing Inc., WI [M]
Jeff Piechura, Northwest Fire District, AZ [U]
Gary R. Pope, Fairfax County Fire & Rescue Department, VA [U]
James A. Salmi, Crimson Fire, PA [M]
Alan Saulsbury, Fire Spec Services, Inc., NY [SE]
Thomas A. Stalnaker, Goshen Fire Company, PA [U]
John M. Terefinko, KME Fire Apparatus, PA [M]
Robert D. Tutterow, Jr., Charlotte Fire Department, NC [U]
William von Zehle, Jr., Ridgefield, CT [U]
Rep. International Association of Fire Chiefs
David White, Fire & Safety Specialists, Inc., TX [SE]
John R. Witt, Safetek Emergency Vehicles Ltd., Canada [M]

Alternates

Robert T. Bettenhausen, Tinley Park Volunteer Fire Department, IL [U]
(Alt. to W. von Zehle)
James T. Currin, KME Fire Apparatus, VA [M]
(Alt. to J. M. Terefinko)
Andrew L. Duke, Fairfax County Fire & Rescue Department, VA [U]
(Alt. to G. R. Pope)
Ronald L. Ewers, Class I, FL [M]
(Alt. to G. Handwerk)
David V. Haston, U.S. Department of Agriculture, CA [RT]
(Alt. to D. McKenzie)
James Johannessen, Underwriters Laboratories Inc., PA [RT]
(Alt. to T. Hillenbrand)
Brad C. Kobielusz, Poudre Fire Authority, CO [U]
(Alt. to R. D. Tutterow)
J. Roger Lackore, Pierce Manufacturing Inc., WI [M]
(Alt. to D. A. Ogilvie)
Madhu Manikkam, Emergency One, Inc., FL [M]
(Alt. to W. McCombs)
Thomas H. McCullough, II, VFIS Claims Management, Inc., PA [I]
(Alt. to G. P. Carlson)
W. Michael Pietsch, Mike Pietsch, P.E. Consulting Services, Inc., TX [SE]
(Alt. to D. White)
Michael C. Ruthy, W. S. Darley & Company, WI [M]
(Alt. to P. F. Darley)
Thomas G. Stites, Sutphen Corporation, OH [M]
(Alt. to K. L. Koch)
Edward F. Straw, Insurance Services Office, Inc., GA [I]
(Alt. to R. Dorio)
Phillip L. Turner, Elkhart Brass Manufacturing Co., Inc., IN [M]
(Alt. to W. M. Ballantyne)
Dean David Ulrich, Los Angeles City Fire Dept., CA [U]
(Alt. to D. L. Frazeur)

Nonvoting

Howard L. McMillen, Fort Worth, TX
(Member Emeritus)
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Committee Scope: This Committee shall have primary responsibility for documents on the design and performance of fire apparatus for use by the fire service.

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NFPA 1912

Standard for

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2006 Edition

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A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex E. Editorial changes to extracted material consist of revising references to an appropriate division in this document or the inclusion of the document number with the division number when the reference is to the original document. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

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

Chapter 1 Administration

1.1* Scope. This standard specifies the minimum requirements for the refurbishing of automotive fire apparatus utilized for fire fighting and rescue operations, whether the refurbishing is done at the fire department or municipal maintenance facilities, or at the facilities of private contractors or apparatus manufacturers.

1.2 Purpose. This standard specifies the minimum requirements for the refurbishing of automotive fire/rescue apparatus, to ensure that any apparatus refurbished in accordance with this standard meets applicable motor vehicle regulations and applicable portions of the appropriate edition of the NFPA automotive fire apparatus standard.

1.2.1 Apparatus that receives a Level I refurbishing is intended to meet the current edition of the appropriate NFPA automotive fire apparatus standard.

1.2.2 Apparatus that receives a Level II refurbishing is intended to meet the appropriate NFPA automotive fire apparatus standard in effect when the apparatus was originally constructed.

1.3 Application.

1.3.1 This standard is applicable to fire apparatus contracted for refurbishing on or after July 1, 2006; however, nothing shall prevent the use of the standard prior to July 1, 2006, if the purchaser and contractor agree. The standard is not intended to be applied retroactively.

1.3.2 This standard shall not apply to the repair of fire apparatus.

1.4 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.

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

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

1.5* Units of Measure. In this standard, values for measurement in U.S. units are followed by an equivalent in metric units. Either set of values can be used but the same set of values (either U.S. units or metric units) shall be used consistently.

Chapter 2 Referenced Publications

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

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

NFPA 1901, *Standard for Automotive Fire Apparatus,* 2003 edition.

NFPA 1906, *Standard for Wildland Fire Apparatus,* 2006 edition.

NFPA 1911, *Standard for Service Tests of Fire Pump Systems on Fire Apparatus,* 2002 edition.

NFPA 1914, *Standard for Testing Fire Department Aerial Devices,* 2002 edition.

NFPA 1931, *Standard for Manufacturer's Design of Fire Department Ground Ladders,* 2004 edition.

NFPA 1961, *Standard on Fire Hose,* 2002 edition.

NFPA 1964, *Standard for Spray Nozzles,* 2003 edition.

2.3 Other Publications.

2.3.1 NEMA Publication. National Electrical Manufacturers Association, 1300 North 17th Street, Suite 1847, Rosslyn, VA 22209.

NEMA Z535.4, *Standard for Product Safety Signs and Labels,* 2002.

2.3.2 Other Publication.

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

2.4 References for Extracts in Mandatory Sections.

NFPA 58, *Liquefied Petroleum Gas Code,* 2004 edition.

NFPA 1901, *Standard for Automotive Fire Apparatus,* 2003 edition.

NFPA 1906, *Standard for Wildland Fire Apparatus,* 2006 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.

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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 Shall. Indicates a mandatory requirement.

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

3.3 General Definitions.

3.3.1 Acceptance. An agreement between the purchasing authority and the contractor that the terms and conditions of the contract have been met. [**1901**, 2003]

3.3.2 Acceptance Tests. Tests performed on behalf of or by the purchaser at the time of delivery to determine compliance with the specifications for the fire apparatus. [**1901**, 2003]

3.3.3 Aerial Device. An aerial ladder, elevating platform, or water tower that is designed to position personnel, handle materials, provide continuous egress, or discharge water. [**1901**, 2003]

3.3.4 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.

3.3.5 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. [**1901**, 2003]

3.3.6 Angle of Approach. The smallest angle made between the road surface and a line drawn from the front point of ground contact of the front tire to any projection of the apparatus in front of the front axle. [**1901**, 2003]

3.3.7 Angle of Departure. The smallest angle made between the road surface and a line drawn from the rear point of ground contact of the rear tire to any projection of the apparatus behind the rear axle. [**1901**, 2003]

3.3.8 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. [**1901**, 2003]

3.3.9 Center of Gravity. The point at which the entire weight of the fire apparatus is considered to be concentrated so that, if supported at this point, the apparatus would remain in equilibrium in any position. [**1901**, 2003]

3.3.10 Chassis. The basic operating motor vehicle including the engine, frame, and other essential structural and mechanical parts, but exclusive of the body and all appurtenances for the accommodation of driver, property, passengers, appliances, or equipment related to other than control. Common usage might, but need not, include a cab (or cowl). [**1901**, 2003]

3.3.11 Component. A constituent part of a fire apparatus or system.

3.3.12 Continuous Egress. A continuous exit or rescue path down an aerial device from an elevated position to the ground. [**1901**, 2003]

3.3.13* Contractor. The person or company responsible for fulfilling an agreed-upon contract. [**1901**, 2003]

3.3.14 Defect. A discontinuity in a part or a failure to function that interferes with the service or reliability for which the part was intended. [**1901**, 2003]

3.3.15 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. [**1901**, 2003]

3.3.16 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. [**1906,** 2006]

3.3.17 Final-Stage Manufacturer. A person who performs such manufacturing operations on an incomplete vehicle that it becomes a completed vehicle. [**1906,** 2006]

3.3.18 Fire Apparatus. A vehicle 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. [**1901**, 2003]

3.3.19 Fire Pump. A water pump with a rated capacity of 250 gpm (1000 L/min) or greater at 150 psi (1000 kPa) net pump pressure that is mounted on a fire apparatus and used for fire fighting. [**1901**, 2003]

3.3.20 Gallon. U.S. Standard. 1 U.S. gal = 0.833 Imperial gal = 231 $in.^3$ = 3.785 L. [**58**, 2004]

3.3.21 Gauge. A visual device that indicates a measurement.

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

3.3.23* 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.

3.3.24* Grade. A measurement of the angle used in road design and expressed as a percentage of elevation change over distance. [**1901**, 2003]

3.3.25* GVWR (Gross Vehicle Weight Rating). The final-stage manufacturer's specified maximum load-carrying capacity of a vehicle having two axle systems (a multiaxle axle installation is one system).

3.3.26 Initial Attack Apparatus. Fire apparatus with a permanently mounted 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. [**1901**, 2003]

3.3.27 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 30 volts (V) rms (ac) or 42.4 V peak (dc) or greater. [**1901**, 2003]

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3.3.28 Low-Voltage Circuit, Equipment, or System. An electrical circuit, equipment, or system where the voltage does not exceed 30 volts (V) rms (ac) or 42.4 V peak (dc).

3.3.29 Manufacturer. The person or persons, company, firm, corporation, partnership, or other organization responsible for turning raw materials or components into a finished product. [**1901**, 2003]

3.3.30 Mobile Foam Fire Apparatus. Fire apparatus with a permanently mounted fire pump, foam proportioning system, and foam concentrate tank(s) whose primary purpose is for use in the control and extinguishment of flammable and combustible liquid fires in storage tanks and other flammable liquid spills. [**1901**, 2003]

3.3.31 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. [**1901**, 2003]

3.3.32* Net Pump Pressure. The sum of the discharge pressure and the suction lift converted to psi or kPa when pumping at draft, or the difference between the discharge pressure and the intake pressure when pumping from a hydrant or other source of water under positive pressure. [**1901**, 2003]

3.3.33 Operator. A person qualified to operate a fire apparatus.

3.3.34 Pump Operator's Panel. The area on a fire apparatus that contains the gauges, controls, and other instruments used for operating the pump. [**1901**, 2003]

3.3.35 Pump Operator's Position. The location from which the pump operator operates the pump. [**1901**, 2003]

3.3.36 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. [**1901**, 2003]

3.3.37* Purchaser. The authority having responsibility for the specification and acceptance of the apparatus. [**1901**, 2003]

3.3.38 Purchasing Authority. The agency that has the sole responsibility and authority for negotiating, placing, and, where necessary, modifying each and every solicitation, purchase order, or other award issued by a governing body. [**1901**, 2003]

3.3.39* 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. [**1901**, 2003]

3.3.40 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 waterway uncharged. [**1901**, 2003]

3.3.41 Rated Capacity (Water Pump). The flow rate to which the pump manufacturer certifies compliance of the pump when it is new. [**1901**, 2003]

3.3.42 Refurbishing.

3.3.42.1* *Level I Refurbishing.* The assembly of a new fire apparatus by the use of a new chassis frame, driving and crew compartment, front axle, steering and suspension components, and the use of either new components or components from an existing apparatus for the remainder of the apparatus.

3.3.42.2* *Level II Refurbishing.* The upgrade of major components or systems of a fire apparatus with components or systems that comply with the applicable standards in effect at the time the original apparatus was manufactured.

3.3.43 Repair. To restore to sound condition after failure or damage.

3.3.44 Replacement. The removal of an existing component or system and the installation of a similar component or system generally of the same model or the same capability (i.e., "like for like" replacement).

3.3.45* Special Services Fire Apparatus. A multipurpose vehicle that primarily provides support services at emergency scenes. [**1901**, 2003]

3.3.46 Suspension System. The components utilized to attach the axle(s) to the frame assembly.

3.3.47 Tanker. See 3.3.31, Mobile Water Supply Apparatus.

3.3.48 Tender. See 3.3.31, Mobile Water Supply Apparatus.

3.3.49 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. [**1901**, 2003]

3.3.50 Unequipped Fire Apparatus. The completed fire apparatus excluding personnel, agent(s), and any equipment removable without the use of tools. [**1901,** 2003]

3.3.51* Upgrade. The substitution or addition of components or systems with new components or systems with improved performance or capability.

3.3.52 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.

3.3.53 Wildland Fire Apparatus. Fire apparatus designed for fighting wildland fires that is equipped with a pump having a capacity normally between 10 gpm and 500 gpm (38 L/min and 1900 L/min), a water tank, limited hose and equipment, and that has pump-and-roll capability. [**1906**, 2006]

Chapter 4 General Requirements

4.1* General.

4.1.1 Fire apparatus receiving Level I refurbishing shall meet the requirements of applicable chapters of the current edition of NFPA 1901, *Standard for Automotive Fire Apparatus*, if the apparatus is not a wildland fire apparatus, or NFPA 1906, *Standard for Wildland Fire Apparatus*, if the apparatus is a wildland fire apparatus, except as noted in Chapter 5.

4.1.2 Fire apparatus receiving Level II refurbishing shall meet the requirements of applicable chapters of the edition of the NFPA automotive fire apparatus standard that was in effect at the time of its original manufacture, except as noted in Chapter 6.

4.2* Responsibility of Purchaser. It shall be the responsibility of the purchaser to specify the details of the fire apparatus refurbishing; its required performance, including where operations at elevations above 2000 ft (600 m) or on grades greater than 6 percent are required; the maximum number of

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fire fighters to ride within the apparatus; specific added continuous electrical loads that exceed the minimum of this standard; and any hose, ground ladders, or equipment to be carried by the apparatus that exceed the minimum requirements of this standard.

4.3 Responsibility of the Contractor.

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

4.3.2* Responsibility for the fire apparatus and equipment shall remain with the contractor until such responsibilities are accepted by the purchaser.

4.4 Fire Apparatus Components. All components shall be installed in accordance with that component manufacturer's installation instructions.

4.4.1 Fire Pump. If the fire apparatus is equipped with a new fire pump, the pump and its associated equipment shall meet the requirements for fire pumps in the current edition of NFPA 1901, *Standard for Automotive Fire Apparatus*.

4.4.2 Auxiliary Pump. If the fire apparatus is equipped with a new auxiliary pump, the pump and its associated equipment shall meet the requirements for auxiliary pumps in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

4.4.3 Wildland Water Pump. If the fire apparatus is equipped with a new wildland water pump, the pump and its associated equipment shall meet the requirements for water pumps in the current edition of NFPA 1906.

4.4.4 Water Tank. If the fire apparatus is equipped with a new water tank, the water tank shall meet the requirements for water tanks in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

4.4.5 Aerial Device. If the fire apparatus is equipped with a new aerial device (i.e., aerial ladder, elevating platform, or water tower), the aerial device shall meet the requirements for aerial devices in the current edition of NFPA 1901.

4.4.6 Foam Proportioning System. If the fire apparatus is equipped with a new foam proportioning system, the apparatus shall meet the requirements for foam proportioning systems in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

4.4.7 Compressed Air Foam System. If the fire apparatus is equipped with a new compressed air foam system, the system shall meet the requirements for compressed air foam systems in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

4.4.8 Line-Voltage Electrical System. If the fire apparatus is equipped with a new line-voltage electrical system or components, the system or components shall meet the requirements for line-voltage electrical systems in the current edition of NFPA 1901.

4.4.9 Command and Communications. If the fire apparatus is equipped with a new command and communications area, the area shall meet the requirements for command and communications areas in the current edition of NFPA 1901.

4.4.10 Air System. If the fire apparatus is equipped with a new air system, the system shall meet the requirements for air systems in the current edition of NFPA 1901.

4.4.11 Winch System. If the fire apparatus is equipped with a new winch system, the system shall meet the requirements for winches in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

4.5 Chassis Components. Each component shall be installed in accordance with that component manufacturer's installation instructions.

4.5.1 Engine. If the fire apparatus is equipped with a new engine, the system shall meet the requirements for engines in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

4.5.2 Transmission/Transfer Case. If the fire apparatus is equipped with a new transmission or transfer case, the component(s) shall meet the requirements for transmissions and transfer cases in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

4.5.3 Braking System. If the fire apparatus is equipped with a new braking system, the system shall meet the requirements for braking systems in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

4.5.4 Axle(s). If the fire apparatus is equipped with a new axle(s), the component(s) shall meet the requirements for axles in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

4.5.5 Suspension, Wheels, and Tires. If the fire apparatus is equipped with new suspension, wheels, or tires, the component(s) shall meet the requirements for new suspension, wheels, and tires in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

4.5.6 Cooling System. If the fire apparatus is equipped with a new cooling system, the system shall meet the requirements for cooling systems in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

4.5.7 Low-Voltage Electrical System. If the fire apparatus is equipped with a new low-voltage electrical system or components, the system or components shall meet the requirements for low-voltage electrical systems in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

4.5.8 Frame. If the fire apparatus is equipped with a new chassis frame, the frame shall meet the requirements for chassis frames in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

4.5.9 Driveline. If the fire apparatus is equipped with a new driveline, the components shall meet the requirements for drivelines in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

4.5.10 Lubrication System. If the fire apparatus is equipped with a new lubrication system, the system shall meet the requirements for lubrication systems in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

4.5.11 Fuel and Air System. If the fire apparatus is equipped with a new fuel and air system, the system shall meet the requirements for fuel and air systems in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

4.5.12 Exhaust System. If the fire apparatus is equipped with a new exhaust system, the system shall meet the requirements for exhaust systems in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

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4.5.13 Driving and Crew Compartment. If the fire apparatus is equipped with a new driving and crew compartment, the assembly shall meet the requirements for driving and crew compartments in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

4.6 Governmental Requirements. The fire apparatus shall comply with all applicable federal and state motor vehicle laws and regulations.

4.7 Personnel Protection.

4.7.1* Guards, shields, or other protection shall be added to refurbished fire apparatus where necessary to prevent injury to personnel by hot, moving, or rotating parts during normal nonmaintenance operations.

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

4.7.3 Vehicular workmanship shall ensure a safe operating environment free of accessible sharp projections and edges.

4.7.4 Safety-related (e.g., caution, warning, danger) tags and labels shall meet the requirements of NEMA Z535.4, *Standard for Product Safety Signs and Labels.*

4.8* Carrying Capacity. The GAWR and 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 4.8.2.

4.8.1 The contractor shall establish the estimated in-service weight during the design of the work to be done in refurbishing the fire apparatus.

4.8.2 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)*200 lb (90 kg) in each seating position
(5) 70 lb (32 kg) for each seating position for personal gear unless specified as not applicable
(6) Fixed equipment such as pumps, aerial devices, generators, reels, and air systems as installed
(7) Ground ladders, suction hose, designed hose load in their hose beds and on their reels
(8) An allowance for miscellaneous equipment that is the greatest of the values shown in Table 4.8.2, a purchaser-provided list of equipment to be carried with weights, or a purchaser-specified miscellaneous equipment allowance

4.8.3 The contractor shall engineer and design the work that will occur to the fire apparatus during the refurbishment such that the completed apparatus, when loaded to its estimated in-service weight, with all movable weights distributed as close as practical to their intended in-service configuration, does not exceed the gross vehicle weight rating (GVWR).

Chapter 5 Level I Refurbishing

5.1* General. Fire apparatus refurbished to Level I standards shall meet the current requirements of NFPA 1901, *Standard for Automotive Fire Apparatus*, or NFPA 1906, *Standard for Wildland Fire Apparatus*, whichever is applicable, for those components unless specified otherwise in this chapter.

5.2* Carrying Capacity. If a fire apparatus system or component is to be upgraded, the contractor shall ensure that the completed apparatus does not exceed the GAWR and GCWR, or GVWR, of the chassis when carrying the estimated in-service weight of the unequipped apparatus as defined in 4.8.2.

5.3 Vehicle Stability.

5.3.1 When the apparatus is loaded to its estimated in-service weight, the height of the vehicle's center of gravity shall not exceed the chassis manufacturer's maximum limit.

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

5.3.3 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.

5.3.4* 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.

5.4 Frame. The fire apparatus frame shall be replaced with a new chassis frame meeting the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable.

5.5 Drivetrain.

5.5.1 If the original drivetrain or associated components are used, the contractor shall perform a thorough inspection of the drivetrain components not scheduled for replacement (such as the drive shaft, end yokes or flanges, universal joints, and associated mountings) for wear, balance, stress cracks, or other damage.

5.5.2 The contractor shall notify the purchaser in writing of any damage discovered during the inspection.

5.5.3 If a new drivetrain or associated components are installed, the contractor shall certify that the installation meets the component manufacturer's recommendations.

5.6 Engine and Engine System Design.

5.6.1 If the original engine and accessories are used, the contractor shall perform a thorough inspection of the engine and related accessories including, but not limited to, mountings, fan belts, and filters.

5.6.1.1 The inspection shall check for wear, fluid leaks, loss of power, and other potential problems.

5.6.1.2 The contractor shall notify the purchaser in writing of all necessary repairs and services needed to bring the engine and related accessories within the engine manufacturer's original specifications.

5.6.1.3 All belts and filters shall be replaced.

5.6.2* If the existing engine and/or engine system is to be replaced, it shall be replaced with one that meets the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable.

5.6.2.1 The contractor shall furnish certification that the engine meets Environmental Protection Agency (EPA) standards that were in effect at the time of contract signing as well as certification that the installation meets the engine manufacturer's specifications.

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Table 4.8.2 Miscellaneous Fire Apparatus Equipment Allowance

		Equipment Allowance	
Fire Apparatus Type	**Size**	**lb**	**kg**
Pumper	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	10,000 lb–15,000 lb (4,500 kg–7,000 kg) GVWR	900	410
	15,001 lb–20,000 lb (7,001 kg–9,000 kg) GVWR	1,500	680
	>20,000 lb (>9,000 kg) GVWR	2,000	910
Mobile water supply	All	1,000	455
Aerial	All	2,500	1,135
Quint	All	2,500	1,135
Special service	10,000 lb–15,000 lb (4,500 kg–7,000 kg) GVWR	2,000	910
	15,001 lb–20,000 lb (7,001 kg–9,000 kg) GVWR	2,500	1,135
	20,001 lb–30,000 lb (9,001 kg–14,000 kg) GVWR	3,000	1,350
	30,001 lb–40,000 lb (14,001 kg–18,000 kg) GVWR	4,000	1,800
	40,001 lb–50,000 lb (18,001 kg–23,000 kg) GVWR	6,000	2,700
	50,001 lb–60,000 lb (23,001 kg–27,000 kg) GVWR	8,000	3,600
	>60,000 lb (>27,000 kg) GVWR	10,000	4,500
Mobile foam	All	2,000	910
Wildland	5,000 lb–10,000 lb (2,200 kg– 4,500 kg) GVWR	300	136
	10,001 lb–15,000 lb (4,501 kg–7,000 kg) GVWR	500	227
	15,001 lb–20,000 lb (7,001 kg–9,000 kg) GVWR	1,000	454
	20,001 lb–26,000 lb (9,001 kg–12,000 kg) GVWR	1,500	680
	>26,000 lb (>12,000 kg) GVWR	2,000	910

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

5.7 Cooling System.

5.7.1 If the original cooling system is to be reused, the contractor shall perform a thorough inspection of the cooling system for leaks, blockages, wear, or other problems that could affect vehicle engine cooling.

5.7.1.1 The contractor shall notify the purchaser in writing of any problems discovered during the inspection.

5.7.1.2 The cooling system shall be flushed, and new coolant meeting the engine manufacturer's specifications shall be added.

5.7.2 If the cooling system is to be replaced, it shall be replaced with one that meets the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable, as well as the engine manufacturer's specifications.

5.8 Lubrication System.

5.8.1 If the original lubrication system is to be reused, the contractor shall perform a thorough inspection of the lubrication system for leaks, blockages, or other problems that could affect vehicle lubrication.

