Report of the Committee on
Fire Department Apparatus

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Nonvoting

William F. Foley, Orland Fire Protection District, IL
(Member Emeritus)

Howard L. McMillen, City of Fort Worth Fire Department, TX
(Member Emeritus)

Heinz E. Otte, Mendota Heights, MN
(Member Emeritus)

Staff Liaison: Carl E. Peterson

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

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

The Report of the Technical Committee on Fire Department Apparatus is presented for adoption.

This Report was prepared by the Technical Committee on Fire Department Apparatus and proposes for adoption, a complete revision to NFPA 1901, Standard for Automotive Fire Apparatus, 1999 edition. NFPA 1901-1999 is published in Volume 9 of the 2001 National Fire Codes and in separate pamphlet form.

This Report has been submitted to letter ballot of the Technical Committee on Fire Department Apparatus, which consists of 28 voting members. The results of the balloting, after circulation of any negative votes, can be found in the report.
The scope is being rewritten to better explain the 28
Sections 1-5 and 1-6 are being moved to comply
Add a new section on retroactivity to read as
Technical Committee on Fire Department Apparatus,
We compared the 1901 standards to the MK systems
Accept
Move sections 1-5 and 1-6 to become Sections
1-1.  Scope in your definition states “sustained”. The MK systems
Examples:
Scope in your definition states “sustained”. The MK systems
4-1 Speaks to pumps and pump performance. The MK systems do not have
pumps. A few examples are listed below.
4.1.1 Speaks to pump ratings. The MK systems do not have pumps but are
pneumatically driven.
4.1.2.1 Speaks to capacity whereas the MK system again is pneumatically driven
and has only one rate of discharge of water other than gating at the
nozzle.
4-1.3 Speaks to pump suction capacity. There is no pump therefore not applicable.
5-1 Speaks to tank capacity. The MK systems use a dry chemical as its
primary extinguishment agent therefore water is a secondary agent and the
volume is not more than 100 gal.
7-1 Involves the equipment carried on the vehicle. The MK systems are
designed to be light weight and maneuverable with the intent that they may be able to move around
structures and traffic problems by going off road or any place needed to gain
access to the emergency scene.
8-1 Again speaks to pumps.
9-1 Speaks to tests for acceptance. The MK systems are tested for flow,
leakage and safety at 1.5 times the rated capacity of the pressure at which
any of the systems will operate.
We at Phoenix Fire Systems, Inc. are always willing to answer any
questions you may have and are also willing to take an active role in the
formulation of any new standard that would address our new and growing
technology.
Note: Supporting material is available for review at NFPA headquarters.
COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The submitter has not provided specific recommendations for text that should be changed in NFPA 1901.
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-2-(1-1) : Accept
SUBMITTER: Technical Committee on Fire Department Apparatus,
RECOMMENDATION: Revise 1-1 to read as follows:
This standard defines the requirements for new automotive fire apparatus
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.
Revise A-1-1 to read as follows:
The term “new” as applied in this standard is intended to refer to the
original construction of a fire apparatus using all new components and parts.
SUBSTANTIATION: The scope is being rewritten to better explain the
scope of the document as currently written, it is more of an application
statement. Much of the current appendix material is being moved to be
appendix material to sections 1-4 and 1-5.
COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-3-(1-4) : Accept
SUBMITTER: Technical Committee on Fire Department Apparatus,
RECOMMENDATION: Revise 1-4 to read as follows:
1-4 Application.
1.4.1* This standard shall apply to new fire apparatus;
(1) of 10,000 lb (4500 kg) or greater
(2) designed for structural fire fighting or for supporting associated fire
department operations
1901-6-(1-7 Automatic Electrical Load Management System) : Accept

RECOMMENDATION: Revise the definition of Automatic Electrical Load Management System to read as follows:

A device that continuously monitors the electrical system voltage and automatically sheds predetermined loads in a selected order to prevent over-discharging of the apparatus’ batteries. Shedding of the loads occurs without human intervention and is capable of being manually overridden.

SUBSTANTIATION: If the Load Manager is installed in a way that it can not be overridden, it is still an Automatic Electrical Load Management System. If there is a requirement that a manual override capability be provided, or if a comment is appropriate that such an override is allowed, it should be made in 11-3.5. Also, adding the word automatically in the first sentence negates the need to have the first part of the second sentence.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-7-(1-7 Breathing Air) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus,

RECOMMENDATION: Change the definition of Breathing Air to correspond to the definition in proposed NFPA 1989, Standard on Breathing Air Quality for Fire and Emergency Services Respiratory Protection which reads as follows:

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

Add a definition for Synthetic Breathing Air as follows:

A manufactured breathing air that is produced by blending nitrogen and oxygen.

SUBSTANTIATION: The current wording is not a definition and references should not be part of a definition.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-8-(1-7 Class B Fires) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus,

RECOMMENDATION: Adopt the preferred definition from the NFPA Glossary of Terms for the following term:

Class B Fires, (preferred) NFPA 1. 2000 ed.

Fires in flammable liquids, combustible liquids, petroleum gasses, tar, oils, oil-based paints, solvents, lacquers, alcohols, and flammable gases.

SUBSTANTIATION: Adoption of preferred definitions will assist the user by providing consistent meaning of defined terms throughout the National Fire Codes.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-9-(1-7 Compressed Air Foam System (CFAS)) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus,

RECOMMENDATION: Move the second sentence to the appendix.

SUBSTANTIATION: The second sentence is not part of the definition but explanatory material. As such it belongs in the appendix.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-10-(1-7 Fill Station) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus,

RECOMMENDATION: Delete the definition of Fill station.

Add a definition for SCBA Fill Station to read as follows:

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

SUBSTANTIATION: The definition change better describes the “fill station” application and safeguards in compliance to this standard.

Since the introduction of the 1999 edition of NFPA 1901, there has been no reported injuries with the new containment systems and new designs in fill stations are evolving, a major step forward in standards improvement for fire apparatus.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-11-(1-7 Fire Apparatus) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus,

RECOMMENDATION: Revise the definition of fire apparatus to read as follows:

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.

SUBSTANTIATION: As currently defined, the definition is limiting. Not all fire apparatus is over 10,000 lb GVWR although it is the intent to cover only apparatus over 10,000 lb GVWR in NFPA 1901. This is being handled with the revised application statement. The revised definition better defines fire apparatus.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-12-(1-7 Fire Pump) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus,

RECOMMENDATION: Revise the definition of Fire Pump to read as follows:

A water pump with a rated capacity of 250 gpm (100 L/min) or greater at 150 psi (10 bar) net pump pressure that is mounted on a fire apparatus and used for fire fighting.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-13-(1-7 Generator (Alternator), Portable) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus,

RECOMMENDATION: Delete the definition of “Generator (Alternator), Fixed.”

Revise the definition of “Generator (Alternator), Portable” in 1-7 to read as follows:

Portable Generator. A mechanically driven power source that can be removed from the vehicle and operated at a location that is remote from the vehicle. The device has an integral distribution panel with overcurrent protection and receptacle outlets.

Add a definition for power source to read as follows:

Power Source. A device that produces line voltage electricity.

Add a definition for fixed power source to read as follows:

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

SUBSTANTIATION: The definition of generator (alternator) fixed is being deleted as it is no longer used in the document.

The 7 kW is information, not requirement, and is unnecessary to the definition of portable generator. Throughout the document an 8 kW divider is used for other characteristics.

The new terms Power Source and Fixed Power Source is used in the line voltage chapter and the committee feels a definition would be helpful.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-14-(1-7 Line Voltage Circuit, Equipment, or System) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus,

RECOMMENDATION: Revise the definition of “Line Voltage Circuit, Equipment, or System” to read as follows:

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.

SUBSTANTIATION: As a result of changes to 21-2.1 (see Proposal 1901-186 (Log #CP70), the upper limitation of 250 volts is being removed.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28
The justification for adding an additional chapter is that the committee is including both inch-pound units and metric units. Add new text to read as follows:

"Master Discharge Outlets. Any fire pump discharge outlet with a fire hose connection of 5 in. or larger intended to supply 100% of the capacity of the fire pump from draft at 150 psi."

SUBSTANTIATION: a. When a large or master suction inlet is specified, the intent of the purchaser is job specific - that of discharging a large volume of water not capable of being delivered by a standard 2.50 in. discharge outlet.
b. Section 14-7.3 with Appendix is the only area under 14-7 Pump Discharge Outlets which addresses piping and valves in conjunction with intended flow rates and said area is specific only to smaller preconnected lines.
c. The table in Section 14-7.1 refers to outlet size and flow rate without mention of limitations or cautioning that the design of the installation can affect performance (as it did with suction piping in Section A-14-2.4.2).
d. The use of large diameter hose is becoming common place and there exists an infinite number of possible locations and methods to pipe discharge outlets, some of which may not be capable of delivering "large flows" or may not be able to deliver large flows with reasonable friction losses.
e. There does not exist a definition, common to all manufacturers and purchasers, of a large diameter or master discharge outlet. Standard 1901 does not state what performance is expected of one. (i.e. pumping a certain gpm into a large diameter hose line, supplying an apparatus mounted master stream and/or as a certain percentage of a fire pump's capacity).
f. By specifically defining a large or master discharge outlet being capable of flowing a measurable large volume (i.e. in excess of 50% of the pump's capacity):
   1) Purchasers have a means to define the performance expected.
   2) Manufacturers can assure piping designs and installations will be appropriate for the intended use.
   3) A means will be provided to measure, test and, if required, certify the installation.

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: The committee is rejecting this proposal for 2 reasons. First, definitions are not added to a document unless they define terms that are going to be used in the document and there is no proposal to use this term. Secondly, it is not always possible to draft 100 percent of the capacity of a pump through a single inlet particularly as the size of the pump increases. Note that on larger pumps, Table 14-2.4.1(a) allows multiple suction lines for pumps of 1500 gpm or greater. See also 14-2.4.2(3) which allows the purchaser to specify if single suction line performance is required.

Large auxiliary suction lines are generally intended to bring a hydrant supply into the pump and often cannot be configured to allow 100 percent of capacity from draft. However, if that is an operational requirement, the purchaser can specify specific performance for any intake and can measure that performance as part of acceptance tests.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-17-(1-7) Ramp Breakover Angle (New) : Reject

SUBMITTER: Dan W. McKenzie, USDA Forest Service

RECOMMENDATION: Add the following new definition:

"Ramp Breakover Angle. The angle measured between two (2) lines tangent to the front and rear tire static loaded radius, and intersecting at a point on the underside of the vehicle that defines the largest ramp over which the vehicle can roll."

SUBSTANTIATION: The ramp breakover angle is important for a very small ramp breaker angle can limit the operations of the apparatus.

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: The term is not used in the document.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-18-(1-8) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus

RECOMMENDATION: Revise the text associated with 1-8 to read as follows:

1-8 Units and Formulas. In this standard, values for measurement in inch-pound units are followed by an equivalent in metric units. Either set of values can be used but the same set of values (either inch-pound units or metric units) shall be used throughout.

SUBSTANTIATION: The committee is including both inch-pound units and metric units but is cautioning persons not to mix and match units. If the apparatus is to be built using inch pound units, those units must be used throughout. Likewise, if the apparatus is to be built using metric units, those units must be used throughout.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-19-(2-2.2) : Reject

SUBMITTER: Bill McCombs, Alan Saulsbury, Federal Signal Fire Rescue Group

RECOMMENDATION: Add a line item in Table 2-2.2 for Rescue Pumper.

SUBSTANTIATION: The justification for adding an additional chapter stems from the increasing percentage of "Rescue Pumpers" being utilized by the fire service, as they adapt their equipment to new and more varied roles. The increased EMS, Rescue, and Haz-mat roles are forcing many departments to combine these functions into vehicles also serving the traditional pumper role. This is resulting in over weight vehicles when all of the additional equipment for these functions is added to vehicles designed for normal pumper service.

An additional chapter is needed to give guidance on recommended equipment for "Rescue Pumpers" as well as define a miscellaneous equipment allowance that will more accurately define the intended service function of the vehicle. This should more clearly communicate the fire departments intentions to a vehicle manufacturer during a bid request and reduce the number of surprises when the vehicle is delivered and loaded with equipment.

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: See committee meeting action on public proposal 1901-43 (Log #43) which adds a requirement for additional weight when larger cubic footage of compartmentation is provided. The committee does not want to establish a pumper-rescue type of fire apparatus but does feel the changes made to provide for additional weight should solve the problem of overweight vehicles.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28
REVISE 2-6.2 (4.10.2 in the draft) to read as follows:

2-6.2 The manufacturer shall have the facilities and equipment necessary to conduct the required testing, a program for the calibration of all instruments, and procedures to ensure the proper control of all testing.

2-6.4 Appropriate forms or data sheets shall be provided and used during the testing.

2-6.5 Programs shall be in place for training, proficiency testing, and performance verification of any staff involved with certification.

2-6.6 On the basis of the company that manufactures or installs the product, the certification organization shall be presented in writing to a qualified witness to tests and certify results.

Revise 11-14.1 to read as follows:

11-14.1 The apparatus low-voltage electrical system shall be tested as required by this section and the test results certified by the apparatus manufacturer. The certification shall be delivered to the purchaser with the apparatus.

11-14.3.1 to read as follows:

11-14.3.1 If the fire pump has a rated capacity of 750 gpm (2850 L/min) or greater, the pump shall be tested after the pump and all its associated piping and equipment have been installed on the apparatus. The tests shall be conducted at the manufacturer's approved facility and certified by the independent third-party testing certification organization approved by the purchaser.

REVISE 18-24 to read as follows:

18-24 Certification Tests. The completed apparatus with the aftermarket shall be tested to the criteria defined in this section at the manufacturer's independent testing certification organization approved by the purchaser.

REVISE 2-6.2 to read as follows:

2-6.2 All required signs, plates, and labels shall be permanent in nature, securely attached, and shall meet the requirements of Section 2-3.5 and UL 969 Standard for Marking and Labeling Sytems. Add an appendix item to 2-6.2 to read as follows:

2-6.2.1 The signs, plates and labels shall have resistance to damage from temperatures between -30°F and 160°F (-35°C and 71°C) and exposure to oil, fuel, water, hydraulic fluids, or other fluids used on the apparatus.

2-6.2.2 The exterior mounted labels relating to safety or critical operational equipment shall not be used on the apparatus.

2-6.2.3 The exterior mounted labels relating to safety or critical operational equipment shall be tested at the manufacturer's approved facility and certified by the independent testing certification organization approved by the purchaser.

REVISE 18-24 to read as follows:

18-24 Certification Tests. The completed apparatus with the aftermarket shall be tested to the criteria defined in this section at the manufacturer's independent testing certification organization approved by the purchaser.
The Standard is explicit in specifying weight
2-8.3 Load Distribution.
2-8.3.1* Using the information supplied by the purchaser, the apparatus manufacturer shall calculate the load distribution for the apparatus.
2-8.3.2 The manufacturer shall engineer the vehicle to comply with the Gross Axle Weight Ratings (GAWR), the overall G.V.W.R. and the chassis manufacturer's load balance guidelines.
2-8.3.3* The purchaser shall locate the equipment on the apparatus to assure the difference in weight, from side to side on the end of each axle shall not exceed 7 percent or the limit allowed by the axle or component manufacturer.

Add appendix material as follows:
A-2-8.3.1 It is critical that the purchaser provide the manufacturer the equipment inventory and mounting locations for equipment on the apparatus. This should include existing equipment and estimated future equipment to be carried. The projections of total equipment payload and mounting locations are essential for proper engineering of a new fire apparatus. It is the responsibility of the purchaser to properly load the vehicle and place equipment to comply to GWR, front to rear weight distribution, and right to left load balance of this standard.
A-2-8.3.3 The projections of total equipment payload and mounting locations are essential for proper engineering of a new fire apparatus.

SUBSTANTIATION: The present wording could mean that the manufacturer could be responsible for the uneven loading of an apparatus after delivery of the apparatus. Positioning of equipment is critical on high cubic foot apparatus with full depth compartments. The change makes the purchaser responsible for load placement and limitations thereof based on the information the purchaser provided the manufacturer.

COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-26-(2-14) : Reject
SUBMITTER: Bill Adams, William F. Adams & Associates
RECOMMENDATION: Revise text to read as follows:
(7) Chassis weight distribution in pounds with water and manufacturer mounted equipment (front and rear) (front, rear and each side).

SUBSTANTIATION: The Standard is explicit in specifying weight distribution front to rear and side to side, however, testing is only required for the front to rear weight loading. Improper weight distribution can directly affect vehicle stability and performance characteristics. By nature of loading equipment on a vehicle after delivery and acceptance, a Purchaser can alter the handling characteristics and safe operation of a new vehicle. Verifying conformity to the weight distribution requirement at the time of delivery will: (1) insure a vehicle is compliant with the Standard upon delivery, (2) assist the Purchaser in safe equipment load distribution after delivery and (3) establish a basis to help alleviate and resolve possible problems in the future in regard to weight distribution, handling characteristics and warranty claims.

COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The committee feels this will add cost with limited benefit. The weight is important after the apparatus is inservice.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-25-(2-11.3(2)) : Accept
SUBMITTER: Technical Committee on Fire Department Apparatus,
RECOMMENDATION: Revise the wording of 2-11.3 (4.19.2 in the draft) to read as follows:
2-11.3 Operations and Service Documentation.
2-11.3.1 The contractor shall supply, at time of delivery, at least two sets of complete operation and service documentation covering the completed apparatus as delivered and accepted.
2-11.3.2 The documentation shall address at least the inspection, maintenance, and operations of the vehicle and all major components thereof.
2-11.3.3 The contractor shall also provide documentation of the following items for the entire apparatus and each major operating system or major component of the apparatus,
(1) Manufacturer's name and address
(2) Country of manufacture
(3) Source for service and technical information
(4) Parts replacement information
(5) Descriptions, specifications, and ratings of the chassis, pump (if applicable), and aerial device (if applicable)
(6) Wiring diagrams for low voltage and line voltage systems to include the following information:
a) Pictorial representations of circuit logic for all electrical components and wiring
b) Circuit identification
c) Connector pin identification
d) Zone location of electrical components
e) Safety interlocks
f) Alternator - battery power distribution circuits
g) equivalent circuit logic implemented in multiplexing systems
(7) Lubrication charts
(8) Operating instructions for the chassis, any major components such as a pump or aerial device, and any auxiliary systems
(9) Precautions related to multiple configurations of aerial devices, if applicable
(10) Instructions regarding the frequency and procedure for recommended maintenance
(11) Overall apparatus operating instructions
(12) Safety considerations
(13) Limitations of use
(14) Inspection procedures
(15) Recommended maintenance procedures
(16) Troubleshooting guide
(17) Apparatus body, chassis, and other component manufacturer's warranties
(18) Special data required by this standard
(19) Copies of completed manufacturer testing and certifications, third party testing and certifications, and other component manufacturer certifications
(20) A material safety data sheet (MSDS) shall be provided for any fluid that is specified for use on the apparatus.

COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-27-(2-14) : Reject
SUBMITTER: Bill Adams, William F. Adams & Associates
RECOMMENDATION: Revise text to read as follows:
(19)(i) Weight documents from a certified scale - showing actual loading on the front axle, rear axle(s), left side, right side, and overall vehicle (with water tank full but without personnel, equipment, and hose) - shall be supplied with the completed vehicle to determine compliance with Section 10-1 and Section 2-8.

SUBSTANTIATION: The Standard is explicit in specifying weight distribution front to rear and side to side, however, certification is only required for the front to rear weight loading. Improper weight distribution can directly affect vehicle stability and performance characteristics. By nature of loading equipment on a vehicle after delivery and acceptance, a Purchaser can alter the handling characteristics and safe operation of a new vehicle. Certifying conformity to the weight distribution requirement at the time of delivery will: (1) insure a vehicle is compliant with the Standard upon delivery, (2) assist the Purchaser in safe equipment load distribution after delivery and (3) establish a basis to help alleviate and resolve possible problems in the future in regard to weight distribution, handling characteristics and warranty claims.

COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The committee feels this will add cost with limited benefit. The weight is important after the apparatus is inservice.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-28-(2-14 (New) ) : Accept
SUBMITTER: Technical Committee on Fire Department Apparatus,
RECOMMENDATION: Add a new section before the existing 2-14 to read as follows (This will be 4.18 in the draft):
Documentation. Any documentation provided with the apparatus shall be permitted to be in printed or electronic format, audio-visual format, or a combination thereof.
Add an appendix to read as follows:

It is important for the purchaser and contractor to agree on the format that the documentation is to be delivered in. It is also important that the purchaser consider the long term ramifications of the changing media technology if electronic format is used for delivery of the documentation. Software and hardware will need to be maintained over the years to utilize electronic documentation.

Add a definition of documentation to read as follows:

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

SUBSTANTIATION: The new wording will allow documentation to be on video tape, CD ROM, and other electronic means which some fire departments find is more useful for documentation of the apparatus.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-29-(2-14(i)) (New) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus,

RECOMMENDATION: After (h) add the following wording (this is 4.19.1(i) in the draft):

(i) If the apparatus has a fixed line voltage power source, the certification of the test for the fixed power source.

SUBSTANTIATION: Adoption of the changes proposed to Chapter 21 will require third party testing of fixed line voltage power sources and this will alert purchasers to the fact they need to get this documentation.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-30-(2-14(i)) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus,

RECOMMENDATION: Add a new item to the list to read as follows (this is 4.19.1(i) in the draft):

(l) If the apparatus is equipped with an air system, test results of the air quality, the SCBA fill station, and the air system installation (see chapter 23).

SUBSTANTIATION: Additional certification requirements have been added in chapter 23 and they need to be added here to ensure they documentation is delivered with the apparatus.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-31-(3-8.2) : Accept in Principle

SUBMITTER: Dan W. McKenzie, USDA Forest Service

RECOMMENDATION: Replace the last paragraph with:

Two wheel chocks, mounted in a readily accessible location. With the apparatus on hard surface (pavement or concrete), a wheel chock shall be placed against the tire of the most heaviest loaded axle and the wheel chock shall hold the fully loaded apparatus on a 10% grade. The apparatus transmission shall be in neutral, transfer case in two-wheel drive if apparatus is all wheel drive, tires at correct pressure, and all brakes released. The apparatus tire shall not climb over, damage, or slide the chock(s).

SUBSTANTIATION: Wheel chocks should and can have a performance requirement. One wheel chock holding a fully loaded truck on a ten percent grade is a reasonable performance requirement.

COMMITTEE MEETING ACTION: Accept in Principle

Revise the requirement for wheel chocks in 3-8.2 (5.8.3 in the draft) to read as follows:

Two wheel chocks, mounted in readily accessible locations, each designed to hold the fully loaded apparatus on a 10 percent grade with the transmission in neutral and the parking brake released.

Delete 3-8.2.1.

COMMITTEE STATEMENT: The current wording about wheel chocks has proved to be unsatisfactory. The reference to SAE standard J348 Standard for Wheel Chocks has required a wheel chock no satisfactory to the fire service. It is so large and unwieldy that many companies choose to not carry them, or if they are carried they are not used. The folding version has proved to be unsatisfactory. The SAE standard is a theoretical geometric analysis of part of the problem, without any reference to actual performance. It uses the automobile parking brake performance, an $8,000 pound GVW, and geometric considerations instead of performance in defining the parameters for designing the wheel chocks. Brad Kobielusz of the Poudre Fire Authority in Fort Collins, Colorado, did extensive research and testing of a wide variety of currently available wheel chocks. The field tests were performed on a 16% slope with a 6,000 pound trailer before striking the wheel chock. His tests found that the SAE J348 chocks were no more effective than other, smaller, chocks. With no chock tested did the wheel climb over the chock. The common failure, especially with the SAE J348 type chock, was for the tire to push the chock along without stopping the wheel. This issue is not addressed in SAE J348.

The requirement for 2 extra wheel chocks if the apparatus is equipped with an aerial device is being deleted as these were originally furnished to assist with the stability during aerial operations. Changes to stabilizer systems make these unnecessary in many cases. If the manufacturer feels that extra wheel chocks are necessary when an aerial device is used, they should be furnished with the apparatus and their use discussed in the operating instruction.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-32-(3-8.2, 4-7.2, 6-8.1, 7-8.2): Reject

SUBMITTER: Charles F. Studley, Cross & Studley, Inc.

RECOMMENDATION: Add new text as follows:

Man pierce and pull forcible entry tool.

SUBSTANTIATION: Response time is critical to the saving of lives and property. From placing bunker gear, so that the firefighter only has to step into his boots and pull up his suspenders, back up to quick release air pack, change traffic light patterns from the cab of the truck, first truck in does not spend time catching a hydrant, number one nozzle man advances with preconnect only to find the door locked. At this point all our careful planning and hundreds of training hours, and our $200,000 to $350,000 fully equipped trucks, Fail! The fire service does not have a comprehensive forcible entry training program nor until now has there been a manual pierce and pull forcible entry tool specifically to defeat locked doors. The fastest way to breach a locked door is to apply a concentrated force to the door so as to move the door in the direction it is intended to open. In swinging doors require using a maul or ram. Out swinging doors require using a manual pierce & pull entry tool.

Over the last three years a manual pierce & pull entry tool has proven itself by defeating locked doors encountered by U.S. Customs, DEA, various SWAT and Narcotics Teams in the US and Europe. This method of forcible entry is being used in both federal and state training for fire service and law enforcement.

In my personal career as a Firefighter-Paramedic, I would have saved more lives with this type of entry tool then with the defibrillator.

I submit to you in this day and age, with all the resources available to us, that it is absurd that a locked door breaks the chain of efficiency and we are reduced to a “work around.” In some cases the “work around” will exceed the elapsed time that it has taken to arrive on scene.

In summation, pierce and pull forcible entry tools of this type have opened 90% of the doors in less than five (5) seconds, and it is the first entry tool that can effectively be used in training.

A pierce and pull forcible entry tool belongs on all Quints, Aerials, Pumpers & First Attack vehicles.

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: There are a number of generic tools required to be carried on fire apparatus that can be used for forcible entry. The recommendation is for the addition of a tool that is of a very specific design and available from a single source. The committee cannot recommend single source products.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-33-(3-8.2.1) : Reject

SUBMITTER: Dan W. McKenzie, USDA Forest Service

RECOMMENDATION: Replace section 3-8.2.1 with the following:

If the pumper is equipped with an aerial device, two additional wheel chocks shall be provided, mounted in readily accessible locations.

SUBSTANTIATION: Wheel chocks should and can have a performance requirement. One wheel chock holding a fully loaded truck on a ten percent grade is a reasonable performance requirement.

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: See public Proposal 1901-31 (Log #75) which deletes this paragraph.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-34-(3-8.2.1) : Reject

SUBMITTER: Dan W. McKenzie, USDA Forest Service

RECOMMENDATION: Add new text as follows:

A five percent grade is a reasonable performance requirement.

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: See public Proposal 1901-31 (Log #75) which deletes this paragraph.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-35-(3-8.2.1) : Reject

SUBMITTER: Dan W. McKenzie, USDA Forest Service

RECOMMENDATION: Remove section 3-8.2.1 with the following:

If the pumper is equipped with an aerial device, two additional wheel chocks shall be provided, mounted in readily accessible locations.

SUBSTANTIATION: Wheel chocks should and can have a performance requirement. One wheel chock holding a fully loaded truck on a ten percent grade is a reasonable performance requirement.

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: See public Proposal 1901-31 (Log #75) which deletes this paragraph.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-36-(3-8.2.1) : Reject

SUBMITTER: Dan W. McKenzie, USDA Forest Service

RECOMMENDATION: Add new text as follows:

A five percent grade is a reasonable performance requirement.

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: See public Proposal 1901-31 (Log #75) which deletes this paragraph.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-37-(3-8.2.1) : Reject

SUBMITTER: Dan W. McKenzie, USDA Forest Service

RECOMMENDATION: Add new text as follows:

A five percent grade is a reasonable performance requirement.

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: See public Proposal 1901-31 (Log #75) which deletes this paragraph.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28
The justification for adding an additional chapter stems from the increasing percentage of "Rescue Pumps" being utilized by the fire service, as they adapt their equipment to new and more varied roles. The increased EMS, Rescue, and Haz-mat roles are forcing many departments to combine these functions into vehicles also serving the traditional pumper role. This is resulting in over weight vehicles when all of the additional equipment for these functions is added to vehicles designed for normal pumper service.

An additional chapter is needed to give guidance on recommended equipment for "Rescue Pumps" as well as define a miscellaneous equipment allowance that will more accurately match the intended service function of the vehicle. This should more clearly communicate the fire departments intentions to a vehicle manufacturer during a bid request and reduce the number of surprises when the vehicle is delivered and loaded with equipment.

COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: See committee meeting action on public Proposal 1901-43 (Log #43) which adds a requirement for additional weight when a pumper has functions of compartimentation. The committee does not want to establish a rescue-pumper type of fire apparatus but does feel the changes made to provide for additional weight should solve the problem of overweight vehicles.

VOTE ON COMMITTEE MEMBERS: 28
AFFIRMATIVE: 28

1901-35-(4-7-2.): Accept in Principle
SUBMITTER: Dan W. McKenzie, USDA Forest Service
RECOMMENDATION: Replace the last paragraph with:

Two wheel chocks, mounted in a readily accessible area. With the apparatus on hard surface (pavement or concrete), a wheel chock shall be placed against the tire of the most heaviest loaded axle and the wheel chock shell hold the fully loaded apparatus on a 10% grade. The apparatus transmission shall be in neutral, transfer case in two-wheel drive if apparatus is all wheel drive, tires at correct pressure, and all brakes released. The apparatus tire shall not climb over, damage, or slide the chock(s).

COMMITTEE MEETING ACTION: Accept in Principle
COMMITTEE STATEMENT: Accept the requirement for wheel chocks in 4-7-2 (6.7.3 in the draft) read as follows:

Two wheel chocks, mounted in readily accessible locations, each designed to hold the fully loaded apparatus on a 10 percent grade with the transmission in neutral and the parking brake released.

VOTE ON COMMITTEE MEMBERS: 28
AFFIRMATIVE: 28

1901-36-(5-7-2.1): Accept in Principle
SUBMITTER: Dan W. McKenzie, USDA Forest Service
RECOMMENDATION: Replace the last paragraph with:

Two wheel chocks, mounted in a readily accessible location. With the apparatus on hard surface (pavement or concrete), a wheel chock shall be placed against the tire of the most heaviest loaded axle and the wheel chock shell hold the fully loaded apparatus on a 10% grade. The apparatus transmission shall be in neutral, transfer case in two-wheel drive if apparatus is all wheel drive, tires at correct pressure, and all brakes released. The apparatus tire shall not climb over, damage, or slide the chock(s).

COMMITTEE MEETING ACTION: Accept in Principle
COMMITTEE STATEMENT: The current wording about wheel chocks has proved to be unsatisfactory. The reference to SAE standard J348/ Standard for Wheel Chocks has required a wheel chock no satisfactory to the fire service. It is so large and unwieldy that many companies choose to not carry them, or if they are carried they are not used. The folding version has been a danger for injured fingers and has not been well accepted. The SAE standard is a theoretical geometric analysis of part of the problem, without any reference to actual performance. It uses the automobile parking brake performance, an 80,000 pound GVW, and strictly geometric considerations instead of performance in defining the parameters for designing the wheel chocks. Brad Kobielusz of the Poudre Fire Authority in Fort Collins, Colorado, did extensive research and testing of a wide variety of currently available wheel chocks. The field tests were performed on a 16% slope with a 6-inch pre-roll before hitting the wheel chock. His tests found that the SAE J348 chocks were no more effective than other, smaller, chocks. With no wheel chock tested did the wheel climb over the chock. The common failure, especially with the SAE J348 type chock, was for the tire to push the chock along without stopping the truck. This issue is not addressed in SAE J348.

VOTE ON COMMITTEE MEMBERS: 28
AFFIRMATIVE: 28
COMMITTEE STATEMENT: The current wording about wheel chocks has proved to be unsatisfactory. The reference to SAE standard J348 Standard for Wheel Chocks has required a wheel chock no satisfactory to the fire service. It is large and unwieldy that many companies choose to not carry them, or if they are carried they are not used. The folding version has a been a danger for injured fingers and has not been well accepted. The SAE standard is a theoretical geometric analysis of part of the problem, without any reference to actual performance. It uses the automobile parking brake performance, an 80,000 pound GVW, and strictly geometric considerations instead of performance in defining the parameters for designing the wheel chocks. Brad Kobielusz of the Poudre Fire Authority in Fort Collins, Colorado, did extensive research and testing of a wide variety of currently available wheel chocks. His tests found that the SAE J348 chocks were no more effective than other, smaller, chocks. With no chock tested did the wheel climb over the chock. The common failure, especially with the SAE J348 type chock, was for the tire to push the chock along without stopping the truck. This issue is not addressed in SAE J348.

COMMITTEE MEETING ACTION: Accept in Principle

SUBMITTER: Dan W. McKenzie, USDA Forest Service

RECOMMENDATION: Replace the last paragraph with:

If an aerial device is being changed as these were originally furnished to assist with the stability during aerial operations. Changes to stabilizer systems make these unnecessary in many cases. If the manufacturer feels that extra wheel chocks are necessary when an aerial device is used, they should be furnished with the apparatus and their use discussed in the operating instruction.

COMMITTEE MEETING ACTION: Accept in Principle

SUBMITTER: Technical Committee on Fire Department Apparatus

RECOMMENDATION: Revise the requirement in 8-5 (10.5.2 in the draft) to read as follows:

Two wheel chocks, mounted in readily accessible locations, each designed to hold the fully loaded apparatus on a 10 percent grade with the transmission in neutral and the parking brake released.

SUBSTANTIATION: The current wording about wheel chocks has proved to be unsatisfactory. The reference to SAE standard J348 Standard for Wheel Chocks has required a wheel chock no satisfactory to the fire service. It is so large and unwieldy that many companies choose to not carry them, or if they are carried they are not used. The folding version has been a danger for injured fingers and has not been well accepted. The SAE standard is a theoretical geometric analysis of part of the problem, without any reference to actual performance. It uses the automobile parking brake performance, an 80,000 pound GVW, and strictly geometric considerations instead of performance in defining the parameters for designing the wheel chocks. Brad Kobielusz of the Poudre Fire Authority in Fort Collins, Colorado, did extensive research and testing of a wide variety of currently available wheel chocks. His tests found that the SAE J348 chocks were no more effective than other, smaller, chocks. With no chock tested did the wheel climb over the chock. The common failure, especially with the SAE J348 type chock, was for the tire to push the chock along without stopping the truck. This issue is not addressed in SAE J348.

COMMITTEE MEETING ACTION: Accept in Principle

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

SUBMITTER: Dan W. McKenzie, USDA Forest Service

RECOMMENDATION: Replace the last paragraph with:

Two wheel chocks, mounted in readily accessible locations, each designed to hold the fully loaded apparatus on a 10 percent grade with the transmission in neutral and the parking brake released.

COMMITTEE MEETING ACTION: Accept in Principle

REVISE THE REQUIREMENT IN 8-5 (10.5.2 IN THE DRAFT)

SUBMITTER: Dan W. McKenzie, USDA Forest Service

RECOMMENDATION: Replace the last paragraph with:

One wheel chock holding a fully loaded truck on a ten percent grade is a reasonable performance requirement.

COMMITTEE MEETING ACTION: Accept in Principle

REVISE THE REQUIREMENT FOR WHEEL CHOCKS IN 6-8.1 (8.8.2 IN THE DRAFT)

SUBMITTER: Dan W. McKenzie, USDA Forest Service

RECOMMENDATION: Revise the requirement for wheel chocks in 6-8.1 (8.8.2 in the draft) to read as follows:

Four wheel chocks, mounted in a readily accessible location. With the apparatus on hard surface (pavement or concrete), a wheel chock shall be placed against the tire of the most heaviest loaded axle and the wheel chock shall hold the fully load apparatus on a 10% grade. The apparatus transmission shall be in neutral, transmission and the parking brake released.

COMMITTEE MEETING ACTION: Accept in Principle

REVISE THE REQUIREMENT FOR WHEEL CHOCKS IN 7-8.2 (9.8.3 IN THE DRAFT)

SUBMITTER: Dan W. McKenzie, USDA Forest Service

RECOMMENDATION: Revise the requirement for wheel chocks in 7-8.2 (9.8.3 in the draft) to read as follows:

One wheel chock holding a fully loaded apparatus on a 10 percent grade with the transmission in neutral and the parking brake released.

COMMITTEE MEETING ACTION: Accept in Principle

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

SUBMITTER: Dan W. McKenzie, USDA Forest Service
COMMITTEE MEETING ACTION: Accept in Principle
Revise the requirement for wheel chocks in 9-9.2 (11.9.3) in the draft to read as follows:
Two wheel chocks, mounted in readily accessible locations, each designed to hold the fully loaded apparatus on a 10 percent grade with the transmission in neutral and the parking brake released.

COMMITTEE MEETING ACTION: Delete 9-9.2.1.

COMMITTEE MEETING ACTION: Current wording about wheel chocks has proved to be unsatisfactory. The reference to SAE standard J348 is not that the disintegration of the cab is causing crushing fatal injuries.

COMMITTEE MEETING ACTION: Add text to read as follows:
If the finished 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 10-1.

SUBSTANTIATION: The minimum required equipment in many cases does not weigh nearly as much as the weight allowance. Some apparatus, such as quints, may not have available weight capacity, or space for compartment to hold the Table 10-1 weight allowance. Some large apparatus, especially ladders and large rescue pieces have space for, and after delivery will carry, much greater loads than the Table 10-1 allowance.

COMMITTEE MEETING ACTION: Accept in Principle
Revise 10-1 (A.12.1 in the draft) to read as follows:
10-1* Carrying Capacity. The GAWR and the GCWR of the chassis shall be adequate to carry the weight of the unequipped apparatus, the fully loaded water and other tanks, the specified hose load, unequipped personnel weight, ground ladders, permanently mounted equipment such as generators, mounted reels, air systems, and other permanent installations, and a miscellaneous equipment allowance of 15 pounds per ft² (240 Kg per m²) of space in enclosed compartments and open bays available for miscellaneous equipment. Any space occupied by permanently mounted equipment shall not be included in this calculation.

COMMITTEE MEETING ACTION: Delete table 10-1.
Change the reference in A-10-1 paragraph 3 to refer to the allowance described in Section 10-1 instead of the allowance shown in Table 10-1.

AFFIRMATIVE: 28
VOTE ON COMMITTEE ACTION: (Log #43)

COMMITTEE STATEMENT: The current wording about wheel chocks in 9-9.2 has proved to be unsatisfactory. The reference to SAE standard J348 is not that the disintegration of the cab is causing crushing fatal injuries. The data on fire fighter fatalities shows that most often when fire fighters are killed in apparatus accidents and rollovers, they are thrown from the cab or thrown around in the cab because they are not properly seated and belted, not that the disintegration of the cab is causing crushing fatal injuries.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

AFFIRMATIVE: 28
VOTE ON COMMITTEE ACTION: (Log #82)

1901-41-(9-9.2.1): Reject
SUBMITTER: Dan W. McKenzie, USDA Forest Service
RECOMMENDATION: Replace section 9-9.2.1 with the following:
If the mobile foam apparatus is equipped with an aerial device, two additional wheel chocks shall be provided, mounted in readily accessible locations.

COMMITTEE MEETING ACTION: Reject
COMMITTEE MEETING ACTION: See public Proposal 1901-40 (Log #78) which deletes this paragraph.

AFFIRMATIVE: 28
VOTE ON COMMITTEE ACTION: (Log #1)

1901-42-(10-1): Reject
NOTE: This Proposal appeared as Comment 1901-37 (Log #16) which was held from the May 1999 ROC on Proposal 1901-217.

SUBMITTER: John J. Chadwick, Jr., American LaFrance Corp.
RECOMMENDATION: Add text to read as follows:
The vehicle cab shall meet the requirements of United Nation Agreement, Addendum 28, Revision 1: Regulation No. 29, March 15, 1974, Uniform Provision Concerning the Approval of Vehicles with Regard to the Protection of the Occupants of the Cab of a Commercial Vehicle.

Note: Supporting material available upon request at NFPA headquarters.

SUBSTANTIATION: Use of this standard will establish a recognized, international standard for specifying the structural integrity of the vehicle cab with regard to the safety and protection of the occupants. This Regulation is an established UN standard for vehicles and provides for reasonable qualitative requirements which allow for the design, testing and certification of vehicle cabs. The current NFPA standards do not provide for a definitive standard for cab structural integrity and safety.

COMMITTEE MEETING ACTION: Reject
COMMITTEE MEETING ACTION: This is a minimum standard and the purchaser can specify additional testing or certification requirements. The current NFPA standards were based on the data on fire fighter fatalities shows that most often when fire fighters are killed in apparatus accidents and rollovers, they are thrown from the cab or thrown around in the cab because they are not properly seated and belted, not that the disintegration of the cab is causing crushing fatal injuries.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

COMMITTEE STATEMENT: This is a minimum standard and the purchaser can specify additional testing or certification requirements. The current NFPA standards were based on the data on fire fighter fatalities shows that most often when fire fighters are killed in apparatus accidents and rollovers, they are thrown from the cab or thrown around in the cab because they are not properly seated and belted, not that the disintegration of the cab is causing crushing fatal injuries.
Table 10-1 Miscellaneous Equipment Allowance

<table>
<thead>
<tr>
<th>Apparatus Type</th>
<th>Chassis-GVWR</th>
<th>Equipment Allowance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumper fire apparatus</td>
<td>All, less than 250 cu. ft. compartment space</td>
<td>2000 lb (900 kg)</td>
</tr>
<tr>
<td></td>
<td>All, 250 cu. ft. or more of compartment space</td>
<td>2500 lb (1125 kg)</td>
</tr>
<tr>
<td>Initial attack fire apparatus</td>
<td>10,000 lb to 15,000 lb GVWR</td>
<td>900 lb (400 kg)</td>
</tr>
<tr>
<td></td>
<td>(4500 kg to 6800 kg)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15,001 lb to 20,000 lb GVWR</td>
<td>1500 lb (675 kg)</td>
</tr>
<tr>
<td></td>
<td>(6801 kg to 9000 kg)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20,001 lb and up GVWR</td>
<td>2000 lb (900 kg)</td>
</tr>
<tr>
<td></td>
<td>(9001 kg and up)</td>
<td></td>
</tr>
<tr>
<td>Mobile water supply fire apparatus</td>
<td>All</td>
<td>1000 lb (450 kg)</td>
</tr>
<tr>
<td>Aerial fire apparatus</td>
<td>All</td>
<td>2500 lb (1125 kg)</td>
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<td>Quint fire apparatus</td>
<td>All</td>
<td>2500 lb (1125 kg)</td>
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<td>Special service fire apparatus</td>
<td>10,000 lb to 15,000 lb GVWR</td>
<td>2000 lb (900 kg)</td>
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<tr>
<td></td>
<td>(4500 kg to 6800 kg)</td>
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<tr>
<td></td>
<td>15,001 lb to 20,000 lb GVWR</td>
<td>2500 lb (1125 kg)</td>
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<tr>
<td></td>
<td>(6801 kg to 9000 kg)</td>
<td></td>
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<tr>
<td></td>
<td>20,001 lb and up GVWR</td>
<td>3000 lb (1350 kg)</td>
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<td></td>
<td>(9001 kg and up)</td>
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<td></td>
<td>20,001 lb - 30,000 lb GVWR</td>
<td>4000 lb (1800 kg)</td>
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<td>(9001 kg to 14000 kg)</td>
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<td>30,001 lb - 40,000 lb GVWR</td>
<td>6000 lb (2700 kg)</td>
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<td>(14001 kg to 18000 kg)</td>
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<tr>
<td></td>
<td>40,001 lb - 50,000 lb GVWR</td>
<td>8000 lb (3600 kg)</td>
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<td>(18001 kg to 23000 kg)</td>
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<td></td>
<td>50,001 lb - 60,000 lb GVWR</td>
<td>10000 lb (4500 kg)</td>
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<tr>
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<td>(23001 kg to 27000 kg)</td>
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</tr>
<tr>
<td></td>
<td>60,001 lb and up GVWR</td>
<td>15000 lb (6750 kg)</td>
</tr>
<tr>
<td></td>
<td>(27001 kg and up)</td>
<td></td>
</tr>
<tr>
<td>Mobile foam fire apparatus</td>
<td>All</td>
<td>2000 lb (900 kg)</td>
</tr>
</tbody>
</table>

Under Loading. Brake equipment on heavy vehicles can be sensitive to the weight distribution of the vehicle. Specifying a GVWR significantly greater than the intended in-service weight can lead to poor brake performance, chatter, and squeal. Purchasers who specify configurations with limited compartment volume on a high capacity chassis should consult the manufacturer to ensure that a vehicle with an under loaded condition will not result.

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

Add a new definition of Miscellaneous Equipment Allowance to read as follows:

Miscellaneous equipment allowance does not include the weight of fixed generators, hose reels, cord reels, breathing air systems or other major equipment or components specified by the purchaser to be permanently mounted as received from the apparatus manufacturer, nor does it include the weight of suction hose, fire hose, ground ladders, or personnel specified by the manufacturer.

COMMITTEE STATEMENT:

Special service apparatus such as rescue trucks are often configured with the sole purpose of carrying miscellaneous equipment. The size can run from a small utility body to a tractor-trailer haz-mat or trench rescue equipment truck. The current miscellaneous equipment allowance does not change as the vehicle GVWR grows large. The proposed changes to Table 10-1 will account for additional equipment capacity as larger chassis are specified.

There is no clear definition of miscellaneous equipment other than the minimum list of equipment found in each of the apparatus chapters. Manufacturers are interpreting the miscellaneous equipment allowance in different ways. The proposed definition attempts to clarify the intent.

Purchasers who specify very large compartment volume should be aware that their chassis may or may not be specified to carry all the equipment that may physically fit in a compartment. Table A-10-1 provides some guidance. This table is based on measurements of equipment weights on numerous pieces of in-service apparatus.

If the purchaser plans to load the apparatus with a lot of heavy equipment, and provides the apparatus manufacturer with a list of that equipment as called for in 1-5, that information should be used by the manufacturer in selecting chassis ratings.

A minimal apparatus, such as a pumper with the minimum required 40 cubic feet of compartment space, may have problems with under-loading. The new paragraph in the appendix makes the purchaser and manufacturer aware that this may be an issue to address.

The metric equivalents have been incorporated into this proposal.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

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1901-44-(Table 10-1): Accept in Principle

SUBMITTER: Bill McCombs, Alan Saulsbury, Federal Signal Fire Rescue Group

RECOMMENDATION: Add to Table 10-1: An equipment allowance of 3,000 lbs. for rescue pumpers.

SUBSTANTIATION: The justification for adding an additional chapter stems from the increasing percentage of “Rescue Pumpers” being utilized by the fire service, as they adapt their equipment to new and more varied roles. The increased EMS, Rescue, and Haz-mat roles are forcing many departments to combine these functions into vehicles also serving the traditional pumper role. This is resulting in over weight vehicles when all of the additional equipment for these functions is added to vehicles designed for normal pumper service.

An additional chapter is needed to give guidance on recommended equipment for “Rescue Pumpers” as well as define a miscellaneous equipment allowance that will more accurately define the intended service function of the vehicle. This should more clearly communicate the fire departments intentions to a vehicle manufacturer during a bid request and reduce the number of surprises when the vehicle is delivered and loaded with equipment.

COMMITTEE MEETING ACTION: Accept in Principle

COMMITTEE STATEMENT: See committee meeting action on public proposal 1901-43 (Log #43) which adds a requirement for additional weight when larger cubic footage of compartmentation is provided. The committee does not want to establish a pumper-rescue type of fire apparatus but does feel the changes made to provide for additional weight should solve the problem of overweight vehicles.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

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1901-45-(10-2.2.2): Accept

SUBMITTER: Technical Committee on Fire Department Apparatus

RECOMMENDATION: Delete the paragraph.

SUBSTANTIATION: This is obsolete language as vehicles do not use radiator shutters any more.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

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AUTOMATIC LUBRICATION SYSTEM (ALS) SPECIFICATIONS

The ALS shall be operated via an electronic control module with System Identification and capable of being changeable without disruption of other system functions. The electronic module shall have a cycle interval of pump pause time from 0.1 to 99.9 hours, and pump running time from 0.1 to 99.9 minutes. The control module shall have a cycle of the system or pump run time, with metering nipples bearing dosage requirements specified in the ALS. The ALS shall be readily accessible for adjustment. Service brakes and parking brakes shall be independently applied. All brakes shall be readily accessible for adjustment.

COMMITTEE STATEMENT: The committee feels that fire apparatus braking is extreme service and the stronger standard should apply.

AFFIRMATIVE: 28

VOTE ON COMMITTEE ACTION: Accept

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

The benefit of the system will provide:
- Less Maintenance
- Less Downtime
- Less consumption of grease
- Better Planned Preventative Maintenance Intervals
- Increase in the life of pins and bushings by up to 400%
- The system is electronically controlled, wired through the ignition circuit and provides grease to endpoints in a timed interval. The post lubrication principle allows grease to be held under spring pressure in piston distributors, and delivered to the endpoints in the off-cycle of the lubricating pump. This feature brings positive pressure to the points so they are lubricated in a timely fashion, ensuring that the grease does not get away from the points of least resistance. Monitoring of the system will indicate a fault in the cab, so the fault may be corrected.

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: This is a minimum standard and the proposal goes beyond what the committee feels needs to be on every fire apparatus. The purchaser can specify an automatic lubrication system if they want one on their apparatus.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: The breaking system shall meet Federal Motor Vehicle Safety Standards No. 105, “Hydraulic and electric brake systems,” if equipped with a hydraulic braking system or No. 121, “Air brake systems” if equipped with an air braking system.

SUBSTANTIATION: By law vehicles must meet one of these FMVSS (105 or 121).

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: The committee feels that fire apparatus braking is extreme service and the stronger standard should apply.

AFFIRMATIVE: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: The committee feels that fire apparatus braking is extreme service and the stronger standard should apply.

AFFIRMATIVE: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

COMMITTEE MEETING ACTION: Accept

COMMITTEE STATEMENT: The committee feels that fire apparatus braking is extreme service and the stronger standard should apply.

AFFIRMATIVE: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

COMMITTEE MEETING ACTION: Accept

COMMITTEE STATEMENT: The committee feels that fire apparatus braking is extreme service and the stronger standard should apply.

AFFIRMATIVE: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

COMMITTEE MEETING ACTION: Accept

COMMITTEE STATEMENT: The committee feels that fire apparatus braking is extreme service and the stronger standard should apply.

AFFIRMATIVE: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

COMMITTEE MEETING ACTION: Accept

COMMITTEE STATEMENT: The committee feels that fire apparatus braking is extreme service and the stronger standard should apply.

AFFIRMATIVE: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

COMMITTEE MEETING ACTION: Accept

COMMITTEE STATEMENT: The committee feels that fire apparatus braking is extreme service and the stronger standard should apply.

AFFIRMATIVE: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

COMMITTEE MEETING ACTION: Accept

COMMITTEE STATEMENT: The committee feels that fire apparatus braking is extreme service and the stronger standard should apply.

AFFIRMATIVE: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

COMMITTEE MEETING ACTION: Accept

COMMITTEE STATEMENT: The committee feels that fire apparatus braking is extreme service and the stronger standard should apply.

AFFIRMATIVE: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

COMMITTEE MEETING ACTION: Accept

COMMITTEE STATEMENT: The committee feels that fire apparatus braking is extreme service and the stronger standard should apply.

AFFIRMATIVE: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

COMMITTEE MEETING ACTION: Accept

COMMITTEE STATEMENT: The committee feels that fire apparatus braking is extreme service and the stronger standard should apply.

AFFIRMATIVE: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

COMMITTEE MEETING ACTION: Accept

COMMITTEE STATEMENT: The committee feels that fire apparatus braking is extreme service and the stronger standard should apply.

AFFIRMATIVE: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

COMMITTEE MEETING ACTION: Accept

COMMITTEE STATEMENT: The committee feels that fire apparatus braking is extreme service and the stronger standard should apply.

AFFIRMATIVE: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28
COMMITTEE MEETING ACTION:Reject

COMMITTEE STATEMENT: The committee feels that fire apparatus braking is extreme service and the stronger standard should apply.

NUMBER OF COMMITTEE MEMBERS:28

VOTE ON COMMITTEE ACTION:AFFIRMATIVE: 28

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1901-52-(Chapter 11) : Accept in Principle

SUBMITTER: W. Kenneth Menke . III, The Fire Products Company

RECOMMENDATION: Add all current language and changes found in Chapter 4, Low-Voltage Electrical Systems and Warning Devices, of the current edition of 1906 to Chapter 11 of 1901 if does not already exist.

SUBSTANTIATION: Improve commonality between the two standards.

COMMITTEE MEETING ACTION: Accept

COMMITTEE STATEMENT: The committee reviewed the differences between Chapter 11 in NFPA 1901 and Chapter 4 in NFPA 1906 and found that with the exception of the 2 changes noted above and a couple of editorial changes, the differences need to remain as wildland fire apparatus has a few unique characteristics.

NUMBER OF COMMITTEE MEMBERS:28

VOTE ON COMMITTEE ACTION:AFFIRMATIVE: 28

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1901-53-(11-3.2(d)) : Reject

SUBMITTER: Kevin W. Word, Ferrara Fire Apparatus Inc.

RECOMMENDATION: Revise text to read as follows:

(d) The lighting necessary to produce 1 footcandle (11 lx) of illumination on all walking surfaces on the apparatus and on the ground at all egress points onto and off the apparatus, 5 footcandles (54 lx) of illumination on all control and instrument panels, and 50 percent of the total compartment lighting load in the absence of sufficient ambient lighting.

SUBSTANTIATION: The average fire apparatus already has a demanding load on its electrical system. The requirement of illumination even if there is sufficient ambient lighting adds to the parasitic loads. The lighting should only be required when ambient lighting does not meet the listed footcandle specifications. Therefore, it should be allowed to equip the apparatus with features for evening and dark operations that would automatically trigger the lighting of the areas mentioned in 11-3.2(d).

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: There is no way of defining what is "sufficient ambient lighting." It would add another level of electrical complexity and NFPA 1901 is a minimum standard.

NUMBER OF COMMITTEE MEMBERS:28

VOTE ON COMMITTEE ACTION:AFFIRMATIVE: 28

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1901-54-(11-3.2(d)) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus

RECOMMENDATION: Revise 11-3.2(b) (13.3.3(2) in the draft) to read as follows:

(2) All legally required clearance and marker lights, headlights, and other electrical devices.

SUBSTANTIATION: The changed wording makes the requirement more international as it is not tied to United States government regulations.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS:28

VOTE ON COMMITTEE ACTION:AFFIRMATIVE: 28

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1901-55-(11-4.4) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus

RECOMMENDATION: Revise 11-4.4 (13.4.4 in the draft) to read as follows:

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

Add a new paragraph after 11-4.4.1 to read as follows:

11-4.4.2 A motor generator set shall be provided to power the engine if the batteries are not accessible without lifting the cab of a tilt-cab apparatus.

SUBSTANTIATION: It is impractical and unnecessary to totally protect batteries from contact with road spray. The paragraph dealing with jump starting apparatus has been added to provide a safe way of jump starting a fire apparatus if the battery arrangement is such that they are not accessible unless the cab is tilted up.

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1901-56- (Table 11-8.11) : Reject

SUBMITTER: W. Kenneth Menke  , III, The Fire Products Company

RECOMMENDATION: Change wording in the under Calling for Right-of-Way referencing Yellow to allow Yellow in Zone A.

SUBSTANTIATION: End users are demanding brighter warning lights and have already determined that the addition of yellow warning signals on the back of apparatus has dramatically improved visibility and safety.

As a manufacturer of emergency warning lights, we are now experiencing more requests from end users for yellow warning signal to the front, on multi-colored lightbars. Optically, yellow is a very bright color improving visibility; it simply is not a nationally recognized emergency color in the response mode. If the end user deems it of value to add yellow to their forward emergency warning lights while responding because of safety, NFPA should not prohibit it. If there is concern that a fire department may think they can respond with an all yellow lightbar, language could be added stating that yellow may be used to the front in Clearing Right-of-Way mode only when used in combination with the recognized emergency colors red and blue.

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: The committee feels the current color scheme is correct subject to the authority having jurisdiction.

NUMBER OF COMMITTEE MEMBERS:28

VOTE ON COMMITTEE ACTION:AFFIRMATIVE: 28

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1901-57-(11-8.13.2) : Accept in Principle

SUBMITTER: W. Kenneth Menke  , III, The Fire Products Company

RECOMMENDATION: Delete entire paragraph 11-8.13.2

SUBSTANTIATION: On large apparatus, the upper level lighting system is traditionally 9 to 10 ft above the ground requiring lower level warning lights for visibility. This is not true on small vehicles. The standard has already deemed that the separation of the upper and lower level lights to be insignificant allowing the performance values to be combined. The chassis design of smaller vehicles is making installation of grille and fender lights more difficult, and at times may significantly impact the air flow to the engine. Customers may certainly request more lights, but as a minimum standard, I do not think lower level front warning lights should be required unless they are deemed a safety issue, and if that is true, performance numbers should be required for these lights as found in large vehicles.

COMMITTEE MEETING ACTION: Accept in Principle

Revise 11-8.13.2 (13.8.14.2 in the draft) to read as follows:

One or more lower-level optical warning devices shall be visible from the front and side of the apparatus. The optical center of the lower level optical warning devices in the front of the vehicle shall be mounted forward of the front wheel centerline and as close to the front corner points of the apparatus as practical. Mounted in close proximity to each front corner of the apparatus with The optical center of the device(s) shall be at a distance between 18 in. and 48 in. (457 mm and 1220 mm) above ground.

COMMITTEE STATEMENT: The committee is revising 11-8.15.2 to clarify that one of more optical warning device(s) can be used but an optical warning device must be seen from both the front and sides of the vehicle near the front corner points.

NUMBER OF COMMITTEE MEMBERS:28

VOTE ON COMMITTEE ACTION:AFFIRMATIVE: 28

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1901-58- (11-8.13.3) : Accept

SUBMITTER: W. Kenneth Menke  , III, The Fire Products Company

RECOMMENDATION: Under Blocking Right-of-Way, At any H point, for Zone B & D change values from 10,000 to 8,000.

SUBSTANTIATION: Develop consistency in the table between Clearing Right-of-Way and Blocking Right-of-Way for the H value at any point.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS:28

VOTE ON COMMITTEE ACTION:AFFIRMATIVE: 28

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1901-59-(11-8.14.1) : Accept in Principle
SUBMITTER: W. Kenneth Menke. III, The Fire Products Company
RECOMMENDATION: Add language to include the Testing parameters for LED’s found in SAE J1889, L.E.D. Lighting Devices.
STATIONARY: This addresses current testing parameters on new technology.
COMMITTEE MEETING ACTION: Accept in Principle
Revise the first sentence of 11-8.14.1 (13.8.15.1.1 in the draft) to read as follows:
All optical warning devices shall be tested to the requirements of SAE J595, Flashing Warning Lamps for Authorized Emergency, Maintenance, and Service Vehicles, SAE J318, Gaseous Discharge Warning Lamp for Authorized Emergency, Maintenance, and Service Vehicles, or SAE J1889, L.E.D. Lighting Devices.
COMMITTEE STATEMENT: The committee is incorporating the submitter’s request and clarifying that the optical warning devices need to be tested to these standards.
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-60-(11.8.14.2) : Accept
SUBMITTER: W. Kenneth Menke. III, The Fire Products Company
RECOMMENDATION: Add text to read as follows:
The results of the testing shall be used by the apparatus builder or purchaser to determine compliance with this standard and shall be available upon request from the optical warning device manufacturer.
STATIONARY: In Section 11-8.14.2, the current edition requires the use of photometric test data obtained by or on behalf of the device manufacturer to determine compliance but does not require the device manufacturer to provide this data upon request.
Note: Supporting material is available for review at NFPA headquarters.
COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-61-(11-10.3) : Accept
SUBMITTER: Technical Committee on Fire Department Apparatus
RECOMMENDATION: Add wording to 11-10.3 (13.10.4.2 in the draft) to read as follows:
Compartments such as ladder tunnels, pikepole storage tubes, or underbody compartments designed around the volumetric requirements of specific equipment that can be removed without the use of article illumination shall be permitted to be exempted for the requirement for compartment lighting.
STATIONARY: There is no need for internal illumination if the stored object can be safely located and removed from the storage compartment without such illumination.
COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-62-(11-10.3) : Accept
SUBMITTER: Technical Committee on Fire Department Apparatus
RECOMMENDATION: Revise 11-10.3 (13.10.3 in the draft) to read as follows:
11.10.3 Interior Work Lighting.
11.10.3.1 The apparatus shall have sufficient lighting to provide a minimum level of 1 foot-candle (10 lx) on all work surfaces, steps, and walkways. 11.10-3.2 The apparatus shall have sufficient lighting to provide an average level of 3 foot-candle (30 lx) in the driving and crew compartments. 11.10.3.3 Each engine compartment and pump compartment shall have a light of at least 20 candlepower (250 Lumens) capable of opening, extending or being deployed in a manner that is likely to cause damage to the apparatus if the apparatus is moved.
COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-63-(11-10.4) : Accept
SUBMITTER: Technical Committee on Fire Department Apparatus
RECOMMENDATION: Add a sentence after 11-10.3 (see 13.10.7 in draft) to read as follows:
All work lights mounted in wet locations shall be tested in conformance with SAE J575, Test Methods and Equipment for Lighting Devices and Components for Use on Vehicles Less Than 2052 mm in Overall Width, and shall comply with the following performance requirements of that standard:
(1) Vibration
(2) Moisture
(3) Dust
(4) Corrosion
(5) High temperature
(6) Low temperature
(7) Durability
(8) Warpage
STATIONARY: During night operation, reliable work lights of compliant brightness and positioned at work locations are essential to the safe performance of many tasks on and about the apparatus.
COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-64-(11-11(5)) : Accept
SUBMITTER: Technical Committee on Fire Department Apparatus
RECOMMENDATION: Revise 11-11(5) (13.11.1(5) in the draft) to read as follows:
Any other device that is permanently attached to the apparatus and is capable of opening, extending or being deployed in a manner that is likely to cause damage to the apparatus if the apparatus is moved.
COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-65-(11-13) : Accept
SUBMITTER: Technical Committee on Fire Department Apparatus
RECOMMENDATION: Revise 11-13 (13.13 in the draft) to read as follows:
11.13 Stop, Tail, and Directional Lights.
11.13.1 The apparatus shall be equipped with all legally required stop, tail, and directional lights.
11.13.2 Directional lights shall be visible from the front, sides, and rear of the apparatus.
11.13.3 On apparatus 30 ft (10 m) or longer in length, a turn signal shall be mounted approximately midway along the apparatus at approximately running board height.
11.13.4 Equipment shall not be mounted in a manner that obscures the stop, tail, or directional lights.
STATIONARY: The changed wording makes the requirement more international as it is not tied to United States government regulations. It also better organizes the material.
COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
need to ensure that fire apparatus occupants have sufficient head clearance in all seating positions, while recognizing the inherent limitations of apparatus built on commercial vehicle products. The committee reached the following consensus:

1. The bouncing motion of a suspension seat hinders the driver’s ability to maintain precise control of the throttle, brake, steering wheel, and other driving controls. The bouncing motion of a poorly adjusted suspension seat can also increase the potential for injury. For these reasons, the subcommittee feels that the fixed seat is a more appropriate selection for most fire apparatus.

2. The current seat to ceiling requirement in NFPA 1901 does not specify the state of adjustment that the seat must be in when the measurement is taken. This leaves the recommendation open to a wide variety of interpretations.

3. The composition of headliners and the location of structural members in the roof area above seating positions should be addressed. A layer of soft headliner material should not be considered in the same manner as rigid structural members.

4. The density of seat cushion foam, cushion shape, and covering materials varies with seat model, seat manufacturer, and customer specifications. It is therefore difficult to obtain consistent measurement of head room using the current procedure described in NFPA 1901 paragraph 12-1.3. While the use of the H-Point provides a much more precise measurement, it is not a point that can be physically located on the seat, nor is it commonly understood outside the automotive engineering community. H-Point determination requires an H-Point measurement tool. This tool simulates a human hips and torso of a specific size and weight. H-Point will vary with the size, shape, and material of the seat back, seat frame, and seat cushion. For this reason, the seat manufacturer must be required to provide a reference point that can be measured to by anyone interested in checking for NFPA 1901 compliance.

Effect of Proposed Change on Commercial Chassis Apparatus
An informal survey of commercial chassis seating has revealed that a requirement that is overly generous will force commercial chassis suppliers to reduce their seat mounting height even with a fixed seat. This would be counterproductive to vehicle safety by compromising the forward visibility of the operator. The attached spreadsheet shows that by selecting 35 in. as the fixed seat criteria, and 37 in. as the suspension seat criteria, the current popular commercial chassis could comply with the standard by providing fixed seats at approximately mid-travel position of their current suspension seats. These criteria will still increase the headroom requirements over today’s standard by 2.2 in. for fixed seats, and 4.2 in. for suspension seats.

Under the proposed changes, a 95-percentile male will have 1 in. of clearance between his head and the headliner when sitting perfectly upright in a fixed seat. Since the sitting height of a large person can be as much as 3.5 in. lower in a natural posture, the practical head clearance will be more like 4.5 in. In a suspension seat, the head clearance will be 3 in. when sitting perfectly upright, and 6.5 in. in a natural slump.

Survey Assumptions
1. I assumed that the test fixture that measures H-Point would settle into every seat cushion by 0.62 in. I obtained this estimate from representatives of Seats Inc. The amount that the test fixture (and an actual human) will settle will obviously vary with seat cushion shape and the firmness of the material used.

2. The survey assumes that those commercial manufactures that may not offer fixed seats could provide a fixed seat option at the same height as the mid-travel of their suspension seats offering NFPA compliance.

3. Anthropometric charts from SAE J833

4. Physical measurements were taken without depressing the headliner or the seat cushion.

The subcommittee feels it is important that the decision makers at NFPA recognize that while custom cab manufacturers in the fire industry have greater flexibility to respond to changes in the NFPA requirements, it is unlikely that large manufacturers of commercial trucks will be willing to adjust their cab roof designs in response to an NFPA mandate. Most commercial chassis designs will not accommodate the proposed changes when offering suspension style seats. While the subcommittee does not see this as a crucial issue (it may in fact begin to move the industry in a direction away from the use of suspension style seats), NFPA mandates on commercial chassis fire apparatus may not be pleased with the new requirements. Purchasers intent on purchasing commercial apparatus with suspension seats always have the option of signing a waiver indicating their acceptance of a product not compliant with the intent of NFPA 1901.
3) For non-suspension style seats, the minimum vertical dimension shall be 35 in (88 mm) measured with the seat adjusted to its lowest position.

12-1.5.2 When independent vertical and or horizontal seat adjustment is provided, it shall be fully adjustable within 10 seconds.

12-1.5.3 Ceiling height shall be measured at the lowest surface in the area immediately above the projected area of the seat with any soft headliner material depressed.

Accept the submitted appendix to the new 12-1.5.1 but add one sentence to the end to read as follows:

If H-point data is not available, it can be approximated by measuring 5 inches (130 mm) ahead of the seat back and 5 inches (75 mm) up from the non-depressed seat cushion surface.

Make the remainder of 12.1.5 a new paragraph (see 14.1.8 in the draft).

COMMITTEE STATEMENT: The committee accepted the proposal in principle but decided to provide a means of “approximating” the H-point rather than adding labels to the seats. A requirement was added to ensure that any seat can be adjusted within 10 seconds so that complicated or slow adjustments are not provided. Seat to ceiling height wording was revised to differentiate between suspension seats with and without independent height adjustments.

**NUMBER OF COMMITTEE MEMBERS:** 28

**VOTE ON COMMITTEE ACTION:** AFFIRMATIVE: 28

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1901-68-(12-1.6): Accept

SUBMITTER: Technical Committee on Fire Department Apparatus,

RECOMMENDATION: Revise 12-1.6 (renumbered as 14.1.9 in the draft) to read as follows:

12.1.6 SCBA Mounting.

12.1.6.1 Where SCBA units are mounted within a driving or crew compartment, a positive automatically latching mechanical means of holding the SCBA device in its stowed position shall be provided. A-12.6.1 SCBA units and other equipment stored in the crew compartment can cause injuries to occupants of the compartment if they fly around the compartment as the result of an accident or other impact.

12.6.2 The bracket holding device and its mounting shall retain the SCBA unit when subjected to a 9-G force and shall be installed in accordance with the bracket manufacturer’s requirements.

12.6.3 Mounting devices shall be of a type that positively latch around the cylinder shroud.

12.6.4 If the SCBA unit is mounted in a seatback, the release mechanism shall be accessible to the user while seated and without having to reach behind them.

12.6.5 The bracket holding device and its mounting shall retain the SCBA unit when subjected to a 9-G force and shall be installed in accordance with the bracket manufacturer’s requirements.

SUBSTANTIATION: The existing straps are frequently not used resulting in SCBA missiles in an accident. Automatically latching brackets are available and do not allow the SCBA to be placed in the bracket without latching it in place in compliance with the standard. This change clarifies the apparent intent of the 1996 standard requiring a bracket to “positively latch around the cylinder shroud” (See 13-5.1).

COMMITTEE MEETING ACTION: Accept

**NUMBER OF COMMITTEE MEMBERS:** 28

**VOTE ON COMMITTEE ACTION:** AFFIRMATIVE: 28

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1901-69-(12-4.5): Accept

SUBMITTER: Technical Committee on Fire Department Apparatus,

RECOMMENDATION: Revise the second sentence of 12.4.5 (14.4.5.2 in the draft) to read as follows:

The communication system shall be operable without the tiller operator having to take his/her hands off the steering wheel.

SUBSTANTIATION: As currently written, this could be an arrangement that required the tiller operator to push a remote button to talk. In a case where immediate action is necessary, this could present a problem.

COMMITTEE MEETING ACTION: Accept

**NUMBER OF COMMITTEE MEMBERS:** 28

**VOTE ON COMMITTEE ACTION:** AFFIRMATIVE: 28

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1901-70-(13-6): Accept

SUBMITTER: Technical Committee on Fire Department Apparatus,

RECOMMENDATION: Revise 13-6 (renumbered as 15.6 in the draft) to read as follows:

13.6 Pump and Plumbing Access.

13.6.1 One or more doors or panels that open or are removable without the use of tools shall be provided to allow visual inspection or access for checking the fire pump and plumbing area.

13.6.2 The clear opening shall have no one dimension measure less than 18 in. (460 mm).

13.6.3 Additional door(s) or panel(s) that require no more than standard tools to open or remove shall be provided for access to the pump and plumbing area.

13.6.4 All valves, gauges, controls, and other plumbing equipment shall be accessible for service and replacement.

13.6.5 The clear space required by the pump manufacturer to perform in-truck overhaul and maintenance shall be provided.

A.13.6.5 The purchaser should consider specifying additional doors or removable panels for service, maintenance, or replacement of components in the fire pump installation.

SUBSTANTIATION: The committee has rewritten the section to separate the requirements for access to the pump compartment to visually determine if something is wrong from the need to maintain, repair or replace components of the pump system. The new provisions provide for quick visibility and inspection of the pump and the plumbing area when it is not necessary for a person to crawl into the area. The use of any tools to gain access to a pump enclosed by a metal frame. Hinged or quickly removable panels do not add substantial cost to a vehicle.

Panels that meet the present requirement are too small to permit a person to gain access to the pump area or really work on the plumbing. The new requirement will provide for that access when it is necessary to service or repair the pump or its piping system. It is also important that the opening area be “clear” and not blocked by piping, valves, tanks, generator, foam systems, ladders, or other fixed equipment.

**COMMITTEE MEETING ACTION: Accept**

**NUMBER OF COMMITTEE MEMBERS:** 28

**VOTE ON COMMITTEE ACTION:** AFFIRMATIVE: 28

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1901-71-(13-7.3): Accept

SUBMITTER: Jeffrey Bowman, Anaheim Fire Department

RECOMMENDATION: Replace 13-7.3 with the following:

13-7.3 Slip resistance.

13-7.3.1 All materials used for exterior surfaces designated as stepping, stepping, and walking areas and all interior steps shall have a minimum slip resistance in any orientation of 0.68 when tested wet using the English XL tester in accordance with ASTM F 1679, Standard Test Method for Using a Portable Incubation Tribometer (VIT), or 0.52 when tested wet using the Brungraber Mark II Tester in accordance with Standard Test Method for Using a Portable Incubation Articulated Slit Slip Tester (PIAST).

13-7.3.2 All materials used for interior floors shall have a minimum slip resistance in any orientation of 0.58 when tested dry using the English XL tester in accordance with ASTM F 1679, Standard Test Method for Using a Portable Incubation Tribometer (VIT), or 0.47 when tested dry using the Brungraber Mark II Tester in accordance with ASTM F 1677, Standard Test Method for Using a Portable Incubation Articulated Slit Slip Tester (PIAST).

13-7.3.3 Sampling Strategy.

13-7.3.3.1 For uniformly patterned materials, at least 16 readings shall be taken on each sample. Each reading shall be taken 90 degrees clockwise from the previous orientation, resulting in at least 4 readings in each orientation. The readings shall be averaged and reported as the slip resistance for the material.

13-7.3.3.2 For directionally patterned materials, at least 32 readings shall be taken on each sample. Each reading shall be taken 45 degrees clockwise from the previous orientation, resulting in at least 4 readings in each orientation. The 4 readings in each direction shall be averaged and reported as the slip resistance for the material in that orientation.

13-7.3.4 The contractor shall supply at the time of delivery of the apparatus, a certification that all materials used for exterior surfaces designated as stepping, stepping, and walking areas; all interior steps; and all interior floors meet the requirement of 13-7.3.

13-7.3.5 Where the fuel fill is located at or near a stepping surface, the surface shall be construction of an open grate-type material to facilitate draining of accidentally spilled fuel to lessen any slipping hazard.

Add the following reference to 25-1.2.4.


SUBSTANTIATION: The purpose of the TIA is to allow for use of another test instrument in measuring slip resistance, clarify the test procedure, add slip resistant requirements for interior floor surfaces and make the requirements for steps consistent whether exterior or interior.

