

# NFPA® 1912

## Standard for Fire Apparatus Refurbishing

### 2011 Edition



NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471  
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**NFPA® 1912**  
**Standard for**  
**Fire Apparatus Refurbishing**  
**2011 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 December 14, 2010, with an effective date of January 3, 2011, and supersedes all previous editions.

This edition of NFPA 1912 was approved as an American National Standard on January 3, 2011.

**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.

The second edition was reorganized to conform with the *Manual of Style for NFPA Technical Committee Documents*. It was updated to reflect changes that had been incorporated in NFPA 1901, *Standard for Automotive Fire Apparatus*. It was also 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 was 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.

The 2011 edition of NFPA 1912 has been reviewed by the Technical Committee on Fire Department Apparatus, which updated references and added Annex A material to the section on stability control to reflect the new requirements in NFPA 1901, *Standard for Automotive Fire Apparatus*.

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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

## Fire Apparatus Refurbishing

## 2011 Edition

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Changes other than editorial are indicated by a vertical rule beside the paragraph, table, or figure in which the change occurred. These rules are included as an aid to the user in identifying changes from the previous edition. Where one or more complete paragraphs have been deleted, the deletion is indicated by a bullet (•) between the paragraphs that remain.

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

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

## Chapter 1 Administration

**1.1\* Scope.** This standard 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*, 2009 edition.

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

NFPA 1911, *Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus*, 2007 edition.

NFPA 1931, *Standard for Manufacturer's Design of Fire Department Ground Ladders*, 2010 edition.

NFPA 1961, *Standard on Fire Hose*, 2007 edition.

NFPA 1964, *Standard for Spray Nozzles*, 2008 edition.

## 2.3 Other Publications.

**2.3.1 NEMA Publications.** 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 Publications.

*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*, 2011 edition.

NFPA 1901, *Standard for Automotive Fire Apparatus*, 2009 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.

### 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, 2009]

**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, 2009]

**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, 2009]

**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, 2009]

**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, 2009]

**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, 2009]

**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, 2009]

**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, 2009]

**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, 2009]

**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, 2009]

**3.3.13\* Contractor.** The person or company responsible for fulfilling an agreed-upon contract. [1901, 2009]

**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, 2009]

**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, 2009]

**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, 2009]

**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, 2009]

**3.3.20 Gallon, U.S. Standard.** 1 U.S. gal = 0.833 Imperial gal = 231 in.<sup>3</sup> = 3.785 L. [58, 2011]

**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, 2009]

**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 multi-axle 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, 2009]

**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, 2009]

**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, 2009]

**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, 2009]

**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, 2009]

**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, 2009]

**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, 2009]

**3.3.35 Pump Operator's Position.** The location from which the pump operator operates the pump. [1901, 2009]

**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, 2009]

**3.3.37\* Purchaser.** The authority having responsibility for the specification and acceptance of the apparatus. [1901, 2009]

**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, 2009]

**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, 2009]

**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, 2009]

**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, 2009]

### 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, 2009]

**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, 2009]

**3.3.50 Unequipped Fire Apparatus.** The completed fire apparatus excluding personnel, agent(s), and any equipment removable without the use of tools. [1901, 2009]

**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 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.

**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.

**5.3.5\*** A lateral acceleration indicator that is adjustable for sensitivity and that provides both visual and audio signals and warnings to the driver shall be provided as an alternative to tilt table testing, or in circumstances where the vehicle is unable to meet tilt table requirements as referenced in NFPA 1901.

**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.



**Table 4.8.2 Miscellaneous Fire Apparatus Equipment Allowance**

| Fire Apparatus Type | Size  | Equipment Allowance |       |
|---------------------|---|---------------------|-------|
|                     |   | lb                  | kg    |
| Pumper              | Less than 250 ft <sup>3</sup> (7 m <sup>3</sup> ) compartment space*  | 2,000               | 910   |
|                     | 250 ft <sup>3</sup> (7 m <sup>3</sup> ) 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.

**5.6.1.3** 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.

## **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.

**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.

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

#### **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.

**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 1911
- (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.

**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.



**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, head-lights, and other electrical devices except windshield wipers and four-way hazard flashers
- (3) The radio(s) at a duty cycle of 10 percent transmit and 90 percent receive (for calculation and testing purposes, a default value of 5 A continuous)
- (4) 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.