5.8.1.1 The contractor shall notify the purchaser in writing of any problems discovered during the inspection.

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5.8.2 If the lubrication system is to be replaced, it shall be replaced with one that meets the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable, and the engine manufacturer's standards.

5.9 Fuel and Air Systems. The fire apparatus fuel and air intake systems shall be replaced with new fuel and air intake systems that meet the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable, and the engine manufacturer's standards.

5.10 Exhaust System. The original fire apparatus exhaust system shall be replaced with a new exhaust system that meets the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable, and the engine manufacturer's standards.

5.11 Vehicle Components.

5.11.1 Braking System.

5.11.1.1 The contractor shall certify that the braking system meets the performance requirements of the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

5.11.1.2 When a new braking system or brake components are installed, the contractor shall certify that the installation meets the component manufacturer's requirements.

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

5.11.1.3.1* When the fire apparatus, as delivered, is loaded to its GVWR or GCWR, if applicable, the parking brake system shall hold the apparatus on at least a 20 percent grade.

5.11.1.3.2 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.

5.11.1.3.3 Parking brakes on steerable axles of tiller vehicles shall be provided where necessary to meet the requirements of this standard.

5.11.1.3.4 Air-applied brakes or mechanically actuated brakes shall be acceptable on steerable axles of tiller vehicles.

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

5.11.2 Suspension, Wheels, and Tires.

5.11.2.1 The suspension system shall be replaced with a new suspension system that meets the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable.

5.11.2.2* If the existing axle(s), wheels, or tires are utilized, the contractor shall inspect and verify the condition of these components for continued use in emergency service.

5.11.2.2.1 Damaged components shall be repaired or replaced.

5.11.2.3 The contractor shall certify that the axles, wheels, and tires of the completed fire apparatus meet all current federal and state GVWR, GCWR, and GAWR requirements.

5.11.2.4 Angle of Approach and Departure.

5.11.2.4.1 If the fire apparatus is being refurbished to NFPA 1901, an angle of approach and an angle of departure of at least 8 degrees shall be maintained at the front and rear of the vehicle when it is loaded to its GVWR or GCWR, if applicable.

5.11.2.4.2 If the fire apparatus is being refurbished to NFPA 1906, an angle of approach and an angle of departure of at least 20 degrees shall be maintained at the front and rear of the vehicle when it is loaded to its GVWR or GCWR, if applicable.

5.11.3 Steering. The fire apparatus steering system shall be replaced with a new steering system meeting the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable.

5.11.4 Transmission/Transfer Case.

5.11.4.1 If either the original transmission or the transfer case is reused, the contractor shall inspect the transmission or transfer case, its mountings, and any associated accessories for wear, damage, and fluid leaks.

5.11.4.1.1 The contractor shall notify the purchaser in writing of any problems discovered during the inspection.

5.11.4.1.2 All fluids and filters shall be changed.

5.11.4.2 In the event a new or refurbished transmission or transfer case is installed in the fire apparatus, the contractor shall certify that the installation meets the transmission or transfer case manufacturer's specifications for installation on that specific type of apparatus.

5.11.5 Fuel Tank. The fire apparatus fuel tank shall be replaced with a new tank that meets the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable.

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

5.12 Low-Voltage Electrical Systems and Warning Devices. The fire apparatus electrical wiring system and warning devices shall be replaced with a complete new system that meets the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable.

5.13* Driving and Crew Compartments. The fire apparatus driving and crew compartments shall be replaced with new driving and crew compartments that meet the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable, and the chassis manufacturer's standards.

5.14 Body, Compartmentation, and Hose Storage.

5.14.1 If the original fire apparatus body is to be reused, it shall be inspected for serviceability and upgraded to meet the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable.

5.14.2 If the fire apparatus body, compartmentation, and hose storage areas are to be replaced, they shall be replaced with components that meet the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable.

5.14.3 If new compartments are to be added to an existing fire apparatus body, they shall meet the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable.

5.14.4* The fire apparatus shall comply with the current requirements for metal finish in NFPA 1901 or NFPA 1906, whichever is applicable, including the application of reflective striping.

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5.15 Fire Pump and Associated Equipment.

5.15.1 If the original fire pump is reused, the contractor shall inspect the fire pump, its mountings, and its associated accessories for wear, damage, and leaks.

5.15.2 The contractor shall notify the purchaser in writing of any problems discovered during the inspection.

5.15.3 All new or upgraded parts or components shall meet the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable.

5.15.4 The pump packing shall be adjusted according to the pump manufacturer's recommendations.

5.16 Water Tanks.

5.16.1 If the existing water tank is to be reused, the contractor shall inspect the water tank for serviceability and report any defects to the purchaser in writing.

5.16.2* If a new water tank is installed, it shall meet the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable.

5.16.2.1 Installation of a new water tank shall not result in the completed fire apparatus exceeding the GAWR and GCWR or GVWR of the chassis under the conditions specified in Section 5.2.

5.17 Aerial Devices.

5.17.1 If the original aerial device is to be used, a full inspection and test as defined in NFPA 1914, *Standard for Testing Fire Department Aerial Devices*, shall be performed.

5.17.1.1 A test shall be performed prior to refurbishing to determine the condition of the aerial device.

5.17.2 If the original aerial device is reused, it shall meet the requirements of the NFPA automotive fire apparatus standard in effect at the time of the contract signing for the original manufacture of the apparatus.

5.18 Equipment Carried on Fire Apparatus.

5.18.1 If new ground ladders are furnished, they shall meet the requirements of NFPA 1931, *Standard for Manufacturer's Design of Fire Department Ground Ladders*.

5.18.2 If new hose is furnished, it shall meet the requirements of NFPA 1961, *Standard on Fire Hose*.

5.18.3 If new nozzles are furnished, they shall meet the requirements of NFPA 1964, *Standard for Spray Nozzles*.

5.19 Tests and Delivery Data Requirements.

5.19.1 Fire Apparatus Certification Tests.

5.19.1.1 If the refurbished fire apparatus is equipped with a fire pump that has a rated capacity of 750 gpm (3000 L/min) or greater, the pump system shall be tested after the pump and all its associated piping and equipment have been installed on the apparatus.

5.19.1.1.1 The tests shall be conducted at the contractor's approved facility and certified by an independent testing organization approved by the purchaser.

5.19.1.1.2 The certification shall include at least the tests defined in 5.19.2 through 5.19.6.

5.19.1.1.3 If the apparatus is equipped with a water tank, the water tank-to-pump flow test defined in 5.19.7 shall be included.

5.19.1.2 If the refurbished fire apparatus is equipped with a fire pump that has a rated capacity of less than 750 gpm (3000 L/min), the pump shall be tested after the pump and all its associated piping and equipment have been installed on the apparatus.

5.19.1.2.1 The tests shall be conducted at the manufacturer's approved facility and certified by the contractor.

5.19.1.2.2 The certification shall include at least the tests defined in 5.19.2 and 5.19.4 through 5.19.6.

5.19.1.2.3 If the apparatus is equipped with a water tank, the water tank-to-pump flow test defined in 5.19.7 shall be included.

5.19.2 Pumping Tests. A pumping certification test shall be conducted in accordance with the test requirements defined in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

5.19.3 Pumping Engine Overload Test.

5.19.3.1 If a new fire pump is installed, a pumping engine overload test shall be conducted in accordance with the test requirements defined in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

5.19.3.2 If the original fire pump is retained or reused, a pumping engine overload test shall be conducted in accordance with the test requirements of the NFPA automotive fire apparatus standard that was in effect at the time of the contract signing for the original manufacture of the apparatus.

5.19.4 Pressure Control System Test.

5.19.4.1 If the refurbished fire apparatus is equipped with a new pressure control system on the fire pump, it shall be tested in accordance with the test requirements defined in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

5.19.4.2 If the original pressure control system is retained or reused, it shall be tested in accordance with the pressure control device testing requirements of NFPA 1911, *Standard for Service Tests of Fire Pump Systems on Fire Apparatus*.

5.19.5 Priming System Test.

5.19.5.1 If the refurbished fire apparatus is equipped with a new priming system on the fire pump, it shall be tested in accordance with the test requirements defined in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

5.19.5.2 If the original priming system is retained or reused, it shall be tested in accordance with the priming system test requirements of NFPA 1911.

5.19.6 Vacuum Test.

5.19.6.1 If the refurbished fire apparatus is equipped with a new fire pump, a vacuum test shall be conducted in accordance with the test requirements defined in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

5.19.6.2 If the original fire pump is retained or reused, a vacuum test shall be conducted in accordance with the test requirements of NFPA 1911.

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5.19.7 Water Tank-to-Pump Flow Test.

5.19.7.1 If the refurbished fire apparatus has a new water tank(s), fire pump(s), or pump piping, a water tank-to-pump flow test shall be conducted in accordance with the test requirements in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

5.19.7.2 If the original water tank(s), pump(s), and pump piping is retained or reused, a water tank-to-pump flow test shall be conducted to ensure the installation meets the requirements of the NFPA automotive fire apparatus standard in effect at the time of the contract signing for the original manufacture of the apparatus.

5.19.8 Aerial Device Certification Tests. If a new or reutilized aerial device is installed on the refurbished fire apparatus, the completed apparatus shall be tested at the manufacturer's approved facility and certified by an independent testing organization approved by the purchaser.

5.19.8.1 New aerial devices shall be tested according to the current edition of NFPA 1901.

5.19.8.2 Reutilized aerial devices shall be tested to the NFPA automotive fire apparatus standard in effect at the time of the original aerial device manufacture.

5.19.9 Refurbisher's Pre-Delivery Tests.

5.19.9.1 Water Tank Capacity Test. If the refurbished fire apparatus has a new water tank, the water tank manufacturer shall certify the capacity of the water tank and the certification shall be provided to the purchaser when the apparatus is delivered.

5.19.9.1.1 If the refurbished fire apparatus retains or reuses the original water tank, the tank shall be tested to ensure it meets the requirements of the NFPA automotive fire apparatus standard in effect at the time of the contract signing for the original manufacture of the apparatus.

5.19.9.2 Piping Hydrostatic Test.

5.19.9.2.1 If the refurbished fire apparatus has a new fire pump or pump piping system, a piping hydrostatic test shall be conducted in accordance with the test requirements in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

5.19.9.2.2 If the refurbished fire apparatus retains or reuses the original pump(s) and pump piping, a piping hydrostatic test shall be conducted to ensure the integrity of the piping installation meets the requirements of the NFPA automotive fire apparatus standard in effect at the time of the contract signing for the original manufacture of the apparatus.

5.19.9.3 Electrical System Tests. Electrical system tests shall be conducted in accordance with the test requirements in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable, on all refurbished fire apparatus.

5.19.9.4* Foam System Tests.

5.19.9.4.1 If the refurbished fire apparatus has a newly installed foam system or system components, the system shall be tested in accordance with the test requirements in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

5.19.9.4.2 If the refurbished fire apparatus reuses the original foam systems and system components, the system shall be tested to ensure it meets the requirements of the NFPA automotive fire apparatus standard in effect at the time of the contract signing for the original manufacture of the apparatus.

5.19.10* Road Tests.

5.19.10.1 If the refurbished fire apparatus has any upgraded powertrain components (engine, transmission, driveline, or axles), it shall be road tested in accordance with 5.19.10.4 through 5.19.10.8.

5.19.10.2 If the refurbished fire apparatus reuses all of the original powertrain components (engine, transmission, driveline, and axles), it shall be tested to ensure it meets the requirements of the NFPA automotive fire apparatus standard in effect at the time of the contract signing for the original manufacture of the apparatus.

5.19.10.3 The tests shall be conducted at a location and in a manner that does not violate local, state, or federal traffic laws.

5.19.10.4 The fire apparatus shall be loaded to its estimated in-service weight.

5.19.10.4.1 The tests shall be conducted on dry, level, paved roads that are in good condition.

5.19.10.4.2 The engine shall not be operated in excess of the maximum governed speed.

5.19.10.5 Acceleration tests shall consist of two runs in opposite directions over the same route.

5.19.10.5.1 The vehicle shall attain a speed of 35 mph (55 km/hr) from a standing start within 25 seconds.

5.19.10.5.2 The vehicle shall attain a minimum top speed of not less than 50 mph (80 km/hr).

5.19.10.6 If the fire apparatus is equipped with an auxiliary braking system, the manufacturer shall road test the system to confirm that the system is functioning as intended by the auxiliary braking system manufacturer.

5.19.10.7 If the apparatus is equipped with an air brake system, the service brakes shall bring the apparatus, when loaded to its GVWR, to a complete stop from an initial speed of 20 mph (32.2 km/hr), in a distance not exceeding 35 ft (10.7 m) by actual measurement on a paved, level, dry surface road that is free of loose material, oil, or grease.

5.19.10.8 If the apparatus is equipped with a hydraulic brake system, the service brakes shall bring the apparatus, when loaded to its GVWR, to a complete stop from an initial speed of 30 mph (48.2 km/hr), in a distance not exceeding 88 ft (26.8 m) by actual measurement on a paved, level, dry surface road that is free of loose material, oil, or grease.

5.19.11 Tests on Delivery.

5.19.11.1 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.

5.19.11.2 Aerial device stability tests shall not be run at other than the refurbisher's or the aerial device manufacturer's facility.

5.20 Data Required of the Contractor.

5.20.1 The contractor shall supply, at the time of delivery, at least two copies of complete operation, service, and parts manuals covering the completed fire apparatus as delivered and accepted.

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5.20.1.1 This requirement shall be permitted to be adjusted to cover only manuals for those new components or systems that are changed from the original configuration.

5.20.1.2 The requirement for either complete or partial manuals shall be supplied by the purchasing authority.

5.20.2 The contractor shall supply, at the time of delivery, at least one copy of the following:

(1) Engine manufacturer's certified brake horsepower curve for a new engine installation showing the maximum governed speed
(2) Contractor's record of fire apparatus refurbishing, including, if applicable, all technical information required for inspection to comply with NFPA 1914
(3) Pump manufacturer's certification of suction capabilities for new pump installations
(4) Pump manufacturer's certification of hydrostatic test for new pump installations
(5) Certification of inspection and test
(6) If the apparatus is equipped with a pump, a copy of the chassis manufacturer's approval for stationary pumping applications
(7) Weight documents from a certified scale showing actual loading on the front axle, rear axle(s), and overall vehicle (with the water tank full but without personnel, equipment, and hose) to determine compliance with Section 4.8

5.20.3 A label shall be affixed to the vehicle certifying that the vehicle is in compliance with all applicable Federal Motor Vehicle Safety Standards (FMVSS) in effect at the time of completion.

5.20.4 If the original fire pump is replaced with a new fire pump, a new test plate shall be provided on the pump operator's panel.

5.20.4.1 The new test plate shall give the rated discharges and pressures, together with the speed of the engine, as determined by the certification test for each unit; the position of the parallel–series pump as used; and the governed speed of the engines as stated by the engine manufacturer on a certified brake horsepower curve.

5.20.4.2 The test plate shall be stamped with complete information at the contractor's facility and attached to the vehicle prior to delivery.

Chapter 6 Level II Refurbishing

6.1* General. All new or upgraded components utilized in Level II refurbishing shall meet the requirements of the current edition of NFPA 1901, *Standard for Automotive Fire Apparatus*, or NFPA 1906, *Standard for Wildland Fire Apparatus*, whichever is applicable, for those components, unless otherwise specified in this chapter.

6.1.1 The purchaser shall specify which components and systems are to be upgraded.

6.1.2 Any upgraded system shall be compatible with its associated components.

6.1.3 Systems or components that are not compatible shall not be installed on the refurbished fire apparatus.

6.2* Carrying Capacity. If a fire apparatus system or component is to be upgraded, the contractor shall ensure that the refurbished apparatus does not exceed the GAWR and GCWR, or GVWR, of the chassis when carrying the estimated in-service weight of the unequipped apparatus as defined in 4.8.2.

6.3* Vehicle Stability.

6.3.1* When the apparatus is loaded to its estimated in-service weight, the height of the vehicle's center of gravity shall not exceed the chassis manufacturer's maximum limit.

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

6.3.3 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.

6.3.4* 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.

6.4 Frame.

6.4.1 If the apparatus' frame is to be upgraded, all parts of the frame not scheduled to be replaced shall be inspected for wear, broken or loose bolts or other fittings, bent or damaged members, or other problems.

6.4.2 The contractor shall notify the purchaser in writing of any problems or abnormal conditions discovered during the inspection.

6.5 Drivetrain.

6.5.1 If the apparatus drivetrain is to be upgraded, the contractor shall inspect all components of the drivetrain not scheduled to be replaced for wear, balance, stress cracks, or other damage.

6.5.1.1 The inspection shall include the drive shaft, end yokes or flanges, universal joints, and associated mountings.

6.5.1.2 The contractor shall notify the purchaser in writing of any damaged components or other problems discovered during the inspection.

6.5.2 If a new drivetrain or associated components are installed or existing components are modified, the contractor shall ensure that the installation meets the component manufacturer's recommendations.

6.6 Engine and Engine System Design.

6.6.1* If the engine or an engine system component(s) is upgraded, the contractor shall inspect the engine and all related accessories that are not scheduled to be replaced for wear, fluid leaks, loss of power, excessive smoke, or other potential problems.

6.6.1.1 The contractor shall notify the purchaser in writing of all necessary repairs and services needed to bring the engine and related accessories within applicable manufacturers' specifications.

6.6.1.2 All belts and filters shall be replaced.

6.6.2* If the existing engine or engine system is to be replaced, it shall be replaced with one that meets or exceeds the requirements of the NFPA automotive fire apparatus standard that was in effect at the time the apparatus was manufactured.

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6.6.2.1 The contractor shall furnish certification that the engine meets or exceeds the EPA standards that were in effect at the time of the original apparatus construction, as well as certification that the installation meets the engine manufacturer's requirements.

6.7 Cooling System.

6.7.1 If the cooling system or any related component(s) are to be upgraded, the contractor shall inspect all portions of the cooling system that are not scheduled to be replaced for leaks, blockages, wear, and other conditions that could affect the cooling of the vehicle's engine.

6.7.1.1 The contractor shall notify the purchaser in writing of any problems or abnormal conditions discovered during the inspection.

6.7.1.2 The cooling system shall be flushed, and new coolant that meets the engine manufacturer's requirements shall be added.

6.7.2 If the cooling system or cooling system components are upgraded, the contractor shall certify that the upgraded cooling system meets the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable, and the engine manufacturer.

6.7.3 The upgraded engine cooling system shall maintain a temperature in the engine at or below the engine manufacturer's maximum temperature rating under all conditions of operation for which the fire apparatus is designed.

6.8 Lubrication System.

6.8.1 If the lubrication system or any related component(s) is to be upgraded, the contractor shall inspect all portions of the lubrication system that are not scheduled to be replaced for leaks, wear, and other problems that could affect the performance of the system.

6.8.2 The contractor shall notify the purchaser in writing of any problems or abnormal conditions discovered during the inspection.

6.8.3 The upgraded lubrication system shall meet the engine manufacturer's requirements.

6.9 Fuel and Air Systems.

6.9.1 If the fuel system or air intake system is to be upgraded, the contractor shall inspect all portions of the system not scheduled to be replaced for leaks, wear, and other problems that could affect the performance of the system.

6.9.2 The contractor shall notify the purchaser in writing of any problems or abnormal conditions discovered during the inspection.

6.9.3 The contractor shall certify that the upgraded fuel system or air intake system meets the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable, and the engine manufacturer.

6.10 Exhaust System.

6.10.1 If the exhaust system components are to be upgraded, the contractor shall inspect all portions of the system that are not scheduled to be replaced for leaks, loose hangers, rusted tubing, wear, and other problems that could affect the performance of the exhaust system.

6.10.2 The contractor shall notify the purchaser in writing of any problems or abnormal conditions discovered during the inspection.

6.10.3 The contractor shall certify that the upgraded exhaust system meets the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable, and the engine manufacturer.

6.11 Vehicle Components.

6.11.1 Braking System.

6.11.1.1* If the braking system is to be upgraded, the contractor shall inspect all portions of the braking system and associated accessories that are not scheduled to be replaced for wear, leakage, loss of performance, and other problems that could affect the performance of the braking system.

6.11.1.1.1 The contractor shall notify the purchaser in writing of any problems or abnormal conditions found during the inspection.

6.11.1.2* If a new braking system or new brake components are installed, the installation shall meet the manufacturers' recommendations.

6.11.1.3 The contractor shall certify that the braking system meets or exceeds the performance requirements of the edition of the NFPA automotive fire apparatus standard in effect at the time of contract signing for the original manufacture of the apparatus.

6.11.2 Suspension, Wheels, and Tires.

6.11.2.1* If the suspension, wheels, or tires are to be upgraded, the contractor shall inspect the axles, wheels, tires, springs, hangers, mountings, and suspension system accessories that are not scheduled to be replaced for wear, stress cracks, sagging, improper bolt torque, and other problems.

6.11.2.2 The contractor shall notify the purchaser in writing of any damaged components or other problems that are discovered during the inspection.

6.11.2.3 The manufacturer shall certify that the upgraded suspension, wheels, and tires of the fire apparatus meet all applicable component manufacturers' standards as well as all GVWR, GCWR, and GAWR ratings.

6.11.2.4 The refurbished apparatus shall meet all applicable federal and state weight ratings.

6.11.2.5* When the fire apparatus, as delivered, is loaded to its GVWR or GCWR, if applicable, the parking brake system shall hold the apparatus on at least a 20 percent grade.

6.11.3 Steering.

6.11.3.1 If the steering system is to be upgraded, the contractor shall inspect the entire system, including the steering box, steering gear, drag links, power steering pump, hose, and accessories that are not scheduled to be replaced for wear, leakage, loss of performance, and other problems.

6.11.3.2 The contractor shall notify the purchaser in writing of any damaged components or other problems that are discovered during the inspection.

6.11.3.3 The contractor shall certify that the upgraded steering system meets the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable, and the component manufacturer.

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

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

6.11.4 Transmission/Transfer Case.

6.11.4.1 If either the transmission or the transfer case is to be upgraded, the contractor shall inspect all components of the transmission or transfer case, their mountings, and the associated accessories that are not scheduled to be replaced for wear, damage, and fluid leaks.

6.11.4.1.1 All fluid levels and filters shall be checked.

6.11.4.1.2 The contractor shall notify the purchaser in writing of any damaged components or other problems that are discovered during the inspection.

6.11.4.2 If an upgraded transmission is installed in the fire apparatus, the contractor shall certify that the installation meets the transmission manufacturer's specifications for installation in the specific type of apparatus, as well as the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable.

6.11.5 Fuel Tank.

6.11.5.1 If the fuel tank is to be upgraded, the contractor shall inspect all components of the fuel tank, its mountings, and associated accessories that are not scheduled to be replaced for wear, damage, and fluid leaks.

6.11.5.2 The contractor shall notify the purchaser in writing of any damaged components or other problems that are discovered during the inspection.

6.11.5.3 Fuel tanks that are replaced shall be replaced with new tanks that meet the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable.

6.11.6* Tow Hooks. If upgraded front or rear tow hooks or tow eyes are installed on the fire apparatus, they shall be attached to the frame structure to allow towing (not lifting) of the apparatus without damage.

6.12 Low-Voltage Electrical Systems and Warning Devices.

6.12.1* General. Any upgraded 12 V or 24 V electrical systems or warning devices installed on the fire apparatus shall be appropriate for the service intended and shall meet the specific requirements of Section 6.12.

6.12.2* If the low-voltage electrical system is upgraded, the contractor shall inspect the components of the electrical system not scheduled to be replaced for problems that could affect the vehicle's electrical performance.