The TIA adds provisions to allow for the use of the Brungraber Mark II Tester in addition to the English XL Tester when testing the slip resistance of stepping, standing and walking surfaces on fire apparatus. On some surfaces with widely spaced pattern designs, the English XL Tester with its 1.25-in. diameter test sensor is not able to properly test the surface. The Brungraber Mark II Tester with its 3-in. by 3-in test sensor is able to test these widely spaced pattern designs surfaces. Without the TIA to allow the use of another tester, some surface materials that may appear to be appropriate for use on fire apparatus will not be able to be tested. This could exclude these materials from use, as the manufacturer could not provide slip resistance data on the product using the defined test instrument.
The TIA is changing the requirement for interior steps to require them to meet the exterior stepping, standing and walking surface requirements as these steps are often wet and many injuries are associated with wet steps. Requirements are being added for interior floor areas which were not addressed initially and about which questions have been raised. These floor areas need to be able to be decontaminated easily and therefore a lower slip resistance is being allowed to accommodate materials that have been used successfully in these applications without a history of slip injuries.

The implementation of the requirement in 13-7.3 has also raised other issues that the TIA proposes to clarify. One is what material is to be used as the test sensor. It is outside the intent of the committee that Neodium be used as the test sensor material and adding this requirement will provide consistency to the tests. Another issue deals with how many repetitions and in what orientation are required when testing and wording is being added to address that issue. Wording is being changed to clarify that the material can be type tested, it is not the intent to have each final step or walking surface tested after manufacture. Finally a requirement for certification to the purchaser that the material meets the requirements is being added.

**COMMITTEE MEETING ACTION: Accept**

**NUMBER OF COMMITTEE MEMBERS:** 28  
**VOTE ON COMMITTEE ACTION:**  
**AFFIRMATIVE:** 28

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13-11.3 A label shall be placed on or near each receiver or anchor that states the maximum winch load rating and the maximum rope load rating that each receiver or anchor can support.  
Renumber existing 13-11 as 13-12  
Add a definition of removable winch to read as follows:  
Removable winch. A winch with quick disconnects for power and controls that can be temporarily mounted on the apparatus at a permanently installed mounting receiver.

**SUBSTANTIATION:** The installation of receivers for rescue rope and removable winches on rescue vehicles has become very popular as it allows winches to be used on any side of the vehicle and provides anchors for rope operations. Trailer hitch receivers are used as receivers with removable winches. The type III commercial hitch receiver is designed to a safety factor of 1.5 to 1, therefore the mounting of the receiver should be designed to the same safety factor. If these same receivers are to be used to anchor rope operations where personnel are being lifted, the rating should be downgraded to provide a larger safety factor similar to that required for OSHA approved hoist design.

**COMMITTEE MEETING ACTION: Accept**

**NUMBER OF COMMITTEE MEMBERS:** 28  
**VOTE ON COMMITTEE ACTION:**  
**AFFIRMATIVE:** 28

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13-11.1 Receivers or anchors shall be designed for mounting and use by a maximum of 600 kPa (87 psig) at altitudes up to 2000 feet by means of the pump priming device and sustaining...

Add additional sentence at end of paragraph: "The pump priming device shall be capable of operating with no lubricant or a biodegradable nontoxic lubricant.

**SUBSTANTIATION:** This proposal provides all the performance requirements for the priming device to the "Design and Performance Requirements" section rather than having some of the requirements stated in the section and some in 14-10.4. See related proposal to 14-10.8.

**COMMITTEE MEETING ACTION: Accept in Part**  
Make the change in the first sentence but do not add the additional sentence.

**COMMITTEE STATEMENT:** The proposed additional sentence is currently in 14-10.8 and the committee feels it is better where it currently is located. Paragraph 14-10.8 deals with priming devices whereas this section deals with the pump integrity and the priming device is a tool used in determining that integrity.

**NUMBER OF COMMITTEE MEMBERS:** 28  
**VOTE ON COMMITTEE ACTION:**  
**AFFIRMATIVE:** 28

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13-12.1 Receivers or anchors shall be designed for mounting and use by a maximum of 600 kPa (87 psig) at altitudes up to 2000 feet by means of the pump priming device and sustaining...

Add additional sentence at end of paragraph: "The pump priming device shall be capable of operating with no lubricant or a biodegradable nontoxic lubricant.

**SUBSTANTIATION:** This proposal provides all the performance requirements for the priming device to the "Design and Performance Requirements" section rather than having some of the requirements stated in the section and some in 14-10.4. See related proposal to 14-10.8.

**COMMITTEE MEETING ACTION: Accept in Part**  
Make the change in the first sentence but do not add the additional sentence.

**COMMITTEE STATEMENT:** The proposed additional sentence is currently in 14-10.8 and the committee feels it is better where it currently is located. Paragraph 14-10.8 deals with priming devices whereas this section deals with the pump integrity and the priming device is a tool used in determining that integrity.

**NUMBER OF COMMITTEE MEMBERS:** 28  
**VOTE ON COMMITTEE ACTION:**  
**AFFIRMATIVE:** 28

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13-7.3: Accept in Principle  
**COMMITTEE MEETING ACTION: Accept in Principle**  
**NUMBER OF COMMITTEE MEMBERS:** 28  
**VOTE ON COMMITTEE ACTION:**  
**AFFIRMATIVE:** 28

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13-2.1 Fire pumps, of the single suction variety, are commonly found midship configured with a master suction inlet on each side of the apparatus. Both rear and front master suction inlets; and likewise may or may not be configured with a side master suction inlet.

b) Fire pumps, of the single suction variety, are commonly found midship configured with a master suction inlet on each side of the apparatus. Both rear and front master suction inlets; and likewise may or may not be configured with a side master suction inlet.

c) Traditional midship mounted fire pumps are commonly found with both rear and front master suction inlets; and likewise may or may not be configured with a master suction inlet on each side of the apparatus.

d) The purchaser should be aware that which suction inlet the certified test was performed and concurrently at which inlet or inlets the fire pump is capable of pumping capacity and equally as important the purchaser should be aware that which inlet or inlets the fire pump is not capable of meeting pump capacity.

Concurrently, an advisory could be included in the appendix advising purchasers to specify if the manufacturer shall provide a "flow certification" for a particular "auxiliary" master suction inlet(s) - especially if the same might be used for drafting purposes.

**COMMITTEE MEETING ACTION: Reject**

**COMMITTEE STATEMENT:** These paragraphs require the pump manufacturer to certify that the pump is capable of certain performance. The information on which inlet arrangement that may have been used during certification will not be relevant after the pump is installed on the apparatus and the body builder adds the piping and valving to plumb out the pump.

**NUMBER OF COMMITTEE MEMBERS:** 28  
**VOTE ON COMMITTEE ACTION:**  
**AFFIRMATIVE:** 28

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1901-72-(13-8): Reject  
**SUBMITTER:** Dan W. McKenzie, USDA Forest Service  
**RECOMMENDATION:** Change “1 in.” to “3/4 in.” for minimum diameter of handrails  
**COMMITTEE MEETING ACTION:** Reject  
**NUMBER OF COMMITTEE MEMBERS:** 28  
**VOTE ON COMMITTEE ACTION:**  
**AFFIRMATIVE:** 28

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1901-73-(13-9): Accept in Principle  
**COMMITTEE MEETING ACTION: Accept in Principle**  
**NUMBER OF COMMITTEE MEMBERS:** 28  
**VOTE ON COMMITTEE ACTION:**  
**AFFIRMATIVE:** 28

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1901-75-(14-2.3.3): Accept in Part  
**SUBMITTER:** Thomas J. Mettler, Waterous Company  
**RECOMMENDATION:** Change first sentence to read: "The completed pumping system shall be capable of developing a vacuum of 22 in. Hg (74.5 Pa) at altitudes up to 2000 feet by means of the pump priming device and sustaining..."

Add additional sentence at end of paragraph: "The pump priming device shall be capable of operating with no lubricant or a biodegradable nontoxic lubricant.

**SUBSTANTIATION:** This proposal provides all the performance requirements for the priming device to the "Design and Performance Requirements" section rather than having some of the requirements stated in the section and some in 14-10.4. See related proposal to 14-10.8.

**COMMITTEE MEETING ACTION: Accept in Part**  
Make the change in the first sentence but do not add the additional sentence.

**COMMITTEE STATEMENT:** The proposed additional sentence is currently in 14-10.8 and the committee feels it is better where it currently is located. Paragraph 14-10.8 deals with priming devices whereas this section deals with the pump integrity and the priming device is a tool used in determining that integrity.

**NUMBER OF COMMITTEE MEMBERS:** 28  
**VOTE ON COMMITTEE ACTION:**  
**AFFIRMATIVE:** 28

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1901-76-(14-2.4): Reject  
**SUBMITTER:** Bill Adams, William F. Adams & Associates  
**RECOMMENDATION:** Add new text to read as follows:  
"The pump manufacturer shall indicate at which suction inlet(s) the certified test was performed.

**SUBSTANTIATION:** a) Neither Section 14-2.4.1 or Section 14-2.4.2 specifies which master suction inlet can, shall or may be used to certify fire pump capacity.

b) Fire pumps, of the single suction variety, are commonly found midship mounted as well as being rear mounted and front mounted; and may or may not be configured with a side master suction inlet.

c) Traditional midship mounted fire pumps are commonly found with both rear and front master suction inlets; and likewise may or may not be configured with a master suction inlet on each side of the apparatus.

d) The purchaser should be aware that which suction inlet the certified test was performed and concurrently at which inlet or inlets the fire pump is capable of pumping capacity and equally as important the purchaser should be aware that which inlet or inlets the fire pump is not capable of meeting pump capacity.

Concurrently, an advisory could be included in the appendix advising purchasers to specify if the manufacturer shall provide a "flow certification" for a particular "auxiliary" master suction inlet(s) - especially if the same might be used for drafting purposes.

**COMMITTEE MEETING ACTION: Reject**

**COMMITTEE STATEMENT:** These paragraphs require the pump manufacturer to certify that the pump is capable of certain performance. The information on which inlet arrangement that may have been used during certification will not be relevant after the pump is installed on the apparatus and the body builder adds the piping and valving to plumb out the pump.

**NUMBER OF COMMITTEE MEMBERS:** 28  
**VOTE ON COMMITTEE ACTION:**  
**AFFIRMATIVE:** 28

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838
1901-85-(14-6.3) : Accept in Principle

SUBMITTER: Tom Hilienbrand, Underwriters Laboratories Inc.

RECOMMENDATION: Add new text to read as follows: If the valve suction inlets are mounted by siamese or adapters on the drafting inlets they shall be project beyond the apparatus running board.

COMMITTEE MEETING ACTION: Accept in Principle

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-86-(14-6.5) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus,

RECOMMENDATION: Revise the first sentence of 14-6.5 (16.6.5 in the draft) to read as shown:

Add an appendix to read as follows:

The bleeder valve should be used prior to the removal of a hose or a cap or other closure connected to an intake. The bleeder valve should also be used while filling a hose connected to an intake with water. Failure to use the bleeder valve in these situations might result in serious injury or death.

SUBSTANTIATION: The bleeder valve should be used for more that just bleeding off air or water from a hose connected to an intake. If the inlet is valve, pressure could be trapped between the valve and the cap or closure. The appendix helps explain the use of bleeder valve.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-87-(14-6.6) : Accept in Principle

SUBMITTER: Steve Morelan, Little Canada Fire Dept., Inc., MN

RECOMMENDATION: Revise the last sentence of 14-6.6 (see 16.6.6.1 in the draft) to read as follows:

The pressure relief device shall discharge to atmosphere and the discharge shall be piped or directed away from the pump operators position.

SUBSTANTIATION: The discharge from larger relief devices is such that a pump operator could be injured when the valve opens. Therefore it is necessary for that discharge to be directed away from the pump operator.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-88-(14-6.6) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus,

RECOMMENDATION: Revise the last sentence of 14-6.6 (see 16.6.6.1 in the draft) to read as follows:

The pressure relief device shall discharge to atmosphere and the discharge shall be piped or directed away from the pump operators position.

SUBSTANTIATION: The discharge from larger relief devices is such that a pump operator could be injured when the valve opens. Therefore it is necessary for that discharge to be directed away from the pump operator.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-89-(14-6.8) : Accept in Principle

SUBMITTER: Steve Morelan, Little Canada Fire Dept., Inc., MN

RECOMMENDATION: Revise text to read as follows:

Caps or closures for 3.5 in. (89 mm) and smaller intakes shall be easily removable from the intakes, but remain secured to the apparatus.

SUBSTANTIATION: Delete the mandatory use of "chains or cables" to secure the caps and closures to the apparatus. This requirement is design restrictive. It should not matter how they are secured.

COMMITTEE MEETING ACTION: Accept in Principle

Revise 14-6.8 (16.6.9 in the draft) to read as follows:

Caps or closures for 3.5 in. (89 mm) and smaller intakes shall be removable from the intakes, but remain secured to the apparatus.

Also make the same wording change in 15-4.2.2 (17.5.2.2 in the draft)

COMMITTEE STATEMENT: The word "easily" is not being used as it is not a measurable condition. The change to 15-4.2.2 is for consistency of terminology and requirements in the document.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-90-(14-7.1) : Reject

SUBMITTER: Gary Handwerk, Hale Products, Inc.

RECOMMENDATION: Add text to read as follows:

Each discharge rated outlet size of 3 1/2" or larger shall be equipped with an adjustable automatic pressure relief device installed on the outlet side of the valve to bleed off excess pressure. The pressure relief device shall discharge to atmosphere.

SUBSTANTIATION: This is to prevent over pressure on LDH, it also will help to take up return shockwaves from a water hammer in that line.

COMMITTEE MEETING ACTION: Reject

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-91-(14-7.3) : Reject

SUBMITTER: Gary Handwerk, Hale Products, Inc.

RECOMMENDATION: Add text to read as follows:

Each discharge rated outlet size of 3 1/2" or larger shall be equipped with an adjustable automatic pressure relief device installed on the outlet side of the valve to bleed off excess pressure. The pressure relief device shall discharge to atmosphere.

SUBSTANTIATION: This is to prevent over pressure on LDH, it also will help to take up return shockwaves from a water hammer in that line.

COMMITTEE MEETING ACTION: Reject

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28
COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: This sentence is being deleted. See Proposal 1901-96 (Log #CP19).

RECOMMENDATION: Add the following (bold) heading to this paragraph:
Add an additional sentence to read:

COMMITTEE STATEMENT: The committee did not add a new 14-7.1.3 in Proposal 1901-91 (Log #115) but did add appendix material which included information related to pressure relief devices on large diameter discharges and suggested performance requirements similar to those listed here for inclusion in 14-6.6. The committee has reduced the flow at which the pressure rise is measured as 1000 gpm to too much water to expect a pressure relief device to discharge.

COMMITTEE MEETING ACTION: Accept in Principle

COMMITTEE STATEMENT: Manual transmissions do not need interlocks, they are self correcting. The committee has reworked sections 14-10.2 through 14-10.5 to better clarify the requirements based on whether the fire apparatus is driven by an automatic chassis transmission or a manual chassis transmission. See Committee Meeting Action on Proposal 1901-98 (Log #125).

COMMITTEE MEETING ACTION: Accept in Principle

COMMITTEE STATEMENT: This sentence is being deleted. See Proposal 1901-96 (Log #CP19).

COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The word “automatic”.

COMMITTEE MEETING ACTION: Accept
COMMITTEE STATEMENT: The change to 15-4.2.2 is for consistency of terminology and requirements, not a measurable condition.

COMMITTEE MEETING ACTION: Accept
COMMITTEE STATEMENT: The change to 15-4.2.2 is for consistency of terminology and requirements, not a measurable condition.

COMMITTEE MEETING ACTION: Accept in Principle
COMMITTEE STATEMENT: The length and complexity of the subsections of 14-10 make it difficult for the reader to distinguish. Adding the heading to the paragraph will make the document easier to understand.

COMMITTEE MEETING ACTION: Accept in Principle
COMMITTEE STATEMENT: Stationary Pump Driven Through Split Shaft PTO – Manual Chassis Transmission. Where the apparatus is equipped with an automatic chassis transmission, the water pump is driven by the chassis engine through the transmission’s main driveline, and the apparatus is to be used for stationary pumping only, an interlock system shall be provided to ensure that the pump drive system components are engaged in the pumping mode of operation so that the pumping system can be operated from the pump operator’s position.

COMMITTEE MEETING ACTION: Accept in Principle
COMMITTEE STATEMENT: Stationary Pump Driven Through Split Shaft PTO – Automatic Chassis Transmission. Where the apparatus is equipped with an automatic chassis transmission, the water pump is driven by the chassis engine through the transmission’s main driveline, and the apparatus is to be used for stationary pumping only, an interlock system shall be provided to ensure that the pump drive system components are engaged in the pumping mode of operation so that the pumping system can be operated from the pump operator’s position.

COMMITTEE MEETING ACTION: Accept in Principle
COMMITTEE STATEMENT: Stationary Pump Driven Through Split Shaft PTO – Manual Chassis Transmission. Where the apparatus is equipped with an automatic chassis transmission, the water pump is driven by the chassis engine through the transmission’s main driveline, and the apparatus is to be used for stationary pumping only, an interlock system shall be provided to ensure that the pump drive system components are engaged in the pumping mode of operation so that the pumping system can be operated from the pump operator’s position.

COMMITTEE MEETING ACTION: Accept in Principle
COMMITTEE STATEMENT: Stationary Pump Driven Through Split Shaft PTO – Automatic Chassis Transmission. Where the apparatus is equipped with an automatic chassis transmission, the water pump is driven by the chassis engine through the transmission’s main driveline, and the apparatus is to be used for stationary pumping only, an interlock system shall be provided to ensure that the pump drive system components are engaged in the pumping mode of operation so that the pumping system can be operated from the pump operator’s position.
A “Throttle Ready” indicator shall be provided at the pump operator’s panel that indicates that the apparatus is in “OK to Pump” mode or that the parking brake is engaged.

A-14-10.4 Stationary Pump Driven Through Transmission-Mounted PTO, Front-Of-Engine Crank Shaft PTO, Or Engine Flywheel PTO – Automatic Chassis Transmission. Where the apparatus is equipped with an automatic chassis transmission, the water pump is driven by the transmission-mounted (SAE) PTO, front-of-engine crankshaft PTO, or engine flywheel PTO, and the apparatus is to be used for stationary pumping only with the chassis transmission in neutral, an interlock system shall be provided to ensure that the pump drive system components are engaged in the pumping mode of operation so that the pump system can be operated from the pump operator’s position.

A-14-10.4.1 A “Pump Engaged” indicator shall be provided both in the driving compartment and on the pump operator’s panel to indicate that the pump shift has been successfully completed.

A-14-10.4.2 An “OK to Pump” indicator shall be provided in the driving compartment to indicate that the pump is engaged, the chassis transmission is in neutral, and the parking brake is engaged.

A-14-10.5 Stationary Pump Driven Through Transmission-Mounted PTO, Front-Of-Engine Crank Shaft PTO, Or Engine Flywheel PTO – Manual Chassis Transmissions. Where the apparatus is equipped with a manual chassis transmission, the water pump is driven by a transmission-mounted (SAE) PTO, front-of-engine crankshaft PTO, or engine flywheel PTO, and the apparatus is to be used for stationary pumping only with the chassis transmission in neutral, an interlock system shall be provided to ensure that the pump drive system components are engaged in the pumping mode of operation so that the pump system can be operated from the pump operator’s position.

A-14-10.5.1 A “Pump Engaged” indicator shall be provided both in the driving compartment and on the pump operator’s panel to indicate that the pump shift has been successfully completed.

A-14-10.5.2 An “OK to Pump” indicator shall be provided in the driving compartment to indicate that the pump is engaged and the parking brake is engaged.

A-14-10.5.3 A “Throttle Ready” indicator shall be provided at the pump operator’s panel that indicates that the apparatus is in “OK to Pump” mode or that the chassis transmission is in neutral and the parking brake is engaged.

A-14-10.5.4 An “OK to Pump” indicator shall be provided in the driving compartment to indicate that the pump is engaged, the chassis transmission is in neutral, and the parking brake is engaged.

A-14-10.6 Stationary and “Pump and Roll” Pump – Automatic Chassis Transmissions. Where the water pump is driven by a transmission-mounted (SAE) PTO, front-of-engine crankshaft PTO, or engine flywheel PTO, and the apparatus is designed to be used in both the stationary pumping mode and the “pump and roll” pumping mode with the automatic chassis transmission in neutral for stationary pumping and in a road gear for pump and roll pumping, an interlock system shall be provided to ensure that the pump drive system components are properly engaged in the pumping mode of operation so that the apparatus can be operated in either stationary or pump and roll pumping mode.

A-14-10.6.1 A “Pump Engaged” indicator shall be provided both in the driving compartment and at the pump operator’s panel to indicate that the pump shift has been successfully completed.

A-14-10.6.2 An “OK to Pump” indicator shall be provided in the driving compartment to indicate that the pump is engaged, the chassis transmission is in neutral, and the parking brake is engaged. An “OK to Pump and Roll” indicator shall be provided in the driving compartment to indicate that the pump shift has been successfully completed and that the “pump and roll” pumping mode with the chassis transmission in neutral for stationary pumping or in a road gear for pump and roll pumping, an interlock system shall be provided to ensure that the pump drive system components are engaged in the pumping mode of operation so that the pump system can be operated from the pump operator’s position.

A-14-10.6.3 A “Throttle Ready” indicator shall be provided at the pump operator’s panel that indicates that the apparatus is energized when the “OK to Pump” indicator is energized or when the parking brake is engaged.

A-14-10.7 Stationary and “Pump and Roll” Pumps -- Manual Chassis Transmissions. Where the water pump is driven by a transmission-mounted (SAE) PTO, front-of-engine crankshaft PTO, or engine flywheel PTO, and the apparatus is designed to be used in both the stationary pumping mode and the “pump and roll” pumping mode with the chassis transmission in neutral for stationary pumping or in a road gear for pump and roll pumping, an interlock system shall be provided to ensure that the pump drive system components are properly engaged in the pumping mode of operation so that the apparatus can be operated in either stationary or pump and roll pumping mode.

A-14-10.7.1 A “Pump Engaged” indicator shall be provided both in the driving compartment and at the pump operator’s panel to indicate that the pump shift has been successfully completed.

A-14-10.7.2 An “OK to Pump” indicator shall be provided in the driving compartment to indicate that the pump is engaged and the parking brake is engaged. An “OK to Pump and Roll” indicator shall be provided in the driving compartment to indicate that the pump shift has been successfully completed and that the “pump and roll” pumping mode with the chassis transmission in neutral for stationary pumping or in a road gear for pump and roll pumping, an interlock system shall be provided to ensure that the pump drive system components are engaged in the pumping mode of operation so that the pump system can be operated from the pump operator’s position.

A-14-10.7.3 A “Throttle Ready” indicator shall be provided at the pump operator’s panel that is energized when the “OK to Pump” indicator is energized or when the parking brake is engaged.

A-14-10.8 Stationary Pumps Driven Through Transfer Case PTO’s — Automatic Chassis Transmissions. Where the apparatus is equipped with an automatic chassis transmission, the water pump is driven by the chassis transmission through the main driveline and through a transfer case, and the apparatus is to be used for stationary pumping only, an interlock system shall be provided to ensure that the pump drive system components are engaged in the pumping mode of operation so that the pump system can be operated from the pump operator’s position.

A-14-10.8.1 A “Pump Engaged” indicator shall be provided in the driving compartment to indicate that the pump shift has been successfully completed.

A-14-10.8.2 An “OK to Pump” indicator shall be provided in the driving compartment to indicate that the pump is engaged, the chassis transmission is in pump gear, the transfer case drive to the chassis wheels is in neutral and the parking brake is engaged.

A-14-10.8.3 A “Throttle Ready” indicator shall be provided at the pump operator’s panel that indicates that the apparatus is in “OK to Pump” mode or that the chassis transmission is in neutral and the parking brake is engaged.

A-14-10.9 Stationary Pumps Driven Through Transfer Case PTO’s – Manual Chassis Transmissions. Where the apparatus is equipped with a manual chassis transmission, the water pump is driven by the chassis engine through the transmission’s main driveline and through a transfer case, and the apparatus is to be used for stationary pumping only, an interlock system shall be provided to ensure that the pump drive system components are engaged in the pumping mode of operation so that the pump system can be operated from the pump operator’s position.

A-14-10.9.1 A “Pump Engaged” indicator shall be provided in the driving compartment to indicate that the pump shift has been successfully completed.

A-14-10.9.2 An “OK to Pump” indicator shall be provided in the driving compartment to indicate that the pump is engaged, the chassis transmission is in pump gear, the transfer case drive to the chassis wheels is in neutral and the parking brake is engaged.

A-14-10.9.3 A “Throttle Ready” indicator shall be provided at the pump operator’s panel that indicates that the apparatus is in “OK to Pump” mode or that the parking brake is engaged.

A-14-10.10 Pump Operator’s Panel Engine Speed Advancement — Automatic Chassis Transmission. An interlock system shall be provided to prevent advancement of the engine speed at the pump operator’s panel unless the chassis transmission is in neutral and the parking brake is engaged, or the apparatus is in the “OK to Pump” mode.

A-14-10.11 Pump Operator’s Panel Engine Speed Advancement — Manual Chassis Transmission. An interlock system shall be provided to prevent advancement of the engine speed at the pump operator’s panel unless the apparatus is equipped with an automatic chassis transmission or a manual chassis transmission.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

COMMITTEE STATEMENT: Paragraphs A-14-10.2 through A-14-10.5 are being rewritten to better clarify the requirements based on whether the fire apparatus is driven by an automatic chassis transmission or a manual chassis transmission.

14-10.11 Fire apparatus is driven by an automatic chassis transmission or a manual chassis transmission. Where the apparatus is equipped with an automatic chassis transmission, the water pump is driven by the chassis transmission through the main driveline and through a transfer case, and the apparatus is to be used for stationary pumping only, an interlock system shall be provided to ensure that the pump drive system components are engaged in the pumping mode of operation so that the pump system can be operated from the pump operator’s position.

14-10.11.1 A “Pump Engaged” indicator shall be provided in the driving compartment to indicate that the pump shift has been successfully completed.

14-10.11.2 An “OK to Pump” indicator shall be provided in the driving compartment to indicate that the pump is engaged, the chassis transmission is in pump gear, the transfer case drive to the chassis wheels is in neutral and the parking brake is engaged.

14-10.11.3 A “Throttle Ready” indicator shall be provided at the pump operator’s panel that indicates that the apparatus is in “OK to Pump” mode or that the chassis transmission is in neutral and the parking brake is engaged.

14-10.11.4 Stationary Pumps Driven Through Transfer Case PTO’s – Automatic Chassis Transmissions. Where the apparatus is equipped with an automatic chassis transmission, the water pump is driven by the chassis engine through the transmission’s main driveline and through a transfer case, and the apparatus is to be used for stationary pumping only, an interlock system shall be provided to ensure that the pump drive system components are engaged in the pumping mode of operation so that the pump system can be operated from the pump operator’s position.

14-10.11.5 A “Pump Engaged” indicator shall be provided in the driving compartment to indicate that the pump shift has been successfully completed.

14-10.11.6 An “OK to Pump” indicator shall be provided in the driving compartment to indicate that the pump is engaged, the chassis transmission is in neutral, and the parking brake is engaged. An “OK to Pump and Roll” indicator shall be provided in the driving compartment to indicate that the pump shift has been successfully completed and that the “pump and roll” pumping mode with the chassis transmission in neutral for stationary pumping or in a road gear for pump and roll pumping, an interlock system shall be provided to ensure that the pump drive system components are engaged in the pumping mode of operation so that the pump system can be operated from the pump operator’s position.

14-10.11.7 A “Throttle Ready” indicator shall be provided at the pump operator’s panel that is energized when the “OK to Pump” indicator is energized or when the chassis transmission is in neutral and the parking brake is engaged.

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: The committee has reworked sections 14-10.1 through 14-10.5 to better clarify the requirements based on whether the fire apparatus is driven by an automatic chassis transmission or a manual chassis transmission. See Committee Meeting Action on Proposal 1901-98 (Log #125). The rewrite took into consideration the submitters concerns.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28
The committee has reworked sections 14-10.2 through 14-10.5 to better clarify the requirements based on whether the fire apparatus is driven by an automatic chassis transmission or a manual chassis transmission. See Committee Meeting Action on Proposal 1901-98 (Log #125). The rewrite took into consideration the submitters concerns.

RECOMMENDATION: The committee has reworked sections 14-10.2 through 14-10.5 to better clarify the requirements based on whether the fire apparatus is driven by an automatic chassis transmission or a manual chassis transmission. See Committee Meeting Action on Proposal 1901-98 (Log #125). The rewrite took into consideration the submitters concerns.

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

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1901-104-(14-10.3.1) : Reject
SUBMITTER: Steve Morelan, Little Canada Fire Dept., Inc., MN
RECOMMENDATION: Revise text to read as follows: “A “Pump Engaged” indicator shall be provided in the driving compartment to indicate that the pump shift has been successfully completed.”

COMMITTEE STATEMENT: The committee has reworked sections 14-10.2 through 14-10.5 to better clarify the requirements based on whether the fire apparatus is driven by an automatic chassis transmission or a manual chassis transmission. See Committee Meeting Action on Proposal 1901-98 (Log #125). The rewrite took into consideration the submitters concerns.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

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1901-105-(14-10.3.2) : Reject
SUBMITTER: Thomas J. Mettler, Waterous Company
RECOMMENDATION: Delete paragraph.

COMMITTEE STATEMENT: The committee has reworked sections 14-10.2 through 14-10.5 to better clarify the requirements based on whether the fire apparatus is driven by an automatic chassis transmission or a manual chassis transmission. See Committee Meeting Action on Proposal 1901-98 (Log #125). The rewrite took into consideration the submitters concerns.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

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1901-106-(14-10.3.3) : Reject
SUBMITTER: Steve Morelan, Little Canada Fire Dept., Inc., MN
RECOMMENDATION: Revise text to read as follows: “A “Throttle Ready” indicator shall be provided at the pump operator’s position.”

COMMITTEE STATEMENT: The committee has reworked sections 14-10.2 through 14-10.5 to better clarify the requirements based on whether the fire apparatus is driven by an automatic chassis transmission or a manual chassis transmission. See Committee Meeting Action on Proposal 1901-98 (Log #125). The rewrite took into consideration the submitters concerns.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

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1901-107-(14-10.3.4) : Reject
SUBMITTER: Thomas J. Mettler, Waterous Company
RECOMMENDATION: Change text to read: “A “Pump Engaged” indicator and an “Ok to Pump” indicator shall be provided in the driving compartment to indicate that the pump shift has been successfully completed and the pump is engaged, the chassis transmission is in neutral, and the parking brake is engaged.”

COMMITTEE STATEMENT: The committee has reworked sections 14-10.2 through 14-10.5 to better clarify the requirements based on whether the fire apparatus is driven by an automatic chassis transmission or a manual chassis transmission. See Committee Meeting Action on Proposal 1901-98 (Log #125). The rewrite took into consideration the submitters concerns.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

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1901-108-(14-10.3.5) : Reject
SUBMITTER: Thomas J. Mettler, Waterous Company
RECOMMENDATION: Change text to read: “A “Pump Engaged” indicator and an “Ok to Pump” indicator shall be provided in the driving compartment to indicate that the pump shift has been successfully completed and the pump is engaged, the chassis transmission is in neutral, and the parking brake is engaged.”

COMMITTEE STATEMENT: The committee has reworked sections 14-10.2 through 14-10.5 to better clarify the requirements based on whether the fire apparatus is driven by an automatic chassis transmission or a manual chassis transmission. See Committee Meeting Action on Proposal 1901-98 (Log #125). The rewrite took into consideration the submitters concerns.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

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1901-109-(14-10.3.6) : Reject
SUBMITTER: Thomas J. Mettler, Waterous Company
RECOMMENDATION: Change text to read: “A “Throttle Engaged” indicator and an “Ok to Pump” indicator shall be provided in the driving compartment to indicate that the pump shift has been successfully completed and the pump is engaged, the chassis transmission is in neutral, and the parking brake is engaged.”

COMMITTEE STATEMENT: The committee has reworked sections 14-10.2 through 14-10.5 to better clarify the requirements based on whether the fire apparatus is driven by an automatic chassis transmission or a manual chassis transmission. See Committee Meeting Action on Proposal 1901-98 (Log #125). The rewrite took into consideration the submitters concerns.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

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1901-110-(14-10.3.7) : Reject
SUBMITTER: Thomas J. Mettler, Waterous Company
RECOMMENDATION: Change text to read: “A “Throttle Engaged” indicator and an “Ok to Pump” indicator shall be provided in the driving compartment to indicate that the pump shift has been successfully completed and the pump is engaged, the chassis transmission is in neutral, and the parking brake is engaged.”

COMMITTEE STATEMENT: The committee has reworked sections 14-10.2 through 14-10.5 to better clarify the requirements based on whether the fire apparatus is driven by an automatic chassis transmission or a manual chassis transmission. See Committee Meeting Action on Proposal 1901-98 (Log #125). The rewrite took into consideration the submitters concerns.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

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1901-111-(14-10.3.8) : Reject
SUBMITTER: Thomas J. Mettler, Waterous Company
RECOMMENDATION: Change text to read: “A “Throttle Engaged” indicator and an “Ok to Pump” indicator shall be provided in the driving compartment to indicate that the pump shift has been successfully completed and the pump is engaged, the chassis transmission is in neutral, and the parking brake is engaged.”

COMMITTEE STATEMENT: The committee has reworked sections 14-10.2 through 14-10.5 to better clarify the requirements based on whether the fire apparatus is driven by an automatic chassis transmission or a manual chassis transmission. See Committee Meeting Action on Proposal 1901-98 (Log #125). The rewrite took into consideration the submitters concerns.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

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COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The committee has reworked sections 14-10.2 through 14-10.5 to better clarify the requirements based on whether the fire apparatus is driven by an automatic chassis transmission or a manual chassis transmission. See Committee Meeting Action on Proposal 1901-98 (Log #125). The rewrite took into consideration the submitters concerns.
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-111-(14-10.4.2) : Reject
SUBMITTER: Thomas J. Mettler, Waterous Company
RECOMMENDATION: Change first sentence to read as follows: “A “Pump Engaged” indicator and an “Ok to Pump” indicator shall be provided in the driving compartment to indicate that the pump shift has been successfully completed and the pump is energized, the chassis transmission is in neutral, and the parking brake is engaged.”
SUBSTANTIATION: Identifies indicator requirements as required by 14-10.1 and identifies those indicators that are to be provided in the driving compartment with one paragraph.

COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The committee has reworked sections 14-10.2 through 14-10.5 to better clarify the requirements based on whether the fire apparatus is driven by an automatic chassis transmission or a manual chassis transmission. See Committee Meeting Action on Proposal 1901-98 (Log #125). The rewrite took into consideration the submitters concerns.
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-112-(14-10.4.2) : Reject
SUBMITTER: Steve Morelan, Little Canada Fire Dept., Inc., MN
RECOMMENDATION: Revise text to read as follows: An “Ok to Pump” indicator shall be provided in the driving compartment to indicate that the pump is engaged, the chassis transmission is in neutral, and the parking brake is engaged. An “Ok to Pump and Roll” indicator shall be provided in the driving compartment and shall be energized when the pump is engaged, the chassis transmission is in pump and roll gear, and the parking brake is released.
SUBSTANTIATION: 1. Replace “road gear” in the last sentence with “pump and roll gear” for clarity. Most apparatus designed for pump and roll are required to be in a particular road gear for efficient operation. The indicator should not indicate that it is OK to pump until a proper road gear is selected. For example, if a particular apparatus will not pump when the chassis transmission is in reverse gear, then the “Ok to Pump and Roll” indicator should not be energized when the chassis transmission is in reverse gear. 2. Delete the last sentence for simplification. When the “Ok to Pump and Roll” indicator is energized, the “Ok to Pump” indicator shall not be energized. It is impossible for them to be energized at the same time since one requires the parking brake to be engaged and the other requires it to be released.

COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The committee has reworked sections 14-10.2 through 14-10.5 to better clarify the requirements based on whether the fire apparatus is driven by an automatic chassis transmission or a manual chassis transmission. See Committee Meeting Action on Proposal 1901-98 (Log #125). The rewrite took into consideration the submitters concerns.
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-113-(14-10.4.3) : Reject
SUBMITTER: Steve Morelan, Little Canada Fire Dept., Inc., MN
RECOMMENDATION: Revise text to read as follows: A “Throttle Ready” indicator shall be provided at the pump operator’s panel that is energized when the chassis transmission is in neutral and the parking brake engaged.
SUBSTANTIATION: Simplify. It is redundant to state that the “Throttle Ready” indicator shall be provided at the pump operator’s panel that is energized when the chassis transmission is in neutral and the parking brake engaged.

COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The committee has reworked sections 14-10.2 through 14-10.5 to better clarify the requirements based on whether the fire apparatus is driven by an automatic chassis transmission or a manual chassis transmission. See Committee Meeting Action on Proposal 1901-98 (Log #125). The rewrite took into consideration the submitters concerns.
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-114-(14-10.4.3) : Reject
SUBMITTER: Steve Morelan, Little Canada Fire Dept., Inc., MN
RECOMMENDATION: Revise text to read as follows: A “Throttle Ready” indicator be energized when the “Ok to Pump” indicator is energized since per 14-10.4.2, for the “Ok to Pump” indicator to be energized, the chassis transmission must be in neutral and the parking brake must be engaged. This recommendation does not change the requirements, it simply eliminates unnecessary text.

COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The committee has reworked sections 14-10.2 through 14-10.5 to better clarify the requirements based on whether the fire apparatus is driven by an automatic chassis transmission or a manual chassis transmission. See Committee Meeting Action on Proposal 1901-98 (Log #125). The rewrite took into consideration the submitters concerns.
1901-114-(14-10.5) : Reject

SUBMITTER: Steve Morelan, Little Canada Fire Dept., Inc., MN

RECOMMENDATION: Revise text to read as follows:
An interlock system shall be provided to prevent advancement of the engine speed at the pump operator’s panel unless the “Throttle Ready” indicator is energized.

SUBSTANTIATION: Simplify the text. This recommendation does not change the requirements - the “Throttle Ready” indicator is only energized when all of the current requirements listed in this paragraph are met (chassis transmission is in neutral and the parking brake is engaged, or the apparatus is in “OK to Pump” mode).

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: The committee has reworked sections 14-10.2 through 14-10.5 to better clarify the requirements based on whether the fire apparatus is driven by an automatic chassis transmission or a manual chassis transmission. See Committee Meeting Action on Proposal 1901-98 (Log #125). The rewrite took into consideration the submitters concerns.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-114-(14-10.7.1) : Accept in Part

NOTE: This Proposal appeared as Comment 1901-127 (Log #83) which was held from the May 1999 ROC on Proposal 1901-217.


RECOMMENDATION: Delete 30 psi. List as 10 psi and change 100 psi to 70 psi.

SUBSTANTIATION: 30 psi jump will not protect firefighters on NFPA smooth bore tips on NFPA hose compliments. Dangerous surges will increase nozzle reaction to unsafe levels. Departments using low pressure tips will have the same problems. The range of pressure falls below a 2 in. tip of a 150 ft 2 1/2 in. hose. So 70 psi should be the base line not 100 psi.

COMMITTEE MEETING ACTION: Accept in Part

[ Change 100 psi to 70 psi in 14-10.7.1(1) [16.10.13.1(1) in the draft].]

COMMITTEE STATEMENT: The committee feels the 30 psi rise is reasonable given the fact that pressure control systems are mechanical systems. A 30 psi rise at the pump will not translate to a 30 psi at the nozzle given the increased friction loss as more water moves through the hose. The purchaser can specify a lower increase if they feel it necessary.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-115-(14-10.7.1) : Accept in Principle

SUBMITTER: Gary Handwerk, Hale Products, Inc.

RECOMMENDATION: Over a range of pressure from 400 50 psi to 300 psi.

SUBSTANTIATION: This expands the relief valve/governor performance to operate with up to 100 psi hydraulic relay lines. It also improves control at low pressure hose line operations.

COMMITTEE MEETING ACTION: Accept in Principle

COMMITTEE STATEMENT: See Committee Meeting Action on Proposal 1901-115 (Log #3).

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-115-(14-10.7.1.1) : Accept in Principle

SUBMITTER: Gary Handwerk, Hale Products, Inc.

RECOMMENDATION: Over a range of pressure from 400 50 psi to 300 psi.

SUBSTANTIATION: This expands the relief valve/governor performance to operate with up to 100 psi hydraulic relay lines. It also improves control at low pressure hose line operations.

COMMITTEE MEETING ACTION: Accept in Principle

COMMITTEE STATEMENT: See Committee Meeting Action on Proposal 1901-115 (Log #3).

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-115-(14-10.7.1.2) : Accept

SUBMITTER: Thomas J. Mettler, Waterous Company

RECOMMENDATION: Change text to read: “With initial engine and pump controls set to produce a range of flows from 150 gpm (568 L/Min) to the needed capacity”.

SUBSTANTIATION: Requirement of original wording is impossible to meet when all discharge valves are closed.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-116-(14-10.7.3) : Accept in Principle

SUBMITTER: Gary Handwerk, Hale Products, Inc.

RECOMMENDATION: Add a new paragraph after 14-10.7.2 to read:
An adjustable automatic pressure relief device shall be installed on the pump system to bleed off pressure from a hose connected to the pump intake. The adjustable pressure relief device shall discharge to atmosphere.

SUBSTANTIATION: This reinstates suction pump valve lost in 1996 rewrite.

COMMITTEE MEETING ACTION: Accept in Principle

[ Add a new 14-6.7 see 16.6.7 in the draft to read as follows: If the pump is equipped with one or more intakes larger than 3 1/2 in (89 mm) that are not valved, an adjustable automatic pressure relief device shall be installed on the pump system to bleed off excess pressure from a hose connected to the pump intake. The automatic pressure relief device shall be adjustable from a minimum of 90 psi (620 kPa) to at least 185 psi (1275 kPa). The pressure relief device, when preset at 125 psi (860 kPa), shall not allow a pressure rise greater than 60 psi (400 kPa) at the device inlet while flowing a minimum of 150 gpm (570 L/min). The pressure relief device shall discharge to atmosphere.

Renumber current 14-6.7 and 14-6.8 as 14-6.8 and 14-6.9.

COMMITTEE STATEMENT: The committee is adding the requested requirement for a pressure relief device together with the performance requirements for the pressure relief device.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-119-(14-10.7.3 & 14-10.7.4) : Reject

SUBMITTER: Gary Handwerk, Hale Products, Inc.

RECOMMENDATION: Change 14-10.7.3 to 14-10.7.4 and change 14-
10.7.4 to 14-10.7.5.

SUBSTANTIATION: This makes room for new 14-10.7.3.

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: See committee meeting action on Proposal 1901-118 (Log #14) which added this wording in a different section so it is not necessary to renumber.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-120-(14-10.7.4) : Accept

SUBMITTER: Thomas J. Mettler, Waterous Company

RECOMMENDATION: Delete paragraph.

SUBSTANTIATION: The pressure control system is certified as one of the requirements included in 14-13, specifically stated in 14-13.1.1 and 14-
13.4. Also, 2-14, Data Required of the Contractor, makes no mention of this certification and it historically has not been provided.

COMMITTEE MEETING ACTION: Accept

Also move the appendix material currently associated with 14-10.7.4 to become the appendix to 14-10.7.1.

COMMITTEE STATEMENT: The appendix material is helpful and should be retained.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-121-(14-10.8) : Accept in Part

SUBMITTER: Thomas J. Mettler, Waterous Company

RECOMMENDATION: Revise second sentence to read: “It shall be capable of meeting the requirements of 14-2.3.2 and 14-2.3.3.

COMMITTEE MEETING ACTION: Accept in Part

SUBSTANTIATION: 14-10 provides requirements for pump controls. The performance capability requirements of the priming device are provided in 14-2.3.2 and 14-2.3.3. No need to repeat here. Note that performance requirements in original text have been proposed for inclusion in 14-2.3.3 via a separate proposal. Substantiation for elimination of text stating: “An exhaust shall not be used” - this requirement is design restrictive and also is not defined. The priming device should be performance based.

COMMITTEE MEETING ACTION: Accept in Part

Revise the second sentence as shown and delete the third sentence. Retain the fourth sentence.

COMMITTEE STATEMENT: The fourth sentence is being left here rather than being moved to a separate proposal.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-122-(14-10.8) : Accept

SUBMITTER: Thomas J. Mettler, Waterous Company

RECOMMENDATION: Revise second sentence to read: “It shall be capable of meeting the requirements of 14-2.3.2 and 14-2.3.3.

COMMITTEE MEETING ACTION: Accept in Part

SUBSTANTIATION: 14-10 provides requirements for pump controls. The performance capability requirements of the priming device are provided in 14-2.3.2 and 14-2.3.3. No need to repeat here. Note that performance requirements in original text have been proposed for inclusion in 14-2.3.3 via a separate proposal. Substantiation for elimination of text stating: “An exhaust shall not be used” - this requirement is design restrictive and also is not defined. The priming device should be performance based.

COMMITTEE MEETING ACTION: Accept in Part

Revise the second sentence as shown and delete the third sentence. Retain the fourth sentence.

COMMITTEE STATEMENT: The fourth sentence is being left here rather than being moved to a separate proposal.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28
1901-122-(14-12.1) : Accept

SUBMITTER:  Steve Morelan, Little Canada Fire Dept., Inc., MN

RECOMMENDATION:  Add the following (bold) heading to this paragraph:

Pump operator’s panel.

1901-123-(14-12.1.4) : Reject

SUBMITTER:  Steve Morelan, Little Canada Fire Dept., Inc., MN

RECOMMENDATION:  Combine 14-12.2 and 14-12.2.1 and renumber the combination as 14-12.1.4.  Accordingly, renumber 14-12.2.1.1 as 14-12.1.4.1; and renumber 14-12.1.2 as 14-12.1.4.2.

COMMITTEE MEETING ACTION:  Reject

COMMITTEE STATEMENT:  While it may make logical sense to move the material that is in 14-2.2 and its subparagraphs under 14-2.1, the NFPA manual of style now requires each paragraph to contain only one requirement.  Accordingly, 14-2.2 and its subparagraphs are being further subdivided (see draft).  Moving the text would require numbering to the seventh and eighth levels which is unwieldy.  The committee feels that the current requirements are understood and should be maintained as a separate subsection.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION:  AFFIRMATIVE: 28

1901-124-(14-12.2) : Reject

SUBMITTER:  Steve Morelan, Little Canada Fire Dept., Inc., MN

RECOMMENDATION:  Develop a specification for a pump overheating indicator and/or automatic bypass line.

SUBSTANTIATION:  To warn the operator when the pump overheats.  Overheating can cause catastrophic failure of the pump without warning and is a significant safety concern.

COMMITTEE MEETING ACTION:  Reject

COMMITTEE STATEMENT:  The committee feels a requirement for a pump overheating indicator and/or automatic bypass line is beyond what should be required in a minimum standard.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION:  AFFIRMATIVE: 28

1901-125-(14-12.2.1) : Accept in Principle

SUBMITTER:  Bill Adams, William F. Adams & Associates

RECOMMENDATION:  Revise text to read as follows:

Master pump intake and pump discharge pressure indicating devices shall be located within 8 in. (200 mm) of each other edge to edge, with the intake pressure indicating device to the left of or above the pump discharge pressure indicating device.

SUBSTANTIATION:  Mandating the intake gauge be located only to the left of the discharge gauge restricts the physical parameters in which a pump panel can be laid out - placing an undue limitation upon the design process.  With emphasis being placed upon multi-functional roles of fire apparatus, physical space is at a premium.  Pump manufacturer(s) are manufacturing pumps allowing smaller width pump houses.  The side to side requirement prohibits designing a pump panel that is narrow in width and long vertically.  Allowing the master gauges to be placed vertically will give manufacturers flexibility in design.  Specifying the intake pressure device be located below the discharge pressure device follows the established custom of water “in on the bottom” and “out on the top”.

COMMITTEE MEETING ACTION:  Accept in Principle

Revise 14-12.2.1 (16.12.2.1 in the draft) to read as follows:

Master pump intake and pump discharge pressure indicating devices shall be located within 8 in. (200 mm) of each other edge to edge, with the intake pressure indicating device to the left of or below the pump discharge pressure indicating device.

COMMITTEE STATEMENT:  Suction intakes are lower than discharge outlets on the pump so the intake gauge should be lower rather than higher if they are not side-by-side.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION:  AFFIRMATIVE: 28

1901-126-(14-13.2.1.3) : Accept

SUBMITTER:  Technical Committee on Fire Department Apparatus

RECOMMENDATION:  Delete the last sentence of 14-13.2.1.3 and add the following text to that paragraph (see 16.13.2.1.3.2 and 16.13.2.1.3.3 in the draft):

If the vehicle is equipped with a fixed power source driven by the same engine that drives the fire pump, it shall be running at a minimum of 50 percent of its rated capacity throughout the pumping portion of the pump test.  The following devices shall be permitted to be turned off or not operating during the pump test.

1. Aerial hydraulic pump
2. Foam pump
3. Hydraulically driven equipment
4. Winch
5. Windshield wipers
6. Four-way hazard flashers

SUBSTANTIATION:  As a minimum standard, the committee has tried to make the pumping test reflective of real use conditions by defining certain devices that do not need to be running during the pump tests.  The purchaser can specify these devices be running during the test if their needs are such in actual application.

COMMITTEE MEETING ACTION:  Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION:  AFFIRMATIVE: 28

1901-127-(14-13.2.2.6) : Accept

SUBMITTER:  Technical Committee on Fire Department Apparatus

RECOMMENDATION:  Revise 14-13.2.2.6 (16.13.2.2.6 in the draft) to read as follows:

The engine speed-measuring equipment shall consist of a non-adjustable tachometer supplied from the engine or transmission electronics, a revolution counter on a checking shaft outlet and a stopwatch, or other engine speed-measuring means that is accurate to within ± 50 rpm of actual speed.

SUBSTANTIATION:  This proposed wording is clearer than the existing wording and consistent with wording in NFPA 1911.

COMMITTEE MEETING ACTION:  Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION:  AFFIRMATIVE: 28

1901-128-(14-13.2.3.1) : Accept

SUBMITTER:  Technical Committee on Fire Department Apparatus

RECOMMENDATION:  Revise the first sentence of 14-13.2.3.1 (16.13.2.3.3 of the draft) to read as follows:

If the apparatus is equipped with a fire pump rated at 750 gpm (3000 L/min) or greater, the pump shall be subjected to a 3-hour pumping test from draft consisting of 2 hours of continuous pumping at rated capacity.

SUBSTANTIATION:  The document does not actually say that the test has to be from draft although it is implied.  Adding the 2 words clarifies the conditions.  The change to the metric value is for consistency with the metric values stated in the document.

COMMITTEE MEETING ACTION:  Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION:  AFFIRMATIVE: 28

1901-129-(14-13.2.3.2) : Accept

SUBMITTER:  Technical Committee on Fire Department Apparatus

RECOMMENDATION:  Revise the first sentence of 14-13.2.3.2 (16.13.2.3.4 of the draft) to read as follows:

If the apparatus is equipped with a fire pump rated at less than 750 gpm (3000 L/min), the pump shall be subjected to a 50-minute pumping test from draft consisting of 1/2 hour of continuous pumping at rated capacity.

SUBSTANTIATION:  The document does not actually say that the test has to be from draft although it is implied.  Adding the 2 words clarifies the conditions.  The change to the metric value is for consistency with the metric values stated in the document.

COMMITTEE MEETING ACTION:  Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION:  AFFIRMATIVE: 28
The pressure is being changed in 2 places, (Log #17) (Log #12).

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: The committee has developed a new section dealing with the performance requirements for auxiliary pumps. The ratings for high pressure pumps is being tied to the number of hose reels that can be operated simultaneously from the pump, which could be different from the number of hose reels on the apparatus. This new section also addresses the performance of medium pressure pumps as requested in proposal 1901-134 (Log #17). The performance is being tied to operation from the water tank on the apparatus as that is the typical fire fighting application.

The last sentence of A-15-1 is being deleted as it no longer applies with the changes defined in this proposal.

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

NUMBER OF COMMITTEE MEMBERS: 28

1901-139-(17-4.1) : Accept in Principle

COMMITTEE STATEMENT: Medium pressure auxiliary pumps shall meet the following performance, 100% capacity @ 150 psi, 70% capacity @ 200 psi and 50% capacity @ 250 psi. Performance is being tied to operation from the apparatus water tank(s). Pump rating shall be 30, 60, 90, 120 or 250 gpm.

COMMITTEE MEETING ACTION: Accept in Principle

COMMITTEE STATEMENT: See Committee Meeting Action on Proposal 1901-133 (Log #18).

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

NUMBER OF COMMITTEE MEMBERS: 28

1901-134-(15-1.2) (New): Accept in Principle

COMMITTEE STATEMENT: Delete the last sentence of A-15-1.

COMMITTEE MEETING ACTION: Accept in Principle

COMMITTEE STATEMENT: The committee feels this is beyond what NFPA 1901 trucks. This chapter could cause a very dangerous safety related problem. If someone built a truck with one of this kind of pump, they may have performance tests conducted”. The submitter further realizes that mandatory testing of the complete system will add expense to the apparatus. However, the pressure control system plays a vital role in fireground safety and complete testing of the system should be required.

COMMITTEE MEETING ACTION: Re却

COMMITTEE STATEMENT: Additional testing is unnecessary as the requirement in 14-10.7.1 is for net pump pressure. The committee feels the test is verifying that the pressure control is working properly. Net pump pressure does not change with suction conditions. Pressure relief systems are required to work on net pump pressure.

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

NUMBER OF COMMITTEE MEMBERS: 28

1901-131-(14-13.5.1, 14-13.6) : Accept

COMMITTEE MEETING ACTION: Accept

COMMITTEE STATEMENT: Technical Committee on Fire Department Apparatus, recommends as follows (see 16.13.6 of the draft):

1. Add a new sentence after the first sentence of 14-13.6 to read as follows:

   "At altitudes above 2000 ft (610 m), the vacuum attained shall be permitted to be less than 22 in. Hg (0.75 bar) by 1 in. Hg (0.034 bar) for each 1000 ft (305 m) of altitude above 2000 ft (610 m)."

2. Add a new sentence after the first sentence of 14-13.6 to read as follows:

   "Pressure relief systems are required to work on net pump pressure."

COMMITTEE MEETING ACTION: Accept

COMMITTEE STATEMENT: The purpose of the priming device test is to ensure that the pump can be primed within the time frames established in the standard. Paragraph 14-13.5.1 really deals with the vacuum test which is covered in 14-13.6 and adding the proposed sentence the 14-13.6 provides the capability to perform vacuum tests at higher elevations without penalty.

COMMITTEE MEETING ACTION: Accept

COMMITTEE STATEMENT: The pressure is being changed in 2 places, once in 14-13.7(i) and once in the paragraph following 14-13.7(i) (see 16.13.7.1(i) and 16.13.7.2 in the draft).

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

NUMBER OF COMMITTEE MEMBERS: 28

1901-132-(14-13.7(i)) : Accept

COMMITTEE MEETING ACTION: Accept

COMMITTEE STATEMENT: The pressure is being changed in 2 places, once in 14-13.7(i) and once in the paragraph following 14-13.7(i) (see 16.13.7.1(i) and 16.13.7.2 in the draft).

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

NUMBER OF COMMITTEE MEMBERS: 28

1901-133-(15-1.1) (New) : Accept in Principle in Part

COMMITTEE MEETING ACTION: Accept in Principle in Part

COMMITTEE STATEMENT: The committee feels this is beyond what should be required in a minimum standard and the purchaser can specify additional tank fill arrangements if they desire such capability.
1901-137-(18-2.5) : Accept in Principle
SUBMITTER: Steffen Kohleisen, METZ Aerials USA
RECOMMENDATION: Revise text to read as follows:
The ladder rungs shall be equally spaced on a maximum 14 in. (356 mm) centers and minimum 11.75 in. (300 mm) centers and shall have a skid resistant surface or covering.
SUBSTANTIATION: The committee is adding the word equally so as to ensure that rung spacing does not change along the length of the ladder.

1901-138-(18-2.8) : Reject
SUBMITTER: Craig Davis, The City of Midwest City, Fleet Services Department
RECOMMENDATION: Continuous top rails shall be provided on the ladder, shall have a minimum width of 1 in. (25 mm), and shall be at a minimum height of 12 in. (305) above the centerline of all rungs, including the outermost rung of the outermost fly section.

1901-141-(18-2.11) : Accept
SUBMITTER: Stephen Kohleisen, METZ Aerials USA
RECOMMENDATION: Revise text to read as shown:
Two folding steps with skirts shall be provided on the ladder for use by the ladder pipe-monitor operator.

1901-142-(18-2.11) : Accept
SUBMITTER: Technical Committee on Fire Department Apparatus
RECOMMENDATION: Revise the first sentence of 18-2.29 (20.2.9 of the draft) to read as shown:
Steps, with the exception of the ground to the first step, shall be spaced on no more than 457 mm (18 in.) centers.

1901-143-(18-2.16.6, 18-7.7.6) : Accept
SUBMITTER: Technical Committee on Fire Department Apparatus
RECOMMENDATION: Revise 18-2.13.6 and 18-7.7.6 (20.2.13.6 and 20.7.7.6 of the draft) to read as follows:
The quality of the breathing air shall meet the requirements of NFPA 1989, Standard on Breathing Air Quality for Fire and Emergency Services Respiratory Protection.

1901-144-(18-4.1) : Accept
SUBMITTER: Technical Committee on Fire Department Apparatus
RECOMMENDATION: Revise 18-4.1 and split it into 2 paragraphs to read as follows: (see 20.4.1 and 20.4.2 of the draft):
18-4.1 Indicating devices that are lighted and marked with a label shall be visible from an operator’s position and shall indicate the following:
(1) Rungs are aligned for climbing
(2) Aerial ladder is aligned with the travel bed

18-4.2 A system that is lighted and marked with labels shall be visible from the operator’s position to indicate the elevation, extension, and rated capacities.

The number current 18-4.2 as 18-4.3

SUBSTANTIATION: The NFPA Style manual does not allow exceptions and by rewriting this requirement, the current exception is avoided.
COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

AFFIRMATIVE: 28

COMMITTEE MEETING ACTION: Accept
SUBMITTER: Tom Hiltenbrand, Underwriters Laboratories Inc.
RECOMMENDATION: Add new text as follows: "Indication that the truck is level shall be provided at operator's station."

SUBSTANTIATION: NFPA 1901 does not currently require this. The ULC Harmonization/Adoption Task Group recommends this be included in the NFPA Standard. This wording was adopted from ULC S515-M85 8.8.5.5.

COMMITTEE MEETING ACTION: Accept in Principle
Add text to 18-21.2.1 (20.21.1.2 of the draft) to read as follows:

An indicator(s) shall be provided to denote when the vehicle is operable within the manufacturer's range of level conditions.

COMMITTEE STATEMENT: The committee feels this requirement is better in the section with stabilization requirements. Also, as manufacturers may have a range of conditions within which the aerial device can be operated, the wording has been revised to reflect that the indicator needs to show when the apparatus is within that range.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

COMMITTEE MEETING ACTION: Accept
SUBMITTER: Technical Committee on Fire Department Apparatus, Technical Committee on Fire Apparatus, Technical Committee on Fire Apparatus.

RECOMMENDATION: Add text to 18-5.3.1 (see 20.5.3.3 through 20.5.3.6 of the draft) to read as follows:

Rollers, pulleys and roller guides shall be equipped with self lubricating bearings or readily accessible grease fitting. Slide pads, rollers and bearings, when used, shall be readily accessible for replacement. When wire rope, chains, or cables are used to extend the ladder sections, the system shall be redundant with a minimum of two wire ropes, chains or cables used per ladder section. A means shall be provided to prevent damage to the extension system at full retraction or full extension.

Delete 18-5.3.2, 18-5.3.2.1, 18-5.3.2.2, and 18-5.3.2.3.

SUBSTANTIATION: The bearings on the rollers and roller guides of an aerial device are a critical component of the extension/retraction capability and the proper lubrication of those bearings is important to the proper operation of the aerial device. The addition of this requirement will also bring NFPA 1901 in line with a similar requirement in ULC 515, Standard for Automotive Fire Apparatus. The third and fourth sentences being added replace out of date language about ladder pads which is being deleted with the deletion of the identified paragraphs.

COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

COMMITTEE MEETING ACTION: Reject
SUBMITTER: Steffen Kohleisen, METZ Aerials USA
RECOMMENDATION: Revise text to read as follows:

The horizontal traverse of the monitor shall not exceed the aerial ladder manufacturer's recommendations. The monitor shall be capable of swiveling 180 degrees from a line parallel to the ladder and down, the horizontal traverse of the monitor shall be at least 45 degrees from each side of center, but shall not exceed the aerial ladder manufacturer's recommendations.

SUBSTANTIATION: This is the same wording as for the detachable water pipe (18-6.2.2). There is no reason why the requirements for a remote controller monitor should be different.

COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The committee has invested considerable time and effort to develop a standard for water system flows from aerial ladders, elevating platforms and water towers. These ratings have improved the safety of these devices and the committee feels it is regressive to reduce the current minimums. Manufacturers have had to redesign products to meet this standard.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

COMMITTEE MEETING ACTION: Reject
SUBMITTER: Steffen Kohleisen, METZ Aerials USA
RECOMMENDATION: Revise text to read as follows:

The aerial ladder and its waterway system shall be capable of flowing 1000 gpm (3785 l/min) its rated capacity at 100 psi (690 kPa) nozzle pressure at a minimum of 80% of the full elevation and extension.

SUBSTANTIATION: As a result of the proposed changes to [18-6.1(b), (c)] to "...a minimum of 500 gpm", the requirement should be changed to "...its rated capacity".

Full elevation and extension are the weakest position of an aerial ladder. When flowing water in this position the ladder is put under extreme stress and fire fighters at the ladder tip are put in danger. By reducing length and elevation angle in this requirement fire fighters are encouraged to use their ladder safely.

COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The committee has invested considerable time and effort to develop a standard for water system flows from aerial ladders, elevating platforms and water towers. These ratings have improved the safety of these devices and the committee feels it is regressive to reduce the current minimums. Manufacturers have had to redesign products to meet this standard.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

COMMITTEE MEETING ACTION: Reject
SUBMITTER: Steffen Kohleisen, METZ Aerials USA
RECOMMENDATION: Revise text to read as follows:

The aerial ladder and its waterway system shall be capable of flowing 1000 gpm (3785 l/min) its rated capacity at 100 psi (690 kPa) nozzle pressure at a minimum of 80% of the full elevation and extension.

SUBSTANTIATION: As a result of the proposed changes to [18-6.1(b), (c)] to "...a minimum of 500 gpm", the requirement should be changed to "...its rated capacity".

Full elevation and extension are the weakest position of an aerial ladder. When flowing water in this position the ladder is put under extreme stress and fire fighters at the ladder tip are put in danger. By reducing length and elevation angle in this requirement fire fighters are encouraged to use their ladder safely.

COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The committee has invested considerable time and effort to develop a standard for water system flows from aerial ladders, elevating platforms and water towers. These ratings have improved the safety of these devices and the committee feels it is regressive to reduce the current minimums. Manufacturers have had to redesign products to meet this standard.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

COMMITTEE MEETING ACTION: Reject
SUBMITTER: Steffen Kohleisen, METZ Aerials USA
RECOMMENDATION: Revise text to read as follows:

A permanently attached monitor capable of flowing a minimum of 500 gpm (1893 l/min) 4000 gpm (1525 l/min) waterway swivel shall not exceed 100 psi (690 kPa) at its rated capacity 4000 gpm (1525 l/min) with the ladder at full horizontal extension.

SUBSTANTIATION: As a result of the proposed changes to [18-6.1(b), (c)] to "...a minimum of 500 gpm", the requirement should be changed to "...its rated capacity".

Full elevation and extension are the weakest position of an aerial ladder. When flowing water in this position the ladder is put under extreme stress and fire fighters at the ladder tip are put in danger. By reducing length and elevation angle in this requirement fire fighters are encouraged to use their ladder safely.

COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The committee has invested considerable time and effort to develop a standard for water system flows from aerial ladders, elevating platforms and water towers. These ratings have improved the safety of these devices and the committee feels it is regressive to reduce the current minimums. Manufacturers have had to redesign products to meet this standard.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

COMMITTEE MEETING ACTION: Reject
SUBMITTER: Steffen Kohleisen, METZ Aerials USA
RECOMMENDATION: Revise text to read as follows:

The requirement, that the monitor must be capable of flowing 1,000 gpm prevents the use of lightweight medium duty ladders. Departments with limited space cannot get a pre-piped waterway/monitor assembly that would allow them to flow 300 to 700 gpm.

COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The committee has invested considerable time and effort to develop a standard for water system flows from aerial ladders, elevating platforms and water towers. These ratings have improved the safety of these devices and the committee feels it is regressive to reduce the current minimums. Manufacturers have had to redesign products to meet this standard.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28
A large platform with a payload of 750 lb. or more weighs up to 80,000 lb. The resulting turning radius of 80 to 90 ft wall to window or other opening onto the aerial platform.

COMMITTEE STATEMENT: The committee is not changing the size of the platform floor area as it feels that 7 sq. ft. of platform floor area is inadequate for fire fighters with protective clothing and SCBA, and allows no room when it is necessary during a rescue to bring a victim from a window or other opening onto the aerial platform.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

The system shall be controlled by the British Standards Institute (BSI) standard for fire appliances. A water curtain system (together with the pre-piped waterway) shall be a minimum of 2,000 gpm (7500 l/min) nozzles, with the water delivery system full of water but not discharging, in any position of operation.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

A department should have the choice to purchase an elevating platform strictly for rescue and they should be able to choose from a 2,3, or 4-man platform. A pre-piped waterway and a 500, a 750, or a 1000 gpm monitor should be available as an option.

COMMITTEE MEETING ACTION: Accept in Part
COMMITTEE STATEMENT: The steps and the floor of the platform shall be provided with skid-resistant surfaces that meet the requirements of 13-7.3.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

Accept

COMMITTEE MEETING ACTION: Accept
COMMITTEE STATEMENT: It is a safety issue not to have a water curtain under the platform to protect the occupants.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

A water curtain system (together with the pre-piped waterway) adds to the total weight (and cost) of the apparatus. A department that wants to use this unit mainly for rescue should be able to choose the water curtain system as an option.

A typical NFPA compliant elevating platform is at least 45 ft long and weighs up to 80,000 lb. The resulting turning radius of 80 to 90 ft wall to wall is too large to maneuver such an apparatus through small town streets. The size of these apparatus is a result of the requirements of NFPA 1901, where elevating platforms have to be equipped with a large platform with a minimum capacity of 750 lb., and a pre-piped waterway capable of flowing at least 1000 gpm through one or more permanently mounted monitors. A small town department that uses their aerial mainly for rescue and very seldom for fire fighting, would still have to purchase an elevating platform equipped with a pre-piped waterway and a permanently mounted monitor.

COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: It is a safety issue not to have a water curtain under the platform to protect the occupants.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

A department should have the choice to purchase an elevating platform strictly for rescue and they should be able to choose from a 2,3, or 4-man platform. A pre-piped waterway and a 500, a 750, or a 1000 gpm monitor should be available as an option.

COMMITTEE MEETING ACTION: Accept
COMMITTEE STATEMENT: The steps and the floor of the platform shall be provided with skid-resistant surfaces that meet the requirements of 13-7.3.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

A water curtain system (together with the pre-piped waterway) adds to the total weight (and cost) of the apparatus. A department that wants to use this unit mainly for rescue should be able to choose the water curtain system as an option.

A typical NFPA compliant elevating platform is at least 45 ft long and weighs up to 80,000 lb. The resulting turning radius of 80 to 90 ft wall to wall is too large to maneuver such an apparatus through small town streets. The size of these apparatus is a result of the requirements of NFPA 1901, where elevating platforms have to be equipped with a large platform with a minimum capacity of 750 lb., and a pre-piped waterway capable of flowing at least 1000 gpm through one or more permanently mounted monitors. A small town department that uses their aerial mainly for rescue and very seldom for fire fighting, would still have to purchase an elevating platform equipped with a pre-piped waterway and a permanently mounted monitor.

COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: It is a safety issue not to have a water curtain under the platform to protect the occupants.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

A department should have the choice to purchase an elevating platform strictly for rescue and they should be able to choose from a 2,3, or 4-man platform. A pre-piped waterway and a 500, a 750, or a 1000 gpm monitor should be available as an option.

COMMITTEE MEETING ACTION: Accept
COMMITTEE STATEMENT: The steps and the floor of the platform shall be provided with skid-resistant surfaces that meet the requirements of 13-7.3.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

A water curtain system (together with the pre-piped waterway) adds to the total weight (and cost) of the apparatus. A department that wants to use this unit mainly for rescue should be able to choose the water curtain system as an option.

A typical NFPA compliant elevating platform is at least 45 ft long and weighs up to 80,000 lb. The resulting turning radius of 80 to 90 ft wall to wall is too large to maneuver such an apparatus through small town streets. The size of these apparatus is a result of the requirements of NFPA 1901, where elevating platforms have to be equipped with a large platform with a minimum capacity of 750 lb., and a pre-piped waterway capable of flowing at least 1000 gpm through one or more permanently mounted monitors. A small town department that uses their aerial mainly for rescue and very seldom for fire fighting, would still have to purchase an elevating platform equipped with a pre-piped waterway and a permanently mounted monitor.

COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: It is a safety issue not to have a water curtain under the platform to protect the occupants.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

A department should have the choice to purchase an elevating platform strictly for rescue and they should be able to choose from a 2,3, or 4-man platform. A pre-piped waterway and a 500, a 750, or a 1000 gpm monitor should be available as an option.

COMMITTEE MEETING ACTION: Accept
COMMITTEE STATEMENT: The steps and the floor of the platform shall be provided with skid-resistant surfaces that meet the requirements of 13-7.3.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

A water curtain system (together with the pre-piped waterway) adds to the total weight (and cost) of the apparatus. A department that wants to use this unit mainly for rescue should be able to choose the water curtain system as an option.

A typical NFPA compliant elevating platform is at least 45 ft long and weighs up to 80,000 lb. The resulting turning radius of 80 to 90 ft wall to wall is too large to maneuver such an apparatus through small town streets. The size of these apparatus is a result of the requirements of NFPA 1901, where elevating platforms have to be equipped with a large platform with a minimum capacity of 750 lb., and a pre-piped waterway capable of flowing at least 1000 gpm through one or more permanently mounted monitors. A small town department that uses their aerial mainly for rescue and very seldom for fire fighting, would still have to purchase an elevating platform equipped with a pre-piped waterway and a permanently mounted monitor.

COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: It is a safety issue not to have a water curtain under the platform to protect the occupants.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

A department should have the choice to purchase an elevating platform strictly for rescue and they should be able to choose from a 2,3, or 4-man platform. A pre-piped waterway and a 500, a 750, or a 1000 gpm monitor should be available as an option.

COMMITTEE MEETING ACTION: Accept
COMMITTEE STATEMENT: The steps and the floor of the platform shall be provided with skid-resistant surfaces that meet the requirements of 13-7.3.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

A water curtain system (together with the pre-piped waterway) adds to the total weight (and cost) of the apparatus. A department that wants to use this unit mainly for rescue should be able to choose the water curtain system as an option.
SUBSTANTIATION: By reducing the minimum capacity of an elevating platform the entire apparatus may be built smaller and lighter. A department would then be able to choose a 2, 3, or 4-man platform, depending on their needs.

A typical NFPA compliant elevating platform is at least 45 ft long and weighs up to 80,000 lb. The resulting turning radius of 80 to 90 ft wall to wall is too large for small town streets where elevating platforms have to be equipped with a large platform with a minimum capacity of 750 lb, and a pre-piped waterway capable of flowing at least 1000 gpm through one or more permanently mounted monitors. The size of these apparatus is a result of the requirements of NFPA 1901, where elevating platforms have to be equipped with a large platform with a minimum capacity of 750 lb, and a pre-piped waterway capable of flowing at least 1000 gpm through one or more permanently mounted monitors. A small town department that uses their aerial mainly for rescue and very seldom for fire fighting, would still have to purchase an elevating platform equipped with a pre-piped waterway and a permanently mounted monitor. Although according to different studies and essays (i.e. Leading with Ladders, by Michael A. Wieder, National Fire and Rescue July/August 2001) the rated capacity set forth in Section 18-19-159 is 227 kg (500 lb) from the platform with the booms or sections and the monitors and nozzles positioned in any configuration allowed by the manufacturer while carrying a minimum load of 257 kg (560 lb) 114 kg (250 lb) on the platform.

SUBSTANTIATION: A water delivery system should be optional on elevating platforms like it is on aerial ladders. A permanent waterway adds weight to the aerial apparatus and significantly increases its cost. The department should be able to decide whether they want one or not. The rated weight capacity while flowing water should be reduced according to our proposal on section 18-8.1.

A typical NFPA compliant elevating platform is at least 45 ft long and weighs up to 80,000 lb. The resulting turning radius of 80 to 90 ft wall to wall is too large to maneuver such an apparatus through small town streets. The size of these apparatus is a result of the requirements of NFPA 1901, where elevating platforms have to be equipped with a large platform with a minimum capacity of 750 lb, and a pre-piped waterway capable of flowing at least 1000 gpm through one or more permanently mounted monitors. A small town department that uses their aerial mainly for rescue and very seldom for fire fighting, would still have to purchase an elevating platform equipped with a pre-piped waterway and a permanently mounted monitor. Although according to different studies and essays (i.e. Leading with Ladders, by Michael A. Wieder, National Fire and Rescue July/August 2001) the rated capacity set forth in Section 18-19-159 is 227 kg (500 lb) from the platform with the booms or sections and the monitors and nozzles positioned in any configuration allowed by the manufacturer while carrying a minimum load of 257 kg (560 lb) 114 kg (250 lb) on the platform.

COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The committee has invested considerable time and effort to develop a standard for water system flows from aerial ladders, elevating platforms and water towers. These ratings have produced safe vehicles for the fire service. The committee feels it is regressive to reduce the current minimum capacities.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-159-(18-9.2) : Reject
SUBMITTER: Karl Molf, Surfside Beach, SC
RECOMMENDATION: Revise 18-9.2 to read as follows:

Provisions shall be made for lower station controls to override the platform station controls. This provision shall be in the form of a “RED” button a minimum of an one inch marked “EMERGENCY STOP” or a foot pedal at the lower station control.

SUBSTANTIATION: There are elevating platforms where the platform operations can only be overridden by placing the “Platform” toggle switch in the OFF position. This means the operator/safety person stationed on the platform must look for the platform toggle switch. This could take valuable time and set up a dangerous situation if the person operating the platform controls doesn’t see wires or other obstruction that could put the firefighters in danger.

COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The committee feels this product should have a built in waterway system.
COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The committee has invested considerable time and effort to develop a standard for water system flows from aerial ladders, elevating platforms, and water towers. These ratings have improved the safety of these devices and the committee feels it is regressive to reduce the current minimums. Manufacturers have had to redesign products to meet this standard.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

COMMITTEE STATEMENT: The water delivery system is provided it shall be capable of delivering a minimum of 500 gpm (1893 l/min), 1000 gpm (3780 l/min) at 100 psi (690 kPa) nozzle pressure with the elevating platform at rated vertical height.

SUBSTANTIATION: A water delivery system should be optional on elevating platforms like it is on aerial ladders. A permanent nozzle connection adds weight to the aerial apparatus and significantly increases its cost. The department should be able to decide whether they need one or not.

By reducing the required water flow the apparatus may be built smaller and lighter.

A typical NFPA compliant elevating platform is at least 45 ft long and weighs up to 80,000 lb. The resulting turning radius of 80 to 90 ft will be too large to maneuver such an apparatus through small town streets. The size of these apparatus is a result of the requirements of NFPA 1901, where elevating platforms have to be equipped with a large platform with a minimum capacity of 750 lb, and a pre-piped waterway capable of flowing at least 1000 gpm through one or more permanently mounted monitors.

A small town department that uses their aerial mainly for rescue and very seldom for fire fighting, would still have to purchase an elevating platform equipped with a pre-piped waterway and a permanently mounted monitor. Although according to different studies and essays (i.e. Leading with Ladders, by Michael A. Wieder, National Fire and Rescue July/August 2001) rescue is the first priority of an aerial apparatus and fire fighting is the least important. If this truck would be too big to operate in their town, the only other option would be a straight ladder.

Performing a rescue from a straight ladder, however, puts both fire fighters and victims at great risk. The safest way to rescue people that are not used to climbing ladders (like senior citizens and children) is to put them in a basket or a platform and bring them to the ground.

A department should have the choice to purchase an elevating platform strictly for rescue and they should be able to choose from a 2,3, or 4-man platform. A pre-piped waterway and a 500, a 750, or a 1000 gpm monitor should be available as an option.

COMMITTEE STATEMENT: The committee has invested considerable time and effort to develop a standard for water system flows from aerial ladders, elevating platforms and water towers. These ratings have improved the safety of these devices and the committee feels it is regressive to reduce the current minimums. Manufacturers have had to redesign products to meet this standard.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The second part of this draft refers to NFPA 1901-163-(18-12.1) which has been rejected. The committee feels that this standard should not be reduced.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28
meeting the stability requirements of Section 18-21. Using these systems makes aerial operation much safer than overriding (deactivating) the interlocks.

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: Language in the standard already accomplishes the objective to be achieved by this proposal.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-168-(18-17.6) : Accept

SUBMITTER: Steffen Kohllesen, METZ Aerials USA

RECOMMENDATION: Revise text to read as follows:

Where a three-lever system is used to control the basic functions of the aerial device, the levers shall be distinctively different from the other controls on the panel, and arranged adjacent to each other with the extension control being the left lever, the rotation control being the center lever, and the elevation control being the right lever. Where a two-lever system is used, the extension control shall be to the left and a combination lever for rotation and elevation shall be to the right.

SUBSTANTIATION: Since combination levers are available there has to be a regulation for their use. The proposal is conforming to the requirement for the three-lever system for extension and elevation.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-169-(18-17.8) : Reject

SUBMITTER: Karl Marzolf, Surfside Beach, SC

RECOMMENDATION: Revise 18.17.8 to read as shown:

All controls regulating the movement of the aerial device shall automatically return to the neutral position, with that aeronautical function coming to an immediate stop upon release by the operator.

SUBSTANTIATION: There are elevating platforms where both the turntable and platform controls are electrically controlling hydraulic valves. When any function is performed there is a 2 to 3 second delay built-in to the system when you bring the control handle to the neutral position. This means if you are rotating and move the control handle to the neutral position the platform will continue to move 2 to 3 seconds before it stops. This makes it next to impossible to come up to a window for a rescue and do it safely. The same applies to extension and elevation. When going to the roof of a building with the intention of setting the platform on or near the roof, with the 2 to 3 second delay the platform comes down hard on the roof and puts reverse strain on the ladder which will eventually cause a ladder failure.

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: Ramping is proper for safe operation as immediate stops are potentially hazardous to the platform operator and place excessive loading on the aerial device.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-170-(18-18.1) : Accept

SUBMITTER: Steffen Kohllesen, METZ Aerials USA

RECOMMENDATION: Revise text to read as follows:

If the operator’s position is on the turntable, the turntable platform shall be provided with a railing at least 1067 mm (42 in) high. The railing design shall be capable of withstanding a 102 kg (225 lb) force applied at any point from any direction without permanent deformation. Where the operator’s position is equipped with an operator’s seat, the seat shall be provided with a railing or an armrest capable of withstanding a 102 kg (225 lb) force applied at any point from the inside of the seat.

SUBSTANTIATION: Some aerial manufacturers use operator seats at the turntable. There needs to be a requirement for the railing.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-171-(18-20.3) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus,

RECOMMENDATION: Revise the first sentence of 18-20.3 (20.20.3 in the draft) to read as follows:

Wire rope, chain, and attaching systems used to extend and retract the fly sections or booms shall have a 5:1 safety factor based on ultimate strength under all normal operating conditions allowed by the manufacturer.
little protection and so the reverse is true. There is less likelihood of running out of CAFS foam at 0.2 – 0.3% than there is of having a power or water related issue. The less protection the less protection using this extra water technique which makes a very watery milky foam and really cannot be called CAFS. It is much closer to aspirated foam, not nearly as effective or good quality CAFS foam.

It is important to understand why the low pressure concept in CAFS Systems offers greater safety and is much more effective over the full range of fire situations most fire departments have to contend with. The reason is most low pressure systems usually use medium foam – 10:1 expanded foam. This applies a 1/4 to 3/8 in. thick layer of foam over most knock down and protection which provides excellent fire fighter protection. When a fire fighter paints his or her way into a structure fire situation with medium CAFS foam, there is always greater safety if something goes wrong – power supply, water side or foam side fails. The fire fighter, by painting his or her way into the structural fire, always has a way out. Anyone who has ever tried to set fire to a room after it has had good CAFS foam applied knows how hard it is to get a fire started again.

CAFS Designations

With the development of CAFS in Canada and the USA, different types of CAFS Systems have evolved. For the lack of a better designation, I have for the following criteria to indicate the basic differences in the systems – Low pressurized systems Type A and high pressure Type B.

Low-pressure systems generally operate between forty and one hundred and twenty pounds per square inch (ps) and these systems normally operate in the 50 to 80 psi range when delivering CAFS foam. Low pressure systems are also capable of delivering foam more than 4000 ft in a 1 1/2 in. (38 mm) hose on level land and can deliver foam seven to eight hundred feet in height in the same size of hose. These systems deliver 35 to 400 gallons of foam solution per minute.

Low pressure CAFS Systems can be grouped into three basic sizes – Low pressure Type I CAFS 35 to 60 gpm single line CAF Systems. On the smaller end of these systems an aspirated foam line is often used as a back up line.

The Low-Pressure Type II CAFS range of low pressure CAFS Systems operate 70 to 120 gpm of foam solution. These systems generally operate two 1 1/2 in. (38 mm) CAFS lines, a small monitor and also may supply a tele a squirt or ladder unit.

The Low Pressure Type III CAFS range of low pressure CAFS Systems operate from 140 to 400 plus gpm. Generally these systems will operate one 2 1/2 in. and two to three 1 1/2 in. – 1 3/4 in. hand lines and a monitor of coarse elevated devices – ladders etc.

All of these CAFS systems are capable of making the four types of CAFS foam – wet, medium, dry and very dry foam. It should be noted that there are several hundred low pressure rapid response CAFS Systems operating in Canada and USA of the I and II sizes. Most of these systems have been put in place within the last five years and they for the most part are first line units or the only unit for the fire departments. These units are not to be confused with wild land units or brush trucks of which there are many hundreds of units. Most of these fire department systems can be evenly divided between AI and AII CAF Systems, with the trend to more type A-II units in the 80 – 100 gallon dual CAFS units.

• Most low pressure CAFS Systems incorporate the following:
  • Four wheel drive trucks either two man or four man cabs with ratings of 12,000 to 19,000 lb GVW.
  • Truck bodies of either nine foot or 12 foot full bodies.
  • The CAFS Systems on board this unit incorporate 200 to 500 (US) gallon water tanks, single or double CAF Systems.
  • Most have roll out CAF Systems for easy maintenance and service.

The High Pressure Type systems are well documented in NFPA but even they need work, such as using two gallons of water for one SCFM of air. This should be changed to one SCFM of air to one gallon of water. If there is a requirement for extra water for a specific department, then it may be added. Again High Pressure systems need to be capable of producing the four types of foam. Wet, Medium, dry and very dry.

Testing should be such that at least the four types of foam have been produced and the recommended size of the hand line valve and tip is outlined for each CAF unit.

COMMITTEE STATEMENT: Reject

COMMITTEE MEETING ACTION: Reject

COMMITTEE MEETING ACTION: Affirmative 28

COMMITTEE STATEMENT: NFPA 1901 defines the requirements for systems and components installed on fire apparatus and CAFS is one such system. The committee is not interested in developing a separate standard for only the component systems. Systems designed to the current CAFS requirements are being used in the field and are acceptable to users. If the submitter feels a need for change to the current requirements, he should submit specific wording together with test data to show that such systems will work effectively together with the fires that fire fighters using apparatus designed to NFPA 1901, expect to extinguish.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: Affirmative 28

1901-175-(19-3.6) : Reject

SUBMITTER: Tom Reser, Edwards Manufacturing Inc.

RECOMMENDATION: Revise 19-3.6 to read as follows:

A means shall be provided to prevent water backflow into the foam proportioning system and the foam concentrate storage tank. Where water is supplied directly from a potable water source, this requirement shall be to prevent foam solution backflow into the water source.

SUBSTANTIATION: The requirement for a means to prevent foam solution backflow into a potable water supply was eliminated from this revision. For reasons of public safety, this requirement needs to be reinstated. The proposed language does not pose undue hardship on any foam proportioning system manufacturer or user since the water source that is being protected is defined and qualified.

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: This is an operator training issue. There is not a practical, cost effective way to solve this issue.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: Affirmative 28

1901-176-(19-3.7) : Reject

NOTE: This Proposal appeared as Comment 1901-168 (Log #42) which was held from the May 1999 ROC on Proposal 1901-217.


RECOMMENDATION: Insert new paragraph to read as follows:

19-3.7* A means shall be provided to prevent contamination of an external water source with foam concentrate or foam solution.

SUBSTANTIATION: Automatic controlled foam proportioning systems that inject foam concentrate into the water pump discharge at a higher pressure than the water discharge pressure have the potential to force foam concentrate or foam solution into the external water source.

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: This is an operator training issue. There is not a practical, cost effective way to solve this issue.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: Affirmative 28

1901-177-(19-3.7) : Reject

NOTE: This Proposal appeared as Comment 1901-170 (Log #152) which was held from the May 1999 ROC on Proposal 1901-217.

SUBMITTER: Mark Haider, Waterous Co.

RECOMMENDATION: Add new paragraph 19-3.7 and renumber subsequent paragraphs.

Paragraph to read “A means shall be provided to prevent foam solution backflow into the water supply.”

Appendix A-19-3.6 should then be changed to A-19-3.7.

SUBSTANTIATION: The paragraph stresses the importance of protecting the water supply. Some means or method is needed to insure the water supply is safe from foam solution/concentrate contamination.

Section A-19-3.6 is more relevant to this new paragraph 19-3.7 then the present 19-3.6.

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: This is an operator training issue. There is not a practical, cost effective way to solve this issue.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: Affirmative 28

1901-178-(19-3.8) : Reject

NOTE: This Proposal appeared as Comment 1901-171 (Log #123) which was held from the May 1999 ROC on Proposal 1901-137.

SUBMITTER: Tom Reser, Edwards Manufacturing Inc.

RECOMMENDATION: Add text to read as follows:

19-3.8* A means shall be provided to prevent foam concentrate or foam solution from contaminating the water source.”

SUBSTANTIATION: Many injection type or balanced pressure proportioned foam systems can introduce foam concentrate into the water pump and water source. Contamination of the water source must be avoided, certainly when operating on a hydrant system.

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: This is an operator training issue. There is not a practical, cost effective way to solve this issue.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: Affirmative 28
NFPA 1901 — May 2003 ROP — Copyright, NFPA

1901-179-(19-3.8) : Reject
NOTE: This Proposal appeared as Comment 1901-172 (Log #155) which was held from the May 1999 ROC on Proposal 1901-123.

SUBMITTER: Phil Turner, Elkhart Brass
RECOMMENDATION: The March 1998 draft had a Section 19-3.8 that should remain in the standard. “If the foam proportioning system injects foam concentrate on the discharge side of the water pump, a means shall be provided to automatically prevent foam concentrate and foam solution from flowing back into the water pump or water tank.

SUBSTANTIATION: This is an important feature of a foam system that the user and designer must be aware of. Further, a means to prevent the water source from becoming contaminated must be supplied.

COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: This is an operator training issue. There is not a practical, cost effective way to solve this issue.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 28

1901-180-(19-3.8) : Reject
NOTE: This Proposal appeared as Comment 1901-173 (Log #191) which was held from the May 1999 ROC on Proposal 1901-123.

SUBMITTER: Thomas High, Pierce Manufacturing Inc.
RECOMMENDATION: Add text to read as follows:
If total capacity of the foam proportioning system is less than 15 gallons per minute (56.7 l/min) of foam concentrate, and injects foam concentrate into the discharge side of the water pump, a means shall be provided to automatically prevent foam concentrate and foam solution from flowing back into the water pump or water tank.

SUBSTANTIATION: In response to Mr. Ruhl’s concern about adding additional seemingly unnecessary expense to a foam system, this argument is valid in the large industrial balanced pressure foam systems, where the pump operator can see the discharge lines and would be aware if a line was shut down.

This is rarely the case with the typical municipal engine. The hose lines are stretched from the engine into the building. The foam systems currently used on the municipal apparatus are typically designed to proportion Class A type foam concentrates. The Class A concentrates are very susceptible to back flow into the water pump, which can then back flow into the municipal water system. The check valve in the discharge side of the water pump would prevent the foam concentrate from entering the municipal water system. This is more of a concern to the municipal Fire Department than it would be to the industrial department.

The typical municipal Fire Department pump operator is required to perform many different tasks at an emergency scene. The operator may not always be able to observe the handlines and shut off the foam system if the handlines are shut down. The addition of an automatic check valve in the discharge piping would make the system more user friendly and prevent any unnecessary contamination of a public water supply.

COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: This is an operator training issue. There is not a practical, cost effective way to solve this issue.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 28

1901-181-(19-7.3) : Accept
SUBMITTER: Technical Committee on Fire Department Apparatus,
RECOMMENDATION: Revise 19-7.3 (21.7.3 in the draft) to read as follows:
The drivetrain components that transmit power to the foam concentrate pump shall be capable of providing the performance listed on the plate required in 19-9.3 as a continuous duty basis.

SUBSTANTIATION: The current wording is ambiguous and the revised wording is to clarify the intent of the requirement.

COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 28

1901-182-(19-10) : Accept in Principle
SUBMITTER: Dan W. McKenzie, USDA Forest Service
RECOMMENDATION: Replace the last two sentences with: “Foam proportioning system accuracy shall be ±30 percent of proportioner setting below 1 percent foam and for 1 percent and above percent foam ±15 percent of proportioner setting.”

SUBSTANTIATION: Foam proportioners are used with both class A and class B foams. A proportioner used with class A foam is now set up with a target of the proportioner actual setting while the proportioner or class B foam is set up with a target of 115 percent of the proportioner actual setting. They both should be set up with a target of the proportioner actual setting. Many proportioners now in use can hit the target is 115 percent of proportioner setting this means they are using more foam than necessary and this will result in the foam pumping operation not lasting as long as it could.

COMMITTEE MEETING ACTION: Accept in Principle
Revise the third sentence of 19-10 (see 21.10.2.1 of the draft) to read as follows:
Systems designed to produce foam solution at ratios of less than 1 percent shall proportion foam concentrate to an accuracy of -0/+40 percent.

COMMITTEE STATEMENT: Class B foams are tested at a specific ratio of foam concentrate to water. Because of the manner in which class B foams work in suppressing the release of flammable liquid vapors, the foam may not work properly if used at a ratio less than its tested ratio. Some foams for application on Class B fires are now starting to appear on the market that have suggested ratios of less than 1 percent. Therefore the committee feels that no minus percent should be allowed in the accuracy of foam proportioners.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 28

1901-183-(19-10) : Accept in Principle
RECOMMENDATION: Current Language:
Systems designed to produce foam solution at ratios of less than 1 percent shall proportion foam concentrate to an accuracy of +/- 20 percent.
Systems designed to produce foam solution at ratios of 1 percent or greater shall proportion foam concentrate to an accuracy of -0/+30 percent or 1 percentage point, whichever is less.

1901-184-(19-10) : Accept in Principle
RECOMMENDATION: Current Language:
Systems designed to produce foam solution at ratios of less than 1 percent shall proportion foam concentrate to an accuracy of +/-30 percent.
Systems designed to produce foam solution at ratios of 1 percent or greater shall proportion foam concentrate to an accuracy of ±0/+40 percent.

COMMITTEE MEETING ACTION: Accept in Principle
Revise the third sentence of 19-10 (see 21.10.2.1 of the draft) to read as follows:
Systems designed to produce foam solution at ratios of less than 1 percent shall proportion foam concentrate to an accuracy of ±0/±40 percent.

COMMITTEE STATEMENT: Class B foams are tested at a specific ratio of foam concentrate to water. Because of the manner in which class B foams work in suppressing the release of flammable liquid vapors, the foam may not work properly if used at a ratio less than its tested ratio. Some foams for application on Class B fires are now starting to appear on the market that have suggested ratios of less than 1 percent. Therefore the committee feels that no minus percent should be allowed in the accuracy of foam proportioners.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 28

1901-185-(19-10) : Accept in Principle
RECOMMENDATION: Current Language:
Systems designed to produce foam solution at ratios of less than 1 percent shall proportion foam concentrate to an accuracy of +/-30 percent.
Systems designed to produce foam solution at ratios of 1 percent or greater shall proportion foam concentrate to an accuracy of ±0/+40 percent.

COMMITTEE MEETING ACTION: Accept in Principle
Revise the third sentence of 19-10 (see 21.10.2.1 of the draft) to read as follows:
Systems designed to produce foam solution at ratios of less than 1 percent shall proportion foam concentrate to an accuracy of ±0/±40 percent.

COMMITTEE STATEMENT: Class B foams are tested at a specific ratio of foam concentrate to water. Because of the manner in which class B foams work in suppressing the release of flammable liquid vapors, the foam may not work properly if used at a ratio less than its tested ratio. Some foams for application on Class B fires are now starting to appear on the market that have suggested ratios of less than 1 percent. Therefore the committee feels that no minus percent should be allowed in the accuracy of foam proportioners.

NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 28

855
Why the need for new language:

Technical Committee on Fire Department Apparatus,

Revise 21-4.4 (23.4.4 of the draft) to read as

Accept

This is already covered by other requirements in this

Delete 21-2.1 and its appendix

The paragraph is poorly written but it is being

Accept

Accept in Principle

Technical Committee on Fire Department Apparatus,

Flowmeters are not required or needed for proper

Accept

Accept

AFFIRMATIVE: 28
1901-189-(21-4.7.1 and 21-4.7.2) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus, RECOMMENDATION: Revise 21-4.7.1 and 21-4.7.2 (renumbered as 23.4.8 in the draft) to read as follows: 21-4.7.1 If the power source is rated at less than 8 \( \frac{3}{4} \) kW, a "power on" indicator shall be provided.
21-4.7.2 If the power source is rated at 3 kW or more but less than 8 \( \frac{3}{4} \) kW, a voltmeter shall be provided.

21-4.7.3* If the power source is rated at 8 kW or more, the following instrumentation shall be provided at the operator's panel: (1) Voltmeter (2) Amperage Current meters for each ungrounded leg (3) Frequency (cycle) meter (4) Power source hour meter

Move the first paragraph of A-21-4.7.2 to be A-21-5.3.1 and leave the existing second paragraph as the annex to A-21-4.7.3

SUBSTANTIATION: The new wording for 21-4.7.2 covers medium size generators that are more likely to power electric motors where low voltage is more serious, rather than just lights. Many 3 to 6.5 kW generators incorporate this voltmeter as standard.

COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-190-(21-4.10) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus, RECOMMENDATION: Revise 21-4.10 (23.4.11 of the draft) to read as follows: 21-4.10 If there is permanent wiring on the apparatus that is designed to be connected to the power source, a power source specification label shall be permanently attached to the apparatus at the operator's control station. The label shall provide the operator with the information detailed in Figure 21-4.10. In Figure 21-4.10, change the words "Nominal Rating" to "Continuous Duty Rating.
Delete the words "at rated voltage(s)."

SUBSTANTIATION: Changing "nominal rating" to "continuous duty rating" is a minor correction will assure that the generator rating is continuous duty rating for the applicable installation. The phrase "at rated voltages" is superfluous. The exception in the text means that portable generators not connected to wiring in the apparatus do not require a power source specification label.

COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-191-(21-5) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus, RECOMMENDATION: Add new section as 21-5 (see 23.5 in the draft) and renumber 21-5 Chassis Engine Driven Generators. Where the generator is driven by the chassis engine, the following requirements shall apply: 21-5.1 A "GENERATOR ENGAGED" indicator shall be provided in the driving compartment to indicate that the generator shaft has been successfully completed. Completion of the generator shift may require that the chassis transmission be shifted into the proper gear (split shaft PTO's only). This indicator is not required if the generator is always engaged. 21-5.2 An "OK TO OPERATE GENERATOR" indicator shall be provided in the driving compartment to indicate that the generator is engaged, transmission is in the proper gear (automatic transmissions only), and the parking brake is engaged. This indicator is not required if the generator is always engaged and operating. 21-5.3 An interlock system shall be provided to prevent advancement of the engine speed in the cab or at an operator's panel unless the transmission is in neutral and the parking brake is engaged, or the apparatus is in the "OK TO PUMP" or "OK TO OPERATE GENERATOR" mode. Delete sections 21-5.1.6, 21-5.1.6.1, 21-5.1.6.2, 21-5.1.7, 21-5.1.7.1, 21-5.1.7.2, 21-5.1.8, 21-5.2.4, 21-5.2.4.1 and renumber as needed.

SUBSTANTIATION: This rewrite is for simplification and unification of requirements. It brings these requirements in line with changes made in the fire pump chapter.

COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-192-(21-5.1.6.3) : Accept in Principle

SUBMITTER: Lisa S. Breu, Pierce Manufacturing Inc. RECOMMENDATION: Add new text as follows: "An "OK to Operate Generator" indicator shall be provided at the operators panel that is energized when the "OK to operate generator" indicator is energized in the driving compartment.

SUBSTANTIATION: The section for generators driven by the main driveline, 21-5.1.6, does not specify an indicator at the operator's panel. This section should be similar to the PTO Driven generator section 21-5.1.7. The indicator at the operator's panel should notify the operator when the generator is ready for use.

COMMITTEE MEETING ACTION: Accept in Principle
COMMITTEE STATEMENT: See Proposal 1901-191 (Log #CP75) which the committee believes meets the submitter's intent.
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-193-(21-5.1.7.2) : Accept in Principle

SUBMITTER: Lisa S. Breu, Pierce Manufacturing Inc. RECOMMENDATION: Revise text as follows: A "Throttle Ready" 'Generator Engaged" indicator shall be posted at the operator's panel that is energized when the "Generator Engaged" indicator is energized, or when the chassis transmission is in neutral and the parking brake is engaged.

SUBSTANTIATION: The indicator at the operators panel should be consistent with the driving compartment indicator. Also, there may not be a means to control the throttle at the operator's panel. The "ok to operate generator" indicator is not defined in the PTO Generator section 21-5.1.7. Only a "generator engaged" indicator is defined.

COMMITTEE MEETING ACTION: Accept in Principle
COMMITTEE STATEMENT: See Proposal 1901-191 (Log #CP75) which the committee believes meets the submitter's intent.
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-194-(21-5.2.2) : Reject

SUBMITTER: Lisa S. Breu, Pierce Manufacturing Inc. RECOMMENDATION: Delete entire section.

SUBSTANTIATION: This section limits the size of the generator which may be used without affecting pumping operations. For example, the torque and speed requirements for a pump on a 30 kW generator may not allow operation at idle. If the engine speed is automatically increased to allow generator operation, the pressure control system for the pump may not operate.

COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The committee feels this paragraph is still important and has actually strengthened the requirement. See Proposal 1901-195 (Log #CP76).
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-195-(21-5.2.2) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus, RECOMMENDATION: Revise 21-5.2.2 to read as follows (See 23.6.2.3 and 23.6.2.4 of the draft): 21-5.2.2 A hydraulic generator system shall operate at all engine speeds, or smaller size hydraulic generators are acceptable for these applications. The power source label might specify a reduced output below some RPM to limit torque requirements on the PTO.

COMMITTEE MEETING ACTION: Accept
COMMITTEE STATEMENT: The committee feels this paragraph is still important and has actually strengthened the requirement. See Proposal 1901-195 (Log #CP76).
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28
Corrosion resistant metals such as aluminum, stainless steel, and copper are acceptable as well as corrosion protected metals such as galvanized steel, plastic coated steel and enameled steel.

**COMMITTEE MEETING ACTION**: Accept

**NUMBER OF COMMITTEE MEMBERS**: 28

**VOTE ON COMMITTEE ACTION**: AFFIRMATIVE: 28

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**SUBMISSION**: Technical Committee on Fire Department Apparatus

**RECOMMENDATION**: Revise 21-10.5.2 (23.12.5.2 in the draft) to read as follows:

- 21-10.5.2 All receptacles located in a dry location shall be of the grounding type. Receptacles shall be not less than 30 in. (762 mm) above the indoor floor height.

**SUBSTANTIATION**: If it is a dry location there is no need for the receptacles to be over 12 inches high. Typical receptacles in a building are 12 inches off the floor. This will allow receptacles inside of crew cabs near seat areas.

**COMMITTEE MEETING ACTION**: Accept

**NUMBER OF COMMITTEE MEMBERS**: 28

**VOTE ON COMMITTEE ACTION**: AFFIRMATIVE: 28

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**SUBMISSION**: Technical Committee on Fire Department Apparatus

**RECOMMENDATION**: Revise 21-11.5 (23.13.5 in the draft) to read as follows:

- Electrical cord shall be Type SEOW-A, SOOW-A or Type STOOW-A.

**SUBSTANTIATION**: The cable should be oil resistant (the extra O) as well as wet location (the W) and outdoor (the A).

**COMMITTEE MEETING ACTION**: Accept

**NUMBER OF COMMITTEE MEMBERS**: 28

**VOTE ON COMMITTEE ACTION**: AFFIRMATIVE: 28

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**SUBMISSION**: Technical Committee on Fire Department Apparatus

**RECOMMENDATION**: Add a new paragraph as 21-12.4 (23.14.4 in the draft):

- Pole lights that extend need to be safely operable.

**COMMITTEE MEETING ACTION**: Accept

**NUMBER OF COMMITTEE MEMBERS**: 28

**VOTE ON COMMITTEE ACTION**: AFFIRMATIVE: 28

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**SUBMISSION**: Technical Committee on Fire Department Apparatus

**RECOMMENDATION**: Revise 21-5.5.2 (23.6.5.3 in the draft) to read as follows:

- Where the generator apparatus is to be used for either stationary or direct drive

**SUBSTANTIATION**: Existing 21-5.2 only applies to hydraulically driven generators.

**COMMITTEE MEETING ACTION**: Accept

**NUMBER OF COMMITTEE MEMBERS**: 28

**VOTE ON COMMITTEE ACTION**: AFFIRMATIVE: 28

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**SUBMISSION**: Technical Committee on Fire Department Apparatus

**RECOMMENDATION**: Add a new paragraph as 21-9.3 (23.11.3.1 in the draft) to read as follows:

- Supports shall be made of nonmetallic materials or corrosion resistant or corrosion protected metal.

**COMMITTEE MEETING ACTION**: Accept

**NUMBER OF COMMITTEE MEMBERS**: 28

**VOTE ON COMMITTEE ACTION**: AFFIRMATIVE: 28

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**COMMITTEE STATEMENT**: See Proposal 1901-191 (Log #CP75) which totally deletes this paragraph.

**NUMBER OF COMMITTEE MEMBERS**: 28

**VOTE ON COMMITTEE ACTION**: AFFIRMATIVE: 28

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**COMMITTEE STATEMENT**: See Proposal 1901-191 (Log #CP80) which totally deletes this paragraph.

**NUMBER OF COMMITTEE MEMBERS**: 28

**VOTE ON COMMITTEE ACTION**: AFFIRMATIVE: 28

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**COMMITTEE STATEMENT**: See Proposal 1901-191 (Log #CP83) which totally deletes this paragraph.

**NUMBER OF COMMITTEE MEMBERS**: 28

**VOTE ON COMMITTEE ACTION**: AFFIRMATIVE: 28

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**COMMITTEE STATEMENT**: See Proposal 1901-191 (Log #CP85) which totally deletes this paragraph.

**NUMBER OF COMMITTEE MEMBERS**: 28

**VOTE ON COMMITTEE ACTION**: AFFIRMATIVE: 28

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**COMMITTEE STATEMENT**: See Proposal 1901-191 (Log #CP86) which totally deletes this paragraph.

**NUMBER OF COMMITTEE MEMBERS**: 28

**VOTE ON COMMITTEE ACTION**: AFFIRMATIVE: 28

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**COMMITTEE STATEMENT**: See Proposal 1901-191 (Log #CP75) which totally deletes this paragraph.

**NUMBER OF COMMITTEE MEMBERS**: 28

**VOTE ON COMMITTEE ACTION**: AFFIRMATIVE: 28
21-14.5.3 Frequency shall be maintained within ±5 cycles of the frequency specified on the power source specification label during the entire test.

21-14.5.3.4 The following conditions shall be recorded at least every 1/2 hour during the test.

(1) The voltage, frequency, and amperes at full rated load.

(2) The prime mover’s oil pressure, water temperature, transmission temperature, hydraulic fluid temperature, and the battery charge rate, as applicable.

(3) The ambient temperature and altitude.

21-14.5.3.6 The electrical loads and conditions specified in 13.14.3.4 shall be applied during the testing unless an auxiliary engine drives the power source.

21-14.5.3.7 If the apparatus is equipped with a fire pump, the 2-hour operational test of the fixed power source shall be completed with the fire pump pumping at 100 percent capacity at 150 psi (1000 kPa) net pump pressure. The test shall be permitted to be run concurrently with the pump certification test required in 16.13.1.

21-14.5.3.8 Accessories driven by the power source prime mover shall not be functionally disconnected or otherwise rendered inoperative during the line voltage electrical tests.

21-14.5.3.9 The following devices shall be permitted to be turned off or not operating during the fixed power source test:

(1) Aerial hydraulic pump
(2) Foam pump
(3) Hydraulically driven equipment
(4) Winch
(5) Windshield wipers
(6) Four-way hazard flashers

21-14.5.10 If the line voltage power is derived from the vehicle’s low-voltage system and is the primary source for line voltage, the power source shall not be shut off as a load management system during the two-hour test.

21-14.6 The results of each test shall be recorded on an appropriate form and provided with the delivery documentation.

Delete the last sentence of 14-13.2.1.3.

Delete A-21-14.11.

Remumber A-21-14.4.1 as A-21-14

Add an appendix item to A-21-14.5 to read as follows:

Commercially available small, intermittent duty low cost generators generally are advertised with power ratings tested under the most favorable operating conditions. Also, some generators are advertised at peak output or intermittent duty ratings, rather than continuous duty output. Where a generator will be subjected to higher than ideal operating temperatures, or the advertised rating is not a continuous duty rating, the apparatus manufacturer should de-rate the generator and provide the de-rated data on the power source specification label. The generator should then be tested at this de-rated condition. It is important that the power source specification label on the apparatus meets the fire department requirements for generator output as it indicates the rating to which the generator is tested. The Power Source Specification Label referred to in this paragraph will indicate the rating to which the generator will be tested and will represent the de-rated condition.

SUBSTANTIATION: In response to a request for formal interpretation of NFPA 1901, paragraph 14-13.2.1.3, the committee has reviewed the wording of this section. The proposed changes to the wording accomplish the following objectives:

The pump and power source interact with each other. They must be tested together but the statement in the 1999 version is ambiguous. The revised wording allows the pump and power source to be tested together, but a failure of the power source will not prevent finishing the complete pump test and then repeating the 2-hour portion of the test with the pump at capacity along with the power source.

Pump and generator testing require certification by a third party due to the critical nature of both generator and fire pump operations. Performance of line voltage power sources used to operate ventilation fans, lighting, or other fire scene equipment is considered mission critical. The proposed modification adds a requirement that line voltage power sources be certified by a third-party independent testing agency.

Portable generators are exempted from the certification and 2-hour test because they are completely independent of the apparatus.

Many commercial generators or poorly installed generators will not be able to perform on a continuous basis at their advertised rating. The procedure described requires the apparatus manufacturer to de-rate power sources when necessary to a demonstrable continuous performance level.

An appendix paragraph is being added to explain the relationship between generator output and heat, and educate the purchaser with regard to advertised ratings vs reality.

All fixed power sources are required to pass the same test, which mirrors realistic usage on the fire ground. The exception covers a short-term power source used only in-route until a generator is started at the fire ground.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28
AFFIRMATIVE: 28
VOTE ON COMMITTEE ACTION:  
COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28

1901-209-(22-9.2.1, and 22-9.2.2 (new)): Accept
SUBMITTER: Technical Committee on Fire Department Apparatus,  
RECOMMENDATION: Add two new paragraphs after 22-9.2 as follows: (see 24.9.3.1 and 24.9.3.2 in the draft):
- 22-9.2.1 Floor surfaces, walking surfaces, and access steps, shall comply with Section 13-7.
- 22-9.2.2 Access handrails shall comply with Section 13-8.

SUBSTANTIATION: This wording will clarify that the command area needs to comply with section 13-7 and 13-8.

COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-210-(22-11.2): Accept
SUBMITTER: Technical Committee on Fire Department Apparatus,  
RECOMMENDATION: Revise 22-11.2 (24.11.2 in the draft) to read as follows: All equipment not used during transit such as computer equipment shall be stored in cabinets or mounted to comply with Section 12-1.7.

SUBSTANTIATION: This wording will assure that equipment is adequately secured in the command or crew cab areas.

COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-208-(22-2.3): Accept
SUBMITTER: Technical Committee on Fire Department Apparatus,  
RECOMMENDATION: Delete existing 22-2.3.

Add wording as 12-1.10 (14.11.13 in the draft) to read as follows: Any interior area to be occupied by personnel shall have a minimum of two (2) means of escape. The opening shall be large enough for a person to escape through the opening.

Add an appendix to the new paragraph to read as follows:
- A-12-1.10 If the purchaser does not specify seating for personnel in an enclosed body area, a secondary means of escape is not required. If the purchaser “might” install such seating in the future, then it is recommended that the secondary escape provisions be provided when apparatus is purchased.

SUBSTANTIATION: The new wording better describes when escape provisions are required. Appendix items denotes the recommendation for providing the same, if seating is to be provided in future.

COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-208-(22-2.3): Accept
SUBMITTER: Technical Committee on Fire Department Apparatus,  
RECOMMENDATION: Delete existing 22-2.3.

Add wording as 12-1.10 (14.11.13 in the draft) to read as follows: Any interior area to be occupied by personnel shall have a minimum of two (2) means of escape. The opening shall be large enough for a person to escape through the opening.

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SUBSTANTIATION: The new wording better describes when escape provisions are required. Appendix items denotes the recommendation for providing the same, if seating is to be provided in future.

COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-210-(22-11.2): Accept
SUBMITTER: Technical Committee on Fire Department Apparatus,  
RECOMMENDATION: Revise 22-11.2 (24.11.2 in the draft) to read as follows: All equipment not used during transit such as computer equipment shall be stored in cabinets or mounted to comply with Section 12-1.7.

SUBSTANTIATION: This wording will assure that equipment is adequately secured in the command or crew cab areas.

COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-211-(22-11.3): Accept
SUBMITTER: Technical Committee on Fire Department Apparatus,  
RECOMMENDATION: Revise 22-11.3 (24.11.3 in the draft) to read as follows: 22-11.3.3 Electrical outlets specifically for computer use, whether 12 volt or 120 volt, shall be marked with a label for their intended usage and power output.

22-11.3.2 The outlet shall be tested by the apparatus builder to insure they are secure from the enclosure.

SUBSTANTIATION: This wording will provide assurance that the computer equipment is adequately secured in the command or crew cab areas.

COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-214-(23-2.10): Accept
SUBMITTER: Technical Committee on Fire Department Apparatus,  
RECOMMENDATION: Revise 23-2.10 to read as follows: 23-2.10.1 All major components and accessories shall be identified with a label. 23-2.10.2 Caution and warning signs shall be affixed where necessary. 23-2.10.3 Instruction plate(s) shall be installed, as applicable, to advise the operator on the proper adjustment or setting of controls for safe operation. 23-2.10.4 Controls, gauges, valves, and other equipment shall be marked with a label indicating their function. 23-2.10.5 All controls and valves shall have a label to indicate movement direction. 23-2.10.6 The major component manufacturers and installers of the air system shall provide electrical diagrams and air piping drawings that document the system and its operation.

A-23-2.10.6 The purchaser may wish to require the air compressor manufacturer to include a plan for initial start-up and final stage installation of the proposed air system to provide drawing of the air system arrangement, operator’s panel layout, and air piping to allow pre-purchase evaluation of the operational characteristics of the system proposed.

23-2.10.6.1 All symbols used shall be described in a key chart on the drawing.

23-2.10.6.2 All drawings shall be delivered with the fire apparatus.

23-2.10.6.3 The following information shall be shown: 1) The general arrangement of the air system, including air storage, air compressor (if provided), air panel, SCBA fill station (if provided), and air inlets and outlets

2) The electrical wiring arrangement and controls, denoting shore-power, low voltage, and line voltage equipment

3) The air operator’s control panel surface showing all controls, gauges, valves, outlets, and other specified equipment including the labeling on the panel and controls.

4) The air piping arrangement with air flow direction indicated and showing all valves, gauges, controls, cylinders or vessels, and furnished equipment.

23-2.11 Documentation.

23-2.11.1 Two complete sets of documentation that cover the operation and maintenance of the system shall be provided.

23-2.11.2 The documentation shall be permitted to be in printed or electronic format, audio-visual format, or a combination thereof.

23-2.11.3 Nomenclature for switches, controls, and indicators shall be consistent with that used on the diagrams required in 23-2.10.6 and on equipment nameplates.

23-2.11.4 The manuals shall include, but not necessarily be limited to, the following: (1) An illustrated parts list (2) A schedule of maintenance and adjustment checks (3) A lubrication schedule (4) Troubleshooting information to enable a technician to locate trouble and to make repairs or adjustments to the equipment.
The current 23-2.10 is being divided into three parts:

- Revise 23-3.6.1 (25.3.6.1 in the draft)
- Revise 23-4.1 (25.4.1 of the draft)
- Revise 23-3.3.2 (25.3.3.2 in the draft)

23-2.12.1.1 This training shall include:

1. Complete system component familiarization/walk around
2. A complete review of the system and its safety features
3. Review of all operation, service, and maintenance documentation
4. Hands on familiarization of the compressor system and air management panel, including actual SCBA filling, air reel operations, and other pertinent operations of the system.

23-2.12.2.2 The trainer shall be certified by the fire department compressor system assemblers quarters of training for such compressor.

23-2.12.2 If a breathing air system that includes a compressor/purification system is provided, a representative of the fire department apparatus manufacturer shall provide training to fire department personnel.

- A-23-2.12.2 Due to the extremely complicated nature of breathing air compressor systems, training is a critical component of the safe use of the system. Expectations for training should be carefully defined in the purchase specifications.

23-2.12.3 The Fire Department shall designate one or two individuals that are to be the focal points for all of the breathing air system training and equipment indoctrination.

23-2.12.4 The Fire Department shall designate where the training is to take place.

SUBSTANTIATION: The current 23-2.10 is being divided into three parts, one dealing with requirements for labels and plates, one for documentation, and one for training and instructions.

New wording clarifies the intent of the committee and removes non-specific language. It provides clear descriptions of the exact labeling, documentation and training required on the completed product.

The training requirements have been enhanced as air systems that include a compressor/purification system are extremely complex. It is important that the users fully understand the operation, service and maintenance of these systems. Misuse could be a serious safety issue. Since the purchaser's are usually purchasing their first air compressor vehicle or it is a replacement of a unit that is several years old, it is essential that the breathing air system manufacturer properly train the users on the new system, system installation, service, maintenance, the operating hazards as well as safeguards of the new system. Normally the installers of such equipment are not qualified to perform such training.

An air cascade system and booster systems are less complicated and normally fire apparatus manufacturer's or their representatives can train fire departments on normal operations.

COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-216-(23-3.6.1): Accept
SUBMITTER: Technical Committee on Fire Department Apparatus,
RECOMMENDATION: Revise 23-3.6.1 (25.3.6.1 in the draft) to read as follows:
- All compressors shall have automatic audible and visual alarms and controls at the main operator's panel. It is required to shut down the compressor and prevent automatic restart when any of the following conditions occur:
  1. Low oil level or low oil pressure
  2. Discharge air temperature is higher than recommended by the manufacturer
  3. Moisture in the compressed air at the purification system outlet exceeds 24 ppm

SUBSTANTIATION: The requirement to have all safety alarms at the main operator's panel is important as the compressor and compressor manufacturer's operating temperature range.

COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-217-(23-4.1): Accept
SUBMITTER: Technical Committee on Fire Department Apparatus,
RECOMMENDATION: Revise 23-4.1 (25.4.1 in the draft) to read as follows:
1. If the processed air is to be used as breathing air, the purification system shall produce breathing air that meets the requirements of NFPA 1909 Standard On Breathing Air Quality For Fire And Emergency Services Respiratory Protection.

Add new appendix material as A-23-4.1 to read as follows:
- The purchaser may require a quality of air other than that used for fire fighting. In those situations, it is important that the purchaser specify the standards that such quality has to meet.

SUBSTANTIATION: NFPA is processing a new standard for breathing air quality that will be in place by the time the next edition of NFPA 1901 is adopted and it should be referenced rather than CGA and NFPA 1500.

COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-218-(23-4.3): Accept
SUBMITTER: Technical Committee on Fire Department Apparatus,
RECOMMENDATION: Add an additional sentence to the end of 23-4.3 (25.4.3.3 of the draft) to read as follows:
- The purification system shall be protected from mechanical damage caused by loose equipment stored on the apparatus

Add an appendix as A-23-4.3 (see A-25.3.4.2 of the draft) to read as follows:
- The purification system should be located where it is easily accessible for service, preferably on slide out tracks or in location where purifier cartridge and filter elements can be installed from the top. These units can be remote mounted from the air compressor and operator's panel.

SUBSTANTIATION: It is important that the purification system be protected from mechanical damage as damage could affect the performance of the system or the quality of the breathing air. The appendix provides additional information on the location of purification system and available mounting system or accessibility.

COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-219-(23-3.3.2): Accept
SUBMITTER: Technical Committee on Fire Department Apparatus,
RECOMMENDATION: Add an appendix to 23-3.3.2 to read as follows:
- Special air flow engineering, supplemental fans, additional doors and vents may be required for the release of heated air from the air compressor during long periods of operation.

Add a new appendix to 23-3.3.2 to read as follows:
- These could include automatic operating doors in the roof of the apparatus, manually opened roof doors, large electric driven exhaust fans, etc. These extra provisions installed by the final stage installer could ensure there is adequate cooling to keep the air compressor within the compressor manufacturer's operating temperature range.

COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-220-(25-3.3.2) : Accept
SUBMITTER: Technical Committee on Fire Department Apparatus,
RECOMMENDATION: Add a new paragraph to 25-3.3.2 to read as follows:
- These could include automatic operating doors in the roof of the apparatus, manually opened roof doors, large electric driven exhaust fans, etc. These extra provisions installed by the final stage installer could ensure there is adequate cooling to keep the air compressor within the compressor manufacturer's operating temperature range.

COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

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of multiple cylinders, the other chambers shall contain air cylinders of equal size filled to a gauge pressure of 4500 psi (30,000 kPa) during the test. These cylinders shall not rupture during the test. 23-9.4.2 The testing shall prove that the air refill station is capable of containing all fragments of a failed cylinder so as to protect the operator and not rupture cylinders in adjacent chambers and prove that the venting provisions direct the air concussive release away from the operator. 23-9.4.3 All test results shall be certified by an independent third-party certification organization.

SUBSTANTIATION: The changes are editorial to clarify that the testing is single article type testing, not testing each refill station. It also removes some ambiguous wording and brings the wording of 23-9.4.3 in line with changes being made regarding the third party being called a certification organization rather than a testing organization.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION:

AFFIRMATIVE: 28

1901-223-(23-10.9.2) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus,

RECOMMENDATION: Delete 23-10.9.2

SUBSTANTIATION: Air reels can be mounted in remote areas or compartments, equipped with protective rollers or guides for hose. Visibility of reel spool area is not required. Only access to the reel for service or removal.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION:

AFFIRMATIVE: 28

1901-224-(23-11.1) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus,

RECOMMENDATION: Revise 23-11.1 (25.11.1 of the draft) to read as follows:

All air hose and couplings supplied shall comply to their intended application, i.e. low pressure utility air vs. high pressure breathing air. Low pressure hose does not have to be 1 safety factor.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION:

AFFIRMATIVE: 28

1901-225-(23-11.3) : Accept in Principle

SUBMITTER: Dave Weinaug, Pierce Manufacturing, Inc.

RECOMMENDATION: Revise text to read as follows:

The discharge end of any high-pressure breathing air hose shall have a slow-operating valve with a right-hand female thread fitting of the appropriate type and pressure rating for its intended purpose. The hose shall be certified and a removable threaded that plug attached to a chain. The discharge end of any low pressure (other types of hose shall have either a slow-operating valve and a threaded connection or a quick disconnect-type connection.

SUBSTANTIATION: Current wording of the first sentence incorrectly implies that all hoses used in high pressure applications are used for filling cylinders. Not all high pressure hoses are used for this purpose, as in the case of a refill hose that connects to a system refill fitting on a cascade system control panel. The word “thread” should be deleted, because it excludes the high pressure quick disconnect fittings used by MSA.

Regarding the plug, I am unable to locate either a supplier or a manufacturer that will produce threaded male CGA 346, 347, or 677 dust plugs with chains. It appears this statement requires the use of fittings that do not exist. In addition, there would be no need for such dust plugs on fill hoses inside of fill enclosure stations, most of which are equipped with holders for their fill hoses.

The reference to “other types” of hose in the second sentence seems too general. Breathing air system pressures are typically classified in very broad terms as either high pressure or low pressure. The first sentence clearly addresses all high pressure hoses, so the second sentence should clearly address all low pressure hoses. All possible hoses will then be addressed in the combination of these two sentences.

Without the word “either”, this sentence reads that all low pressure hoses must have a valve, and the end fitting can be either threaded or a quick disconnect. The majority of these low pressure quick disconnects shut
Committee Meeting Action: Accept in Principle

Revise 23-11.3 (25.11.3 in the draft) to read as follows:

23-11.3 Discharge Ends.

The discharge end of any breathing air hose shall have a threaded connection.

23-11.3.1 If no other fittings are installed at the end of the hose, a protective cap shall be provided to prevent internal contamination of the hose during shipping.

23-11.3.2 If the discharge end of hose will terminate with a threaded connection when in use, it shall be equipped with a slow-operating valve.

23-11.3.3 If the threaded end of the hose terminates in a quick connection fitting, a slow operating valve and protective cap shall not be required.

23-11.3.4 Connections to hose shall comply with 25.2.7.

23-11.3.2 The discharge end of utility air hose shall have either a threaded connection and slow-operating valve or a quick connection fitting.

Add a new appendix to read as follows:

A.23-11.3.1 The discharge end of any breathing air hose may have various fittings, threads, or quick connections installed on the threaded end of the discharge hose. The purchaser needs to specify the particular hose termination, thread size, valve control, quick connection fitting, expected application of hose, and other pertinent information if the manufacturer is to provide appropriate connections.

Committee Statement: The committee is changing the requirements to functional testing. Breathing air hose regardless of pressure and utility air hose. There can be applications where breathing air is supplied by hose at pressures below 300 psi. Breathing air hose needs to be protected from contamination. The wording was changed to reflect common applications in the market place.

Number of Committee Members: 28

Vote on Committee Action: Affirmative: 28

1901-226-(23-12) : Accept

Submitter: Technical Committee on Fire Department Apparatus,

Recommendation: Revise 23-12 (25.12 of the draft) to read as follows:

Low Pressure Utility Air Supply. Where the non-emergency use air outlets are supplied by the chassis air brake system, the air supply shall be from an auxiliary air circuit that is equipped with a pressure protection valve (PPV) and auxiliary air tanks. Revise A-23-12 (A.25.12 of the draft) to read as follows:

The size of the air supply piping, chassis air compressor cubic feet per minute rating, and auxiliary air reservoir(s) cubic foot capacity are of critical importance in supplying non-emergency application utility air outlets. These air outlets could be used for filling truck tires, pressurized water fire extinguishers, etc. Such air brake connections are not intended to be used for rescue air bags, tools, air reels, and other rescue applications, due to their limited duration, volume, and pressure. Air supply for low pressure utility applications should be from dedicated air compressors or air cascade storage tanks.

Substantiation: The changes remove air supply from air brake system to air reels and rescue equipment. Air supply from an air brake system should be limited to air outlets for miscellaneous applications.

Committee Meeting Action: Accept

Number of Committee Members: 28

Vote on Committee Action: Affirmative: 28

1901-227-(23-13.3) : Accept

Submitter: Technical Committee on Fire Department Apparatus,

Recommendation: Revise 23-13.3 (see 25.13.3 through 25.13.3.2 of the draft) to read as follows:

All components of the piping system shall meet the requirements of Sections 23-2. The piping system shall be arranged with an air regulator that shall limit the air pressure in the piping to the desired operating pressure. A pressure relief valve set to relieve the pressure at 10% above the desired operating pressure shall be installed on the downstream side of the regulator.

Substantiation: The changes are editorial to reduced verbiage. Changed pressure relief valve setting to similar setting as found in other sections of the air chapter—relating to pressure regulators.

Committee Meeting Action: Accept

Number of Committee Members: 28

Vote on Committee Action: Affirmative: 28

1901-228-(23-14) : Accept

Submitter: Technical Committee on Fire Department Apparatus,

Recommendation: Revise Section 23-14 (Section 25.14 in the draft) to read as follows:

23-14.4 If the tests of some components of the apparatus are being certified by an independent testing organization, the purchaser might wish to specify that these tests also be certified by the independent testing organization.

23-14.1 The complete air system shall be tested by the final system installer after its installation on the fire apparatus is complete, using the testing procedure prescribed by the system manufacturer.

23-14.2 The following items shall be tested or verified on all air systems.

a) Confirm that the fluid levels are at the manufacturer’s recommended levels including the lubricant and coolant, if liquid cooled.

b) Verify the expiration date of the purification filters and cartridges and that they have been installed as required by the manufacturer of the system.

c) Operate the air compressor for a minimum of two hours or the period required to completely fill the onboard air storage cylinders or vessels, whichever is longer.

d) Confirm that all compressor interstage pressures are within guidelines as established by the compressor manufacturer.

e) Confirm the operation of the compressor shutdown switch at the pressure requested by the purchaser.

f) Confirm the set point of the final pressure safety relief valve and pressure maintaining valve.

g) Confirm the factory set limits of all electrical shutdown devices including low oil pressure, automatic condensate drain system, high air temperature, excessive processed air moisture, high carbon monoxide and motor amperage draw.

h) Perform a cooling airflow test in the compartment where the compressor is installed and assure the flow meets the compressor manufacturer’s requirements.

25.14.4 Air Quality.

25.14.4.1 Prior to delivery of the apparatus to the end user, the final system installer shall drain an air sample from the system and submit the sample to be tested in accordance with NFPA 1989.

25.14.4.2 The breathing air shall meet the air quality standards defined in NFPA 1989.

23-14.5 If the system’s air supply includes a compressor/purification system, the following additional items shall be verified or tested:

a) Confirm that the fluid levels are at the manufacturer’s recommended levels including the lubricant and coolant, if liquid cooled.

b) Verify the expiration date of the purification filters and cartridges and that they have been installed as required by the manufacturer of the system.

c) Operate the air compressor for a minimum of two hours or the period required to completely fill the onboard air storage cylinders or vessels, whichever is longer.

d) Confirm that all compressor interstage pressures are within guidelines as established by the compressor manufacturer.

e) Confirm the operation of the compressor shutdown switch at the pressure requested by the purchaser.

f) Confirm the set point of the final pressure safety relief valve and pressure maintaining valve.

g) Confirm the factory set limits of all electrical shutdown devices including low oil pressure, automatic condensate drain system, high air temperature, excessive processed air moisture, high carbon monoxide and motor amperage draw.

h) Perform a cooling airflow test in the compartment where the compressor is installed and assure the flow meets the compressor manufacturer’s requirements.

25.14.4.2.1 The breathing air shall meet the air quality standards defined in NFPA 1989.

23-14.5.2 The results of all tests including the air quality analysis shall be documented and shall be included in the documentation that is given to the purchaser upon acceptance of the fire apparatus.

Substantiation: The test requirements have been updated to reflect the type of testing that should be done to ensure the system is fully functional. This included adding a minimum of a 2 hour test at full capacity. This will also ensure that the results of all testing and air quality analysis are delivered with the documentation.

Committee Meeting Action: Accept

Number of Committee Members: 28

Vote on Committee Action: Affirmative: 28

1901-229-(24-1) : Accept

Submitter: Technical Committee on Fire Department Apparatus,

Recommendation: Revise 24-1 (26.1 of the draft) to read as follows:

If a chassis-mounted winch is installed on the apparatus, it shall meet the requirements of this chapter.

Add a new 24-1.1 (see 26.1 of the draft) to read as follows:

The winch shall be designed for the intended use and shall be installed in accordance with winch manufacturer’s recommendations.

Add an appendix to 24-1.1 (see 26.1.1 of the draft) to read as follows:

Watches are classified by manufacturers for different applications and uses. The purchaser may wish to specify winches meet requirements of SAE J706, Rating of Winches. Winches installed on fire apparatus are not designed nor suited for lifting or lowering personnel in rescue applications. Winches of under 20,000# rating on fire apparatus are not designed for removal of apparatus from “buried” off road conditions. A heavy duty wrecker should be used for towing and lifting of fire apparatus.
AFFIRMATIVE: 28

VOTE ON COMMITTEE ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

1901-234-(24-3.1.1) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus, Fire Protection Standard NFPA 1901

RECOMMENDATION: Revise 24-3.1.1 (see 26.3.1.1 and 26.3.1.2 in the draft) to read as follows:

24-3.1.1 Operation of the electric motor shall be by means of a handheld control with forward, neutral, and reverse positions.

24-3.1.2 The control shall be located at the end of an electrical cord that is a minimum 25 ft (7.6 m) long and that plugs into a receptacle near the winch location or shall be integrated into a handheld transmitter operating on a Federal Communications Commission-approved radio frequency for the winch control device.

Remeber number existing 24-3.1.2 as 24-3.1.3

SUBSTANTIATION: The revised wording does not require the controlling device to be operated only by switches.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-235-(24-3.2) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus, Fire Protection Standard NFPA 1901

RECOMMENDATION: Revise 24-3.2 (see 26.3.2 in the draft) to read as follows:

24-3.2 Power Supply.

24-3.2.1 Dedicated power and ground circuits shall be utilized.

24-3.2.2 Wiring shall be sized in accordance with the winch manufacturer's installation instructions and shall comply to Chapter 11 of this standard.

24-3.2.3 The power supply line shall be equipped with a resettable circuit protection device and properly sized for the winch's power requirements.

SUBSTANTIATION: The new wording improves the installation requirements considering the heavy electric draw by winch motors.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-236-(24-3.3 (New) ): Accept

SUBMITTER: Technical Committee on Fire Department Apparatus, Fire Protection Standard NFPA 1901

RECOMMENDATION: Add new wording after 24-3.2 to cover removable winches to read as follows (see 26.3.3 through 26.3.4.4):

24-3.3 Removable electric winches.

24-3.3.1 Electric winches that are temporarily attached to the apparatus (at sides, rear, or front) shall meet the same requirements as permanently mounted winches.

24-3.3.2 The attachment to the apparatus shall be with quick release devices.

24-3.3.3 The attachment system on the apparatus shall meet the requirements of section 15.11.

24-3.4 Electric Power for Removable Winches.

24-3.4.1 The electrical power supply(ies) from the apparatus to the removable winch shall terminate at a quick disconnect receptacle with a connector plug.

24-3.4.2 The receptacle shall have a label indicating its use.

24-3.4.3 The power cord from the receptacle to the winch shall be sized for the power requirements of the winch.

24-3.4.4 The power cord shall be highly flexible and shall be protected from mechanical damage.

SUBSTANTIATION: The use of removable winches on rescue apparatus has become very popular as it reduces costs and potentially can be used on any side of apparatus. These are often used for stabilization of vehicles during rescue operations.

The new wording addresses these new applications and the attachment of removable winches to the apparatus.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-237-(24-4.2) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus, Fire Protection Standard NFPA 1901

RECOMMENDATION: Add new wording after 24-4.1 to read as follows (see 26.4.2 through 26.4.2.2 of the draft):

24-4.2 The forward-neutral-reverse hydraulic control for the winch shall be electrically operated to permit remote control of the hydraulic winch operations.

24-4.2.1 Operation of the hydraulic winch shall be by means of a handheld control with forward, neutral, and reverse positions.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28
24-4.2.2 The control shall be located at the end of an electrical cord that is a minimum 25 ft (7.6 m) long and that plugs into a receptacle near the winch location or shall be integrated into a handheld transmitter operating on a Federal Communications Commission-approved radio frequency for the winch control device.

- Delete the first paragraph of the appendix to 24-4.4.

**STANDARDIZATION:** Remote control operation of the hydraulic winch should be the same as an electric winch installation. The requirements are being moved into the body of the standard and removed from the appendix of 24-4.

**COMMITTEE MEETING ACTION:** Accept
**NUMBER OF COMMITTEE MEMBERS:** 28
**VOTE ON COMMITTEE ACTION:** AFFIRMATIVE: 28

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1901-238-(24-4.5) : Accept  
**SUBMITTER:** Technical Committee on Fire Department Apparatus, **RECOMMENDATION:** Revise 24-4.5 (26.4.6 of the draft) to read as follows:

**REVISED TEXT:**

- The hydraulic winch engagement controls shall be located in the driving compartment.
- Revise 24-4.5.1 (26.4.6.1 of the draft) to read as follows:
  - A "HYDRAULIC WINCH ENGAGED" indicator shall be provided in the driving compartment to indicate that the hydraulic pump engagement has been successfully completed.
- Add an appendix to 24-4.5.1 (see A.26.4.6.1 of the draft) to read as follows:

**REVISED TEXT:**

Completion of the engagement might require that the chassis transmission be shifted into the proper gear (split shaft PTO’s only).

**REVISED TEXT:**

An "OK TO OPERATE WINCH" indicator shall be provided in the driving compartment to indicate that the winch is engaged, the transmission is in the proper gear (automatic transmissions only), and the parking brake is engaged.

- Add a new 24-4.5.3 to read as follows (see 26.4.6.3 of the draft):

**REVISED TEXT:**

An interlock system shall be provided to prevent advancement of the engine speed in the cab or at any operator’s panel unless the transmission is in neutral and the parking brake is engaged, or the apparatus is in the "OK TO OPERATE WINCH" mode.

**SUBSTANTIATION:** The revised wording simplifies the requirement and makes it consistent with wording corrected in other chapters on pumps and generators.

**COMMITTEE MEETING ACTION:** Accept  
**NUMBER OF COMMITTEE MEMBERS:** 28  
**VOTE ON COMMITTEE ACTION:** AFFIRMATIVE: 28

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1901-239-(32-5.3.1) : Accept  
**SUBMITTER:** Technical Committee on Fire Department Apparatus, **RECOMMENDATION:** Revise 21-5.3.1 (23.6.3.2 i the draft) to read as follows:

**REVISED TEXT:**

(1) Installed so that fumes, vapor, heat, and vibrations do not enter the interior passenger compartment.

(2) Have the exhaust outlet piped to the exterior and located so that exhaust is directed away from any operator’s position.

(3) Generators 8 KW and over shall be equipped with a high temperature automatic shut down system and low oil automatic shut down.

(4) Generators shall be installed in accordance with manufacturer’s installation requirements for ventilation and service accessibility.

(5) Generators installed in compartments requiring the compartment doors to be open during operation shall be equipped with a compartment door interlock system, or the compartment shall be equipped with a high temperature alarm.

(6) Generators installed in compartments on slide trays and designed for operation in the “slide out” position shall have interlocks to assure such operation or the compartment shall be equipped with a high temperature alarm.

(7) Permanently installed generators shall have easily accessible engine oil drain provisions or piping to a remote location for oil changing.

(8) Generators located away or remote from the main operator’s area (top of vehicle, over pump, hidden in body, etc.) shall have a remote operating panel with required instrumentation, start and stop controls, and other controls necessary for safe operation.

- Add an additional paragraph to A-21-5.3.1 after the paragraph moved from A-21-4.7.2.

**REVISED TEXT:**

The purchaser may want to specify a high temperature indicator to help troubleshoot automatic shutdowns.

**SUBSTANTIATION:** These additional requirements are common practice for generators and found in good generator installations. This will bring the standard in line with general industry practice.

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COMMITTEE MEETING ACTION:** Accept  
**NUMBER OF COMMITTEE MEMBERS:** 28  
**VOTE ON COMMITTEE ACTION:** AFFIRMATIVE: 28

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1901-240-(Appendix A) : Accept in Principle  
**SUBMITTER:** Richard B. Mills, Akron Brass/Rep. FAMA  
**RECOMMENDATION:** Add new text as follows:

"The recommended minimum equipment listed in this standard, i.e., nozzles, hose, ladders, etc., may not meet ISO standards for point credits that individual fire departments may need or require. Please refer to the ISO schedules for this information."

**SUBSTANTIATION:** Placement in the standard could be relative to the following paragraphs and their sub-paragraphs - NFPA 1901 Paragraphs 4-6, 4-7, 5-6, 5-7, 6-7, 7-7, 7-8, 8-4, 8-5, and 9-8, 9-9.

**COMMITTEE MEETING ACTION:** Accept in Principle  
**AFFIRMATIVE:** 28

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The following two methods test wheel chock performance:

1. Place the fully loaded apparatus on a 10% or greater grade having a hard surface (pavement or concrete) and place a wheel chock on the downhill side of a wheel of the most heavily loaded axle. The transmission must be in neutral; if apparatus is all wheel drive, tires at correct pressure, and all brakes released. The chock is deemed to be functional if the chock holds the fully loaded apparatus on the grade.

2. The recommended minimum equipment listed in this standard, i.e., nozzles, hose, ladders, etc., may not maximize a community’s grading.

- Add an appendix to 3-7 to read as follows:

**REVISED TEXT:**

See A-3-7.

- Add the wording as appendix to 4-6 and 4-7, 5-6 and 5-7, 6-7 and 6-8, 7-7, 7-8, 8-4 and 8-5, and 9-8, 9-9.

**COMMITTEE MEETING ACTION:** Accept in Principle  
**AFFIRMATIVE:** 28

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Wheel chocks provide an increased margin of safety for vehicle stability when parked on slopes. This standard (NFPA 1901) requires apparatus to carry two or four wheel chocks depending on the type of unit. One wheel chock on hard surface (pavement or concrete) and place a wheel chock on the downhill side of a wheel of the most heavily loaded axle. The transmission must be in neutral; if apparatus is all wheel drive, the transfer case must be in two-wheel drive if apparatus is all wheel drive, tires at correct pressure, and all brakes released shall hold the apparatus on a 10% grade. Apparatus with steeper grades in their response area should consider specifying higher performance wheel chocks. When making a wheel chock selection, the fire department should take into consideration the type of surface encountered in their area of operations. For example, wheel chocks may perform differently when used on slippery or non-paved soft surfaces.

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The following methods test wheel chock performance:

1. Place the fully loaded apparatus on a 10% or greater grade having a hard surface (pavement or concrete) and place a wheel chock on the downhill side of a wheel of the most heavily loaded axle. The transmission must be in neutral; if apparatus is all wheel drive, the transfer case must be in two-wheel drive if apparatus is all wheel drive, tires at correct pressure, and all brakes released. The chock is deemed to be functional if the chock holds the fully loaded apparatus on the grade.

2. The apparatus shall be the same as an electric winch installation. The requirements are being moved into the body of the standard and removed from the appendix of 24-4.

**COMMITTEE MEETING ACTION:** Accept  
**NUMBER OF COMMITTEE MEMBERS:** 28  
**VOTE ON COMMITTEE ACTION:** AFFIRMATIVE: 28

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**SUBMITTER:** Dan W. McKenzie, USDA Forest Service  
**RECOMMENDATION:** Add the following wording:

Wheel chocks provide an increased margin of safety for vehicle stability when parked on slopes. This standard (NFPA 1901) requires apparatus to carry two or four wheel chocks depending on the type of unit. One wheel chock on hard surface (pavement or concrete) and place a wheel chock on the downhill side of a wheel of the most heavily loaded axle. The transmission must be in neutral; if apparatus is all wheel drive, the transfer case must be in two-wheel drive if apparatus is all wheel drive, tires at correct pressure, and all brakes released. The chock is deemed to be functional if the chock holds the fully loaded apparatus on the grade.
Examples of auxiliary braking systems include: engine retarders, transmission retarders, exhaust retarders, and driveline retarders. These systems can be activated by various means and settings, both automatic and manual in operation. The purchaser should carefully evaluate all auxiliary braking systems based on truck weight, terrain, duty cycle, and many other factors.

Some auxiliary braking devices should be disconnected when the apparatus is operated on slippery surfaces. Follow the auxiliary braking device manufacturer’s recommendations for proper instructions.

STANDARDIZATION: The recommendation for auxiliary braking devices for over 31,000 GVWR was removed, since these devices could be provided on any size vehicle. In addition, the systems are applicable for various terrain and duty cycle hazards.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-244-(A-10-3.2-3.3) : Accept in Principle

SUBMITTER: Ron W. French, W. Chicago, IL

RECOMMENDATION: T The angle of approach or departure affects the road clearance of the vehicle going over short steep grades such as would be found in a driveway entrance, crossing a high crowned road at right angles, or in off-road service. Too low an angle of approach or departure will result in the apparatus scraping the ground. The accompanying diagram shows the method of determining the angle (in this case) of departure. The angle of approach (front of the vehicle) is measured in the same fashion.

In the illustration the line AT represents the circumstance where the tailboard is the determining lowest point. (The line BT represents a circumstance where the tailboard is not the lowest point, in this case it is a fuel tank). The angle of departure is shown as “X”. To determine the angle, the rear wheel is backed up on a length of cord. The cord is pulsed taut and held while the height (“H”) is measured at a specific distance (“L”) from the point where the cord meets the tire/road interface (The actual distance “L” is not important, choose a convenient distance). The ratio of “H”/”L” is the tangent of the angle of departure. Knowing the ratio the angle may be determined from a table of the functions of angles. Since the standard requires a minimum angle of 8°, and since the tangent of 8° is 0.14054, if the ratio of “H” divided by “L” is 0.14054 or larger, the angle of departure is 8° or greater.

STANDARDIZATION: To clarify meaning of angle of approach/departure provide a means to determine angle of approach/departure.

COMMITTEE MEETING ACTION: Accept in Principle

RECOMMENDATION: T The angle of approach or departure affects the road clearance of the vehicle going over short steep grades such as would be found in a driveway entrance, crossing a high crowned road at right angles, or in off-road service. Too low an angle of approach or departure will result in the apparatus scraping the ground. Figure A-10-3.2-3.3 shows the method of determining the angle (in this case) of departure. The angle of approach (front of the vehicle) is measured in the same fashion.

In the illustration, the line AT represents the circumstance where the rear step is the determining lowest point. The line BT represents a circumstance where the rear step is not the lowest point, in this case it is a fuel tank. The angle of departure is shown as XA or XB. To determine the angle of departure, a thin steel strip is placed up against the rear of the tires or a cord can be stretched tight from one rear tire to the other. By eying and determining the lowest point (the rear step, fuel tank, or other equipment or component) that would make the smallest angle of departure, use a plumb bob hanging from this location to determine the location of this point on the ground. Mark this point on the ground (point of the plumb bob). Measure the vertical distance from the ground where the plumb bob was hung to where the plumb line makes an angle of approach (position V). Measure the horizontal distance from the plumb bob point to in front of the steel strip or to the cord running from rear tire to rear tire (distance H). Divide the vertical distance (V) by the horizontal distance (H). The ratio of V/H is the tangent of the angle of departure. Knowing this ratio, the angle of departure may be determined from a table of trigonometric functions of angles or from a math calculator. Since the standard requires a minimum angle of departure of 8 degrees and the tangent of 8 degrees is 0.1405, if the ratio of V divided by H is 0.1405 or larger, the angle of departure is 8 degrees or greater.

COMMITTEE MEETING ACTION: The committee feels the additional explanation and revisions to the figure will further assist users in easily determining the angle of approach or departure for their apparatus.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28
Recommendation to 1901-244 (Log #31)

1901-245-(A-12-4.3) : Accept
SUBMITTER: Technical Committee on Fire Department Apparatus,
RECOMMENDATION: Revise the wording in A-12-4.3 (A.14.4.3 in the draft) to read as shown:
In many areas, the overall height of the vehicle needs to be restricted in order to clear bridges, station doors, and so forth. The tiller driving compartment roof is normally the highest point on the vehicle. Hence, the height of the tiller driving compartment and the inside headroom might have to be reduced to achieve the desired overall height. Careful consideration should be given to the packaging of the tiller body in deciding ground ladder and body compartment design to achieve the required seat head heights.
SUBSTANTIATION: In view of the work done to improve seating areas (see committee meeting action on public proposal 1901-67 (Log #63), the committee does not want to be recommending reducing head height. It is important that adequate head height be maintained for the tiller operator and, if overall height of the apparatus is a concern, the tiller body has to be designed to accommodate the tiller operators position without compromising the head height.
COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 28

Committee Action to 1901-244 (Log #31)

1901-246-(A-14-5.1) : Reject
SUBMITTER: Steve Morelan, Little Canada Fire Dept., Inc., MN
RECOMMENDATION: Delete the following text:
The term “all bronze” indicates that the pump’s main casing, impeller, intake and discharge manifolds, and other principal components that are exposed to the water to be pumped, with the exception of the shaft bearings and seals, are made of a high-copper alloy material.
SUBSTANTIATION: The term “all bronze” is no longer used in this standard - it was removed from 14-5.1 in 1991. Therefore, the term does not need definition and in fact is out of context.
COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The committee feels that even though the term “all bronze” is not used in the standard, it is used in the field sometimes and leaving the explanation provides useful information.
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 28
INTAKES AT THE FRONT OR REAR OF THE APPARATUS, OR OTHERWISE SPECIALLY SITUATED, MIGHT NOT ALLOW DRAFTING RATED CAPACITY AT RATED PRESSURE. WHEN PROVIDED, THE PURCHASER SHOULD ASK THE MANUFACTURER TO CERTIFY THE FLOW RATES FROM AUXILIARY INTAKES.

RECOMMENDATION: Add a sentence to the end of A-14.6.1 in the draft to read as follows: When provided, the purchaser should also consider requiring the manufacturer to certify the actual flow rates from auxiliary intakes.

COMMITTEE MEETING ACTION: Accept in principle

COMMITTEE STATEMENT: Additional guidance is warranted for valves 3-in (75-mm) and larger valves.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

RECOMMENDATION: Revise text to read as follows:

When a large auxiliary suction inlet is specified, the intent of the purchaser is a job-specific - that of supplying a master suction inlet on that side of the apparatus.

COMMITTEE MEETING ACTION: Accept

COMMITTEE STATEMENT: The eight inches required for a slow operating valve is not definitive enough to provide helpful guidance.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-249-(A-14-7.5) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus

RECOMMENDATION: Add an appendix to 14-7.5 (see A.16.7.5.2 in the draft) to read as follows:

Control of discharges on apparatus are now available in pull type actuators, trunnion or swing valves, cable control, gear operated hand wheel control, hydraulic, air, and electric operators. These are available with either quick operating and slow operating valve mechanisms. The nozzle and hose pressure control system is covered under 14-13. The procedure is defined in 14-13.4.

COMMITTEE MEETING ACTION: Accept

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-253-(A-17-3.2) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus

RECOMMENDATION: Delete the appendix.

COMMITTEE MEETING ACTION: Accept

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-250-(A-14-10.1.2) : Accept

SUBMITTER: Steve Morelan, Little Canada Fire Dept., Inc., MN

RECOMMENDATION: Revise text to read as follows:

Pumps are operated from the side, top, front or rear of the vehicle, and there is no pumping requirement that there is any power applied to the wheels while pumping. Therefore, it is essential that any controls which could apply power to the wheels while pumping, be equipped with a means to prevent dislocation of the control from its set position in the pumping mode.

SUBSTANTIATION: As currently written, this section only addresses the pump shaft PTO drive arrangement. It is equally important to prevent the chassis transmission from being engaged when stationary pumping through a transmission-mounted (SAE) PTO, front-of-engine crank shaft PTO, or engine flywheel PTO. The revised wording addresses these other situations.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-248-(A-14-10.7.4) : Reject

NOTE: This Proposal appeared as Comment 1901-221 (Log #168) which was held from the May 1999 ROC on Proposal 1901-217.

SUBMITTER: Steve Morelan, Little Canada Fire Dept., Inc., MN

RECOMMENDATION: Add the following to the last paragraph:

The table below shows the five critical test points pursuant to the requirements of 14-10.7.1.

<table>
<thead>
<tr>
<th>Intake Pressure (psi)</th>
<th>Discharge Pressure (psi)</th>
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<tr>
<td>-10</td>
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</tr>
<tr>
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<td>300</td>
</tr>
<tr>
<td>185</td>
<td>285</td>
</tr>
<tr>
<td>185</td>
<td>300</td>
</tr>
</tbody>
</table>

SUBSTANTIATION: The table clarifies the requirements set forth in 14-10.7.1 for those who might wish to have performance tests conducted on the installed system. The test points are not easily identifiable when reading the text.