**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*.



## 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 the Inspection, Maintenance, Testing, and Retirement of In-Service Automotive 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.

**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 1911, if the aerial device has not been tested to the complete requirements of NFPA 1911 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 edi-

tion 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.

## 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 1911
- (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 <sup>3</sup> )             | 0.02832 cubic meter (m <sup>3</sup> ) |
| 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 <sup>3</sup> ) | 35.31 cubic feet (ft <sup>3</sup> )              |
| 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.



**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. <sup>3</sup> )    |
| 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, 2009]

**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, 2009]

**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, 2009]

**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, 2009]

**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, under-vehicle 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 8½ 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 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:

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

**A.5.3.5** The 2009 revision of NFPA 1901 requires electronic stability control for those apparatus that fail to pass the established roll stability criteria. The following items impact the roll stability safety of the apparatus and should be considered when making decisions on how to refurbish the apparatus.

*Custom fire apparatus cab.* The nature of the custom fire apparatus cab makes it much stronger in rollovers than typical conventional commercial chassis cabs. There is much anecdotal evidence to indicate that the crashworthiness of a typical custom fire apparatus cab is significantly greater than a typical commercial cab, and most custom chassis manufacturers can provide test data on cab integrity.

*Lateral acceleration alert device.* There are both mechanical and electronic devices available that will measure the lateral acceleration of a vehicle. Although these devices will not prevent rollover, they can be used effectively as a driver training tool to indicate when the vehicle is approaching the roll threshold and as a reminder to the driver that excessive lateral acceleration can lead to a rollover event.

*Side roll protection.* Many custom fire apparatus manufacturers offer side air bags or curtains that inflate during a roll event and that are usually combined with seat belt pretensioning devices and suspension seat pull-down devices. This option can reduce injury during a rollover as long as the occupants are seated and belted.

*Roll stability control.* This technology electronically senses the lateral acceleration of the vehicle and takes action by de-powering the engine and applying the brakes if the vehicle approaches a roll threshold. The effectiveness of this product is limited to events on relatively flat pavement, since it cannot do much to help the situation once a vehicle is off the road and leaning into a ditch.

*Electronic stability control (ESC).* ESC uses a steering wheel position sensor, a vehicle yaw sensor, a lateral accelerometer, and individual wheel brake controls in conjunction with the antilock brake system (ABS). The system tracks the direction that the driver intends to steer and uses brake application at individual wheels to help straighten out the vehicle.

*Driver skill and experience.* While the design and features of the vehicle are important to safe driving, the most important aspect of crash prevention is the skill and experience of the operator. The operator's attitude, training, experience, and qualifications, and the application of those qualities, are the most important elements in crash prevention. The operator

must ensure that the physical limits of the vehicle are not exceeded. Driver skill is developed only through training and practice.

**A.5.6.2** It should be noted that older engines might not meet current EPA standards and might 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 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:

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

**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 might 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.)

**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



## 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)

**FIGURE B.1** Specification Form for Fire Apparatus Refurbishing.

**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*



### 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   |
|--------|--------|------|-------------------------------|--|
|        |        |      |                               | <input type="checkbox"/> Use existing <input type="checkbox"/> Replace <input type="checkbox"/> Addition |
|        |        |      |                               | <input type="checkbox"/> Use existing <input type="checkbox"/> Replace <input type="checkbox"/> Addition |
|        |        |      |                               | <input type="checkbox"/> Use existing <input type="checkbox"/> Replace <input type="checkbox"/> Addition |
|        |        |      |                               | <input type="checkbox"/> Use existing <input type="checkbox"/> Replace <input type="checkbox"/> Addition |
|        |        |      |                               | <input type="checkbox"/> Use existing <input type="checkbox"/> Replace <input type="checkbox"/> Addition |
|        |        |      |                               | <input type="checkbox"/> Use existing <input type="checkbox"/> Replace <input type="checkbox"/> Addition |
|        |        |      |                               | <input type="checkbox"/> Use existing <input type="checkbox"/> Replace <input type="checkbox"/> Addition |