6.12.2.1 The inspection shall include the condition of wires, connectors, relays, fuses, and/or circuit breakers and related components.

6.12.2.2 The contractor shall notify the purchaser in writing of any damaged components or problems that are discovered during the inspection.

6.12.3 Power Supply.

6.12.3.1 If the alternator is to be upgraded, it shall be replaced by a 12 V or 24 V alternator.

6.12.3.2 The alternator shall have a minimum output at idle to meet the minimum continuous electrical load of the fire apparatus as defined in 6.12.3.3 at 200°F (93°C) ambient temperature within the engine compartment, and it shall be provided with full automatic regulation.

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

(1) The propulsion engine and transmission
(2) All legally required clearance and marker lights, headlights, and other electrical devices except windshield wipers and four-way hazard flashers
(3) The radio(s) at a duty cycle of 10 percent transmit and 90 percent receive (for calculation and testing purposes, a default value of 5 A continuous)
(4) If the fire apparatus is not a wildland fire apparatus, the lighting necessary to produce 1 fc (10 lx) of illumination on all walking surfaces on the apparatus and on the ground at all egress points off of 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 where the apparatus is blocking 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

6.12.3.4 Load Management.

6.12.3.4.1* If the total connected electrical load of the upgraded low-voltage electrical system exceeds the minimum continuous electrical output rating of the installed alternator(s) operating under the conditions specified in 6.12.3.2, an automatic electrical load management system shall be required.

6.12.3.4.2 The minimum continuous electrical load defined in 6.12.3.3 shall not be subject to automatic load management.

6.12.4* Optical Warning Devices. If the optical warning devices are to be upgraded, the contractor shall inspect the components of the optical warning system that are not scheduled to be replaced for problems that could affect the vehicle's warning devices.

6.12.4.1 The inspection shall include the condition of wires, connectors, relays, fuses and/or circuit breakers, motors, lenses, and related components.

6.12.4.2 The contractor shall notify the purchaser in writing of any problems or discrepancies that are discovered during the inspection.

6.12.5 Audible Warning Devices.

6.12.5.1 Audible warning equipment in the form of at least one automotive traffic horn and one electric or electronic siren shall be provided.

6.12.5.2 A means shall be provided to allow the activation of the siren within convenient reach of the driver.

6.12.5.3 If upgraded or additional air horns, electric siren(s), or electronic siren speaker(s) are installed, they shall be mounted as low and as far forward on the fire apparatus as practical.

6.12.5.4 Upgraded or additional audible warning equipment shall not be mounted on the roof of the apparatus.

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6.13* Driving and Crew Compartments.

6.13.1 If the driving and/or crew compartment(s) is to be upgraded, the contractor shall inspect the driving and crew compartments, their mountings, and associated accessories for wear, damage, and corrosion.

6.13.1.1 The contractor shall notify the purchaser in writing of any damaged components that are discovered during the inspection.

6.13.2* If a new driving and/or crew compartment is installed, it shall be a fully enclosed design that meets the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable.

6.13.2.1 The driving compartment shall have a seating capacity for a minimum of two fire fighters except at a tiller driving position, which shall have seating for at least one person.

6.13.2.2 The driving and crew compartments shall have a combined seating capacity at least equal to the maximum number of persons expected to ride within the fire apparatus *(See Section 4.2.)*

6.13.3 If the new driving and/or crew compartment is of a tilt-up design, it shall be arranged so that all the manufacturer's recommended routine maintenance checks of lubricant and fluid levels can be performed easily by the operator without raising the driving and/or crew compartment and without the need for hand tools.

6.13.4 After installation of the new driving and/or crew compartment, airflow through the radiator shall be sufficient to comply with the cooling system requirements as defined in 6.7.3.

6.13.5 Fully Enclosed Crew Compartment Conversions. If an existing two-door open canopy–style crew compartment is converted into a fully enclosed crew compartment, the added-on portion of the crew compartment shall comply with all applicable requirements of NFPA 1901.

6.14 Body, Compartmentation, and Hose Storage.

6.14.1 If the body, compartmentation, or hose storage areas are to be upgraded, the contractor shall inspect all portions of the body, compartmentation, or hose storage areas that are not scheduled to be replaced for wear, damage, and corrosion.

6.14.1.1 The contractor shall notify the purchaser in writing of any damaged components that are discovered during the inspection.

6.14.2* If a new body, compartmentation, or hose storage area is installed, it shall meet the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable.

6.14.3 If additional compartments are added to an existing body, they shall meet the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable.

6.14.4 Metal Finish.

6.14.4.1 The fire apparatus, when refinished, shall comply with the current requirements for metal finish in NFPA 1901 or NFPA 1906, including the application of reflective striping.

6.14.4.2 If the metal finish is to be upgraded, all exposed ferrous metal surfaces that are not plated or stainless steel shall be cleaned and prepared and shall be painted or coated.

6.14.4.2.1 The paint or coating, including any primer, shall be applied in accordance with the paint or coating manufacturer's recommendations.

6.14.4.2.2 The purchaser shall specify whether nonferrous body components are to be painted and any lettering, numbering, or decorative striping to be furnished.

6.15 Fire Pump and Associated Equipment. If the fire pump or associated equipment is to be upgraded, the contractor shall inspect all portions of the fire pump, its mountings, and any associated accessories that are not scheduled to be replaced for wear, damage, and leaks.

6.15.1 The contractor shall notify the purchaser in writing of any damaged components or other problems that are discovered during the inspection.

6.15.2 All upgraded parts or components shall be compatible with the original fire pump.

6.15.3 The fire pump packing shall be adjusted to the pump manufacturer's recommended tolerances.

6.16 Water Tank.

6.16.1 If the existing water tank is to be reused, the contractor shall inspect the tank for serviceability and shall report any defects to the purchaser in writing.

6.16.2* If a new water tank is installed, it shall meet the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable.

6.16.3 Installation of a new water tank shall not result in the refurbished apparatus exceeding the GAWR and GCWR or GVWR of the chassis under the conditions specified in Section 6.2.

6.17 Aerial Devices.

6.17.1 If the aerial device is to be upgraded, the contractor shall inspect all components of the aerial device, its mountings, controls, and associated accessories that are not scheduled to be replaced for wear, damage, corrosion, and other deficiencies.

6.17.1.1 The contractor shall notify the purchaser in writing of any damaged components or other problems that are discovered during the inspection.

6.17.1.2 All new or replacement parts or components shall be compatible with the design of the original aerial device and shall meet the requirements of the NFPA automotive fire apparatus standard in effect at the time of the contract signing for the original manufacture of the apparatus.

6.17.2 If a replacement aerial device is installed, the new device shall meet the current requirements of NFPA 1901 and shall be so certified by the contractor.

6.18 Equipment Carried on the Fire Apparatus.

6.18.1 If new ground ladders are furnished, they shall meet the requirements of NFPA 1931, *Standard for Manufacturer's Design of Fire Department Ground Ladders.*

6.18.2 If new hose is furnished, it shall meet the requirements of NFPA 1961, *Standard on Fire Hose.*

6.18.3 If new nozzles are furnished, they shall meet the requirements of NFPA 1964, *Standard for Spray Nozzles.*

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6.19 Tests and Delivery Data Requirements.

6.19.1 Pump Certification Tests.

6.19.1.1 If the refurbished fire apparatus is equipped with a new or upgraded fire pump that has a rated capacity of 750 gpm (3000 L/ min) or greater, the pump system shall be tested after the pump and all its associated piping and equipment have been installed on the apparatus.

6.19.1.1.1 The tests shall be conducted at the contractor's approved facility and certified by an independent testing organization that is approved by the purchaser.

6.19.1.1.2 The certification shall include at least the tests defined in 6.19.2 through 6.19.6.

6.19.1.1.3 If the apparatus is equipped with a water tank, the water tank-to-pump flow test as defined in 6.19.7 shall be included in the certification.

6.19.1.2 If the refurbished fire apparatus is equipped with a new or upgraded fire pump that has a rated capacity of less than 750 gpm (3000 L/min), the pump system shall be tested after the pump and all its associated piping and equipment have been installed on the apparatus.

6.19.1.2.1 The tests shall be conducted at the manufacturer's approved facility and certified by the contractor.

6.19.1.2.2 The certification shall include at least the tests defined in 6.19.2 and 6.19.4 through 6.19.6.

6.19.1.2.3 If the apparatus is equipped with a water tank, the water tank-to-pump flow test as defined in 6.19.7 shall be included in the certification.

6.19.1.3 If the refurbished fire apparatus is equipped with an existing fire pump that is neither upgraded nor replaced, the pump shall be tested after the refurbishing is complete.

6.19.1.3.1 The tests shall be conducted at the manufacturer's approved facility and certified by the contractor.

6.19.1.3.2 The certification shall include at least the tests defined in 6.19.2 and 6.19.4 through 6.19.6.

6.19.1.3.3 If the apparatus is equipped with a water tank, the water tank-to-pump flow test as defined in 6.19.7 shall be included in the certification.

6.19.2 Pumping Tests.

6.19.2.1 If the refurbished fire apparatus is equipped with a new or upgraded fire pump, the pumping test shall be conducted in accordance with the test requirements defined in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

6.19.2.2 If the original fire pump is retained, the pumping test shall be conducted in accordance with the test requirements of the NFPA automotive fire apparatus standard in effect at the time of the contract signing for the original manufacture of the apparatus.

6.19.3 Pumping Engine Overload Test.

6.19.3.1 If the refurbished fire apparatus is equipped with a new or upgraded fire pump, a pumping engine overload test meeting the test requirements in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable, shall be conducted.

6.19.3.2 If the refurbished fire apparatus retains its original pump(s), a pumping engine overload test shall be conducted in accordance with the test requirements of the NFPA automotive fire apparatus standard in effect at the time of the contract signing for the original manufacture of the apparatus.

6.19.4 Pressure Control Device Test.

6.19.4.1 If the refurbished fire apparatus is equipped with a new or upgraded pressure control device on the fire pump, the pressure control device shall be tested in accordance with the test requirements defined in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

6.19.4.2 If the original pressure control device is retained, it shall be tested in accordance with the pressure control system test requirements of NFPA 1911, *Standard for Service Tests of Fire Pump Systems on Fire Apparatus*, if it has not been tested within the previous 12 months, or if any work has been done to the pressure control device.

6.19.5 Priming System Test.

6.19.5.1 If the refurbished fire apparatus is equipped with a new or upgraded priming system on the fire pump, the priming system shall be tested in accordance with the test requirements defined in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

6.19.5.2 If the original priming system is retained, it shall be tested in accordance with the priming system test requirements of NFPA 1911, if the priming system has not been tested within the previous 12 months, or if any work has been done to the priming system.

6.19.6 Vacuum Test.

6.19.6.1 If the refurbished fire apparatus has a new or upgraded fire pump or pump piping, a vacuum test shall be conducted in accordance with the test requirements in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

6.19.6.2 If the original fire pump and pump piping are retained, a vacuum test shall be conducted in accordance with the vacuum test requirements of NFPA 1911, if that test has not been conducted within the previous 12 months, or if any work has been done to the pump or piping.

6.19.7 Water Tank-to-Pump Flow Test.

6.19.7.1 If the refurbished apparatus has a new or upgraded water tank(s), pump(s), or pump piping, a water tank-to-pump flow test shall be conducted in accordance with the test requirements in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

6.19.7.2 If the original water tank(s), pump(s), and pump piping are reused, a water tank-to-pump flow test shall be conducted in accordance with the water tank-to-pump flow test requirements of NFPA 1911, if that test has not been conducted within the previous 12 months, or if any work has been done to the pump(s), water tank(s), and pump piping.

6.19.8 Aerial Device Certification Tests.

6.19.8.1 If a new or upgraded aerial device is installed on the refurbished fire apparatus, the completed apparatus shall be tested according to the test requirements of NFPA 1901 at the manufacturer's approved facility and certified by an independent testing organization approved by the purchaser.

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6.19.8.2 If the original aerial device is reused, the completed apparatus shall be inspected and tested in accordance with the complete requirements of NFPA 1914, if the aerial device has not been tested to the complete requirements of NFPA 1914 within the previous 12 months, or if any work has been done to the aerial device or related systems.

6.19.9 Refurbisher's Pre-Delivery Tests.

6.19.9.1 Water Tank Capacity Test.

6.19.9.1.1 A water tank capacity test meeting the current requirements of NFPA 1901 or NFPA 1906, whichever is applicable, shall be conducted on all refurbished fire apparatus having newly installed water tanks.

6.19.9.1.2 Fire apparatus retaining their original water tanks shall be tested to the requirements in the edition of the applicable standard in effect at the time of the original contract signing if any work has been done to the tank or its related systems.

6.19.9.2 Low-Voltage Electrical System Tests.

6.19.9.2.1* If any work is conducted that substantially changes the original low-voltage electrical system of the fire apparatus or adds new loads (such as adding a load management system, new lights, new relay boards, etc.), the apparatus shall be tested according to the requirements of the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

6.19.9.2.2 If any work is conducted on the low-voltage electrical system that leaves the original electrical system configuration intact (such as tightening connections, replacing individual wires, etc.), the apparatus shall be tested according to the requirements of the NFPA automotive fire apparatus standard in effect at the time of the contract signing for the original manufacture of the apparatus.

6.19.9.3 Line-Voltage Electrical System Tests.

6.19.9.3.1* If a new line-voltage electrical system is added or any work is conducted that substantially changes the original line-voltage electrical system on the fire apparatus or adds new line-voltage electrical loads such as lights, permanently connected equipment, receptacles, cord reels, and so forth, the apparatus shall be tested according to the applicable requirements of the current edition of NFPA 1901.

6.19.9.3.2 If any work is conducted on the line-voltage electrical system that leaves the original line-voltage electrical system configuration intact (such as tightening connections, replacing individual wires, etc.), the apparatus shall be tested according to the requirements of the edition of the NFPA automotive fire apparatus standard in effect at the time of the contract signing for the original manufacture of the apparatus. If a new pump is installed and the generator shares the same power source as the pump, the line-voltage electrical system test shall be run concurrently with the pump test.

6.19.9.4* Foam System Tests.

6.19.9.4.1 If the refurbished fire apparatus has a new foam system, the system shall be tested in accordance with the test requirements in the current edition of NFPA 1901 or NFPA 1906, whichever is applicable.

6.19.9.4.2 If the refurbished fire apparatus retains its original foam system and system components, and if any work has been done to the foam system or it has been upgraded, the system shall be tested to ensure it meets the requirements of the edition of the NFPA automotive fire apparatus standard in effect at the time of the contract signing for the original manufacture of the apparatus.

6.19.10 Road Tests.

6.19.10.1* If the refurbished fire apparatus has upgraded powertrain components (engine, transmission, driveline, or axles), it shall be road tested in accordance with 6.19.10.2 through 6.19.10.6.

6.19.10.1.1 If the refurbished fire apparatus reuses the original powertrain (engine, transmission, driveline, and axles), the powertrain shall be tested to ensure it meets the requirements of the edition of the NFPA automotive fire apparatus standard in effect at the time of the contract signing for the original manufacture of the apparatus.

6.19.10.1.2 The tests shall be conducted at a location and in a manner that does not violate local, state, or federal traffic laws.

6.19.10.2 The fire apparatus shall be loaded to its estimated in-service weight.

6.19.10.2.1 The tests shall be conducted on dry, level, paved roads that are in good condition.

6.19.10.2.2 The engine shall not be operated in excess of the maximum governed speed.

6.19.10.3 Acceleration tests shall consist of two runs in opposite directions over the same route.

6.19.10.3.1 The vehicle shall attain a speed of 35 mph (55 km/hr) from a standing start within 25 seconds.

6.19.10.3.2 The vehicle shall attain a minimum top speed of not less than 50 mph (80 km/hr).

6.19.10.4 If the fire apparatus is equipped with an auxiliary braking system, the manufacturer shall road test the system to confirm that the system is functioning as intended by the auxiliary braking system manufacturer.

6.19.10.5 If the apparatus is equipped with an air brake system, the service brakes shall bring the apparatus, when loaded to its GVWR, to a complete stop from an initial speed of 20 mph (32.2 km/hr), in a distance not exceeding 35 ft (10.7 m) by actual measurement on a paved, level, dry surface road that is free of loose material, oil, or grease.

6.19.10.6 If the apparatus is equipped with a hydraulic brake system, the service brakes shall bring the apparatus, when loaded to its GVWR, to a complete stop from an initial speed of 30 mph (48.2 km/hr), in a distance not exceeding 88 ft (26.8 m) by actual measurement on a paved, level, dry surface road that is free of loose material, oil, or grease.

6.19.11 Tests on Delivery.

6.19.11.1 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.

6.19.11.2 Aerial device stability tests shall not be run at other than the refurbisher's or the aerial device manufacturer's facility.

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6.20 Data Required of the Contractor.

6.20.1 If applicable, the contractor shall supply, at the time of delivery, at least one copy of the following:

(1) Engine manufacturer's certified brake horsepower curve for a new engine installation showing the maximum governed speed
(2) Contractor's record of fire apparatus refurbishing including, if applicable, all technical information required for inspection to comply with NFPA 1914
(3) Pump manufacturer's certification of suction capabilities for new pump installations
(4) Pump manufacturer's certification of hydrostatic test for new pump installations
(5) Certification of required inspections and tests
(6) If equipped with a pump, a copy of the chassis manufacturer's approval for stationary pumping applications
(7) Weight documents from a certified scale showing actual loading on the front axle, rear axle(s), and overall vehicle (with the water tank full but without personnel, equipment, and hose) supplied with the completed vehicle to determine compliance with Section 4.8

6.20.2 A label shall be affixed to the vehicle certifying that the vehicle is in compliance with all applicable Federal Motor Vehicle Safety Standards (FMVSS) in effect at the time of completion.

6.20.3 If the original fire pump is replaced with a new fire pump, a new test plate shall be provided on the pump operator's panel that gives the rated discharges and pressures together with the speed of the engine, as determined by the certification tests required by 6.19.1, the position of the parallel-series pump as used, and the governed speed of the engine as stated by the engine manufacturer on a certified brake horsepower curve.

6.20.3.1 The test plate shall be stamped with complete information at the contractor's facility and attached to the vehicle prior to delivery.

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.1.1 This document is designed to be used to aid in developing specifications for the refurbishing of fire apparatus. It is the intent of this standard to ensure that refurbished fire apparatus meet all applicable federal motor vehicle regulations as well as the applicable portions of NFPA 1901 or NFPA 1906, whichever is applicable.

This standard will do the following:

(1) Identify minimum levels of refurbishing
(2) Establish minimum requirements for inspection and/or replacement of all vehicle components
(3) Create informational checklists that will identify areas on the vehicle that should be addressed when considering refurbishing
(4) Create a guideline for any personnel engaged in preparing specifications for fire department or municipal agency emergency vehicle refurbishing

A.1.5 Metric units of measurement in this standard are in accordance with the modernized metric system known as the International System of Units (SI). The liter, a unit that is outside of, but recognized by, SI is commonly used in international fire protection. Table A.1.5(a) and Table A.1.5(b) provide conversion factors as an aid to the user. Table A.1.5(c) provides other conversion factors that could be useful to the reader. Table A.1.5(d) provides a list of the abbreviations used in this standard and their meaning.

Table A.1.5(a) Conversion Factors: U.S. Units to SI Units

U.S.	SI
1 gallon per minute (gpm)	3.785 liters per minute (L/min)
1 imperial gallon per minute (igpm)	4.546 liters per minute (L/min)
1 pound per square inch (psi)	6.895 kilopascals (kPa)
1 inch of mercury (in. Hg) at 60°F (15.6°C)	3.376 kilopascals (kPa)
1 inch (in.)	25.40 millimeters (mm)
1 foot (ft)	0.3048 meter (m)
1 cubic foot (ft^3)	0.02832 cubic meter (m^3)
1 mile per hour (mph)	1.609 kilometer per hour (km/hr)
1 pound (lb)	0.4536 kilogram (kg)
1 footcandle (fc)	10.76 lux (lx)

Table A.1.5(b) Conversion Factors: SI Units to U.S. Units

SI	U.S.
1 liter per minute (L/min)	0.2642 gallon per minute (gpm)
1 liter per minute (L/min)	0.2200 imperial gallon per minute (igpm)
1 kilopascal (kPa)	0.1450 pound per square inch (psi)
1 kilopascal (kPa)	0.2962 inch of mercury (in. Hg) at 60°F (15.6°C)
1 millimeter (mm)	0.03937 inch (in.)
1 meter (m)	3.281 feet (ft)
1 cubic meter (m^3)	35.31 cubic feet (ft^3)
1 kilometer per hour (km/hr)	0.6214 mile per hour (mph)
1 kilogram (kg)	2.205 pounds (lb)
1 lux (lx)	0.09290 footcandle (fc)

A.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

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Table A.1.5(c) Useful Conversion Factors

1 gallon per minute (gpm)	=	0.833 imperial gallon per minute (igpm)
1 imperial gallon per minute (igpm)	=	1.2 gallons per minute (gpm)
1 foot (ft) of water	=	0.433 pound per square inch (psi)
1 pound per square inch (psi)	=	2.31 feet (ft) of water
1 pound per square inch (psi)	=	2.036 inches of mercury (in. Hg)
1 inch of mercury (in. Hg)	=	1.135 feet (ft) of water
1 inch of mercury (in. Hg)	=	0.491 pound per square inch (psi)
1 gallon of water	=	8.34 pounds (lb)
1 gallon of water	=	231 cubic inches ($in.^3$)
1 metric ton (mton)	=	1000 kilograms (kg)
1 kilopascal (kPa)	=	0.01 bar
1 bar	=	100 kilopascals (kPa)

Table A.1.5(d) Abbreviations Used in Standard

Abbreviation	Term	Abbreviation	Term
A	ampere	km/hr	kilometers per hour
ac	alternating current	kPa	kilopascal
C	Centigrade	L	liter
dc	direct current	L/min	liters per minute
F	Fahrenheit	lx	lux
fc	footcandle	m	meter
ft	feet	mm	millimeter
gpm	gallons per minute	mph	miles per hour
in.	inch	psi	pounds per square inch
in. Hg	inches of mercury	V	volt
kg	kilograms		

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.3.3.13 Contractor. The contractor might not necessarily refurbish the vehicle or any portion of the vehicle but is responsible for the completion, delivery, acceptance, and warranty of the entire unit. Since fire apparatus are frequently refurbished in-house by the local fire department or city garage, the term *contractor* would include that department and its personnel if the project were to be done by the local fire department, fire brigade, or other municipal agency.

A.3.3.22 GAWR (Gross Axle Weight Rating). It is a requirement of the National Highway Traffic Safety Administration that the GAWR be posted in the vehicle on a permanently affixed label. The axle system includes, but is not limited to, the axle, tires, suspension, wheels, frame, brakes, and applied engine torque.

The final-stage manufacturer might have to de-rate the GAWR for the purpose of preventing vehicle instability as a result of changes made during the refurbishing. In addition, if an apparatus received a Level I refurbishing, it might have new axles, tires, suspension, and so forth, that allow a higher GAWR than the original rating. The final-stage manufacturer is the one who will know this.

A.3.3.23 GCWR (Gross Combination Weight Rating). A combination vehicle is the combination of a towing vehicle and one or more towed units (trailers). When a trailer is detachable, the GCWR limits the maximum loaded weight for any replacement trailer. The in-service weight or gross combination weight, including any connected trailer, should always be equal to or less than the GCWR.

A.3.3.24 Grade. A 45-degree slope is equal to a 100 percent grade. [**1901,** 2003]

A.3.3.25 GVWR (Gross Vehicle Weight Rating). It is a requirement of the National Highway Traffic Safety Administration that the GVWR of a vehicle be posted in the vehicle on a permanently affixed label. The GVWR can be equal to or less than the sum of the front GAWR and the rear GAWR. The in-service weight or gross vehicle weight should always be equal to or less than the GVWR.