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: Paragraph 14-10.7.4 is being deleted (see Committee Meeting Action on Proposal 1901-120 (Log #93). Certification of the pressure control system is covered under 14-13. The procedure is defined in 14-13.4.

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-251-(A-14-10.7.4) : Reject

SUBMITTER: Technical Committee on Fire Department Apparatus

RECOMMENDATION: Add an appendix to 14-13.2.2.6 (see A.16.13.2.2.6 of the draft) to read as follows:

If a counter speed shaft is not provided, the engine speed can be read with a photo-tach or strobe light on a rotating element.

SUBSTANTIATION: Counter speed shafts are no longer required and the question has arisen of how to get a speed reading when a counter speed shaft is not provided. The appendix material will provide guidance in those situations.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-252-(A-14-13.2.2.6) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus

RECOMMENDATION: Delete the appendix.

SUBSTANTIATION: The minimum tank size on pumpers has been reduced and the operations discussed in the appendix material cannot
necessarily be supported with the reduced tank size. The appendix to section 3-4 discusses tank size.

COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-254-(A-19-1): Reject
SUBMITTER: Dan W. McKenzie, USDA Forest Service
RECOMMENDATION: Add the following term:
Foam-Capable: A foam-capable fire apparatus is a fire apparatus carrying aspirating foam nozzle(s) and is equipped with an automatic regulating proportioning system injecting foam concentrate into the discharge or pressure side of the water pump.

SUBSTANTIATION: This is a term from NFPA 1906 which should also be in NFPA 1901.
COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The term is appropriate and specific to NFPA 1906 and does not apply to industrial and municipal fire apparatus covered by NFPA 1901.
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-255-(A-20-1): Reject
SUBMITTER: Dan W. McKenzie, USDA Forest Service
RECOMMENDATION: Add the following term:
CAFS-Capable. A compressed air foam system (CAFS)-capable fire apparatus is a fire apparatus equipped with the following:
(1) Automatic regulating proportioning system capable of injecting foam concentrate in to the discharge or pressure side of the pump
(2) Air compressor with the capacity to supply the required scfm and automatic air pressure controls
(3) Controls to mix the air and foam solution

SUBSTANTIATION: This is a term from NFPA 1906 which should also be in NFPA 1901.
COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The term is appropriate and specific to NFPA 1906, Standard for Wildland Fire Apparatus and does not apply to industrial and municipal fire apparatus covered by NFPA 1901.
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-256-(A-21-5.2-4): Accept
SUBMITTER: Technical Committee on Fire Department Apparatus,
RECOMMENDATION: Revise A-21-5.2.4 as shown and move the paragraph to the end of A-21-5.1 (see A.23.6.1.1 in the draft).
Due to variable engine speeds causing uncontrolled voltage and frequency variation, direct drive generators are not acceptable for fire apparatus where "generate and roll" capability is required. Hydraulically driven or separate engine driven generators are suited for these applications.

SUBSTANTIATION: The change is a clarification and correction of wording. It is being moved to the direct drive section to which it applies.
COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-257-(A-21-5.3): Accept
SUBMITTER: Technical Committee on Fire Department Apparatus,
RECOMMENDATION: Revise the last sentence of A-21-5.3 (A.23.6.3 in the draft) to read as shown:
Remote generator controls in the cab should be considered and specified if desired.

SUBSTANTIATION: Remote controls at the operator panel are required, but if the desire is to be able to start the generator before arriving on scene, cab controls are needed.
COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-258-(A-21-6): Accept
SUBMITTER: Technical Committee on Fire Department Apparatus,
RECOMMENDATION: Revise the first paragraph of A-21-6 (23.7 in the draft) to read as follows:
Portable generator systems are generally lightweight and designed with an integral fuel tank and controls in one modular package. This allows the system to be picked up and transported to a remote location from the vehicle. Generators designed for portable use should be accessible for removal. These generators are generally not suited for "enclosed" compartment operation or should be mounted on a slide out tray for adequate ventilation. Such installations require interlocks or a high temperature alarm to assure generator is operated in "slide out" condition.

SUBSTANTIATION: The designation of a size for portable generators is being deleted throughout the chapter and the added wording is to provide advise on the mounting of portable generators when they are to be operated on the apparatus.
COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-259-(A-21-11.4): Accept
SUBMITTER: Technical Committee on Fire Department Apparatus,
RECOMMENDATION: Revise A-21-11.4 (A.23.13.4 in the draft) to read as follows:
A suggested minimum capacity of a reel is at least 100 ft (30 m) of cord rated to carry 20 amps at 120 volts ac. When sizing the reel, extra capacity should be provided when multiple receptacles are attached to the cord stored on the reel. A cord reel to supply a single 120 volt circuit requires 3 collector rings and 3 conductors in the cord, for line, neutral and ground. If the power source has 120/240 volt outputs, as most power sources do, a second equivalent circuit with the same rating only requires one additional conductor as the neutral and ground can be common to both circuits. Thus with approximately 25 percent more reel space and cord cost, the cord reel can only supply twice the number of lights or other loads.
Table A.21-11.4 lists the suggested cord size for cord reels based on the desired circuit ampacity and the cord length. The ratings for 5 amp, 7.5 amp and 10 amps should only be used where an appropriate load is permanently connected. Any cord reel with one or more outlets should be rated at 15 amps or greater.
For heavy loads such as large smoke fans and hydraulic rescue tool power plants, the purchaser should consider 240 volt units instead of 120 volt units. This will allow the use of smaller cords and reels. For example, a 150 foot reel to supply a HRT power plant that draws 15 amps at 240 volts would require 14 gauge wire. The same power unit in a version to run on 120 volts would draw 30 amps and would require 10 gauge wire.

Cord reels for 3-phase power or other specialized applications should be designed with the assistance of a qualified electrical engineer.

<table>
<thead>
<tr>
<th>Circuit Ampacity</th>
<th>Cord Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 ft (15 m)</td>
<td>100 ft (30 m)</td>
</tr>
<tr>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>7.5</td>
<td>16</td>
</tr>
<tr>
<td>10</td>
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<td>8</td>
</tr>
<tr>
<td>50</td>
<td>6</td>
</tr>
</tbody>
</table>

*Wire size as AWG

SUBSTANTIATION: The selection of cable for a reel is a complex issue that is often misunderstood. This appendix item gives guidance to purchasers and manufactured on what size cable to use. It is based on various NEC sections applicable to these power cords.
COMMITTEE MEETING ACTION: Accept

869
Revise the third and fourth paragraphs of A-23-3

RECOMMENDATION: Add an appendix to 21-13.2 (see A.23.15.2 in the draft) to read as follows:
A-21-13.2.  When the light mast is mounted above apparatus cab or body, a brush and tree limb guard should be considered to protect the mast and floodlights.

SUBSTANTIATION: The committee is adding a new appendix item to suggest brush guards be considered. Low overhanging tree limbs can become entangled in these lights.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

Accept

Revise A-23.2.1 (A.25.2.1 of the draft) to read as follows:

The new wording gives additional clarification on the exact location of certain instruments, controls, gauges, etc.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

Accept

Bill Adams, William F. Adams & Associates

Breathing air moisture separators are critical to the operation of SCBA's and should be added to the air compressor. Special provisions should be made for moisture separator freeze protection in very cold weather operations.

SUBSTANTIATION: Breathing air moisture separators are critical to operations and must be protected against freezing.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

Accept

1901-263-(A-23-3.6.2) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus,

RECOMMENDATION: Add a new appendix to A-23-3.6.2 (see A.23.3.6.2 in the draft) to read as follows:

A final stage pressure gauge may also be desired at the air control panel, in addition to the gauge near compressor. Special provisions should be made for moisture separator freeze protection in very cold weather operations.

SUBSTANTIATION: The table provided in the appendix would lead the purchaser to think that the compressor cfm output should be determined only from this chart. The determining the number, type, and pressure of the air storage vessels or cylinders is extremely important when purchasing an air system and determining air compressor size.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

Accept

Bill Adams, William F. Adams & Associates

Technical Committee on Fire Department Apparatus

SUBMITTER: Technical Committee on Fire Department Apparatus

RECOMMENDATION: Add an appendix to A-23-3.6.3 (see A.25.3.6.3 in the draft) to read as follows:

The purchaser should consider a shorepower connection to permit external electric power supply to the electric motor. If a shore power connection is provided, it is important to have a transfer switch to allow the user to power the air compressor independently from either the onboard generator or shorepower.

Three phase 240 volt electric motors with "soft starting" provisions are the most practical electric motors for air compressors. The fire station electrical supply should be checked for compatibility with the breathing air compressor. The generator should be sized to provide additional capacity for floodlight, emergency power applications, and other utility usage. A general guideline would be to specify a generator output with twice the capacity as required for the breathing air compressor. The vehicle should be provided with a compatible shorepower cable and plugs, sized to match electric motor requirements. The shorepower cable shall also be sized to reflect distance from fire station service entrance to the vehicle shorepower receptacle.

SUBSTANTIATION: Shorepower is ideal with electric compressors and a transfer switch is a critical part of any installation that includes the two different power sources that could be energized at the same time. The remainder of the appendix items are normal guidelines that should be followed in air compressor design and purchasing.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

Accept

Annex B Specifying and Procuring Fire Apparatus

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

B.1 General. The purchase of new fire apparatus involves a major investment and should be treated as such. Fire apparatus are complex mechanical equipment that should not be purchased in a haphazard manner. A purchase 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. 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 to be protected but also at how these might change over the life of the fire apparatus.

B.1.1 Writing the Specifications. This standard provides the minimum technical requirements that new fire apparatus are expected to meet. It is recognized that many purchasers will desire additional features of operation over and above these minimum requirements. The requirements in this
standard, together with the appendix material, should be carefully studied. Details, such as anywhere that the apparatus being specified needs to exceed the minimum requirements or where a special compartment or portion should be carefully defined in the specifications for the apparatus. This might include special performance requirements, defining the number of seats and the seating arrangement for fire fighters riding on the apparatus, or providing space for hose or equipment the apparatus will be required to carry. Completion by the purchaser of the form shown in Figure B.1.1 should assist the purchaser in developing their specifications and provide the information required in the various sections of this document.

B.1.1.1 The fire department or other organization to whom the apparatus is fixed equipment components. These major "support function" components could represent the most concentrated and heaviest load elements of the vehicle. It is vital that these elements be laid out early in the initial designs and 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

These load considerations should be located in exterior compartments or in the interior of the vehicle to be functional and organized in a layout to be user-friendly in emergency applications. Specifically, the following fixed equipment are examples of this:

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

B.1.2.2 A major support function of any fire apparatus, no matter the type, is the portable equipment. This is why this document places so much emphasis on final GVWR and carrying capacity of the completed vehicle, which includes both fixed and portable equipment. The listings of portable and fixed equipment are so variable, depending on the mission of the vehicle, that the fire department needs to measure and weigh their specific equipment.

The fire department should classify the equipment as follows:

Existing — equipment currently in service
Proposed — new equipment that will be carried as the apparatus goes into service
Future — equipment that might be carried in the future

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

B.1.1.3 After determining the list of present, proposed, and future equipment, the fire department should analyze the “actual” cubic footage (cubic meters) of the compartments necessary for the equipment. The actual usable space in compartments also should be considered, in addition to the individual cubic feet (cubic meters) for each item of equipment to be carried. The following factors might increase the required cubic footage (cubic meters) of storage space required and thus the size of the vehicle body:

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

B.1.1.4 Where there is a special condition that is unique to 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 occasionally need special attention. The purchaser or their agents prior to the official release of the apparatus specifications. For example, the purchaser might want assurance that the internal structure of the apparatus meets the specified performance. The tests are an important feature in the specifications. Height, width, under-vehicle clearance, wheelbase, turning radius, length, and so forth might occasionally need special attention. This standard is designed to ensure sound equipment that is capable of furnishing the training, including where it is to be provided, its duration, and what training aids, such as video tapes or training manuals, are to be furnished.

B.1.1.5 The purchaser should also define in the specifications the warranty designated for the completed apparatus. The warranty is a guarantee of the integrity of the apparatus 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.1.1.6 Training of designated fire department personnel is essential to ensure that the purchaser and user are aware of, and instructed in, the proper operation, care, and maintenance of the apparatus acquired. This training should provide the initial instruction on the new 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 furnishing the training, the scope of the training to be provided, its duration, and what training aids, such as video tapes or training manuals, are to be furnished.

B.1.2 Obtaining and Studying Proposals. When the specifications are complete, they should be distributed to apparatus manufacturers or contractors with a request for bids or proposals to furnish the specified apparatus. The request should specify a date, time, and place for the formal opening of the bids. This date should allow at least 1 month for the apparatus department to study the specifications and estimate the cost of the apparatus. More time might be required if engineering drawings of the proposed apparatus are required.

B.1.2.1 The request also should state the time period during which the purchaser desires the tender to bid. 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.1.2.2 It is recommended that a pre-bid meeting be held between the purchaser of a piece of fire apparatus and the apparatus manufacturers or their agents prior to the official release of the apparatus specifications. Such a meeting is designed to allow for a detailed review of the draft specifications by all parties. This meeting 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.1.2.3 With a performance specification, it is usually possible to obtain more favorable bids, since there is genuine competition and the specifications are not overly restrictive. The bid should be accompanied by a detailed description of the apparatus, a list of equipment to be furnished, and other construction and performance details, including, but not limited to, estimated 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.1.2.4 Manufacturers’ proposals might include amendments and exceptions. Frequently, these changes are offered to meet price requirements more favorably. Some changes may be preferable to the purchaser. For example, if the contractor is building 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 manufacturers can be substantial penalties for infraction of these rules and, therefore, cannot build apparatus to specifications that would require them to perform unlawfully or to delete required items or to include any that are illegal.

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 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.

B.1.3 Many apparatus purchasers find it favorable to provide for an inspection by the purchaser’s attorney, engineer, and other appropriate officials for assistance in developing the detailed specifications.

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B.1.3 Many apparatus purchasers find it favorable to provide for an inspection by the purchaser’s attorney, engineer, and other appropriate officials for assistance in developing the detailed specifications.

B.1.3.1 Awarding the Contract. 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 manufacturer. Some apparatus purchasers find it advantageous to purchase the apparatus directly from the manufacturer, taking title, and then resell the apparatus to the purchasing authority. Other manufacturers work
2) Axle ratings higher than the axle manufacturer’s published ratings should be accompanied by a written application approval from the axle manufacturer.

(t) Obtain the nominal suspension rating from the vehicle or suspension manufacturer.

Note: Suspensions are designed to provide adequate suspension travel at the rated load. Over-sized suspensions may provide longer suspension life, but the harsher ride quality that results may reduce the life of other vehicle components.

(u) Enter the Axle Weight Rating by selecting the lowest value from each column. This value should match the chassis manufacturer’s certification label affixed inside the cab.

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<th>Weight per Unit Length</th>
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SUBSTANTIATION: Annex B has been expanded using material that was previously the appendix to 1-5, the existing Apparatus Purchasing Specification Form and two new forms and supporting instructions. The “Delivery Inspection Form” and the “As Delivered Weight Analysis Calculation Worksheet” provide purchasers easy guides to determine if their new apparatus complies with NFPA 1901. The checklist is not all-inclusive but does include items that are particularly relevant to the safety of the vehicle.

COMMITTEE MEETING ACTION: Accept

NUMBER OF COMMITTEE MEMBERS: 28

VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-267+ (Appendix C (new)) : Accept

SUBMITTER: Technical Committee on Fire Department Apparatus

RECOMMENDATION: Add a new Appendix C to read as follows:

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 The 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. In order to ensure 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.

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

See the draft shown at the end of this report for Figure C.1.

C.1.1 The approximate measurements and weights of equipment that are commonly available and used during fire department operations are listed on the worksheet. The purchaser should fill in the number of units of each type of equipment they anticipate carrying in the column titles QTY (quantity) and multiply that by the weight per unit to give the total weight. The dimensions of each piece of equipment are given to assist in planning compartment size or the planned location on the fire apparatus. Where the purchaser desires to carry specific equipment in a specific compartment, that compartment designation should be shown in the column titled Compartment Location.
C.1.2 An Excel spreadsheet that contains this list may be downloaded from the FAMA website, www.fama.org, and customized to show only the equipment your department expects to carry. There are additional columns on the spreadsheet to assist the fire department in maintaining records of the equipment it carries on the apparatus.

SUBSTANTIATION: A major problem with fire apparatus is overloading of the apparatus after it is in service. This is often attributable to the fact that the purchaser does not advise the apparatus manufacturer what they intend to carry for tools and equipment. Annex C is a worksheet from material developed by the Fire Apparatus Manufacturers Association that allows the purchaser to identify specifically what tools and equipment they plan to carry and to determine the weight of such equipment. Dimensions have also been given for each tool or piece of equipment to allow the purchaser to plan compartment space and storage needs.

COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28

1901-268-(Entire Document): Accept

SUBMITTER: Technical Committee on Fire Department Apparatus, Automotive Fire Apparatus as shown at the end of this report.

RECOMMENDATION: Completely revise NFPA 1901, Standard for Automotive Fire Apparatus as shown at the end of this report.

SUBSTANTIATION: As part of the complete revision, the committee is restructuring the document to update it to the NFPA Manual of Style. This includes moving the list of referenced documents from chapter 25 to Chapter 2 and the definitions from Chapter 1 to Chapter 3. Some of the text currently in Chapter 1 is being moved to the new Chapter 4 as the Manual of Style limits what can be in Chapter 1. All chapters have been subsequently renumbered to accommodate these changes. The metric values were updated as appropriate. The numbering has been changed to reflect the new method of numbering and the “Appendixes” renamed “Annexes.” The entire document was reviewed and editorially updated to clean up ambiguous language and clarify the requirements.

COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 28
VOTE ON COMMITTEE ACTION: AFFIRMATIVE: 28
NFPA 1901 — May 2003 ROP — Copyright, NFPA

NFPA 1901
Standard for
Automotive Fire Apparatus
2003 Edition

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

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

Chapter 1 Administration

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

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

1.3 Application.

1.3.1* This standard shall apply to new fire apparatus as follows:

(1) Of 10,000 lb (4500 kg) or greater gross vehicle weight rating (GVWR)
(2) Designed for use under emergency conditions to transport personnel and equipment and to support the suppression of fires and mitigation of other hazardous situations
(3) Contracted for on or after January 1, 2004

1.3.2 Nothing shall prevent the use of the standard prior to January 1, 2004 if the purchaser and contractor both agree.

1.3.3 This standard shall not apply to wildland fire apparatus, which are covered by NFPA 1906, Standard for Wildland Fire Apparatus.

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

1.5 Equivalency. Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety in place of those prescribed by this standard, provided technical documentation is submitted to the authority having jurisdiction to demonstrate equivalency and the system, method, or device is approved for the intended purpose.

1.6* Units and Formulas. In this standard, values for measurement in inch-pound units are followed by an equivalent in metric units. Either set of values can be used but the same set of values (either inch-pound units or metric units) shall be used throughout.

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, P.O. Box 9101, Quincy, MA 02269-9101.


2.3 Other Publications.

2.3.1 ANSI Publication. American National Standards Institute, Inc., 11 West 42nd Street, 13th floor, New York, NY 10036.

ANSI Z34.1, Standard for Third-Party Certification Programs for Products, Processes, and Services, 1993


2.3.2 ASME Publications. American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017.

ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 and Division 2, 2001.


2.3.3 ASNT Publication. American Society for Nondestructive Testing, Inc., 1711 Arlington Lane, Columbus, OH 43226-0518.


2.3.4 ASTM Publications. American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.


2.3.5 AWS Publications. American Welding Society, 550 N.W. LeJuene Road, Miami, FL 33126.


2.3.6 CSA Publications. Canadian Standards Association, 178 Rexdale Boulevard, Toronto, Ontario M9W 1R3, Canada

CSA W47.1, Standard for Certification of Companies for Fusion Welding of Steel Structures, 1992


2.3.7 CGA Publications. Compressed Gas Association, 1725 Jefferson Davis Highway, Suite 1004, Arlington, VA 22202.


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

SAE J541, Voltage Drop for Starting Motor Circuits, 1996.
SAE J553, Circuit Breakers, 1996.
SAE J554, Electric Fuses (Cartridge Type), 1987.
SAE J575, Test Methods and Equipment for Lighting Devices and Components for Use on Vehicles Less Than 2032 mm in Overall Width, 1992.
SAE J683, Tire Chain Clearance — Trucks, Buses (except Suburban, Intercity, and Transit Buses), and Combinations of Vehicles, 1985.

SAE J1690, Flashers, 1996.
SAE J1127, Battery Cable, 2000.
SAE J1128, Low Tension Primary Cable, 2000.
SAE J1292, Automobile, Truck, Truck-Tractor, Trailer, and Motor Coach Wiring, 1981.
SAE J1330, Photometry Laboratory Accuracy Guidelines, 2000
SAE J1560, Low Tension Thin Wall Primary Cable, 1992.
SAE J1690, Flashers, 1996.
SAE J2077, Miniature Blade Type Electrical Fuses, 1990.

2.3.9 TRA Publication. The Tire and Rim Association, Inc., 175 Montrose Ave, West, Copley, OH 44321.
Tire and Rim Association — Year Book, 2002.

2.3.10 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062.

No. 210, “Seat belt assembly anchorages.”
No. 302, “Flammability of interior materials.”
Title 49, Code of Federal Regulations, paragraph 393.94(c), “Vehicle interior noise levels test procedure.”

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 included, common usage of the terms shall apply.

3.2 NFPA Official Definitions.
3.2.1* Approved. Acceptable to the authority having jurisdiction.
3.2.2* Authority Having Jurisdiction (AHJ). The organization, office, or individual responsible for approving equipment, materials, an installation, or a procedure.
3.2.3 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
3.2.4* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.
3.2.5 Shall. Indicates a mandatory requirement.
3.2.6 Should. Indicates a recommendation or that which is advised but not required.
3.3 General Definitions.
3.3.1 Acceptance. An agreement between the purchasing authority and the contractor that the terms and conditions of the contract have been met.
3.3.2 Acceptance Tests. Tests performed on behalf of or by the purchaser at the time of delivery to determine compliance with the specifications for the fire apparatus.
3.3.3 Active Horizontal Angles of Light Emission. The angles, measured in a horizontal plane passing through the optical center of the optical source, as specified by the manufacturer of the optical device, between which the optical source contributes optical power.
3.3.4 Aerial Device. An aerial ladder, elevating platform, or water tower that is designed to position personnel, handle materials, provide continuous egress, or discharge water.
3.3.5 Aerial Fire Apparatus. A vehicle equipped with an aerial ladder, elevating platform, aerial ladder 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.
3.3.6 Aerial Ladder. A self-supporting, turntable-mounted, power-operated ladder of two or more sections permanently attached to a self-propelled automotive fire apparatus and designed to provide a continuous egress route from an elevated position to the ground.
3.3.7 Air Control Panel. A consolidated arrangement of valves, regulators, gauges, and air system piping at a location that allows the operator to monitor and control the airflow and pressure within the air system from a centralized location.
3.3.8 Air Quality Monitors. Instruments that monitor the air for such elements as carbon monoxide levels, moisture levels, and percent of oxygen.
3.3.9 Air Tank. A storage vessel meeting the requirements of either U.S. Department of Transportation (DOT) or American Society of Mechanical Engineers (ASME) and used to store an accumulation of air under pressure.
3.3.10 Air Truck. A vehicle used to supply breathing air either to refill self-contained breathing apparatus (SCBA) or to supply respirators directly through hose lines.
3.3.11 Angle of Approach. The smallest angle made between the road surface and a line drawn from the front point of ground contact of the front tire to any projection of the apparatus in front of the front axle.
3.3.12 Angle of Departure. The smallest angle made between the road surface and a line drawn from the rear point of ground contact of the rear tire to any projection of the apparatus behind the rear axle.
3.3.13 Articulating Boom. An aerial device consisting of two or more folding boom sections whose extension and retraction modes are accomplished by adjusting the angle of the knuckle joints.
3.3.14 ASME Pressure Vessel. A pressure vessel used for the storage or accumulation of air or gas under pressure that is constructed and tested in accordance with the ASME Boiler and Pressure Vessel Code.
3.3.15 Authorized Person. A person approved or assigned to perform specific types of duties or to be at a specific location at the job site.

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

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

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

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

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

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

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

3.3.23 Bonding. The permanent joining of metallic parts to form an electrically conductive path that will ensure electrical continuity and the capacity to conduct safely any current likely to be imposed.

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

3.3.25 Booster Pump. See 3.3.19, Auxiliary Pump.

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

3.3.27 Breathing Air. A respirable gas mixture derived from either normal atmospheric air for from manufactured synthetic air, stored in a compressed state in storage cylinders and respirator breathing air cylinders, and supplied to the user in gaseous form.

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

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

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

3.3.31 Cable. A wire rope used to transmit forces from one component to another for the purpose of extending or retracting an aerial device.

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

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

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

3.3.35 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, or passengers, appliances, or equipment related to other than control. Common usage might, but need not, include a cab (or cowl).

3.3.36 Class A Fire. A fire in ordinary combustible materials, such as wood, cloth, paper, rubber, and many plastics.

3.3.37 Class A Foam. Foam intended for use on Class A fires.

3.3.38 Class B Fire. A fire in flammable liquids, combustible liquids, petroleum greases, tar, oils, oil-based paints, solvents, lacquers, alcohols, and flammable gases. [1: 2.1.24]

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

3.3.40 Combination Vehicle. A vehicle consisting of a pulling tractor and trailer.

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

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

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

3.3.44 Continuous Duty. Operation at a constant rated load for an indefinitely long period.

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

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

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

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

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

3.3.50 Discharge Outlet Size. The nominal size of the first fire hose connection from the pump.

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

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

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

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

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

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

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

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

3.3.59 Electrical Equipment, Portable. Any electrical equipment that is not fixed. (See 3.3.58, Electrical Equipment, Fixed.)

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

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

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

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

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

3.3.65 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.

3.3.66 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.

3.3.67 Fixed Power Source. Any line voltage power source except a portable generator.
Any section of an aerial telescoping device beyond the base section.

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

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

Foam firefighting agent as received from the source grounding system.

The apparatus and techniques used to mix concentrate with water to make foam solution.

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

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

United States gallon.

A round, analog pressure-indicating device that uses mechanical means to measure pressure.

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

The chassis manufacturer’s specified maximum, load-carrying capacity of an axle system, as measured at the tire-ground interfaces.

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

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

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

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

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

Water to fire emergency scenes to be applied by other vehicles or pumping equipment.

Obtainable speed, and with the pump intake pressure at atmospheric pressure and its mounting brackets, boards, or trays.

A condition of a mobile unit in which the sum of the discharge pressure and the intake pressure when pumping from a hydrant or other source of water under positive pressure exceeds some predetermined value that is less than that required to operate the overcurrent protective device of the supply circuit.

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

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

The clearance under a vehicle at all locations except the axles and driveshift connections to the axle.

A device intended for the protection of personnel that functions to deenergize a circuit or portion thereof within an established period of time when a current to ground exceeds some predetermined value that is less than that required to operate the ground-fault circuit interrupter (GFCI).

A non-current-carrying conductor of a line voltage circuit, equipment, or system where the voltage does not exceed 30 volts (V) rms (ac) or 42.4 V peak (dc), usually 12 V dc in fire apparatus.

The person or persons, company, firm, corporation, partnership, or other organization responsible for turning raw materials or components into a finished product.

The maximum pump discharge pressure obtained with all discharge outlets closed, with the pump primed and running with the pump drive engine operating at maximum obtainable speed, and with the pump intake pressure at atmospheric pressure or less.

The continuous electrical current required to operate the minimum requirement of electrical devices defined by this standard.

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

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.

A vehicle designed primarily for transporting (pickup, transporting, and delivering) water to fire emergency scenes to be applied by other vehicles or pumping equipment.

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

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

A standard screw thread that has dimensions for inside (female) and outside (male) fire hose connections as defined in NFPA 1963, Standard for Fire Hose Connections.

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.

A panel containing gauges, switches, instruments, or controls where an operator can visually monitor the applicable functions.
3.3.117 Optical Center. The point specified by the optical warning device manufacturer of highest intensity when measuring the output of an optical warning device.

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

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

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

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

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

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

3.3.124 Panelboard. A single panel or group of panel units designed for assembly in the form of a single panel, including buses and automatic overcurrent devices, and equipped with or without switches for the control of light, heat, or power circuits; designed to be placed in a cabinet or cutout box placed in or against a wall, partition, or other support; and accessible only from the front. [70c100]

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

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

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

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

3.3.129 Power Supply Assembly. Any cord or distribution assembly that is partly comprised of the neutral conductor, grounding conductor, and line voltage conductors connected from the load side of the power source to the line side of the primary panelboard.

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

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

3.3.132 Psi. Pounds per square inch.

3.3.133 PTO. Power takeoff.

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

3.3.135 Pump Operator’s Position. The location from which the pump operator operates the pump.

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

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

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

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

3.3.140 Qualified Person. A person who, by possession of a recognized degree, certificate, professional standing, or skill, and who, by knowledge, training, and experience, has demonstrated the ability to deal with problems relating to a particular subject matter, work, or project. [1500:1-5]

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

3.3.142 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.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3.3.157 Standard Cubic Feet per Minute (SCFM). An expression of airflow rate in which the airflow rate is corrected to standard temperature and pressure.

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

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

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

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

3.3.162 Synthetic Breathing Air. A manufactured breathing air that is produced by blending nitrogen and oxygen.

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

3.3.164 Total Connected Electrical Load. The total current required to operate all of the devices permanently connected to the apparatus that can be simultaneously energized but does not include intermittent-type loads such as primers and booster reel rewind motors.

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

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

3.3.167 Turntable Alignment Indicator. An indicator that facilitates alignment of the aerial device with the boom support for bedding purposes.
3.3.168* Type 4 Rating. A rating for electrical equipment that is intended for outdoor use because it provides a degree of protection from falling rain, splashing water, and hose-directed water.

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

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

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

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

3.3.173 Water Tower. An aerial device consisting of permanently mounted power-operated booms and a waterway designed to supply a large capacity mobile elevated water stream. The booms can be of articulating design or telescoping design.

3.3.174 Wet Location. A nonsheltered location inside a compartment with a door or cover that, while open, exposes the electrical enclosure or panelboard to the same environmental conditions as the exterior of the fire apparatus. A location on a nonenclosed, exterior surface of a fire apparatus body or driving and crew compartment where the enclosure or panel is exposed to the environment. (See also 3.3.147, Road Spray Location.)

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

Chapter 4 General Requirements

4.1 General. All fire apparatus shall meet the requirements of the following chapters:

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

4.2 Requirements by Apparatus Type.

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

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

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

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

4.3* Responsibility of Purchaser. It shall be the responsibility of the purchaser to specify the following details of the apparatus:

(1) Its required performance, including where operations at elevations above 2000 ft (600 m) or on grades greater than 6 percent are required
(2) The maximum number of fire fighters to ride within the apparatus
(3) Specific added continuous electrical loads that exceed the minimum requirements of this standard
(4) Any hose, ground ladders, or equipment to be carried by the apparatus that exceed the minimum requirements of this standard.

4.4 Responsibility of Contractor.
### Table 4.2.2 Requirements by Apparatus

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

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

4.8.1 A representative of the manufacturer shall witness all tests and shall refuse to certify any test results for a system if all components of that system requiring testing do not pass the testing required by this standard.

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

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

4.8.4 Appropriate forms or data sheets shall be provided and used during the testing.

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

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

4.9 Personnel Protection.

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

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

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

4.9.4 Safety related (caution, warning, danger) signs shall meet the requirements of ANSI Z535.4, Product Safety Signs and Labels.

4.10 Controls and Instructions.

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

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

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

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

4.10.2.1 The signs, plates, and labels shall have resistance to damage from temperatures between –30°F and 160°F (–35°C and 71°C) and exposure to oil, fuel, water, hydraulic fluids, or other fluids used on the apparatus.

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

4.10.3 No gauge or visual display shall be more than 84 in. (2.1 m) above the level where the operator stands to read the instrument.

4.10.4 The central midpoint or centerline of any control shall be no more than 72 in. (1.8 m) vertically above the ground or platform that is designed to serve as the operator’s standing position.

4.11 Component Protection.

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

4.11.2 The type of equipment described in 4.11.1 shall be furnished with protective looms, grommets, or other devices at each point where they pass through body panels or structural members or wherever they lay against a sharp metal edge.

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

4.12 Vehicle Stability.

4.12.1 The height of the fully loaded vehicle’s center of gravity shall not exceed the chassis manufacturer’s maximum limit.

4.12.2 Weight Distribution.
4.17 Tests on Delivery.

4.17.1* If acceptance tests are desired at the point of delivery, they shall be run in accordance with the provisions of this standard and shall duplicate the tests that the purchaser specifies.

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

4.18 Documentation. Any documentation provided with the apparatus shall be permitted to be in printed or electronic format, audio-visual format, or a combination thereof.

4.19 Data Required of the Contractor.

4.19.1 Fire Apparatus Documentation. The contractor shall supply, at the time of delivery, at least one copy of the following documents:

1. The manufacturer’s record of apparatus construction details, including the following information:
   - Owner’s name and address
   - Apparatus manufacturer, model, and serial number
   - Chassis make, model, and serial number
   - GAWR of front and rear axles
   - Front tire size and total rated capacity in pounds (kg)
   - Rear tire size and total rated capacity in pounds (kg)
   - Chassis weight distribution in pounds with water and manufacturer mounted equipment (front and rear)
   - Engine make, model, serial number, rated horsepower and related speed, and governed speed
   - Type of fuel and fuel tank capacity
   - Electrical system voltage and alternator output in amps
   - Battery make, model, and capacity in cold cranking amps (CCA)
   - Chassis transmission make, model, and serial number; and if so equipped, chassis transmission PTO(s) make, model, and gear ratio
   - Pump make, model, rated capacity in gallons per minute (liters per minute where applicable), and serial number
   - Pump transmission make, model, serial number, and gear ratio
   - Auxiliary pump make, model, rated capacity in gallons per minute (liters per minute where applicable), and serial number
   - Water tank certified capacity in gallons or liters
   - Aerial device type, rated vertical height in feet (meters), rated horizontal reach in feet (meters), and rated capacity in pounds (kilograms)
   - Paint numbers
   - Company name and signature of responsible company representative
   - If the apparatus has a fire pump, the pump manufacturer’s certification of suction capability (see 16.2.4.1)
   - If the apparatus has a fire pump, a copy of the apparatus manufacturer’s approval for stationary pumping applications (see 16.3.1)
   - If the apparatus has a fire pump, the engine manufacturer’s certified brake horsepower curve for the engine furnished, showing the maximum governed speed (see 16.3.2)
   - If the apparatus has a fire pump, the pump manufacturer’s certification of the hydrostatic test (see 16.5.2)
   - If the apparatus has a fire pump, the certification of inspection and test for the fire pump (see 16.13.4)
   - If the apparatus has an aerial device, the certification of inspection and test for the aerial device (see Section 20.24)
   - If the apparatus has an aerial device, all the technical information required for inspections to comply with NFPA 1914, Standard for Testing Fire Department Aerial Devices
   - If the apparatus has a fixed line voltage power source, the certification of the test for the fixed power source
   - If the apparatus is equipped with an air system, test results of the air quality, the SCBA fill station, and the air system installation (see Chapter 25)

2. In addition to the above, the contractor shall supply, at the time of delivery, at least two sets of the following items for the entire apparatus and each major operating system or major component of the apparatus:
   - Manufacturer’s name and address
   - Country of manufacture
   - Source for service and technical information
   - Parts replacement information
   - Descriptions, specifications, and ratings of the chassis, pump (if applicable), and aerial device (if applicable)
   - Wiring diagrams for low voltage and line voltage systems to include the following information:
     - Pictorial representations of circuit logic for all electrical components and wiring
     - Circuit identification
     - Connector pin identification
     - Zone location of electrical components
     - Safety interlocks
     - Alternator-battery power distribution circuits
     - Equivalent circuit logic implemented in multiplexing systems
   - Lubrication charts
   - Operating instructions for the chassis, any major components such as a pump or aerial device, and any auxiliary systems
   - Precautions related to multiple configurations of aerial devices, if applicable
   - Instructions regarding the frequency and procedure for recommended maintenance
   - Overall apparatus operating instructions
   - Safety considerations
   - Limitations of use
   - Inspection procedures
   - Recommended maintenance procedures
   - Troubleshooting guide
   - Apparatus body, chassis, and other component manufacturer’s warranties
   - Special data required by this standard
   - Copies of completed manufacturer testing and certifications, independent third-party certifications of test results, and other component manufacturer’s certifications
   - A material safety data sheet (MSDS) for any fluid that is specified for use on the apparatus

4.19.2 Operations and Service Documentation.

4.19.2.1 The contractor shall supply, at time of delivery, at least two sets of complete operation and service documentation covering the completed apparatus as delivered and accepted.

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

4.19.2.3 The contractor shall also provide documentation of the following items for the entire apparatus and each major operating system or major component of the apparatus:

1. The manufacturer’s record of apparatus construction details, including the following information:
   - Owner’s name and address
   - Apparatus manufacturer, model, and serial number
   - Chassis make, model, and serial number
   - GAWR of front and rear axles
   - Front tire size and total rated capacity in pounds (kg)
   - Rear tire size and total rated capacity in pounds (kg)
   - Chassis weight distribution in pounds with water and manufacturer mounted equipment (front and rear)
   - Engine make, model, serial number, rated horsepower and related speed, and governed speed
   - Type of fuel and fuel tank capacity
   - Electrical system voltage and alternator output in amps
   - Battery make, model, and capacity in cold cranking amps (CCA)
   - Chassis transmission make, model, and serial number; and if so equipped, chassis transmission PTO(s) make, model, and gear ratio
   - Pump make, model, rated capacity in gallons per minute (liters per minute where applicable), and serial number
   - Pump transmission make, model, serial number, and gear ratio
   - Auxiliary pump make, model, rated capacity in gallons per minute (liters per minute where applicable), and serial number
   - Water tank certified capacity in gallons or liters
   - Aerial device type, rated vertical height in feet (meters), rated horizontal reach in feet (meters), and rated capacity in pounds (kilograms)
   - Paint numbers
   - Company name and signature of responsible company representative
   - If the apparatus has a fire pump, the pump manufacturer’s certification of suction capability (see 16.2.4.1)
   - If the apparatus has a fire pump, a copy of the apparatus manufacturer’s approval for stationary pumping applications (see 16.3.1)
   - If the apparatus has a fire pump, the engine manufacturer’s certified brake horsepower curve for the engine furnished, showing the maximum governed speed (see 16.3.2)
   - If the apparatus has a fire pump, the pump manufacturer’s certification of the hydrostatic test (see 16.5.2)
   - If the apparatus has a fire pump, the certification of inspection and test for the fire pump (see 16.13.4)
   - If the apparatus has an aerial device, the certification of inspection and test for the aerial device (see Section 20.24)
   - If the apparatus has an aerial device, all the technical information required for inspections to comply with NFPA 1914, Standard for Testing Fire Department Aerial Devices
   - If the apparatus has a fixed line voltage power source, the certification of the test for the fixed power source
   - If the apparatus is equipped with an air system, test results of the air quality, the SCBA fill station, and the air system installation (see Chapter 25)

   - Weight documents from a certified scale — showing actual loading on the front axle, rear axle(s), and overall fire apparatus (with the water tank full but without personnel, equipment, and hose)

   - Written load analysis and results of the electrical system performance tests required in Chapter 13

   - When the apparatus is equipped with a water tank, the certification of water tank capacity (see Section 19.6)
Chapter 5 Pumper Fire Apparatus Requirements

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

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

5.3 Aerial Device.

5.3.1 If the pumper fire apparatus is equipped with an aerial device, the aerial device shall meet the requirements of Chapter 20.

5.3.2 If the aerial device is equipped with a permanently mounted waterway, the fire pump shall be capable of supplying the flow requirements of 20.6.1, 20.12.1, or 20.16.1 with a maximum intake gauge pressure of 20 psi (150 kPa).

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

5.3.4 Signs shall be placed to warn the pump operator of electrocution hazards.

5.4* Water Tank. The pumper shall be equipped with a water tank(s) that meets the requirements of Chapter 19 and that has a minimum certified capacity (combined, if applicable) of 300 gal (1100 L).

5.5* Equipment Storage. A minimum of 40 ft² (1.1 m²) of enclosed weather-resistant compartmentation that meets the requirements of Chapter 15 shall be provided for the storage of equipment.

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

1. A minimum hose storage area of 30 ft² (0.8 m²) for 2 1/2-in. (65-mm) or larger fire hose
2. Two areas, each a minimum of 3.5 ft² (0.1 m²), to accommodate 1 1/2-in. (38-mm) or larger preconnected fire hose lines

5.7* Equipment Supplied by the Contractor. The contractor shall supply the equipment listed in 5.7.1 and 5.7.2 and shall provide and install such brackets or compartments as are necessary to mount the equipment.

5.7.1 Ground Ladders.

5.7.1.1 All ground ladders carried on the apparatus shall meet the requirements of NFPA 1931, Standard on Design of and Design Verification Tests for Fire Department Ground Ladders.

5.7.1.2* At a minimum, the following ladders shall be carried on the apparatus:

1. One straight ladder equipped with roof hooks
2. One extension ladder
3. One attic ladder

5.7.2 Suction Hose.

5.7.2.1 A minimum of 15 ft (4.5 m) of soft suction hose or 20 ft (6 m) of hard suction hose shall be carried.

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

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

5.7.2.1.3 Where soft suction hose is provided, it shall have long-handle female couplings with the local hydrant outlet connection on one end and the pump intake connection on the other end.

5.7.2.2 Suction hose shall meet the requirements of NFPA 1961, Standard on Fire Hose.

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

5.8* Minor Equipment.

5.8.1 General. The list of equipment in 5.8.2 and 5.8.3 shall be available on the pumper fire apparatus before the apparatus is placed in service.

5.8.1.1 Brackets or compartments shall be furnished so as to organize and protect the equipment.

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

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

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

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

1. One 6-lb (2.7-kg) flathead axe mounted in a bracket fastened to the apparatus
2. One 6-lb (2.7-kg) pickhead axe mounted in a bracket fastened to the apparatus
3. One 6-ft (2-m) pike pole or plaster hook mounted in a bracket fastened to the apparatus
4. One 8-ft (2.4-m) or longer pike pole mounted in a bracket fastened to the apparatus
5. Two portable hand lights mounted in brackets fastened to the apparatus
6. One approved dry chemical portable fire extinguisher with a minimum 80-B:C rating mounted in a bracket fastened to the apparatus
7. One 2 1/2-gal (9.5-L) or larger water extinguisher mounted in a bracket fastened to the apparatus
8. One gated swivel intake connection with pump intake threads on one end and one or more female connections compatible with the supply hose carried on the other
9. One self-contained breathing apparatus (SCBA) complying with NFPA 1981, Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire and Emergency Services, for each assigned seating position, but not less than four, mounted in brackets fastened to the apparatus or stored in containers supplied by the SCBA manufacturer
10. One spare SCBA cylinder for each SCBA carried, each mounted in a bracket fastened to the apparatus or stored in a specially designed storage space
11. One first aid kit
12. Four combination spanner wrenches mounted in brackets fastened to the apparatus
13. Two hydrant wrenches mounted in brackets fastened to the apparatus
14. Two double female adapters, sized to fit 2 1/2-in. (65-mm) or larger fire hose, mounted in brackets fastened to the apparatus
15. Two double male adapters, sized to fit 2 1/2-in. (65-mm) or larger fire hose, mounted in brackets fastened to the apparatus
16. One rubber mallet, suitable for use on suction hose connections, mounted in a bracket fastened to the apparatus
17. Two salvage covers each a minimum size of 12 ft x 14 ft (3.7 m x 4.3 m)
18. Two wheel chocks, mounted in readily accessible locations, each designed to hold the fully loaded apparatus on a 10 percent grade with the transmission in neutral and the parking brake released.

5.8.3.1 If the pumper is equipped with an aerial device with a permanently mounted ladder, four ladder belts meeting the requirements of NFPA 1983, Standard on Fire Service Life Safety Rope and System Components, shall be provided.

Chapter 6 Initial Attack Fire Apparatus

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

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

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6.3 Water Tank. Initial attack apparatus shall be equipped with a water tank(s) that meets the requirements of Chapter 19 and that has a minimum certified capacity (combined, if applicable) of 200 gal (790 L).

6.4* Equipment Storage. A minimum of 22 ft² (0.6 m²) of enclosed weather-resistant compartmentation that meets the requirements of Chapter 15 shall be provided for the storage of equipment.

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

1. A minimum hose storage area of 10 ft² (0.3 m²) for 2 1/2-in. (65-mm) or larger fire hose.
2. Two areas, each a minimum of 3.5 ft² (0.1 m²), to accommodate 1 1/2-in. (38-mm) or larger preconnected fire hose lines.

6.6* Equipment Supplied by the Contractor. The contractor shall supply the equipment listed in 6.6.1 and 6.6.2 and shall provide and install such brackets or compartments as are necessary to mount the equipment.

6.6.1 Ground Ladders.

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

6.6.1.2 All ground ladders on the apparatus shall meet the requirements of NFPA 1931, Standard on Design of and Design Verification Tests for Fire Department Ground Ladders.

6.6.2 Suction Hose.

6.6.2.1 A minimum of 15 ft (4.5 m) of soft suction hose or 20 ft (6 m) of hard suction hose shall be carried.

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

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

6.6.2.1.3 Where soft suction hose is provided, it shall have long-handle female couplings with the local hydrant outlet connection on one end and the pump intake connection on the other end.

6.6.2.2 Suction hose shall meet the requirements of NFPA 1961, Standard on Fire Hose.

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

6.7* Minor Equipment.

6.7.1 General. The list of equipment in 6.7.2 and 6.7.3 shall be available on the initial attack fire apparatus before the apparatus is placed in service.

6.7.1.1 Brackets or compartments shall be furnished so as to organize and protect the equipment.

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

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

1. 300 ft (90 m) of 2 1/2-in. (65-mm) or larger fire hose.
2. 400 ft (120 m) of 1 1/2-in. (38-mm), 1 3/4-in. (45-mm), or 2-in. (52-mm) fire hose.
3. Two combination spray nozzles, 95 gpm (360 L/min) minimum.

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

1. One 6-lb (2.7-kg) pickhead axe mounted in a bracket fastened to the apparatus.
2. One 6-ft (2-m) pike pole or plater hook mounted in a bracket fastened to the apparatus.
3. Two portable hand lights mounted in brackets fastened to the apparatus.
4. One approved dry chemical portable fire extinguisher with a minimum 80-B:C rating mounted in a bracket fastened to the apparatus.
5. One 2 1/2-gal (9.5-L) or larger water extinguisher mounted in a bracket fastened to the apparatus.
6. One gated swivel intake connection with pump intake threads on one end and one or more female connections compatible with the supply hose carried on the other.
7. One SCBA complying with NFPA 1981, Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire and Emergency Services, for each assigned seating position, but not less than two, mounted in brackets fastened to the apparatus or stored in containers supplied by the SCBA manufacturer.
8. One spare SCBA cylinder for each SCBA carried, each mounted in a bracket fastened to the apparatus or in a specially designed storage space(s).
9. One first aid kit.
10. Two combination spanner wrenches mounted in a bracket(s) fastened to the apparatus.
11. One hydrant wrench mounted in a bracket fastened to the apparatus.
12. One double female adapter, sized to fit 2 1/2-in. (65-mm) or larger fire hose, mounted in a bracket fastened to the apparatus.
13. One double male adapter, sized to fit 2 1/2-in. (65-mm) or larger fire hose, mounted in a bracket fastened to the apparatus.
14. One rubber mallet, for use on suction hose connections, mounted in a bracket fastened to the apparatus.
15. Two wheel chocks, mounted in readily accessible locations, each designed to hold the fully loaded apparatus on a 10 percent grade with the transmission in neutral and the parking brake released.

Chapter 7 Mobile Water Supply Fire Apparatus

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

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

7.3 Water Tank. The mobile water supply apparatus shall be equipped with a water tank(s) that meets the requirements of Chapter 19 and that has a minimum certified capacity (combined, if applicable) of 1000 gal (4000 L).

7.4* Equipment Storage. A minimum of 20 ft² (0.6 m²) of enclosed weather-resistant compartmentation meeting the requirements of Chapter 15 shall be provided for the storage of equipment.

7.5 Hose Storage.

7.5.1* A minimum hose storage area of 6 ft² (0.2 m²) for 2 1/2-in. (65-mm) or larger fire hose that meets the requirements of Section 15.10 shall be provided.

7.5.2 If the apparatus is equipped with a fire pump, two areas, each a minimum of 3.5 ft² (0.1 m²), shall be provided to accommodate 1 1/2-in. (38-mm) or larger preconnected fire hose lines shall be provided.

7.6* Suction Hose. If the mobile water supply fire apparatus is equipped with a pump, the requirements in 7.6.1 through 7.6.3 shall apply.

7.6.1 A minimum of 15 ft (4.5 m) of soft suction hose or 20 ft (6 m) of hard suction hose shall be carried.

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

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

7.6.1.3 Where soft suction hose is provided, it shall have long-handle female couplings with the local hydrant outlet connection on one end and the pump intake connection on the other end.

7.6.2 Suction hose shall meet the requirements of NFPA 1961, Standard on Fire Hose.

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

7.7 Minor Equipment.

7.7.1 The list of equipment in 7.7.2 and 7.7.3 shall be available on the initial attack fire apparatus before the apparatus is placed in service.

7.7.1.1 Brackets or compartments shall be furnished so as to organize and protect the equipment.
**Chapter 8 Aerial Fire Apparatus**

**8.1 General.**

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

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

8.2 Aerial Device. The apparatus shall be equipped with an aerial ladder, elevating platform, or water tower that meets the requirements of Chapter 20.

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

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

8.3.2 Signs shall be placed to warn the pump operator of electrocution hazards.

8.3.3 If the aerial fire apparatus is equipped with a fire pump that is intended to supply water to a permanently mounted waterway, the fire pump shall be capable of supplying the flow requirements of 20.6.1, 20.12.1, or 20.16.1 with a maximum intake gauge pressure of 20 psi (150 kPa).

8.4 Water Tank. If the aerial fire apparatus is equipped with a water tank, it shall meet the requirements of Chapter 19.

8.5 Equipment Storage. A minimum of 40 ft³ (1.1 m³) of enclosed weather-resistant compartmentation meeting the requirements of Chapter 15 shall be provided for the storage of equipment.

8.6 Hose Storage.

8.6.1 Any hose on the aerial fire apparatus shall be carried on the apparatus before the apparatus is placed in service.

8.8.1 Minor Equipment.

8.8.1.1 The list of equipment in 8.8.2 and 8.8.3 shall be available on the aerial fire apparatus before the apparatus is placed in service.

8.8.1.2 Brackets or compartments shall be furnished so as to organize and protect the equipment.

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

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

1. One 6-lb (2.7-kg) flathead or pickhead axe mounted in a bracket fastened to the apparatus
2. Two claw tools mounted in brackets fastened to the apparatus
3. One 6-ft (2-m) or longer pike pole or plaster hook mounted in a bracket fastened to the apparatus
4. Two combination spray nozzles, 95 gpm (360 L/min) minimum
5. Two combination spanner wrenches mounted in a bracket fastened to the apparatus
6. One 6-lb (2.7-kg) flathead or pickhead axe mounted in brackets fastened to the apparatus
7. Two portable hand lights mounted in brackets fastened to the apparatus
8. Four portable hand lights mounted in brackets fastened to the apparatus
9. One approved dry chemical portable fire extinguisher with a minimum 80-B:C rating mounted in a bracket fastened to the apparatus
10. One 2 1/2-gal (9.5-L) or larger water extinguisher mounted in a bracket fastened to the apparatus
11. One double female adapter, sized to fit 2 1/2-in. (65-mm) or larger fire hose, mounted in a bracket fastened to the apparatus
12. One double female adapter, sized to fit 2 1/2-in. (65-mm) or larger fire hose, mounted in a bracket fastened to the apparatus
13. Two wheel chocks, mounted in readily accessible locations, each designed to hold the fully loaded apparatus on a 10 percent grade with the transmission in neutral and the parking brake released.
14. Six salvage covers, each a minimum size of 12 ft × 18 ft (3.6 m × 5.5 m)

8.7 Ground Ladders.

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

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

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

8.7.3 The contractor shall provide such brackets or compartments as are necessary to mount the equipment.

8.7.4 The ground ladders shall meet the requirements of NFPA 1931, Standard on Design of and Design Verification Tests for Fire Department Ground Ladders.

8.8 Minor Equipment.

8.8.1 The list of equipment in 8.8.2 and 8.8.3 shall be available on the aerial fire apparatus before the apparatus is placed in service.

8.8.1.1 Brackets or compartments shall be furnished so as to organize and protect the equipment.

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

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

1. One 6-lb (2.7-kg) flathead axes mounted in brackets fastened to the apparatus
2. Three 6-lb (2.7-kg) pickhead axes mounted in brackets fastened to the apparatus
3. Four pike poles mounted in brackets fastened to the apparatus
4. Two 3-ft to 4-ft (1-m to 1.2-m) plaster hooks with D handles mounted in brackets fastened to the apparatus
5. Two crowbars mounted in brackets fastened to the apparatus
6. Two claw tools mounted in brackets fastened to the apparatus
7. Two 12-lb (5-kg) sledgehammers mounted in brackets fastened to the apparatus
8. Four portable hand lights mounted in brackets fastened to the apparatus
9. One approved dry chemical portable fire extinguisher with a minimum 80-B:C rating mounted in a bracket fastened to the apparatus
10. One 2 1/2-gal (9.5-L) or larger water extinguisher mounted in a bracket fastened to the apparatus
11. One SCBA complying with NFPA 1981, Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire and Emergency Services, but not less than two, mounted in brackets fastened to the apparatus or stored in containers supplied by the SCBA manufacturer
12. One SCBA cylinder for each SCBA carried, each mounted in a bracket fastened to the apparatus or stored in a specially designed storage space(s)
13. One first aid kit
14. Two combination spanner wrenches mounted in a bracket fastened to the apparatus
15. One hydrant wrench mounted in a bracket fastened to the apparatus
16. One double female adapter, sized to fit 2 1/2-in. (65-mm) or larger fire hose, mounted in a bracket fastened to the apparatus
17. One double female adapter, sized to fit 2 1/2-in. (65-mm) or larger fire hose, mounted in a bracket fastened to the apparatus
18. One attic ladder
19. Two straight ladders (with folding roof hooks)
20. Two extension ladders
21. Two wheel chocks, mounted in readily accessible locations, each designed to hold the fully loaded apparatus on a 10 percent grade with the transmission in neutral and the parking brake released.

8.3.2 If the aerial fire apparatus is equipped with a fire pump that is intended to supply water to a permanently mounted waterway, the fire pump shall be capable of supplying the flow requirements of 20.6.1, 20.12.1, or 20.16.1 with a maximum intake gauge pressure of 20 psi (150 kPa).

8.4 Water Tank. If the aerial fire apparatus is equipped with a water tank, it shall meet the requirements of Chapter 19.

8.5 Equipment Storage. A minimum of 40 ft³ (1.1 m³) of enclosed weather-resistant compartmentation meeting the requirements of Chapter 15 shall be provided for the storage of equipment.

8.6 Hose Storage.

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

8.6.2 If the apparatus is equipped with a fire pump and a water tank, two areas, each a minimum of 3.5 ft³ (0.1 m³), to accommodate 1 1/2-in. (38-mm) or larger preconnected fire hose lines, shall be provided.

8.7 Ground Ladders.

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

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

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

8.7.3 The contractor shall provide such brackets or compartments as are necessary to mount the equipment.

8.7.4 The ground ladders shall meet the requirements of NFPA 1931, Standard on Design of and Design Verification Tests for Fire Department Ground Ladders.

8.8 Minor Equipment.

8.8.1 The list of equipment in 8.8.2 and 8.8.3 shall be available on the aerial fire apparatus before the apparatus is placed in service.

8.8.1.1 Brackets or compartments shall be furnished so as to organize and protect the equipment.

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

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

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

8.8.3 If the aerial fire apparatus is equipped with a fire pump, the following shall be supplied:
   (1) Two double female adapters, sized to fit 2 1/2-in. (65-mm) or larger fire hose, mounted in brackets fastened to the apparatus
   (2) Two double male adapters, sized to fit 2 1/2-in. (65-mm) or larger fire hose, mounted in brackets fastened to the apparatus
   (3) One rubber mallet, for use on suction hose connections, mounted in a bracket fastened to the apparatus
   (4) One gated swivel intake connection with pump intake threads on one end and one or more female connections compatible with the supply hose carried on the other end
   (5) Two hydrant wrenches mounted in brackets fastened to the apparatus

Chapter 9 Quint Fire Apparatus

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

9.2 Fire Pump.

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

9.2.2* The fire pump shall be capable of supplying the flow requirements of 20.6.1 or 20.12.1 with a maximum intake gauge pressure of 20 psi (150 kPa).

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

9.2.4 Signs shall be placed to warn the pump operator of electrocution hazards.

9.3 Aerial Device. The apparatus shall be equipped with an aerial ladder or an elevating platform with a permanently installed waterway that meets the requirements of Chapter 20.

9.4 Water Tank. The apparatus shall be equipped with a water tank(s) that meets the requirements of Chapter 19 and that has a minimum certified capacity (combined, if applicable) of 300 gal (1100 L).

9.5* Equipment Storage. A minimum of 40 ft’ (1.1 m)’ of enclosed weather-resistant compartmentation that meets the requirements of Chapter 15 shall be provided for the storage of equipment.

9.6* Hose Storage. Hose bed area(s), compartments, or reels that comply with Section 15.10 shall be provided to accommodate the following:
   (1) A minimum hose storage area of 30 ft’ (0.8 m) for 2 1/2-in. (65-mm) or larger fire hose
   (2) Two areas, each a minimum of 3.5 ft’ (0.1 m), to accommodate 1 1/2-in. (38-mm) or larger preconnected fire hose lines

9.7* Equipment Supplied by the Contractor. The contractor shall supply the equipment listed in 9.7.1 and 9.7.2 and shall provide and install such brackets or compartments as are necessary to mount the equipment.

9.7.1 Ground Ladders.

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

9.7.1.2 All ground ladders carried on the apparatus shall meet the requirements of NFPA 1931, Standard on Design of and Design Verification Tests for Fire Department Ground Ladders.

9.7.2 Suction Hose.

9.7.2.1 A minimum of 15 ft (4.5 m) of soft suction hose or 20 ft (6 m) of hard suction hose shall be carried.

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

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

9.7.2.1.3 Where soft suction hose is provided, it shall have long-handle female couplings with the local hydrant outlet connection on one end and the pump intake connection on the other end.

9.7.2.2 Suction hose shall meet the requirements of NFPA 1961, Standard on Fire Hose.

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

9.8* Minor Equipment.

9.8.1 The list of equipment in 9.8.2 and 9.8.3 shall be available on the quint fire apparatus before the apparatus is placed in service.

9.8.1.1 Brackets or compartments shall be furnished so as to organize and protect the equipment.

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

9.8.2* Fire Hose and Nozzles. The following fire hose and nozzles shall be carried on the apparatus:
   (1) 800 ft (240 m) of 2 1/2-in. (65-mm) or larger fire hose, in any combination
   (2) 400 ft (120 m) of 1 1/2-in. (38-mm), 1 1/4-in. (45-mm), or 2-in. (52-mm) fire hose, in any combination
   (3) One combination spray nozzle, 200 gpm (750 L/min) minimum
   (4) Two combination spray nozzles, 95 gpm (360 L/min) minimum
   (5) One playpipe with shutoff and 1-in. (25-mm), 1 1/4-in. (32-mm) tips

9.8.3* Miscellaneous Equipment. The following additional equipment shall be carried on the apparatus:
   (1) One 6-lb (2.7-kg) flathead axe mounted in a bracket fastened to the apparatus
   (2) One 6-lb (2.7-kg) pickhead axe mounted in a bracket fastened to the apparatus
   (3) One 6-ft (2-m) pike pole or plaster hook mounted in a bracket fastened to the apparatus
   (4) One 8-ft (2.4-m) or longer pike pole mounted in a bracket fastened to the apparatus
   (5) Two portable hand lights mounted in brackets fastened to the apparatus
(6) One approved dry chemical portable fire extinguisher with a minimum 80-B:C rating mounted in a bracket fastened to the apparatus

(7) One 21/2-gal (9.5-L) or larger water extinguisher mounted in a bracket fastened to the apparatus

(8) One gated swivel intake connection with pump intake threads on one end and one or more female connections compatible with the supply hose carried on the other

(9) One SCBA with NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire and Emergency Services*, for each assigned seating position, but not less than four, mounted in brackets fastened to the apparatus or stored in containers supplied by the SCBA manufacturer

(10) One spare SCBA cylinder for each SCBA carried, each mounted in a bracket fastened to the apparatus or stored in a specially designed storage space(s)

(11) One spare SCBA cylinder for each SCBA carried

(12) One first aid kit

(13) Four combination spanner wrenches mounted in brackets fastened to the apparatus

(14) Two hydrant wrenches mounted in brackets fastened to the apparatus

(15) Two double female adapters, sized to fit 21/2-in. (65-mm) or larger fire hose, mounted in brackets fastened to the apparatus

(16) Two double male adapters, sized to fit 21/2-in. (65-mm) or larger fire hose, mounted in brackets fastened to the apparatus

(17) One rubber mallet, for use on suction hose connections, mounted in a bracket fastened to the apparatus

(18) Four salvage covers, each a minimum size of 12 ft x 14 ft (3.7 m x 4.3 m)

(19) Four ladder belts meeting the requirements of NFPA 1983, *Standard on Fire Service Life Safety Rope and System Components*

(20) One 150-ft (45-m) light-use life safety rope meeting the requirements of NFPA 1983, *Standard on Fire Service Life Safety Rope and System Components*

(21) One 150-ft (45-m) general-use life safety rope meeting the requirements of NFPA 1983, *Standard on Fire Service Life Safety Rope and System Components*

(22) Two wheel chocks, mounted in readily accessible locations, each designed to hold the fully loaded apparatus on a 10 percent grade with the transmission in neutral and the parking brake released.

### Chapter 10 Special Service Fire Apparatus

#### 10.1 General

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

#### 10.2 Pump

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

#### 10.3* Equipment Storage

A minimum of 120 ft² (3.4 m²) of enclosed weather-resistant compartmentation meeting the requirements of Chapter 15 shall be provided for the storage of equipment.

#### 10.4* Equipment Supplied by the Contractor

The contractor shall supply the equipment listed in 10.4.1 and 10.4.2 and shall provide and install such brackets or compartments as are necessary to mount the equipment.

##### 10.4.1 Ground Ladders

If ground ladders are carried on the apparatus, the truck shall meet the requirements of NFPA 1931, *Standard on Design and Construction of Fire Apparatus*.

##### 10.4.2 Suction Hose

If the special service fire apparatus is equipped with a pump, the requirements in 10.4.2.1 through 10.4.2.3 shall apply.

10.4.2.1 A minimum of 15 ft (4.5 m) of soft suction hose or 20 ft (6 m) of hard suction hose shall be carried.

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

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

10.4.2.1.3 Where soft suction hose is provided, it shall have long-handle female couplings with the local hydrant outlet connection on one end and the pump intake connection on the other end.

10.4.2.2 Suction hose shall meet the requirements of NFPA 1961, *Standard on Fire Hose*.

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

#### 10.5* Minor Equipment

##### 10.5.1 Equipment Furnished by the Contractor

The list of equipment in 10.5.2 shall be available on the special service fire apparatus before the apparatus is placed in service.

##### 10.5.1.1 Brackets or compartments shall be furnished so as to organize and protect the equipment.

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

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

1. Two portable hand lights mounted in brackets fastened to the apparatus

2. One approved dry chemical portable fire extinguisher with a minimum 80-B:C rating mounted in a bracket fastened to the apparatus

3. One 21/2-gal (9.5-L) or larger water extinguisher mounted in a bracket fastened to the apparatus

4. One SCBA complying with NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire and Emergency Services*, for each assigned seating position, but not less than two, mounted in brackets fastened to the apparatus or stored in containers supplied by the SCBA manufacturer

5. One spare SCBA cylinder for each SCBA carried, each mounted in a bracket fastened to the apparatus or stored in a specially designed storage space(s)

6. One first aid kit

7. Two wheel chocks, mounted in readily accessible locations, each designed to hold the fully loaded apparatus on a 10 percent grade with the transmission in neutral and the parking brake released.

### Chapter 11 Mobile Foam Fire Apparatus

#### 11.1 General

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

#### 11.2 Fire Pump

The apparatus shall be equipped with a fire pump that has a minimum rated capacity of 750 gpm (3000 L/min) or an industrial supply pump that meets the requirements of Chapter 16 or an industrial supply pump that meets the requirements of Chapter 18.

#### 11.3 Aerial Device

11.3.1 If the mobile foam fire apparatus is equipped with an aerial device, the aerial device shall meet the requirements of Chapter 20.

11.3.2* The aerial device shall be equipped with a permanently mounted waterway, and the fire pump shall be capable of supplying the flow requirements of 20.6.1, 20.12.1, or 20.16.1 with a maximum intake gauge pressure of 20 psi (150 kPa).

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

11.3.4 Signs shall be placed to warn the pump operator of electrocution hazards.

#### 11.4 Foam Proportioning System

The apparatus shall be equipped with a foam proportioning system that meets the requirements of Chapter 21.

#### 11.5 Foam Tank

The mobile foam fire apparatus shall be equipped with a foam concentrate tank(s) that meets the requirements of Chapter 21 and that has a minimum certified capacity (combined, if applicable) of 500 gal (2000 L).

#### 11.6* Equipment Storage

A minimum of 40 ft³ (1.13 m³) of enclosed weather-resistant compartmentation that meets the requirements of Chapter 15 shall be provided for the storage of equipment.

#### 11.7* Hose Storage

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

1. A minimum hose storage area of 30 ft² (0.8 m²) for 21/2-in. (65-mm) or larger fire hose

2. Two areas, each a minimum of 3.5 ft² (0.1 m²), to accommodate 11/2-in. (38-mm) or larger preconnected fire hose lines

#### 11.8* Equipment Supplied by the Contractor

The contractor shall supply the equipment listed in 11.8.1 and shall provide and install such brackets or compartments as are necessary to mount the equipment.

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11.8.1 Suction Hose.

11.8.1.1 A minimum of 15 ft (4.5 m) of soft suction hose or 20 ft (6 m) of hard suction hose shall be carried.

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

11.8.1.2 Where soft suction hose is provided, it shall have long-handle female couplings with the local hydrant outlet connection on one end and the pump intake connection on the other end.

11.8.1.2 Suction hose shall meet the requirements of NFPA 61, Standard on Fire Hose.

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

11.9* Minor Equipment.

11.9.1 General. The list of equipment in 11.9.2 and 11.9.3 shall be available on the mobile foam fire apparatus before the apparatus is placed in service.

11.9.1.1 Brackets or compartments shall be furnished so as to organize and protect the equipment.

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

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

1. 800 ft (240 m) of 2 1/2-in. (65-mm) or larger fire hose, in any combination

2. 400 ft (120 m) of 1 1/2-in. (38-mm), 1 1/2-in. (45-mm), or 2-in. (52-mm) fire hose, in any combination

3. Four foam or spray nozzles, 200 gpm (750 L/min) minimum

4. Two foam or spray nozzles, 95 gpm (360 L/min) minimum

5. One preconnected monitor, rated to discharge a minimum of 1000 gpm (4000 L/min), mounted on top of the fire apparatus with a spray or foam nozzle rated at a minimum of 1000 gpm (4000 L/min)

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

1. One 6-lb (2.7-kg) pickhead axe mounted in a bracket fastened to the apparatus

2. One 6-ft (2-m) pike pole or plaster hook mounted in a bracket fastened to the apparatus

3. Two portable hand lights mounted in brackets fastened to the apparatus

4. One approved dry chemical portable fire extinguisher with a minimum 80-B:C rating mounted in a bracket fastened to the apparatus

5. One gated swivel intake connection with pump intake threads on one end and one or more female connections compatible with the supply hose carried on the other

6. One SCBA complying with NFPA 1981, Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire and Emergency Services, for each assigned seating position, but not less than four, mounted in brackets fastened to the apparatus or stored in containers supplied by the SCBA manufacturer

7. One spare SCBA cylinder for each SCBA carried, each mounted in a bracket fastened to the apparatus or stored in a specially designed storage space

8. One first aid kit

9. Four combination spanner wrenches mounted in brackets fastened to the apparatus

10. Two hydrant wrenches mounted in brackets fastened to the apparatus

11. Two double female adapters, sized to fit 2 1/2-in. (65-mm) or larger fire hose, mounted in brackets fastened to the apparatus

12. Two double male adapters, sized to fit 2 1/2-in. (65-mm) or larger fire hose, mounted in brackets fastened to the apparatus

13. One rubber mallet, suitable for use on suction hose connections, mounted in a bracket fastened to the apparatus

(14) Two wheel chocks, mounted in readily accessible locations, each designed to hold the fully loaded apparatus on a 10 percent grade with the transmission in neutral and the parking brake released.

11.9.3.1 If the mobile foam fire apparatus is equipped with an aerial device with a permanently mounted ladder, four ladder belts meeting the requirements of NFPA 1983, Standard on Fire Service Life Safety Rope and System Components, shall be provided.

Chapter 12 Chassis and Vehicle Components

12.1* Carrying Capacity. The GAWR and the GCWR of the chassis shall be adequate to carry the weight of the unequipped apparatus, the fully loaded water and other tanks, the specified hose load, unequipped personnel weight, ground ladders, and miscellaneous equipment allowance as defined in Table 12.1.

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<th>Table 12.1 Miscellaneous Equipment Allowance</th>
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*Compartment space for pumphers is calculated based on total enclosed compartment inside dimensions.

12.1.1 If the purchaser provides a list of equipment to be carried with weights, or a specified miscellaneous equipment allowance, and that value exceeds the minimum specified in Table 12.1, then this value shall be used for the miscellaneous equipment allowance.

12.1.2* The unequipped personnel weight shall be calculated at 200 lb (90 kg) per person multiplied by the number of seating positions on the apparatus.

12.1.3 A final manufacturer’s certification of the GVWR or GCWR, along with a certification of the GAWR, shall be supplied on a label affixed to the vehicle.
12.2 Engine and Engine System Design.

12.2.1* Chassis Engine.

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

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

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

12.2.1.4 Engine Speed Control.

12.2.1.4.1* An engine speed control device shall be installed to allow an increase in the engine speed when the apparatus is parked.

12.2.1.4.2* An interlock shall prevent the operation of this engine speed control device unless the parking brake is fully engaged and the transmission is in neutral or park, or unless the engine speed control device is used with chassis engine-driven components, in which case it shall be interlocked with the engagement of those components.

12.2.1.5 The installation of the engine, transmission, and engine- and transmission-driven accessories (PTOs, etc.) shall meet the engine and transmission manufacturer’s installation recommendations for the service intended.

12.2.1.6 An engine hourmeter shall be provided.

12.2.2 Cooling System.

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

12.2.2.2 Drain Valves.

12.2.2.2.1 Readily accessible drain valves shall be installed at the lowest point of the cooling system and at such other points as are necessary to permit complete removal of the coolant from the system.

12.2.2.2.2 Drain valves shall be designed such that they will not open accidentally due to vibration.

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

12.2.2.4 Radiator cores shall be compatible with commercial antifreeze solutions.

12.2.3 Lubrication System.

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

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

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

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

12.2.4 Fuel and Air System.

12.2.4.1* Diesel Engines.

12.2.4.1.1 Air Intake System.

12.2.4.1.1.1* An air filter shall be provided in the engine’s intake air system.

12.2.4.1.1.2 Air inlet restrictions shall not exceed the engine manufacturer’s recommendations.

12.2.4.1.1.3* The air inlet shall be protected so as to prevent water and burning embers from entering the air intake system.

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

12.2.4.1.2* The fuel supply lines and fuel filters shall meet the engine manufacturer’s recommendations.

12.2.4.1.3 Electric Fuel Priming System.

12.2.4.1.3.1* Where an electric fuel priming system is furnished, the valving and piping shall be arranged and marked with a label so that it can be operated only to reprime the fuel system.

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

12.2.4.2 Gasoline Engines.

12.2.4.2.1 Air Intake System.

12.2.4.2.1.1 An air filter shall be provided in the engine’s intake air system.

12.2.4.2.1.2 Air inlet restrictions shall not exceed the engine manufacturer’s recommendations.

12.2.4.2.1.3 The air inlet shall be protected so as to prevent water and burning embers from entering the air intake system.

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

12.2.4.2.2 Fuel System.

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

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

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

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

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

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

12.2.5 Exhaust System.

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

12.2.5.2 Exhaust pipe discharge shall be directed away from any operator’s position.

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

12.2.5.4 Silencing devices shall be provided.

12.2.5.5 Exhaust back pressure shall not exceed the limits specified by the engine manufacturer.

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

12.3 Vehicle Components.

12.3.1 Braking System.
12.3.1.1 The vehicle shall be equipped with an all-wheel antilock braking system if such a system is available from the chassis manufacturer.

12.3.1.2 All brakes shall be readily accessible for adjustment.

12.3.1.3 Service brakes and parking brakes shall be independently applied.

12.3.1.4 The service brake application valve, when applied, shall operate all the service brakes on the vehicle or combination vehicle.

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

   (1) An automatic moisture ejector

   (2) An air dryer

   (3) A pressure protection valve to prevent the use of all air-operated accessories except air-operated windshield wipers and air-assist steering, if provided, when the system air pressure drops below 80 psi (550 kPa).

   (4) A quick build-up section in the air reservoir system arranged so that if the apparatus has a completely discharged air system, it is able to move within 60 seconds of start up.

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

12.3.1.5.2 On a chassis that cannot be equipped with a quick build-up air brake system, an onboard automatic electric compressor with an automatically ejected electric shorelin or a fire station compressed air shorelin hookup shall be permitted in order to maintain full operating air pressure while the vehicle is not running.

12.3.1.6* Parking Brakes.

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

12.3.1.6.2 The parking brake system shall hold the fully loaded apparatus on at least a 20 percent grade.

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

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

12.3.1.6.5 Air-applied brakes or mechanically actuated brakes shall be permitted on these axles.

12.3.1.7 The service brakes shall be capable of bringing the fully laden apparatus to a complete stop from an initial speed of 20 mph (30 kph), in a distance not exceeding 35 ft (10 m) by actual measurement, on a paved, level surface that is free of loose material, oil, or grease.