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

#### Breathing Apparatus

| Quantity | Make/Model | Mounting Location | Source   |
|----------|------------|-------------------|--|
|          |            |                   | <input type="checkbox"/> Use existing <input type="checkbox"/> Contractor supply <input type="checkbox"/> Purchaser supply |
|          |            |                   | <input type="checkbox"/> Use existing <input type="checkbox"/> Contractor supply <input type="checkbox"/> Purchaser supply |
|          |            |                   | <input type="checkbox"/> Use existing <input type="checkbox"/> Contractor supply <input type="checkbox"/> Purchaser supply |
|          |            |                   | <input type="checkbox"/> Use existing <input type="checkbox"/> Contractor supply <input type="checkbox"/> Purchaser supply |
|          |            |                   | <input type="checkbox"/> Use existing <input type="checkbox"/> Contractor supply <input type="checkbox"/> Purchaser supply |

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

\_\_\_\_\_  
 \_\_\_\_\_

FIGURE B.1 *Continued*

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

**FIGURE B.1** *Continued*



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

**FIGURE B.1** *Continued*

**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 \_\_\_\_\_**FIGURE B.1** *Continued*

**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 \_\_\_\_\_

**FIGURE B.1** *Continued*

**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: \_\_\_\_\_

**FIGURE B.1** *Continued*

### 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? \_\_\_\_\_

FIGURE B.1 *Continued*



**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 \_\_\_\_\_

**FIGURE B.1** *Continued*

**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 \_\_\_\_\_

**FIGURE B.1** *Continued*

**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: \_\_\_\_\_

**FIGURE B.1** *Continued*

## 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: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**FIGURE B.1** *Continued*



**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? \_\_\_\_\_

**FIGURE B.1** *Continued*

### 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: \_\_\_\_\_

\_\_\_\_\_

**FIGURE B.1** *Continued*

**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

**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 might 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.

**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, wheelbase, 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.

**DETERMINING EQUIPMENT WEIGHT ON FIRE APPARATUS WORKSHEET**

| <b>Equipment Description</b>              | <b>Dimensions (in.)</b> | <b>Weight (lb)</b> | <b>Quantity</b> | <b>Total Weight (lb)</b> | <b>Compartment Location</b> |
|---|-------------------------|--------------------|-----------------|--------------------------|-----------------------------|
| <b>Ground Ladders</b>                     |                         |                    |                 |                          |                             |
| 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.

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



**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.

**FIGURE C.1** *Continued*

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

| Equipment Description                                    | Dimensions (in.)                  | Weight (lb) | Quantity | Total Weight (lb) | Compartment Location |
|--|-----------------------------------|-------------|----------|-------------------|----------------------|
| <b>Portable or Folding Tank</b>                          |                                   |             |          |                   |                      |
| Tank, portable, 1000 gal                                 | 99 × 7 × 30                       | 125         |          |                   |                      |
| Tank, portable, 2000 gal                                 | 135 × 7 × 30                      | 165         |          |                   |                      |
| Tank, portable, 3000 gal                                 | 159 × 7 × 30                      | 185         |          |                   |                      |
| <b>Nozzles</b>   |                                   |             |          |                   |                      |
| 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*

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

| Equipment Description                               | Dimensions (in.) | Weight (lb) | Quantity | Total Weight (lb) | Compartment Location |
|---|------------------|-------------|----------|-------------------|----------------------|
| <b>Adapters, Fittings, Caps</b>                     |                  |             |          |                   |                      |
| 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*

**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*

**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 <sub>2</sub> ), 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*



**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<br>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<br>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.

**FIGURE C.1** *Continued*

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

| Equipment Description                          | Dimensions (in.)                      | Weight (lb) | Quantity | Total Weight (lb) | Compartment Location |
|--|---------------------------------------|-------------|----------|-------------------|----------------------|
| <b>Small Rescue or Entry Equipment</b>         |                                       |             |          |                   |                      |
| 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          |          |                   |                      |
| <b>Small Hand Tools</b>                        |                                       |             |          |                   |                      |
| 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*

**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, ⅝ × 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,<br>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, ⅝ 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,<br>handle 3 × 4.5 × 0.5    | 1.5  |  |  |  |
| Tool, hand, fork, four-tine           | Tines 12 × 8.75 × 0.5,<br>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*

**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*