A.3.3.32 Net Pump Pressure. When operating from a hydrant, the net pump pressure is typically less than the discharge pressure. For example, if the discharge pressure gauge reads 150 psi (1034 kPa) and the intake (suction) gauge reads 20 psi (138 kPa), the net pump pressure equals 130 psi (896 kPa). When operating from draft, the net pump pressure will be above the discharge pressure. For example, if the discharge pressure gauge reads 145 psi (1000 kPa) and the intake (suction) gauge reads 10 in. Hg (34 kPa) vacuum, the net pump pressure will be 150 psi (1034 kPa) (1 in. Hg = 0.5 psi = 3.4 kPa). [**1901,** 2003]

A.3.3.37 Purchaser. In the case of refurbished apparatus, the purchaser can be the original owner of the vehicle scheduled for refurbishing, or it may be a person, organization, or jurisdiction considering the purchase of a refurbished fire apparatus.

A.3.3.39 Quint. The primary purpose of this type of fire apparatus is to combat structural and associated fires, and to support fire-fighting and rescue operations by positioning personnel, handling materials, providing continuous egress, or discharging water at positions elevated from the ground. [**1901,** 2003]

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A.3.3.42.1 Level I Refurbishing. A vehicle that has undergone Level I refurbishing receives a new make and model designation and a new Certificate of Origin for the current calendar year.

A.3.3.42.2 Level II Refurbishing. A vehicle that has undergone Level II refurbishing retains its original make and model identification as well as its original title and year of manufacture designation.

A.3.3.45 Special Services Fire Apparatus. These services could be rescue, command, hazardous material containment, air supply, electrical generation and floodlighting, or transportation of support equipment and personnel. [**1901,** 2003]

A.3.3.51 Upgrade. It is recommended that consideration be given to using upgraded components or systems that meet current standards to the maximum extent possible, to ensure that the refurbished apparatus will approach the performance and safety requirements of newly manufactured apparatus.

A.4.1 It is recommended that upgraded components or systems meeting current NFPA standards be installed whenever possible for enhanced safety and serviceability. Replacement parts, components, or systems should meet the current requirements of NFPA 1901, *Standard for Automotive Fire Apparatus*, or NFPA 1906, *Standard for Wildland Fire Apparatus*, whichever is applicable. Meeting the requirements will help to make the fire apparatus as safe as possible, in addition to making for easier availability of parts for maintenance and repair.

Where local operating conditions necessitate apparatus of unusual design, the purchaser should carefully define the special requirements in the specifications. Height, width, undervehicle clearance, wheelbase, turning radius, length, and so forth, can occasionally need special attention. For example, a community having low overpasses needs to have a refurbished apparatus capable of traveling underneath these overpasses. The specifications for the refurbished apparatus should state the maximum travel height that is allowable.

A.4.2 The refurbishing of a fire apparatus generally involves a major investment and should be treated as such. Fire apparatus are complex mechanical equipment that should not be refurbished in a haphazard manner. A decision to refurbish should be made only after a detailed study of the fire department's apparatus needs, taking into consideration other equipment the department owns or plans to buy.

A.4.3.1 Depending on the scope of the refurbishing, the detailed description could include estimated in-service weight, wheelbase, principal dimensions, angle of approach, angle of departure, ramp breakover angle, transmission ratios, axle ratios, and, if applicable, the rated capacity of the aerial device. The purpose of these contractor specifications is to define what the contractor intends to furnish and deliver to the purchaser.

A.4.3.2 Depending on the scope of the refurbishing, a qualified and responsible representative of the contractor should instruct personnel, specified by the purchaser, in the operation, care, and maintenance of the refurbished fire apparatus and equipment delivered. If the refurbishing does not change any of the operating procedures of the apparatus, instruction on the operation, care, and maintenance of the refurbished fire apparatus and equipment might not be required.

A.4.7.1 The engine compartment and the underside of the vehicle are not considered areas of normal nonmaintenance operation.

A.4.8 The carrying capacity of a fire apparatus is one of the least understood features of design, and one of the most important. All apparatus have a GVWR or maximum total weight, which should not be exceeded by the apparatus refurbisher or by the user after the vehicle has been placed in service. For tractor-drawn vehicles, the GCWR weight should not be exceeded. There are many factors that make up the GVWR, including the design of the springs and suspension system, the rated axle capacity, the rated tire loading, and the distribution of the weight between the front and rear wheels.

One of the most critical factors is the size of the water tank. Water weighs approximately 8⅓ lb/gal (1 kg/L). A value of 10 lb/gal (1.2 kg/L) can be used when estimating the weight of the tank and its water, making a 500 gal (2000 L) tank and its water about 2.5 tons (2400 kg).

If the completed apparatus is not to be overloaded, the purchaser should provide the contractor with the weight of equipment to be carried if it is in excess of the allowance shown in Table 4.8.2.

Overloading the apparatus by the refurbisher through design, or by the user through specifying a larger water tank on a small chassis, or by the user adding a great deal of equipment after the apparatus has been returned to service will materially reduce the life of the vehicle and will undoubtedly result in increased maintenance costs, particularly with respect to transmissions, clutches, and brakes. Overloading can also seriously affect handling characteristics, making steering and braking particularly difficult.

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

Fire apparatus should be able to perform their intended service under adverse conditions that could require operation off paved streets or roads. Chassis components should be selected with the rigors of service in mind.

A.4.8.2(4) A weight of 250 lb (114 kg) for a fully equipped fire fighter is used in other NFPA standards. The 200 lb (90 kg) per person weight used in 4.8.2(4) does not include the weight of SCBA and tools carried by a fire fighter, as the weight of this equipment is accounted for in 4.8.2(8).

A.5.1 The National Highway Traffic Safety Administration (NHTSA) in the United States has a regulation, 49 CFR 571.7e, for determining when the modifications to a used vehicle are so extensive that the resulting vehicle will be considered new for the purposes of the Federal Motor Vehicle Safety Standards (FMVSS). Section 571.7(e) states: "Combining new and used components. When a new cab is used in the assembly of a truck, the truck will be considered newly manufactured … unless the engine, transmission, and drive axle(s) (as a minimum) of the assembled vehicle are not new, and at least two of these components were taken from the same vehicle."

A.5.2 Vehicles are designed with a specific GAWR and GCWR, or GVWR, based on the safe carrying capacity of components and/or the entire vehicle. Increasing the weight over these limits can result in loss of stability, lack of adequate braking, or

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other handling problems, all of which have the potential for injury or death to fire fighters and civilians. Requesting a contractor to exceed these limits or to compound an overweight problem creates a potential liability issue for both the purchaser and the contractor. Vehicles at or above their GAWR and GCWR or GVWR should not be considered for refurbishing unless upgraded components are installed to increase the weight ratings, or the refurbishing will result in a net decrease in vehicle weight.

A.5.3.4 The projections of total equipment payload and mounting locations are essential for proper engineering of a refurbished fire apparatus. The purchaser of the fire apparatus should maintain the side-to-side loading requirement in 5.3.4 as equipment is loaded or installed on the apparatus.

The percentage difference in tire load should be calculated as shown in the following formula:

$$\frac{\left(\begin{matrix}\text{heavier}\\ \text{weight}\end{matrix}\right)-\left(\begin{matrix}\text{lighter}\\ \text{weight}\end{matrix}\right)}{\text{total weight}}\times 100 = \text{percent difference}$$

A.5.6.2 It should be noted that older engines may not meet current EPA standards and may not be able to be economically upgraded to current standards.

A.5.11.1.3.1 A purchaser might elect to configure the fire apparatus to tow a trailer. However, even if the combination vehicle is within the GCWR, it might be impossible for the combination vehicle to be operated safely or to hold on a grade when parked, if the trailer is not equipped with its own braking system. The purchaser should ensure that any added trailers have sufficient braking capacity for safe operation.

A.5.11.2.2 Due to the hazards associated with split rims and the injuries resulting from them, they should be considered for replacement with solid rims whenever possible.

Consideration should be given to replacement of tires per the tire manufacturer's recommendations. Tires are subject to other factors besides wear, including, but not limited to, dry rot, sidewall damage, and cuts. Tires with any of these conditions should be replaced.

A.5.13 A driving/crew compartment replacement with increased seating capacity can have an impact on the vehicle weight, which should be taken into consideration. A fully enclosed driving/crew compartment to seat more than the original number of personnel can require upgrades to suspension, axles, tires, and other components. Driving/crew compartment extensions with full enclosures are also acceptable means to accomplish this safety design feature. The use of three-point seat belts is encouraged. All forward-facing seats adjacent to a side wall should be provided with a Type 2 pelvic and upper torso restraint–style seat belt assembly conforming to the Federal Motor Vehicle Safety Standard (FMVSS) No. 209, "Seat belt assemblies."

The purchaser should consider specifying remote controls on the mirrors to facilitate correct mirror adjustment. When necessary, heated mirrors should also be considered.

A.5.14.4 All exposed ferrous metal surfaces that are not chrome-plated or stainless steel should be cleaned and prepared and should be painted to the color(s) specified by the purchaser. If nonferrous body components are furnished, the purchaser should specify which surfaces are to be painted. The paint, including the primer, should be applied in accordance with the paint manufacturer's recommendations.

A.5.16.2 When dealing with a new water tank installation, the specified changes must take into consideration the overall weight of the tank cradle, additional plumbing required, and water or agent weight, as well as the tank itself. Apparatus stability and braking ability can be adversely affected by exceeding the maximum allowable configurations. Contractors as well as purchasers can be held accountable and liable if maximum limits are exceeded. Therefore, exceeding the maximum should not be considered and if additional tank size is still preferred or required, weight reductions in other areas such as hose load, miscellaneous equipment, or newer lightweight components should be utilized to maintain, yet not exceed, the maximum allowable limits.

A.5.19.9.4 NFPA 1901, *Standard for Automotive Fire Apparatus*, did not have any requirements for foam prior to the 1991 edition. It is recommended that the foam system manufacturer's test requirements be utilized for apparatus that were purchased prior to the effective date of NFPA 1901, *Standard for Automotive Fire Apparatus*, 1991 edition, and retain their original foam systems.

A.5.19.10 Any time the engine or drivetrain is altered or replaced with different components, the purchaser should require road testing to ensure the refurbished apparatus meets minimum acceptable standards.

A.6.1 The National Highway Traffic Safety Administration (NHTSA) in the United States has a regulation, 49 CFR 571.7e, for determining when the modifications to a used vehicle are so extensive that the resulting vehicle will be considered new for the purposes of the Federal Motor Vehicle Safety Standards (FMVSS). Section 571.7(e)7 states: "Combining new and used components. When a new cab is used in the assembly of a truck, the truck will be considered newly manufactured … unless the engine, transmission, and drive axle(s) (as a minimum) of the assembled vehicle are not new, and at least two of these components were taken from the same vehicle."

A.6.2 Vehicles are designed with specific GAWR and GCWR, or GVWR ratings based on the safe carrying capacity of components and/or the entire vehicle. Increasing the weight over these limits can result in loss of stability, lack of adequate braking, or other handling problems, all of which have the potential for injury or death to fire fighters and civilians. Requesting a contractor to exceed these limits or to compound an overweight problem creates a potential liability issue for both the purchaser and the contractor. Vehicles at or above their GAWR and GCWR, or GVWR ratings should not be considered for refurbishing unless upgraded components are installed to increase the weight ratings, or the refurbishing will result in a net decrease in vehicle weight.

A.6.3 Vehicle stability is one of the most critical factors in apparatus safety. When a chassis manufacturer's requirement on center of gravity and weight distribution are known, they should be complied with to ensure a stable apparatus.

A.6.3.1 All other factors being equal, an apparatus with a lower height will be more stable and less prone to overturning.

A.6.3.2 Front axle loads should not be less than the minimum axle loads specified by the chassis manufacturer, under full load and all other loading conditions. Apparatus with extreme weight bias at front or rear can be difficult to control on curves or on road surfaces with poor adhesion.

A.6.3.4 The projections of total equipment payload and mounting locations are essential for proper engineering of a

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refurbished fire apparatus. The purchaser of the fire apparatus should maintain the side-to-side loading requirement in 6.3.4 as equipment is loaded or installed on the apparatus.

The percentage difference in tire load should be calculated as shown in the following formula:

$$\frac{\left(\begin{matrix}\text{heavier}\\ \text{weight}\end{matrix}\right)-\left(\begin{matrix}\text{lighter}\\ \text{weight}\end{matrix}\right)}{\text{total weight}}\times 100 = \text{percent difference}$$

A.6.6.1 The purchaser should consider the following tests when the engine or engine system is to be refurbished:

(1) Compression test
(2) Blowby test
(3) Fuel pressure test
(4) Oil analysis

A.6.6.2 It should be noted that older engines may not meet current EPA standards and may not be able to be economically upgraded to current standards.

A.6.11.1.1 Problems with the vehicle braking system have the potential for causing serious accidents, resulting in injury or death to both fire fighters and civilians. In addition, there is a corresponding liability issue in the operation of a vehicle with an inadequate braking system. It is recommended that all required braking system repairs be made before the apparatus is returned to service.

A.6.11.1.2 Consideration should be given to installing an antilock braking system (ABS) when the braking system is to be upgraded.

A.6.11.2.1 Due to the hazards associated with split rims and the injuries resulting from them, they should be considered for replacement with solid rims whenever possible.

A.6.11.2.5 See A.5.11.1.3.1.

A.6.11.6 If the purchaser wants the tow hooks or tow eyes to be accessible without having to open compartment doors, the specifications should state that fact.

A.6.12.1 This section defines the requirements for upgraded alternators, batteries, load management, and instrumentation to detect incipient electrical system failure. The intent is to require that an upgraded electrical system will operate the apparatus using power supplied by the alternator, shed non-essential electrical loads where necessary, and provide early warning of electrical failure in time to permit corrective action.

A.6.12.2 All components that are upgraded should be replaced with components meeting the current edition of NFPA 1901 or NFPA 1906, as appropriate. The current standard provides additional lighting for safety and makes provision for two modes of operation: responding and blocking the right-of-way. Consideration should also be given to having the contractor furnish a wiring schematic of the rewired areas of the apparatus to enable vehicle repair technicians to more easily troubleshoot the electrical system or make additions to the system.

A.6.12.3.3(7) The purchaser needs to analyze the electrical loads that have to be maintained to fulfill the mission of the refurbished apparatus and to define those loads for the refurbisher of the apparatus. The purchaser needs to understand, however, that there is a limit to the output capacity of an alternator system on the apparatus' engine, and that this standard requires that the apparatus be capable of maintaining the minimum continuous electrical load under the conditions defined in 6.12.3.2. When that load is exceeded and larger alternators are not available, the purchaser and the refurbisher need to work together to determine how to reduce the minimum continuous electrical load so that it can be sustained under the conditions defined in 6.12.3.2.

A.6.12.3.4.1 Reduced crew sizes have forced the apparatus operator to assume many new fireground tasks besides that of operating the apparatus. Even if the operator is at the apparatus, he is too busy with higher priority tasks to pay much attention to monitoring the condition of the electrical system.

Electrical loads on modern fire apparatus frequently exceed the alternator capacity and can be supplied only by the deep discharge of the apparatus batteries. The high-cycle batteries that are designed to provide the large amount of amperage to crank modern diesel engines are severely damaged when deeply discharged. The automatic load management is intended to protect the electrical system from needless damage while maintaining the operation of essential devices.

It is important that the priority of all managed loads be specified by the purchaser so that, as electrical loads are disconnected from the apparatus' electrical system, they are shed in an order least likely to affect emergency operations. Optical warning devices in excess of the minimum required in NFPA 1901, *Standard for Automotive Fire Apparatus*, or NFPA 1906, *Standard for Wildland Fire Apparatus*, whichever is applicable, can and should be load managed.

A.6.12.4 Consideration should be given to upgrading the optical warning devices to the current edition of NFPA 1901, *Standard for Automotive Fire Apparatus*, or NFPA 1906, *Standard for Wildland Fire Apparatus*, whichever is applicable, both for improved safety during emergency responses, as well as to minimize current draw when operating at the scene. The upgraded lighting should provide an increased measure of safety, as well as minimize loads to the low-voltage electrical system.

A.6.13 The purchaser should consider specifying remote controls on the mirrors to facilitate correct mirror adjustment. When necessary, heated mirrors should also be considered.

A.6.13.2 Cab replacements with increased seating capacity can have an impact on the vehicle weight, and this should be taken into consideration. A fully enclosed cab for more than the original number of personnel can require upgrades to suspension, axles, tires, and other components. Canopy cab extensions with patio door–type closures or separate telephone booth–type personnel enclosures are also acceptable means to accomplish this safety design feature. The use of three-point seat belts, where available, is encouraged.

A.6.14.2 It is recommended that any upgrades to the existing body, compartmentation, or hose storage area be made according to current NFPA standards.

A.6.16.2 When dealing with a new tank installation, the specified changes must take into consideration the overall weight of the tank cradle, additional plumbing required, and water or agent weight, as well as the tank itself. Apparatus stability and braking ability can be adversely affected by tank modifications. Contractors as well as purchasers can be held accountable and liable if maximum limits are exceeded. Therefore, exceeding the maximum should not be considered, and if additional tank size is still preferred or required, weight reductions in other areas such as hose load, miscellaneous equipment, or newer lightweight components should be utilized to maintain, yet not exceed, the maximum allowable limits. *(See Sections 6.2 and 6.3.)*

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A.6.19.9.2.1 A substantial change would include replacing the alternator, adding or replacing the load management system, upgrading the electrical control systems, or increasing the total connected load by 20 percent or more over the original as-delivered load.

A.6.19.9.3.1 A substantial change would include replacing the power source, replacing the line-voltage control system, or increasing total line-voltage load by 20 percent or more over the original as-delivered load.

A.6.19.9.4 There were no foam system requirements for apparatus built prior to the adoption of the 1991 edition of NFPA 1901, *Standard for Automotive Fire Apparatus.*

A.6.19.10.1 Any time the engine or drivetrain is altered or replaced with different components, the purchaser should require road testing to ensure the refurbished apparatus meets minimum acceptable standards.

Annex B Fire Apparatus Refurbishing Specifications

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

B.1 General. Fire apparatus refurbishing can range from simple cosmetic–type restorations to complete Level I refurbishing. Therefore, the amount of information that the contractor and purchaser require can vary greatly. Depending on the scope of the proposed work, consideration should be given to the details discussed in some or all of the following paragraphs. It is recommended that the form in Figure B.1 be used to identify the information needed to properly develop specifications for those portions of the fire apparatus that are to be modified or upgraded during the refurbishing.

The local fire chief and fire department staff know the conditions under which the apparatus will be used. However, competent advice should also be obtained from knowledgeable and informed sources such as other experienced fire service personnel, trade journals, training instructors, maintenance personnel, and fire equipment and component manufacturers. The fire insurance rating authority should also be consulted.

The study should look not only at current operations and risks protected but also at how these might change over the life of the fire apparatus.

B.1.1 Writing the Specifications.

B.1.1.1 This standard provides the minimum technical requirements that refurbished fire apparatus are expected to meet. It is recognized that many purchasers will desire additional features beyond these minimum requirements. The requirements in this standard, together with the annex material, should be carefully studied. Details of where the apparatus has to exceed the minimum requirements or where a specific arrangement is required should be carefully defined in the specifications for the refurbished apparatus. These details might include special performance requirements, the number of seats and seating arrangement for fire fighters riding on the apparatus, or the provision of space for extra hose or equipment the apparatus will be required to carry.

B.1.1.2 Where local operating conditions necessitate apparatus of an unusual design, the purchaser needs to define carefully the special requirements in the specifications. Height, width, under-vehicle clearance, wheelbase, turning radius, length, and so forth, might need special attention. For example, a community with many narrow, winding streets should have apparatus capable of readily negotiating switchbacks without delay.

B.1.1.3 Fixed Components.

B.1.1.3.1 A major consideration in the design of a refurbished fire apparatus is the fixed components. These include the following:

(1) Electrical generators
(2) Water tanks, fire pumps, and other fire-fighting equipment
(3) Air cascades or compressors
(4) Reels of all types

B.1.1.3.2 These fixed components could represent the most concentrated and heaviest loads on the vehicle. They could be located in exterior compartments or within the interior of the vehicle. They should be organized in the layout to be functional and user friendly in emergency applications. It is vital that these components be situated on the vehicle to provide for the following:

(1) Good load distribution
(2) Balance (both front-to-rear and right-to-left)
(3) Low center of gravity

B.1.1.4 Portable Equipment.

B.1.1.4.1 A major function of any fire apparatus, no matter what the type, is to carry portable equipment to the emergency scene. Portable equipment can add significant weight to the vehicle. For this reason, this standard places emphasis on the final GVWR and carrying capacity of the refurbished apparatus, which includes both fixed and portable equipment.

B.1.1.4.2 Because the listings of portable and fixed equipment carried on the apparatus varies depending upon the mission of the vehicle, the fire department should measure and weigh their specific equipment to ensure the refurbished apparatus has adequate carrying capacity to accommodate both the volume and weight of the equipment.

B.1.1.4.3 The fire department should classify the equipment as follows:

(1) Existing equipment to be carried
(2) Proposed new equipment to be carried
(3) Possible equipment to be carried in the future

In this way, a chassis with an adequate GVWR can be provided to ensure that the vehicle will not be overloaded in the future.

B.1.1.4.4 After determining the weight and volume of present, proposed, and future portable equipment, the fire department should analyze the actual volume and arrangement of space necessary for the portable equipment. The following factors could increase the volume required:

(1) Compartment door and box pan interference
(2) Mounting implications
(3) Compartment shelving
(4) Slide trays
(5) Components of the body such as component flanges, notches, and other interferences that affect removal of equipment from a compartment
(6) Ventilation requirements of a generator, air compressor, or other equipment

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APPARATUS REFURBISHING SPECIFICATION FORM

For any items that are to be added or upgraded, provide as much detail as needed to allow the refurbisher to provide the desired components and workmanship. Add additional sheets as necessary. Consult the appropriate sections of NFPA 1901, *Standard for Automotive Apparatus*, or NFPA 1906, *Standard for Wildland Fire Apparatus*, for details that might need to be specified for new or significantly upgraded systems.

PROCUREMENT ISSUES

This is a request for ❑ Bid ❑ Proposal

Date of bid/proposal opening: _____

Purchaser's name and address: _____

_____

Contact name and telephone number: _____

Sealed bid envelope information, address, and identification marking: _____

_____

The bidder is to honor the bid price for _____ days.

When will the apparatus be available to start the refurbishment? _____

How will the apparatus be delivered to the refurbisher? _____

If an interim inspection trip(s) to the refurbishing plant is to be provided, indicate:

Number of trips: _____ Number of participants: _____ Who will pay expenses? _____

How many parts, service, and operation manuals are to be provided? _____

❑ Complete or ❑ Partial manuals required.

Where is the delivery of the refurbished apparatus to occur? _____

Where and when is the acceptance to occur? _____

Is operation and service instruction and demonstration required? _____ Where? _____

For _____ persons for _____ days.

Specify the details of any special payment plan or schedule required: _____

_____

Is an approval drawing required? ❑ Yes ❑ No

Is a bid bond required? ❑ Yes ❑ No What percent of bid price? _____

Is a performance bond required? ❑ Yes ❑ No What percent of bid price? _____

If an extended warranty on specific components is required, indicate which components and the length of the warranty:

_____

Is a warranty bond required? ❑ Yes ❑ No In what amount? _____

GENERAL REQUIREMENTS

What are the maximum allowable dimensions of the apparatus?