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

12.3.2 Suspension and Wheels.

12.3.2.1* Each load-bearing tire and rim of the apparatus shall not carry a weight in excess of the recommended load for the operation of truck tires of the size used, as published in the Fire and Rim Association — Year Book, and as recommended by the tire manufacturer, when the apparatus is loaded as indicated in Section 12.1.

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

12.3.2.2 Axle housings and any components other than wheels and tires shall clear the road surface by at least 8 in. (203 mm).

12.3.2.3* An angle of approach and an angle of departure of at least 8 degrees shall be maintained at the front and rear of the vehicle when it is loaded as indicated in Section 12.1.

12.3.2.4 Clearance for tire chains shall be provided in accordance with SAE J963, Tire Chain Clearance — Trucks, Buses (except Suburban, Intercity, and Transit Buses), and Combinations of Vehicles.

12.3.2.5 Steering.

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

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

12.3.2.6 Tractor-Drawn Aerial Fire Apparatus.

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

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

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

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

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

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

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

12.3.3* Transmission.

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

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

12.3.4 Fuel Tank.

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

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

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

12.3.4.4 The tank fill piping shall be placed so it is protected from mechanical damage.

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

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

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

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

Chapter 13 Low-Voltage Electrical Systems and Warning Devices

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

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

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

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

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

13.2.1.3 All circuits shall otherwise be wired in conformance with SAE J1929, Automobile, Truck, Truck-Tractor, Trailer, and Motor Coach Wiring.

13.2.2 Wiring and Wire Harness Construction.

13.2.2.1 All insulated wire and cable shall conform to SAE J1127, Battery Cable; SAE J1128, Low Tension Primary Cable, type SXL, GXL or TXL; or SAE J1560, Low Tension Thin Wall Primary Cable.

13.2.2.1.1 All conductors shall be constructed in accordance with SAE J1127, Battery Cable; SAE J1128, Low Tension Primary Cable; or
13.2.2.2 The overall covering of conductors shall be moisture-resistant loom or braid that has a minimum continuous rating of 194°F (90°C) except when good engineering practice dictates special consideration for loom installations exposed to higher temperatures.

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

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

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

13.2.4.2 All terminal strips shall have protective covers.

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

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

13.2.6* Wiring shall be uniquely identified at least every 2 ft (0.6 m) by color coding or permanent marking with a circuit function code. The identification shall reference a wiring diagram. [See 4.19.2.3(6).]

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

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

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

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

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

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

13.3 Power Supply.

13.3.1 A 12-volt or 24-volt electrical alternator shall be provided.

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

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

(1) The propulsion engine and transmission.
(2) All legally required clearance and marker lights, headlights, and other electrical devices.
(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 amperes continuous shall be used.)

(4) The lighting necessary to produce 1 footcandle (10 lx) of illumination on all walking surfaces on the apparatus and on the ground at all egress points onto and off the apparatus, 5 footcandles (50 lx) of illumination on all control and instrument panels and 50 percent of the total compartment lighting loads.

(5) The minimum optical warning system required in Section 13.8, where the apparatus is blocking the right-of-way.

(6) The continuous electrical current required to simultaneously operate any fire pumps, aerial devices, and hydraulic pumps.

(7) *Other warning devices and electrical loads defined by the purchaser as critical to the mission of the apparatus.

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

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

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

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

13.3.6 Load Management.

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

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

13.4 Batteries.

13.4.1 Batteries shall be of the high-cycle type.

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

13.4.3 The battery system CCA rating shall meet or exceed the minimum CCA recommendations of the engine manufacturer.

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

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

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

13.4.4.3 Where an enclosed battery compartment is provided, it shall be ventilated to the exterior to prevent the buildup of heat and explosive fumes.

13.4.4.4* The batteries shall be protected against vibration and temperatures that exceed the battery manufacturer’s recommendation.

13.4.5* An onboard battery conditioner or charger, or a polarized inlet, shall be provided for charging all batteries. Where an onboard conditioner or charger is supplied, the associated line voltage electrical power system shall be installed in accordance with Chapter 23.

13.4.6 A master load disconnect switch shall be provided between the starter solenoid(s) and the remainder of the electrical loads on the apparatus.

13.4.6.1 The batteries shall be connected directly to the starter solenoid(s).

13.4.6.2 Electronic control systems and similar devices shall be permitted to be otherwise connected if so specified by their manufacturer.

13.4.6.3 The alternator shall be wired directly to the batteries through the ammeter shunt(s), if one is provided, and not through the master load disconnect switch.

13.4.6.4* A green “battery on” pilot light that is visible from the driver’s position shall be provided.

13.4.7 A sequential switching device shall be permitted to energize the optical warning devices required in 13.3.3 and other high-current devices, provided the switching device energizes the electrical devices required in 13.3.3 first and within 5 seconds.
13.5 Starting Device.
13.5.1 An electrical starting device shall be provided for the engine.
13.5.2 Where the electrical starting device is operating under maximum load, the voltage drop of the conductors between the battery and the starting device shall be in accordance with SAE J541, Voltage Drop for Starting Motor Circuits.
13.6 Temperature Exposure. Any alternator, electrical starting device, ignition wiring, distributor, or ignition coil shall be moisture resistant and protected such that it is not exposed to a temperature that exceeds the component manufacturer’s recommendations.
13.7 Electromagnetic Interference.
13.7.1* Electromagnetic interference suppression shall be provided, as required, to satisfy the radiation limits specified in SAE J551/2, Test Limits and Methods of Measurement of Radio Disturbance Characteristics of Vehicles, Motorboats, and Spark-Ignited Engine-Driven Devices.
13.7.2 The purchaser shall indicate if testing and certification under SAE J551/2, Test Limits and Methods of Measurement of Radio Disturbance Characteristics of Vehicles, Motorboats, and Spark-Ignited Engine-Driven Devices, is required.

13.8 Optical Warning Devices. Each apparatus shall have a system of optical warning devices that meets or exceeds the requirements of this section.
13.8.1* The optical warning system shall consist of an upper and lower warning level.
13.8.2 The requirements for each level shall be met by the warning devices in that particular level without consideration of the warning devices in the other level.
13.8.3 For the purpose of defining and measuring the required optical performance, the upper and lower warning levels shall each be divided into four warning zones.
13.8.3.1 The four zones shall be determined by drawing lines through the geometric center of the apparatus at 45 degrees to a line lengthwise of the apparatus through the geometric center.
13.8.3.2 The four zones shall be designated A, B, C, and D in a clockwise direction with zone A to the front of the apparatus in accordance with Figure 13.8.3.2.

Figure 13.8.3.2 Warning Zones for Optical Warning Devices. [Existing Figure 11-8.2, 1999 edition of NFPA 1901, no change]

13.8.4 Each optical warning device shall be installed on the apparatus and connected to the apparatus's electrical system in accordance with the requirements of this standard and the requirements of the manufacturer of the device.
13.8.5 A master optical warning device switch that energizes all of the optical warning devices shall be provided.
13.8.6 The optical warning system on the fire apparatus shall be capable of two separate signaling modes during emergency operations.
13.8.6.1 One mode shall signal to drivers and pedestrians that the apparatus is responding to an emergency and is calling for the right-of-way.
13.8.6.2 One mode shall signal that the apparatus is stopped and is blocking the right-of-way.
13.8.7 A switching system shall be provided that senses the position of the parking brake or the park position of an automatic transmission.
13.8.7.1 When the master optical warning system switch is closed and the parking brake is released or the automatic transmission is not in park, the warning devices signaling the call for the right-of-way shall be energized.
13.8.7.2 When the master optical warning system switch is closed and the parking brake is on or the automatic transmission is in park, the warning devices signaling the blockage of the right-of-way shall be energized.
13.8.7.3 The system shall be permitted to have a method of modifying the two signaling modes.
13.8.8 The optical warning devices shall be constructed or arranged so as to avoid the projection of light, either directly or through mirrors, into any driving or crew compartment(s).
13.8.9 The front optical warning devices shall be placed so as to maintain the maximum possible separation from the headlights.
13.8.10 The optical sources on each level shall be of sufficient number and arranged so that failure of a single optical source does not create a measurement point, in any zone on the same level as the failed optical source, without a warning signal at a distance of 100 ft (30 m) from the geometric center of the apparatus.
13.8.11* Flash Rate.
13.8.11.1 The minimum flash rate of any optical source shall be 75 flashes per minute, and the minimum number of flashes at any measurement point shall be 150 flashes per minute.
13.8.11.1.2 The optical energy provided by the nonflashing optical sources shall not be included in the calculations of the zone’s total optical power.
13.8.11.2 The flasher of any current-interrupted flashing device shall otherwise meet the requirements of SAE J1690, Flashers.
13.8.12.1 Permissible colors or combinations of colors in each zone, within the constraints imposed by applicable laws and regulations, shall be as shown in Table 13.8.12.1.

<table>
<thead>
<tr>
<th>Color</th>
<th>Calling for Right-of-Way</th>
<th>Blocking Right-of-Way</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>Any zone</td>
<td>Any zone</td>
</tr>
<tr>
<td>Blue</td>
<td>Any zone</td>
<td>Any zone</td>
</tr>
<tr>
<td>Yellow</td>
<td>Any zone except A</td>
<td>Any zone</td>
</tr>
<tr>
<td>White</td>
<td>Any zone except C</td>
<td>Not permitted</td>
</tr>
</tbody>
</table>

13.8.12.2 All colors shall be as specified in SAE J578, Color Specification, for red, blue, yellow, or white.
13.8.13* Requirements for Large Apparatus.
13.8.13.1 If the apparatus has a bumper-to-bumper length of 25 ft (7.6 m) or more or has an optical center on any optical warning device greater than 8 ft (2.4 m) above level ground, the requirements of 13.8.13.2 through 13.8.13.6 shall apply.
13.8.13.2 Upper-Level Optical Warning Devices.
13.8.13.2.1 The upper-level optical warning devices shall be mounted as high and as close to the corner points of the apparatus as is practical in order to define the clearance lines of the apparatus.
13.8.13.2.2 The upper-level optical warning devices shall not be mounted above the maximum height, specified by the device manufacturer, that gives an intensity value at 4 ft (1.2 m) above level ground and 100 ft (30.5 m) from the optical warning device of less than 50 percent of that required at the optical center.
13.8.13.3 Lower-Level Optical Warning Devices.
13.8.13.3.1 In order to define the clearance lines of the apparatus, the optical center of the lower-level optical warning devices in the front of the vehicle shall be mounted forward of the front axle centerline and as close to the front corner points of the apparatus as is practical.
13.8.13.3.2 The optical center of the lower-level optical warning devices at the rear of the vehicle shall be mounted behind the rear axle centerline and as close to the rear corners of the apparatus as is practical.
13.8.13.3.3 The optical center of any lower-level device shall be between 18 in. and 62 in. (460 mm and 1600 mm) above level ground.
13.8.13.4 Midship Optical Warning Devices.
13.8.13.4.1 A midship optical warning device shall be mounted on both the right and left sides of the apparatus if the distance between the front and rear lower-level optical devices exceeds 25 ft (7.6 m) at the optical center.
13.8.13.4.2 Additional midship optical warning devices shall be required, where necessary, to maintain a horizontal distance between the centers of adjacent lower-level optical warning devices of 25 ft (7.6 m) or less.
13.8.13.4.3 The optical center of any midship mounted optical warning device shall be between 18 in. and 62 in. (460 mm and 1600 mm) above level ground.
13.8.13.5* For each operating mode, the combined optical power of all the optical sources shall meet or exceed the zone total optical power requirements shown in Table 13.8.13.5.

Table 13.8.13.5 Minimum Optical Power Requirements for Large Apparatus

<table>
<thead>
<tr>
<th>Zone</th>
<th>Level</th>
<th>Mode of Operation</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Clearing Right-of-Way</td>
<td>Blocking Right-of-Way</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>At Any H Point</td>
<td>At Any Point 5° Up or 5° Down from H</td>
<td>At Any H Point</td>
</tr>
<tr>
<td>A</td>
<td>Upper</td>
<td>1,000,000</td>
<td>10,000</td>
<td>3,500</td>
</tr>
<tr>
<td>B</td>
<td>Upper</td>
<td>400,000</td>
<td>10,000</td>
<td>3,500</td>
</tr>
<tr>
<td>C</td>
<td>Upper</td>
<td>400,000</td>
<td>10,000</td>
<td>3,500</td>
</tr>
<tr>
<td>D</td>
<td>Upper</td>
<td>400,000</td>
<td>10,000</td>
<td>3,500</td>
</tr>
<tr>
<td>A</td>
<td>Lower</td>
<td>150,000</td>
<td>3,750</td>
<td>1,300</td>
</tr>
<tr>
<td>B</td>
<td>Lower</td>
<td>150,000</td>
<td>3,750</td>
<td>1,300</td>
</tr>
<tr>
<td>C</td>
<td>Lower</td>
<td>150,000</td>
<td>3,750</td>
<td>1,300</td>
</tr>
<tr>
<td>D</td>
<td>Lower</td>
<td>150,000</td>
<td>3,750</td>
<td>1,300</td>
</tr>
</tbody>
</table>

Notes:
1. All values are in candela-seconds/minute.
2. \( H \) = Horizontal plane passing through the optical center.

13.8.14* Requirements for Small Apparatus.

13.8.14.1 If the apparatus has a bumper-to-bumper length of less than 25 ft (7.6 m) and has the optical center of all optical warning devices at 8 ft (2.4 m) or less above level ground, the requirements of 13.8.14.2 through 13.8.14.5 shall apply.


13.8.14.2.1 The upper-level optical warning devices shall be mounted as high as practical, but not over 8 ft (2.4 m), at the optical center.

13.8.14.2.2 The upper-level optical warning devices shall be permitted to be combined in one or more enclosures and shall be permitted to be mounted on the cab roof or any other convenient point.


13.8.14.3.1 One or more lower-level optical warning devices shall be visible from the front and side of the apparatus.

13.8.14.3.2 The optical center of the lower level optical warning devices in the front of the vehicle shall be mounted forward of the front wheel centerline and as close to the front corner points of the apparatus as practical.

13.8.14.3.3 The optical center of the device(s) shall be between 18 in. and 48 in. (460 mm and 1220 mm) above level ground.

13.8.14.4 For each operating mode, the combined optical power of all the optical sources mounted on both the upper and lower levels shall meet or exceed the zone’s total optical power requirements shown in Table 13.8.14.4.

13.8.14.5 No individual measurement point shall be less than that shown in Table 13.8.14.4.


13.8.15.1 Mechanical and Environmental Test.

13.8.15.1.1 All optical warning devices shall be tested to the requirements of SAE J595, Flashing Warning Lamps for Authorized Emergency, Maintenance, and Service Vehicles; SAE J1318, Gaseous Discharge Warning Lamp for Authorized Emergency, Maintenance, and Service Vehicles; or SAE J1889, L.E.D. Lighting Devices.

13.8.15.1.2 Optical devices and components designed for mounting only in weatherproof, interior spaces shall be tested in conformance with SAE J845, Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles, and shall comply with the vibration test and the warpage test for plastic components.

Table 13.8.14.4 Minimum Optical Power Requirements for Small Apparatus

<table>
<thead>
<tr>
<th>Zone</th>
<th>Mode of Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Clearing Right-of-Way</td>
</tr>
<tr>
<td></td>
<td>At Any H Point</td>
</tr>
<tr>
<td>A</td>
<td>1,000,000</td>
</tr>
<tr>
<td>B</td>
<td>200,000</td>
</tr>
<tr>
<td>C</td>
<td>400,000</td>
</tr>
<tr>
<td>D</td>
<td>200,000</td>
</tr>
</tbody>
</table>

Notes:
1. All values are in candela-seconds/minute.
2. \( H \) = Horizontal plane passing through the optical center.
13.8.15.1.3 Optical devices and components designed for mounting on the exterior of the apparatus or in non-weatherproof interior spaces shall be tested in conformance with SAE J845, and shall comply with the following performance requirements of that standard:

(1) Vibration
(2) Moisture
(3) Dust
(4) Corrosion
(5) High temperature
(6) Low temperature
(7) Durability
(8) Warpage

13.8.15.2 Photometric Test Procedures for Optical Devices.

13.8.15.2.1 Testing shall be performed by, or on behalf of, the device manufacturer to ensure compliance with the requirements of 13.8.15.2.2 through 13.8.15.2.5.2.

13.8.15.2.1.1 The results of the testing shall be used by the apparatus builder or purchaser to determine compliance with this standard and shall be available upon request from the optical warning device manufacturer.

13.8.15.2.1.2 The goniometer, integrating photometer, and other equipment used to take the test measurements shall meet the requirements of SAE J1330, Photometry Laboratory Accuracy Guidelines.

13.8.15.2.2 The optical source shall be mounted in a goniometer and operated as it would be in a normal system application.

13.8.15.2.2.1 The minimum distance between the light emitting surface of the source being tested and the front face of the photometer detector shall be 59 ft (18 m).

13.8.15.2.2.2 The goniometer shall be oriented and the integrating photometer shall be set to integrate light pulses from the source for 20 seconds.

13.8.15.2.3 For all tests performed with the power applied, the lighting system, or component thereof, shall be operated at 12.8 volts ±0.1 volt for 12-volt rated equipment and 25.6 volts ±0.2 volt for 24-volt rated equipment.

13.8.15.2.3.1 If the equipment is rated for operation on both 12 volts and 24 volts, the tests shall be performed at both voltages.

13.8.15.2.3.2 Voltage shall be measured at the point of entry into the component.

13.8.15.2.4 The technique described in 13.8.15.2.2 through 13.8.15.2.2.2 shall be performed along the horizontal plane that passes through the optical center beginning at the optical center and repeated at 5-degree intervals to the left and right of the optical center throughout the active horizontal angle of light emission of the optical source.

13.8.15.2.5 Measurements shall be repeated at 5 degrees up and 5 degrees down from the horizontal plane that passes through the optical center, beginning at a point on a line passing through the optical center, and perpendicular to the horizontal plane and passing through the optical center.

13.8.15.2.5.1 The measurements shall be repeated at 5-degree intervals to the left and right of this line throughout the active horizontal angle of light emission of the optical source.

13.8.15.2.5.2 If the optical warning device contains more than one optical source, the test shall be repeated for each optical source.

13.8.15.2.6 The apparatus manufacturer shall be permitted to demonstrate compliance of the warning system by one of the following methods:

(1) Certification that the system was installed within the geometric parameters specified by the manufacturer of the system and referencing the optical source test reports provided by the manufacturer of the system.

(2) Certification that a mathematical calculation based on test reports for individual optical sources provided by the manufacturer of the devices and performed by a qualified person demonstrates that the combination of individual devices as installed meets the requirements of this standard.

(3) Actual measurement of the lighting system after installation on the apparatus.

13.9 Audible Warning Devices.

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

13.9.1.1 The siren manufacturer shall certify the siren as meeting the requirements of SAE J1849, Emergency Vehicle Sirens.

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

13.9.2 Where furnished, air horns, electric siren(s), and electronic siren speaker(s) shall be mounted as low and as far forward on the apparatus as practical.

13.9.3 Audible warning equipment shall not be mounted on the roof of the apparatus.

13.10 Work Lighting.

13.10.1 The work area immediately behind the vehicle shall be illuminated to a level of at least 3 footcandles (30 lx) within a 10 ft × 10 ft (3 m × 3 m) square to the rear of the vehicle.

13.10.1.1 If a hose bed is provided, lighting on this hose bed shall be at a level of 3 footcandles (30 lx) or higher.

13.10.1.2 Lateral hose beds (crosslays) that are permanently covered shall not be required to be illuminated.

13.10.2 The fire apparatus shall be equipped with lighting that is capable of providing illumination at a minimum level of 1 footcandle (10 lx) on ground areas within 30 in. (800 mm) of the edge of the apparatus in areas designed for personnel to climb onto the apparatus or descend from the apparatus to the ground level.

13.10.2.1 Lighting designed to provide illumination on areas under the driver and crew riding area exits shall be activated automatically when the exit doors are opened.

13.10.2.2 All other ground area lighting shall be switchable. (For pump control panel light requirement, see 16.9.2.)

13.10.3 Interior Work Lighting.

13.10.3.1 The apparatus shall have sufficient lighting to provide a minimum level of 1 foot-candle (10 lx) on all work surfaces, steps, and walkways.

13.10.3.2 The apparatus shall have sufficient lighting to provide an average level of 3 foot-candle (30 lx) in the driving and crew compartments.

13.10.3.3 Each engine compartment and pump compartment shall have a light of at least 20 candlepower (250 lumens)

13.10.4 Equipment Compartment Lighting.

13.10.4.1 Each enclosed tool and equipment compartment greater than 4 ft³ (0.1 m³) in volume and having an opening greater than 144 in.² (0.9 m²) shall have an average minimum level of lighting of 1 foot-candle (10 lx).

13.10.4.2 Compartments such as ladder tunnels, pikepole storage tubes, or underbody compartments designed around the volumetric requirements of specific equipment that can be removed without the use of article illumination shall not be required to have compartment lighting.

13.10.5 Switches for all work lighting shall be readily accessible.

13.10.6 The lights shall be arranged or protected to minimize accidental breakage.

13.10.7 All work lights mounted in wet locations shall tested in conformance with SAE J3575, Test Methods and Equipment for Lighting Devices and Components for Use on Vehicles Less Than 2032 mm in Overall Width, and shall comply with the following performance requirements of that standard:

(1) Vibration
(2) Moisture
(3) Dust
(4) Corrosion
(5) High temperature
(6) Low temperature
(7) Durability
(8) Warpage

13.11 Hazard Light.

13.11.1 A red flashing or rotating light, located in the driving compartment, shall be illuminated automatically whenever the apparatus’s parking brake is not fully engaged and any of the following conditions exist:

(1) Any passenger or equipment compartment door is open
(2) Any ladder or equipment rack is not in the stowed position
(3) Stabilizer system not in its stowed position
(4) Powered light tower is extended
(5) Any other device that is permanently attached to the apparatus and is capable of opening, extending, or being deployed in a manner that is likely to cause damage to the apparatus if the moved apparatus is moved.

13.11.2 This section shall not apply to manually raised pole lights with an extension of less than 5 ft (1.5 m).

13.11.3 The hazard light shall be marked with a sign that reads: “Do Not Move Apparatus When Light Is On.”

13.12 Backup Alarm. An electronic or electric backup alarm shall be provided that meets the Type D (87 dBA) requirements of SAE J994, Alarm — Backup — Electric, Laboratory Performance Testing.

13.13 Stop, Tail, and Directional Lights.

13.13.1 The apparatus shall be equipped with all legally required stop, tail, and directional lights.

13.13.2 Directional lights shall be visible from the front, sides, and rear of the apparatus.

13.13.3 On apparatus 30 ft (10 m) or longer in length, a turn signal shall be mounted approximately midway along the apparatus at approximately running board height.

13.13.4 Equipment shall not be mounted in a manner that obscures the stop, tail, or directional lights.

13.14 Electrical System Performance Tests.

13.14.1* The fire apparatus low-voltage electrical system shall be tested as required by this section and the test results certified by the apparatus manufacturer. The certification shall be delivered to the purchaser with the apparatus.

13.14.2 Tests shall be performed when the air temperature is between 0°F and 110°F (−18°C and 43°C).

13.14.3 Test Sequence.

13.14.3.1 The three tests defined in 13.14.3.2 through 13.14.3.4 shall be performed in the order in which they appear.

13.14.3.1.1 Before each test, the batteries shall be fully charged until the voltage stabilizes at the voltage regulator set point and the lowest charge current is maintained for 10 minutes.

13.14.3.1.2 Failure of any of these tests shall require a repeat of the sequence.

13.14.3.2 Reserve Capacity Test.

13.14.3.2.1 The engine shall be started and kept running until the engine and engine compartment temperatures are stabilized at normal operating temperatures and the battery system is fully charged.

13.14.3.2.2 The engine shall be shut off and the minimum continuous electrical load shall be activated for 10 minutes.

13.14.3.2.3 All electrical loads shall be turned off prior to attempting to restart the engine.

13.14.3.2.4 The battery system shall then be capable of restarting the engine.

13.14.3.2.5 Failure to restart the engine shall be considered a test failure.

13.14.3.3 Alternator Performance Test at Idle.

13.14.3.3.1 The minimum continuous electrical load shall be activated with the engine running at idle speed.

13.14.3.3.2 The engine temperature shall be stabilized at normal operating temperature.

13.14.3.3.3 The battery system shall be tested to detect the presence of battery discharge current.

13.14.3.3.4 The detection of battery discharge current shall be considered a test failure.

13.14.3.4 Alternator Performance Test at Full Load.

13.14.3.4.1 The total continuous electrical load shall be activated with the engine running up to the engine manufacturer’s governed speed.

13.14.3.4.2 The test duration shall be a minimum of 2 hours.

13.14.3.4.3 Activation of the load management system shall be permitted during this test.

13.14.3.4.4 An alarm sounded by excessive battery discharge, as detected by the system required in 13.3.4, or a system voltage of less than 11.8 volts dc for a 12-volt nominal system or 23.6 volts dc for a 24-volt nominal system, for more than 120 seconds, shall be considered a test failure.


13.14.4.1 Following the completion of the tests described in 13.14.3.2 through 13.14.3.4, the engine shall be shut off.

13.14.4.2 The total continuous electrical load shall be activated and shall continue to be applied until the excessive battery discharge alarm activates.

13.14.4.3 With the load still applied, the battery voltage shall be measured at the battery terminals.

13.14.4.4 A reading of less than 11.7 volts dc for a 12-volt nominal system or 23.4 volts dc for a 24-volt nominal system shall be considered a test failure.

13.14.4.5 The battery system shall then be able to restart the engine.

13.14.4.6 Failure to restart the engine shall be considered a test failure.

13.15 Documentation. At the time of delivery, the manufacturer shall provide the following:

1. Documentation of the electrical system performance tests
2. A written load analysis, including the following:
   (a) The nameplate rating of the alternator
   (b) The alternator rating under the conditions specified in 13.3.2
   (c) Each component load specified in 13.3.3 comprising the minimum continuous load
   (d) Additional loads that, when added to the minimum continuous load, determine the total connected load
   (e) Each individual intermittent load

Chapter 14 Driving and Crew Areas

14.1 General.

14.1.1 Each crew riding position shall be within a fully enclosed personnel area.

14.1.2 A label that states the number of personnel the vehicle is designed to carry shall be located in an area visible to the driver.

14.1.3* Each crew riding position shall be provided with a seat and an approved seat belt designed to accommodate a person with and without heavy clothing.

14.1.3.1 All forward-facing seats adjacent to a side wall shall be provided with a Type 2 pelvic and upper torso restraint-style seat belt assembly conforming to the Federal Motor Vehicle Safety Standard (FMVSS) No. 209, “Seat belt assemblies.”


14.1.3.3 Tiller seats shall have a lap belt.

14.1.3.4 Signs that read “Occupants must be seated and belted when apparatus is in motion” shall be visible from each seated position.

14.1.3.5 Each seating position that is not intended to be used during transit shall be individually labeled as follows:

**WARNING:** THIS SEAT IS NOT TO BE OCCUPIED WHILE VEHICLE IS IN MOTION.

14.1.4 Materials used within the driving and crew compartment shall comply with Federal Motor Vehicle Safety Standard (FMVSS) No. 302, “Flammability of interior materials.”

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

14.1.6 At any seat location, the maximum noise level shall be 90 dBA without any warning devices in operation, as measured by the test procedure defined in 49 CFR 393.94(c), “Vehicular interior noise levels test procedure,” except that the test shall be performed with the vehicle traveling at a steady speed of 45 mph (72 kph) on a level, paved, smooth surface road.

14.1.7 Seat Head Height.

14.1.7.1* The minimum vertical dimension from the seat H-point to the ceiling for each belted seating position shall be as follows.
(1) For suspension style seats with independent height adjustment, the minimum vertical dimension shall be 37 in (940 mm) measured with the head height adjustment in its lowest position and the suspension inflated and/or raised to the upper limit of its travel.

(2) For suspension style seats without independent height adjustment, the minimum vertical dimension shall be 37 in (940 mm) measured with the suspension inflated and/or raised to the upper limit of its travel.

(3) For non-suspension style seats, the minimum vertical dimension shall be 35 in (882 mm) measured with the seat adjusted to its lowest position.

14.1.7 Seat Adjustment.

14.1.7.1 The manufacturer shall provide a seat with an approved seat belt mounting device mounted on the seat belt anchor in accordance with SAE J833, "SAE J833, Seating System for Motor Vehicles, Seat, Belt, and Harness System Requirements and Test Procedures".

14.1.7.2 The seat is adjustable in a fully forward position and shall be within 10 seconds.

14.1.7.3 The back cushion shall be adjustable in a fully forward position and shall be within 8 seconds.

14.1.8 Seat Arrangement.

14.1.8.1 Each seating space shall have a minimum width of 22 in. (560 mm) at the shoulder level.

14.1.8.2 Seat cushions shall be a minimum of 18 in. (460 mm) in width and 15 in. (380 mm) from the front of the cushion to the face of the seat back.

14.1.8.3 A back cushion that extends from the face of the seat vertically at least 18 in. (460 mm) and that is a minimum of 18 in. (460 mm) wide shall be provided.

14.1.8.3.1 The back cushion shall be permitted to be split to accommodate a fully recessed SCBA and bracket.

14.1.8.3.2 Where the back cushion is split, a headrest shall be supplied.

14.1.9 SCBA Mounting.

14.1.9.1 Where SCBA units are mounted within a driving or crew compartment, a positive automatically latching mechanical means of holding the SCBA device in its stowed position shall be provided.

14.1.9.2 The bracket holding device and its mounting shall retain the SCBA unit when subjected to a 9-G force and shall be installed in accordance with the bracket manufacturer's requirements.

14.1.9.3 Mounting devices shall be of a type that positively latch around the cylinder or bracket manufacturer's requirements.

14.1.9.4 If the SCBA unit is mounted in a seatback, the release mechanism shall be accessible to the user while seated and without having to reach behind them.

14.1.10 Equipment Mounting.

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

14.1.10.2 All equipment not required to be used during an emergency response, with the exception of SCBA units, shall not be mounted in a driving or crew area unless it is contained in a fully enclosed and latched compartment capable of containing the contents when a 9-G force is applied in the longitudinal axis of the vehicle or a 3-G force is applied in any other direction, or the equipment is mounted in a bracket(s) that can contain the equipment when the equipment is subjected to those same forces.

14.1.11 Steps and access handrails that comply with 15.7.1 through 15.7.3.2 shall be provided as necessary for access to all driving and crew compartments.

14.1.12 Where the crew compartment and the driving compartment are separated, prohibiting direct voice communication, a two-way buzzer or two-way voice intercom system shall be provided.


14.1.13.1 Any interior area to be occupied by personnel shall have a minimum of two means of escape.

14.1.13.2 Each opening shall be large enough for a person to escape through the opening.

14.2 Cab Tilt Systems. If the apparatus has a cab tilt system, the system shall meet the requirements of 14.2.1 through 14.2.3.2.

14.2.1 If the operation of the tilt cab system is accomplished by hydraulic means, the system shall be equipped with devices to prevent the motion of the cab in the event of any hydraulic hose failure.

14.2.2 If the cab has a powered tilting system, the system shall be interlocked to operate only when the parking brake is engaged and shall be configured so that the failure of a single component will not result in unintentional tilting of the cab.
**14.4.3.2** The seating space shall be a minimum of 22 in. (560 mm) in width at the shoulder level.

**14.4.3.3** The seat cushion shall be a minimum of 18 in. (460 mm) in width and 15 in. (380 mm) from the front of the cushion to the face of the seat back.

**14.4.3.4** A back cushion shall be provided.

**14.4.3.5** The seat shall have an adjustment range of at least 3 in. (76 mm) from front to rear and be adjustable by the tiller operator.

**14.4.4** A warning indicator in the driving compartment shall activate if the parking brake is released and the tiller operator is not signaling his/her presence.

**14.4.5** Communications.

**14.4.5.1** A two-way buzzer system or a two-way voice intercom shall be provided for communication between the driver and the tiller operator.

**14.4.5.2** The communication system shall be operable without the tiller operator having to take his/her hands off the steering wheel.

**14.4.6** A heater or ventilation system and defroster shall be provided.

**14.4.7** A windshield wiper and washer fluid system shall be provided.

**14.4.8** The following instrumentation and controls shall be mounted in the tiller operator’s compartment and shall be identified and visible to the tiller operator while seated:

   (1) Heater/defroster controls
   (2) Turn signal indicator lights
   (3) Two-way buzzer signal switch
   (4) Windshield wiper and washer fluid control

**14.4.9** Controls and switches that are expected to be operated by the tiller operator while the apparatus is in motion shall be within convenient reach for that operator.

**14.4.10** Exterior rearview mirrors shall be provided at the tiller position.

**Chapter 15 Body, Compartments, and Equipment Mounting**

**15.1** Compartmentation.

**15.1.1** Any enclosed external compartments shall be weather resistant, ventilated, and have provisions for drainage of moisture.

**15.1.2** All electrical junctions or wiring within compartments shall be protected from mechanical damage resulting from equipment stored in the compartment.

**15.2** Radio Space. A protected space or compartment shall be provided for the installation of radio equipment.

**15.3** Equipment Containment.

**15.3.1** Equipment holders or compartments shall be provided for all tools, equipment, and other items that are on the apparatus.

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

**15.3.3** All tools and equipment shall be readily accessible.

**15.4** Powered Equipment Racks. When a powered equipment rack is provided, it shall meet the requirements of this section.

**15.4.1** The equipment rack shall be constructed of materials that are capable of carrying the equipment that is intended to be mounted on the equipment rack.

**15.4.2** A lock shall be provided that will retain the equipment rack in the road travel position when the vehicle is in motion.

**15.4.3** An interlock shall be provided to prevent operation of the equipment rack unless the apparatus parking brake has been activated.

**15.4.4** Controls shall be provided in a position where the operator can visually follow the travel of the equipment rack.

**15.4.5** A visual signal shall be provided at the driver’s position to indicate that the equipment rack is in motion, or in the down position, and that the parking brake is not engaged.

**15.4.6** Flashing lights facing the front and rear shall be provided on the equipment rack and shall be illuminated whenever the equipment rack is in the down position.

**15.4.7** The outward ends of the equipment rack that protrude beyond the body of the apparatus shall have reflective material to indicate a hazard or obstruction.

**15.5** SCBA Storage. Storage of complete SCBA units or SCBA cylinders shall be arranged so as to prevent damage, injury, or abrasion to the SCBA from other equipment stored in the general area.

**15.5.1** If a SCBA unit or cylinder is stored within a driving or crew compartment, the mounting shall comply with the requirements of Section 15.5 and 14.1.9.

**15.5.2** If the SCBA cylinder is mounted in a vertical position with the valve down, it shall be supported with a brace or yoke under the cylinder or valve area to prevent downward movement.

**15.5.3** The holding or clamping device shall not injure, wear, scrape, or otherwise affect the SCBA unit or cylinder, including damage to the paint or reflective finish, while the cylinder is being placed in, stored in, or removed from the holder.

**15.5.4** The SCBA storage area shall be a ventilated, dry area away from all heat sources that could damage the SCBA (e.g., mufflers, engines).

**15.5.5** Vertical Storage of SCBA Cylinders in Tubes.

**15.5.5.1** The base of the storage tube shall have a rubber, plastic, or similar device to prevent wear on the cylinder and to prevent damage if the cylinder is accidentally dropped into the storage position.

**15.5.5.2** Each storage tube shall have a drain to prevent accumulation of moisture.

**15.5.6** Horizontal Storage of SCBA Cylinders.

**15.5.6.1** The storage rack or tube assembly shall be designed to prevent the cylinder from accidentally sliding out from the storage rack or tube and shall be installed so as to keep the cylinder from hitting or rubbing on compartment doors by preventing movement or shifting when in transit.

**15.5.6.2** The rear wall of each SCBA storage area or tube shall be covered with a rubber, plastic, or similar material to prevent wear on cylinders.

**15.6** Pump and Plumbing Access.

**15.6.1** One or more doors or panels that open or are removable without the use of tools shall be provided to allow visual inspection or access for checking the fire pump and plumbing area.

**15.6.2** The clear opening shall have no one dimension measure less than 18 in. (460 mm).

**15.6.3** Additional door(s) or panel(s) that require no more than standard tools to open or remove shall be provided for access to the pump and plumbing area.

**15.6.4** All valves, gauges, controls, and other plumbing equipment shall be accessible for service and replacement.

**15.6.5** The clear space required by the pump manufacturer to perform in-truck overhaul and maintenance shall be provided.

**15.7** Stepping, Standing, and Walking Surfaces.

**15.7.1** Steps, platforms, or permanently attached ladders shall be provided so that fire fighters have access to all working and storage areas of the apparatus.

**15.7.1.1** The maximum stepping height shall not exceed 18 in. (460 mm), with the exception of the ground to first step, which shall not exceed 24 in. (610 mm).

**15.7.1.1.1** A permanently attached supplemental access/egress means from the ground to these steps, platforms, or permanently attached ladders shall be provided where the ground to the first step, platform, or ladder exceeds 24 in. (610 mm).

**15.7.1.1.2** The supplemental access means shall consist of a step(s), platform(s), or ladder(s).

**15.7.1.1.3** The ground to first step height shall be determined with the apparatus on level ground.

**15.7.1.1.4** Where the apparatus is supplied with stabilizers, the ground to first step height shall be determined with the apparatus on level ground and the stabilizers deployed in accordance with the manufacturer’s instructions so that the aerial device meets the stability requirements of Section 20.21.

**15.7.1.2** All steps shall have a minimum area of 35 in.² (22,580 mm²), shall be of such a shape that a 5-in. (125-mm) diameter disk does not overlap any side when placed on the step, and shall be arranged to provide at least 8 in. (200 mm) of clearance between the leading edge of the step and any obstruction.
15.7.1.3 All platforms shall have a minimum depth of 8 in. (200 mm) from the leading edge of the platform to any obstruction.

15.7.1.4 All ladders shall have at least 7 in. (175 mm) of clearance between any rung and the body or other obstruction.

15.7.2 All steps, platforms, or ladders shall sustain a minimum static load of 500 lb (200 kg) without deformation.

15.7.3* Slip Resistance.

15.7.3.1 All materials used for exterior surfaces designated as stepping, standing, and walking areas and all interior steps shall have a minimum slip resistance in any orientation of 0.68 when tested wet using the English XL tester in accordance with ASTM F 1679, Standard Test Method for Using a Variable Incidence Tribometer (VIT), or 0.52 when tested dry using the Brungraber Mark II Tester in accordance with ASTM F 1677, Standard Test Method for Using a Portable Inclining Articulated Strut Slip Test (PIAST).

15.7.3.2 All materials used for interior floors shall have a minimum slip resistance in any orientation of 0.58 when tested dry using the English XL tester in accordance with ASTM F 1679, Standard Test Method for Using a Variable Incidence Tribometer (VIT), or 0.47 when tested dry using the Brungraber Mark II Tester in accordance with ASTM F 1677, Standard Test Method for Using a Portable Inclining Articulated Strut Slip Tester (PIAST).

15.7.3.3 A standard Neolite® test sensor shall be used with both the English XL tester and the Brungraber Mark II tester.

15.7.3.4 Sampling Strategy.

15.7.3.4.1 For uniformly patterned materials, at least 16 readings shall be taken on each sample.

15.7.3.4.1.1 Each reading shall be taken 90 degrees clockwise from the previous orientation, resulting in at least four readings in each orientation.

15.7.3.4.1.2 The readings shall be averaged and reported as the slip resistance for the material.

15.7.3.4.2 For directionally patterned materials, at least 32 readings shall be taken on each sample.

15.7.3.4.2.1 Each reading shall be taken 45 degrees clockwise from the previous orientation, resulting in at least four readings in each orientation.

15.7.3.4.2.2 The four readings in each direction shall be averaged and reported as the slip resistance for the material in that orientation.

15.7.3.5 The contractor shall supply at the time of delivery of the apparatus a certification that all materials used for exterior surfaces designated as stepping, standing, and walking areas, all interior steps, and all interior floors meet the requirements of 15.7.3.

15.7.3.6 Where the fuel fill is located at or near a stepping surface, the surface shall be constructed of an open grate-type material to facilitate draining of accidentally spilled fuel to lessen any slipping hazard.

15.7.4 A label shall be located on the vehicle at the rear step areas and at any cross walkways to warn personnel that riding in or on these areas while the vehicle is in motion is prohibited.

15.8* Access Handrails.

15.8.1 Access handrails shall be provided at each entrance to a driving or crew compartment and at each position where steps or ladders for climbing are located.

15.8.2 Access handrails shall be constructed of, or covered with, a slip-resistant, noncorrosive material.

15.8.3 Handrails shall be between 1 in. and 1/2 in. (25 mm and 42 mm) in diameter and have a minimum clearance between the handrails and any surface of at least 2 in. (52 mm).

15.8.4* All handrails shall be designed and mounted to reduce the possibility of hand slippage and to avoid snagging of hose, equipment, or clothing.

15.9 Metal Finish.

15.9.1 Where dissimilar metals are to be mounted together, the mounting base material shall have an isolation barrier prior to assembly to prevent dissimilar metal reaction.

15.9.2* Painting.

15.9.2.1 All exposed ferrous metal surfaces that are not plated or stainless steel shall be cleaned and prepared and shall be painted or coated.

15.9.2.2 The paint or coating, including any primer, shall be applied in accordance with the paint or coating manufacturer’s recommendation.

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

15.9.3 A reflective stripe(s) shall be affixed to the perimeter of the apparatus.

15.9.3.1 The stripe or combination of stripes shall be a minimum of 4 in. (100 mm) in total width and shall conform to the minimum requirements of ASTM D 4956, Standard Specification for Retroreflective Sheeting for Traffic Control, Type I, Class 1 or Class 3.

15.9.3.2 At least 50 percent of the cab and body length on each side, at least 50 percent of the width of the rear, and at least 25 percent of the width of the front of the apparatus shall have the reflective material affixed to it.

15.9.3.3 A graphic design meeting the reflectivity requirements of this paragraph shall be permitted to replace all or part of the required striping material if the design or combination thereof covers at least the same perimeter length(s) required above.

15.10* Hose Storage.

15.10.1* The hose storage area(s) is provided, it shall comply with this section.

15.10.2 The bottom shall be made of removable sections fabricated from noncorrosive materials.

15.10.3 The bottom shall be constructed to prevent the accumulation of water and allow ventilation to aid in drying of hose.

15.10.4 The interior shall be smooth and free from all projections, such as nuts, sharp angles, or brackets, that might cause damage to the hose.

15.10.5 Reels, handrails, ladders, and equipment holders shall be placed so as not to obstruct the laying or removal of hose from the storage area.

15.10.6 Any hose storage area designated to carry 2 1/4-in. (65-mm) or larger hose shall be a minimum of 5 ft (1.5 m) in length.

15.11 Receivers and Anchors for Rope and Removable Winches.

15.11.1 Receivers or anchors installed at any location on the apparatus for use as removable winch anchors shall be designed and affixed to provide at least a 1.5 to 1 safety factor over the load rating of the removable winch.

15.11.2 Receivers or anchors installed at any location on the apparatus for use with rope operations shall be designed and affixed to the apparatus to provide at least a 5 to 1 safety factor over the breaking strength of the rope that will be used.

15.11.3 A label shall be placed on or near each receiver or anchor that states the maximum winch load rating and the maximum rope load rating that the receiver or anchor can support.

15.12 Slip-on Fire-Fighting Module.

15.12.1 The major components of the slip-on unit, pump, pumping engine, tank, electrical, and plumbing shall meet the requirements of the applicable chapters of this standard covering those components.

15.12.2* The weight of a completed skid-mounted fire-fighting package, including fuel, oil, and standard equipment carried, shall be distributed on the frame so as to provide a balanced unit when it is lifted or moved.

15.12.3 Intake and discharge piping shall not interfere with the routine maintenance of the pump, engine, or auxiliary systems and shall not unduly restrict the servicing of these components.

15.12.4 Mounting.

15.12.4.1 The slip-on unit shall be mounted in a manner that allows access to the engine, pump, and auxiliary systems for routine maintenance.

15.12.4.2 The slip-on unit shall be removable using common hand tools.

15.12.4.3 The slip-on unit shall be mounted in a manner that prevents damage by vibration.

15.12.4.4 Special anchorage shall be provided on the vehicle chassis and on the skid-mounted fire-fighting package to secure the skid-mounted firefighting package to the vehicle chassis.

15.12.4.5 The anchorage described in 15.12.4.4 shall be designed to prevent movement of the unit during rapid acceleration or deceleration.
16.1 Application. If the apparatus is equipped with a fire pump, the provisions of this chapter shall apply.

16.2 Design and Performance Requirements.

16.2.1 Fire Pump Rated Capacity.

16.2.1.1 The fire pump shall be mounted on the apparatus and shall have a minimum rated capacity of 250 gpm (1000 L/min) at 150 psi (1000 kPa) net pump pressure.

16.2.1.2 Pumps of higher capacity shall be rated at one of the capacities specified in Table 16.2.4.1(a).

16.2.2 Where the apparatus is designed for pump and roll operations, the minimum performance shall be 20 gpm (76 L/min) at 100 psi (700 kPa) at an apparatus ground speed on level ground of 2 mph (3.2 kmph).

16.2.3 Pumping System Capability.

16.2.3.1 The pumping system provided shall be capable of delivering the following:

1. 100 percent of rated capacity at 150 psi (1000 kPa) net pump pressure
2. 70 percent of rated capacity at 200 psi (1400 kPa) net pump pressure
3. 50 percent of rated capacity at 250 psi (1700 kPa) net pump pressure

16.2.3.2 When dry, the pumping system shall be capable of meeting the requirements of 16.2.3.2.1 through 16.2.3.2.3 in both parallel and series operation.

16.2.3.3 Vacuum.

(1) Where pumps are of the parallel/series type, they shall complete the requirements of 16.2.3.2.1 through 16.2.3.2.3 in both parallel and series operation.

16.2.3.3.1 The completed pumping system shall be capable of developing a vacuum of 22 in. Hg (75 kPa) at altitudes up to 2000 ft (600 m) by means of the pump priming device and sustaining the vacuum for at least 5 minutes with a loss not to exceed 10 in. Hg (34 kPa).

16.2.3.3.2 The requirement in 16.2.3.3.1 shall be met with all intake valves open, all intakes capped or plugged, all discharge caps removed, and without the use of the pump primer during the 5-minute period.

16.2.4 Pump Suction Capability.

16.2.4.1* The pump manufacturer shall certify that the fire pump is capable of pumping 100 percent of rated capacity at 150 psi (1000 kPa) net pump pressure from draft through 20 ft (6 m) of suction hose with a strainer attached under the following conditions:

1. An altitude of 2000 ft (600 m) above sea level
2. Atmospheric pressure of 29.9 in. Hg (101 kPa) (corrected to sea level)
3. Water temperature of 60°F (15.6°C)
4. Suction hose size, number of hose, and lift as indicated in Table 16.2.4.1(a)
5. Friction and entrance loss in suction hose, including strainer, as given in Table 16.2.4.1(b) or Table 16.2.4.1(c)

16.2.4.2* The pump manufacturer shall certify that the fire pump is capable of pumping rated capacity at 150 psi (1000 kPa) net pump pressure at any of the following special conditions when these conditions are specified by the purchaser:

1. An altitude of 2000 ft (600 m)
2. At lifts higher than those listed in Table 16.2.4.1(a) or through more than 20 ft (6 m) of suction hose, or both
3. For pumps having a rated capacity of 1500 gpm (6000 L/min) or larger, through a single suction hose only, or through the number of hose listed in Table 16.2.4.1(a) attached to one side of the apparatus only

### Table 16.2.4.1(a) Suction Hose Size, Number of Suction Lines, and Lift for Fire Pumps

<table>
<thead>
<tr>
<th>Rated Capacity</th>
<th>Maximum Suction Hose Size</th>
<th>Maximum Number of Suction Lines</th>
<th>Maximum Lift</th>
</tr>
</thead>
<tbody>
<tr>
<td>gpm</td>
<td>L/min</td>
<td>in.</td>
<td>mm</td>
</tr>
<tr>
<td>250</td>
<td>1,000</td>
<td>3</td>
<td>75</td>
</tr>
<tr>
<td>300</td>
<td>1,100</td>
<td>3</td>
<td>75</td>
</tr>
<tr>
<td>350</td>
<td>1,300</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>500</td>
<td>2,000</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>750</td>
<td>3,000</td>
<td>4½</td>
<td>110</td>
</tr>
<tr>
<td>1,000</td>
<td>4,000</td>
<td>5</td>
<td>125</td>
</tr>
<tr>
<td>1,250</td>
<td>5,000</td>
<td>6</td>
<td>150</td>
</tr>
<tr>
<td>1,500</td>
<td>6,000</td>
<td>6</td>
<td>150</td>
</tr>
<tr>
<td>1,750</td>
<td>7,000</td>
<td>6</td>
<td>150</td>
</tr>
<tr>
<td>2,000</td>
<td>8,000</td>
<td>6</td>
<td>150</td>
</tr>
<tr>
<td>2,250</td>
<td>9,000</td>
<td>8</td>
<td>200</td>
</tr>
<tr>
<td>2,500</td>
<td>10,000</td>
<td>8</td>
<td>200</td>
</tr>
<tr>
<td>3,000</td>
<td>12,000</td>
<td>8</td>
<td>200</td>
</tr>
</tbody>
</table>

Where more than one suction line is used, all suction lines do not have to be the same hose size.
### Table 16.2.4.1(b) Friction and Entrance Loss in 20 ft of Suction Hose, Including Strainer (inch-pound units)

<table>
<thead>
<tr>
<th>Flow Rate (gpm)</th>
<th>Suction Hose Size (inside diameter)</th>
<th>ft water</th>
<th>in. Hg</th>
<th>ft water</th>
<th>in. Hg</th>
<th>ft water</th>
<th>in. Hg</th>
<th>ft water</th>
<th>in. Hg</th>
<th>ft water</th>
<th>in. Hg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>One 3 in.</td>
<td></td>
<td></td>
<td>One 3(\frac{1}{2}) in.</td>
<td></td>
<td>One 4 in.</td>
<td></td>
<td>One 4(\frac{1}{2}) in.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>250</td>
<td>5.2 (1.2)</td>
<td>4.6</td>
<td></td>
<td>7.5 (1.7)</td>
<td>6.6</td>
<td>4.8 (1.1)</td>
<td>4.2</td>
<td>4.8 (1.1)</td>
<td>4.2</td>
<td>5.0 (1.3)</td>
<td>4.4</td>
</tr>
<tr>
<td>175</td>
<td>2.6 (0.6)</td>
<td>2.3</td>
<td></td>
<td>3.8 (0.8)</td>
<td>3.4</td>
<td>2.4 (0.5)</td>
<td>2.1</td>
<td>2.4 (0.5)</td>
<td>2.1</td>
<td>2.5 (0.7)</td>
<td>2.1</td>
</tr>
<tr>
<td>125</td>
<td>1.4 (0.3)</td>
<td>1.2</td>
<td></td>
<td>1.9 (0.4)</td>
<td>1.7</td>
<td>1.2 (0.3)</td>
<td>1.1</td>
<td>1.2 (0.3)</td>
<td>1.1</td>
<td>0.7 (0.1)</td>
<td>0.6</td>
</tr>
<tr>
<td>300</td>
<td>7.5 (1.7)</td>
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<td></td>
<td>3.5 (0.8)</td>
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<td>2.5 (0.7)</td>
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<td></td>
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<td>3.6 (0.8)</td>
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<td></td>
<td>1.8 (0.4)</td>
<td>1.6</td>
</tr>
<tr>
<td>150</td>
<td>1.9 (0.4)</td>
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<td></td>
<td>0.9 (0.2)</td>
<td>0.8</td>
<td>0.7 (0.1)</td>
<td>0.6</td>
<td></td>
<td></td>
<td>0.9 (0.3)</td>
<td>0.8</td>
</tr>
<tr>
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<td>0.9 (0.3)</td>
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### Table 16.2.4.1(b) Continued

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<th>in. Hg</th>
<th>ft water</th>
<th>in. Hg</th>
<th>ft water</th>
<th>in. Hg</th>
<th>ft water</th>
<th>in. Hg</th>
<th>ft water</th>
<th>in. Hg</th>
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</thead>
<tbody>
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<td></td>
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<td></td>
<td>One 4(\frac{1}{2}) in.</td>
<td></td>
<td>One 5 in.</td>
<td></td>
<td>One 6 in.</td>
<td></td>
<td>Two 4(\frac{1}{2}) in.</td>
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<tr>
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<td>7.4</td>
<td>3.4 (0.6)</td>
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<td>1.7 (0.3)</td>
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<td>0.9 (0.2)</td>
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<td>13.0 (2.4)</td>
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<td>4.7</td>
<td>5.5 (1.2)</td>
<td>4.9</td>
<td></td>
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<td>1.3 (0.3)</td>
<td>1.1</td>
<td>1.4 (0.3)</td>
<td>1.2</td>
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</tr>
<tr>
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<td>3.9 (0.8)</td>
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<td>2.0 (0.4)</td>
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<td>11.0 (2.2)</td>
<td>9.7</td>
</tr>
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<td></td>
<td></td>
<td>5.0 (0.9)</td>
<td>4.6</td>
<td>5.3 (1.1)</td>
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<td>2.3</td>
<td></td>
<td></td>
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<tr>
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</tr>
</tbody>
</table>
Table 16.2.4.1(b) Continued

<table>
<thead>
<tr>
<th>Flow Rate (gpm)</th>
<th>Two 5 in.</th>
<th>Two 6 in.</th>
<th>Three 6 in.</th>
<th>One 8 in.</th>
<th>Two 8 in.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ft water</td>
<td>in. Hg</td>
<td>ft water</td>
<td>in. Hg</td>
<td>ft water</td>
</tr>
<tr>
<td>1500</td>
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<td>4.2</td>
<td>1.9 (0.4)</td>
<td>1.7</td>
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</tr>
<tr>
<td>1050</td>
<td>2.3 (0.5)</td>
<td>2.0</td>
<td>0.9 (0.3)</td>
<td>0.8</td>
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</tr>
<tr>
<td>750</td>
<td>1.2 (0.2)</td>
<td>1.1</td>
<td>0.5 (0.1)</td>
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</tr>
<tr>
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<td>5.7</td>
<td>2.6 (0.5)</td>
<td>2.3</td>
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<tr>
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<td>2.3 (0.6)</td>
</tr>
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<td>1.3 (0.3)</td>
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<td>0.6 (0.1)</td>
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<td>2.3 (0.7)</td>
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</table>

Note: Figures in parentheses indicate increment to be added or subtracted for each 10 ft of hose greater than or less than 20 ft.
### Table 16.2.4.1(c) Friction and Entrance Loss in 6 m of Suction Hose, Including Strainer (metric units)

<table>
<thead>
<tr>
<th>Flow Rate (L/min)</th>
<th>Suction Hose Size (inside diameter)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>One 75 mm</td>
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<td></td>
<td>Meters water</td>
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<tr>
<td>1000</td>
<td>1.6 (0.04)</td>
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<td>.22 (0.05)</td>
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<tr>
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<tr>
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### Table 16.2.4.1(c) Continued

<table>
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<th>Flow Rate (L/min)</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>One 100 mm</td>
</tr>
<tr>
<td></td>
<td>Meters water</td>
</tr>
<tr>
<td>3000</td>
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</tr>
<tr>
<td>2100</td>
<td>1.7 (0.05)</td>
</tr>
<tr>
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</tr>
<tr>
<td>4000</td>
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</tr>
<tr>
<td>2800</td>
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</tr>
<tr>
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</tr>
<tr>
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</tr>
<tr>
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</tr>
<tr>
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</tr>
<tr>
<td>6000</td>
<td>2.3 (0.04)</td>
</tr>
<tr>
<td>4200</td>
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</tr>
<tr>
<td>3000</td>
<td>0.6 (0.01)</td>
</tr>
<tr>
<td>7000</td>
<td>3.2 (0.05)</td>
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<tr>
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<td>1.5 (0.03)</td>
</tr>
<tr>
<td>3500</td>
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</tr>
<tr>
<td>8000</td>
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<tr>
<td>5600</td>
<td>2.1 (0.04)</td>
</tr>
<tr>
<td>4000</td>
<td>1.1 (0.02)</td>
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</tbody>
</table>
16.3 Pumping Engine Requirements.

16.3.1 The apparatus manufacturer shall approve the use of the pumping engine for stationary pumping applications based on the size of the fire apparatus and the rating of the pump being furnished.

16.3.2 Engine Speed.

16.3.2.1 The engine shall be capable of performing the pumping tests herein specified without exceeding the maximum governed speed of the engine as shown on a certified brake horsepower curve of the type of engine used without accessories.

16.3.2.2 The brake horsepower curve certification shall be signed by a responsible official of the engine manufacturer.

16.3.3 On fire pumps of 750 gpm (3000 L/min) or greater, the engine/pump combination shall be capable of delivering the rated pump capacity at 165 psi (1100 kPa) net pump pressure.

16.3.4* If a separate pumping engine is provided, it shall meet the requirements of 12.2.1.1, 12.2.1.2, 12.2.1.6, 12.2.2, 12.2.3.1, 12.2.3.2, 12.2.4, 12.2.5, and Sections 13.4 and 13.5.

16.3.5 A supplementary heat exchanger cooling system shall be provided for the pump drive engine.

16.3.5.1 Valving shall be installed to permit water from the discharge side of the pump to cool the coolant circulating through the engine cooling system without intermixing.

16.3.5.2 The heat exchanger shall maintain the temperature of the coolant in the pump drive engine not in excess of the engine manufacturer’s temperature rating under all pumping conditions.

16.3.5.3 A drain(s) shall be provided to allow draining of the heat exchanger so as to prevent damage from freezing.

16.3.6 Indicator or Light.

16.3.6.1 Where a separate engine is used to drive the pump, an indicator or light that is energized when the pump engine is running shall be provided in the driving compartment.

16.3.6.2 The indicator or light shall be marked with a label that reads “Pump Engine Running.”

16.4 Power Train Capability.

16.4.1 All components in the power train from the engine to the fire pump shall be capable of transmitting the torque necessary to power the pump, as installed in the apparatus, for the pump performance points specified in 16.2.3.1 without exceeding the component manufacturer’s continuous duty torque rating.

16.4.2 When pumping continuously at each of the pump performance points specified in 16.2.3.1, lubricant temperatures in any power train component installed in the apparatus from the engine to the pump shall not exceed the component manufacturer’s recommendation for maximum temperature.

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Table 16.2.4.1(c) Continued

<table>
<thead>
<tr>
<th>Flow Rate (L/min)</th>
<th>Two 125 mm</th>
<th>Suction Hose Size (inside diameter)</th>
<th>Two 150 mm</th>
<th>Three 150 mm</th>
<th>One 200 mm</th>
<th>Two 200 mm</th>
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<tr>
<td></td>
<td>Meters water</td>
<td>kPa</td>
<td>Meters water</td>
<td>kPa</td>
<td>Meters water</td>
<td>kPa</td>
</tr>
<tr>
<td>6000</td>
<td>1.4 (0.03)</td>
<td>14</td>
<td>0.6 (0.01)</td>
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</tr>
<tr>
<td>4200</td>
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<td>0.3 (0.01)</td>
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<td></td>
</tr>
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<td>3000</td>
<td>0.4 (0.01)</td>
<td>4</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>7000</td>
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<td>0.8 (0.02)</td>
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<td></td>
</tr>
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<td></td>
</tr>
<tr>
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<td>0.2 (0.01)</td>
<td>2</td>
<td></td>
<td></td>
</tr>
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<td>8000</td>
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<td>1.0 (0.02)</td>
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<td>13</td>
</tr>
<tr>
<td>5600</td>
<td>1.2 (0.02)</td>
<td>13</td>
<td>0.5 (0.01)</td>
<td>5</td>
<td>0.6 (0.02)</td>
<td>6</td>
</tr>
<tr>
<td>4000</td>
<td>0.6 (0.01)</td>
<td>6</td>
<td>0.3 (0.01)</td>
<td>3</td>
<td>0.3 (0.01)</td>
<td>3</td>
</tr>
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<td>13</td>
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</tr>
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<td>0.7 (0.01)</td>
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<td>.03 (0.01)</td>
<td>3</td>
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<tr>
<td>4500</td>
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<td>0.3 (0.01)</td>
<td>3</td>
<td>.02 (0.01)</td>
<td>2</td>
</tr>
<tr>
<td>10000</td>
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<td>39</td>
<td>1.6 (0.03)</td>
<td>16</td>
<td>.07 (0.02)</td>
<td>7</td>
</tr>
<tr>
<td>7000</td>
<td>2.0 (0.04)</td>
<td>19</td>
<td>0.8 (0.02)</td>
<td>8</td>
<td>.04 (0.01)</td>
<td>4</td>
</tr>
<tr>
<td>5000</td>
<td>1.0 (0.02)</td>
<td>10</td>
<td>0.4 (0.01)</td>
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<td>.02 (0.01)</td>
<td>2</td>
</tr>
<tr>
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<td></td>
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<td>23</td>
<td>.10 (0.02)</td>
<td>10</td>
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<tr>
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<td>12</td>
<td>.05 (0.01)</td>
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<td></td>
<td></td>
<td>0.6 (0.01)</td>
<td>6</td>
<td>.03 (0.01)</td>
<td>3</td>
</tr>
</tbody>
</table>

Note: Figures in parentheses indicate increment to be added or subtracted for each 3 m of hose greater than or less than 6 m.
16.4.3* When the engine and pumping system, under any pumping condition, have the capability to exceed the component manufacturer’s continuous duty torque rating, a means shall be provided to control the engine output to a level equal to or below the component manufacturer’s continuous duty torque rating.

16.5 Construction Requirements.

16.5.1* Wetted moving parts shall be constructed of a corrosion-resistant material.

16.5.2 Hydrostatic Test.

16.5.2.1 The pump body shall be subjected to a hydrostatic test to a gauge pressure of 500 psi (3400 kPa) minimum for 10 minutes.

16.5.2.2 The pump manufacturer shall provide a certificate of completion for the hydrostatic test.

16.5.3 Where an auxiliary pump is provided in combination with a fire pump and where the pumps are interconnected so that pressure from one pump can be transmitted to the other pump, check valves, intake or discharge relief valves, pump drive gear ratios, or other automatic means shall be provided to avoid pressurizing either pump beyond its maximum rated hydrostatic pressure.

16.5.4 The entire discharge and intake piping system, valves, drain cocks and lines, and intake and outlet closures, excluding the tank fill and tank to pump lines on the tank side of the valves in those lines, shall be capable of withstanding a minimum hydrostatic burst gauge pressure of 500 psi (3400 kPa).

16.5.5 Pulsation-Free Fire Streams.

16.5.5.1 The pump shall be capable of producing fire streams that are free from pulsations.

16.5.5.2 When an accumulator is used to provide pulsation-free fire streams, the accumulator shall be constructed and tested in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 2.

16.5.6 The pump shall allow a positive pressure water source to directly add to the pump’s net pump pressure.

16.6 Pump Intake Connections.

16.6.1* Intake(s) of the same or larger size and quantity than the maximums specified in Table 16.2.4.1(a) for suction hose size and number of suction lines shall be provided.

16.6.1.1 The intakes specified in 16.6.1 shall have male National Hose threads if the apparatus is to be used in the United States of America.

16.6.1.2 If the couplings on the suction hose carried on the apparatus are of a different size than the pump intake(s) or have means of hose attachment other than that provided on the intake(s), an adapter(s) shall be provided to allow connection of the suction hose to the pump intake(s).

16.6.1.3* A plate shall be provided on the pump operators panel that states the following:

“Warning: Death or serious injury might occur if proper operating procedures are not followed. The pump operator, as well as individuals connecting supply or discharge hoses to the apparatus, must be familiar with the operator’s manual, water hydraulics hazards, and component limitations.”

16.6.2 Intake Strainer.

16.6.2.1 Each intake shall have a removable or accessible strainer inside the connection.

16.6.2.2* The strainer(s) shall restrict spherical debris that is too large to pass through the pump.

16.6.3 At least one valved intake shall be provided that can be controlled from the pump operator’s position.

16.6.3.1 The valve and piping shall be a minimum 2 1/2 in. (65 mm) nominal size.

16.6.3.2 If the intake is 2 1/2 in. (65 mm) nominal size, the intake shall be equipped with a female swivel coupling with National Hose threads.

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

16.6.5* Each valved intake shall be equipped with a bleeder valve having a minimum 1/4-in. (19-mm) pipe thread connection to bleed off air or water.

16.6.5.1 The bleeder valve shall be operational without the operator having to get under the apparatus.

16.6.5.2 If a valved appliance is attached to an intake, it shall be equipped with a 1/4-in. (19-mm) bleeder valve on each intake.

16.6.6 Each valved intake having a connection size of 3 1/2 in. (90 mm) or larger shall be equipped with an adjustable automatic pressure relief device installed on the supply side of the valve to bleed off pressure from a hose connected to the valved intake.

16.6.6.1 The pressure relief device shall discharge to atmosphere and the discharge shall be piped or directed away from the pump operator’s position.

16.6.6.2 The automatic pressure relief device shall be adjustable from a minimum of 90 psi (620 kPa) to at least 185 psi (1275 kPa).

16.6.6.3 The pressure relief device, when preset at 125 psi (860 kPa), shall not allow a pressure rise greater than 60 psi (400 kPa) at the device inlet while flowing a minimum of 150 gpm (570 L/min).

16.6.7 If the pump is equipped with one or more intakes larger than 3 1/2 in. (89 mm) that are not valved, an adjustable automatic pressure relief device shall be installed on the pump system to bleed off excess pressure from a hose connected to the pump intake.

16.6.7.1 The automatic pressure relief device shall be adjustable from a minimum of 90 psi (620 kPa) to at least 185 psi (1275 kPa).

16.6.7.2 The pressure relief device, when preset at 125 psi (860 kPa), shall not allow a pressure rise greater than 60 psi (400 kPa) at the device inlet while flowing a minimum of 150 gpm (570 L/min).

16.6.7.3 The pressure relief device shall discharge to atmosphere.

16.6.8 All intakes shall be provided with caps or closures capable of withstanding a hydrostatic burst gauge pressure of 500 psi (3400 kPa).

16.6.8.1 Intakes having male threads shall be equipped with caps; intakes having female threads shall be equipped with plugs.

16.6.8.2 Where adapters for special threads or other means for hose attachment are provided on the intakes, closures shall be provided for the adapters in lieu of caps or plugs.

16.6.9 Caps or closures for 3 1/2-in. (90-mm) and smaller intakes shall be removable from the intakes but remain secured to the apparatus.

16.6.10 If the suction inlets are to be equipped with a valve, siamese, or adapter that will remain in place while the apparatus is in motion, that valve, siamese, or adapter shall not project beyond the apparatus running board.

16.6.11 The purchaser shall specify if any valve, siamese, or adapter is to be permanently installed on an intake and identify the brand and model of such item.

16.7 Pump Discharge Outlets.

16.7.1* Discharge outlets of 2 1/2 in. (65 mm) or larger shall be provided to discharge the rated capacity of the pump at the flow rates shown in Table 16.7.1.

<table>
<thead>
<tr>
<th>Outlet Size</th>
<th>Flow Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>in.</td>
<td>mm</td>
</tr>
<tr>
<td>2 1/2</td>
<td>65</td>
</tr>
<tr>
<td>3</td>
<td>75</td>
</tr>
<tr>
<td>3 1/2</td>
<td>90</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>4 1/2</td>
<td>110</td>
</tr>
<tr>
<td>5</td>
<td>125</td>
</tr>
<tr>
<td>6</td>
<td>150</td>
</tr>
</tbody>
</table>

16.7.1.1 If the apparatus is equipped with an aerial device with a waterway that is permanently connected to the pump, the discharge from that waterway shall be permitted to be credited as a 1000-gpm (4000-L/min) outlet.

16.7.1.2 A minimum of two 2 1/2-in. (65-mm) outlets shall be provided on any pump rated at 750 gpm (3000 L/min) or greater, and a minimum of one 2 1/2-in. (65-mm) outlet shall be provided on any pump rated at less than 750 gpm (3000 L/min).

16.7.2 Discharge Outlet Connections.

16.7.2.1 All 2 1/2-in. (65-mm) or larger discharge outlets shall be equipped with male National Hose threads.

16.7.2.2* Adapter couplings with special threads or other means for hose attachment shall be permitted to be furnished on any or all outlets.
16.7.3* The piping and valves supplying any preconnected 1 1/2-in. (38-
mm), 1 3/4-in. (45-mm), or 2-in. (52-mm) hose line include the piping to the
preconnected hose storage areas specified in Section 5.6(2), Section 6.5(2),
7.5.2, 8.6.2, Section 9.6(2), or Section 11.7(2), as applicable, shall be at least
2 in. (52 mm) in size.
16.7.4 All discharge outlets, except outlets to which a hose will be
preconnected, shall be equipped with caps or closures capable of
withstanding a minimum hydrostatic burst gauge pressure of 100 psi (700
kPa) over the maximum pump close-off pressure or 500 psi (3400 kPa),
whichever is greater.
16.7.4.1 Where adapters are provided on the discharge outlets, the closures
shall fit on the adapters.
16.7.4.2 Caps or closures for outlets 3 2/3-in. (90 mm) and smaller in size
shall be removable from the outlet but remain secured to the apparatus.
16.7.5 Each discharge outlet shall be equipped with a valve that can be
opened and closed smoothly at the flows shown in Table 16.7.1 at pump
discharge gauge pressures of 250 psi (1700 kPa).
16.7.5.1 The flow-regulating element of each valve shall not change its
position under any condition of operation that involves discharge pressures
to the maximum pressure of the pump; the means to prevent a change in
position shall be incorporated in the operating mechanism and shall be
permitted to be manually or automatically controlled.
16.7.5.2 Any 3-in. (75-mm) or larger discharge valve shall be a slow-
operating valve.
16.7.6 All 1 1/2-in. (38-mm) or larger discharge outlets shall be equipped
with a drain or bleeder valve having a minimum 7/16-in. (11-mm) pipe thread
connection for draining or bleeding off pressure from a hose connected to
the outlet.
16.7.7 Any 2-in. (52-mm) or larger discharge outlet that is located more
than 42 in. (1067 mm) off the ground to which hose is to be connected and
that is not in a hose storage area shall be supplied with a sweep elbow of at
least 30 degrees downward.
16.7.8 Valves.
16.7.8.1 Each pump discharge shall have a valve that can be controlled from
the pump operator’s position.
16.7.8.2 A secondary valve shall be permitted to be provided at a discharge
outlet if required for special applications.
16.7.9* Location of Discharge Outlets.
16.7.9.1 No discharge outlet larger than 2 1/4 in. (65 mm) shall be located at
the pump operator’s panel.
16.7.9.2 If the apparatus has a top console-type pump operator’s panel,
vertical discharge outlets larger than 2 1/4 in. (65 mm) shall be permitted at
the top midship position of apparatus where the outlets are used for directly
connected deck guns or monitors and no fire hose is used for coupling the
components.
16.7.10 Where the valve operating mechanism does not indicate the position
of the valve, an indicator shall be provided to show when the valve is closed.
16.8 Pump Drains.
16.8.1 A readily accessible drain valve(s) that is marked with a label as to its
function shall be provided to allow for draining of the pump and all water-
carrying lines and accessories.
16.8.2 The drain valve(s) shall be operational without the operator having to
get under the apparatus.
16.9 Pump Operator’s Panel.
16.9.1* Each pump control, gauge, and other instrument necessary to
operate the pump shall be located on a panel known as the pump operator’s
panel and shall be marked with a label as to its function.
16.9.2 All gauges, discharge outlets, pump intakes, and controls shall be
illuminated to a minimum lighting level of 5 footcandles (50 lx).
16.10* Pump Controls.
16.10.1 General Provisions. Provisions shall be made for placing the pump
drive system in operation using controls and switches that are identified and
within convenient reach of the operator.
16.10.1.1 Where the pump is driven by the chassis engine and engine
compression brakes or engine exhaust brakes are furnished, they shall be
automatically disengaged for pumping operations.
16.10.1.2* Any control device used in the pumping system power train
between the engine and the pump, except a manual pump shift override
device, if provided, shall be equipped with a means to prevent unintentional
movement of the control device from its set position in the pumping mode.
16.10.1.3 A label indicating the chassis transmission shift selector position
to be used for pumping shall be provided in the driving compartment and
located so that it can be read from the driver’s position.
16.10.1.4 Where the pump is driven by the chassis engine and transmission
through a split shaft PTO, the driving compartment speedometer shall
register when the pump drive system is engaged.
16.10.1.5 Where chassis transmission retarders are furnished, they shall be
disengaged for pumping operations.
16.10.2 Stationary Pump Driven Through Split Shaft PTO —
Automatic Chassis Transmission. Where the apparatus is equipped with
an automatic chassis transmission, the water pump is driven by the chassis
gine through the transmission’s main driveline, and the apparatus is to be
used for stationary pumping only, an interlock system shall be provided to
ensure that the pump drive system components are engaged in the pumping
mode of operation so that the pumping system can be operated from the
pump operator’s position.
16.10.2.1* A “Pump Engaged” indicator shall be provided in the driving
compartment to indicate that the pump shift process has been successfully
completed.
16.10.2.2 An “OK to Pump” indicator shall be provided in the driving
compartment to indicate that the pump is engaged, the chassis transmission
is in pump gear, and the parking brake is engaged.
16.10.2.3 A “Throttle Ready” indicator shall be provided at the pump
operator’s panel that indicates that the apparatus is in “OK to Pump” mode or
that the chassis transmission is in neutral and the parking brake is engaged.
16.10.3 Stationary Pump Driven Through Split Shaft PTO — Manual
Chassis Transmission. Where the apparatus is equipped with a manual
chassis transmission, the water pump is driven by the chassis engine through
the transmission’s main driveline, and the apparatus is to be used for
stationary pumping only, an interlock system shall be provided to ensure
that the pump drive system components are engaged in the pumping mode
of operation so that the pumping system can be operated from the pump
operator’s position.
16.10.3.1* A “Pump Engaged” indicator shall be provided in the driving
compartment to indicate that the pump shift has been successfully
completed.
16.10.3.2 An “OK to Pump” indicator shall be provided in the driving
compartment to indicate that the pump is engaged and the parking brake is
engaged.
16.10.3.3 A “Throttle Ready” indicator shall be provided at the pump
operator’s panel that indicates that the apparatus is in “OK to Pump” mode or
that the parking brake is engaged.
16.10.4 Stationary Pump Driven Through Transmission-Mounted
PTO, Front-Of-Engine Crank Shaft PTO, or Engine Flywheel PTO
Automatic Chassis Transmission. Where the apparatus is equipped with an
automatic chassis transmission, the water pump is driven by the chassis
engine through a transmission-mounted (SAE) PTO, front-of-engine crankshaft PTO, or
engine flywheel PTO, and the apparatus is to be used for stationary pumping
only with the chassis transmission in neutral, an interlock system shall be
provided to ensure that the pump drive system components are engaged in
the pumping mode of operation so that the pump system can be operated from
the pump operator’s position.
16.10.4.1 A “Pump Engaged” indicator shall be provided both in the driving
compartment and on the pump operator’s panel to indicate that the pump
shift has been successfully completed.
16.10.4.2 An “OK to Pump” indicator shall be provided in the driving
compartment to indicate that the pump is engaged, the chassis transmission
is in neutral, and the parking brake is engaged.
16.10.4.3 A “Throttle Ready” indicator shall be provided at the pump
operator’s panel that indicates that the apparatus is in “OK to Pump” mode or
that the chassis transmission is in neutral and the parking brake is engaged.
16.10.5 Stationary Pump Driven Through Transmission-Mounted
PTO, Front-Of-Engine Crank Shaft PTO, or Engine Flywheel PTO — Manual
Chassis Transmissions. Where the apparatus is equipped with a manual
chassis transmission, the water pump is driven by a transmission-mounted
(SAE) PTO, front-of-engine crankshaft PTO, or engine flywheel PTO, and
the apparatus is to be used for stationary pumping only with the chassis
transmission in neutral, an interlock system shall be provided to ensure
that the pump drive system components are engaged in the pumping mode
of operation so that the pump system can be operated from the pump operator’s
position.
A "OK to Pump and Roll" indicator shall be provided in the driving compartment and on the pump operator’s panel to indicate that the pump shift has been successfully completed.

16.10.5.2 An "OK to Pump" indicator shall be provided in the driving compartment to indicate that the pump is engaged and the parking brake is engaged.

16.10.5.3 A “Throttle Ready” indicator shall be provided at the pump operator’s panel that indicates that the apparatus is in “OK to Pump” mode or that the parking brake is engaged.

16.10.6 Stationary and “Pump and Roll” Pump — Automatic Chassis Transmissions. Where the water pump is driven by a transmission-mounted (SAE) PTO, front-of-engine crankshaft PTO, or engine flywheel PTO, and the apparatus is designed to be used in both the stationary pumping mode and the “pump and roll” pumping mode with the automatic chassis transmission in neutral for stationary pumping and in a road gear for pump and roll pumping, an interlock system shall be provided to ensure that the pump drive system components are properly engaged in the pumping mode of operation so that the apparatus can be operated in either stationary or pump and roll pumping mode.

16.10.6.1 A “Pump Engaged” indicator shall be provided both in the driving compartment and at the pump operator’s panel to indicate that the pump shift has been successfully completed.

16.10.6.2 Indicators.

16.10.6.2.1 An “OK to Pump” indicator shall be provided in the driving compartment to indicate that the pump is engaged, the chassis transmission is in neutral, and the parking brake is engaged.

16.10.6.2.2 An “OK to Pump and Roll” indicator shall be provided in the driving compartment and shall be energized when the pump is engaged, the chassis transmission is in road gear, and the parking brake is released.

16.10.6.2.3 When the “OK to Pump and Roll” indicator is energized, the “OK to Pump” indicator shall not be energized.

16.10.6.3 A “Throttle Ready” indicator shall be provided at the pump operator’s panel that is energized when the “OK to Pump” indicator is energized or when the chassis transmission is in neutral and the parking brake is engaged.

16.10.7 Stationary and “Pump and Roll” Pumps — Manual Chassis Transmissions. Where the water pump is driven by a transmission-mounted (SAE) PTO, front-of-engine crankshaft PTO, or engine flywheel PTO, and the apparatus is designed to be used in both the stationary pumping mode and the “pump and roll” pumping mode with the chassis transmission in neutral for stationary pumping or in a road gear for pump and roll pumping, an interlock system shall be provided to ensure that the pump drive system components are properly engaged in the pumping mode of operation so that the apparatus can be operated in either stationary or pump and roll pumping mode.

16.10.7.1 A “Pump Engaged” indicator shall be provided both in the driving compartment and at the pump operator’s panel to indicate that the pump shift has been successfully completed.

16.10.7.2 An “OK to Pump” indicator shall be provided in the driving compartment to indicate that the pump is engaged and the parking brake is engaged.

16.10.7.3 An “OK to Pump and Roll” indicator shall be provided in the driving compartment and shall be energized when the pump is engaged, the chassis transmission is in road gear, and the parking brake is released.

16.10.7.4 When the “OK to Pump and Roll” indicator is energized, the “OK to Pump” indicator shall not be energized.

16.10.7.5 A “Throttle Ready” indicator shall be provided at the pump operator’s panel that is energized when the “OK to Pump” indicator is energized or when the parking brake is engaged.

16.10.8 Stationary Pumps Driven Through Transfer Case PTOs — Automatic Chassis Transmissions. Where the apparatus is equipped with an automatic chassis transmission, the water pump is driven by the chassis engine through the transmission’s main driveline and through a transfer case, and the apparatus is to be used for stationary pumping only, an interlock system shall be provided to ensure that the pump drive system components are engaged in the pumping mode of operation so that the pump drive system can be operated from the pump operator’s position.

16.10.8.1 A “Pump Engaged” indicator shall be provided in the driving compartment to indicate that the pump is engaged, the chassis transmission is in pump gear, the transfer case drive to the chassis wheels is in neutral, and the parking brake is engaged.

16.10.8.2 An “OK to Pump” indicator shall be provided in the driving compartment to indicate that the pump is engaged, the parking brake is engaged.

16.10.8.3 A “Throttle Ready” indicator shall be provided at the pump operator’s panel that indicates that the apparatus is in “OK to Pump” mode or that the chassis transmission is in neutral and the parking brake is engaged.

16.10.9 Stationary Pumps Driven Through Transfer Case PTOs — Manual Chassis Transmissions. Where the apparatus is equipped with a manual chassis transmission, the water pump is driven by the chassis engine through the transmission’s main driveline and through a transfer case, and the apparatus is to be used for stationary pumping only, an interlock system shall be provided to ensure that the pump drive system components are engaged in the pumping mode of operation so that the pump drive system can be operated from the pump operator’s position.

16.10.9.1 A “Pump Engaged” indicator shall be provided in the driving compartment to indicate that the pump shift has been successfully completed.

16.10.9.2 An “OK to Pump” indicator shall be provided in the driving compartment to indicate that the pump is engaged, the transfer case drive to the chassis wheels is in neutral, and the parking brake is engaged.

16.10.9.3 A “Throttle Ready” indicator shall be provided at the pump operator’s panel that indicates that the apparatus is in “OK to Pump” mode or that the parking brake is engaged.

16.10.10 Pump Operator’s Panel Engine Speed Advancement — Automatic Chassis Transmission. An interlock system shall be provided to prevent advancement of the engine speed at the pump operator’s panel unless the chassis transmission is in neutral and the parking brake is engaged or the apparatus is in the “OK to Pump” mode.

16.10.11 Pump Operator’s Panel Engine Speed Advancement — Manual Chassis Transmission. An interlock system shall be provided to prevent advancement of the engine speed at the pump operator’s panel unless the parking brake is engaged or the apparatus is in the “OK to Pump” mode.

16.10.12 Parallel/Series Control.

16.10.12.1 With parallel/series centrifugal pumps, the control positions for parallel operation (volume) and series operation (pressure) shall be indicated.

16.10.12.2 The control for changing the pump from series to parallel, and vice versa, shall be operable at the pump operator’s position.

16.10.13* Pressure Control System.

16.10.13.1* A system shall be provided that, when set in accordance with the manufacturer’s instructions, will automatically control the discharge pressure to a maximum of 30 psi (20 kPa) pressure rise above the set pressure(s) when all discharge valves are closed no more rapidly than in 3 seconds, and no more slowly than in 10 seconds, during the following conditions:

1. Over a range of pressures from 70 psi to 300 psi (500 kPa to 20 kPa) net pump pressure with intake gauge pressure between -10 psi and 185 psi (-70 kPa and 1300 kPa) and discharge gauge pressure between 90 psi and 300 psi (600 kPa and 2000 kPa)

2. With initial engine and pump controls set to produce a range of flows from 150 gpm (550 L/min) to the rated capacity of the pump

16.10.13.2 If the pump is equipped with a relief valve system where the system does not control engine speed, the system shall be equipped with a means to indicate when the system is in control of the pressure.

16.10.13.2.1 If the pump is equipped with a governor system that controls engine speed, an indicator shall show when the system is turned on and whether it is controlling the engine speed or pump pressure.

16.10.13.2.2 Either system shall be controllable by one person at the pump operator position.

16.10.13.3 If the system discharges water to the atmosphere, the discharge shall be in a manner that will not expose personnel to high-pressure water streams.

16.10.14* Priming Device. A priming device shall be provided and controlled from the pump operator’s position.

16.10.14.1 The priming device shall be capable of meeting the requirements of 16.2.3.2 and 16.2.3.3.

16.10.14.2 The priming device shall be capable of operating with no lubricant or a biodegradable nontoxic lubricant.

16.10.15 Protection of Pump Controls.

16.10.15.1 Protection of Pump Controls. All pump controls and devices shall be installed so as to be protected against mechanical damage or the effects of adverse weather conditions on their operation.

16.11 Pump Engine Controls.

16.11.1* A throttle control that holds its set position shall be provided to control the pump engine speed.
16.11.2 The throttle control shall be located not higher than 72 in. (1800 mm) nor lower than 42 in. (1067 mm) from the operator’s standing position with all instruments in full view.

16.12 Instrumentation.

16.12.1 Pump Operators Panel.

16.12.1.1* The following controls and instruments shall be provided and installed as a group at the pump operator’s panel:

1. A master pump intake pressure indicating device
2. A master pump discharge pressure indicating device
3. A pumping engine tachometer
4. A pumping engine coolant temperature indicator
5. A pumping engine oil pressure indicator
6. A voltmeter
7. The pump pressure control(s)
8. The pumping engine throttle
9. The primer control
10. The water tank to pump valve control
11. The water tank fill valve control
12. The water tank level indicator

16.12.1.2 The instruments and controls required by 16.12.1.1 shall be placed so as to keep the pump operator as far as practicable from all discharge and intake connections and in a location where they are visible and operationally functional while the operator remains stationary.

16.12.1.3 Any instrumentation exposed to the elements shall be weatherproof.

16.12.1.4 The pumping engine oil pressure and engine-coolant temperature indicators shall be equipped with audible and visual warnings.

16.12.1.5 All engine operation indicators on the pump operator’s panel shall be in addition to those on the vehicle’s instrument panel.

16.12.2 Master Pump Intake and Discharge Pressure Indicating Devices.

16.12.2.1 Master pump intake and pump discharge pressure indicating devices shall be located within 8 in. (200 mm) of each other, edge to edge, with the intake pressure indicating device to the left of or below the pump discharge pressure indicating device.

16.12.2.1.1 The intake pressure indicating device shall read from 30 in. Hg (100 kPa) vacuum to at least a gauge pressure of 300 psi (2000 kPa).

16.12.2.1.2 The discharge pressure indicating device shall read from a gauge pressure of 0 psi or lower to a gauge pressure of at least 300 psi (2000 kPa).

16.12.2.1.3 Pressure indicating devices shall not be damaged by a 30 in. Hg (100 kPa) vacuum.

16.12.2.1.4 Pressure indicating devices shall be marked with labels that read “Pump Intake” for the intake pressure indicating device and “Pump Discharge” for the discharge pressure indicating device.

16.12.2.1.5 Where analog gauges are used, there shall be at least a 1-in. (25-mm) diameter differential in viewing area between the master gauges and the individual discharge gauges, with the master gauges being the larger.

16.12.2.1.5.1 The accuracy of gauges shall be a minimum of Grade 1A as defined in ASME B40.100, Pressure Gauges and Gauge Attachments.

16.12.2.1.5.2 Numerals for master gauges shall be a minimum of 0.25 in. (6.4 mm) high.

16.12.2.1.5.3 There shall be graduation lines showing at least every 10 psi (70 kPa), with major and intermediate graduation lines emphasized and figures at least every 100 psi (700 kPa).

16.12.2.1.5.4 Analog pressure gauges shall be vibration and pressure pulsation dampened, be resistant to corrosion, condensation, and shock, and have internal mechanisms that are factory lubricated for the life of the gauge.

16.12.2.1.6 If digital master pressure indicating devices are used, they shall meet the requirements of 16.12.2.1.6.1 through 16.12.2.1.6.3.

16.12.2.1.6.1 The digits shall be at least 1/2 in. (12.7 mm) high.

16.12.2.1.6.2 Digital pressure indicating devices shall display pressure in increments of not more than 10 psi (70 kPa).

16.12.2.1.6.3 Digital master pressure indicating devices shall have an accuracy of ±3 percent over the full scale.

16.12.3 Discharge Outlet Instrumentation.

16.12.3.1 A flowmeter or a pressure indicating device shall be provided for each discharge outlet 1/2 in. (38 mm) or larger in size and shall be marked with a label to indicate the outlet to which it is connected.

16.12.3.2* Any discharge outlet 3/4 in. (90 mm) or larger that is equipped with a flowmeter shall also be provided with a pressure indicating device.

16.12.3.3 The pressure indicating device or flowmeter display shall be located adjacent to the corresponding control valve with no more than 6 in. (150 mm) separating the pressure indicating device or flowmeter bezel and the valve control midpoint or centerline.

16.12.3.4 If both a flowmeter and pressure indicating device are provided for an individual discharge outlet, the pressure indicating device shall be located within 6 in. (150 mm) of the valve control midpoint or centerline, and the flowmeter display shall be adjacent to and within 2 in. (52 mm) of the pressure indicating device bezel.

16.12.3.5 Pressure indicating devices shall be connected to the outlet side of the valve.

16.12.3.6 Flowmeters shall display flow in increments no greater than 10 gpm (38 L/min).

16.12.3.7 Where analog pressure gauges are used, they shall have a minimum accuracy of Grade B as defined in ASME B40.100, Pressure Gauges and Gauge Attachments.

16.12.3.7.1 Numerals for gauges shall be a minimum 1/2 in. (4 mm) high.

16.12.3.7.2 There shall be graduation lines showing at least every 10 psi (70 kPa), with major and intermediate graduation lines emphasized and figures at least every 100 psi (700 kPa).

16.12.3.7.3 Analog pressure gauges shall be vibration and pressure pulsation dampened, be resistant to corrosion, condensation, and shock, and have internal mechanisms that are factory lubricated for the life of the gauge.

16.12.3.8 If a digital pressure indicating device is used, they shall meet the requirements of 16.12.3.8.1 through 16.12.3.8.3.

16.12.3.8.1 The digits shall be at least 0.25 in. (6.4 mm) high.

16.12.3.8.2 Digital pressure indicating devices shall display pressure in increments of not more than 10 psi (70 kPa).

16.12.3.8.3 Digital pressure indicating devices shall have an accuracy of ±3 percent over the full scale.

16.12.3.9 Each flowmeter shall be calibrated to an accuracy of ±5 percent when flowing the amount of water shown in Table 16.12.3.9 for the pipe size in which it is mounted.

Table 16.12.3.9 Flowmeter Calibration Flow for Each Pipe Size

<table>
<thead>
<tr>
<th>Pipe size</th>
<th>Flow</th>
<th>Flowmeter Calibration Flow for Each Pipe Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>in.</td>
<td>mm</td>
<td>gpm</td>
</tr>
<tr>
<td>1</td>
<td>25</td>
<td>40</td>
</tr>
<tr>
<td>1 1/2</td>
<td>38</td>
<td>90</td>
</tr>
<tr>
<td>2</td>
<td>52</td>
<td>160</td>
</tr>
<tr>
<td>2 1/2</td>
<td>65</td>
<td>250</td>
</tr>
<tr>
<td>3</td>
<td>75</td>
<td>375</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>625</td>
</tr>
<tr>
<td>5</td>
<td>125</td>
<td>1000</td>
</tr>
<tr>
<td>6</td>
<td>150</td>
<td>1440</td>
</tr>
</tbody>
</table>

16.12.4 Each pressure indicating device or flowmeter, and its respective display, shall be mounted and attached so it is protected from accidental damage and excessive vibration.

16.12.5 Connections for test gauges shall be provided at the pump operator’s panel.
16.13.2.1 Pump Certification.

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

16.13.1.1.1 The tests shall include at least the pumping test (see 16.13.2), the pump drive engine test (see 16.13.3), the pressure control system test (see 16.13.4), the priming device tests (see 16.13.5), and the vacuum test (see 16.13.6).

16.13.1.2 If the apparatus is equipped with a water tank, the water tank to pump flow test (see 16.13.7) shall be included.

16.13.1.3 The tests results shall be certified by an independent third-party certification organization.

16.13.1.2 If the fire pump 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.

16.13.1.2.1 The test shall include at least the pumping test (see 16.13.2), the pressure control system test (see 16.13.4), the priming device tests (see 16.13.5), and the vacuum test (see 16.13.6).

16.13.1.2.2 If the apparatus is equipped with a water tank, the water tank to pump flow test (see 16.13.7) shall be included.

16.13.1.2.3* The tests results shall be certified by the apparatus manufacturer.

16.13.1.3 Test Plate.

16.13.1.3.1 A test plate shall be provided at the pump operator’s panel that gives 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 engine as stated by the engine manufacturer on a certified brake horsepower curve.

16.13.1.3.2 The plate shall be completely stamped with all information at the factory and attached to the vehicle prior to shipping.

16.13.2 Pumping Test.

16.13.2.1 Conditions for Test.

16.13.2.1.1 The test site shall be adjacent to a supply of clear water at least 4 ft (1.2 m) deep, with the water level not more than 10 ft (3 m) below the center of the pump intake, and close enough to allow the suction strainer to be submerged at least 2 ft (0.6 m) below the surface of the water when connected to the pump by 20 ft (6 m) of suction hose.

16.13.2.1.2* Tests shall be performed when conditions are as follows:

1. Air temperature: 0°F to 110°F (-18°C to 43°C)
2. Water temperature: 35°F to 90°F (2°C to 32°C)
3. Barometric pressure: 29 in. Hg (98.2 kPa), minimum (corrected to sea level)

16.13.2.1.3 Engine-driven accessories shall not be functionally disconnected or otherwise rendered inoperative during the tests.

16.13.2.1.3.1 If the chassis engine drives the pump, the electrical loads and conditions specified in 13.14.3.4 shall be applied during the pumping portion of this test.

16.13.2.1.3.2 If the vehicle is equipped with a fixed power source driven by the same engine that drives the fire pump, it shall be running at a minimum of 50 percent of its rated capacity throughout the pumping portion of the pump test.

16.13.2.1.3.3 The following devices shall be permitted to be turned off or not operating during the pump test:

1. Aerial hydraulic pump
2. Foam pump
3. Hydraulically driven equipment
4. Winch
5. Windshield wipers
6. Four-way hazard flashers

16.13.2.2 Equipment.

16.13.2.2.1 Suction Hose.

16.13.2.2.1.1 The suction hose shall be of the appropriate size for the rated capacity of the pump [see Table 16.2.4.1(a)].

16.13.2.2.1.2 A suction strainer and hose that will allow flow with total friction and entrance loss not greater than that specified in Table 16.2.4.1(b) or Table 16.2.4.1(c) shall be used.

16.13.2.2.2* The suction hose shall be tested for the rated capacity of the pump to the nozzles or other flow measuring equipment without exceeding a flow velocity of 35 ft/sec (10 m/sec) [approximately 500 gpm (2000 L/min) for 2 1/2 in. (65-mm) hose].

16.13.2.2.3 Where nozzles are used, they shall be smoothbore, and the inside diameters shall be from 3/4 in. to 2 1/2 in. (19 mm to 63.5 mm).

16.13.2.2.4 Test Gauges.

16.13.2.2.4.1 All test gauges shall meet the requirements for Grade A gauges as defined in ASME B40.100, Pressure Gauges and Gauge Attachments, and shall be at least size 3 1/2 per ASME B40.100.

16.13.2.2.4.2 A mercury manometer shall be permitted to be used in lieu of a pump intake gauge.

16.13.2.2.4.3 The pump intake gauge shall have a range of 30 in. Hg (100 kPa) vacuum to zero for a vacuum gauge, or 30 in. Hg (100 kPa) vacuum to a gauge pressure of 150 psi (1000 kPa) for a compound gauge.

16.13.2.2.4.4 The discharge pressure gauge shall have a gauge pressure range of 0 psi to 400 psi (0 kPa to 2800 kPa).

16.13.2.2.4.5 Pilot gauges shall have a gauge pressure range of at least 0 psi to 160 psi (0 kPa to 1100 kPa).

16.13.2.2.4.6* All gauges shall be calibrated in the month preceding the tests using a dead weight gauge tester or a master gauge meeting the requirements for Grade 3A or 4A gauges, as defined in ASME B40.100, Pressure Gauges and Gauge Attachments, that has been calibrated within the preceding year.

16.13.2.2.4.7 All test gauge connections shall include a means for “snubbing,” such as needle valves to damp out rapid needle movements.

16.13.2.2.4.8* The engine speed-measuring equipment shall consist of a nonadjustable tachometer supplied from the engine or transmission electronics, a revolution counter on a checking shaft outlet and a stop watch, or other engine speed-measuring means that is accurate to within ± 50 rpm of actual speed.

16.13.2.3 Procedure.

16.13.2.3.1* The ambient air temperature, water temperature, vertical lift, elevation of test site, and atmospheric pressure (corrected to sea level) shall be determined and recorded prior to and after each pump test.

16.13.2.3.2* The engine, pump, transmission, and all parts of the apparatus shall exhibit no undue heating, loss of power, or other defect during the entire test.

16.13.2.3.3 If the apparatus is equipped with a fire pump rated at 750 gpm (3000 L/min) or greater, the pump shall be subjected to a 3-hour pumping test from draft consisting of 2 hours of continuous pumping at rated capacity at 150 psi (1000 kPa) net pump pressure, followed by 1 1/2 hour of continuous pumping at 70 percent of rated capacity at 200 psi (1400 kPa) net pump pressure and 1 1/2 hour of continuous pumping at 50 percent of rated capacity at 250 psi (1700 kPa) net pump pressure.

16.13.2.3.4* The pump shall not be stopped until after the 2-hour test at rated capacity, unless it becomes necessary to clean the suction strainer.

16.13.2.3.5 The pump shall be permitted to be stopped between tests in order to change the hose or nozzles, clean the strainer, or add fuel for the pump drive engine.

16.13.2.3.6 The capacity, discharge pressure, intake pressure, and engine speed shall be recorded at least every 15 minutes but not less than three times for each test sequence.

16.13.2.3.7 The average net pump pressure shall be calculated and recorded based on the average values for discharge and intake pressure.

16.13.2.3.8 If the apparatus is equipped with a fire pump rated at less than 750 gpm (3000 L/min), the pump shall be subjected to a 50-minute pumping test from draft consisting of 1 1/2 hour of continuous pumping at rated capacity at 150 psi (1000 kPa) net pump pressure, followed by 10 minutes of
continuous pumping at 70 percent of rated capacity at 200 psi (1400 kPa) net pump pressure, and 10 minutes of continuous pumping at 50 percent of rated capacity at 250 psi (1700 kPa) net pump pressure.

16.13.2.3.4.1 The pump shall not be stopped until after the 1/4-hour test at rated capacity, unless it becomes necessary to clean the suction strainer.

16.13.2.3.4.2 The primer shall be operated in accordance with the manufacturer’s instructions to maintain the discharge gauge pressure at 250 psi (1700 kPa) ±5 percent.

16.13.2.3.4.3 The capacity, discharge pressure, intake pressure, and engine speed shall be recorded at least every 10 minutes but not less than three times for each test sequence.

16.13.2.3.4.4 The average net pump pressure shall be calculated and recorded based on the average values for discharge and intake pressure.

16.13.3 Pumping Engine Overload Test. If the pump has a rated capacity of 750 gpm (3000 L/min) or greater, the apparatus shall be subjected to an overload test consisting of pumping rated capacity at 165 psi (1100 kPa) net pump pressure for at least 10 minutes.

16.13.3.1 This test shall be performed immediately following the pumping test of rated capacity at 150 psi (1000 kPa).

16.13.3.2 The capacity, discharge pressure, intake pressure, and engine speed shall be recorded at least three times during the overload test.

16.13.4 Pressure Control System Test. The pressure control system on the pump shall be tested as follows:

(1) The pump shall be operated at draft, delivering rated capacity at a discharge gauge pressure of 150 psi (1000 kPa).
(2) The pressure control system shall be set in accordance with the manufacturer’s instructions to maintain the discharge gauge pressure at 150 psi (1000 kPa) ±5 percent.
(3) All discharge valves shall be closed no more rapidly than in 3 seconds’ time and no more slowly than in 10 seconds’ time.
(4) The rise in discharge pressure shall not exceed 30 psi (200 kPa) and shall be recorded.
(5) The original conditions of pumping rated capacity at a discharge gauge pressure of 150 psi (1000 kPa) shall be reestablished.
(6) The pressure discharge gauge shall be reduced to 90 psi (620 kPa) by throttling the engine fuel supply, with no change to the discharge valve settings, hose, or nozzles.
(7) The pressure control system shall be set according to the manufacturer’s instructions to maintain the discharge gauge pressure at 90 psi (620 kPa) ±5 percent.
(8) All discharge valves shall be closed no more rapidly than in 3 seconds’ time and no more slowly than in 10 seconds’ time.
(9) The rise in discharge pressure shall not exceed 30 psi (200 kPa) and shall be recorded.
(10) The pump shall be operated at draft, pumping 50 percent of rated capacity at a discharge gauge pressure of 250 psi (1700 kPa).
(11) The pressure control system shall be set in accordance with the manufacturer’s instructions to maintain the discharge gauge pressure at 250 psi (1700 kPa) ±5 percent.
(12) All discharge valves shall be closed no more rapidly than in 3 seconds’ time and no more slowly than in 10 seconds’ time.
(13) The rise in discharge pressure shall not exceed 30 psi (200 kPa) and shall be recorded.

16.13.5.2 This test shall be performed in connection with priming the pump for the pumping test.

16.13.5.2 The interval from the time the primer is started until the time the pump is discharging water shall be noted.

16.13.5.3 The time required to prime the pump shall not exceed 30 seconds if the rated capacity is 1250 gpm (5000 L/min) or less.

16.13.5.4 The time required to prime the pump shall not exceed 45 seconds if the rated capacity is 1500 gpm (6000 L/min) or more.

16.13.5.5 An additional 15 seconds shall be permitted in order to meet the requirements of 16.13.5.3 and 16.13.5.4 when the pump system includes an auxiliary 4-in. (100-mm) or larger intake pipe having a volume of 1 ft³ (0.3 m³) or more.
17.2.2 The performance of a high-pressure auxiliary pump shall be a minimum of 66 gpm (250 L/min) at 600 psi (4000 kPa) discharge pressure for each high-pressure hose reel connected to it that can be operated simultaneously.

17.2.3 Medium Pressure Auxiliary Pumps.

17.2.3.1 The pump shall have one of the following rated capacities: 30 gpm (115 L/min), 60 gpm (230 L/min), 90 gpm (345 L/min), 120 gpm (460 L/min), 250 gpm (1000 L/min), or 350 gpm (1300 L/min).

17.2.3.2 The pump shall be capable of pumping 100 percent of its rated capacity at 150 psi (1000 kPa) discharge pressure, 70 percent of its rated capacity at 200 psi (1400 kPa) discharge pressure, and 50 percent of its rated capacity at 250 psi (1700 kPa) discharge pressure.

17.2.4 The rating for auxiliary pumps shall be based on the pump taking water from the apparatus water tank.

17.3 Power Train Capability.

17.3.1* All components in the power train from the engine to the pump shall be capable of transmitting the continuous duty power required by the pump for at least 50 minutes at the pump's rated capacity and pressure.

17.3.2* When pumping rated capacity and pressure, lubricant temperatures in any power train component shall not exceed the component manufacturer's recommendation for maximum temperature.

17.4 Construction Requirements. The pump, piping, and valves shall be capable of withstanding a minimum hydrostatic burst pressure of 100 psi (700 kPa) above the maximum system operating pressure.

17.5 Pump Intake Connections.

17.5.1* Each pump intake connection shall be sized to permit the full rated performance of the pump and shall be equipped with a valve that can be controlled from the pump operator's position.

17.5.2 Each external intake shall be equipped with National Hose threads, a removable or accessible strainer, and a bleeder valve to bleed off air or water from a hose connected to the intake.

17.5.2.1 Adapter couplings with special threads or other means for hose attachment shall be permitted to be furnished on any or all intakes.

17.5.2.2 All intakes shall be provided with closures capable of withstanding a hydrostatic burst gauge pressure of 500 psi (3400 kPa).

17.5.2.2.1 Intakes having male threads shall be equipped with caps; intakes having female threads shall be equipped with plugs.

17.5.2.2.2 Where adapters for special threads or other means for hose attachment are provided on the intakes, closures shall be provided for the adapters in lieu of caps or plugs.

17.5.2.3 Caps or closures for 3/4", (90-mm) and smaller intakes shall be removable from the intakes, but remain secured to the apparatus.

17.6 Pump Discharge Connections.

17.6.1 Each pump discharge shall be equipped with a valve that can be controlled from the pump operator's position.

17.6.2 Any discharge outlets that are fed by lines from both the auxiliary pump and the main pump shall have check valves in both supply lines.

17.6.3 Discharge Outlet Connections.

17.6.3.1* All discharge outlets shall be equipped with male National Hose threads.

17.6.3.2 Adapter couplings with special threads or other means for hose attachment shall be permitted to be furnished on any or all outlets.

17.6.4 All discharge outlets, except outlets to which a hose will be preconnected, shall be equipped with caps or closures capable of withstanding a minimum hydrostatic burst gauge pressure of 100 psi (700 kPa) over the maximum pump close-off pressure or 500 psi (3400 kPa), whichever is greater.

17.6.4.1 Where adapters are provided on the discharge outlet, the closures shall fit on the adapters.

17.6.4.2 Caps or closures for outlets 3/4", (90-mm) and smaller in size shall be removable from the outlet but remain secured to the apparatus.

17.6.5 If a water tank fill line is provided, the line shall be connected to the pump discharge manifold directly to the water tank and shall include a valve that can be controlled from the pump operator's position.

17.7 Pump Operator's Panel.

17.7.1 Each pump control, gauge, and other instrument necessary to operate the auxiliary pump shall be located on a panel and shall be marked with a label as to its function.

17.7.2 All gauges, instruments, discharge outlets, pump intakes, and controls located on the auxiliary pump operator's panel shall be illuminated to a minimum lighting level of 0.5 footcandles (5.4 lx).

17.8 Pump Controls.

17.8.1 Provisions shall be made for placing the pump in operation.

17.8.2 The control for the pump engagement mechanism shall be marked with a label to indicate when the pump is properly engaged in pumping position.

17.8.3 Parallel/ Series Control.

17.8.3.1 With parallel/series centrifugal pumps, the positions for parallel operation (volume) and series operation (pressure) shall be indicated.

17.8.3.2 The control for changing the pump from series to parallel, and vice versa, shall be located on the pump operator's panel.

17.8.4 If more than one discharge outlet is provided, a relief valve or other pressure control device shall be provided that is capable of limiting the pump discharge pressure.

17.8.5 All pump controls and devices shall be installed so as to be protected against mechanical damage or the effects of adverse weather conditions on their operation.

17.8.6 Drain Valve(s).

17.8.6.1 A readily accessible drain valve(s) that is marked with a label as to its function shall be provided to allow the pump and all water-carrying lines and accessories to be drained.

17.8.6.2 The drain valve(s) shall be operational without the operator having to get under the apparatus.

17.8.7 A bypass line of not less than 1/2", in. (6.3 mm) diameter, which has a valve that can be controlled from the pump operator's position or an automatic-type control, shall be installed from the discharge manifold directly to the water tank or ground.

17.9 Pump Drive Systems.

17.9.1 Where the pump is driven by a transmission-mounted (SAE) PTO, front-of-engine crankshaft PTO, or flywheel PTO, the provisions of 16.10.4 through 16.10.7 shall be applied as applicable.

17.9.2 Where the pump is driven by a chassis transmission-mounted (SAE) PTO and the pump system does not conform to 16.4.2, a visible or audible warning device shall be provided on the pump operator’s panel that is actuated if the temperature of the lubricant in the chassis transmission exceeds the transmission manufacturer's recommended maximum temperature.

17.9.3 Indicator Light.

17.9.3.1 Where a separate engine is used to drive the auxiliary pump, an amber indicator light shall be provided in the driving compartment that is energized when the pump engine is running.

17.9.3.2 This light shall be marked with a label that reads “Pump Engine Running.”

17.9.4* If a separate pumping engine is provided, it shall meet the requirements of 12.2.1.1, 12.2.1.2, 12.2.2, 12.2.3.1, 12.2.3.2, 12.2.4, 12.2.5, and Sections 13.4 and 13.5.

17.10 Engine Controls.

17.10.1 A throttle control that holds its set position shall be provided to control the engine speed. It shall be located so that it can be manipulated from the pump operator’s position with all instrumentation in full view.

17.10.2 This throttle control shall be permitted to be the same throttle control that is used for the main fire pump.

17.11 Gauges and Instruments.

17.11.1 Master Pump Discharge Pressure Indicating Device. A master discharge pressure indicating device shall be provided.

17.11.1.1 It shall read from a gauge pressure of 0 to at least 300 psi (2000 kPa) but not less than 100 psi (700 kPa) higher than the maximum pressure that can be developed by the pump when it is operating with zero intake pressure.

17.11.1.2 Where an analog pressure gauge is used, it shall have a minimum accuracy of Grade 1A as defined in ASME B40.100, Pressure Gauges and Gauge Attachments.
17.11.1.2.1 Numerals for master gauges shall be a minimum 0.25 in. (6.4 mm) high.

17.11.1.2.2 There shall be graduation lines showing at least every 10 psi (70 kPa), with major and intermediate graduation lines emphasized and figures at least every 100 psi (700 kPa).

17.11.1.2.3 Analog pressure gauges shall be vibration and pressure pulsation dampened, be resistant to corrosion, condensation, and shock, and have internal mechanisms that are factory lubricated for the life of the gauge.

17.11.1.3 If a digital pressure indicating device is used, the digits shall be at least 0.25 in. (6.4 mm) high.

17.11.1.3.1 Digital pressure indicating devices shall display pressure in increments of not more than 10 psi (70 kPa).

17.11.1.3.2 Digital master pressure indicating devices shall have an accuracy of ±3 percent over the full scale.

17.11.2 Discharge Outlet Instrumentation. If the apparatus is equipped with 1 1/2-in. (38-mm) or larger discharge outlets that can only be supplied by the auxiliary pump, these discharge outlets shall be equipped with pressure indicating devices or flowmeters.

17.11.2.1 The pressure indicating device or flowmeter display shall be located adjacent to the corresponding valve control with no more than 6 in. (150 mm) separating the pressure indicating device or flowmeter bezel and the valve control centerline.

17.11.2.2 Pressure indicating devices shall be connected to the outlet side of the valve.

17.11.2.3 Flowmeters shall display flow in not greater than 10 gpm (38 L/min).

17.11.2.4 Where an analog pressure gauge is used, the gauge shall have a minimum accuracy of Grade B as defined in ASME B40.100, Pressure Gauges and Gauge Attachments.

17.11.2.4.1 Numerals for gauges shall be a minimum 1/8 in. (4 mm) high.

17.11.2.4.2 There shall be graduation lines showing at least every 10 psi (70 kPa), with major and intermediate graduation lines emphasized and figures at least every 100 psi (700 kPa).

17.11.2.4.3 Analog pressure gauges shall be vibration and pressure pulsation dampened, be resistant to corrosion, condensation, and shock, and have internal mechanisms that are factory lubricated for the life of the gauge.

17.11.2.5 If a digital pressure indicating device is used, the digits shall be at least 0.25 in. (6.4 mm) high.

17.11.2.5.1 Digital pressure indicating devices shall display pressure in increments of not more than 10 psi (70 kPa).

17.11.2.5.2 Digital pressure indicating devices shall have an accuracy of ±3 percent over the full scale.

17.11.3 Protection of Gauges and Instruments. Each pressure indicating device or flowmeter, and its respective display, shall be mounted and attached so it is protected from accidental damage and excessive vibration.

17.12 Testing. The pump, piping, valves, and caps or plugs shall be hydrostatically tested to 100 psi (700 kPa) above the maximum system operating pressure, and the apparatus manufacturer shall certify the test results in writing.

Chapter 18 Industrial Supply Pump and Associated Equipment

18.1 Application. If the apparatus is equipped with a industrial supply pump, the provisions of this chapter shall apply.

18.2 Design and Performance Requirements.

18.2.1 Rated Capacity.

18.2.1.1 The industrial supply pump shall be mounted on the apparatus and shall have a minimum rated capacity of 3000 gpm (12000 L/min) at 100 psi (700 kPa) net pump pressure.

18.2.1.2 Pumps of higher capacity shall be rated at one of the capacities specified in Table 18.2.4.1(a).

18.2.2 A label on the pump panel shall state “This apparatus is equipped with an industrial supply pump that has a different performance envelope than a fire pump.”

18.2.3* Pumping System Capability.

18.2.3.1 The pumping system provided shall be capable of delivering the following:

(1) 100 percent of rated capacity at 100 psi (700 kPa) net pump pressure

(2) 70 percent of rated capacity at 150 psi (1000 kPa) net pump pressure

(3) 50 percent of rated capacity at 200 psi (1400 kPa) net pump pressure

18.2.3.2 Priming Capability.

18.2.3.2.1 When dry, the pump system shall be capable of taking suction through 20 ft (6 m) of suction hose under the conditions specified in Table 18.2.4.1(a) for the rated capacity of the pump, and discharging water in not more than 45 seconds.

18.2.3.2.2 An additional 15 seconds shall be permitted to meet these requirements where the pump system includes an auxiliary 4-in. (100-mm) or larger intake pipe having a volume of 1 ft³ (0.3 m³) or more.

18.2.3.3 Vacuum.

18.2.3.3.1 The completed pumping system shall be capable of developing a vacuum of 22 in. Hg (75 kPa) at altitudes up to 2000 ft (600 m) by means of the pump priming device and sustaining the vacuum for at least 5 minutes with a loss not to exceed 10 in. Hg (34 kPa).

18.2.3.3.2 The requirement in 18.2.3.3.1 shall be met with all intake valves open, all intakes capped or plugged, all discharge caps removed, and without the use of the pump primer during the 5-minute period.

18.2.4 Pump Suction Capability.

18.2.4.1* The pump manufacturer shall certify that the industrial supply pump is capable of pumping 100 percent of rated capacity at 100 psi (700 kPa) net pump pressure from draft through 20 ft (6 m) of suction hose with a strainer attached under the following conditions:

(1) An altitude of 2000 ft (600 m) above sea level

(2) Atmospheric pressure of 29.9 in. Hg (101 kPa) (corrected to sea level)

(3) Water temperature of 60°F (15.6°C)

(4) Suction hose size, number of hose, and lift as indicated in Table 18.2.4.1(a)

(5) Friction and entrance loss in suction hose, including strainer, as given in Table 18.2.4.1(b) or Table 18.2.4.1(c)

Table 18.2.4.1(a) Suction Hose Size, Number of Suction Lines, and Lift for Industrial Supply Pumps

<table>
<thead>
<tr>
<th>gpm</th>
<th>L/min</th>
<th>Maximum Suction Hose Size</th>
<th>Maximum Number of Suction Lines</th>
<th>Maximum Lift</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,000</td>
<td>12,000</td>
<td>8</td>
<td>200</td>
<td>4</td>
</tr>
<tr>
<td>3,500</td>
<td>14,000</td>
<td>8</td>
<td>200</td>
<td>4</td>
</tr>
<tr>
<td>4,000</td>
<td>16,000</td>
<td>8</td>
<td>200</td>
<td>4</td>
</tr>
<tr>
<td>4,500</td>
<td>18,000</td>
<td>8</td>
<td>200</td>
<td>4</td>
</tr>
<tr>
<td>5,000</td>
<td>20,000</td>
<td>8</td>
<td>200</td>
<td>4</td>
</tr>
</tbody>
</table>
### Table 18.2.4.1(b) Friction and Entrance Loss in 20 ft of Suction Hose, Including Strainer (inch-pound units)

<table>
<thead>
<tr>
<th>Flow Rate (gpm)</th>
<th>Suction Hose Size (inside diameter)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Two 6 in.</td>
</tr>
<tr>
<td></td>
<td>ft. water*</td>
</tr>
<tr>
<td>3000</td>
<td>7.6 (1.4)</td>
</tr>
<tr>
<td>2100</td>
<td>3.7 (0.7)</td>
</tr>
<tr>
<td>1500</td>
<td>1.9 (0.4)</td>
</tr>
<tr>
<td>3500</td>
<td></td>
</tr>
<tr>
<td>2450</td>
<td></td>
</tr>
<tr>
<td>1750</td>
<td></td>
</tr>
<tr>
<td>4000</td>
<td>4.8 (0.9)</td>
</tr>
<tr>
<td>2800</td>
<td>2.8 (0.5)</td>
</tr>
<tr>
<td>2000</td>
<td>1.4 (0.3)</td>
</tr>
<tr>
<td>4500</td>
<td>7.6 (1.4)</td>
</tr>
<tr>
<td>3150</td>
<td>3.7 (0.7)</td>
</tr>
<tr>
<td>2250</td>
<td>1.9 (0.4)</td>
</tr>
<tr>
<td>5000</td>
<td>7.6 (1.4)</td>
</tr>
<tr>
<td>3500</td>
<td>3.8 (0.7)</td>
</tr>
<tr>
<td>2500</td>
<td>2.4 (0.4)</td>
</tr>
</tbody>
</table>

*Figures in parentheses indicate increment to be added or subtracted for each 10 ft of hose greater than or less than 20 ft.

### Table 18.2.4.1(b) continued

<table>
<thead>
<tr>
<th>Flow Rate Gpm</th>
<th>Suction Hose Size (inside diameter)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>One 8-in</td>
</tr>
<tr>
<td></td>
<td>ft. water*</td>
</tr>
<tr>
<td>3000</td>
<td>10.1 (3.0)</td>
</tr>
<tr>
<td>2100</td>
<td>4.7 (1.3)</td>
</tr>
<tr>
<td>1500</td>
<td>2.3 (0.7)</td>
</tr>
<tr>
<td>3500</td>
<td>3.2 (0.8)</td>
</tr>
<tr>
<td>2450</td>
<td>1.5 (0.4)</td>
</tr>
<tr>
<td>1750</td>
<td>0.7 (0.2)</td>
</tr>
<tr>
<td>4000</td>
<td>4.3 (1.1)</td>
</tr>
<tr>
<td>2800</td>
<td>2.0 (0.6)</td>
</tr>
<tr>
<td>2000</td>
<td>1.0 (0.3)</td>
</tr>
<tr>
<td>4500</td>
<td>5.6 (1.4)</td>
</tr>
<tr>
<td>3150</td>
<td>2.5 (0.9)</td>
</tr>
<tr>
<td>2250</td>
<td>1.2 (0.4)</td>
</tr>
<tr>
<td>5000</td>
<td>7.0 (1.7)</td>
</tr>
<tr>
<td>3500</td>
<td>3.2 (1.0)</td>
</tr>
<tr>
<td>2500</td>
<td>1.5 (0.4)</td>
</tr>
</tbody>
</table>
Table 18.2.4.1(c) Friction and Entrance Loss in 6 m of Suction Hose, Including Strainer (metric units)

<table>
<thead>
<tr>
<th>Flow Rate (L/min)</th>
<th>Suction Hose Size (inside diameter)</th>
<th>Two 150 mm</th>
<th>Three 150 mm</th>
<th>Four 150 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>m of water*</td>
<td>kPa</td>
<td>m of water*</td>
<td>kPa</td>
</tr>
<tr>
<td>12,000</td>
<td>2.3 (0.4)</td>
<td>23</td>
<td>1.0 (0.2)</td>
<td>10</td>
</tr>
<tr>
<td>8,400</td>
<td>1.1 (0.2)</td>
<td>12</td>
<td>0.5 (0.1)</td>
<td>5</td>
</tr>
<tr>
<td>6,000</td>
<td>0.6 (0.1)</td>
<td>6</td>
<td>0.3 (0.1)</td>
<td>3</td>
</tr>
<tr>
<td>14,000</td>
<td></td>
<td>0.8 (0.2)</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>9,800</td>
<td></td>
<td>0.4 (0.1)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>7,000</td>
<td></td>
<td>0.2 (0.1)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>16,000</td>
<td>1.5 (0.3)</td>
<td>15</td>
<td>1.0 (0.2)</td>
<td>10</td>
</tr>
<tr>
<td>11,200</td>
<td>0.9 (0.2)</td>
<td>8</td>
<td>0.5 (0.1)</td>
<td>5</td>
</tr>
<tr>
<td>8,000</td>
<td>0.4 (0.1)</td>
<td>4</td>
<td>0.3 (0.1)</td>
<td>3</td>
</tr>
<tr>
<td>18,000</td>
<td>2.3 (0.4)</td>
<td>23</td>
<td>1.3 (0.2)</td>
<td>13</td>
</tr>
<tr>
<td>12,600</td>
<td>1.1 (0.2)</td>
<td>11</td>
<td>0.7 (0.1)</td>
<td>6</td>
</tr>
<tr>
<td>9,000</td>
<td>0.6 (0.1)</td>
<td>6</td>
<td>0.3 (0.1)</td>
<td>3</td>
</tr>
<tr>
<td>20,000</td>
<td>2.3 (0.4)</td>
<td>23</td>
<td>1.4 (0.3)</td>
<td>14</td>
</tr>
<tr>
<td>14,000</td>
<td>1.2 (0.2)</td>
<td>12</td>
<td>0.7 (0.2)</td>
<td>7</td>
</tr>
<tr>
<td>10,000</td>
<td>0.7 (0.1)</td>
<td>7</td>
<td>0.4 (0.1)</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 18.2.4.1(c) continued

<table>
<thead>
<tr>
<th>Flow Rate (L/min)</th>
<th>Suction Hose Size (inside diameter)</th>
<th>One 200 mm</th>
<th>Two 200 mm</th>
<th>Three 200 mm</th>
<th>Four 200 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>m of water*</td>
<td>kPa</td>
<td>m of water*</td>
<td>kPa</td>
<td>m of water*</td>
</tr>
<tr>
<td>12,000</td>
<td>3.1 (0.9)</td>
<td>31</td>
<td>0.7 (0.2)</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>8,400</td>
<td>1.4 (0.4)</td>
<td>14</td>
<td>0.3 (0.1)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>6,000</td>
<td>0.7 (0.2)</td>
<td>7</td>
<td>0.2 (0.1)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>14,000</td>
<td>1.0 (0.2)</td>
<td>9</td>
<td>0.4 (0.1)</td>
<td>4</td>
<td>0.2 (0.1)</td>
</tr>
<tr>
<td>9,800</td>
<td>0.5 (0.1)</td>
<td>4</td>
<td>0.2 (0.1)</td>
<td>2</td>
<td>0.1 (0.1)</td>
</tr>
<tr>
<td>7,000</td>
<td>0.2 (0.1)</td>
<td>2</td>
<td>0.1 (0.1)</td>
<td>1</td>
<td>0.1 (0.1)</td>
</tr>
<tr>
<td>16,000</td>
<td>1.3 (0.3)</td>
<td>13</td>
<td>0.6 (0.2)</td>
<td>6</td>
<td>0.3 (0.1)</td>
</tr>
<tr>
<td>11,200</td>
<td>0.6 (0.2)</td>
<td>6</td>
<td>0.3 (0.1)</td>
<td>3</td>
<td>0.2 (0.1)</td>
</tr>
<tr>
<td>8,000</td>
<td>0.3 (0.1)</td>
<td>3</td>
<td>0.1 (0.1)</td>
<td>1</td>
<td>0.1 (0.1)</td>
</tr>
<tr>
<td>18,000</td>
<td>1.7 (0.4)</td>
<td>17</td>
<td>0.8 (0.2)</td>
<td>8</td>
<td>0.4 (0.1)</td>
</tr>
<tr>
<td>12,600</td>
<td>0.8 (0.3)</td>
<td>7</td>
<td>0.3 (0.1)</td>
<td>3</td>
<td>0.2 (0.1)</td>
</tr>
<tr>
<td>9,000</td>
<td>0.4 (0.1)</td>
<td>4</td>
<td>0.2 (0.1)</td>
<td>1</td>
<td>0.1 (0.1)</td>
</tr>
<tr>
<td>20,000</td>
<td>2.1 (0.5)</td>
<td>21</td>
<td>0.9 (0.2)</td>
<td>10</td>
<td>0.5 (0.1)</td>
</tr>
<tr>
<td>14,000</td>
<td>1.0 (0.3)</td>
<td>9</td>
<td>0.5 (0.2)</td>
<td>4</td>
<td>0.2 (0.1)</td>
</tr>
<tr>
<td>10,000</td>
<td>0.5 (0.1)</td>
<td>4</td>
<td>0.2 (0.1)</td>
<td>2</td>
<td>0.1 (0.1)</td>
</tr>
</tbody>
</table>

* Figures in parentheses indicate increments to be added or subtracted for each 3 m of hose less than or greater than 6 m.
18.2.4.2* The pump manufacturer shall certify that the pump is capable of pumping rated capacity at 100 psi (700 kPa) net pump pressure at any of the following special conditions when these conditions are specified by the purchaser:

(1) At an elevation above 2000 ft (600 m)

(2) At lifts higher than those listed in Table 18.2.4.1(a) or through more than 20 ft (6 m) of suction hose, or both

18.3 Pumping Engine Requirements.

18.3.1 The apparatus manufacturer shall approve the use of the pumping engine for stationary pumping applications based on the size of the fire apparatus and the rating of the pump being furnished.

18.3.2 Engine Speed.

18.3.2.1 The engine shall be capable of performing the pumping tests herein specified without exceeding the maximum governed speed of the engine as shown on a certified brake horsepower curve of the type of engine used without accessories.

18.3.2.2 The brake horsepower curve certification shall be signed by a responsible official of the engine manufacturer.

18.3.3* If a separate pumping engine is provided, it shall meet the requirements of 12.2.1.1, 12.2.1.2, 12.2.1.6, 12.2.2, 12.2.3.1, 12.2.3.2, 12.2.4, 12.2.5, and Sections 13.4 and 13.5.

18.3.4 A supplementary heat exchanger cooling system shall be provided for the pump drive engine.

18.3.4.1 Valving shall be installed to permit water from the discharge side of the pump to cool the coolant circulating through the engine cooling system without intermixing.

18.3.4.2 The heat exchanger shall maintain the temperature of the coolant in the pump drive engine not in excess of the engine manufacturer’s temperature rating under all pumping conditions.

18.3.4.3 A drain(s) shall be provided to allow draining of the heat exchanger so as to prevent damage from freezing.

18.3.5 Indicator or Light.

18.3.5.1 Where a separate engine is used to drive the pump, an indicator or light that is energized when the pump engine is running shall be provided in the driving compartment.

18.3.5.2 The indicator or light shall be marked with a label that reads “Pump Engine Running.”

18.4 Power Train Capability.

18.4.1 Indicator or Light. All components in the power train from the engine to the fire pump shall be capable of transmitting the torque necessary to power the pump, as installed in the apparatus; for the pump performance points specified in 18.2.3.1 without exceeding the component manufacturer’s continuous duty torque rating.

18.4.2 When pumping continuously at each of the pump performance points specified in 18.2.3.1, lubricant temperatures in any power train component installed in the apparatus from the engine to the pump shall not exceed the component manufacturer’s recommendation for maximum temperature.

18.4.3* When the engine and pumping system, under any pumping condition, have the capability to exceed the component manufacturer’s continuous duty torque rating, a means shall be provided to control the engine output to a level equal to or below the component manufacturer’s continuous duty torque rating.

18.5 Construction Requirements.

18.5.1* Wetted moving parts shall be constructed of a corrosion-resistant material.

18.5.2 Hydrostatic Test.

18.5.2.1 The pump body shall be subjected to a hydrostatic test to a gauge pressure of 500 psi (3400 kPa) minimum for 10 minutes.

18.5.2.2 The pump manufacturer shall provide a certificate of completion for the hydrostatic test.

18.5.3 Where an auxiliary pump is provided in combination with an industrial supply pump and where the pumps are interconnected so that pressure from one pump can be transmitted to the other pump, check valves, intake or discharge relief valves, pump drive gear ratios, or other automatic means shall be provided to avoid pressurizing either pump beyond its maximum rated hydrostatic pressure.

18.5.4 The entire discharge and intake piping system, valves, drain cocks and lines, and intake and outlet closures, excluding the tank fill and tank to pump lines on the tank side of the valves in those lines, shall be capable of withstanding a minimum hydrostatic burst gauge pressure of 500 psi (3400 kPa).

18.5.5 Pulsation – Free Fire Streams.

18.5.5.1 The pump shall be capable of producing fire streams that are free from pulsations.

18.5.5.2 When an accumulator is used to provide a pulsation-free fire streams, the accumulator shall be constructed and tested in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 2.

18.5.6 The pump shall allow a positive pressure water source to directly add to the pump’s net pump pressure.

18.6 Pump Intake Connections.

18.6.1* Intake(s) of the same or larger size and quantity than the maximums specified in Table 18.2.4.1(a) for suction hose size and number of suction lines shall be provided.

18.6.1.1 The intakes specified in 18.6.1 shall have male National Hose threads if the apparatus is to be used in the United States of America.

18.6.1.2 If the couplings on the suction hose carried on the apparatus are of a different size than the pump intake(s) or have means of hose attachment other than that provided on the intake(s), an adapter(s) shall be provided to allow connection of the suction hose to the pump intake(s).

18.6.1.3* A plate shall be provided on the pump operators panel that states the following:

“Warning: Death or serious injury might occur if proper operating procedures are not followed. The pump operator, as well as individuals connecting supply or discharge hoses to the apparatus, must be familiar with the operator’s manual, water hydraulics hazards, and component limitations.”

18.6.2* Intake Strainer.

18.6.2.1 Each intake shall have a removable or accessible strainer inside the connection.

18.6.2.2* The strainer(s) shall restrict spherical debris that is too large to pass through the pump.

18.6.3 At least one valved intake shall be provided that can be controlled from the pump operator’s position.

18.6.3.1 The valve and piping shall be a minimum 2 1/2 in. (65 mm) nominal size.

18.6.3.2 If the intake is 2 1/2 in. (65 mm) nominal size, the intake shall be equipped with a female swivel coupling with National Hose threads.

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

18.6.5* Each valved intake shall be equipped with a bleeder valve having a minimum 1/2-in. (19-mm) pipe thread connection to bleed off air or water.

18.6.5.1 The bleeder valve shall be operational without the operator having to get under the apparatus.

18.6.5.2 If a valved appliance is attached to an intake, it shall be equipped with a 1/2-in. (19-mm) bleeder valve on each intake.

18.6.6 Each valved intake having a connection size of 3 1/2 in. (90 mm) or larger shall be equipped with an adjustable automatic pressure relief device installed on the supply side of the valve to bleed off pressure from a hose connected to the valve intake.

18.6.6.1 The automatic pressure relief device shall be adjustable from a minimum of 90 psi (620 kPa) to at least 185 psi (1275 kPa).

18.6.6.2 The pressure relief device, when preset at 125 psi (860 kPa), shall not allow a pressure rise greater than 60 psi (400 kPa) at the device inlet while flowing a minimum of 150 gpm (570 L/min).

18.6.6.3 The pressure relief device shall discharge to atmosphere and be piping or directed away from the pump operator’s position.

18.6.7 If the pump is equipped with one or more intakes larger than 3 1/2 in. (89 mm) that are not valved, an adjustable automatic pressure relief device shall be installed on the pump system to bleed off excess pressure from a hose connected to the pump intake.

18.6.7.1 The automatic pressure relief device shall be adjustable from a minimum of 90 psi (620 kPa) to at least 185 psi (1275 kPa).

18.6.7.2 The pressure relief device, when preset at 125 psi (860 kPa), shall not allow a pressure rise greater than 60 psi (400 kPa) at the device inlet flowing a minimum of 150 gpm (570 L/min).
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18.6.7.3 The pressure relief device shall discharge to atmosphere.

18.6.8 All intakes shall be provided with caps or closures capable of withstanding a hydrostatic burst gauge pressure of 500 psi (3400 kPa).

18.6.8.1 Intakes having male threads shall be equipped with caps; intakes having female threads shall be equipped with plugs.

18.6.8.2 Where adapters for special threads or other means for hose attachment are provided on the intakes, closures shall be provided for the adapters in lieu of caps or plugs.

18.6.9 Caps or closures for 3/4-in. (90-mm) and smaller intakes shall be removable from the intakes but remain secured to the apparatus.

18.6.10 If the suction intakes are to be equipped with a valve, siamese, or adapter that will remain in place while the apparatus is in motion, that valve, siamese, or adapter shall not project beyond the apparatus running board.

18.6.11 The purchaser shall specify if any valve, siamese, or adapter is to be permanently installed on an intake and identify the brand and model of such item.

18.7 Pump Discharge Outlets.

18.7.1* Discharge outlets of 2 1/2-in. (65 mm) or larger shall be provided to discharge the rated capacity of the pump at the flow rates shown in Table 18.7.1.

<table>
<thead>
<tr>
<th>Outlet Size</th>
<th>Flow Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>in.</td>
<td>mm</td>
</tr>
<tr>
<td>2 1/2</td>
<td>65</td>
</tr>
<tr>
<td>3</td>
<td>75</td>
</tr>
<tr>
<td>3 1/2</td>
<td>90</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>4 1/2</td>
<td>110</td>
</tr>
<tr>
<td>5</td>
<td>125</td>
</tr>
<tr>
<td>6</td>
<td>150</td>
</tr>
</tbody>
</table>

18.7.1.1 If the apparatus is equipped with an aerial device with a waterway that is permanently connected to the pump, the discharge from that waterway shall be permitted to be credited as a 1000-gpm (4000-L/min) outlet.

18.7.1.2 A minimum of two 2 1/2-in. (65-mm) outlets shall be provided.

18.7.2 Discharge Outlet Connections.

18.7.2.1 All 2 1/2-in. (65-mm) or larger discharge outlets shall be equipped with male National Hose threads.

18.7.2.2* Adapter couplings with special threads or other means for hose attachment shall be permitted to be furnished on any or all outlets.

18.7.3* The piping and valves supplying any preconnected 1 1/2-in. (38-mm), 1 3/4-in. (45-mm), or 2-in. (52-mm) hose line including the piping to the preconnected hose storage areas specified in Section 11.7(2) shall be at least 2 in. (52 mm) in size.

18.7.4 All discharge outlets, except outlets to which a hose will be preconnected, shall be equipped with caps or closures capable of withstanding a minimum hydrostatic burst gauge pressure of 100 psi (700 kPa) over the maximum pump close-off pressure or 500 psi (3400 kPa), whichever is greater.

18.7.4.1 Where adapters are provided on the discharge outlets, the closures shall fit on the adapters.

18.7.4.2 Caps or closures for outlets 3 1/2-in. (90-mm) and smaller in size shall be removable from the outlet but remain secured to the apparatus.

18.7.5 Each discharge outlet shall be equipped with a valve that can be opened and closed smoothly at the flows shown in Table 18.7.1 at pump discharge gauge pressures of 250 psi (1700 kPa).

18.7.5.1 The flow-regulating element of each valve shall not change its position under any condition of operation that involves discharge pressures to the maximum pressure of the pump; the means to prevent a change in position shall be incorporated in the operating mechanism and shall be permitted to be manually or automatically controlled.

18.7.5.2 Any 3-in. (75-mm) or larger discharge valve shall be a slow-operating valve.

18.7.6 All 1 1/2-in. (38-mm) or larger discharge outlets shall be equipped with a drain or bleeder valve having a minimum 1/4-in. (19-mm) pipe thread for draining or bleeding off pressure from a hose connected to the outlet.

18.7.7 Any 2-in. (52-mm) or larger discharge outlet that is located more than 42 in. (1067 mm) off the ground to which hose is to be connected and that is not in a hose storage area shall be supplied with a sweep elbow of at least 30 degrees downward.

18.7.8 Valves.

18.7.8.1 Each pump discharge shall have a valve that can be controlled from the pump operator’s position.

18.7.8.2 A secondary valve shall be permitted to be provided at a discharge outlet if required for special applications.

18.7.9* Location of Discharge Outlets.

18.7.9.1 No discharge outlet larger than 2 1/2-in. (65 mm) shall be located at the pump operator’s panel.

18.7.9.2 If the apparatus has a top console-type pump operator’s panel, vertical discharge outlets larger than 2 1/2-in. (65 mm) shall be permitted at the top midship position of apparatus where the outlets are used for directly connected deck guns or monitors and no fire hose is used for coupling the components.

18.7.10 Where the valve operating mechanism does not indicate the position of the valve, an indicator shall be provided to show when the valve is closed.

18.8 Pump Drains.

18.8.1 A readily accessible drain valve(s) that is marked with a label as to its function shall be provided to allow for draining of the pump and all water-carrying lines and accessories.

18.8.2 The drain valve(s) shall be operational without the operator having to get under the apparatus.

18.9 Pump Operator’s Panel.

18.9.1* Each pump control, gauge, and other instrument necessary to operate the pump shall be located on a panel known as the pump operator’s panel and shall be marked with a label as to its function.

18.9.2 All gauges, discharge outlets, pump intakes, and controls shall be illuminated to a minimum lighting level of 5 footcandles (50 lx).

18.10* Pump Controls.

18.10.1 General Provisions. Provisions shall be made for placing the pump drive system in operation using controls and switches that are identified and within convenient reach of the operator.

18.10.1.1 Where the pump is driven by the chassis engine and engine compression brakes or engine exhaust brakes are furnished, they shall be automatically disengaged for pumping operations.

18.10.1.1* Any control device used in the pumping system power train between the engine and the pump, except a manual pump shift override device if provided, shall be equipped with a means to prevent unintentional movement of the control device from its set position in the pumping mode.

18.10.1.3 A label indicating the chassis transmission shift selector position to be used for pumping shall be provided in the driving compartment and located so that it can be read from the driver’s position.

18.10.1.4 Where the pump is driven by the chassis engine and transmission through a split shaft PTO, the driving compartment speedometer shall register when the pump drive system is engaged.

18.10.1.5 Where chassis transmission retarders are furnished, they shall be automatically disengaged for pumping operations.

18.10.2 Stationary Pump Driven Through Split Shaft PTO — Automatic Chassis Transmission. Where the apparatus is equipped with an automatic chassis transmission, the water pump is driven by the chassis engine through the transmission’s main driveline, and the apparatus is to be used for stationary pumping only, an interlock system shall be provided to ensure that the pump drive system components are engaged in the pumping mode of operation so that the pumping system can be operated from the pump operator’s position.

18.10.2.1 A “Pump Engaged” indicator shall be provided in the driving compartment to indicate that the pump shift process has been successfully completed.

18.10.2.2 An “OK to Pump” indicator shall be provided in the driving compartment to indicate that the pump is engaged, the chassis transmission is in pump gear, and the parking brake is engaged.

18.10.2.3 A “Throttle Ready” indicator shall be provided at the pump operator’s panel that indicates that the apparatus is in “OK to Pump” mode or that the chassis transmission is in neutral and the parking brake is engaged.
18.10.3 Stationary Pump Driven Through Split Shaft PTO — Manual Chassis Transmission. Where the apparatus is equipped with a manual chassis transmission, the water pump is driven by the chassis engine through the transmission's main driveline, and the apparatus is to be used for stationary pumping only, an interlock system shall be provided to ensure that the pump drive system components are engaged in the pumping mode of operation so that the pumping system can be operated from the pump operator’s position.

18.10.3.1" A “Pump Engaged” indicator shall be provided in the driving compartment to indicate that the pump shift has been successfully completed.

18.10.3.2 An “OK to Pump” indicator shall be provided in the driving compartment to indicate that the pump is engaged and the parking brake is engaged.

18.10.3.3 A “Throttle Ready” indicator shall be provided at the pump operator’s panel that indicates that the apparatus is in “OK to Pump” mode or that the parking brake is engaged.

18.10.4 Stationary Pump Driven Through Transmission-Mounted PTO, Front-of-Engine Crank Shaft PTO, or Engine Flywheel PTO — Automatic Chassis Transmission. Where the apparatus is equipped with an automatic chassis transmission, the water pump is driven by a transmission-mounted (SAE) PTO, front-of-engine crankshaft PTO, or engine flywheel PTO, and the apparatus is to be used for stationary pumping only; the chassis transmission in neutral, an interlock system shall be provided to ensure that the pump drive system components are engaged in the pumping mode of operation so that the pumping system can be operated from the pump operator’s position.

18.10.4.1 A “Pump Engaged” indicator shall be provided both in the driving compartment and on the pump operator’s panel to indicate that the pump shift has been successfully completed.

18.10.4.2 An “OK to Pump” indicator shall be provided in the driving compartment to indicate that the pump is engaged, the chassis transmission is in neutral, and the parking brake is engaged.

18.10.4.3 A “Throttle Ready” indicator shall be provided at the pump operator’s panel that indicates that the apparatus is in “OK to Pump” mode or that the chassis transmission is in neutral and the parking brake is engaged.

18.10.5 Stationary Pump Driven Through Transmission-Mounted PTO, Front-of-Engine Crank Shaft PTO, or Engine Flywheel PTO — Manual Chassis Transmission. Where the apparatus is equipped with a manual chassis transmission, the water pump is driven by a transmission-mounted (SAE) PTO, front-of-engine crankshaft PTO, or engine flywheel PTO, and the apparatus is to be used for stationary pumping only with the chassis transmission in neutral, an interlock system shall be provided to ensure that the pump drive system components are engaged in the pumping mode of operation so that the pumping system can be operated from the pump operator’s position.

18.10.5.1 A “Pump Engaged” indicator shall be provided both in the driving compartment and on the pump operator’s panel to indicate that the pump shift has been successfully completed.

18.10.5.2 An “OK to Pump” indicator shall be provided in the driving compartment to indicate that the pump is engaged and the parking brake is engaged.

18.10.5.3 A “Throttle Ready” indicator shall be provided at the pump operator’s panel that indicates that the apparatus is in “OK to Pump” mode or that the parking brake is engaged.

18.10.6 Stationary and “Pump and Roll” Pump — Automatic Chassis Transmission. Where the water pump is driven by a transmission-mounted (SAE) PTO, front-of-engine crankshaft PTO, or engine flywheel PTO, the parking brake is released.

18.10.6.1 A “Pump Engaged” indicator shall be provided both in the driving compartment and at the pump operator’s panel to indicate that the pump shift has been successfully completed.

18.10.6.2.1 An “OK to Pump” indicator shall be provided in the driving compartment to indicate that the pump is engaged, the chassis transmission is in neutral, and the parking brake is engaged.

18.10.6.2.2 An “OK to Pump and Roll” indicator shall be provided in the driving compartment and shall be energized when the pump is engaged, the chassis transmission is in road gear, and the parking brake is released.

18.10.6.2.3 When the “OK to Pump and Roll” indicator is energized, the “OK to Pump” indicator shall not be energized.

18.10.6.3 A “Throttle Ready” indicator shall be provided at the pump operator’s panel that is energized when the “OK to Pump” indicator is energized or when the chassis transmission is in neutral and the parking brake is engaged.

18.10.6.4 An “OK to Pump and Roll” indicator shall be provided in the driving compartment to indicate that the pump is engaged and the parking brake is released.

18.10.7 Stationary and “Pump and Roll” Pumps — Manual Chassis Transmissions. Where the water pump is driven by a transmission-mounted (SAE) PTO, front-of-engine crankshaft PTO, or engine flywheel PTO, and the apparatus is designed to be used in both the stationary pumping mode and the “pump and roll” pumping mode with the chassis transmission in neutral for stationary pumping or in a road gear for pump and roll pumping, an interlock system shall be provided to ensure that the pump drive system components are properly engaged in the pumping mode of operation so that the apparatus can be operated in either stationary or pump and roll pumping mode.

18.10.7.1 A “Pump Engaged” indicator shall be provided both in the driving compartment and at the pump operator’s panel to indicate that the pump shift has been successfully completed.

18.10.7.2 An “OK to Pump” indicator shall be provided in the driving compartment to indicate that the pump is engaged and the parking brake is engaged.

18.10.7.3 An “OK to Pump and Roll” indicator shall be provided in the driving compartment and shall be energized when the pump is engaged and the parking brake is released.

18.10.7.4 When the “OK to Pump and Roll” indicator is energized, the “OK to Pump” indicator shall not be energized.

18.10.7.5 A “Throttle Ready” indicator shall be provided at the pump operator’s panel that is energized when the “OK to Pump” indicator is energized or when the parking brake is engaged.

18.10.8 Stationary Pumps Driven Through Transfer Case PTOs — Automatic Chassis Transmissions. Where the apparatus is equipped with an automatic chassis transmission, the water pump is driven by the chassis engine through the transmission’s main driveline and through a transfer case, and the apparatus is to be used for stationary pumping only, an interlock system shall be provided to ensure that the pump drive system components are engaged in the pumping mode of operation so that the pumping system can be operated from the pump operator’s position.

18.10.8.1 A “Pump Engaged” indicator shall be provided in the driving compartment to indicate that the pump shift has been successfully completed.

18.10.8.2 An “OK to Pump” indicator shall be provided in the driving compartment to indicate that the pump is engaged, the chassis transmission is in pump gear, the transfer case drive to the chassis wheels is in neutral, and the parking brake is engaged.

18.10.8.3 A “Throttle Ready” indicator shall be provided at the pump operator’s panel that indicates that the apparatus is in “OK to Pump” mode or that the chassis transmission is in neutral and the parking brake is engaged.

18.10.9 Stationary Pumps Driven Through Transfer Case PTOs — Manual Chassis Transmissions. Where the apparatus is equipped with a manual chassis transmission, the water pump is driven by the chassis engine through the transmission’s main driveline and through a transfer case, and the apparatus is to be used for stationary pumping only, an interlock system shall be provided to ensure that the pump drive system components are engaged in the pumping mode of operation so that the parking brake is engaged.

18.10.9.1 A “Pump Engaged” indicator shall be provided in the driving compartment to indicate that the pump shift has been successfully completed.

18.10.9.2 An “OK to Pump” indicator shall be provided in the driving compartment to indicate that the pump is engaged and the parking brake is engaged.

18.10.9.3 A “Throttle Ready” indicator shall be provided at the pump operator’s panel that indicates that the apparatus is in “OK to Pump” mode or that the chassis transmission is in neutral and the parking brake is engaged.

18.10.10 Pump Operator’s Panel Engine Speed Advancement — Automatic Chassis Transmission. An interlock system shall be provided to prevent advancement of the engine speed at the pump operator’s panel unless the chassis transmission is in neutral and the parking brake is engaged.

18.10.11 Pump Operator’s Panel Engine Speed Advancement — Manual Chassis Transmission. An interlock system shall be provided to prevent advancement of the engine speed at the pump operator’s panel unless the chassis transmission is in neutral and the parking brake is engaged.

18.10.10.1 A “Pump Engaged” indicator shall be provided in the driving compartment to indicate that the pump is engaged, the chassis transmission is in neutral, and the parking brake is released.

18.10.10.2 An “OK to Pump” indicator shall be provided in the driving compartment to indicate that the pump is engaged and the parking brake is engaged.

18.10.10.3 A “Throttle Ready” indicator shall be provided at the pump operator’s panel that indicates that the apparatus is in “OK to Pump” mode or that the chassis transmission is in neutral and the parking brake is engaged.

18.10.10.4 An “OK to Pump and Roll” indicator shall be provided in the driving compartment to indicate that the pump is engaged and the parking brake is released.
18.10.12 Parallel/Series Control.
18.10.12.1 With parallel/series centrifugal pumps, the control positions for parallel operation (volume) and series operation (pressure) shall be indicated.
18.10.14.2 The control for changing the pump from series to parallel, and vice versa, shall be operable at the pump operator’s position.
18.10.13* Pressure Control System.
18.10.14* Priming Device. A priming device shall be provided that, when set in accordance with the manufacturer’s instructions, will automatically control the discharge pressure to a maximum of 30 psi (20 kPa) pressure rise above the set pressure(s) when all discharge valves are closed no more rapidly than in 3 seconds, and no more slowly than in 10 seconds, during the following conditions:

(1) Over a range of pressures from 70 psi to 300 psi (500 kPa to 20 kPa) net pump pressure with intake gauge pressure between −10 psi and 185 psi (−70 kPa and 1300 kPa) and discharge gauge pressure between 90 psi and 300 psi (600 kPa and 2000 kPa)

(2) With initial engine and pump controls set to produce a range of flows from 150 gpm (550 L/min) to the rated capacity of the pump

18.10.13.2 If the pump is equipped with a relief valve system where the system does not control engine speed, the system shall be equipped with a means to indicate when the system is in control of the pressure.
18.10.13.2.1 If the pump is equipped with a governor system that controls engine speed, an indicator shall show when the system is turned on and whether it is controlling the engine speed or pump pressure.
18.10.13.2.2 Either system shall be controllable by one person at the pump operator position.
18.10.13.3 If the system discharges water to the atmosphere, the discharge shall be in a manner that will not expose personnel to high-pressure water streams.
18.10.14* Priming Device. A priming device shall be provided and controlled from the pump operator’s position.
18.10.14.1 The priming device shall be capable of meeting the requirements of 18.2.3.2 and 18.2.3.3.
18.10.14.2 The priming device shall be capable of operating with no lubricant or a biodegradable nontoxic lubricant.
18.10.15 Protection of Pump Controls. All pump controls and devices shall be installed so as to be protected against mechanical damage or the effects of adverse weather conditions on their operation.
18.11 Pump Engine Controls.
18.11.1* A throttle control that holds its set position shall be provided to control the pump engine speed.
18.11.2 The throttle control shall be located not higher than 72 in. (1800 mm) nor lower than 42 in. (1067 mm) from the operator’s standing position with all instruments in full view.
18.12 Instrumentation.
18.12.1 Pump Operators Panel.
18.12.1.1* The following controls and instruments shall be provided and installed as a group at the pump operator’s panel:

1. A master pump intake pressure indicating device
2. A master pump discharge pressure indicating device
3. A pumping engine tachometer
4. A pumping engine coolant temperature indicator
5. A pumping engine oil pressure indicator
6. A voltmeter
7. The pump pressure control(s)
8. The pumping engine throttle
9. The primer control
10. The water tank to pump valve control
11. The water tank fill valve control
12. The water tank level indicator

18.12.1.2 The instruments and controls required by 18.12.1 shall be placed so as to keep the pump operator as far as practicable from all discharge and intake connections and in a location where they are visible and operationally functional while the operator remains stationary.
18.12.1.3 Any instrumentation exposed to the elements shall be weatherproof.
18.12.1.4 The pumping engine oil pressure and engine-coolant temperature indicators shall be equipped with audible and visual warnings.
18.12.1.5 All engine operation indicators on the pump operator’s panel shall be in addition to those on the vehicle’s instrument panel.
18.12.2 Master Pump Intake and Discharge Pressure Indicating Devices.
18.12.2.1 Master pump intake and pump discharge pressure indicating devices shall be located within 8 in. (200 mm) of each other, edge to edge, with the intake pressure indicating device to the left of or below the pump discharge pressure indicating device.