Overall height in in. (mm): _____ (measured at the highest projection)

Overall length in in. (mm): _____ (measured at the front and rearmost projections)

Wheelbase in in. (mm): _____ (only if it is to change)

Width in in. (mm): _____ (measured at the outside of the mirrors)

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FIGURE B.1 Specification Form for Fire Apparatus Refurbishing.

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APPARATUS REFURBISHING SPECIFICATION FORM *(continued)*

Maximum weight on the front axle in lb (kg): _____ (only if it is different from current front GAWR)

Maximum weight on the rear axle in lb (kg): _____ (only if it is different from current rear GAWR)

What is the maximum wall-to-wall turning radius allowable? _____ ft (m)

Maximum elevation at which the apparatus will operate if over 2000 ft (600 m): _____

Maximum grade that the apparatus will climb if over 6 percent (across 20 percent, up/down 25 percent, stationary 10 percent grades for wildland fire apparatus): _____

Specify the minimum ambient air temperature in which the apparatus is to operate: _____ (°F) (°C)

Specify the maximum ambient air temperature in which the apparatus is to operate: _____ (°F) (°C)

Specify the apparatus road performance if it is to exceed the minimum specified in this standard: _____

_____

Specify maximum road speed required (only if upgrading engine, transmission, drive axle, or tires): _____

Specify the maximum number of persons to ride on the apparatus: _____

Hose Thread Size Information (required if changing or upgrading intakes or discharges)

TPI × OD or size and type (e.g., 2½ in. NH or 4 in. Storz)	
1 in. =	1½ in. =
2 in. =	2½ in. =
3 in. =	3½ in. =
4 in. =	4½ in. =
5 in. =	6 in. =
Hydrant =	

Testing and Acceptance

If independent certification of tests is required for the pump system, aerial device, line-voltage power source, or other systems, what independent testing organization is to certify the tests? _____

Is anyone representing the purchaser to witness the refurbisher's pre-delivery tests? ❑ Yes ❑ No

If yes, who? _____

Where are the road tests to be conducted? _____

What tests will the contractor be required to perform on delivery? _____

APPARATUS TYPE

This apparatus is to be used as a(n):

- ❑ Pumper
- ❑ Initial attack apparatus
- ❑ Mobil water supply apparatus
- ❑ Aerial fire apparatus
- ❑ Quint fire apparatus
- ❑ Special service apparatus
- ❑ Mobil foam fire apparatus
- ❑ Wildland fire apparatus

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FIGURE B.1 *Continued*

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APPARATUS REFURBISHING SPECIFICATION FORM *(continued)*

What functions or services is this apparatus to perform? _____

_____

_____

Suction Hose

Hose: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new

Soft or hard: _____

Size and length: _____

Connection type and size: _____

Mounting: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new

Arrangement, bracket style, and location: _____

_____

Ground Ladders

Number	Length	Type	Mounting Location and Bracket	Source
				❑ Use existing ❑ Replace ❑ Addition
				❑ Use existing ❑ Replace ❑ Addition
				❑ Use existing ❑ Replace ❑ Addition
				❑ Use existing ❑ Replace ❑ Addition
				❑ Use existing ❑ Replace ❑ Addition
				❑ Use existing ❑ Replace ❑ Addition
				❑ Use existing ❑ Replace ❑ Addition

Indicate whether a specific type or make of ladder is desired for replacements and additions: _____

_____

Breathing Apparatus

Quantity	Make/Model	Mounting Location	Source
			❑ Use existing ❑ Contractor supply ❑ Purchaser supply
			❑ Use existing ❑ Contractor supply ❑ Purchaser supply
			❑ Use existing ❑ Contractor supply ❑ Purchaser supply
			❑ Use existing ❑ Contractor supply ❑ Purchaser supply
			❑ Use existing ❑ Contractor supply ❑ Purchaser supply

Special requirements for breathing apparatus or its mounting, including diameters of SCBA cylinders to be utilized:

_____

_____

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FIGURE B.1 *Continued*

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APPARATUS REFURBISHING SPECIFICATION FORM *(continued)*

Equipment Carried on Apparatus

Miscellaneous equipment allowance if it exceeds the standard's minimum weight: _____ lb (kg)

Attach a list of equipment and tools to be supplied by the contractor with the apparatus, stating the item, quantity, where it is to be mounted or carried, the weight of each item, and its dimensions (L × W × D).

Attach a list of equipment and tools to be supplied by the fire department to be carried on the apparatus, stating the item, quantity, where it is to be mounted or carried, contractor's responsibility for mounting, the weight of each item, and its dimensions (L × W × D).

Attach a list of equipment and tools that might be carried on the apparatus in the future, stating the item, quantity, the desired mounting location or compartment where it is likely to be carried, the weight of each item, and its dimensions (L × W × D).

Attach a list of fixed equipment and permanent components required on the apparatus, stating the item, quantity, where it is to be mounted or carried, the weight of each item, and its dimensions (L × W × D).

If additional compartment space is required in addition to what is necessary to store the equipment on the attached four lists, indicate space requirements: _____

_____

CHASSIS AND VEHICLE COMPONENTS

Engine:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Transmission:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Traction control system:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Antilock braking system:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Drive shaft(s) :	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Front axle:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Rear axle:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Braking system:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Auxiliary braking system:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Parking brakes:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Suspension:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Wheels:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Tires:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Cooling system:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Engine speed control:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Lubrication system:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Air intake system:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Fuel system:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Fuel tank:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Exhaust system:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Steering:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Tow hooks/eyes:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Automatic tire chains:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____

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FIGURE B.1 *Continued*

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APPARATUS REFURBISHING SPECIFICATION FORM *(continued)*

Provide details required on components to be added or upgraded: _____

_____

_____

Provide details on any other specific items to be repaired, replaced, upgraded, or added in addition to the items specified above: _____

_____

_____

Are rear fender liners required? _____

Specify whether the apparatus is designed to operate off paved roads: _____

Specify whether an increased angle of approach is required: _____

Specify whether an increased angle of departure is required: _____

Specify whether a specific ramp breakover angle is required: _____

LOW-VOLTAGE ELECTRICAL SYSTEMS AND WARNING DEVICES

Alternator:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Alternator wiring:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Batteries:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Battery wiring:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Starter:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Starter wiring:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Chassis wiring harness:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Body wiring harness:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Load manager:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Low-voltage alarm:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Warning lights:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Headlights:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Stop, taillights:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Turn signal lights:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Cab handlights or mounted adjustable spotlights:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Traffic horn:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Air horns:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Siren(s):	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Ground lighting:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Hose bed lighting:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Surface lighting:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Interior lighting:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Compartment lighting:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____

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FIGURE B.1 *Continued*

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APPARATUS REFURBISHING SPECIFICATION FORM *(continued)*

Hazard light: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Backup alarm: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Battery charger/conditioner: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Provide details required on components to be added or upgraded: _____

_____

_____

Provide details on any other specific items to be repaired, replaced, upgraded, or added in addition to the items specified above: _____

_____

_____

Specify any electrical loads beyond those defined in the standard that are to be part of the minimum continuous electrical load: _____

If a load management system is being replaced, upgraded, or added, specify the sequence of load shedding: _____

_____

_____

Warning Lights To Be Upgraded or Added

Location	Make and Model	Color
Upper level, forward-facing		
Upper level, side-facing, front		
Upper level, side-facing, midship		
Upper level, side-facing, rear		
Upper level, rear-facing		
Lower level, forward-facing		
Lower level, side-facing, front		
Lower level, side-facing, midship		
Lower level, side-facing, rear		
Lower level, rear-facing		

DRIVING AND CREW COMPARTMENTS

Cab: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Doors: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Personnel enclosure: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Seat belts: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Seats: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

SCBA mounting: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Equipment mounting: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

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FIGURE B.1 *Continued*

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APPARATUS REFURBISHING SPECIFICATION FORM *(continued)*

Cab tilt:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Mirrors:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Rear view camera system:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Instrumentation:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Intercom system:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Heating:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Air conditioning:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Steps or handrails:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Steering wheel/column:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____

Maximum number of seating positions in the apparatus: _____

Provide details required on components to be added or upgraded: _____

_____

_____

Provide details on any other specific items to be repaired, replaced, upgraded, or added in addition to the items specified above: _____

_____

_____

BODY, COMPARTMENTS, AND EQUIPMENT MOUNTING

Entire body:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Compartment doors:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Door stays:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Door latches/locks:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Compartment floors:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Pump enclosure:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Compartment lighting:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	_____
Body trim:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Steps/walkways/ladders:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Handrails:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Hose bed(s):	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Hose bed covers:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Equipment storage:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Suction hose storage:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Powered equipment racks:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Radio compartment:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
Computer equip. provisions:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____
SCBA storage:	❑ No change	❑ Inspect	❑ Replace	❑ Upgrade	❑ Add new _____

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FIGURE B.1 *Continued*

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APPARATUS REFURBISHING SPECIFICATION FORM *(continued)*

SCBA bottle storage: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Pump panel(s): ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Receivers/anchors: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Provide details required on components to be added or upgraded: _____

_____

_____

Provide details on any other specific items to be repaired, replaced, upgraded, or added in addition to the items specified above: _____

_____

_____

Body material: _____

Tread plate material: _____

Color scheme of apparatus: _____

Paint number(s) and manufacturer, if known: _____

Striping, decoration, and lettering required: _____

List any areas not to be painted: _____

Is rustproof treatment required? ❑ Yes ❑ No

Provide details of locations to be treated: _____

Hose To Be Carried for Preconnected Lines

Length	Size	Location	Bed or Reel

Hose To Be Carried in Hose Bed or on Reels

Length	Size	Location	Bed or Reel

Specify any requirements for anchoring and lifting a slip-on fire-fighting unit: _____

_____

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FIGURE B.1 *Continued*

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APPARATUS REFURBISHING SPECIFICATION FORM *(continued)*

FIRE PUMP, WATER PUMP, OR INDUSTRIAL SUPPLY PUMP

Pump: ❑ Use existing pump ❑ Overhaul ❑ Replace ❑ Upgrade _____

Pump drive engine: ❑ Not applicable ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Discharges: ❑ No changes

❑ Add new discharges _____

❑ Remove discharges _____

❑ Upgrade discharges _____

Deck gun: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Booster reel(s): ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Intakes: ❑ No changes

❑ Add new intakes _____

❑ Remove intakes _____

❑ Upgrade intakes _____

Valves: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Valve controls: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Intake relief system: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Pressure control system: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Priming system: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Gauges: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Flowmeters: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Provide details required on components to be added or upgraded: _____

_____

_____

Provide details on any other specific items to be repaired, replaced, upgraded, or added in addition to the items specified above: _____

_____

_____

Pump-rated capacity: _____ gpm (L/min) at _____ psi (kPa) with _____ stages

Pump-and-roll capacity, if required: _____ gpm (L/min) at _____ psi (kPa) at vehicle speed _____ mph (km/hr)

Specify pump performance requirements:

If altitude over 2000 ft (600 m), specify altitude: _____

If lift over 10 ft (3 m) (less for large pumps, see NFPA 1901), specify lift: _____

If through more than 20 ft (6 m) of suction hose, specify length: _____

Do local water conditions require special materials for pump and related piping? _____

Is pump panel color-coding required? _____

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APPARATUS REFURBISHING SPECIFICATION FORM *(continued)*

AUXILIARY PUMP

Pump: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Pump drive engine: ❑ Not applicable ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Discharges: ❑ No changes

❑ Add new discharges _____

❑ Remove discharges _____

❑ Upgrade discharges _____

Booster reel(s): ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Intakes: ❑ No changes

❑ Add new intakes _____

❑ Remove intakes _____

❑ Upgrade intakes _____

Valves: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Valve controls: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Intake relief system: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Pressure control system: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Drains: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Priming system: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Gauges: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Flowmeters: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Provide details required on components to be added or upgraded: _____

_____

_____

Provide details on any other specific items to be repaired, replaced, upgraded, or added in addition to the items specified above: _____

_____

_____

Pump-rated capacity: _____ gpm (L/min) at _____ psi (kPa)

Pump-and-roll capacity, if required: _____ gpm (L/min) at _____ psi (kPa) at vehicle speed _____ mph (km/hr)

Specify pump performance requirements:

If altitude over 2000 ft (600 m), specify altitude: _____

WATER TANK

Water tank: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Baffles: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Foam cell: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Tank level gauge: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

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FIGURE B.1 ***Continued***

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APPARATUS REFURBISHING SPECIFICATION FORM *(continued)*

Tank-to-pump line: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Tank fill line: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Direct tank fill: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Tank fill/vent: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Provide details required on components to be added or upgraded: _____

_____

_____

Provide details on any other specific items to be repaired, replaced, upgraded, or added in addition to the items specified above: _____

_____

_____

AERIAL DEVICES

Aerial device: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Ladder sections: ❑ No change ❑ Inspect ❑ Replace ❑ Repair _____

Booms: ❑ No change ❑ Inspect ❑ Replace ❑ Repair _____

Rung covers: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Ladder tip steps: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Turntable access: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Turntable access handrails: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Turntable railings: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Breathing air system: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Stabilizers/outriggers: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Waterway: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Deluge gun: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Pressure relief valve: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Waterway drains: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Waterway flowmeter: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Hydraulic pump: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Hydraulic reservoir: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Auxiliary hydraulic pump: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Rotation system: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Elevation system: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Extension system: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Communication system: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Turntable controls: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Platform: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

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FIGURE B.1 ***Continued***

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APPARATUS REFURBISHING SPECIFICATION FORM *(continued)*

Water curtain system: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Platform heat shield: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Platform controls: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Platform leveling system: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Work lighting: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Ladder/boom lighting: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Spotlight(s): ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Signs and labeling: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade _____

Provide details required on components to be added or upgraded: _____

Provide details on any other specific items to be repaired, replaced, upgraded, or added in addition to the items specified above: _____

FOAM PROPORTIONING SYSTEMS

Foam system: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Type of foam system: _____

Type(s) of foam to be used: _____

Foam concentrate capacity: _____ gal (L)

Discharge Outlets To Be Used with Foam and Their Performance

Discharge Location	Required Flow	Proportioning Rate	Hose Length	Hose Diameter

Is an outside foam system inlet of pickup required? ❑ Yes ❑ No

Type: _____

Is a foam tank refill system required? ❑ Yes ❑ No

If yes, performance requirements: _____

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FIGURE B.1 *Continued*

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APPARATUS REFURBISHING SPECIFICATION FORM *(continued)*

COMPRESSED AIR FOAM SYSTEM (CAFS)

Compressed air foam system: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

What is the total SCFM (SCMM) required? _____

What type of compressor and driver are required? _____

What is the total water pump capacity required? _____

Specify the type of system controls and interlocks required: _____

Discharge Outlets To Be Used with the CAFS and Their Performance

Discharge Location	Required Flow	Hose Length	Hose Diameter

Is automatic water and air pressure tracking required? ❑ Yes ❑ No

If yes, type of system: _____

Is an airflow meter required [SCFM (SCMM)]? ❑ Yes ❑ No

Specify the type of wet/dry control required: _____

LINE-VOLTAGE ELECTRICAL SYSTEM

Line-voltage system: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Power source: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Instrumentation: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Panelboard: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Transfer switch: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Wiring: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Receptacles: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Cord reels: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Scene lighting: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Light tower: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Appliances: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Provide details required on components to be added or upgraded: _____

_____

_____

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FIGURE B.1 *Continued*

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APPARATUS REFURBISHING SPECIFICATION FORM *(continued)*

Provide details on any other specific items to be repaired, replaced, upgraded, or added in addition to the items specified above: _____

_____

_____

COMMAND AND COMMUNICATIONS

Command area: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Provide details required on components to be added or upgraded: _____

_____

_____

Provide details on any other specific items to be repaired, replaced, upgraded, or added in addition to the items specified above: _____

_____

_____

AIR SYSTEMS

Breathing air system: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Compressor: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Air booster: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Air filtration system: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Cascade system: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Fill station: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Air control panel: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Instrumentation: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Air reel(s): ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Provide details required on components to be added or upgraded: _____

_____

_____

Provide details on any other specific items to be repaired, replaced, upgraded, or added in addition to the items specified above: _____

_____

_____

WINCHES

Winch: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

What is the single line pull rating required? _____

What is the wire rope length required? _____

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FIGURE B.1 *Continued*

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APPARATUS REFURBISHING SPECIFICATION FORM *(continued)*

Power source: ❑ Electric ❑ Hydraulic

Specify winch location: _____

Type of control required: _____

Location of control: _____

Provide details required on components to be added or upgraded: _____

_____

_____

Provide details on any other specific items to be repaired, replaced, upgraded, or added in addition to the items specified above: _____

_____

_____

VEHICLE PROTECTION SYSTEM

Brush guards and rails: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Grille guard: ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Skid plates ❑ No change ❑ Inspect ❑ Replace ❑ Upgrade ❑ Add new _____

Provide details required on components to be added or upgraded: _____

_____

_____

Provide details on any other specific items to be repaired, replaced, upgraded, or added in addition to the items specified above: _____

_____

_____

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FIGURE B.1 ***Continued***

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B.1.1.5 This standard is designed to promote sound equipment that is capable of good performance, with inclusion of restrictive features only where needed to specify minimum requirements. The tests and inspections are an important feature of the refurbishing process, and the results should be carefully analyzed to ensure that the completed apparatus meets the specified performance requirements.

B.1.1.6 Since the passage of Public Law 89-563, the National Traffic and Motor Vehicle Safety Act of 1966, the federal government has adopted certain motor vehicle safety standards applicable to all manufacturers of trucks, including fire apparatus. It is unlawful for a manufacturer to deliver a truck not in compliance with these federal standards. These federal safety standards are frequently changed, and their provisions make the incorporation of certain features and devices mandatory. Apparatus refurbishers face substantial penalties for infraction of these rules and, therefore, cannot build to specifications that would require them to perform unlawfully, delete required items, or include any items that are illegal.

B.1.1.7 Additional requirements are placed on both apparatus and engine manufacturers by the Clean Air Act, which is enforced by the Environmental Protection Agency (EPA). These EPA standards have resulted in major changes in the performance of many engines. Neither the engine manufacturer nor the apparatus manufacturer are permitted to modify engines once they are certified to EPA standards. Because of the EPA standards, it is often necessary to install larger engines than might have been previously used in order to obtain the same apparatus performance. New engines installed in refurbished apparatus are required to meet the current EPA standards. Rebuilt engines are only required to meet the requirements in effect at the time of original manufacture of the engine.

B.1.1.8 Depending on the scope of the refurbishing, it may be desirable to provide for an interim inspection at the contractor's refurbishing facility. The advantages of such a provision include the opportunity to evaluate construction prior to final assembly and painting. The specifications should detail the particulars of such an inspection.

B.1.1.9 The chief of the fire department (or a designated representative) normally exercises the acceptance authority following satisfactory completion of tests and inspections for compliance with purchase specifications. The specifications should provide details of delivery expectations, including the desired training, the required acceptance tests, and who is responsible for the various costs associated with the delivery and acceptance.

B.1.1.10 If training of designated fire department personnel is required due to the scope of the refurbishing, it is essential to ensure that the purchaser and user are aware of, and instructed in, the proper operation, care, and maintenance of the acquired apparatus. This training should provide the initial instruction on the refurbished apparatus. The training is typically delivered by a qualified representative of the contractor in the user's community. The specifications should clearly identify the arrangement for providing the training, including its location, its duration, and necessary training aids such as videotapes or training manuals.

B.1.1.11 The purchaser should also define in the specifications the warranty desired for the refurbished apparatus. The warranty is a written guarantee of the integrity of the refurbishing or its components that defines the manufacturer's responsibility within a given time period. The warranty is sometimes extended for a second warranty period beyond the terms of the basic warranty for specific components, such as the engine, pump, frame, water tank, and so forth. If a secondary manufacturer is involved in modifying components that are warranted by the original manufacturer, the responsibility for warranty work should be clearly understood by the original manufacturer, the secondary manufacturer, the contractor, and the purchaser.

B.1.1.12 The purchaser might consider a warranty bond to ensure that any warranty work will be performed, even if the apparatus refurbisher should go out of business. A warranty bond is a third-party secured bond established by the refurbisher before delivery of a vehicle to guarantee workmanship, quality of material, or other stated performance of the vehicle components.

B.1.1.13 Finally, it is recommended that the fire chief, fire department staff, or committee assigned to develop the specifications consult with the purchaser's attorney, engineer, and other appropriate officials for assistance in developing the detailed specifications.

B.1.2 Obtaining and Studying Proposals.

B.1.2.1 When the specifications are complete, they should be distributed to apparatus refurbishers and contractors with a request for bids or proposals to furnish the specified refurbished apparatus. The request should specify a date, time, and place for the formal opening of the bids. This date should allow at least one month for the apparatus refurbishers to study the specifications and estimate the cost of the apparatus refurbishing. More time could be required if engineering drawings of the refurbished apparatus are required.

B.1.2.2 Time should also be allocated to allow the prospective apparatus refurbishers to examine the apparatus prior to submitting a bid. Someone familiar with the work to be performed should accompany the prospective bidder, so as to answer any questions that could arise. However, it is imperative that all bidders are provided with the same information.

B.1.2.3 The request also should state the time period during which the purchaser expects the bidder to honor the bid price and whether a bid bond is required. A bid bond guarantees that if a contract is offered to the bidder within the defined time period, the bidder will enter into the contract under the terms of the bid.

B.1.2.4 A pre-bid meeting should be considered between the purchaser of a refurbished fire apparatus and the prospective apparatus refurbishers or their agents prior to the submittal of the bids. Such a meeting is designed to allow for a detailed review of the draft specifications by all present at the meeting. Problems with the specifications, ideas on how to provide the purchaser with the desired apparatus in other ways, clarification of the purchaser's intent, and other questions can be resolved prior to the formal bid process. The meeting can often prevent misunderstandings or problems prior to their occurrence. It also gives the prospective bidders an opportunity to inspect the apparatus scheduled for refurbishing prior to bidding.

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B.1.2.5 With a performance specification, it is usually possible to obtain more favorable bids, because there is genuine competition and the specifications are not overly restrictive. The bid or proposal should be accompanied by a detailed description of the refurbished apparatus, a list of equipment to be furnished, and other construction and performance details, including, but not limited to, estimated in-service weight, wheel base, principal dimensions, transmission, and axle ratios. The purpose of the contractor's specifications is to define what the contractor intends to furnish and deliver to the purchaser.

B.1.2.6 Refurbishers' proposals might include amendments and exceptions. Frequently, these changes are offered to meet price requirements or because individual refurbishers prefer to work on apparatus in a manner more convenient to them. If the intent of the original specification is not changed and the bid is favorable, the purchaser should consider accepting these amendments with the approval of the purchasing authority. On the other hand, extreme care should be taken to avoid allowing exceptions that merely devalue the apparatus and give one bidder an advantage.

B.1.2.7 The purchaser should study the proposals, look for deviations from the specifications, and obtain clarification where necessary. If the purchaser has specifically provided for alternatives when calling for bids, extra care should be exercised when evaluating the bids, as combinations of complicated bid information will need careful analysis. The financial arrangements, a delivery date, and the method of delivery should be stipulated and agreed to by the purchasing authority.

B.1.3 Awarding the Contract.

B.1.3.1 With the award of a contract, it is important for the purchasing authority to understand exactly who the contract is with and the nature of the relationship with the apparatus refurbisher.

B.1.3.2 Some purchasing authorities require a performance bond as part of the contract. A performance bond is a bond executed in connection with a contract that guarantees that the contractor will fulfill all of the undertakings, covenants, terms, conditions, and agreements contained in the contract. Should the contractor fail to meet the terms of the contract, the bonding company will be responsible for the difference in cost between the original contract price and the new price of the apparatus when it has to be supplied by another contractor.