18.12.2.2.1 The intake pressure indicating device shall read from 30 in. Hg (100 kPa) vacuum to at least a gauge pressure of 300 psi (2000 kPa).
18.12.2.2.2 The discharge pressure indicating device shall read from a gauge pressure of 0 psi or lower to a gauge pressure of at least 300 psi (2000 kPa).
18.12.2.2.3 Pressure indicating devices shall not be damaged by a 30 in. Hg (100 kPa) vacuum.
18.12.2.2.4 Pressure indicating devices shall be marked with labels that read “Pump Intake” for the intake pressure indicating device and “Pump Discharge” for the discharge pressure indicating device.
18.12.2.2.5 Where analog gauges are used, there shall be at least a 1-in. (25-mm) diameter differential in viewing area between the master gauges and the individual discharge gauges, with the master gauges being the larger.
18.12.2.2.5.1 The accuracy of gauges shall be a minimum of Grade 1A as defined in ASME B40.100, Pressure Gauges and Gauge Attachments.
18.12.2.2.5.2 Numerals for master gauges shall be a minimum of 0.25 in. (6.4 mm) high.
18.12.2.2.5.3 There shall be graduation lines showing at least every 10 psi (70 kPa), with major and intermediate graduation lines emphasized and figures at least every 100 psi (700 kPa).
18.12.2.2.5.4 Analog pressure gauges shall have vibration and pressure pulsation dampened, be resistant to corrosion, condensation, and shock, and have internal mechanisms that are factory lubricated for the life of the gauge.
18.12.2.2.5.5 Where digital gauges are used, they shall meet the requirements of 18.12.2.1.6.1 through 18.12.2.1.6.3.
18.12.2.2.6.1 The digits shall be at least 1/2 in. (12.7 mm) high.
18.12.2.2.6.2 Digital pressure indicating devices shall display pressure in increments of not more than 10 psi (70 kPa).
18.12.2.2.6.3 Digital master pressure indicating devices shall have an accuracy of ±3 percent over the full scale.
18.12.3 Discharge Outlet Instrumentation.
18.12.3.1 A flowmeter or a pressure indicating device shall be provided for each discharge outlet 1/8 in. (38 mm) or larger in size and shall be marked with a label to indicate the outlet to which it is connected.
18.12.3.2* Any discharge outlet 3/8 in. (90 mm) or larger that is equipped with a flowmeter shall also be provided with a pressure indicating device.
18.12.3.3 The pressure indicating device or flowmeter display shall be located adjacent to the controlling valve control with no more than 6 in. (150 mm) separating the pressure indicating device or flowmeter bezel and the valve control midpoint or centerline.
18.12.3.4 If both a flowmeter and pressure indicating device are provided for an individual discharge outlet, the pressure indicating device shall be located within 6 in. (150 mm) of the valve control midpoint or centerline, and the flowmeter display shall be adjacent to and within 2 in. (52 mm) of the pressure indicating device bezel.
18.12.3.5 Pressure indicating devices shall be connected to the outlet side of the valve.
18.12.3.6 Flowmeters shall display flow in increments no greater than 10 gpm (38 L/min).
18.12.3.7 Where analog pressure gauges are used, they shall have a minimum accuracy of Grade B as defined in ASME B40.100, Pressure Gauges and Gauge Attachments.
18.12.3.7.1 Numerals for gauges shall be a minimum 1/8 in. (4 mm) high.

18.12.3.7.2 There shall be graduation lines showing at least every 10 psi (70 kPa), with major and intermediate graduation lines emphasized and figures at least every 100 psi (700 kPa).

18.12.3.7.3 Analog pressure gauges shall be vibration and pressure pulsation dampened, be resistant to corrosion, condensation, and shock, and have internal mechanisms that are factory lubricated for the life of the gauge.

18.12.3.8 If a digital pressure indicating device is used, they shall meet the requirements of 18.12.3.7.1 through 18.12.3.7.3.

18.12.3.8.1 The digits shall be at least 0.25 in. (6.4 mm) high.

18.12.3.8.2 Digital pressure indicating devices shall display pressure in increments of not more than 10 psi (70 kPa).

18.12.3.8.3 Digital pressure indicating devices shall have an accuracy of ±3 percent over the full scale.

18.12.3.9 Each flowmeter shall be calibrated to an accuracy of ±5 percent when flowing the amount of water shown in Table 18.12.3.9 for the pipe size in which it is mounted.

<table>
<thead>
<tr>
<th>Pipe size</th>
<th>Flow</th>
<th>gpm</th>
<th>L/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25</td>
<td>40</td>
<td>150</td>
</tr>
<tr>
<td>1 1/2</td>
<td>38</td>
<td>90</td>
<td>340</td>
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<td>2</td>
<td>52</td>
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<td>250</td>
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</tr>
<tr>
<td>6</td>
<td>150</td>
<td>1440</td>
<td>5500</td>
</tr>
</tbody>
</table>

18.12.4 Each pressure indicating device or flowmeter, and its respective display, shall be mounted and attached so it is protected from accidental damage and excessive vibration.

18.12.5 Connections for test gauges shall be provided at the pump operator's panel.

18.12.5.1 One test gauge connection shall be connected to the intake side of the pump, and the other shall be connected to the discharge manifold of the pump.

18.12.5.2 The test gauge connections shall have a 0.25-in. (6.4-mm) standard pipe thread, shall be plugged, and shall be marked with a label.

18.13 Required Testing.

18.13.1 Pump Certification.

18.13.1.1 The pump shall be tested after the pump and all its associated piping and equipment have been installed on the apparatus.

18.13.1.1.1 The tests shall include at least the following tests (see 18.13.2), the pressure control system test (see 18.13.3), the priming device tests (see 18.13.4), and the vacuum test (see 18.13.5).

18.13.1.1.2 If the apparatus is equipped with a water tank, the water tank to pump flow test (see 18.13.6) shall be included.

18.13.1.1.3 The tests results shall be certified by an independent third-party certification organization.

18.13.1.2 Test Plates.

18.13.1.2.1 A test plate shall be provided at the pump operator's panel that gives 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 engine as stated by the engine manufacturer on a certified brake horse power curve.

18.13.1.2.2 The plate shall be completely stamped with all information at the factory and attached to the vehicle prior to shipping.

18.13.2 Pumping Test.

18.13.2.1 Conditions for Test.

18.13.2.1.1 The test site shall be adjacent to a supply of clear water at least 4 ft (1.2 m) deep, with the water level not more than 10 ft (3 m) below the center of the pump intake, and close enough to allow the suction strainer to be submerged at least 2 ft (0.6 m) below the surface of the water when connected to the pump by 20 ft (6 m) of suction hose.

18.13.2.1.2 Tests shall be performed when conditions are as follows:

1. Air temperature: 0°F to 110°F (~18°C to 43°C)
2. Water temperature: 35°F to 90°F (2°C to 32°C)
3. Barometric pressure: 29 in. Hg (98.2 kPa), minimum (corrected to sea level)

18.13.2.1.3 Engine-driven accessories shall not be functionally disconnected or otherwise rendered inoperative during the tests.

18.13.2.1.4 If the vehicle is equipped with a fixed power source driven by the same engine that drives the fire pump, it shall be running at a minimum of 50 percent of its rated capacity throughout the pumping portion of the pump test.

18.13.2.1.5 The following devices shall be permitted to be turned off or not operating during the pump test:

1. Aerial hydraulic pump
2. Foam pump
3. Hydraulically driven equipment
4. Winch
5. Windshield wipers
6. Four-way hazard flashers

18.13.2.1.6 All structural enclosures, such as floorboards, gratings, grills, and heat shields, not furnished with a means for opening them in service shall be kept in place during the tests.

18.13.2.2 Equipment.

18.13.2.2.1 Suction Hose.

18.13.2.2.1.1 The suction hose shall be of the appropriate size for the rated capacity of the pump (see Table 18.2.4.1(a)).

18.13.2.2.1.2 A suction strainer and hose that will allow flow with total friction and entrance loss not greater than that specified in Table 18.2.4.1(b) or Table 18.2.4.1(c) shall be used.

18.13.2.2.2 Sufficient fire hose shall be provided to discharge the rated capacity of the pump to the nozzles or other flow measuring equipment without exceeding a flow velocity of 35 ft/sec (10 m/sec) [approximately 500 gpm (2000 L/min)] for 2 1/2-in. (65-mm) hose.

18.13.2.2.3 Where nozzles are used, they shall be smoothbore, and the inside diameters shall be from 1/2 in. to 2 1/2 in. (19 mm to 63.5 mm).

18.13.2.2.4 Test Gauges.

18.13.2.2.4.1 All test gauges shall meet the requirements for Grade A gauges as defined in ASME B40.100, Pressure Gauges and Gauge Attachments, and shall be at least size 3 1/2 per ASME B40.100.

18.13.2.2.4.2 A mercury manometer shall be permitted to be used in lieu of a pump intake gauge.

18.13.2.2.4.3 The pump intake gauge shall have a range of 30 in. Hg (150 kPa) vacuum to zero for a vacuum gauge, or 30 in. Hg (100 kPa) vacuum to a gauge pressure of 150 psi (1000 kPa) for a compound gauge.

18.13.2.2.4.4 The discharge pressure gauge shall have a gauge pressure range of 0 psi to 400 psi (0 kPa to 2800 kPa).

18.13.2.2.4.5 Pilot gauges shall have a gauge pressure range of at least 0 psi to 160 psi (0 kPa to 1100 kPa).

18.13.2.2.4.6 All gauges shall be calibrated in the month preceding the tests using a dead weight gauge tester or a master gauge meeting the requirements for Grade 3A or 4A gauges, as defined in ASME B40.100, Pressure Gauges and Gauge Attachments, that has been calibrated within the preceding year.

18.13.2.2.5 All test gauge connections shall include a means for “snubbing,” such as needle valves to damp out rapid needle movements.

18.13.2.2.6* The engine speed-measuring equipment shall consist of a nonadjustable tachometer supplied from the engine or transmission...
The interval from the time the primer is started until the time the 3
begun.

18.13.5.3 The time required to prime the pump shall not exceed 45 seconds.

18.13.5.2 The engine, pump, transmission, and all parts of the apparatus shall exhibit no undue heating, loss of power, or other defect during the entire test.

18.13.5.3.3 The pump shall be subjected to a 3-hour pumping test from draft consisting of 2 hours of continuous pumping at rated capacity at 100 psi (700 kPa) net pump pressure, followed by /₄ hour of continuous pumping at 70 percent of rated capacity at 150 psi (1000 kPa) net pump pressure, and /₄ hour of continuous pumping at 50 percent of rated capacity at 200 psi (1400 kPa) net pump pressure.

18.13.5.3.3.1 The pump shall not be stopped until after the 2-hour test at rated capacity, unless it becomes necessary to clean the suction strainer.

18.13.5.3.3.2 The pump shall be permitted to be stopped between tests in order to change the hose or nozzles, clean the strainer, or add fuel for the pump drive engine.

18.13.5.3.3.3 The capacity, discharge pressure, intake pressure, and engine speed shall be recorded at least every 15 minutes but not less than three times for each test sequence.

18.13.5.3.3.4 The average net pump pressure shall be calculated and recorded based on the average values for discharge and intake pressure.

18.13.5 Pressure Control System Test. The pressure control system on the pump shall be tested as follows:

1. The pump shall be operated at draft, delivering rated capacity at a discharge gauge pressure of 100 psi (700 kPa).

2. The pressure control system shall be set in accordance with the manufacturer’s instructions to maintain the discharge gauge pressure at 100 psi (700 kPa) ± 5 percent.

3. All discharge valves shall be closed no more rapidly than in 3 seconds’ time and no more slowly than in 10 seconds’ time.

4. The rise in discharge pressure shall not exceed 30 psi (200 kPa) and shall be recorded.

5. The pump shall be operated at draft, pumping 50 percent of rated capacity at a discharge gauge pressure of 200 psi (1400 kPa).

6. The pressure control system shall be set in accordance with the manufacturer’s instructions to maintain the discharge gauge pressure at 200 psi (1400 kPa) ± 5 percent.

7. All discharge valves shall be closed no more rapidly than in 3 seconds’ time and no more slowly than in 10 seconds’ time.

8. The rise in discharge pressure shall not exceed 30 psi (200 kPa) and shall be recorded.

18.13.4 Priming Device Tests. With the apparatus set up for the pumping test, the primer shall be operated in accordance with the manufacturer’s instructions until the pump has been primed and is discharging water.

18.13.4.1 This test shall not be performed in connection with priming the pump for the pumping test.

18.13.4.2 The interval from the time the primer is started until the time the pump is discharging water shall be noted.

18.13.4.3 The time required to prime the pump shall not exceed 45 seconds.

18.13.4.4 An additional 15 seconds shall be permitted in order to meet the requirements of 18.13.4.3 when the pump system includes an auxiliary 4-in. (100-mm) or larger intake pipe having a volume of 1 ft³ (0.3 m³) or more.

18.13.5 Vacuum Test. The vacuum test shall consist of subjecting the interior of the pump, with all intake valves open, all intakes capped or plugged, and all discharge caps removed, to a vacuum of 22 in. Hg (75 kPa) by means of the pump priming device.

18.13.5.1 At altitudes above 2000 ft (600 m), the vacuum attained shall be permitted to be less than 22 in. Hg (75 kPa) by 1 in. Hg (3.4 kPa) for each 1000 ft (305 m) of altitude above 2000 ft (600 m).

18.13.5.2 The vacuum shall not drop more than 10 in. Hg (34 kPa) in 5 minutes.

18.13.5.3 The primer shall not be used after the 5-minute test period has begun.

18.13.5.4 The engine shall not be operated at any speed greater than the governed speed during this test.

18.13.6 Water Tank to Pump Flow Test.

18.13.6.1 A water tank to pump flow test shall be conducted as follows:

1. The water tank shall be filled until it overflows.

2. All intakes to the pump shall be closed.

3. The tank fill line and bypass cooling line shall be closed.

4. Hose lines and nozzles for discharging water at the rated tank to pump flow rate shall be connected to one or more discharge outlets.

5. The tank to pump valve(s) and the discharge valves leading to the hose lines and nozzles shall be fully opened.

6. The engine throttle shall be adjusted until the required flow rate − 0±5 percent is established (see 19.2.2).

7. The discharge pressure shall be recorded.

8. The discharge valves shall be closed and the water tank refilled.

9. The bypass line shall be permitted to be opened temporarily, if needed, to keep the water temperature in the pump within acceptable limits.

10. The discharge valves shall be reopened fully and the time noted.

11. If necessary, the engine throttle shall be adjusted to maintain the discharge pressure recorded as noted in 18.13.7.1(7).

12. When the discharge pressure drops by 10 psi (70 kPa) or more, the time shall be noted and the elapsed time from the opening of the discharge valves shall be calculated and recorded.

18.13.6.2 Volume Discharge Calculation.

18.13.6.2.1 The volume discharged shall be calculated by multiplying the rate of discharge in gallons per minute (L/min) times the time in minutes elapsed from the opening of the discharge valves until the discharge pressure drops by at least 10 psi (70 kPa).

18.13.6.2.2 Other means shall be permitted to be used to determine the volume of water pumped from the tank such as a totalizing flow meter, weighing the truck before and after, or refilling the tank using a totalizing flow meter.

18.13.6.3 The rated tank to pump flow rate shall be maintained until 80 percent of the rated capacity of the tank has been discharged.

18.13.7* Manufacturer’s Predelivery Test.

18.13.7.1 The manufacturer shall conduct a piping hydrostatic test prior to delivery of the apparatus.

18.13.7.2 The test shall be conducted as follows:

1. The pump and its connected piping system shall be hydrostatically tested to a gauge pressure of 250 psi (1700 kPa).

2. The hydrostatic test shall be conducted with the tank fill line valve, the bypass line valve if so equipped, and the tank to pump valve closed.

3. All discharge valves shall be open and the outlets capped.

4. All intake valves shall be closed, and nonvalved intakes shall be capped.

5. This pressure shall be maintained for 3 minutes.

Chapter 19 Water Tanks

19.1 Application. If the fire apparatus is equipped with a water tank, the provisions of this chapter shall apply.

19.2 Tank Construction.

19.2.1 All water tanks shall be constructed of noncorrosive material or other materials that are protected against corrosion and deterioration.

19.2.2* The water tanks shall have a means to permit complete cleaning of the tank.

19.2.3* If the water tank is independent of the body and compartments, it shall be equipped with a method for lifting the tank(s) off of the chassis.

19.2.4 Tanks shall be cradled, cushioned, spring-mounted, or otherwise protected from undue stress resulting from travel on uneven terrain, in accordance with the tank manufacturer’s requirements.

19.2.5* All water tanks shall be provided with baffles or swash partitions to form a containment or dynamic method of water movement control.

19.2.5.1 If a containment method of baffling is used, a minimum of two transverse or longitudinal vertical baffles shall be provided.
19.2.5.1.1 There shall be a maximum distance of 48 in. (1220 mm) between any combination of tank vertical walls and baffles.

19.2.5.1.2 Each baffle shall cover at least 75 percent of the area of the plane that contains the baffle.

19.2.5.2 If a dynamic method of partitioning is used, the tank shall contain vertical transverse and longitudinal partitions.

19.2.5.2.1 The vertical partitions shall be secured to the top and bottom of the tank.

19.2.5.2.2 The longitudinal partitions shall extend a minimum of 75 percent of the tank length.

19.2.5.2.3 The partitions shall be arranged in such a manner that the vertical plane of each partition shall create cells for which no dimension shall exceed 48 in. (1220 mm).

19.2.6 Clean-out Sumps.

19.2.6.1 One or more clean-out sumps shall be provided.

19.2.6.2 A 3-in. (75-mm) or larger removable pipe plug shall be furnished in each sump.

19.2.6.3 If the sump is used for the tank to pump line connection, the design shall prevent sludge or debris in the sump from entering the pump.

19.2.7 Water Level Indicator.

19.2.7.1 An indicator shall be provided that shows the level or amount of water in the tank(s).

19.2.7.2 If the apparatus is not equipped with a pump, the indicator shall be visible at the inlet valve position.

19.3 Tank to Pump Intake Line.

19.3.1 If the apparatus is equipped with a pump, the water tank shall be connected to the intake side of the pump with a valve controlled at the pump operator's position.

19.3.2 Certified Capacity.

19.3.2.1 If the water tank has a certified capacity of less than 500 gal (2000 L), the piping and valve arrangement shall be capable of delivering water to the pump at a minimum rate of 250 gpm (1000 L/min).

19.3.2.2 If the water tank has a certified capacity of 500 gal (2000 L) or greater, the piping and valve arrangement shall be capable of delivering water to the pump at a minimum rate of 500 gpm (2000 L/min) or the rated capacity of the pump, whichever is less.

19.3.2.3 The flow required by 19.3.2.1 and 19.3.2 shall be sustainable while pumping a minimum of 80 percent of the certified tank capacity with the apparatus on level ground.

19.3.2.4 An automatic means shall be provided in the tank to pump line that prevents unintentional back-filling of the water tank through that line.

19.3.2.5 Connections or outlets from the tank(s) to the pump shall be designed to prevent air from being entrained while pumping water from the tank.

19.4.3.3* The valve shall be capable of regulating flow and shall be controllable from the pump operator's position.

19.4 Mobile Water Supply Apparatus. If the apparatus is designed to be a mobile water supply apparatus, the requirements of this section shall apply.

19.5 External Fill. An external fill connection leading directly to the tank shall be provided.

19.5.1.1* The external fill connection shall permit a minimum filling rate of 1000 gpm (4000 L/min) from sources external to the unit.

19.5.1.2 The external fill connection shall be provided with a removable or accessible strainer, a shutoff valve capable of being throtled, a minimum 30-degree sweep elbow positioned downward, and a closure cap or plug.

19.5.1.3 Any 3-in. (75-mm) or larger valve shall be a slow-operating valve.

19.5.1.4 A check-type device shall be permitted to be substituted for the modulating and slow-operating valve in those operations where the flow rate is to be controlled at the source.

19.5.2* Water Transfer. Single or multiple tank connections that meet the requirements of 19.5.2.1 and 19.5.2.2 shall be provided.

19.5.2.1 The tank connection(s) shall be capable of allowing water to be transferred from the tank to an external use to the right, left, and rear of the fire apparatus.

19.5.2.2* Each tank connection shall be capable of emptying 90 percent of the tank capacity at a minimum average rate of 1000 gpm (4000 L/min) with the apparatus on level ground.

19.6 Water Tank Capacity Certification.

19.6.1* The manufacturer shall certify the capacity of the water tank prior to delivery of the apparatus.

19.6.2 The certified capacity shall be recorded on the manufacturer's record of construction (see 4.19.1), and the certification shall be provided to the purchaser when the apparatus is delivered.

Chapter 20 Aerial Devices

20.1* General Requirements.

20.1.1 If the apparatus is equipped with an aerial ladder, the aerial device and apparatus shall meet the requirements of Sections 20.2 through 20.6 and Sections 20.17 through 20.25.

20.1.2 If the apparatus is equipped with an elevating platform, the aerial device and apparatus shall meet the requirements of Sections 20.7 through 20.12 and Sections 20.17 through 20.25.

20.1.3 If the apparatus is equipped with a water tower, the aerial device and apparatus shall meet the requirements of Sections 20.13 through 20.25.

20.2 Aerial Ladder Requirements.

20.2.1 The aerial ladder shall consist of two or more ladder sections that, together with the steps and platforms on the apparatus body, provide continuous egress for fire fighters and civilians from an elevated position to the ground.

20.2.2 The rated vertical height of an aerial ladder shall be at least 50 ft (15 m) and shall be measured in a vertical plane with the ladder at maximum elevation and extension from the outermost rung of the outermost fly section to the ground.

20.2.3 The rated horizontal reach of an aerial ladder shall be measured in a horizontal plane from the centerline of the turntable rotation to the outermost rung on the outermost fly section with the aerial ladder extended to its maximum horizontal reach.

20.2.4 Height and reach dimensions shall be taken with the aerial ladder mounted on a chassis meeting the aerial manufacturer’s minimum recommended fire apparatus specifications, with the fire apparatus on level ground, and with the stabilizers deployed in accordance with the manufacturer’s instructions.

20.2.5 The ladder rungs shall be equally spaced on a maximum 14-in. (350-mm) centers and minimum 11.75 in. (300 mm) centers and shall have a skid-resistant surface or covering.

20.2.5.1 Where covering is provided, it shall not twist and shall cover at least 60 percent of the length of each rung.

20.2.5.2 Where round rungs are furnished, the rungs shall have a minimum outside diameter of 1/2 in. (32 mm) including the skid-resistant surface or covering.

20.2.5.3 Where rungs other than round are furnished, they shall have a cross-sectional area not less than 1.2 in.² (775 mm²); a maximum outside dimension of the cross-sectional area (height or width) of 3.2 in. (81 mm),...
including the skid-resistant surface or covering; and a minimum outside dimension of 1/4 in. (19 mm), including the skid-resistant surface or covering.

20.2.5.4 The minimum design load for each rung shall be 500 lb (200 kg) distributed over a 3\(\sqrt{2}\) in.-in. (89-mm) wide area at the center of the length of the rung with the rung oriented in its weakest position.

20.2.6 There shall be a minimum of 18 in. (460 mm) in width inside the aerial ladder between the rails measured at the narrowest point, excluding any mounted equipment.

20.2.7 Obstructions Below the Ladder.

20.2.7.1 Where a solid obstruction below the ladder is wider than 12 in. (300 mm), a minimum clearance of 7 in. (180 mm) between the centerline of the rung and the obstruction shall be provided.

20.2.7.2 Where the solid obstruction below the centerline of the ladder is 12 in. (300 mm) or less in width, the standoff between the centerline of the rung and the obstruction shall be permitted to be less than 7 in. (180 mm), provided there is at least 6 in. (150 mm) of rung width and 7 in. (180 mm) of depth below the centerline of the rung on each side of the obstruction.

20.2.8 Top rails shall be provided on the ladder, shall have a minimum width of 1 in. (25 mm), and shall be at a minimum height of 12 in. (300 mm) above the centerline of the rungs excluding the outermost two rungs of the outermost fly section.

20.2.9 Two folding steps with surfaces that meet the skid-resistant requirements of 15.7.3 shall be provided on the ladder for use by the ladder pipe-monitor operator.

20.2.9.1 Each folding step shall have a minimum design load of 500 lb (200 kg) and shall be a minimum of 35 in.\(^2\) (225 cm\(^2\)) in area.

20.2.9.2 A single step that has a minimum design load of 500 lb (200 kg) and a minimum area of 100 in.\(^2\) (650 cm\(^2\)) shall be permitted to be used in place of the two steps.

20.2.10 Provisions shall be made so that the personnel working on the ladder can attach fall protection harnesses.

20.2.11 The apparatus shall be equipped with steps that meet the skid resistance requirements of 15.7.3 or with rungs that provide a path at any degree of elevation from the bottom rung of the aerial ladder to the ground.

20.2.11.1 Steps, with the exception of the ground to the first step, shall be spaced on no more than 18-in. (460-mm) centers.

20.2.11.2 Handrails shall also be provided within reach at each step location.

20.2.12 With the stabilizers set, the aerial ladder shall be capable of being raised from the bedded position to maximum elevation and extension and rotated 90 degrees.

20.2.12.1 Two or more of these functions shall be permitted to be performed simultaneously.

20.2.12.2 The functions described in 20.2.12 shall be accomplished within 120 seconds if the aerial ladder has a rated vertical height of 110 ft (34 m) or less.

20.2.12.3 The functions described in 20.2.12 shall be accomplished within 180 seconds if the aerial ladder has a rated vertical height over 110 ft (34 m).

20.2.13* Where a breathing air system is provided, it shall supply breathing air for a minimum of one person at the secondary aerial ladder operator’s position and shall meet the requirements of 20.2.13.1 through 20.2.13.7.

20.2.13.1 The system shall include storage for at least 200 ft\(^3\) (5.6 m\(^3\)) of breathing air and shall meet the requirements of Section 25.5.

20.2.13.2 Piping System.

20.2.13.2.1 All components of the piping system shall be designed for a pressure rating of three times the working pressure that they are expected to carry.

20.2.13.2.2 The piping system shall be arranged with a high-pressure regulator at the air supply that shall limit the air pressure in the piping up the aerial device to the pressure required to supply 125 psi (862 kPa) at the outlet point.

20.2.13.2.3 All piping, valves, and components shall be fabricated of corrosion-resistant materials and shall be sized for the number of outlets provided at the secondary aerial ladder operator’s position.

20.2.13.2.4 A pressure relief valve set to relieve the pressure at 1\(\sqrt{2}\) times the working pressure of the piping system in the event of regulator failure shall be provided on the downstream side of the high-pressure regulator.

20.2.13.3 Damage Prevention.

20.2.13.3.1 All valves, pressure regulators, and gauges shall be protected from accidental damage.

20.2.13.3.2 The piping or hose system between the air cylinder(s) and the secondary aerial ladder operator’s position shall be installed so as to prevent damage due to abrasion, bending, pinching, or exposure to excessive heat.

20.2.13.4 Holders shall be provided for the storage of the breathing air equipment when it is not in use.

20.2.13.5 A low air warning system shall be provided that shall monitor the air volume and shall provide an audible and visual warning at both the upper and lower control stations when the air volume is at or below 20 percent.

20.2.13.6 The quality of the breathing air shall meet the requirements of NFPA 1989, Standard on Breathing Air Quality for Fire and Emergency Services Respiratory Protection.

20.2.13.7 All components of the system that the breathing air will be in contact with shall be cleaned of oil, grease, contaminants, and foreign material.

20.3 Aerial Ladder Rated Capacity.

20.3.1 The rated capacity of the aerial ladder shall be a minimum load of 250 lb (114 kg) carried on the outermost rung of the outermost fly section with the aerial ladder placed in the horizontal position at maximum extension.

20.3.1.1 The aerial ladder shall be capable of operating in any position while carrying its rated capacity on the outermost rung of the outermost fly section.

20.3.1.2 If the aerial ladder has a permanently mounted water delivery system, the 250 lb (114 kg) rated capacity shall be determined without water in the system.

20.3.2 The rated capacity of the aerial ladder shall be a minimum load of 250 lb (114 kg) carried on the outermost rung of the outermost fly section with the aerial ladder at 45 degrees to the horizontal and at maximum extension while discharging water at rated capacity through the full range of monitor or nozzle movements as permitted by the aerial manufacturer.

20.3.3 Rated capacities in excess of 250 lb (114 kg) shall be stated in increments of 250 lb (114 kg) and shall be in addition to any fire-fighting equipment installed on the aerial ladder by the manufacturer.

20.3.4* If the aerial ladder is rated in multiple configurations, the manufacturer shall describe these configurations, including the rated capacity of each, in both the operations manual and on a plate at the operator’s control station.

20.4 Aerial Ladder Operating Position.

20.4.1 Indicating devices that are lighted and marked with a label shall be visible from the operator’s position and shall indicate the following:

(1) Rungs are aligned for climbing

(2) Aerial ladder is aligned with the travel bed

20.4.2 A system that is lighted and marked with labels shall be visible from the operators position to indicate the elevation, extension, and rated capacities.

20.4.3 Voice Communication System.

20.4.3.1* A weather-resistant two-way voice communication system shall be provided between the aerial ladder operator’s position and the tip of the ladder.

20.4.3.2 The speaker/microphone at the tip shall allow for hands-free operation.

20.5 Aerial Ladder Operating Mechanisms.

20.5.1 Elevation. A power-operated system for elevating and lowering the aerial ladder under all the rated conditions of loading shall be provided.

20.5.1.1 Where hydraulic components are utilized, they shall meet the requirements of Section 20.19 and shall be designed to prevent damage at the top and bottom limits.

20.5.1.2 An automatic locking device(s) shall be provided so that the desired elevated position can be maintained.

20.5.1.3 A locking device shall be provided that will retain the aerial ladder in the bed when the fire apparatus is in motion.

20.5.2 Rotation. A power-operated turntable shall be provided that shall allow continuous rotation in either direction under all the rated conditions of loading.

20.5.2.1* The turntable rotation bearing shall be accessible for lubrication and retorquing of bolts.
20.5.2.2 The turntable rotation mechanism shall be equipped with an automatically applied brake or self-locking drive that provides sufficient braking capacity while all power systems are nonfunctioning to prevent turntable rotation under all rated conditions of loading.

20.5.3 Extension. A power-operated system for extending and retracting the fly section(s) under all the rated conditions of loading shall be provided.

20.5.3.1 Where hydraulic components are utilized, they shall meet the requirements of Section 20.19.

20.5.3.2 An automatic locking device shall be provided so that the desired position of extension can be maintained.

20.5.3.3 Rollers, pulleys, and roller guides shall be equipped with self-lubricating bearings or readily accessible grease fitting.

20.5.3.4 Slide pads, rollers, and bearings, when used, shall be readily accessible for replacement.

20.5.3.5 When wire rope, chains, or cables are used to extend the ladder sections, the system shall be redundant with a minimum of two wire ropes, chains, or cables used per ladder section.

20.5.3.6 A means shall be provided to prevent damage to the extension system at full retraction or full extension.

20.5.4* Secondary Operator's Position. If a secondary aerial ladder operator's position is located at the tip of the outermost fly section, the following shall apply:

1) The lower control shall override the aerial tip control station.

2) The lower control station shall have a momentary switch that enables the tip controls when closed and disables the tip controls when opened or released.

3) The maximum speed of the ladder functions measured at the tip shall be as follows when operated from the tip control station:

(a) Rotation at 2 ft/sec (0.6 m/sec), when fully extended at 0 degrees elevation.

(b) Elevation and lowering at 1 ft/sec (0.3 m/sec)

(c) Extension and retraction at 0.5 ft/sec (0.15 m/sec)

(d) The step(s) for the tip operator shall be designed to keep the operator's feet from protruding through the outermost fly section.

20.6 Aerial Ladder Water Delivery System.

20.6.1* Where a prepped waterway is provided, the waterway system shall be capable of flowing 1000 gpm (4000 L/min) at 100 psi (700 kPa) nozzle pressure at full elevation and extension.

20.6.1.1 For ladders with a rated vertical height of 110 ft (34 m) or less, the friction loss (total system loss less head loss) between the monitor outlet and a point below the waterway swivel shall not exceed 100 psi (700 kPa) at 1000 gpm (4000 L/min) flow with the ladder at full horizontal extension.

20.6.1.2 A preset relief valve that is capable of protecting the waterway system by relieving pressure through the dumping of water to the environment shall be provided.

20.6.1.2.1 Such dumping shall be through a system of piping terminating in an area away from the operator's position.

20.6.1.2.2 The discharge end of the piping shall not have a threaded connection.

20.6.1.3 A permanently attached monitor shall be provided.

20.6.1.3.1 The monitor shall be capable of swiveling at least 135 degrees from a line parallel to the ladder and down.

20.6.1.3.2 The monitor shall be capable of horizontal traverse at least 45 degrees from each side of center.

20.6.1.3.3 Positive stops shall be provided to prevent the swivel or traverse of the monitor from exceeding the aerial ladder manufacturer's recommendation.

20.6.1.3.4 If a power-operated monitor is provided, the primary controls shall be at the aerial operator's position, and those controls shall be capable of overriding all other monitor controls.

20.6.1.3.5* A permanently installed monitor/nozzle shall not present an obstacle for access to or from the tip of the ladder.

20.6.1.4 A 1000-gpm (4000-L/min) nozzle shall be furnished.

20.6.1.5* The water system shall be arranged so it can be supplied at ground level through an external inlet that is a minimum of 4 in. (100 mm) in size.

20.6.1.6 If the apparatus is equipped with a fire pump capable of supplying the required flow and pressure, a permanent valve connection shall be provided between the pump and the waterway system.

20.6.1.7 A flowmeter shall be installed in the waterway, with a display on either the pump operator's panel or the aerial ladder operator's control panel.

20.6.1.8* A 1/2'-in. (38-mm) minimum drain valve shall be provided at the low point of the waterway inlet system.

20.6.1.9 If the apparatus has a fire pump and normal operations are to supply the waterway through the pump, a cap meeting the requirements of 16.7.4 shall be provided on the external inlet.

20.6.2* Where a prepped waterway is not provided, the following equipment shall be furnished:

1) Ladder pipe with 1/2'-in. (32-mm), 1/2'-in. (35-mm), and 1/2'-in. (38-mm) tips that can be attached to the aerial ladder

2) A single length(s) of 3'-in. (75-mm) or larger attack hose complying with the requirements of NFPA 1961, Standard on Fire Hose, to reach between the installed ladder pipe and the ground with at least 10 ft (3 m) of hose available on the ground with the ladder at full extension.

3) One hose strap for each ladder section

4) Halyards to control the ladder pipe from ground level.

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

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

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

20.7 Elevating Platform Requirements.

20.7.1 The elevating platform shall consist of an elevated tower of two or more booms or sections equipped with a passenger-carrying platform(s) assembly.

20.7.2 The rated vertical height of the elevating platform shall be measured in a vertical plane from the top surface of the platform handrail to the ground, with the platform raised to its position of maximum elevation.

20.7.3 The rated horizontal reach of the elevating platform shall be measured in a horizontal plane from the centerline of the turntable rotation to the outer edge of the platform handrail, with the elevating platform extended to its maximum horizontal reach.

20.7.4 Height and reach dimensions shall be measured with the elevating platforms mounted on a chassis meeting the elevating platform manufacturer's minimum recommended fire apparatus specifications, with the fire apparatus on level ground, and with the stabilizers deployed in accordance with the manufacturer's instructions.

20.7.5 Where the rated vertical height of the elevated platform is 110 ft (34 m) or less, the elevating platform, with stabilizers set, shall be capable of being raised from the bedded position to maximum elevation and extension and rotated 90 degrees within 150 seconds. Two or more of these functions shall be permitted to be performed simultaneously.

20.7.6 Platform Construction.

20.7.6.1 The platform shall have a minimum floor area of 14 ft² (1.3 m²).

20.7.6.2 A continuous guard railing, a minimum of 42 in. (1070 mm) high, shall be provided on all sides.

20.7.6.2.1 The railing shall be constructed so there are no horizontal or vertical openings below it greater than 24 in. (610 mm) in either dimension.

20.7.6.2.2 There shall be a minimum of two gates providing access to the platform.

20.7.6.2.3 Each gate shall be provided with a self-engaging latch.

20.7.6.2.4 The use of a vertical-opening or inward-opening, self-closing gate or door for access to and from the platform shall be permitted to meet the continuous railing requirement.

20.7.6.3 A kick plate of not less than 4 in. (100 mm) high shall be provided around the floor and shall be permitted to swing with the gate.

20.7.6.4 The steps and the floor of the platform shall be provided with skid-resistant surfaces that meet the requirements of 15.7.3.

20.7.6.5 Drain openings shall be provided to prevent water accumulation on the platform floor.

20.7.6.6 Heat Shield.
20.7.7.5 Services Respiratory Protection.

20.7.7.3.1 The piping system shall be arranged with a high-pressure regulator at the air supply that shall limit the air pressure in the piping up the aerial device to the pressure required to supply 125 psi (862 kPa) at the outlet point.

20.7.7.3.2 All piping, valves, and components shall be fabricated of corrosion-resistant materials and shall be sized for the number of outlets provided in the platform.

20.7.7.3.4 A pressure relief valve set to relieve the pressure at 1 1/2 times the working pressure of the piping system in the event of regulator failure shall be provided on the downstream side of the high-pressure regulator.

20.7.7.4 Damage Prevention.

20.7.7.4.1 All valves, pressure regulators, and gauges shall be protected from accidental damage.

20.7.7.4.2 The piping or hose system between the air cylinder(s) and the platform shall be installed so as to prevent damage due to abrasion, bending, pinching, or exposure to excessive heat.

20.7.7.4.4 Holders shall be provided for the storage of the breathing air equipment when it is not in use.

20.7.7.6 The quality of the breathing air shall meet the requirements of NFPA 1901, Standard on Breathing Air Quality for Fire and Emergency Services Respiratory Protection.

20.7.7.7.1 The system shall include storage for at least 400 ft³ (11 m³) of breathing air and shall meet the requirements of Section 25.5.

20.7.7.2 Piping System.

20.7.7.2.1 All components of the piping system shall be designed for a pressure rating of three times the working pressure that they are expected to carry.

20.7.7.2.2 The piping system shall be arranged with a high-pressure regulator at the air supply that shall limit the air pressure in the piping up the aerial device to the pressure required to supply 125 psi (862 kPa) at the outlet point.

20.7.7.2.3 All piping, valves, and components shall be fabricated of corrosion-resistant materials and shall be sized for the number of outlets provided in the platform.

20.7.7.2.4 A pressure relief valve set to relieve the pressure at 1 1/2 times the working pressure of the piping system in the event of regulator failure shall be provided on the downstream side of the high-pressure regulator.

20.7.7.3 Damage Prevention.

20.7.7.3.1 All valves, pressure regulators, and gauges shall be protected from accidental damage.

20.8 Elevating Platform Rated Capacity.

20.8.1 The rated capacity of the elevating platform shall be a minimum of 750 lb (340 kg), with no water in the water delivery system, in any position of operation.

20.8.2 The rated capacity of the elevating platform shall be a minimum of 500 lb (227 kg), with the water delivery system full of water but not discharging, in any position of operation.

20.8.3 The elevating platform shall be capable of delivering a minimum of 1000 gpm (4000 L/min) from the platform with the booms or sections and the monitors and nozzles positioned in any configuration allowed by the manufacturer while carrying a minimum load of 500 lb (227 kg) on the platform.

20.8.4 All rated capacities shall be stated in increments of 250 lb (114 kg) and shall be in addition to any fire-fighting equipment installed on the elevating platform by the manufacturer.

20.8.5 If the elevating platform is rated in multiple configurations, the manufacturer shall describe these configurations, including the rated capacity of each, in the operations manual and on the plates at the operator’s control stations.

20.9 Elevating Platform Operating Positions.

20.9.1 There shall be two control stations, one to be known as the platform control station and the other as the lower control station.

20.9.1.1 All operational controls shall be operable from both of these positions.

20.9.1.2 The lower control station shall be located so as to facilitate observation of the platform while operating the controls.

20.9.1.3 The lower control stations shall be capable of overriding the platform control stations.

20.9.1.4* A weather-resistant two-way voice communication system shall be provided between the platform control station and the lower control station.

20.9.2 Voice Communication System.

20.9.2.1 The horizontal and vertical traverse of the monitors shall not exceed the elevating platform manufacturer’s recommendation.

20.9.2.2 The monitor(s) shall allow the operator to control the aimed direction of the nozzle through a rotation of at least 45 degrees on either side of center and at least 45 degrees above and below horizontal.

20.9.2.3 The horizontal and vertical traverse of the monitors shall not exceed the elevating platform manufacturer’s recommendation.

20.9.2.4 A slow-operating valve shall be provided at the base of any monitor.

20.9.2.5 If a hose connection is provided, it shall be a minimum 2 1/2-in. (65-mm) nominal diameter valve.
20.12.5* The water system shall be arranged so it can be supplied at ground level through an external inlet that is a minimum of 4 in. (100 mm) in size.

20.12.6 If the apparatus is equipped with a fire pump capable of supplying the required flow and pressure, a permanent valved connection shall be provided between the pump and the waterway system.

20.12.7 A flowmeter shall be installed in the waterway with at least one display on the pump operator’s panel or at the elevating platform operator’s position.

20.12.8 A preset relief valve capable of protecting the waterway system by relieving pressure through the dumping of water to the environment shall be provided.

20.12.8.1 Such dumping shall be through a system of piping terminating in an area away from the operator’s position.

20.12.8.2 The discharge end of the piping shall not have a threaded connection.

20.12.9 Waterway Drains.

20.12.9.1* A 1\(\frac{1}{2}\)-in. (38-mm) minimum drain valve shall be provided at the low point of the waterway system.

20.12.9.2 Additional drains shall be provided to drain any portions of the waterway that do not drain to the low point of the system.

20.12.10 If the apparatus has a pump and normal operations are to supply the waterway through the pump, a cap meeting the requirements of 16.7.4 shall be provided on the external inlet.

20.13 Water Tower Requirements.

20.13.1 The water tower shall consist of two or more booms designed to telescope, articulate, or both, and a waterway designed to supply a large capacity elevated water stream.

20.13.2 The rated vertical height of the water tower shall be measured in a vertical plane from the discharge end of the nozzle to the ground, with the nozzle raised to its position of maximum elevation.

20.13.3 The rated horizontal reach of the water tower shall be measured in a horizontal plane from the centerline of the turntable rotation to the end of the nozzle, with the water tower extended to its maximum horizontal reach.

20.13.4 Height and reach dimensions shall be taken with the water tower mounted on a chassis meeting the water tower manufacturer’s minimum recommended fire apparatus specifications, the fire apparatus on level ground, and stabilizers deployed in accordance with the manufacturer’s instructions.

20.13.5 The water tower, with stabilizers set if required, shall be capable of being raised from the bedded position to maximum elevation and extension and rotated 90 degrees within 105 seconds. Two or more of these functions shall be permitted to be performed simultaneously.

20.14 Water Tower Rated Capacity.

20.14.1 The water tower shall be capable of delivering a minimum water stream of 1000 gpm (4000 L/min) at 100 psi (700 kPa) from the water tower nozzle with the booms or sections and nozzle positioned in any configuration permitted by the manufacturer.

20.14.2 The rated capacity shall include the weight of the charged waterway and the maximum nozzle reaction force.

20.14.3 If the water tower is rated in multiple configurations, the manufacturer shall describe these configurations, including the rated capacity of each, in the operations manual and on the plate at the operator’s control station.

20.15 Water Tower Operating Mechanisms.

20.15.1 Power-operated elevating and extending devices shall be provided.

20.15.1.1 They shall be so designed and powered to allow multiple movements of the water tower booms or sections simultaneously under all rated conditions of loading.

20.15.1.2 Where hydraulic components are utilized, they shall meet the requirements of Section 20.19.

20.15.1.3 An automatic locking device(s) shall be provided so that the desired elevated position can be maintained.

20.15.1.4 Provisions shall be made to prevent damage at top and bottom limits of elevation and extension.

20.15.2 A lock shall be provided that will retain the water tower booms or sections in the bed when the fire apparatus is in motion.

20.15.3 If the water tower has a rated water delivery capacity of 3500 gpm (14,000 L/min) or less, a power-operated turntable shall be provided that shall allow continuous rotation in either direction under all the rated conditions of loading.

20.15.3.1* The turntable rotation bearing shall be accessible for lubrication and retorquing of bolts.

20.15.3.2 The turntable rotation mechanism shall be provided with an automatically applied brake or self-locking drive that is capable of preventing turntable rotation under all rated conditions of loading while all power systems are nonfunctioning.

20.16 Water Tower Water Delivery System.

20.16.1 A permanently installed monitor with a nozzle(s) capable of covering a discharge range of at least 300 gpm to 1000 gpm (1100 L/min to 4000 L/min) shall be provided at the top of the water tower and supplied by the permanent water system.

20.16.3 A permanently installed monitor with a nozzle(s) capable of covering a discharge range of at least 300 gpm to 1000 gpm (1100 L/min to 4000 L/min) shall be permitted to be supplied at the operator’s position.

20.16.3.1 The monitor shall be powered so as to allow the operator(s) to control its aimed direction.

20.16.3.2 If the water tower has a rated water delivery capacity of 3500 gpm (14,000 L/min) or less, the monitor, as distinct from the supporting boom, shall allow the operator to control the aimed direction of the nozzle through a rotation of at least 45 degrees either side of center and at least 30 degrees above and 135 degrees below the centerline of the boom.

20.16.3.3 The horizontal and vertical traverse of the monitor shall not exceed the water tower manufacturer’s recommendation.

20.16.4 If a variable pattern spray nozzle is provided, a control shall be provided at the operator’s position to select the desired stream pattern.

20.16.5* The water system shall be arranged so it can be supplied at ground level through an external inlet that is a minimum of 4 in. (100 mm) in size.

20.16.6 If the apparatus is equipped with a fire pump capable of supplying the required flow and pressure, a permanent valved connection shall be provided between the pump and the waterway system.

20.16.7 A flowmeter shall be installed in the water delivery system with the display on either the pump operator’s panel or the water tower operator’s control panel.

20.16.8 A preset relief valve capable of protecting the waterway system by relieving pressure through the dumping of water to the environment shall be provided.

20.16.8.1 Such dumping shall be through a system of piping terminating in an area away from the operator’s position.

20.16.8.2 The discharge end of the piping shall not have a threaded connection.

20.16.9* A 1\(\frac{1}{2}\)-in. (38-mm) minimum drain valve shall be provided at the low point of the waterway system.

20.16.10 If the apparatus has a pump and normal operations are to supply the waterway through the pump, a cap meeting the requirements of 16.7.4 shall be provided on the external inlet.

20.17 Control Devices.

20.17.1 Controls shall be provided at the driver’s position to transfer power to the aerial device.

20.17.2 A visual signal shall be provided at the driver’s position to indicate when the operating mechanisms are engaged.

20.17.3 An interlock shall be provided that prevents operation of the aerial device until the parking brakes have been set and the transmission has been placed in neutral or the transmission is in the drive position with the driveline to the rear axle disengaged.

20.17.4 A power-operated governed engine speed control shall be provided to limit the operating speed of the aerial device apparatus engine to within the operating parameters as determined by the manufacturer and this standard.

20.17.4.1 An interlock shall be provided that allows operation of the engine speed control only after the parking brakes have been set and the transmission is in neutral.
20.17.2 Where the apparatus is equipped with a fire pump, any high idle speed control shall be automatically disengaged when the fire pump is operating.

20.17.5* An interlock system shall be provided to prevent the following:

(1) Rotating the aerial device until the stabilizer(s) is in a configuration to meet the stability requirements of Section 20.21.

(2) Movement of the stabilizers unless the aerial device is in the travel position.

20.17.6 Controls at the operator’s position shall be lighted, marked with a label, and conveniently arranged.

20.17.6.1 These controls shall allow the operator to perform the following:

(1) Elevate and lower the aerial device

(2) Extend and retract the aerial device, if applicable

(3) Rotate the aerial device in either direction, if applicable

(4) Operate the intercom, if applicable

20.17.6.2 A method shall be provided to prevent unintentional movement of the aerial device.

20.17.6.3 Each control shall allow the operator to regulate the speed of elevation, extension, and rotation of the aerial device within the limits determined by the manufacturer and this standard.

20.17.6.4 Each control shall be arranged so it can be operated by an operator with a gloved hand without disturbing any other control(s).

20.17.7 Where a three-lever system is used to control the basic functions of the aerial device, the levers shall be distinctively different from the other controls on the panel and arranged adjacent to each other with the extension control being the left lever, the rotation control being the center lever, and the elevation control being the right lever as shown in Figure 20.17.7.

Figure 20.17.7 Control Lever Arrangement.

[Existing Figure 18-17.6, 1999 edition of NFPA 1901, no change]

20.17.7.1 The aerial device shall extend when the extension control is pushed up or forward (away from the operator).

20.17.7.2 If the rotation control has a forward/backward orientation or an up/down orientation, the turntable shall rotate clockwise when the rotation control is pushed up or forward (away from the operator). Otherwise, the rotational control handle shall move in the direction of rotation.

20.17.7.3 The aerial device shall lower when the elevation control is pushed up or forward (away from the operator).

20.17.8 Where a multifunction control lever is furnished, it shall move in the direction of the function it controls, where possible.

20.17.9 Where a two-lever system is used, the extension control shall be to the left and a combination lever for rotation and elevation shall be to the right.

20.17.10 All controls regulating the movement of the aerial device shall automatically return to the neutral position upon release by the operator.

20.17.11 When electric over hydraulic aerial device controls are incorporated, a readily accessible, manual means of overriding the electric controls shall be provided.

20.18 Safety.

20.18.1* If the operator’s position is on the turntable, the turntable platform shall be provided with a railing at least 42 in. (1070 mm) high.

20.18.1.1 The railing design shall be capable of withstanding a force of 225 lb (1000 N) applied at any point from any direction without permanent deformation.

20.18.1.2 Where the operator’s position is equipped with an operator’s seat, the seat shall be provided with a railing or an armrest capable of withstanding a force of 225 lb (1000 N) applied at any point from the inside of the seat.

20.18.2* Any aerial device operator’s position at ground level shall be arranged so that the operator is not in contact with the ground.

20.18.3 A sign(s) shall be placed at any ground level operator’s position to warn the operator(s) of electrocution hazards.

20.18.4 Where the aerial device includes moving cylinders or other moving parts, these shall be arranged so as to provide hand clearance, or hand guards shall be provided to prevent injury to the operator.

20.18.5 Lighting shall be provided at the base of the aerial device and shall be arranged to illuminate the aerial device in any position of operation.

20.18.6 A spotlight of not less than 75,000 candlepower (1,000,000 lumens) shall be provided on the apparatus by which the operator shall be able to observe the effect of the stream from the ladder pipe or monitor nozzle.

20.18.7 Provisions shall be made so that in the event of failure of the primary operating power source, an auxiliary source of power shall be readily available that is capable of returning the aerial device to the road travel position.

20.18.8 Where the operation of the aerial device is accomplished by hydraulic means, the system shall prevent motion of the aerial device in the event of any hydraulic hose failure.

20.18.9 Where the operation of the aerial device is accomplished by means other than hydraulic, the system shall be designed to prevent motion of the aerial device in the event of a power failure.

20.18.10 All components used to stabilize the apparatus that the aerial device is mounted on shall be designed to prevent instability in the event of a hydraulic hose failure or a power failure.

20.18.11 Where the design of the aerial device incorporates a knuckle, the knuckle shall be as follows:

(1) Equipped with position lights or continuously illuminated by boom lights

(2) Painted with reflective paint or provided with reflective striping

20.19 Hydraulic System.

20.19.1 The nonsealing moving parts of all hydraulic components whose failure results in motion of the aerial device shall have a minimum bursting strength of four times the maximum operating pressure to which the component is subjected.

20.19.1.1 Dynamic sealing parts of all hydraulic components whose failure results in motion of the aerial device shall not begin to extrude or otherwise fail at pressures at or below two times the maximum operating pressure to which the component is subjected.

20.19.1.2 Static sealing parts of all hydraulic components whose failure results in motion of the aerial device shall have a minimum bursting strength of four times the maximum operating pressure to which the component is subjected.

20.19.2 All hydraulic hose, tubing, and fittings shall have a minimum bursting strength of at least three times the maximum operating pressure to which the components are subjected.

20.19.3 All other hydraulic components shall have a minimum bursting strength of at least two times the maximum operating pressure to which the components are subjected.

20.19.4 The hydraulic system shall be provided with an oil pressure gauge at the lower operating position.

20.19.5 Hydraulic Reservoir.

20.19.5.1 A means for checking and filling the hydraulic reservoir shall be readily accessible.

20.19.5.2 The fill location shall be conspicuously marked with a label that reads: “Hydraulic Oil Only.”

20.19.5.3 The manufacturer shall provide instructions for checking and filling the hydraulic reservoir.

20.19.6 The hydraulic system components shall be capable of maintaining, under all operating conditions, oil cleanliness and temperature that complies with the component manufacturer’s recommendations.

20.19.7* The hydraulic system shall have adequate cooling for continuous operation of not less than 25 1/2 hours.

20.19.8 An hourmeter shall be provided that records any time the aerial device hydraulic system is engaged.

20.20 Structure.

20.20.1* All structural load supporting elements of the aerial device that are made of a ductile material shall have a design stress of not more than 20 percent of the minimum ultimate strength of the material, based on the combination of the rated capacity and the dead load, which is equivalent to a 2:1 safety factor.

20.20.2 All structural load supporting elements of the aerial device that are made of a nonductile material shall have a design stress of not more than 50 percent of the minimum yield strength of the material based on the combination of the rated capacity and the dead load, which is equivalent to a 5:1 safety factor.
20.2.3 Wire ropes, chains, and attaching systems used to extend and retract the fly sections or booms shall have a 5:1 safety factor based on ultimate strength under all operating conditions allowed by the manufacturer.

20.2.3.1 The factor of safety for the wire rope shall remain above 2:1 during any extension or retraction system stall.

20.2.3.2 The minimum ratio of the diameter of wire rope used to the diameter of the sheave used shall be 1:12.

20.21 Stabilization.

20.21.1* The stability requirements defined in 20.21.2 and 20.21.3 shall be met by the apparatus that the aerial device is mounted on when that apparatus is in a service-ready condition but with all normally removable items such as water, hose, ground ladders, and loose equipment removed.

20.21.1.1 Items mounted on the aerial device by the manufacturer shall remain mounted.

20.21.1.2 Stabilizers shall be provided, if required, to meet the stability requirements of 20.21.2 and 20.21.3.

20.21.2 The aerial device shall be capable of sustaining a static load 1/1.5 times its rated capacity in every position in which the aerial device can be placed when the apparatus is on a firm and level surface.

20.21.3 Sloping Surface.

20.21.3.1 The aerial device shall be capable of sustaining a static load 1/1.5 times its rated capacity in every position in which the aerial device can be placed when the apparatus is on a slope of 5 degrees (8.7 percent) downward in the direction most likely to cause overturning.

20.21.3.2 If other capabilities, such as a means of turntable leveling, are provided to minimize the effect of the sloping surface, those capabilities shall be permitted to be utilized for the purpose of determining whether the apparatus meets this stability requirement.

20.21.4 If a stabilizer system is provided, it shall meet the requirements of 20.21.4.1 through 20.21.4.4.

20.21.4.1 If the stabilizer system is power operated, the controls shall be arranged so that the operator can view the stabilizers in motion.

20.21.4.1.1 An audible alarm, of not less than 87 dBA measured at any position the stabilizer can be in, shall sound when a stabilizer is moving.

20.21.4.1.2 An indicator(s) shall be provided to denote when the apparatus is operable within the manufacturer's range of level conditions.

20.21.4.1.3 Where the rated vertical height of the aerial device is 110 ft (34 m) or less, all stabilizers shall be deployed from the stored position to the operating position within 90 seconds.

20.21.4.2 The ground contact area for each stabilizer shall be such that a unit pressure of not greater than 75 psi (500 kPa) will be exerted over the ground contact area when the apparatus is fully loaded and the aerial device is carrying its rated capacity in every position permitted by the manufacturer.

20.21.4.2.1 The requirement defined in 20.21.4.2 shall be permitted to be accomplished with stabilizer pads in conjunction with the permanently mounted stabilizer shoes to meet the loading requirement of 75 psi (500 kPa) or less.

20.21.4.2.2 At a minimum, the stabilizer shoe shall be capable of swiveling on an axis parallel to the longitudinal axis of the apparatus.

20.21.4.3 All stabilizers that protrude beyond the body of the apparatus shall be stripped or painted with reflective material so as to indicate a hazard or obstruction.

20.21.4.4 All stabilizers that protrude beyond the body of the apparatus shall be provided with one or more red warning lights located either on the stabilizer or in the body panel above the stabilizer visible on the side of the apparatus where the stabilizer is located.

20.22 Quality Control.

20.22.1 The manufacturer and installer shall have in effect a complete and documented quality control program that will ensure complete compliance with the requirements of this standard.

20.22.2 The quality control program shall include 100 percent nondestructive testing of all critical structural components of the aerial device.

20.22.2.1 The manufacturer shall determine the types of nondestructive testing (NDT) to be conducted.

20.22.2.2 The procedures used for NDT shall comply with the applicable standards defined in 20.22.5.

20.22.2.3 All NDT procedures shall be fully documented with respect to the extent of the examination, the method of testing, and the inspection techniques.

20.22.2.4 All testing shall be performed by ASNT Level II NDT technicians or by an ASNT Level II technician under the supervision of an on-site Level II technician, all of whom have been certified in the test methods used in accordance with ASNT CP-189, Standard for Qualification and Certification of Nondestructive Testing Personnel.

20.22.3 Welder Certification.

20.22.3.1 Welds for all structural load supporting elements shall be performed by certified welders under the guidelines of AWS D1.1, Structural Welding Code — Steel; AWS D1.2, Structural Welding Code — Aluminum; and AWS D1.3, Structural Welding Code — Sheet Steel.

20.22.3.2 Welding performed by fabricators and welders approved by the Canadian Welding Bureau to Canadian Standards Association (CSA) W47.1, Standard for Certification of Companies for Fusion Welding of Steel Structures, or CSA W47.2, Certification of Companies for Fusion Welding of Aluminum, shall be considered as equivalent.

20.22.3.3 Welding performed by machines shall be considered equivalent to welding performed by certified welders.

20.22.4* The manufacturer and installer shall establish applicable welding quality assurance procedures for all weldments.

20.22.4.1 Methods of nondestructive testing shall be described in the manufacturer’s quality assurance procedures and shall be as recommended by AWS B1.10, Guide for the Nondestructive Inspection of Welds.

20.22.4.2 The manufacturer shall designate the welds to be examined, the extent of examination, and the type of testing.

20.22.5 Nondestructive Testing Procedure.

20.22.5.1 All ultrasonic inspections shall be conducted in accordance with the following ASTM standards:

(1) ASTM E 114, Standard Practice for Ultrasonic Pulse-Echo Straight-Beam Examination by the Contact Method

(2) ASTM E 797, Standard Practice for Measuring Thickness by Manual Ultrasonic Pulse-Echo Contact Method

20.22.5.2 All magnetic particle inspections shall be conducted in accordance with ASTM E 709, Standard Guide for Magnetic Particle Examination.

20.22.5.3 All liquid penetrant inspections shall be conducted in accordance with ASTM E 165, Standard Test Method for Liquid Penetrant Examinations.

20.22.5.4 All radiographic inspections shall be conducted in accordance with ASTM E 1032, Standard Test Method for Radiographic Examination of Weldments.

20.22.5.5 All electrical conductivity measurements shall be conducted in accordance with ASTM E 1004, Standard Practice for Determining Electrical Conductivity Using the Electromagnetic (Eddy-Current) Method.

20.22.5.6 All hardness readings shall be conducted in accordance with the following ASTM standards:

(1) ASTM E 6, Standard Terminology Relating to Methods of Mechanical Testing

(2) ASTM E 10, Standard Test Method for Brinell Hardness of Metallic Materials

(3) ASTM E 18, Standard Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials

(4) ASTM E 92, Standard Test Method for Vickers Hardness of Metallic Materials

(5) ASTM B 647, Standard Test Method for Indentation Hardness of Aluminum Alloys by Means of a Webster Hardness Gauge


20.22.5.7 All acoustic emission inspections shall be conducted in accordance with the following ASTM standards:

(1) ASTM E 569, Standard Practice for Acoustic Emission Monitoring of Structures During Controlled Stimulation

(2) ASTM E 650, Standard Guide for Mounting Piezoelectric Acoustic Emission Sensors

20.23 Instruction Plates and Signs.
20.23.1 Plates and signs that provide operational directions, warnings, and cautions shall be installed in positions visible to the operator(s).

20.23.1.1 Instruction plates shall describe the function and operation of each control.

20.23.1.2 Warning and caution signs shall indicate hazards inherent in the operation of the aerial device including, but shall not be limited to the following:

(1) Electrical hazards involved where the aerial device does not provide protection to the personnel from contact with, or in proximity to, an electrically charged conductor

(2) Electrical hazards involved where the aerial device does not provide protection to ground personnel who contact the apparatus when it is in contact with energized electrical conductors

(3) Hazards from stabilizer motion

(4) Hazards that can result from failure to follow manufacturer’s operating instructions.

20.23.2 Labels shall disclose the following information relative to the aerial device:

(1) Make
(2) Model
(3) Insulated or noninsulated
(4) Serial number
(5) Date of manufacture
(6) Rated capacity
(7) Rated vertical height
(8) Rated horizontal reach
(9) Maximum hydraulic system pressure, if applicable
(10) Hydraulic oil requirements (change quantity and type), if applicable

20.24 Certification Tests. The completed apparatus with the aerial device shall be tested to the criteria defined in this section and the test results certified by an independent third-party certification organization.

20.24.1 The aerial device shall be inspected and tested in accordance with the requirements of NFPA 1901, Standard for Testing Fire Department Aerial Devices: including all nondestructive testing, prior to being subjected to the tests defined in 20.24.2 through 20.24.4.

20.24.2 Stability Test.

20.24.2.1 The apparatus that the aerial device is mounted on shall be in a service-ready condition and shall be placed on a firm, level surface.

20.24.2.2 All normally removable items such as water, hose, ground ladders, and loose equipment shall be removed, but items mounted on the aerial device by the manufacturer shall remain. A self-educting master stream nozzle shall meet the requirements of Sections 21.3, 21.4, 21.6, 21.9, and 21.10.

20.24.2.3 If having the stabilizers extended is part of the configuration, the stabilizers shall be deployed to the point where the interlock system allows operation of the aerial device.

20.24.2.4 A load of 1/2\( \times \) times the rated capacity as specified by the manufacturer shall be suspended from the tip of the aerial ladder, or the platform of the elevating platform, when it is in the position of least stability.

20.24.2.5 If the manufacturer specifies a rated capacity while water is flowing, then one times the water load and the worst case nozzle reaction shall be added to the stability test weights.

20.24.2.6 For a water tower, the stability test shall include 1/2\( \times \) times the weight of the water in the system and 1/2\( \times \) times the maximum nozzle reaction force when it is in the position of least stability.

20.24.2.7* The apparatus shall show no signs of instability and the test shall not cause permanent deformation of any components.

20.24.2.8 If the aerial device is an aerial ladder or an elevating platform, the stability shall be further tested as defined in 20.24.2.8.1 through 20.24.2.8.4.

20.24.2.8.1 The apparatus that the aerial device is mounted on shall be placed on a firm surface sloping downward at 5 degrees (8.7 percent grade) in the direction most likely to cause overturning and shall be configured as defined in 20.24.2.2.

20.24.2.8.2 If having the stabilizers extended is part of the configuration, the stabilizers shall be deployed in accordance with the manufacturer’s recommendations.

20.24.2.8.3 A load of 1/2\( \times \) times the rated capacity shall be suspended from the tip of the aerial ladder or the platform of the elevating platform when it is in the position of least stability.

20.24.2.8.4 The apparatus shall show no signs of instability and the test shall not cause permanent deformation of any components.

20.24.3 If the aerial device is an aerial ladder, the test defined in 20.24.3.1 through 20.24.3.2 shall be conducted.

20.24.3.1 With the aerial ladder out of the cradle in the fully extended position at zero degrees elevation, a test load shall be applied in a horizontal direction normal to the ladder centerline.

20.24.3.1.1 For aerial ladders with a pre-piped waterway, a 350-lb (160-kg) test load shall be applied at the ladder tip.

20.24.3.1.2 For aerial ladders without a pre-piped waterway, a 220-lb (100-kg) test load shall be applied at the ladder tip.

20.24.3.2 The turntable shall not rotate and the ladder shall not deflect beyond the what the manufacturer’s specification allows.

20.24.4 Aerial Device Water System Test.

20.24.4.1 If the aerial device is equipped with a permanent water system and has a rated vertical height of 110 ft (34 m) or less, standard model flow test data shall be provided to the purchaser.

20.24.4.2 If the water system has been modified from the standard model configuration, a new flow test shall be conducted to determine that the friction loss in the water system between the base of the swivel and the monitor outlet does not exceed 100 psi (700 kPa) with 1000 gpm (4000 L/min) flowing and with the water system at full extension.

20.24.4.3 A flow test shall be conducted to determine that the water system is capable of flowing 1000 gpm (4000 L/min) at 100 psi (700 kPa) nozzle pressure with the aerial device at full elevation and extension.

20.24.4.3.1 Where the apparatus is equipped with a fire pump designed to supply the water system, the test shall be conducted using the onboard fire pump.

20.24.4.3.2 The intake pressure to the fire pump shall not exceed 20 psi (140 kPa).

20.25* Manufacturer’s Predelivery Test. If the aerial device is equipped with a permanent water delivery system, the manufacturer shall, prior to delivery of the apparatus, hydrostatically test the piping for the waterway system, including the monitor, at the maximum operating pressure required to flow 1000 gpm (4000 L/min) at 100 psi (700 kPa) nozzle pressure at maximum elevation and extension.

Chapter 21 Foam Proportioning Systems

21.1* Application. If the fire apparatus is equipped with a foam proportioning system, it shall comply with the applicable sections of this chapter.

21.2* Requirements by Type of Foam Proportioning System.

21.2.1* Eductor System. An eductor foam proportioning system shall meet the requirements of 21.3.1 through 21.3.6, 21.3.8, Sections 21.4 through 21.6, 21.9, and 21.10.


21.2.3 Intake-Side System. An intake-side foam proportioning system shall meet the requirements of Sections 21.3 through 21.6, 21.9, and 21.10.

21.2.4* Around-the-Pump System. An around-the-pump foam proportioning system shall meet the requirements of Sections 21.3 through 21.6, 21.9, and 21.10.

21.2.5 Balanced Pressure System. A balanced pressure foam proportioning system shall meet the requirements of Sections 21.3 through 21.10.

21.2.6* Direct Injection Systems. A direct injection foam proportioning system shall meet the requirements of Sections 21.3 through 21.7, 21.9, and 21.10.

21.2.7* Water-Powered Direct Injection Foam Proportioning System. A water motor or water turbine foam proportioning system shall meet the requirements of Sections 21.3 through 21.7, 21.9, and 21.10.

21.3 Design and Performance Requirements of a Foam System.
21.3.1* The proportioning system shall be capable of proportioning foam concentrate(s) in accordance with the foam concentrate manufacturer’s recommendations for the type of foam concentrate used in the system over the system’s design range of flow and pressures.

21.3.2 The purchaser shall specify the following:
   (1) Range of water flows and pressures
   (2) Proportioning rates
   (3) Types of concentrate(s) (Class A, Class B, etc.)
   (4) Brand and viscosity of concentrate

21.3.3 The apparatus shall be capable of supplying the power required by the foam proportioning system in addition to the requirements of the other power-dependent systems installed on the apparatus.

21.3.4* Components that are continuously wetted with foam concentrate shall be constructed of materials that will not be damaged in form, fit, or function, when exposed to foam concentrates, including the adverse effects of corrosion, formation of harmful solids, deterioration of gaskets and seals, binding of moving parts, and deterioration of the foam concentrate caused by contact with incompatible materials.

21.3.5 The foam proportioning components that can be flushed with water after use shall be constructed of materials that do not corrode after being flushed with water and allowed to dry. These components shall also be constructed of materials resistant to deterioration by foam concentrates.

21.3.6 The foam concentrate supply line shall not collapse under any operating conditions specified by the manufacturer of the foam proportioning system.

21.3.7 A means shall be provided to prevent water backflow into the foam proportioning system and the foam concentrate storage tank.

21.3.8 A device that consists of a removable element that does not restrict the full flow capacity of the foam supply line shall be provided on the foam concentrate supply side of the foam proportioner to prevent any debris that might affect the operation of the foam proportioning system from entering the system.

21.3.9 Flush Lines.

21.3.9.1 A foam concentrate system flush line(s) shall be provided as required by the foam system manufacturer.

21.3.9.2 A means shall be provided in the flush line(s) to prevent water backflow into the foam concentrate tank or water tank during the flushing operation.

21.3.9.3 Where the foam proportioning system is connected to more than one foam concentrate storage tank, provisions shall be made to flush all common lines to avoid contamination of dissimilar foam concentrates.

21.4 Controls for Foam Systems.

21.4.1* The foam proportioning system operating controls shall be located at the pump operator’s panel and shall be identified as required by 21.9.2.

21.4.2 Foam proportioning systems that require flushing after use shall be provided with controls accessible to the operator to completely flush the system with water according to the manufacturer’s instructions.

21.4.3 Foam proportioning systems that incorporate foam concentrate metering valves shall have each metering valve calibrated and marked with a plate to indicate the rate(s) of the foam concentrate proportioning available as determined by the design of the system.

21.4.4 Foam proportioning systems that incorporate automatic proportioning features shall be equipped with controls that enable the operator to isolate the automatic feature and operate the system.

21.5 Foam System Pressure Indicating Devices, Flowmeters, and Indicators.

21.5.1 The displays of all pressure indicating devices, flowmeters, and other indicators (e.g., fluid level indicators) shall be located so that they are visible from the pump operator’s position and shall meet the requirements of 4.10.3.

21.5.2 If analog pressure gauges are used, they shall meet the requirements of 21.5.2.1 through 21.5.2.4.

21.5.2.1 The gauge shall have a minimum accuracy of Grade B as defined in ASME B40.100, Pressure Gauges and Gauge Attachments.

21.5.2.2 Numerals for master gauges shall be a minimum of \( \frac{1}{2} \) in. (4 mm) high.

21.5.2.3 There shall be graduation lines showing at least every 10 psi (70 kPa), with major and intermediate graduation lines emphasized and figures at least every 100 psi (700 kPa).

21.5.2.4 Analog pressure gauges shall be vibration and pressure pulsation dampened be resistant to corrosion, condensation, and shock, and have internal mechanisms that are factory lubricated for the life of the gauge.

21.5.3 If digital pressure indicating devices are used, they shall meet the requirements of 21.5.3.1 through 21.5.3.3.

21.5.3.1 The digits shall be at least 0.25 in. (6.4 mm) high.

21.5.3.2 Digital pressure indicating devices shall display pressure in increments of not more than 10 psi (70 kPa).

21.5.3.3 Digital pressure indicating devices shall have an accuracy of ± 3 percent over the full scale.

21.5.4 Each pressure indicating device or flowmeter, and its respective display, shall be mounted and attached so it is protected from accidental damage and excessive vibration.

21.5.5 A gauge(s) shall be provided for balanced pressure foam proportioning systems that simultaneously indicates water pressure and foam concentrate pressure.

21.6 Atmospheric Foam Concentrate Tank. If the foam proportioning system incorporates an atmospheric foam concentrate tank, the requirements of 21.6.1 through 21.6.12 shall apply.

21.6.1 The foam concentrate tank or tanks shall be constructed of noncorrosive materials or other materials that are protected against corrosion or deterioration and that will not be adversely affected by the foam concentrate to be stored in the tank.

21.6.2 Swash Partitions.

21.6.2.1 All foam concentrate tanks shall be provided with swash partitions arranged such that the maximum dimension perpendicular to the plane of any partition shall not exceed 36 in. (900 mm).

21.6.2.2 The swash partition(s) shall extend from wall to wall and cover at least 75 percent of the area of the plane of the partition.

21.6.3 The foam concentrate tank shall be provided with a fill tower or expansion compartment having a minimum area of 12 in.\(^2\) (7500 mm\(^2\)) and having a volume of not less than 1 percent of the total tank volume.

21.6.3.1 The fill tower opening shall be protected by a completely sealed airtight cover.

21.6.3.2 The cover shall be attached to the fill tower by mechanical means.

21.6.3.3 The fill opening shall incorporate a removable screen with a mesh not to exceed \( \frac{1}{16} \) in. (6-mm) and shall be arranged so that foam concentrate from a 5-gal (19-L) container can be dumped directly to the bottom of the tank to minimize aeration without the use of funnels or other special devices.

21.6.4 The fill tower shall be equipped with a pressure/vacuum vent that enables the tank to compensate for changes in pressure or vacuum when filling or withdrawing foam concentrate from the tank.

21.6.4.1 The pressure/vacuum vent shall not allow atmospheric air to enter the foam tank except during operation or to compensate for thermal fluctuations.

21.6.4.2 The vent shall be protected to prevent foam concentrate from escaping or directly contacting the vent at any time.

21.6.4.3 The vent shall be of sufficient size to prevent tank damage during filling or foam withdrawal.

21.6.5 The foam concentrate tank shall not be equipped with an overflow pipe or any direct opening to the atmosphere.

21.6.6* The foam concentrate tank(s) shall be designed and constructed to facilitate complete interior flushing and cleaning as required.