B.1.3.3 Before signing a contract, the purchaser should make certain that the successful bidder has a complete and thorough understanding of the specifications. If there are any disagreements, these should be resolved in writing and made part of the contract. If any changes are agreed upon, they should be stated in writing and be signed by both parties. The contract should not be signed until the fire chief (or a designee) and the purchasing authority are satisfied.

B.1.4 Acceptance. When the refurbished apparatus is ready for delivery and acceptance, the purchaser has a responsibility to check the completed apparatus carefully against the specifications and contract to ensure all that is required is being delivered. Depending on the scope of the work, this can include witnessing any required acceptance tests and verifying that the gross vehicle weight and the axle weight distribution are within the chassis and axle ratings.

B.1.4.1 The purchaser also should arrange for any training specified as part of the delivery and ensure that it is properly provided.

B.1.4.2 Only when the purchaser is totally satisfied that the contract has been fulfilled should payment be authorized.

Annex C Weights and Dimensions for Common Equipment

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

C.1 NFPA in cooperation with the Fire Apparatus Manufacturers Association (FAMA) has provided the worksheet shown as Figure C.1 for use by the purchaser in calculating the portable equipment load anticipated to be carried on the apparatus. To ensure that the apparatus chassis is capable of carrying the installed equipment (pump, tank, aerial device, etc.) plus the specified portable equipment load with an appropriate margin of safety, the purchaser should use this worksheet to provide apparatus vendors with the weight of the equipment they anticipate carrying when the apparatus is placed in service.

C.1.1 The approximate measurements and weights of equipment that are commonly available and used during fire department operations are listed on the worksheet. The purchaser should fill in the number of units of each piece of equipment they anticipate carrying in the column titled "Quantity" and multiply that by the weight per unit to get the total weight. The dimensions of each piece of equipment are given to assist in planning compartment size or the location on the fire apparatus. Where the purchaser desires to carry specific equipment in a specific compartment, that compartment designation should be shown in the column titled "Compartment Location."

C.1.2 An Excel spreadsheet that contains the information shown in Figure C.1 can be downloaded from the FAMA website, www.fama.org, and customized to show only the equipment a department expects to carry. There are additional columns on the spreadsheet to assist the fire department in maintaining records of the equipment it carries on the apparatus.

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DETERMINING EQUIPMENT WEIGHT ON FIRE APPARATUS WORKSHEET

Equipment Description	Dimensions (in.)	Weight (lb)	Quantity	Total Weight (lb)	Compartment Location
Ground Ladders					
Ladder, A-frame combo, 14 ft	20.5 × 6.25 × 116	33			
Ladder, attic	2.5 × 1.5 × 137	14			
Ladder, combo folding (Little Giant–type)	20 × 7.75 × 102	28			
Ladder, extension, 2 section, 14 ft	21 × 5 × 115	53			
Ladder, extension, 2 section, 16 ft	21 × 5 × 129	59			
Ladder, extension, 2 section, 20 ft	21 × 5 × 144	66			
Ladder, extension, 2 section, 24 ft	21 × 5 × 171	75			
Ladder, extension, 2 section, 28 ft	22 × 5.75 × 199	114			
Ladder, extension, 3 section, 28 ft	25 × 8.25 × 160	145			
Ladder, extension, 3 section, 30 ft	25 × 8.25 × 174	158			
Ladder, extension, 3 section, 35 ft	25 × 8.25 × 188	170			
Ladder, folding, 8 ft	22.5 × 5.5 × 96	38			
Ladder, folding, 10 ft	30.75 × 5.5 × 120	47			
Ladder, Fresno, 10 ft	13.5 × 5 × 87	41			
Ladder, Fresno, 12 ft	13.5 × 5 × 101	46			
Ladder, Fresno, 14 ft	13.5 × 5 × 115	51			
Ladder, roof, 12 ft, with hooks	19.25 × 2.75 × 144	36			
Ladder, roof, 14 ft, with hooks	19.25 × 2.75 × 168	42			
Ladder, roof, 16 ft, with hooks	19.25 × 2.75 × 192	48			
Pike Poles					
Hook, dry wall, 6 ft	Head 7.25 × 5.5 × 5, handle 64.75 × 1.5 ID	8			
Hook, dry wall, 8 ft	Head 7.25 × 5.5 × 5, handle 88.75 × 1.5 ID	10			
Pike pole, 6 ft	1.5 × 72	6			
Pike pole, 8 ft	1.5 × 96	8			
Pike pole, 10 ft	1.5 × 120	10			
Pike pole, 12 ft	1.5 × 144	12			
Pike pole, closet hook, 3 ft	1.5 × 36	5			
Hose					
Hose, booster, 0.75 in. × 100 ft	0.75 × 1200	59			
Hose, booster, 0.75 in. × 50 ft	0.75 × 600	30			
Hose, booster, 1 in. × 100 ft	1 × 1200	79			
Hose, booster, 1 in. × 50 ft	1 × 600	41			
Hose, DJ, 1.5 in. × 50 ft (roll)	3 × 18.5	18			
Hose, DJ, 1.75 in. × 50 ft, w/ 1.5 in. couplings (roll)	3.25 × 18.5	19			
Hose, DJ, 2.5 in. × 50 ft (roll)	4.5 × 20	32			

For SI units, 1 in. = 25.4 mm; 1 lb = 0.45 kg.

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FIGURE C.1 Worksheet for Determining Equipment Weight on Fire Apparatus.

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DETERMINING EQUIPMENT WEIGHT ON FIRE APPARATUS WORKSHEET *(continued)*

Equipment Description	Dimensions (in.)	Weight (lb)	Quantity	Total Weight (lb)	Compartment Location
Hose, DJ, 2 in. × 50 ft, w/ 1.5 in. couplings (roll)	3.75 × 18.5	20.5			
Hose, DJ, 3 in. × 50 ft, w/ 2.5 in. couplings (roll)	5.25 × 20	40			
Hose, forestry, 1 in. × 100 ft (roll)	1.5 × 32	20			
Hose, LW, cotton, 1.5 in. × 100 ft (roll)	3.25 × 30	22			
Hose, LW, cotton, 1.5 in. × 50 ft (roll)	3.25 × 15	11.5			
Hose, LW, cotton, 2 in. × 50 ft, w/ 1.5 in. couplings (roll)	3.75 × 15.5	14			
Hose, LW, cotton, 4 in. × 100 ft, w/ Storz couplings (roll)	5.75 × 24	68			
Hose, LW, cotton, 5 in. × 100 ft, w/ Storz couplings (roll)	6.75 × 25	84			
Hose, LW, nitrile jacket, 1 in. × 100 ft (roll)	3.25 × 40	33			
Hose, LW, nitrile jacket, 1 in. × 50 ft (roll)	3.25 × 20	18			
Hose, LW, nitrile jacket, 2 in. × 50 ft (roll)	3.75 × 21	24			
Hose, LW, nitrile jacket, 4 in. × 100 ft, w/ Storz coupling (roll)	5.75 × 24	75			
Hose, LW, nitrile jacket, 5 in. × 100 ft, w/ Storz coupling (roll)	6.75 × 26.5	97			
Suction Hose					
Hose, hard suction, 2.5 in. × 8 ft	3 × 96	22			
Hose, hard suction, 2.5 in. × 10 ft	3 × 120	27			
Hose, hard suction, 3 in. × 10 ft, w/ 2.5 in. couplings	3.5 × 120	35			
Hose, hard suction, 4 in. × 10 ft	4.5 × 120	42			
Hose, hard suction, 4.5 in. × 10 ft	5.5 × 120	58			
Hose, hard suction, 5 in. × 10 ft	6 × 120	87			
Hose, hard suction, 6 in. × 10 ft	7 × 120	102			
Strainers					
Strainer, barrel, 2.5 in.	3.25 × 6.3	3.5			
Strainer, barrel, 4 in.	5.25 × 15.25	10.5			
Strainer, barrel, 4.5 in.	6.75 × 15.25	12.5			
Strainer, basket, 3 in.	4.75 × 15.25	9.5			
Strainer, basket, 4 in.	5.75 × 15.25	11.25			
Strainer, floating, 4.5 in.	7 × 21.5 × 26.5	26			
Strainer, floating, 5 in.	7 × 21.5 × 26.5	26			
Strainer, floating, 6 in.	7 × 21.5 × 26.5	31			
Strainer, low level, 5 in.	16 × 13 × 12	20			
Strainer, low level, 6 in.	16 × 13 × 12	20			
Strainer, rope, 20 ft × 0.5 in.	2 × 2 × 4	1			

For SI units, 1 in. = 25.4 mm; 1 lb = 0.45 kg.

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FIGURE C.1 *Continued*

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DETERMINING EQUIPMENT WEIGHT ON FIRE APPARATUS WORKSHEET *(continued)*

Equipment Description	Dimensions (in.)	Weight (lb)	Quantity	Total Weight (lb)	Compartment Location
Portable or Folding Tank					
Tank, portable, 1000 gal	99 × 7 × 30	125			
Tank, portable, 2000 gal	135 × 7 × 30	165			
Tank, portable, 3000 gal	159 × 7 × 30	185			
Nozzles					
Deck gun, mounted, 2.5 in., manual type	15.5 × 17 × 18.5	22.5			
Deck gun, portable, 2.5 in., manual type	22.25 × 25 × 21	38			
Nozzle, booster, 1 in., aluminum	2.5 ID × 9.6	4.3			
Nozzle, booster, 1 in., brass	2.5 ID × 9.6	3.6			
Nozzle, cellar, 1.5 in., brass	5 ID × 5	7.5			
Nozzle, cellar, 2.5 in., brass	7 ID × 5	9.5			
Nozzle, chimney, w/ accessory bag	20 × 12 × 6.5	15			
Nozzle, foam attachment, 1.5 in.	6 ID (bottom) × 3 ID (tip) × 15.9	4.8			
Nozzle, foam, 2.5 in., w/ pickup tube	4.5 ID × 40.5	4.5			
Nozzle, foam, deck gun, w/ pickup hose	Pickup 7.1, nozzle 6 × 7	19			
Nozzle, fog, deck gun	6 ID × 10	11.9			
Nozzle, forestry, 1 in.	2 ID × 6.8	1			
Nozzle, handline, 1.5 in., aluminum	2.5 ID × 9.9	4.4			
Nozzle, handline, 1.5 in., brass	2.5 ID × 9.9	6.5			
Nozzle, handline, 2.5 in., aluminum	3 ID × 12	6.4			
Nozzle, handline, 2.5 in., brass	3 ID × 12	8			
Nozzle, piercing, 1.5 in.	51.5 × 1.5 × 6.5	11			
Nozzle, play pipe, w/ shaper, 2.5 in.	3 ID × 11.25	8			
Nozzle, play pipe, w/ shaper, deck gun, 2.5 in. aluminum	3.5 ID × 3	1.5			
Nozzle, play pipe, w/ shaper, deck gun, 2.5 in., brass	3.5 ID × 3	3.5			
Nozzle, play pipe, 2.5 in., aluminum	10 × 1.5 × 7 (coupling 3.5 × 2)	5.8			
Nozzle, play pipe, 2.5 in., brass	10 × 1.5 × 7 (coupling 3.5 × 2)	11.1			
Nozzle, stacked tips, aluminum, 2.5 in.	3 ID × 9	4			
Nozzle, stacked tips, brass, 2.5 in.	3 ID × 9	8			
Nozzle, stacked tips, deck gun, aluminum, 2.5 in.	3.5 ID × 16.75	4			
Nozzle, straight tip, 1.5 in., aluminum, w/ shutoff	Shutoff 2.5 × 4.9, tip 1.5 × 4.5	2.5			
Nozzle, straight tip, 1.5 in., brass, w/ shutoff	Shutoff 2.5 × 4.9, tip 1.5 × 4.5	5.8			
Nozzle, water curtain, 2.5 in.	10 × 3 × 10	13			

For SI units, 1 in. = 25.4 mm; 1 lb = 0.45 kg.

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FIGURE C.1 *Continued*

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DETERMINING EQUIPMENT WEIGHT ON FIRE APPARATUS WORKSHEET *(continued)*

Equipment Description	Dimensions (in.)	Weight (lb)	Quantity	Total Weight (lb)	Compartment Location
Adapters, Fittings, Caps					
Adapter, 4 in. F × 4 in. Storz, aluminum	3.75 × 6 ID	2.5			
Adapter, 4 in. F × 5 in. Storz, aluminum	3.5 × 7.75 ID	2.5			
Adapter, 4 in. F × 5 in. Storz, aluminum	3.75 × 7.75 ID	2.5			
Adapter, 4.5 in. F × 4 in. Storz, aluminum	3.75 × 6.5 ID	2.5			
Adapter, 4.5 in. F × 5 in. Storz, aluminum	3.5 × 7.75 ID	2.5			
Adapter, 5 in. F × 4 in. Storz, aluminum	3.5 × 6 ID	2.5			
Adapter, 5 in. F × 5 in. Storz, aluminum	4 × 7.75 ID	2.5			
Adapter, 6 in. F × 4 in. Storz, aluminum	3.5 × 8.75 ID	2.5			
Adapter, 6 in. F × 5 in. Storz, aluminum	4 × 8.75 ID	2.5			
Adapter, 6 in. F × 6 in. Storz, aluminum	4 × 8.75 ID	2.5			
Adapter, double female, 1.5 in., aluminum	3 × 2.5 ID	1			
Adapter, double female, 1.5 in., brass	3 × 2.5 ID	2			
Adapter, double female, 2.5 in., aluminum	3.25 × 4 ID	1			
Adapter, double female, 2.5 in., brass	3.25 × 4 ID	4			
Adapter, double male, 1.5 in., aluminum	2.5 × 2 ID	0.5			
Adapter, double male, 1.5 in., brass	2.5 × 2 ID	1			
Adapter, double male, 2.5 in., aluminum	3 × 4 ID	2			
Adapter, double male, 2.5 in., brass	3 × 4 ID	1			
Adapter, reducer, 1.5 in. F × 1 in. M, aluminum	1.5 × 3 ID	0.5			
Adapter, reducer, 1.5 in. F × 1 in. M, brass	1.5 × 3 ID	1			
Adapter, reducer, 2.5 in. F × 1.5 in. M, aluminum	2 × 4 ID	0.5			
Adapter, reducer, 2.5 in. F × 1.5 in. M, brass	2 × 4 ID	3			
Elbow, 2.5 in. F × 2.5 in. M, 30 degree, brass	6.5 × 4.5 ID	4.5			
Elbow, 2.5 in. F × 4 in. Storz, 30 degree, aluminum	7.5 × 6 ID	6			
Elbow, 2.5 in. F × 5 in. Storz, 30 degree, aluminum	7.5 × 7.5 ID	6.5			

For SI units, 1 in. = 25.4 mm; 1 lb = 0.45 kg.

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FIGURE C.1 *Continued*

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DETERMINING EQUIPMENT WEIGHT ON FIRE APPARATUS WORKSHEET *(continued)*

Equipment Description	Dimensions (in.)	Weight (lb)	Quantity	Total Weight (lb)	Compartment Location
Elbow, 3 in. F × 4 in. Storz, 30 degree, aluminum	7.5 × 6 ID	6.5			
Elbow, 3 in. F × 5 in. Storz, 30 degree, aluminum	7.5 × 7.5 ID	7			
Elbow, 4 in. F × 4 in. Storz, 30 degree, aluminum	8 × 6 ID	8			
Elbow, 4 in. F × 5 in. Storz, 30 degree, aluminum	8 × 7.5 ID	8.5			
Intake Valves					
Intake valve, external, 5 in. F × 4 in. Storz, w/ relief valve, aluminum	11 × 8.5 ID, 8 × 6.75 ID, 6 × 3 × 2.75	22.5			
Intake valve, external, 5 in. F × 4 in. Storz, w/ relief valve, brass	11 × 8.5 ID, 8 × 6.75 ID, 6 × 3 × 2.75	63.5			
Intake valve, external, 5 in. F × 5 in. M, w/ relief valve, aluminum	11 × 8.5 ID, 8 × 7.75 ID, 6 × 3 × 2.75	22.5			
Intake valve, external, 5 in. F × 5 in. M, w/ relief valve, brass	11 × 8.5 ID, 8 × 7.75 ID, 6 × 3 × 2.75	63.5			
Intake valve, external, 5 in. F × 5 in. Storz, w/ relief valve, aluminum	11 × 8.5 ID, 8 × 7.75 ID, 6 × 3 × 2.75	22.5			
Intake valve, external, 5 in. F × 5 in. Storz, w/ relief valve, brass	11 × 8.5 ID, 8 × 7.75 ID, 6 × 3 × 2.75	63.5			
Intake valve, external, 6 in. F × 4 in. Storz, w/ relief valve, aluminum	11 × 9.5 ID, 8 × 6.75 ID, 6 × 3 × 2.75	22.5			
Intake valve, external, 6 in. F × 4 in. Storz, w/ relief valve, brass	11 × 9.5 ID, 8 × 6.75 ID, 6 × 3 × 2.75	63.4			
Intake valve, external, 6 in. F × 5 in. Storz, w/ relief valve, aluminum	11 × 9.5 ID, 8 × 7.75 ID, 6 × 3 × 2.75	22.5			
Intake valve, external, 6 in. F × 5 in. Storz, w/ relief valve, brass	11 × 9.5 ID, 8 × 7.75 ID, 6 × 3 × 2.75	63.5			
Intake valve, external, 6 in. F × 6 in. M, w/ relief valve, aluminum	11 × 9.5 ID, 8 × 7.75 ID, 6 × 3 × 2.75	22.5			
Intake valve, external, 6 in. F × 6 in. M, w/ relief valve, brass	11 × 9.5 ID, 8 × 7.75 ID, 6 × 3 × 2.75	63.5			
Hose Equipment					
Intake, valve, gated, 4.5 in. F × 2.5 in. M, aluminum	11 ID × 7	11.5			
Siamese, gated, 5 in. F × (3) 2.5 in. F	10.5 × 12 × 6	29			
Siamese, gated, 6 in. F × (3) 2.5 in. F	10.5 × 12 × 7	29			
Valve, hydrant, 2.5 in. F × 2.5 in. M, aluminum	10.75 × 4.75 × 7.75	5.5			
Valve, hydrant, 2.5 in. F × 2.5 in. M, brass	10.75 × 4.75 × 7.76	14			
Water thief, gated, 2.5 in. F × 2.5 in. M, × (2) 1.5 in. M, aluminum	10.25 × 10 × 6	11			
Water thief, gated, 2.5 in. F × 2.5 in. M, × (2) 1.5 in. M, brass	10.25 × 10 × 6	23.5			

For SI units, 1 in. = 25.4 mm; 1 lb = 0.45 kg.

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FIGURE C.1 *Continued*

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DETERMINING EQUIPMENT WEIGHT ON FIRE APPARATUS WORKSHEET *(continued)*

Equipment Description	Dimensions (in.)	Weight (lb)	Quantity	Total Weight (lb)	Compartment Location
Wye, gated, 1.5 in. F × (2) 1 in. M, aluminum	4.75 × 6 × 3.25	1.75			
Wye, gated, 2.5 in. F × (2) 1.5 in. M, aluminum	7.75 × 8.25 × 5	4.5			
Wye, gated, 2.5 in. F × (2) 1.5 in. M, brass	7.75 × 8.25 × 5	8.5			
Wye, gated, 4 in. Storz distribution, w/ relief valve	15 × 8.75 × 11.25	24			
Wye, gated, 4 in. Storz distribution, w/ relief valve	15 × 8.75 × 11.25	24			
Foam Equipment					
Eductor, foam, 1.5 in. F × 1.5 in. M	2.75 ID × 9.5	9.5			
Eductor, foam, pickup tube	1 ID × 159	7.5			
Foam, Class A, 5 gal pail	14.5 × 11.25 ID	45			
Foam, Class B, 5 gal pail	14.6 × 11.25 ID	45			
Foam system, CAFS, wheeled	55.5 × 31 × 35	602			
Foam system, CAFS, skid	43 × 27 × 27	577			
Fire Ground Hand Tools					
Axe, flat head, 6 lb.	Head 8.75 × 5.25 × 1.25, handle 1.5 ID × 33	8			
Axe, pick head, 6 lb.	Head 11.5 × 5.25 × 1.25, handle 1.5 × 33	8.5			
Crow bar, steel, 36 in.	36 × 4 × 0.75	3.5			
Pry bar, steel, 48 in.	48 × 1 × 1	12.5			
Tool, Halligan	Body 29 × 2.5 × 1.75, point 4.25 × 1 × 1, flat 3.25 × 1.75 × 0.75	10.5			
Long Hand Tools					
Shovel, scoop, 48 in. D-handle	11 × 9 × 3, handle 49 × 1.5 ID	4.5			
Shovel, square end, 48 in. D-handle	9 × 11 × 3, handle 49 × 1.5 ID	4			
Shovel, round end, 48 in. D-handle	11.5 × 8.5 × 3, handle 49 × 1.5 ID	4			
Hammer, sledge, 10 lb.	Head 6.75 × 2.75 × 2.75, handle 1.75 ID × 33	13.5			
Fire Extinguishers					
Extinguisher, carbon dioxide, 15 lb. (CO_2), Class C	Extinguisher 26 × 6.75 ID, horn 11 × 4 ID	44.5			
Extinguisher, dry chemical, 10 lb., Class ABC	21.5 × 5.25 ID	17			
Extinguisher, dry chemical, 20 lb., Class ABC	25 × 7.5 ID	30			

For SI units, 1 in. = 25.4 mm; 1 lb = 0.45 kg; 1 gal = 3.8 L.

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FIGURE C.1 *Continued*

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DETERMINING EQUIPMENT WEIGHT ON FIRE APPARATUS WORKSHEET *(continued)*

Equipment Description	Dimensions (in.)	Weight (lb)	Quantity	Total Weight (lb)	Compartment Location
Extinguisher, foam, pressurized, 2.5 gal, Class B	24.25 × 7 ID	26			
Extinguisher, metal-X, 20 lb., Class D	27.75 × 16 ID	53			
Extinguisher, water, pressurized, 2.5 gal, Class A	24.25 × 7 ID	27			
Hose and Coupling Equipment					
Hose bridge, steel	23 × 32 × 6	42			
Hose, clamp, manual	29.5 × 1.75 × 9.75	15			
Hose, hoist, edge protector	12 × 6 × 6	7			
Hose, jacket, 2.5 in.	13 × 5.5 ID	16.5			
Hose, jacket, 3 in.	15 × 6 ID	26.75			
Hose, roller, air remover	20 × 5.5 × 3	5.5			
Hose, strap	6.5 × 5 × 0.5	0.5			
Mallet, rubber	Head 4 × 2 ID Handle 12 × 1 ID	2.5			
Wrench, hose, booster, pin lug	11.5 × 3.75 × 0.5	0.5			
Wrench, hose, spanner	11.5 × 3.75 × 0.5	0.5			
Wrench, hydrant	Head 6 × 3.75 × 1 Handle 16.5 × 0.75 ID	5			
Wrench, large diameter hose, LDH	4 × 3.75 × 0.5	0.5			
Wrench, spanner, combination	11.5 × 3.75 × 1	0.5			
Wrench, spanner, folding	5.25 × 2 × 0.5	0.5			
Smoke Ejectors					
Fan, smoke ejector, 16 in., electric	19.25 × 18.75 × 13	49			
Fan, smoke ejector, 20 in., electric	25.5 × 24.75 × 16.25	93			
Fan, smoke ejector, 24 in., electric	28.5 × 28 × 18.75	115			
Fan, smoke ejector, positive pressure, electric	19 × 18.75 × 12.75	48			
Fan, smoke ejector, positive pressure, gas	18.75 × 24.5 × 24.75	92			
Holder, fan, smoke ejector, door bar	25 × 4.5 × 3	6.5			
Traffic Control Equipment					
Traffic cones, plastic	8 × 8 × 3.5	10.5			
Traffic flares, case	16.5 × 6.75 × 7.5	27			
Tape, barrier, plastic roll	3.5 × 6.75 ID	3.5			
Vest, reflective	12 × 4.75 × 2	0.5			

For SI units, 1 in. = 25.4 mm; 1 lb = 0.45 kg; 1 gal = 3.8 L.

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FIGURE C.1 *Continued*

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DETERMINING EQUIPMENT WEIGHT ON FIRE APPARATUS WORKSHEET *(continued)*

Equipment Description	Dimensions (in.)	Weight (lb)	Quantity	Total Weight (lb)	Compartment Location
Small Rescue or Entry Equipment					
Bolt cutter, manual, 30 in.	29.25 × 6.25 × 1.25	13			
Hose, air, utility, low pressure, w/ couplings	600 × 0.75 ID	5.5			
Ram, battering, steel, w/ handles	20 × 6 ID	20			
Saw, cut off	19 × 14 × 15	35			
Tool, cutter, panel	7 × 1 × 0.5	0.5			
Tool, entry, "K tool"	4 × 3 × 2	2.5			
Tool, entry, rabbit hydraulic	24 × 18 × 8	28			
Small Hand Tools					
Chisel, coal, 1 in. × 12 in.	12 × 1 ID	1			
Chisel, cold, ½ in. × 6 in.	6 × 0.5 ID	0.5			
Chisel, cold, ¼ in. × 6 in.	6 × 0.25 ID	0.5			
Chisel, cold, ¾ in. × 10 in.	10 × 0.75 ID	0.5			
Cutter, glass, glazier's swivel cutter	12 × 4 × 6	4			
Drill, electric, hammer, battery powered	16.5 × 4.5 × 9	7			
File, metal, 10 in.	10 × 0.75 × 0.25	0.5			
Hammer, ball-peen, 12 oz	Head 3.5 × 1 ID, handle 12 × 1 ID	1			
Hammer, ball-peen, 16 oz	Head 3.75 × 1 ID, handle 12 × 1	1.5			
Hammer, ball-peen, 24 oz	Head 3.75 × 1.25 ID, handle 12 × 1	2			
Hammer, ball-peen, 36 oz	Head 4 × 1.25 ID, handle 12 × 1	2.5			
Hammer, claw	Head 5 × 1.25 ID, handle 13 × 1.25 ID	2.2			
Knife, cutter, seat belt	4 × 2 × 0.25	0.5			
Knife, putty, ¼ in.	7.25 × 1.25 × 0.5	0.5			
Knife, utility	6 × 1.25 × 0.75	0.5			
Pliers, arc joint, 10 in.	10 × 2.25 × 0.5	0.5			
Pliers, arc joint, 16 in.	16 × 4.5 × 0.5	0.5			
Pliers, diagonal cutting, 8 in.	8 × 2 × 0.5	0.5			
Pliers, lineman's, 8 in.	8 × 2 × 0.5	0.5			
Pliers, needle nose, 6 in.	6 × 2 × 0.5	0.5			
Pliers, slip joint, 8 in.	8 × 1.75 × 0.5	0.5			
Pliers, vise grip, 10 in.	10 × 2 × 0.5	1			
Punch, center	4 × 0.25 ID	0.5			
Punch, window, spring loaded	5 × 0.5 ID	0.5			
Saw, drywall	8.5 × 1 ID	0.5			

For SI units, 1 in. = 25.4 mm; 1 oz = 28 g; 1 lb = 0.45 kg.

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FIGURE C.1 ***Continued***

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DETERMINING EQUIPMENT WEIGHT ON FIRE APPARATUS WORKSHEET *(continued)*

Equipment Description	Dimensions (in.)	Weight (lb)	Quantity	Total Weight (lb)	Compartment Location
Saw, hand hacksaw, w/ spare blades and wire blades	18.5 × 4 × 1	1.5			
Saw, hand, crosscut	28 × 6 × 1	1.5			
Screwdriver, Phillips, #2 × 6	8 × 1.25 ID	0.5			
Screwdriver, Phillips, #3 × 8	10.25 × 1.25 ID	0.5			
Screwdriver, slotted, ¼ × 2.5	2.5 × 1 ID	0.5			
Screwdriver, slotted, ¼ × 6	8 × 1 ID	0.5			
Screwdriver, slotted, ⅜ × 12	12 × 1.25 ID	0.5			
Screwdriver, slotted, 5⁄16 × 8	10 × 1.25 ID	0.5			
Shears, metal, snips	9.5 × 2.5 × 0.75	0.5			
Socket, spark plug	2.75 × 1 ID	0.5			
Tape, measure, roll	3.25 × 3.25 × 1.25	0.5			
Tool box, metal, 20 in., hand tools	20 × 8 × 9	10.5			
Tool, axe, hand	Head 5.5 × 3.75 × 0.75, handle 11.75 × 1.5 × 1	3.5			
Wrench, adjustable, 12 in.	12 × 3 × 0.25	1.5			
Wrench, adjustable, 8 in.	8 × 2 × 0.25	0.5			
Wrench, adjustable, 10 in.	10 × 2.5 × 0.25	1			
Wrench, combination, metric, open end, 8 mm to 18 mm (11 piece)	13 × 12 × 1	2.5			
Wrench, combination, SAE, open end, 5⁄16 in. to 1 in. (11 piece)	13 × 12 × 1	2.5			
Wrench, gas, shutoff	8 × 1.5 × 0.5	0.5			
Wrench, hand chain	12 × 2 × 1	1.75			
Wrench, pipe, adjustable, 18 in.	18 × 3 × 0.5	6			
Wrench, ratchet, ⅜ in. drive, metric 8 mm to 18 mm (24 piece)	9.75 × 7.5 × 3	3.5			
Wrench, ratchet, ⅜ in. drive, SAE ⅜ in. to ¾ in. (24 piece)	9.75 × 7.5 × 2	3.5			
Wrench, tire, lug	27.75 × 1 ID	4.5			
Miscellaneous Equipment					
Gauge, air pressure, tires	6.25 × 1 × 0.5	0.5			
Sprinkler, wedges, set	3 × 0.75 × 1	0.5			
Elevator, key	8.25 × 0.25 ID	0.5			
Hooks, hay bail	Hook 10 × 0.5 ID, handle 3 × 4.5 × 0.5	1.5			
Tool, hand, fork, four-tine	Tines 12 × 8.75 × 0.5, handle 48 × 1.5 ID	3.5			
Wrench, water main, shutoff	8 × 1.5 × 0.5	0.5			
Tool, manhole cover lifter	44.1 × 10.2 × 6.7	35.5			
Pump, portable, water, small gasoline	17.5 × 16 × 19.5	50			

For SI units, 1 in. = 25.4 mm; 1 lb = 0.45 kg.

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FIGURE C.1 *Continued*

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DETERMINING EQUIPMENT WEIGHT ON FIRE APPARATUS WORKSHEET *(continued)*

Equipment Description	Dimensions (in.)	Weight (lb)	Quantity	Total Weight (lb)	Compartment Location
Saw, chain, gasoline 61 cc, w/ 19 in. bar	Engine 16.75 × 9.5 × 11.25, bar 19 × 3.75 × 0.25	19			
Brush, foxtail	8 × 1 ID	0.5			
Intercom, system, w/ four headsets	Junction boxes 6.75 × 5.25 × 2.5, 5.25 × 3.6 × 3.1, 7 × 4.3 × 3.1, 8.25 × 5.75 × 4.75, headset 8.5 × 7.5 × 3	31.5			
MRE	12 × 7.5 × 2.5	2			
Tent, fire shelter	10 × 6 × 3.5	3.5			
Wheel chocks, large	21 × 10.25 × 5.75	22			
Wheel chocks, small	10 × 10.25 × 5.75	11			
Electrical Equipment — Low Voltage					
Battery, cable puller	4 × 2.5 × 0.5	2			
Battery, jumper cables	10 × 12 × 2.5	8			
Flashlight, small, w/ batteries	10.25 × 2.25 ID	1.5			
Lantern, head lamp–type	3 × 4 × 2	1.5			
Lanterns, portable, battery powered	11.5 × 4.5 × 6.5	6.5			
Personnel Equipment					
Belt, safety, ladder-type	15 × 5 × 1.75	4.5			
Harness, safety	12 × 4 × 4	2.5			
Light, sticks, Cyalume (box)	6 × 6 × 8	1			
Masks, dust, box	8 × 5 × 5	1			
Rope, life line, bail-out bag	7.5 × 7.5 × 3.5	2			
Water, canteen, 2 qt	7.5 × 3.5 × 8.5	2			
Water, container, 5 gal, w/ water	20 × 12.5 ID	40			
Water, container, 5 gal, w/o water	20 × 12.5 ID	8			
Personnel Gear					
Clothing, parkas	20 × 30 × 4	3			
Gear, entry suit, fire	34 × 24 × 23	50			
Gloves, disposable, box	10 × 5 × 3	1.5			
Gloves, leather, pair	9 × 4.5 × 0.75	0.5			
Gloves, lineman, rubber	18 × 6 × 1	3			
Gloves, neoprene, 8 in. pair	12 × 5 × 2	1			
Gloves, PVC, 8 in. pair	6.5 × 5.5 × 2	0.5			
Gloves, rubber, nitrile, 8 in. pair	7.5 × 4.5 × 1.25	0.5			
Goggles, safety	6 × 3.5 × 2.5	0.5			
Helmet, hard hats	12.5 × 8 × 7	1			
Helmet, tool, rescue	10 × 9 × 7	1.5			

For SI units, 1 in. = 25.4 mm; 1 lb = 0.45 kg; 1 qt = 0.95 L; 1 gal = 3.8 L.

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FIGURE C.1 *Continued*

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DETERMINING EQUIPMENT WEIGHT ON FIRE APPARATUS WORKSHEET *(continued)*

Equipment Description	Dimensions (in.)	Weight (lb)	Quantity	Total Weight (lb)	Compartment Location
SCBA Equipment and Cylinders					
SCBA, alarm, PASS	2 × 3.25 × 1.5	0.5			
SCBA, cylinder, 4500 psi 30 min, spare	22.5 × 7 ID	17			
SCBA, pack, 4500 psi cylinder, w/ PASS and mask	22 × 14 × 7	30.5			
Instruments					
Detector, heat	1 × 1.75 × 6	0.5			
Monitor, carbon monoxide	3.75 × 1.75 × 1	0.5			
Monitor, gas, combustible	5.75 × 6 × 3.25	2.5			
Monitor, oxygen	2 × 3.25 × 1.25	0.5			
Electrical, voltage tester	3 × 8 × 1.5	2.5			
Detector, gas	8.25 × 3.75 × 3.25	3.5			
Radiation, Geiger counter	5.75 × 2.75 × 1.5	1			
Detector, dosimeter	2.75 × 5 × 1.5	0.5			
Detector, microwave leak	6 × 2.5 × 1.25	1.5			
Kit, sample gathering	21 × 17 × 8.5	23			
Hydraulic Rescue Tools and Equipment					
HRT, cutter, aircraft type	28.2 × 11 × 7.3	39			
HRT, hose, spare 16 ft	2 × 16 ID	8			
HRT, hose, spare 30 ft	3 × 16 ID	16.5			
HRT, manifold block	16 × 8 × 5	15			
HRT, pump, electric, simo	28 × 9.5 × 20.7	176			
HRT, pump, electric, single	22 × 9.5 × 20.7	133			
HRT, pump, gas	22 × 17.5 × 20.7	123			
HRT, ram, long	35 × 3.1 × 7	36.5			
HRT, ram, medium	22 × 3.1 × 7	24.5			
HRT, ram, short	15 × 3.1 × 7	18			
HRT, reel, and hose, 50 ft	25 × 20 × 20	100			
HRT, spreader, large	33.25 × 5.5 × 8.25	62			
HRT, tool, combination	33 × 11 × 6.3	38			
HRT, tool, electric combination	33.5 × 10.2 × 6.8	50			
Hydraulic, tool, Porta-Power, 10 ton	3 × 19 × 5	10.5			
Air Rescue Equipment and Bags					
Air bag, controller	19.5 × 14.5 × 5.5	13			
Air bag, high pressure, 6 × 6	6 × 6 × 1.2	1.5			
Air bag, high pressure, 8 × 8	8 × 8 × 1.2	2.5			
Air bag, high pressure, 15 × 15	15 × 15 × 1	11.5			
Air bag, high pressure, 17 × 17	17 × 17 × 1	12.5			
Air bag, high pressure, 22 × 22	22 × 22 × 1	23			

For SI units, 1 ft = 0.3 m; 1 lb = 0.45 kg; 1 ton = 907 kg; 1 psi = 6.9 kPa.

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FIGURE C.1 *Continued*

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DETERMINING EQUIPMENT WEIGHT ON FIRE APPARATUS WORKSHEET *(continued)*

Equipment Description	Dimensions (in.)	Weight (lb)	Quantity	Total Weight (lb)	Compartment Location
Air bag, high pressure, 24 × 24	24 × 24 × 1	26			
Air bag, high pressure, 27 × 27	27 × 27 × 1.2	33.5			
Air bag, high pressure, 30 × 30	31 × 31 × 1.2	41			
Air bag, high pressure, 36 × 36	36 × 36 × 1.2	57			
Air bag, low pressure	27.5 × 27.5 × 2.3	20			
Air bag, pressure regulator	7 × 6 × 4.5	3			
Air chisel, set, w/ air cylinder	26 × 11.5 × 11.5	32			
Air tool, drill	9.5 × 8.5 × 3.5	5			
Air tool, hammer	9.5 × 2.5 ID, 7.75 × 2.25 ID	5.5			
Hose, air, low pressure, 50 ft	22 × 11 × 3	5.5			
Reel, air, low pressure, with 100 ft hose	20.5 × 18 × 19.5	12			
Shoring and Cribbing Equipment — Trench Rescue					
Cribbing, wood, 2 × 4 × 18	1.5 × 3.25 × 18	1.5			
Cribbing, wood, 4 × 4 × 18	3.25 × 3.25 × 18	3.5			
Cribbing, wood, 2 × 4 × 36	1.5 × 3.25 × 36	3			
Wedges, wood, 4 × 4 × 18	3.25 × 3.25 × 18	1.5			
Water Rescue Equipment					
Harness, rescue, body type	16 × 8 × 8	5			
Harness, rescue, chest type	6 × 9 × 2	1.5			
Life preserver, personal flotation device	21 × 15 × 3	2.5			
Jacks, Come-Along, Block and Tackle, Chains					
Jack, mechanical, long highlift	48 × 8 × 2	30			
Jack, hydraulic, bottle type 5 ton	4.5 × 5 × 9	12			
Jack, hydraulic, bottle type 12 ton	5.5 × 5.5 × 9.5	18			
Jack, hydraulic, bottle type 20 ton	6 × 6.5 × 11	31			
Plate, outrigger	24 × 24 × 0.5	30			
Pulley, swivel side	6 × 4 × 1.5	1			
Tool, figure 8	7 × 6 × 0.75	1.5			
Chain, steel, 6 ft with hooks	11 × 7 × 3.5	16.5			
Chain, steel, 10 ft with hooks	14 × 7.5 × 4	21.5			
Chain, shortener	8.75 × 2.5 × 0.75	3			
Chain, shackle	6 × 4 × 1.5	1			
Chain, steel, 20 ft with hooks	9.5 × 5.75 × 5.25	34			
Chain, shackle kit	21 × 14 × 5	13.5			
Winch, manual, come-along	18.5 × 7 × 5	12.5			
Straps, extrication, w/ quick release buckles	7 × 5 × 2	2			

For SI units, 1 in. = 25.4 mm; 1 ft = 0.3 m; 1 lb = 0.45 kg; 1 ton = 907 kg.

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FIGURE C.1 *Continued*

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DETERMINING EQUIPMENT WEIGHT ON FIRE APPARATUS WORKSHEET *(continued)*

Equipment Description	Dimensions (in.)	Weight (lb)	Quantity	Total Weight (lb)	Compartment Location
Rope Rescue Equipment — High-Angle Rescue					
Carabiner, locking	4.4 × 4.4 × 0.5	0.5			
Harness, body	16 × 8 × 8	5			
Harness, chest	6 × 9 × 2	1.5			
Rope, ½ in., Kernmantle, 200 ft, water rescue	11 × 11 ID	22			
Rope, ½ in., nylon, 200 ft	27 × 9 ID	12.5			
Rope, ⅜ in., nylon, 200 ft	26 × 8 ID	9.5			
Rope, ⅝ in., Kernmantle, 200 ft, water rescue	29 × 12 ID	26			
Rope, 50 ft, w/ throw bag	15 × 6 ID	4.5			
Rope, ascender device	2.5 × 9 × 4.5	1.5			
Rope, descender device	16 × 3 × 1	2			
Rope, nylon, ½ in. × 100 ft utility	16.5 × 10.5 ID	22.5			
Rope, pulley block, double	5 × 9 × 3	2			
Sling, nylon	48 × 1 × 0.5	1			
Cutting Equipment					
Cutter, arc air	17 × 18 × 6.5	42			
Cutter, pedal	8.5 × 2.75 × 3	6			
Torch, cutting, acetylene	22.5 × 12.5 × 10	32.5			
Hazmat-Related Items					
Absorbent, oil dry	36 × 24 × 10	15			
Absorbent, pads, 100	17 × 19 × 18	19			
Absorbent, Vermiculite	12 × 12 × 12	7.5			
Broom, Teflon	Broom 36 × 4.25 × 4 Handle 58.5 × 1 ID	4			
Bucket, plastic, 5 gal	14.25 × 12 ID	2			
Caulking, gun	22.5 × 2.5 ID Handle 4.25 × 4.25 × 0.75	2			
Drum, salvage, 8 gal	16.75 × 14 ID	12			
Drum, salvage, 10 gal	16.75 × 14.5 ID	13.5			
Drum, salvage, 110 gal	31 ID × 45	53			
Drum, salvage, 20 gal	21.75 ID × 16.75	15.5			
Drum, salvage, 30 gal	21.75 ID × 28.25	17.5			
Drum, salvage, 55 gal	25 ID × 37.5	23			
Drum, salvage, 85 gal	31 ID × 43.25	47			
Drum, sling	57 × 2 × 0.5	21			
Drum, tank	33.75 × 23.1 ID	81			
Hazmat, tank kit	33.75 × 23.1 ID	75			

For SI units, 1 in. = 25.4 mm; 1 ft = 0.3 m; 1 lb = 0.45 kg; 1 gal = 3.8 L.

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FIGURE C.1 *Continued*

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DETERMINING EQUIPMENT WEIGHT ON FIRE APPARATUS WORKSHEET *(continued)*

Equipment Description	Dimensions (in.)	Weight (lb)	Quantity	Total Weight (lb)	Compartment Location
Neutralizer, acid, 1 gal	12.25 ID × 15	50			
Neutralizer, caustic, 1 gal	12.25 ID × 15	42			
Shovel, nonsparking	Shovel 10 × 11 × 2, handle 28 × 1 ID	2			
Shovel, polypropylene	Shovel 10.5 × 14 × 2, handle 24.5 × 1 ID	3			
Shower, decontamination	21 × 21 × 40	4			
Squeegees, Teflon	Squeegee 3 × 2.25 × 1, handle 72 × 1 ID	3.5			
Suit, Level A hazmat	34 × 21 × 8	21			
Suit, Level B hazmat	14 × 13 × 9	3			
Suit, Level C hazmat	13 × 6.5 × 1.75	1			
Towels, bath, terry, 20 × 36	16 × 6 × 3.75	1			
Stretcher and Patient Control Equipment					
Back board, long	71 × 17.75 × 1.5	17.5			
Back board, short	32 × 16 × 0.75	3			
Body, pouch	17 × 14 × 1	6.5			
Extraction device, KED	34 × 11 × 5	6.5			
Neck brace, C-collar	23 × 10 × 6	3.5			
Stretcher, folding	39.5 × 24.25 × 9.25	60			
Stretcher, scoop	73 × 16.75 × 2	21			
Stretcher, stokes basket	80.5 × 22 × 8	38			
Stretcher, stokes, four-point attachment bridle	4 × 8 × 5	3.5			
Medical and EMS Equipment					
Blanket, disposable	9.5 × 6 × 0.75	0.5			
Blanket, fire, w/ bag	20 × 19 × 2	5.5			
Blanket, wool	19 × 13 × 2.5	4.5			
Defibrilator, cardiac, 12-lead monitor	23.5 × 9.5 × 13	24			
Medical, air way kit	13.75 × 5 × 4.5	4			
Medical, ambulance bag	22 × 13.5 × 8.5	9			
Medical, burn kit	13 × 9 × 5	2.5			
Medical, drug bag	19.25 × 10.5 × 12	24			
Medical, first aid kit, 25 unit	10.5 × 7.5 × 2	5			
Medical, OB kit	9.5 × 7.5 × 3.5	1			
Medical, rescue breather	4.75 × 4 × 2	0.5			
Medical, snakebite kit	5 × 3 × 1.5	0.5			
Medical, splints	36 × 14 × 5	4			
Medical, squeeze bag mask	8.5 × 5.5 × 5.5	0.5			
Medical, suction, portable	15 × 8.25 × 8.75	12			

For SI units, 1 in. = 25.4 mm; 1 lb = 0.45 kg; 1 gal = 3.8 L.

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FIGURE C.1 *Continued*

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DETERMINING EQUIPMENT WEIGHT ON FIRE APPARATUS WORKSHEET *(continued)*

Equipment Description	Dimensions (in.)	Weight (lb)	Quantity	Total Weight (lb)	Compartment Location
Medical, trauma kit	27 × 19 × 10	14.5			
Medical, V-vac	13 × 7 × 5	1			
Oxygen, cylinders, D	4.25 ID × 19.5	8			
Resuscitation, respirator, oxygen	9 ID × 4.5	1.5			
Electrical Equipment					
Cord, electric, 50 ft #12/3	17 × 5 × 2.75	2			
Electrical, "hot stick"	20.5 × 1.75 ID	1.25			
Electrical, pigtail/adapter	1.5 ID × 8	1			
Generator, portable	25.8 × 18.9 × 19.1	147			
Junction box, electric, distribution	8.5 × 6.25 × 7.5	5.5			
Light, flood, tripod	72 × 4.5 ID	30			
Light, portable, 500 watt	13 × 8.5 × 13	9.5			
Reel, electric, portable with cord	20 × 16 × 9	27			
Saw, electric, Sawzall	18 × 6 × 3	8.25			
Gasoline, Engine, Spare Parts (Small Engine and Tools)					
Container, safety can, 2.5 gal	11.5 × 11.5 ID	6			
Electrical, tape	0.75 × 3.5 ID	0.5			
Engine, air filter	3.25 × 4.5 ID	0.5			
Engine, fuel filter	2.75 × 1 ID	0.5			
Engine, oil filter	3.25 × 3 ID	0.5			
Engine, oil, 1 quart	8.5 × 4.25 × 2.25	2			
Engine, spare O-rings, 10	1.25 × 2.5 ID	0.5			
Engine, spark plug	2.75 × 0.75 ID	0.5			
Funnel, plastic	9 × 5 ID	0.5			
Rags, mechanics	16.75 × 11.5 × 8.25	5			
Saw, blade, extra 10 blades	12.25 × 0.5 × 0.5	0.5			
Saw, wood, extra chain (gas)	10.5 × 2 × 0.5	0.5			
Sprayer, Silicone	8.5 × 2.5 ID	41			
Nonsparking Tools					
Tools, nonsparking, drum wrench	15 × 2.5 × 2.25	3			
Tools, nonsparking, hammer	Head 3 × 1 ID, handle 12 × 1 ID	1.5			
Tools, nonsparking, kit	14.25 × 12. ID	19			
Tools, nonsparking, knife	6 × 1.25 × 0.75	0.5			
Tools, nonsparking, pipe wrench	8 × 2.5 × 0.75	5			

For SI units, 1 in. = 25.4 mm; 1 lb = 0.45 kg; 1 gal = 3.8 L.

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FIGURE C.1 *Continued*

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DETERMINING EQUIPMENT WEIGHT ON FIRE APPARATUS WORKSHEET *(continued)*

Equipment Description	Dimensions (in.)	Weight (lb)	Quantity	Total Weight (lb)	Compartment Location
Tools, nonsparking, pliers	8 × 1 × 0.5	0.5			
Tools, nonsparking, putty knife	9 × 3 × 1	1.5			
Tools, nonsparking, screw driver, Phillips	7.5 × 1 ID	0.5			
Tools, nonsparking, screw driver, straight	7.5 × 1 ID	0.5			
Tools, nonsparking, wrench, adjustable	12 × 1.75 × 0.5	1.5			
Special Wildland Equipment					
Axe, brush	Head 9 × 5 × 1, handle 36 × 1.5 ID	7			
Broom, fire swatter	Swatter 11.5 × 15 × 0.25, handle 60 × 1.25 ID	5.5			
Extinguisher, water pump can	17 × 15 × 7	14			
Pick, clay	Head 16.5 × 3 × 0.5, handle 1.5 ID × 36	9			
Rake, fire	Rake 12 × 3.5 × 1, handle 60 × 1.75 ID	4.5			
Tool, Pulaski	Head 13.25 × 4.75 × 1, handle 33.25 × 1.5	6			
Salvage Equipment					
Broom, household	Broom 11 × 11 × 1.75, handle 46 × 1 ID	1.5			
Broom, push, long handle	Broom 19 × 4 × 3, handle 50.5 × 1 ID	4.5			
Bucket, mop, w/ ringer	17.25 × 16 × 21.5	18.5			
Mop, long handle	Mop 21 × 7.75 × 2, handle 60.25 × 1 ID	5.5			
Nails, assorted, can	6 × 5 × 5	5			
Plastic, roll, 100 ft × 20 ft	48 × 10 ID	11			
Pump, electric, sump	11 × 7 ID	19			
Squeegee, long handle	Squeegee 3 × 2.25 × 1, handle 72 × 1 ID	4			
Stapler, construction type	8 × 6 × 0.75	2			
Tape, duct	2 × 7 ID	2			
Tarp, floor runner	36 × 12 ID	22			
Tarp, salvage covers	9 ID × 30	9			
Vacuum, water	27 × 15.75 ID	18.5			

For SI units, 1 in. = 25.4 mm; 1 ft = 0.3 m; 1 lb = 0.45 kg.

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FIGURE C.1 *Continued*

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DETERMINING EQUIPMENT WEIGHT ON FIRE APPARATUS WORKSHEET *(continued)*

Equipment Description	Dimensions (in.)	Weight (lb)	Quantity	Total Weight (lb)	Compartment Location
Reference and Communication					
Binoculars, eye	4.4 × 4.6 × 1.8	1.5			
Book, U.S. Coast Guard, *CHRIS Manual*	11.5 × 11.25 × 6.5	16			
Book, *North American Emergency Response Guidebook*	7.5 × 5.25 × 0.75	1			
Book, map	11.5 × 9.5 × 2.75	6			
Book, medical guide	11 × 9 × 0.5	1			
Book, NFPA, *Fire Protection Guide to Hazardous Materials*	14 × 9 × 1.5	4			
Book, phone	10.75 × 9 × 2	4.5			
Book, Bureau of Explosives, *Emergency Action Guides*	11 × 8.5 × 2	2.5			
Camera, Polaroid or digital	6.8 × 4.2 × 6.4	1.5			
Clipboard	13.75 × 9 × 1.5	2			
Computer, desktop	25 × 17.5 × 16.25	66			
Computer, laptop	11 × 13 × 1.6	8			
Fax machine	15 × 14.25 × 15.75	24.5			
Megaphone, bullhorn	14.5 × 11.5 × 9	3.5			
Radio, hand	7.5 × 2.25 × 1.25	1.5			
Telephone, cell	7.75 × 2 × 2.75	2.5			

For SI units, 1 in. = 25.4 mm; 1 lb = 0.45 kg.

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FIGURE C.1 ***Continued***

Annex D Guidelines for First Line and Reserve Apparatus

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

D.1 General. To maximize fire fighter capabilities and minimize risk of injuries, it is important that fire apparatus be equipped with the latest safety features and operating capabilities. In the last 10 to 15 years, much progress has been made in upgrading functional capabilities and improving the safety features of fire apparatus. Apparatus manufactured prior to 1991 usually included only a few of the safety upgrades required by the 1991 and subsequent editions of the NFPA fire department apparatus standards or the equivalent Underwriters' Laboratories of Canada (ULC) standards. Because the changes, upgrades, and fine tuning to NFPA 1901, *Standard for Automotive Fire Apparatus*, since 1991 have been truly significant, especially in the area of safety, fire departments should seriously consider the value (or risk) to fire fighters by keeping pre-1991 fire apparatus in first-line service.

The 1991 editions of the NFPA fire department apparatus standards included, among many other things, requirements for fully enclosed driving and riding areas, auxiliary braking systems, reflective striping, improved warning lights, and prohibition of roof-mounted audible warning devices. The minimum tip load for an aerial ladder was set at 250 lb (114 kg), and other requirements, such as a minimum rail height, were added to make the aerial ladder safer for fire fighters to use. The 1991 editions have been recognized as the benchmark from which improved and safer fire apparatus have evolved. It is recommended that only apparatus that were designed and manufactured to meet the 1991 or later editions of the NFPA fire department apparatus standards, or apparatus that have been refurbished in accordance with NFPA 1912, *Standard for Fire Apparatus Refurbishing*, to meet the 1991 or later editions of the NFPA fire department apparatus standards, be permitted to operate in first-line service. This will ensure that, while the apparatus may not totally comply with the current editions of the automotive fire apparatus standards, many of the improvements and upgrades required by the standards since 1991 are available for the fire fighters who use the apparatus.

It is recommended that an apparatus manufactured prior to 1991 that is less than 25 years old, that has been properly maintained, and that is still in serviceable condition should be placed in reserve status and upgraded to incorporate as many features of the post-1991 fire apparatus as possible *(see Section D.3)*. Apparatus that were not manufactured to the applicable NFPA fire apparatus standards or that are over 25 years old should be replaced.

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D.2 How the Standards Have Changed. It is a generally accepted fact that fire apparatus, like all types of mechanical devices, have a finite life. How long that is depends on many factors. Some of those factors are vehicle mileage and engine hours, quality of the preventative maintenance program, quality of the driver training program, whether the fire apparatus was used within the design parameters, whether the apparatus was manufactured on a custom or commercial chassis, quality of workmanship by the original manufacturer, quality of the components used, and availability of replacement parts. In the fire service, there are fire apparatus with 8 to 10 years of service that are simply worn out. There are also fire apparatus that were manufactured with quality components, that have had excellent maintenance, and that have responded to a minimum number of incidents that are still in serviceable condition after 20 years. Most would agree that the care of fire apparatus while it is being used and the quality and timeliness of maintenance are perhaps the most significant factors in determining how well a fire apparatus ages.

Prior to 1991, the single fire department apparatus standard was NFPA 1901. It was basically a "reactive standard." If something worked well in field use for a few years, it might have been suggested for inclusion in NFPA 1901. It was a very basic standard. In the late 1980s, the Technical Committee on Fire Department Apparatus decided to become proactive and greatly enhance the value of the standard for the fire service. Task groups were appointed to develop reasonable requirements for the various components that made up a fire apparatus, and a safety task group was charged with looking at issues across the board that would improve the safety of the fire fighters who have to use the apparatus.

The completely revised 1991 edition of the fire department apparatus standards was the result of these efforts and the full committee's strong desire to make the automotive fire apparatus standards not only more "safety oriented" but also more user friendly. In 1991, four standards were actually issued: NFPA 1901, *Standard for Pumper Fire Apparatus*, NFPA 1902, *Standard for Initial Attack Fire Apparatus*, NFPA 1903, *Mobile Water Supply Fire Apparatus*, and NFPA 1904, *Standard for Aerial Ladder and Elevating Platform Fire Apparatus*.

Contained within the 1991 editions of the fire department apparatus standards were requirements for such items as increased battery capacity to ensure starting under most conditions; intersection lights for increased visibility; removal of all roof-mounted audible warning devices to reduce hearing problems; a flashing light in the cab to warn if a cab or body door is open; a backup alarm; an automatic transmission to make it easier to drive (unless the purchaser had a specific reason for a manual transmission); fully enclosed riding areas with reduced noise (dBa) levels to keep the crew members safe and informed; seats and seat belts for all crew members riding on the apparatus; fail-safe door handles so the sleeve of a coat will not inadvertently catch a handle and open a door; and signs requiring everyone to be seated and belted.

In the pump area, the standard specified that 3 in. (75 mm) or larger valves be "slow close," that caps on intakes and discharge outlets be tested to 500 psi (3400 kPa), that an intake relief valve be provided to help manage incoming pressure, that 30 degree sweep elbows be provided on the discharges to eliminate hose kinking, and that all 3 in. (75 mm) and larger discharges be eliminated from the pump panel to reduce the possibility of injuries to the pump operator.

Fire apparatus equipped with electronic or electric engine throttle controls were required to include an interlock system to prevent engine speed advancement, unless the chassis transmission is in neutral with the parking brake engaged; or unless the parking brake is engaged, the fire pump is engaged, and the chassis transmission is in the correct pumping gear. Starting with the 1999 edition of NFPA 1901, all apparatus were required to include an interlock system to control engine speed advancement at the operators' panel.

In the body area, the minimum step surface size and load-carrying capabilities were increased, handrails were required to be slip resistant, and reflective striping was required on all four sides of the apparatus. Electrical system requirements for line-voltage systems were added to include the use of "listed" components that were grounded.

Many requirements were added to increase the operating capabilities of all aerial devices. For aerial ladders, the minimum design strength of the rungs was increased, a height requirement for the hand rails was specified, a minimum load-carrying requirement for folding steps was specified, and the aerial ladder had to have a minimum carrying capacity of 250 lb (114 kg) at the tip when the aerial ladder is at 0 degrees elevation and maximum extension. Where a water tower was equipped with a ladder, the same requirements that applied to an aerial ladder were required of the ladder on the water tower.

The carrying capacity of elevating platforms at 0 degrees elevation and maximum extension was raised to 750 lb (340 kg). Elevating platforms were also required to have handrails, breathing air available in the platform (with low air warning capability) for at least two fire fighters, and a water curtain cooling system under the platform.

All aerial devices had to be capable of supporting a static load of 1½ times their rated capacity in any position. A requirement for a stabilizer movement alarm and reflective striping with warning lights was added. Interlocks to prevent inadvertent movement to an unsupported side and to prevent raising the aerial device prior to the stabilizers being deployed were specified. One hundred percent nondestructive tests became a requirement. All these requirements were included in the 1991 editions of the NFPA fire department apparatus standards.

In 1996, the four fire department apparatus standards (NFPA 1901, NFPA 1902, NFPA 1903, and NFPA 1904) were again combined into a single standard, NFPA 1901, *Standard for Automotive Fire Apparatus*. The 1996 and 1999 editions of NFPA 1901 further enhanced the safety and operating characteristics of all the apparatus. For example, the 1999 edition included chapters on quints and mobile foam apparatus, further defined slip resistance of stepping and walking surfaces, required better mounting of equipment in the driving and crew compartment, required predelivery testing of foam proportioning systems, and specified that fill stations for breathing-air cylinders be designed to totally contain a rupturing cylinder.

The 2003 edition continued to refine the requirements in the driving and crew riding areas with increased head height requirements at seating positions and additional requirements for storage of SCBAs in seatbacks, both aimed at reducing fire fighter injuries. The test protocol for slip resistance of standing and walking surfaces was better defined. There was a general cleanup of the requirements throughout the document to enhance the operational usefulness of the apparatus.

D.3 Upgrading Fire Apparatus. Any apparatus, whether in first-line or reserve service, should be upgraded in accordance with NFPA 1912, as necessary to ensure that the following features are included at a minimum:

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(1) Fully enclosed seating is provided for all members riding on the fire apparatus.
(2) Warning lights meet or exceed the current standard.
(3) Reflective striping meets or exceeds the current standard.
(4) Slip resistance of walking surfaces and handrails meets the current standard.
(5) A low-voltage electrical system load manager is installed if the total connected load exceeds the alternator output.
(6) The alternator output is capable of meeting the total continuous load on the low-voltage electrical system.
(7) Where the GVWR is 36,000 lb (16,000 kg) or more, an auxiliary braking system is installed and operating correctly.
(8) Ground and step lighting meets or exceeds the current standard.
(9) Noise levels in the driving and crew compartment(s) meet the current standard, or appropriate hearing protection is provided.
(10) All horns and sirens are relocated to a position as low and as far forward as possible.
(11) Seat belts are available for every seat and are new or in serviceable condition.
(12) Sign plates are present stating no riding on open areas.
(13) A pump shift indicator system is present and working properly for vehicles equipped with an automatic chassis transmission.
(14) For vehicles equipped with electronic or electric engine throttle controls, an interlock system is present and working properly to prevent engine speed advancement at the operator's panel, unless the chassis transmission is in neutral with the parking brake engaged; or the parking brake is engaged, the fire pump is engaged, and the chassis transmission is in pumping gear.
(15) All loose equipment in the driving and crew areas is securely mounted to prevent its movement in case of an accident.

D.4 Proper Maintenance of Fire Apparatus. In addition to needed upgrades to older fire apparatus, it is imperative that all fire apparatus be checked and maintained regularly to ensure that they will be reliable and safe to use. The manufacturers' instructions should always be followed when maintaining the fire apparatus. Special attention should be paid to the following items, as they are particularly critical to having a reliable unit:

(1) Engine belts, fuel lines, and filters have been replaced in accordance with the manufacturers' maintenance schedule(s).
(2) Brakes, brake lines, and wheel seals have been replaced or serviced in accordance with the manufacturers' maintenance schedule.
(3) Tires and suspension are in serviceable condition, and tires are not more than 7 years old.
(4) The radiator has been serviced in accordance with the manufacturers' maintenance schedule, and all cooling system hoses are new or in serviceable condition.
(5) The alternator output meets its rating.
(6) A complete weight analysis shows the fire apparatus is not over individual axle or total GVWRs.
(7) The fire pump meets or exceeds its original pump rating.
(8) Water tank and baffles are not corroded or distorted.
(9) If equipped with an aerial device, a complete test to original specifications has been conducted and certified by a certified testing laboratory.
(10) If so equipped, the generator and line-voltage accessories have been tested and meet the current standard.

D.5 Refurbishing or Replacing Fire Apparatus. Fire department administrators and fire chiefs should exercise special care when evaluating the cost of refurbishing or updating an apparatus versus the cost of a new fire apparatus. Apparatus that are refurbished should comply with the requirements of NFPA 1912. A thorough cost-benefit analysis of the value of upgrading or refurbishing a fire apparatus should be conducted. In many instances, it will be found that refurbishing costs will greatly exceed the current value of similar apparatus. Experience has also shown that refurbishing fire apparatus that is over 20 years old, other than to paint or repair the apparatus, is a very poor investment.

Some of the factors to evaluate when considering whether to refurbish or replace a fire apparatus include the following:

(1) What is the true condition of the existing apparatus? Has it been in a major accident, or has something else happened to it that would make spending significant money on it ill advised?
(2) Does the current apparatus meet the program needs of the area it is serving? Is it designed for the way the fire department operates today and is expected to operate into the foreseeable future, or is it functionally obsolete? Can it carry everything that is needed to do the job without being overloaded?
(3) If the apparatus is refurbished, will it provide the level of safety and operational capability of a new fire apparatus? Remember, in many cases, refurbishing does not mean increasing the GVWR, so it is not possible to add a larger water tank or additional foam agent tanks, or to plan to carry massive amounts of additional equipment. Enclosing personnel riding areas may add enough weight to the chassis that existing equipment loads need to be reduced so as to not overload the chassis. An aerial ladder that does not have a 250 lb (114 kg) tip load rating at 0 degrees elevation and maximum extension cannot be made stronger.
(4) What is the anticipated cost per year to operate the apparatus if it were refurbished and what would the cost per year be for a new apparatus? Do not forget insurance costs, downtime costs, maintenance costs, depreciation, reliability, and the safety of the users and the public. At what rate are those costs rising each year? Are parts still readily available for all the components on the apparatus? A refurbished 15-year-old apparatus still has 15-year-old parts in it. How long can the fire department operate without the apparatus if it suddenly needed major repairs?
(5) Is there a trade-in value today that will not be there tomorrow? Most apparatus over 12 years old have little trade-in value. Are there creative financing plans or leasing options that can provide a new fire apparatus for little more than the cost of refurbishing or maintaining an older apparatus?

D.6 Conclusion. A fire apparatus is an emergency vehicle that must be relied on to transport fire fighters safely to and from an incident and to operate reliably and properly to support the mission of the fire department. A fire apparatus that breaks down at any time during an emergency operation not only compromises the success of the operation but may jeopardize the safety of the fire fighters relying on that apparatus to support their role in the operation. Old, worn out, or poorly maintained fire apparatus have no role in providing emergency services to a community.

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Annex E Informational References

E.1 Referenced Publications. The documents or portions thereof listed in this annex are referenced within the informational sections of this standard and are not part of the requirements of this document unless also listed in Chapter 2 for other reasons.

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NFPA 1901, *Standard for Pumper Fire Apparatus*, 1991 edition.

NFPA 1901, *Standard for Automotive Fire Apparatus*, 1996 edition.

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NFPA 1904, *Standard for Aerial Ladder and Elevating Platform Fire Apparatus*, 1991 edition.

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NFPA *Fire Protection Guide to Hazardous Materials*, 2001 edition.

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E.1.2.1 Bureau of Explosives Publication. Bureau of Explosives, PO Box 1020, Sewickley, PA 15143.

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U.S. DOT, *North American Emergency Response Guidebook*, 2004.

Title 49, Code of Federal Regulations, Part 571, Federal Motor Vehicle Safety Standards (FMVSS), Sec. 571.7(e), "Combining new and used components."

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U.S. Coast Guard, *CHRIS Manual* (http://www.chrismanual.com/)

E.1.3 Other Reference. Fire Apparatus Manufacturers Association, P.O. Box 397, Lynnfield, MA 01940-0397.

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E.3 References for Extracts in Informational Sections. NFPA 1901, *Standard for Automotive Fire Apparatus*, 2003 edition.

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Sequence of Events Leading to Issuance of an NFPA Committee Document

Step 1: Call for Proposals

- Proposed new Document or new edition of an existing Document is entered into one of two yearly revision cycles, and a Call for Proposals is published.

Step 2: Report on Proposals (ROP)

- Committee meets to act on Proposals, to develop its own Proposals, and to prepare its Report.
- Committee votes by written ballot on Proposals. If two-thirds approve, Report goes forward. Lacking two-thirds approval, Report returns to Committee.
- Report on Proposals (ROP) is published for public review and comment.

Step 3: Report on Comments (ROC)

- Committee meets to act on Public Comments to develop its own Comments, and to prepare its report.
- Committee votes by written ballot on Comments. If two-thirds approve, Report goes forward. Lacking two-thirds approval, Report returns to Committee.
- Report on Comments (ROC) is published for public review.

Step 4: Technical Report Session

- "*Notices of intent to make a motion"* are filed, are reviewed, and valid motions are certified for presentation at the Technical Report Session. ("Consent Documents" that have no certified motions bypass the Technical Report Session and proceed to the Standards Council for issuance.)
- NFPA membership meets each June at the Annual Meeting Technical Report Session and acts on Technical Committee Reports (ROP and ROC) for Documents with "certified amending motions."
- Committee(s) vote on any amendments to Report approved at NFPA Annual Membership Meeting.

Step 5: Standards Council Issuance

- Notification of intent to file an appeal to the Standards Council on Association action must be filed within 20 days of the NFPA Annual Membership Meeting.
- Standards Council decides, based on all evidence, whether or not to issue Document or to take other action, including hearing any appeals.

Committee Membership Classifications

The following classifications apply to Technical Committee members and represent their principal interest in the activity of the committee.

M *Manufacturer:* A representative of a maker or marketer of a product, assembly, or system, or portion thereof, that is affected by the standard.

U *User:* A representative of an entity that is subject to the provisions of the standard or that voluntarily uses the standard.

I/M *Installer/Maintainer:* A representative of an entity that is in the business of installing or maintaining a product, assembly, or system affected by the standard.

L *Labor:* A labor representative or employee concerned with safety in the workplace.

R/T *Applied Research/Testing Laboratory:* A representative of an independent testing laboratory or independent applied research organization that promulgates and/or enforces standards.

E *Enforcing Authority:* A representative of an agency or an organization that promulgates and/or enforces standards.

I *Insurance:* A representative of an insurance company, broker, agent, bureau, or inspection agency.

C *Consumer:* A person who is, or represents, the ultimate purchaser of a product, system, or service affected by the standard, but who is not included in the *User* classification.

SE *Special Expert:* A person not representing any of the previous classifications, but who has a special expertise in the scope of the standard or portion thereof.

NOTES;
1. "Standard" connotes code, standard, recommended practice, or guide.
2. A representative includes an employee.
3. While these classifications will be used by the Standards Council to achieve a balance for Technical Committees, the Standards Council may determine that new classifications of members or unique interests need representation in order to foster the best possible committee deliberations on any project. In this connection, the Standards Council may make appointments as it deems appropriate in the public interest, such as the classification of "Utilities" in the National Electrical Code Committee.
4. Representatives of subsidiaries of any group are generally considered to have the same classification as the parent organization.

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Date 12/18/02 **Name** John B. Smith **Telephone** 617-555-1212
Company _____
Address 9 Seattle St. **City** Seattle **State** WA **Zip** 02255
Please indicate organization represented (if any) Fire Marshals Assn. of North America

1. **a) NFPA Document Title** National Fire Alarm Code
   b) NFPA No. & Edition NFPA 72, 2002 ed. **c) Section/Paragraph** 4.4.7.1.1

2. **Proposal Recommends:** *(check one)* ☐ **new text** ☐ **revised text** ☒ **deleted text**

3. **Proposal.** *(Include proposed new or revised wording, or identification of wording to be deleted.)* Note: Proposed text should be in legislative format, that is, use underscore to denote wording to be inserted (inserted wording) and strike-through to denote wording to be deleted (~~deleted wording~~). Delete exception.

4. **Statement of Problem and Substantiation for Proposal.** Note: State the problem that will be resolved by your recommendation. Give the specific reason for your proposal including copies of tests, research papers, fire experience, etc. If more than 200 words, it may be abstracted for publication. A properly installed and maintained system should be free of ground faults. The occurrence of one or more ground faults should be required to cause a "trouble" signal because it indicates a condition that could contribute to future malfunction of the system. Ground fault protection has been widely available on these systems for years and its cost is negligible. Requiring it on all systems will promote better installations, maintenance and reliability.

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3. **Proposal.** *(Include proposed new or revised wording, or identification of wording to be deleted.)* Note: Proposed text should be in legislative format, that is, use underscore to denote wording to be inserted (inserted wording) and strike-through to denote wording to be deleted (~~deleted wording~~). _____

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