21.6.7 Tank Drain.

21.6.7.1 A minimum \( \frac{1}{8} \)-in. (13-mm) valved drain shall be provided at the lowest point of any foam concentrate tank.

21.6.7.2 The drain shall be piped to drain directly to the surface beneath the apparatus without contacting other body or chassis components.

21.6.8* The foam concentrate tank shall be constructed and installed to be independent of the apparatus body.

21.6.9 The foam concentrate discharge system design shall prevent the siphoning of foam concentrate.

21.6.10 Labels.

21.6.10.1 A label that reads “Foam Tank Fill” shall be placed at or near any foam concentrate tank fill opening.
21.6.10.2* A label shall be placed at or near any foam concentrate tank fill opening that specifies the type(s) of foam concentrate the system is designed to use, any restrictions on the type(s) of foam concentrate that can be used with the system, and a warning message that reads “Warning: Do Not Mix Brands and Types of Foam.”

21.6.11 The foam concentrate tank outlet connection shall be designed and located to prevent aeration of the foam concentrate and shall allow withdrawal of 80 percent of the foam concentrate tank storage capacity under all operating conditions with the apparatus on level ground.

21.6.12 The foam concentrate tank inlet connection, if provided, shall prevent aeration of the foam concentrate under all operating conditions.

21.7* Foam Concentrate Pump. If the foam proportioning system is equipped with a foam concentrate pump, the requirements of 21.7.1 through 21.7.8 shall apply.

21.7.1 The foam concentrate pump shall operate without cavitation when delivering maximum rated flow.

21.7.2* The materials of construction for the foam concentrate pump shall be corrosion-resistant and compatible with the type of foam concentrate(s) listed on the plate required in 21.9.3.

21.7.3 Drivetrain components that transmit power to the foam concentrate pump shall be in accordance with the apparatus manufacturer’s design performance provided on the plate required in 21.9.3.

21.7.4 A means to relieve excess pressure in the foam concentrate pumping system shall be provided to protect the foam concentrate pump from damage.

21.7.5* Foam concentrate pumps that are intended to be supplied from an external source of foam concentrate shall be provided with an external valved intake and discharge connection.

21.8 Pressure Vessel Foam Concentrate or Foam Solution Tanks. If the foam proportioning system incorporates a pressure vessel foam concentrate tank, or the foam solution is contained in a pressure vessel, the requirements of 21.8.1 through 21.8.8 shall apply.

21.8.1 If the tank is charged with a compressed gas or a pressurized liquid, and it falls within the scope of the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, it shall be designed, fabricated, and stamped in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for the rated pressure.

21.8.2 Foam proportioning system piping and components shall be designed to withstand a minimum of 1.5 times the maximum working pressure of the pressure vessel and shall be tested to the working pressure of the pressure vessel after installation.

21.8.3 The pressure vessel tank shall be protected against corrosion from the foam concentrate or water stored in the tank.

21.8.4 If the tank is equipped with a gravity fill (has a fill cap), the fill opening shall be a minimum 2-in. (52-mm) inside diameter.

21.8.4.1 The fill cap shall be equipped with nontapered threads and a compressible gasket.

21.8.4.2 Special wrenches or tools required to tighten the fill cap shall be supplied by the manufacturer and shall be mounted adjacent to the fill cap.

21.8.4.3 A safety vent hole shall be located in the fill cap so that it vents the tank pressure while at least 3/4" threads remain engaged.

21.8.5 A minimum 1/8-in. (13-mm), manually operated, valved vent shall be provided on all pressure vessel tanks.

21.8.6 If the pressure vessel is charged with a compressed gas or a pressurized liquid, a relief valve that meets the applicable requirements of the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, shall be installed on the pressure vessel and set to prevent the vessel pressure from exceeding 110 percent of the maximum allowable working pressure.

21.8.7 A minimum 1/4-in. (13-mm), manually operated, valved drain connection shall be provided on all pressure vessel tanks.

21.8.8 A device indicating the internal pressure of the pressure vessel shall be located at the operator’s position.

21.9* Labels, Plates, and Instructions.

21.9.1 An instruction plate shall be provided for the foam proportioning system that includes, at a minimum, a piping schematic of the system and basic operating instructions.

21.9.2 Each control, gauge, and indicator necessary to operate the foam proportioning system shall be marked with a label as to its function.

21.9.3* A plate, located at the operator’s position, shall provide the following information pertaining to the operating specifications of the foam proportioning system:

1. Foam classification type (Class A, Class B, or Class A and B)
2. Types of foam concentrate(s) compatible with system design (see operating manual)
3. Proportioning rate (percent)
4. Maximum/minimum water flow (gpm)
5. Maximum/minimum operating pressure

21.9.4 Operations and Maintenance Manual

21.9.4.1 Two copies of an operations and maintenance manual shall be provided.

21.9.4.2 The manual shall include a complete diagram of the system together with operating instructions, system foam concentrate capabilities, original system calibration, and detailed outlining all recommended maintenance procedures.

21.10* Foam Proportioning System Accuracy.

21.10.1 The foam proportioning system shall be accurate throughout the manufacturer’s stated range of flow(s) and pressure(s).

21.10.2* The accuracy of the foam proportioning system shall be tested by the apparatus manufacturer prior to delivery of the apparatus.

21.10.2.1 Systems designed to produce foam solution at ratios of less than 1 percent shall proportion foam concentrate to an accuracy of ±0.1 to ±0.2 percent.

21.10.2.2 Systems designed to produce foam solution at ratios of 1 percent or greater shall proportion foam concentrate to an accuracy of ±0.3 to ±1 percent. However, whichever is less.

Chapter 22 Compressed Air Foam Systems

22.1* Application. If the fire apparatus is equipped with a compressed air foam system (CAFS), it shall comply with the applicable sections of this chapter.

22.2 General Requirements.

22.2.1* A foam proportioning system shall be used and shall comply with the applicable requirements of Chapter 19.

22.2.2 The total CAFS rating shall be expressed in terms of air and water flow.

22.2.2.1 The airflow shall be expressed in standard cubic feet per minute (SCFM) [cubic meters per minute (SCMS)] and shall be based on the continuous flow capacity of the compressed air source(s) at a minimum gauge pressure of 125 psi (862 kPa).

22.2.2.2 The water flow shall be expressed in gallons per minute (gpm) [liters per minute (L/min)] at a gauge pressure of 125 psi (862 kPa).

22.2.2.3 The apparatus shall be capable of supplying power for operating the CAFS at its rated capacity while simultaneously providing power to all other power-dependent systems installed on the apparatus.

22.2.4* On a CAFS, the water pump and air pressures shall be automatically balanced within ±10 percent up to the rated pressure of the air compressor.

22.2.5* A means shall be provided on the CAFS for the operator to relieve all pressure from the system after the system has been deactivated.

22.3 Compressed Air Source.

22.3.1 The compressed air source operating in clean environmental conditions shall be designed to provide a continuous rated air supply for a duration of 6 hours without needing adjustment, adding lubrication, or changing air filters.

22.3.2 Relief Valve.

22.3.2.1 The compressed air system shall be equipped with a relief valve that is set to prevent the compressed air system from exceeding 110 percent of the maximum allowable working pressure of the system.

22.3.2.2 The outlet of the relief valve shall be routed to an area that does not expose personnel to air blasts or cause the creation of dust.

22.3.3 If the possibility exists for moisture to build up in the compressed air system, the system shall be equipped with moisture traps and drains.

22.3.4 If a holding, surge, or separator tank (DOT tank or ASME pressure vessel) is provided, it shall comply with 29 CFR 1910.169, “Air receivers,” or equal for the rated pressure.
22.3.4.1 Transportable air tanks shall comply with 49 CFR 178.37, “Specification 3AA and 3AAX, seamless steel cylinders,” or 29 CFR 1910.160, “Air receivers.” Relief valves shall be of the ASME type on ASME cylinders and of the DOT type on DOT cylinders or equal for the rated pressure.

22.3.4.2 Valves installed on air tanks shall meet the requirements of the Compressed Gas Association or equivalent standards regarding pressure and usage with compressed air.

22.3.4.3 If the installation utilizes DOT cylinders, a label shall be placed on the operator’s panel indicating the test date stamped on the cylinders and the date the cylinders will next require testing.

22.4* Air Mixing.

22.4.1 An automatic means shall be provided to prevent the backflow of water or foam solution into the compressed air source, air into the water pump, and both water and air into the foam proportioning equipment.

22.4.2 A means of mixing air and foam solution that provides for a homogeneous mixture of compressed air and foam solution shall be provided on the CAFS.

22.5* Compressed Air System Piping. The discharge plumbing shall be configured to minimize the use of elbows or abrupt turns.

22.6 Air Source Controls.

22.6.1 All compressed air source controls shall be located at the pump operator’s panel and shall be identified with a plate in accordance with the requirements of 22.8.1.

22.6.2 Compressed air systems that require flushing after use shall be provided with controls that are accessible to the operator and enable the operator to completely flush the system with water according to the manufacturer’s instructions.

22.7 Foam System Pressure Indicating Devices, Flowmeters, and Indicators.

22.7.1 The displays of all pressure indicating devices, flowmeters, and indicators (e.g., fluid level indicators) shall be located so they are visible from the pump operator’s position and shall meet the requirements of 4.10.3.

22.7.2 If analog pressure gauges are used, they shall meet the requirements of 22.7.2.1 through 22.7.2.4.

22.7.2.1 The analog pressure gauge shall have a minimum accuracy of Grade B as defined in ASME B40.100, Pressure Gauges and Gauge Attachments.

22.7.2.2 Numerals for master gauges shall be a minimum of \( \frac{3}{4} \) in. (4 mm) high.

22.7.2.3 There shall be graduation lines showing at least every 10 psi (70 kPa), with major and intermediate graduation lines emphasized and figures at least every 100 psi (700 kPa).

22.7.2.4 Analog pressure gauges shall be vibration and pressure pulsation dampened, be resistant to corrosion, condensation, and shock, and have internal mechanisms that are factory lubricated for the life of the gauge.

22.7.3 If digital pressure indicating devices are used, they shall meet the requirements of 22.7.3.1 through 22.7.3.3.

22.7.3.1 The digits shall be at least 0.25 in. (6.4 mm) high.

22.7.3.2 Digital pressure indicating devices shall display pressure in increments of not more than 10 psi (70 kPa).

22.7.3.3 Digital pressure indicating devices shall have an accuracy of \( \pm 3 \) percent over the full scale.

22.7.4 Each pressure indicating device and flowmeter, and its respective display, shall be mounted and attached so it is protected from accidental damage and excessive vibration.

22.7.5 If flowmeters are provided, they shall meet the requirements of 22.7.5.1 and 22.7.5.2.

22.7.5.1 Flowmeter displays shall be located at the pump operator’s panel and shall indicate the airflow in standard cubic feet per minute (SCFM) [cubic meters per minute (SCMS)] and indicate the water flow in gallons per minute (gpm) [liters per minute (L/min)].

22.7.5.2 Flowmeters shall be rated to a hydrostatic burst gauge pressure of 500 psi (3400 kPa) if located on the pressure side of the system.

22.7.6* A pressure indicating device shall be provided for the compressed air source.

22.8 Labels and Instruction Plates.

22.8.1 A plate indicating the identification, function, and operation shall be provided for each control, gauge, and indicator required to operate the compressed air foam system.

22.8.2 A label shall be provided at the pump operator’s panel that gives the rated continuous flow capacity of the compressed air source at a gauge pressure of 125 psi (862 kPa).

22.8.3 An instruction plate shall be provided at the pump operator’s panel that states the following:

(1) Open and close valves slowly.

(2) Do not run with just air/water.

(3) Shut off air when foam tank is empty.

(4) Be prepared for high nozzle reactions — open nozzle slowly.

22.9* Manufacturer’s Predelivery Tests. The manufacturer shall conduct the following tests prior to delivery of the apparatus.

22.9.1 CAFS Capacity Rating Test.

22.9.1.1 The operation of the water pump and the compressed air source shall be tested simultaneously to determine the integrity of the system and to ensure that the power available is capable of operating these components of the CAFS simultaneously.

22.9.1.1.1 The compressed air source shall be operated at its flow capacity at a minimum gauge pressure of 125 psi (862 kPa), and the water pump shall discharge 2 gpm (7.6 L/min) of water at 125 psi (862 kPa) net pump pressure for every 1 SCFM (0.000472 SCMS) of compressed air discharge.

22.9.1.1.2 The discharge shall be through at least two separate discharge openings, one discharging air only and the other discharging water only.

22.9.1.2 One or more lines of fire hose of sufficient diameter shall be provided to allow discharge of the required amount of water from the pump to a nozzle or other flow-measuring equipment without exceeding a flow velocity of 35 ft/sec (10.7 m/sec) [approximately 500 gpm (2000 L/min) for 2 1/2-in. (65-mm) hose].

22.9.1.2.1 The discharge shall be measured using a smoothbore nozzle and pilot tube or other equipment such as flowmeters, volumetric tanks, or weigh tanks.

22.9.1.2.2 Test gauges shall meet the requirements of 16.13.2.2.4 and 16.13.2.2.5.

22.9.1.3 The airflow rate shall be measured using a pressure and temperature compensated flow-measuring device.

22.9.1.3.1 The airflow shall be measured in SCFM at a minimum gauge pressure of 125 psi (862 kPa).

22.9.1.3.2 The airflow-measuring device shall have been calibrated for accuracy within the previous 3 months.

22.9.1.3.3* The air discharge outlet shall have nothing attached directly to it except the test device(s).

22.9.1.4 The water pump and the compressed air source shall be started and the rated flows and pressures as specified in 22.9.1.1.1 shall be established and maintained.

22.9.1.4.1 The system shall be run for 1 hour.

22.9.1.4.2 Readings of the airflow rate and pressure and the water pump pressure and discharge rate shall be taken at least every 10 minutes.

22.9.1.5 Failure of any component of the CAFS to maintain air and water pressures and discharge volumes at or above the system rating shall constitute failure of the test.

22.9.2* Standby Run Test.

22.9.2.1 One 200-ft (60-m) line of 1 1/2-in. (38-mm) hose shall be connected to the discharge of the CAFS and shall be stretched out on level ground.

22.9.2.2 A quarter-turn valve of the same nominal size as the hose shall be installed at the discharge end.

22.9.2.3 The hose shall be restrained immediately behind the valve at the discharge end to prevent uncontrollable movement when the valve is opened.

22.9.2.4 Operating as a CAFS, with a gauge pressure air output at 125 psi (862 kPa), a foam flow shall be established in the hose line.

22.9.2.5 With the water tank at the half full level, the valve at the discharge end of the hose shall be shut no faster than in 3 seconds and no slower than in 10 seconds.
22.9.2.6 The engine(s) speed shall be maintained for 10 minutes without discharging water, air, or foam solution from the CAFS and without operator intervention.

22.9.2.7 A bypass line shall be permitted to be opened temporarily, if needed, to keep the water temperature in the pump within acceptable limits.

22.9.2.8 At the end of 10 minutes, the valve shall be reopened no faster than in 3 seconds and no slower than in 10 seconds.

22.9.2.9 Either damage to the system that affects its rated performance characteristics or the lack of a fire stream immediately upon opening the hose line shall constitute failure of this test.

Chapter 23 Line Voltage Electrical Systems

23.1 Application. Where any part of a line voltage electrical system is provided as a fixed installation, the applicable requirements of this chapter shall apply.

23.2 General Requirements.

23.2.1 Any fixed line voltage power source producing alternating current (ac) line voltage shall produce electric power at 60 cycles ±5 cycles.

23.2.2 Conformance with the National Electrical Code®.

23.2.2.1 All components, equipment, and installation procedures shall conform to NFPA 70, National Electrical Code, except where superseded by the requirements of this chapter.

23.2.2.2 Where the requirements of this chapter differ from those in the NFPA 70, National Electrical Code, the requirements in this chapter shall apply.

23.2.3* When available, line voltage electrical system equipment and materials included on the apparatus shall be listed and used only in the manner for which they have been listed.

23.2.4 All equipment and materials shall be installed in accordance with the manufacturer's instructions.

23.2.5 Location Ratings.

23.2.5.1 Any equipment used in a dry location shall be listed for dry locations.

23.2.5.2 Any equipment used in a wet location shall be listed for wet locations.

23.2.5.3 Any equipment, except a power take-off driven generator, used in an underbody or underchassis location that is subject to road spray shall be either listed as Type 4 or mounted in an enclosure that is listed as Type 4.

23.2.5.4* If a power take-off driven generator is located in an underbody or underchassis location, the installation shall include a shield to prevent road spray from splashing directly on the generator.

23.3 Grounding and Bonding.

23.3.1* Grounding. Grounding shall be in accordance with Section 250.34, “Portable and Vehicle-Mounted Generators,” of NFPA 70, National Electrical Code.

23.3.1.1 Ungrounded systems shall not be used.

23.3.1.2 Only stranded or braided copper conductors shall be used for grounding and bonding.

23.3.1.3 An equipment grounding means shall be provided in accordance with Section 250.62, “Grounding Electrode Conductive Material”; Section 250.118, “Types of Equipment Grounding Conductors”; and Section 250.54, “Supplementary Grounding Electrodes,” of NFPA 70.

23.3.1.4 The grounded current-carrying conductor (neutral) shall be insulated from the equipment grounding conductors and from the equipment enclosures and other grounded parts.

23.3.1.5 The neutral conductor shall be colored white or gray in accordance with Section 200.6, “Means of Identifying Grounded Conductors,” of NFPA 70.

23.3.1.6 Any bonding screws, straps, or buses in the distribution panelboard or in other system components between the neutral and equipment grounding conductor shall be removed and discarded.

23.3.2 Bonding.

23.3.2.1 The neutral conductor of the power source shall be bonded to the vehicle frame.

23.3.2.2 The neutral bonding connection shall only occur at the power source.

23.3.2.3 In addition to the bonding required for the low-voltage return current, each body and each driving or crew compartment enclosure shall be bonded to the vehicle frame by a copper conductor.

23.3.2.3.1 The conductor shall have a minimum amperage rating of 115 percent of the nameplate current rating of the power source specification label as defined in Section 310.15, “Ampacities for Conductors Rated 0-2000 Volts,” of NFPA 70.

23.3.2.3.2 A single conductor that is sized to meet the low-voltage and line voltage requirements shall be permitted to be used.

23.4 Power Source General Requirements. The following requirements shall apply to all line voltage power sources.

23.4.1 All power source system mechanical and electrical components shall be sized to support the continuous duty nameplate rating of the power source.

23.4.2 The power source shall be shielded from contamination that will prevent the power source from operating within its design specifications.

23.4.3 Guards shall be provided to protect personnel from moving parts and any surface with a temperature of 151°F (55°C) or higher.

23.4.4 For power sources of 8 kW or larger, the power source manufacturer shall certify that the power source is capable of supplying the continuous duty rating on the power source specification label at 120°F (49°C) air intake temperature.

23.4.5 Access shall be provided to permit both routine maintenance and removal of the power source for major servicing.

23.4.6 The power source shall be located such that neither it nor its mounting brackets interfere with the routine maintenance of the fire apparatus.

23.4.7 The instrumentation shall be permanently mounted at an operator's panel.

23.4.7.1 The instruments shall be located in a plane facing the operator.

23.4.7.2 Gauges, switches, or other instruments on this panel shall each have a label to indicate their function.

23.4.8 Instrumentation.

23.4.8.1 If the power source is rated at less than 3 kW, a “power on” indicator shall be provided.

23.4.8.2 If the power source is rated at 3 kW or more but less than 8 kW, a voltmeter shall be provided.

23.4.8.3* If the power source is rated at 8 kW or more, the following instrumentation shall be provided at an operator's panel:

(1) Voltmeter
(2) Current meters for each ungrounded leg
(3) Frequency (cycle) meter
(4) Power source hourmeter

23.4.9 An instruction plate(s) that provides the operator with the essential power source operating instructions, including the power-up and power-down sequence, shall be permanently attached to the apparatus at any point where such operations can take place.

23.4.10* Operation.

23.4.10.1 Provisions shall be made for placing the generator drive system in operation using controls and switches that are identified and within convenient reach of the operator.

23.4.10.2 Where the generator is driven by the chassis engine and engine compression brakes or engine exhaust brakes are furnished, they shall be automatically disengaged for generator operations.

23.4.10.3 Where the generator is driven by the chassis engine and an automatic fan clutch is furnished, the fan shall be engaged for generator operations.

23.4.10.4* Any control device used in the generator system power train between the engine and the generator shall be equipped with a means to prevent unintentional movement of the control device from its set position in the power generation mode.

23.4.11 If there is permanent wiring on the apparatus that is designed to be connected to the power source, a power source specification label that is permanently attached to the apparatus at the operator’s control station shall provide the operator with the information detailed in Figure 23.4.11.
23.6.1 Direct Drive (PTO) Generators.


23.6.1.2* The main propulsion engine shall have a governor capable of maintaining the engine speed within the limits required by the generator to meet the frequency control specifications.

23.6.1.3 An interlock system shall be provided to prevent advancement of the engine speed in the driving compartment or at any operator’s panel unless the transmission is in neutral and the parking brake is engaged, or the apparatus is in the “OK to Pump” or “OK to Operate Generator” mode.

23.6.2 Hydraulically Driven Generators.


23.6.2.2* A means shall be provided to activate the hydraulic generator system.

23.6.2.3 A hydraulic generator system shall operate at all engine speeds, or an automatic engine speed control system shall be provided.

23.6.2.4 If the apparatus is equipped with a fire pump driven by the chassis engine, the generator shall be capable of output at idle as specified on the power source specification label.

23.6.2.5 Hydraulic Components.

23.6.2.5.1 A hydraulic system filter and strainer shall be provided and shall be located in a readily accessible area.

23.6.2.5.2 Hydraulic hose shall meet the hydraulic pump manufacturer’s recommendations for pressure, size, vacuum, and abrasion resistance.

23.6.2.5.3* Hydraulic fittings shall meet the hydraulic pump manufacturer’s recommendations for pressure, size, and the type of hose used.

23.6.2.5.4 Where the hydraulic hose comes into contact with other surfaces, the hose shall be protected from chaffing.

23.6.3 Fixed Auxiliary Engine-Driven Generators.

23.6.3.1 The generator shall comply with Article 445, “Generators,” of NFPA 70, National Electrical Code.

23.6.3.2* Power sources powered by a non-chassis engine shall include the following equipment or shall be installed as follows:

(1) Power sources shall be installed so that fumes, vapors, heat, and vibrations do not enter the interior passenger compartment.

(2) Power sources shall have the exhaust outlet piped to the exterior and located so that exhaust is directed away from any operator’s position.

(3) Generators 8 kW and over shall be equipped with a high-temperature automatic shut down system and low oil automatic shut down.

(4) Generators shall be installed in accordance with manufacturer’s installation requirements for ventilation and service accessibility.

(5) Generators installed in compartments requiring the compartment doors to be open during operation shall be equipped with a compartment door interlock system, or the compartment shall be equipped with a high-temperature alarm.

(6) Generators installed in compartments on slide trays and designed for operation in the “slide out” position shall have interlocks to assure such operation or the compartment shall be equipped with a high-temperature alarm.

(7) Permanently installed generators shall have easily accessible engine oil drain provisions or piping to a remote location for oil changing.

(8) Generators located away or remote from the main operator’s area (top of apparatus, over pump, hidden in body, etc.) shall have a remote operating panel with required instrumentation, start and stop controls, and other controls necessary for safe operation.

23.6.3.3 Fuel System.

23.6.3.3.1 Fuel lines shall be protected from chaffing at all wear points.

23.6.3.3.2 If the fuel source is shared with the apparatus engine, a separate fuel pickup system shall be provided that is arranged to ensure that the generator cannot utilize more than 75 percent of the fuel tank’s capacity.

23.6.3.4 Exhaust System.

23.6.3.4.1* The exhaust piping and discharge shall be located or shielded to prevent thermal damage to the apparatus or equipment.

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

23.6.3.4.3 Silencing devices shall be provided and shall not create exhaust backpressure that exceeds the limits specified by the engine manufacturer.

23.6.4 Belt-Driven Generators or Alternators Supplying a Dedicated Inverter.

23.6.4.1 A means shall be provided to engage and disengage the generator.

23.6.4.2 A voltmeter shall be provided at the operator’s panel for all sizes of systems of this type.

23.6.4.3 The belt drive system shall be rated to drive the generator or alternator at the system performance label rating.

23.6.5 Line Voltage Systems Derived from Apparatus Low-Voltage Power Supply Systems.

23.6.5.1* Where a line voltage power source derives its input energy from the apparatus low-voltage electrical system, the system shall be installed in strict compliance with the requirements of Chapter 11.

23.6.5.2 The alternator and/or battery system shall be adequate to provide power to the power source for continuous operation for a minimum of 2 hours at full output.
23.6.5.3 A means that works in coordination with other engine speed controls and interlocks required by this standard shall be provided to advance engine speed to obtain the power stated on the power source specification label.

23.7* Portable Generator Installations. The generator shall comply with Article 445, “Generators,” of NFPA 70, National Electrical Code.

23.7.1 Any portable generator that can be operated while mounted on the apparatus shall be as follows:

1. Installed so that fumes, vapors, heat, excessive noise, and vibrations do not enter interior driving or crew compartments or damage the generator during operation
2. Have the exhaust outlet located so that exhaust is directed away from any operator station located on the apparatus and guarded to protect the operator
3. If the portable generator is remotely mounted, it shall have a remote operator’s control station that shall provide a means for starting and stopping the generator and monitoring the same instrumentation as is required for fixed power sources.

23.7.3 Wiring for Portable Generator Installations. Wiring installed for the purpose of facilitating the distribution of power from a portable generator installation shall conform to the following additional requirements.

23.7.3.1 Circuit conductors shall be sized in relation to the system performance specification label rating and shall be protected by an overcurrent device commensurate with their amperage capacities.

23.7.3.2 There shall be a single output connector cord with all of the conductors in the cord sized to carry a minimum of 115 percent of the nameplate amperage.

23.7.3.3 If there is not an overcurrent protection device at the power source, the output connector cord shall not exceed 72 in. (2 m) in length and shall be connected to an overcurrent protection device.

23.7.3.4 The size of the main overcurrent protection device shall equal the nameplate amperage rating on the power source specification label or the rating of the next larger available size overcurrent protection device where so recommended by the power source manufacturer.

23.7.4 If a connecting plug is required, it shall be sized in relation to the system and conform to NEMA configurations for plugs.

23.8 Line Voltage Supplied from an External Source.

23.8.1* If the apparatus is equipped with a fixed power inlet (shoreline inlet), it shall be a permanently mounted, flanged surface inlet (male recessed–type receptacle with cover) sized in accordance with the anticipated load and wired directly to the system or device to be powered or wired to a transfer switch where required by 23.8.2.

23.8.2 Transfer Switch Applications.

23.8.2.1 A transfer switch shall be required to isolate one power source from the other where a circuit(s) is intended to be supplied from more than one power source.

23.8.2.2* Transfer equipment, including transfer switches, shall operate such that all ungrounded conductors of one power source are disconnected before any ungrounded conductors of the second power source are connected.

23.8.3 The apparatus shall have a label permanently affixed at the power inlet that indicates the information shown in Figure 23.8.3.

![Shore Power Inlet](image)

**Figure 23.8.3 Power Inlet Label**

23.9 Power Supply Assembly.

23.9.1 The conductors used in the power supply assembly between the output terminals of the power source and the main overcurrent protection device shall not exceed 144 in. (4 m) in length.

23.9.2 All power supply assembly conductors, including neutral and grounding conductors, shall have an equivalent amperage rating and shall be sized to carry not less than 115 percent of the amperage of the nameplate current rating of the power source.

23.9.3 For fixed power supplies, all conductors in the power supply assembly shall be Type THHW, THW, USE, THWN, or XHHW stranded conductors enclosed in nonmetallic liquidtight flexible conduit rated for a minimum of 194°F (90°C).

23.9.4 For portable power supplies, conductors located between the power source and the line side of the main overcurrent protection device shall be Type SO or Type SEO with suffix WA flexible cord, rated for 600 volts at 194°F (90°C).

23.10 Overcurrent Protection. Manually resettable overcurrent devices shall be installed to protect the line voltage electrical system components.

23.10.1 Power Source Protection. A main overcurrent protection device shall be provided that is either incorporated in the power source or is connected to the power source by a power supply assembly.

23.10.1.1 The size of the main overcurrent protection device shall not exceed 100 percent of the nameplate amperage rating on the power source specification label or the rating of the next larger available size overcurrent protection device, where so recommended by the power source manufacturer.

23.10.1.2 If the main overcurrent protection device is subject to road spray, the unit shall be housed in a Type 4 rated enclosure.

23.10.2 Branch Circuit Overcurrent Protection. Overcurrent protection devices shall be provided for each individual circuit and shall be sized at not less than 15 amps in accordance with Section 240.4, “Protection of Conductors,” of NFPA 70, National Electrical Code.

23.10.2.1 Any panelboard shall have a main breaker when the panel has six or more individual branch circuits, or the power source is rated 8 kW or larger.

23.10.2.2 Each overcurrent protection device shall be marked with a label to identify the function of the circuit it protects.

23.10.2.3 Dedicated circuits shall be provided for any large appliance or device (air-conditioning units, large motors, etc.) that requires 60 percent or more of the rated capacity of the circuit to which it is connected and that circuit shall serve no other purpose.

23.10.3 Panelboards. All fixed power sources shall be hardwired to a permanently mounted panelboard unless the following situations exist:

1. All line voltage power connections are made through receptacles on the power source and the receptacles are protected by integrated overcurrent devices
2. Only one circuit is hardwired to the power source, which is protected by an integrated overcurrent device

23.10.3.1 The panel shall be visible and located so that there is unimpeded access to the panelboard controls.

23.10.3.2 All panelboards shall be designed for use in their intended location.

23.11 Wiring Methods. Fixed wiring systems shall be limited to the following:

1. Metallic or nonmetallic liquidtight flexible conduit rated at not less than 194°F (90°C)
2. Type SO or Type SEO cord with a WA suffix, rated at 600 volts at not less than 194°F (90°C)

23.11.1 Electrical cord or conduit shall not be attached to chassis suspension components, water or fuel lines, air or air brake lines, fire pump piping, hydraulic lines, exhaust system components, or low-voltage wiring and shall be arranged as follows:

1. Separated by a minimum distance of 12 in. (300 mm) from exhaust piping or shielded from such piping
2. Separated from fuel lines by a minimum distance of 6 in. (150 mm)

23.11.2 A means shall be provided to allow “flexing” between the driving and crew compartment, the body, and other areas or equipment whose movement would stress the wiring.

23.11.3 Electrical cord or conduit shall be supported within 6 in. (150 mm) of any junction box and at a minimum of every 24 in. (600 mm) of run.

23.11.3.1 Supports shall be made of nonmetallic materials or corrosion-resistant or corrosion-protected metal.

23.11.3.2 All supports shall be of a design that does not cut or abrade the conduit or cord and shall be mechanically fastened to the apparatus.

23.11.4 Only fittings and components listed for the type of cord or conduit being installed shall be used.

23.11.5 Splices shall be made only in a listed junction box.
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23.11.6 Additional Requirements for Type SO or Type SEO Cord Installations.

23.11.6.1 Where Type SO or Type SEO cord is installed in a compartment, it shall be installed on the ceiling surface or shall be enclosed in a metal conduit or enclosure with a minimum thickness of 16 MSG.

23.11.6.2 Where Type SO or Type SEO cord penetrates a metal surface, rubber or plastic grommets or bushings shall be installed.

23.11.7 Wiring Identification.

23.11.7.1 Each line voltage circuit originating from the main panelboard shall be identified.

23.11.7.2 The wire or circuit identification shall either reference a wiring diagram or wire list, or shall indicate the final termination point of the circuit.

23.11.7.3 When prewiring for future power sources or devices exists, the unterminated ends shall be marked with a label showing their wire size and intended function.

23.12 Wiring System Components.

23.12.1 Only stranded copper conductors with an insulation rated for at least 194°F (90°C) shall be used.

23.12.1.1 Conductors in Type SO or Type SEO cord shall be sized in accordance with Table 400.5(A) of NFPA 70, National Electrical Code.

23.12.1.2 Conductors used in conduit shall be sized in accordance with Section 310.15, “Amperages for Conductors Rated 0-2000 Volts,” of NFPA 70.

23.12.1.3 Aluminum or copper-clad aluminum conductors shall not be used.

23.12.2 All boxes shall conform to and be mounted in accordance with Article 314, “Outlet, Device, Pull, and Junction Boxes; Conduit Bodies; Fittings; and Manholes,” of NFPA 70.

23.12.2.1 All boxes shall be accessible using ordinary hand tools.

23.12.2.2 Boxes shall not be permitted behind welded or pop-riveted panels.

23.12.2.3 The maximum number of conductors permitted in any box shall be in accordance with Section 314.16, “Number of Conductors in Outlet, Device, and Junction Boxes, and Conduit Bodies” of NFPA 70.

23.12.3* All wiring connections and terminations shall provide a positive mechanical and electrical connection.

23.12.3.1 Connectors shall be installed in accordance with the manufacturer’s instructions.

23.12.3.2 Wire nuts or insulation displacement and insulation piercing connectors shall not be used.

23.12.4 Each switch shall indicate the position of its contact points (i.e., open or closed) and shall be rated for the continuous operation of the load being controlled.

23.12.4.1 All switches shall be marked with a label indicating the function of the switch.

23.12.4.2* Circuit breakers used as switches shall be “switch rated” (SWD) or better.

23.12.4.3 Switches shall simultaneously open all associated line voltage conductors.

23.12.4.4 Switching of the neutral conductor alone shall not be permitted.

23.12.4.5 Line voltage circuits controlled by low-voltage circuits shall be wired through properly rated relays in listed enclosures that control all nongrounded current-carrying conductors.

23.12.5 Receptacles and Inlet Devices.

23.12.5.1* Wet and Dry Locations.

23.12.5.1.1* All wet location receptacle outlets and inlet devices including those on hardwired, remote power distribution boxes, shall be of the grounding type, provided with a wet location cover, and installed in accordance with Section 210-7, “Branch Circuit Receptacle Requirements,” of NFPA 70, National Electrical Code.

23.12.5.1.2 All receptacles located in a wet location shall be not less than 24 in. (600 mm) from the ground.

23.12.5.1.3* Receptacles on off-road fire apparatus shall be a minimum of 30 in. (750 mm) from the ground.

23.12.5.2 All receptacles located in a dry location shall be of the grounding type and shall be at least 12 in. (300 mm) above the interior floor height.

23.12.5.3 No receptacle shall be installed in a face-up position.

23.12.5.4 The face of any wet location receptacle shall be installed in a plane from vertical to not more than 45 degrees off vertical.

23.12.5.5 Receptacle Label.

23.12.5.5.1 Each receptacle shall be marked with a label indicating the nominal line voltage (120 volts or 240 volts) and the current rating in amps of the circuit.

23.12.5.5.2 If the receptacle is dc or other than single phase, that information shall also be marked on the label.

23.12.5.6* All receptacles and electrical inlet devices shall be listed to UL 498, Standard for Safety Attachment Plugs and Receptacles, or other recognized performance standards.

23.12.5.7 Receptacles used for dc voltages shall be rated for dc service.

23.13 Cord Reels.

23.13.1 The power rewind cord reel spool area shall be visible to the operator during the rewind operation, or the reel spool shall be encapsulated to prevent cord from spooling off the reel.

23.13.2 Rollers or guides shall be provided, where required, to prevent damage to the cord at reel spools or compartment openings.

23.13.3 Rewind Provision.

23.13.3.1 Manually operated reels shall have a hand crank.

23.13.3.2 Power rewind–type reels shall have the control in a position where the operator can observe the rewinding operation. If a reel is in an enclosure or out of direct view, the cord entry point to the enclosure shall be visible to the operator of the reel control.

23.13.3.3 The rewind control or crank shall not be over 72 in. (1830 mm) above the operator’s standing position.

23.13.3.4 The rewind control shall be marked with a label indicating its function and shall be guarded to prevent accidental operation.

23.13.4* The reel shall be designed to hold 110 percent of the capacity needed for the intended cord length.

23.13.5* The wire size shall be in accordance with NFPA 70, National Electrical Code, Table 400.5(A).

23.13.6* Electrical cord shall be Type SEOOW-A, Type SOOW-A, or Type STOOW-A.

23.13.7* A label that indicates the following information shall be provided in a visible location adjacent to any permanently connected reel.

1. Current rating
2. Current type
3. Phase
4. Voltage
5. Total cord length

23.13.8 Where a power distribution box is hardwired to the end of a cord that is stored on a fixed cord reel or other fixed storage means, the requirements in 23.13.8.1 through 23.13.8.6 shall apply.

23.13.8.1 The remote power distribution box shall be listed for use in a wet location.

23.13.8.2* The distribution box shall be as follows:

1. Protected from corrosion
2. Capable of being carried with a gloved hand
3. Designed to keep the exterior electrical components above 2 in. (51 mm) of standing water

23.13.8.3* Inlets, receptacles, circuit breakers, or GFCI devices shall not be mounted on the top surface of the horizontal plane.

23.13.8.4 Branch circuit breakers shall be installed in the remote power distribution box if the overcurrent device protecting the feed cord to the box is too large to protect the wiring supplying the devices plugged onto the distribution box.
23.13.8.5* Remote power distribution boxes shall have a light on the box to indicate the power is on.

23.13.8.5.1* The light shall be visible in a 360-degree plane from a minimum of 200 ft (60 m) in complete darkness.

23.13.8.5.2 The light shall be mechanically protected to prevent damage.

23.13.8.6 The hardwired portable cord connection to the box shall have strain relief and meet the intended usage requirements.

23.14 Scene Lighting Systems. Where fixed scene lights are supplied, the requirements in 23.14.1 through 23.14.4 shall apply.

23.14.1 All scene lights shall be provided with a lens or a means for preventing damage from water spray and shall be listed for wet location usage.

23.14.2 Handle on Lights.

23.14.2.1 If the light is adjustable, a handle shall be provided.

23.14.2.2 The design of the light shall not allow the temperature of the handle to exceed 131°F (55°C).

23.14.3 The manufacturer of the device shall type certify that the scene light has been tested and complies with the vibration testing requirements of SAE J575, Test Methods and Equipment for Lighting Devices and Components for Use on Vehicles Less Than 2032 mm in Overall Width.

23.14.4 If manually operated floodlights are not operable from the ground, access steps that meet the requirements of Section 15.7 and handrails that meet the requirements of Section 15.8 shall be provided to allow the user to reach the floodlights.

23.15 Power-Operated Light Mast.

23.15.1* General.

23.15.1.1 The mast shall be designed to sustain the intended tip load with at least a 125 percent safety factor.

23.15.1.2 The mast shall withstand a minimum of a 50-mph (80 kph) wind in a raised, unguayed position.

23.15.2* Installation and Operational Requirements.

23.15.2.1 The mast shall be capable of being raised within 2 minutes.

23.15.2.2 Where the installation precludes the operator from seeing the light in its nested position, a means shall be provided to allow the operator to align the light for nesting when the operator is at the operator’s position.

23.15.2.3* Appropriate warning labels on the hazards of electrocution shall be installed.

23.15.2.4 A means shall be provided to prevent operations that could cause damage to the power supply conductors.

23.15.2.5 In the event of a failure of the light tower’s raising system while the tower is deployed or being deployed, a means shall be provided to limit the rate of descent in order to prevent injury to equipment or personnel.

23.15.2.6 A secondary means of control shall be provided to allow for emergency lowering of the mast.

23.15.2.7 Where the tower is powered by the chassis air brake system, the air supply shall be from an auxiliary air circuit that is equipped with a pressure protection valve and an auxiliary air tank(s).

23.15.2.8* An automatic deenergizing means shall be provided so there is no electrical power to the mast or to the light wiring when the mast is in a stowed position.

23.15.2.9 The hazard warning light required in Section 13.11 shall be illuminated whenever the raised tower is not in the stowed position.

23.15.2.10 The operational envelope of the mast shall be automatically illuminated whenever the mast assembly is being raised, lowered, or rotated.

23.15.3 Labeling.

23.15.3.1 An instruction plate showing the operation of the mast and operational warning signs shall be provided at the operator’s position.

23.15.3.2 A label shall be provided at the operator’s position to indicate the following:

(1) Extended tower height from the ground
(2) Bulb replacement data

23.16* Electrical System Testing.

23.16.1 The wiring and associated equipment shall be tested by the apparatus manufacturer or the installer of the line voltage system.

23.16.2 Dielectric Voltage Withstand Test.

23.16.2.1 The wiring and permanently connected devices and equipment shall be subjected to a dielectric withstand test of 900 volts for 1 minute.

23.16.2.2 The dielectric tester shall have a 500 volt-amperes (VA) or larger transformer, with a sinusoidal output voltage that can be verified.

23.16.2.3 The testing shall be performed after all body work has been completed.

23.16.2.4* The test shall be conducted as follows:

(1) Isolate the power source from the panel board, and disconnect any solid state low-voltage components.
(2) Connect one lead of the dielectric tester to all the hot and neutral busses tied together.
(3) Connect the other lead to the fire apparatus frame or body.
(4) Close any switches and circuit breakers in the circuit(s).
(5) Apply the dielectric voltage for 1 minute in accordance with the testing equipment manufacturer’s instructions.

23.16.3* The electrical polarity of all permanently wired equipment and receptacles shall be tested to verify that wiring connections have been properly made.

23.16.4 Electrical light towers, floodlights, motors, fixed appliances including cord reels, and portable generators shall be operated at their full rating or capacity for 30 minutes to assure proper operation.

23.16.5* Operational Test of Fixed Power Source.

23.16.5.1 If the apparatus is equipped with a fixed power source, the apparatus manufacturer shall perform an operational test on the fixed power sources.

23.16.5.2 The testing of the fixed power source shall be witnessed, and the results of the tests of the fixed power source shall be certified by an independent third-party certification organization.

23.16.5.3 Test Procedure.

23.16.5.3.1 The prime mover shall be started from a cold start condition and the line voltage electrical system loaded to 100 percent of the wattage specified on the power source specification label.

23.16.5.3.2 Testing with a resistive load bank shall be permitted.

23.16.5.3.3 The power source shall be operated in the manner specified by the apparatus manufacturer as documented on instruction placards or in operation manuals.

23.16.5.3.4 The power source shall be operated at 100 percent of the continuous rated wattage as specified on the power source specification label for a minimum of 2 hours.

23.16.5.3.4.1 Wattage shall be maintained at or above the continuous rated wattage during the entire test.

23.16.5.3.4.2 Voltage shall be maintained within ±5 percent of the voltage specified on the power source specification label during the entire test.

23.16.5.3.4.3 Frequency shall be maintained within ±5 cycles of the frequency specified on the power source specification label during the entire test.

23.16.5.3.5 The following conditions shall be recorded at least every 1/4 hour during the test:

(1) The power source output voltage, frequency, and amperes
(2) The prime mover’s oil pressure, water temperature, and transmission temperature, if applicable
(3) The power source hydraulic fluid temperature, if applicable
(4) The ambient temperature and power source air inlet temperature

23.16.5.3.6 The electrical loads and conditions specified in 13.14.3.4 shall be applied during the testing unless an auxiliary engine drives the power source.

23.16.5.3.7 If the apparatus is equipped with a fire pump, the 2-hour operational test of the fixed power source shall be completed with the fire pump pumping at 100 percent capacity at 150 psi (1000 kPa) net pump pressure. The test shall be permitted to be run concurrently with the pump certification test required in 16.13.1.

23.16.5.3.8 Prime Mover Driven Accessories.
23.16.5.3.8.1 Accessories driven by the power source prime mover shall not be functionally disconnected or otherwise rendered inoperative during the line voltage electrical tests.

23.16.5.3.8.2 The following devices shall be permitted to be turned off or not operating during the fixed power source test:

1. Aerial hydraulic pump
2. Foam pump
3. Hydraulically driven equipment
4. Winch
5. Windshield wipers
6. Four-way hazard flashers

23.16.5.3.9 If the line voltage power is derived from the fire apparatus’s low-voltage system and is the primary source for line voltage, the power source shall not be shed by a load management system during the two-hour test.

23.16.6 The results of each test shall be recorded on an appropriate form and provided with the delivery documentation.

Chapter 24 Command and Communications

24.1 General. If the fire apparatus is equipped with a separate communications area or if it is used as a totally dedicated command apparatus, it shall meet the requirements of this chapter.

24.2* Location.

24.2.1* The command center shall be enclosed within a vehicle crew area or body.

24.2.2* The size of the command center located in a body shall be a minimum of 25 ft² (2.3 m²) of floor space.

24.3* Climate Control.

24.3.1 The command area shall be provided with a heater capable of maintaining the temperature at a minimum of 60°F (16°C) with the fire apparatus’s doors closed.

24.3.2 If an air conditioner is provided, it shall be capable of maintaining a minimum temperature of 20°F (11°C) below ambient down to 72°F (22°C) with the fire apparatus’s doors closed.

24.4* Noise Levels. When the fire apparatus is stopped with major operational components in operation, the noise levels in the command area shall not exceed 80 dBA.

24.5 Lighting Levels.

24.5.1 The command area shall have a switch control at the door entry area for general entry lighting or automatic dome lighting.

24.5.2* Lighting levels during command operations shall provide a continuous 100 lumens/ft² (1000 lux) in the command area.

24.6 Command Working Surfaces and Countertop.

24.6.1* Horizontal working surfaces shall be smooth and shall have corners and edges that will not cause injury or damage when rubbed up against.

24.6.2 Chair-level work surfaces shall be 28 in. to 30 in. (710 mm to 760 mm) above the floor.

24.6.3 Stand-up work surfaces shall be 36 in. to 40 in. (900 mm to 1000 mm) above the floor.

24.7 Seating in Command Center.

24.7.1* If seating is provided in the command center and that same seating is used during mobile operations (moving over the highway), the seat(s) and crew area(s) shall comply with Section 14.1.

24.7.2 Storage shall be provided for all seating that is not permanently mounted in the fire apparatus so that the seating can be stored in such a way as to protect all passengers while the fire apparatus is in motion.

24.7.3 A visible label shall be attached to each nonpermanently mounted seat indicating that the seat is not to be used while the fire apparatus is in transit and is to be stored during that time.

24.8* Cabinets and Equipment Storage. Cabinets for the storage of equipment shall be designed and engineered to contain the equipment during periods of transit.

24.9 Wall, Ceiling, and Floor Surfaces.

24.9.1* The interior surfaces shall be designed to sustain the usage expected in a command area.

24.9.2 The interior surfaces of command areas shall be free of sharp corners, projections, and edges.

24.9.3 Floor surfaces shall be capable of being routinely cleaned.

24.9.3.1 Floor mats or coverings shall be durable and removable for cleaning.

24.9.3.2 Floor surfaces, walking surfaces, and access steps shall comply with Section 15.7.

24.9.3.3 Access handrails shall comply with Section 15.8.

24.9.4 Dry-type greaseboards, corkboards, chalk-type boards, or similar bulletin- or command-type wall surfaces shall be fastened in place and shall be replaceable.

24.10 Communications and Electrical Consoles.

24.10.1* The communications equipment shall be installed in accordance with the component manufacturer’s instructions and manuals.

24.10.2 Installation of radio and communications equipment shall conform to Federal Communications Commission (FCC) standards and requirements.

24.10.3 If a radio or electrical console is provided, it shall be enclosed on all sides to afford protection to equipment mounted in it.

24.10.3.1 The front surface shall be hinged or bolted in place.

24.10.3.2 Additional hinged or removable panels shall be provided, as required, for access to equipment.

24.11* Computer Equipment and Installation.

24.11.1 All computer equipment shall be installed in a manner to reduce shock, vibration, and mechanical injury.

24.11.2 All equipment not used during transit such as computer equipment shall be stored in cabinets or mounted to comply with 14.1.10.

24.11.3 Computer Electrical Outlets.

24.11.3.1 Electrical outlets specifically for computer use, whether 12 volt or 120 volt, shall be marked with a label for their intended usage and power output.

24.11.3.2 The outlet shall be tested by the apparatus builder to insure they meet the voltage and amperage specified on the label.

24.12 Video Equipment and Installation.

24.12.1 The purchaser shall detail the exact video equipment that is to be mounted on, and used with, the apparatus.

24.12.2 The storage of video equipment shall be in enclosed cabinets, with padding to prevent mechanical injury and quick release straps to hold the equipment in its designated storage area.

24.12.3 If a video monitor is provided, it shall be mounted so as to prevent it from being damaged during transit.

24.12.4 If the equipment is to be externally mounted, mounting brackets and outlet plugs shall be installed as necessary to accommodate the outside mounting of video equipment.

24.12.5 Roof access ladders, steps, and safety railings shall meet the requirements of and be installed as required by Chapter 15.

Chapter 25 Air Systems

25.1 Application.

25.1.1 Where a breathing air system or a utility air system is mounted on fire apparatus, the requirements of this chapter shall apply.

25.1.2 This chapter shall not apply to a compressed air foam system (CAFS).

25.2* Provisions Applying to All Air Systems.

25.2.1* Compressor and booster supplied systems shall be capable of storage and operation in any ambient temperature between 32°F and 110°F (0°C and 43°C).

25.2.2 Cascade systems shall be capable of storage and operation in any ambient temperature between 9°F and 110°F (–18°C and 43°C).

25.2.3 The air system shall be designed so that it can be stored and operated in environments with relative humidity up to and including 100 percent.

25.2.4 All materials used in the air system shall be corrosion resistant or treated to resist corrosion unless the finished product will be in continual contact with a noncorrosive lubricant.
25.2.5 Assembly and Installation Practices.

25.2.5.1 Installation of low-voltage electrical components shall meet the requirements of Chapter 13, and installation of line voltage electrical components shall meet the requirements of Chapter 23.

25.2.5.2 Hot Surfaces.

25.2.5.2.1 Surfaces over 142°F (61°C) shall be covered with a thermal insulating material or shall be mechanically guarded to protect the operator.

25.2.5.2.2 If covering or guarding the surface affects the operation of the component, a label shall be provided that states “Caution: Hot Surfaces When Operating.”

25.2.5.3 The air system shall be designed and constructed to withstand the stresses, vibrations, and other conditions incident to being mounted on a fire apparatus and being used in mobile service.

25.2.5.4 Locking Devices.

25.2.5.4.1 All screws, pins, bolts, or other fasteners whose failure would create a hazardous condition for personnel or equipment shall be equipped with locking devices.

25.2.5.4.2 Safety wire, self-locking nuts, cotter pins, lock-washers, and liquid-locking compounds shall be acceptable.

25.2.6 Breathing Air Systems.

25.2.6.1 Each part utilized in the fabrication of the air system and its components shall be designed for use in compressed breathing air system at pressures, temperatures, and flow rates that will be encountered during actual air system operation.

25.2.6.2 Discharge air from a compressor shall pass through a purification system prior to distribution.

25.2.6.3 Prior to the initial air quality test and commissioning, the Breathing Air System shall be purged with pure air until moisture and other contaminants have been removed.

25.2.7 General Piping and Installation.

25.2.7.1 All pneumatic fittings, tubing, and hose shall be rated for the maximum allowable working pressure that could be encountered, with a test safety factor of not less than 4:1.

25.2.7.2 All pneumatic fittings, tubing, and hose shall be corrosion resistant treated or treated to resist corrosion.

25.2.7.3 No threaded close nipples shall be used.

25.2.7.4 Plugs shall be bar stock type with hex heads.

25.2.7.5 All piping and tubing shall be blown clean with clean, dry air before it is installed.

25.2.7.6 When making up threaded piping joints, the sealant shall be applied to the thread in a manner that will prohibit entry of the sealant into the piping system.

25.2.7.7 Pipes or tubes installed, but not connected, shall have the ends closed with threaded caps or plugs to prevent the entry of foreign material.

25.2.7.7.1 Air connections on equipment or panels shall be provided with a threaded dust cap on a safety chain or shall be a quick disconnect type fitting.

25.2.7.7.2 The cap or the quick disconnect-type fitting shall have a safety factor of 4:1.

25.2.7.8 All rigid piping compressed air lines shall be clamped to a rigid body or chassis component at a minimum of every 16 in. (400 mm) and within 4 in. (100 mm) on each side of a coupling or elbow.

25.2.7.8.1 Rigid piping shall run in an orderly manner with a minimum of bends and elbows.

25.2.7.8.2 The piping installation shall provide room for maintenance and repairs with access panels provided where applicable.

25.2.7.9 Any rigid piping or flexible lines that run through a compartment shall be protected with removable mechanical protection to prevent wear or damage from equipment stored in the compartment.

25.2.8 Flexible Hose.

25.2.8.1 Flexible hose shall be installed in such a manner as to prevent cuts, abrasions, exposure to damage, excessive temperatures, damage from loose equipment, and excessive bending.

25.2.8.2 The hose shall be installed in a manner that permits removal of the hose without removal of major vehicle components or vehicle-mounted equipment.

25.2.9 Operator’s Panel and Controls.

25.2.9.1 The air operator’s panel containing gauges, instruments, and valves shall face the operator’s position and shall be lighted in compliance with 4.10.1.

25.2.9.2 Any instrument that is to be used as a basis for manual control shall be visible and controlled from the operator’s position.

25.2.9.3 Accessory gauges or controls that are not critical to the mission of the air system shall be permitted to be mounted remotely from the operator’s panel or at another location where they can be monitored.

25.2.9.4 Pressure gauges or other devices shall not be mounted directly on lines where excessive vibration is likely to be present.

25.2.9.5 With the exception of direct connected process instruments (e.g., pressure gauges), instruments shall not use instrument piping or electrical conduit for support.

25.2.9.6 Any gauge shall be capable of reading at least 10 percent but not greater than 50 percent higher than any safety relief valve settings on lines supplying those gauges.

25.2.10 Maintainability.

25.2.10.1 The design of the air system shall provide for maintainability by including, but not necessarily being limited to, the following maintainability objectives and technical and operational constraints:

1. The design shall be such that faults can be isolated to allow access to removable assemblies or components.

2. Fuses, if used, shall be readily accessible.

3. The physical arrangement of components shall be such that they can be inspected, serviced, calibrated, and, if necessary, adjusted without being removed and with minimum disturbance to other parts.

4. The design shall be such that inspection, service, and replacement can be accomplished using a minimum of special tools and support equipment.

5. Test points shall be provided to facilitate malfunction isolation and the connection of calibration instrumentation.

6. If equipment requires oil or other liquid drainage, it shall be provided with a remote drainage system that is equipped with a control valve, threaded plug or cap, and a label to note usage.

25.2.10.2 If special tools are required to service or maintain the air system, those tools shall be supplied by the manufacturer.

25.2.11 Labels and Plates.

25.2.11.1 All major components and accessories shall be identified with a label.

25.2.11.2 Caution and warning signs shall be affixed where necessary.

25.2.11.3 Instruction plate(s) shall be installed, as applicable, to advise the operator on the proper adjustment or setting of controls for safe operation.

25.2.11.4 Controls, gauges, valves, and other equipment shall be marked with a label indicating their function.

25.2.11.5 All controls and valves shall have a label to indicate movement direction.

25.2.11.6* The major component manufacturers and installers of the air system shall provide electrical diagrams and air piping drawings that document the system and its operation.

25.2.11.6.1 All symbols used shall be described in a key chart on the drawing.

25.2.11.6.2 All diagrams and drawings shall be delivered with the fire apparatus.

25.2.11.6.3 The following information shall be shown:

1. The general arrangement of the air system, including air storage, air compressor (if provided), air panel, SCBA fill station (if provided), and air inlets and outlets.

2. The electrical wiring arrangement and controls, denoting shore-power, low voltage, and line voltage equipment.

3. The air operator’s control panel surface showing all controls, gauges, valves, outlets, and other specified equipment including the labeling on the panel and controls.

4. The air piping arrangement with air flow direction indicated and showing all valves, gauges, controls, cylinders or vessels, and furnished equipment.

25.2.11.6.4 The major component manufacturers and installers of the air system shall provide a statement of air capacities and system efficiency, as applicable.

25.2.11.6.5* The major component manufacturers and installers of the air system shall provide a statement of air capacities and system efficiency, as applicable.
25.2.12 Documentation.

25.2.12.1 Two complete sets of documentation that cover the operation and maintenance of the system shall be provided.

25.2.12.2 The documentation shall be permitted to be in printed or electronic format, audio-visual format, or a combination thereof.

25.2.12.3 Nomenclature for switches, controls, and indicators shall be consistent with that used on the diagrams required in 25.2.11.6 and on equipment nameplates.

25.2.12.4 The manuals shall include, but not necessarily be limited to, the following:

- An illustrated parts list
- A schedule of maintenance and adjustment checks
- A lubrication schedule
- Troubleshooting information to enable a technician to locate trouble and make repairs or adjustments to the equipment
- Step-by-step procedures for starting, operating, and stopping the equipment

25.2.13 Training and Instruction.

25.2.13.1* If a breathing air system without a compressor/purification system is provided, the contractor shall provide training to fire department personnel.

25.2.13.1.1 This training shall include:

- Complete system component familiarization/walk around
- A complete review of the system and its safety features
- A review of all operation, service, and maintenance documentation
- Hands-on familiarization of the safe operation of the fill station and air management panel, including actual SCBA filling, air reel operations and other pertinent operations of the system

25.2.13.1.2 The trainer shall be certified by the air compressor system assembler as qualified to perform such training.

25.2.13.2* If a breathing air system that includes a compressor/purification system is provided, a representative of the breathing air system manufacturer shall provide training to fire department personnel.

25.2.13.2.1 The training shall include the items defined in 25.2.13.1.1.

25.2.13.2.2 The training shall also include the following:

- A review of the compressor/purification system operations and maintenance including the operations and maintenance documentation and the name, address, and phone number of the local distributor
- Procedures to change purification cartridges
- Hands-on familiarization of the safe operation of the compressor and purification system

25.2.13.3 The Fire Department shall designate one or two individuals that are to be the focal points for all of the breathing air system training and equipment indoctrination.

25.2.13.4 The Fire Department shall designate where the training is to take place.

25.3* Breathing Air Compressor.

25.3.1 The purchaser shall determine the working pressure and capacity required from the compressor and state those requirements in the purchase specifications.

25.3.2 Compressor Intake.

25.3.2.1* The air intake shall be located where it will not be contaminated by the exhaust of the fire apparatus or the exhaust of the gasoline or diesel engines used to power the compressor or other components on the apparatus.

25.3.2.2 If an extended air intake pipe is used, it shall be installed in accordance with the compressor manufacturer’s specifications.

25.3.3 Cooling.

25.3.3.1 The final installer shall assemble and install all components in accordance with the component manufacturers’ instructions and shall test the final assembled system in accordance with this standard and the operating parameters of the component manufacturers.

25.3.3.2* Provisions shall be made by the final installer to ensure there is adequate cooling to keep the air compressor within the compressor manufacturer’s operating temperature range while it is operating in an ambient temperature range between 32°F and 110°F (0°C and 43°C).

25.3.3.2.1 The final stage installer of the air compressor shall submit air system arrangement drawings, air flow schematic drawings, body drawings, and other pertinent data to the air compressor assembler for written approval.

25.3.3.2.2 A copy of this approval shall be retained by the final assembler in apparatus documentation.

25.3.3.3 The temperature of the compressed air shall not exceed 20°F (11°C) above ambient when measured at the discharge nozzle of the compressor aftercooler.

25.3.3.4 A relief valve shall be provided after each stage of compression.

25.3.5 If interstage condensate traps are provided by the compressor manufacturer, they shall be plumbed to the final separator and to an automatic condensate drain system which shall be plumbed to a reservoir to collect the discharged liquids.

25.3.6 Compressor Controls.

25.3.6.1 All compressors shall have automatic audible and visual alarms and controls at the main operator’s panel that shut down the compressor and prevent automatic restart when any of the following conditions occur:

- Low oil level or low oil pressure
- Discharge air temperature is higher than recommended by the manufacturer
- Moisture in the compressed air at the purification system outlet exceeds 24 ppm
- Carbon monoxide level within the processed air exceeds 10 ppm

25.3.6.2* All compressors shall be equipped with the following:

- An air pressure switch that controls the maximum operating pressure
- Interstage pressure gauges after each compression stage
- Final stage pressure gauge
- Oil pressure gauge on pressure lubricated compressors or an oil level indicator or device on nonpressure oil-type compressors
- Electric, nonresettable hourmeter(s)

25.3.6.3* Compressors with electric motors shall be equipped with the following:

- Magnetic motor starter with motor overload protection
- Electric nonresettable hourmeter to record engine operating hours

25.3.6.4 Compressors with gasoline and diesel engines shall be equipped with the following:

- Means to allow the engine to be started, idled, and run with the compressor disengaged or unloaded
- Electric, nonresettable hourmeter to record engine operating hours

25.3.7 The compressor and driver assembly shall be mounted to a subassembly with shock mounts to provide vibration dampening.

25.3.7.1 The compressor frame shall have provision for safe handling or lifting.

25.3.7.2 Frames for compressors with V-belt drives shall include a means to adjust the V-belt tension.

25.3.8 The air compressor shall have a label affixed in a conspicuous location showing the name and address of the manufacturer, serial number and model number, the date of manufacture, and the rated capacity.

25.4 Purification System.

25.4.1* If the processed air is to be used as breathing air, the purification system shall produce breathing air that meets the requirements of NFPA 1989, Standard On Breathing Air Quality For Fire And Emergency Services Respiratory Protection.

25.4.2 If the processed air is to be used for underwater diving, the purification system shall produce breathing air that meets the requirements of Grade E breathing air as specified by CGA G-7.1, Commodity Specification for Air.

25.4.3 The purification system shall be capable of producing the required air quality at full capacity of the compressor for a minimum of 50 hours with inlet air of 80°F (27°C) at saturation.
25.4.3.1 The purification system shall be equipped with purifier cartridges and filter elements.

25.4.3.2* The design of the purification system shall permit replacement of the purifier cartridges without disconnecting piping or other components.

25.4.3.3 The purifier system shall be protected from mechanical damage caused by loose equipment stored on the apparatus.

25.4.4 A relief valve shall be provided in the purification system, set no higher than 10 percent above the maximum allowable working pressure.

25.4.5 A mechanical separator shall be provided and shall be piped to the automatic drain system.

25.4.5.1 A check valve shall be installed between the mechanical separator and the remainder of the purification system.

25.4.5.2 The mechanical separator and the purifier housings shall be designed for a 1:1 safety factor at their maximum allowable working pressure.

25.4.5.3 The mechanical separator and the purifier housings shall be corrosion resistant or treated to resist corrosion.

25.4.6 An upstream valve and pressure gauge shall be installed ahead of the purifier to control and monitor depressurization before service.

25.4.7 A pressure regulator valve (back pressure regulator or minimum pressure valve) with a minimum setting of 2000 psi (14000 kPa) shall be installed in the purification system downstream of the mechanical separator and purifier housings.

25.4.7.1 A piping connection shall be provided downstream of the pressure regulator valve to provide an air sample for the air quality monitors.

25.4.7.2 A line valve shall be installed on the purifier outlet to isolate the purifier from the remainder of the system during inspection, maintenance, and repairs.

25.5 Air Storage Systems.

25.5.1* Air tanks (DOT tanks or ASME pressure vessels) shall comply with 29 CFR 1910.169, “Air receivers.”

25.5.2 Transportable Air Tanks.


25.5.2.2 Relief valves shall be of the ASME type on ASME cylinders and of the DOT type on DOT cylinders or equal for the rated pressure.

25.5.3 Valves installed on air tanks shall meet the requirements of the Compressed Gas Association regarding pressure and usage with compressed air.

25.5.4 Air tanks shall be permanently stamped or identified in accordance with DOT or ASME regulations.

25.5.5 If the installation utilizes DOT cylinders, a label shall be placed on or near the operator’s panel that provides the following:

(1) The original cylinder test date stamped on the cylinders

(2) The recommended testing interval

(3) Five additional open spaces, appropriately labeled, for the user to enter actual retesting dates

25.5.6 The manufacturer’s test date (month and year) on each air tank shall be current within 12 months of the apparatus delivery date.

25.5.7 Air tanks shall be marked with a label that reads: “High Pressure ___ psi Breathing Air.”

25.5.8 Air Tank Mounting.

25.5.8.1 Air tanks shall be mounted in an arrangement that will hold the tanks in all types of mobile use.

25.5.8.1.1 A protective device(s) shall be provided to protect the air tank valve(s) and associated piping from damage as a result of accidental impact.

25.5.8.1.2 The protective device(s) shall not prevent access for operation and inspection.

25.5.8.2 The air tank mounting shall facilitate removal of air tanks for inspection, testing, or service.

25.5.8.2.1 Air tanks shall be installed so that all air tanks, control valves, and associated piping are readily accessible.

25.5.8.2.2 Air tanks shall be mounted in such a fashion to permit visual inspection of external surfaces and emergency access to shutoff of tank valves.

25.5.8.2.3 The air tank location shall be away from any heat-producing devices such as the generator engine or exhaust.

25.5.9 Air Tank Valve Control and Monitoring.

25.5.9.1 A slow-operating valve(s) shall be provided to control airflow into and out of the storage system (if applicable).

25.5.9.2 A separate inlet connection shall be provided so that the storage system can be refilled from a remote source.

25.5.9.2.1 The inlet connection fitting shall be compatible with the rated pressure of the storage system as specified by CGA G-7, Compressed Air for Human Respiration, and shall be equipped with a dust cap with a chain and “pin hole” to release leaking pressure when not in use.

25.5.9.2.2 A check valve or a line valve shall be provided on the inlet connection.

25.5.9.3 Gauges shall be provided to allow for monitoring pressures from the air storage system or individual air tanks specified by the authority having jurisdiction.

25.6* Air Booster Systems.

25.6.1 Line valves shall be provided at the air control panel or on the air booster to control the booster inlet air supply line and the booster discharge airflow.

25.6.2 A pressure gauge shall be provided on the supply line and the discharge line from the booster.

25.6.3 A safety valve or high-pressure switch shall be installed on the discharge side of the air booster.

25.6.4 The pressure setting on the safety valve or high-pressure switch shall not exceed the maximum allowable working pressure of the booster, the booster’s distribution piping, or the air system components.

25.7 Air Supply Regulation. Air supply regulation shall include the following provisions on an operator’s air control panel:

(1) One air pressure gauge marked with a label that reads: “Supply Pressure” between the air supply line valve and the pressure self-relieving regulator

(2) One slow-operating air supply valve on the intake supply line

(3) One self-relieving adjustable pressure regulator equipped with a device to prevent unintentional adjustment

(4) One air pressure gauge downstream of the pressure regulator

(5) One pressure relief valve preset at not over 10 percent above the pressure regulator output setting

(6) A warning label installed next to the pressure regulator to indicate working pressure setting and that a relief valve will release at 10 percent higher than the working pressure

25.8 Air Control Panel.

25.8.1 The air control panel and system piping arrangement for a compressor-supplied breathing air system shall allow the operator to perform the following functions:

(1) Fill the storage system directly from the compressor/purification system

(2) Fill SCBA cylinders directly from the compressor/purification system

(3) Fill SCBA cylinders directly from the storage system/air booster

(4) Utilize the “cascade method” or “bulk fill method” of filling SCBA cylinders, as desired

(5) Bypass filling of the storage system to “top-off” SCBA directly from the compressor/purification system

(6) Regulate the maximum SCBA fill pressure

(7) Meter airflow to control the SCBA fill rate with a slow-operating valve

(8) Take an air sample to check air quality (at panel or at end of air reel hose, if applicable)

25.8.2 When a cascade system is installed, an air control panel and system piping arrangement shall allow the operator to perform the following functions:

(1) Fill the storage system directly from a remote air compressor
(2) Fill SCBA cylinders directly from a remote air compressor
(3) Fill SCBA cylinders directly from the storage system
(4) Fill SCBA cylinders directly from a booster pump that is supplied by the storage system, if provided
(5) Utilize the "cascade method," the "bulk fill method," or both for filling SCBA cylinders, as appropriate to the design of the system
(6) Regulate the maximum SCBA fill pressure
(7) Meter airflow to control the SCBA fill rate with a slow-operating valve
(8) Take an air sample to check air quality (at the panel or at the end of an air reel hose, if applicable)

25.10* Air Hose Reels.

25.10.1* Air Hose Reel Design.

25.10.1.1 The air hose reel shall be designed to hold at least 110 percent of the intended hose length with a minimum capacity of 100 ft (30 m).
25.10.1.2 The system shall fully enclose the cylinder during filling to contain the fragments if a cylinder ruptures.
25.10.1.3 The system shall fully enclose the refill lines to the cylinders.
25.10.1.4 A fill station within an enclosed crew area shall have provisions to vent the concussive air blast to the exterior of the fire apparatus.
25.10.1.5 A means shall be provided to prevent SCBA or SCUBA cylinders from being refilled unless the system is in the "cylinder fill operation position."
25.10.1.6 A warning sign shall indicate the hazards inherent in the operation of filling SCBA or SCUBA cylinders.

25.10.2 Pressure gauges, pressure regulating devices, and controls shall be provided to allow the operator to control the SCBA cylinder fill pressure and fill rate on each SCBA fill hose.
25.10.3 A valve(s) on a fill line(s) shall be a slow-operating valve.
25.10.4 A separate bleeder and flow restriction device shall be provided on each SCBA fill hose.

25.10.5 Testing and Certification.

25.10.5.1 The manufacturer of the enclosed air refill station shall type test a standard production model to validate the design.
25.10.5.1.1 The test shall include pressurizing a 1-hour SCBA cylinder rated at a gauge pressure of 4500 psi (30,000 kPa) to failure.
25.10.5.1.2 If the system provides for simultaneously refilling of multiple cylinders, the other chambers shall contain air cylinders of equal size filled to a gauge pressure of 4500 psi (30,000 kPa) during the test. These cylinders shall not rupture during the test.
25.10.5.2 The testing shall prove that the air refill station is capable of containing all fragments of a failed cylinder so as to protect the operator and not rupture cylinders in adjacent chambers and prove that the venting provisions direct the concussive air blast away from the operator.
25.10.5.3 All test results shall be certified by an independent third-party certification organization.

25.10.6* Air Supply to Air Reel.

25.10.6.1 The following equipment shall be provided on the intake air supply line to the reel where the air supply gauge pressure is up to 150 psi (1000 kPa):
(1) One air pressure gauge
(2) One slow-operating air supply valve
(3) One check valve
25.10.6.2 The following equipment shall be provided on the intake air supply line to the reel where the air supply gauge pressure is between 151 psi (1000 kPa) and 300 psi (2000 kPa):
(1) One air pressure gauge upstream of the air pressure regulating device
(2) One slow-operating air supply valve
(3) One adjustable pressure regulator equipped with a device to prevent inadvertent or accidental adjustment
(4) One downstream pressure gauge [0 psi to 500 psi (0 kPa and 3400 kPa) range]
25.10.6.3 The following equipment shall be provided on the intake air supply line to the reel where the air supply gauge pressure is over 300 psi (2000 kPa):
(1) One air pressure gauge upstream of the air pressure regulating device
(2) One slow-operating air supply valve
(3) One adjustable pressure regulator equipped with a device to prevent inadvertent or accidental adjustment
(4) One downstream pressure gauge
(5) One preset pressure relief valve set at not over 10 percent above maximum working pressure

25.10.7 The inlet to an air hose reel with an operating gauge pressure of over 300 psi (2000 kPa) shall have a flow limiting device, such as a velocity-type valve, or a manually adjustable orifice-type valve.
25.10.7.1 The device shall be adjusted to restrict excessive flow and shall be located or covered to prevent readjustment.
25.10.7.2 The metering device shall not be used for normal shutoff valve purposes.
25.10.8 The final assembler of the air hose reel, piping, and valve system shall test the system at the maximum operating pressure of the system for 10 minutes with no pressure loss.
25.10.8.1 This test shall include the hose, if supplied, on the reel.
25.10.8.2* A permanent label shall be installed adjacent to the air reel controls to indicate the operating pressure range and the type of air provided, low-pressure utility air [gauge pressure under 300 psi (2000 kPa)], low-pressure breathing air [gauge pressure under 125 psi (800 kPa)], or high-pressure breathing air [gauge pressure over 300 psi (2000 kPa)].
25.10.9 Air Reel Installation.
25.10.9.1 Reels installed in concealed locations shall be accessible for maintenance and servicing, hose access, and reel removal.
25.10.9.2 Rollers and guides shall be installed, where necessary, to prevent damage to the hose at the reel spool or compartment openings and to allow deployment and rewinding of the hose.
25.10.9.3 Reels shall be installed in such a manner so as not to expose the operator to the rewind components.
25.10.9.4 Manually operated reels shall have an operable hand crank with its central midpoint or centerline located not over 72 in. (1.8 m) above the ground or platform that is designed to serve as the operator’s standing position.
25.10.9.5 Switches for power rewind-type reels shall be located in a position that allows the operator to safely rewind the hose.
25.10.9.5.1 The rewind control shall not be over 72 in. (1.8 m) above the operator’s standing position.
25.10.9.5.2 The rewind control shall be marked with a label indicating its function and shall be guarded to prevent accidental activation.

25.10.10* Low-Pressure Breathing Air Reel.

25.10.10.1 The regulation of the output pressure from the breathing air reel shall be at the reel or at an air control panel.

25.10.10.2 No shutoff valves or flow control valves shall be installed downstream of the pressure regulator except at the end of the hose.

25.10.10.3 The low-pressure breathing air supply shall be equipped with a low air pressure audible warning device on the air supply.

25.11 Air Hose.

25.11.* All air hose and couplings supplied shall comply to their intended application and shall have a pressure rating equal to or greater than the highest pressure expected to be encountered as input to the hose with a test safety factor of at least 3:1.

25.12 Where the hose is attached to an air reel, it shall be done in a manner that allows for its removal.

25.13.3 Discharge Ends.

25.13.3.1* The discharge end of any breathing air hose shall have a threaded connection.

25.13.3.1.1 If no other fittings are installed at the end of the hose, a temporary protective cap shall be installed to prevent internal contamination of the hose during shipping.

25.13.3.1.2 If the discharge end of hose will terminate with a threaded connection when in use, it shall be equipped with a slow-operating valve.

25.13.3.1.3 If the threaded end of the hose terminates in a quick connection fitting, a slow operating valve and protective cap shall not be required.

25.13.3.1.4 Connections to hose shall comply with 25.2.7.

25.13.3.2 The discharge end of utility air hose shall have either a threaded connection or a quick connection fitting.

25.13.4 Color Coding.

25.13.4.1 The ends of the hose shall be color coded or marked with a label to designate the operating pressure of the hose.

25.13.4.2 If color coding is used, coding shall be as follows:

1. Blue — utility air hose up to a gauge pressure of 300 psi (2000 kPa)
2. White — breathing air hose up to a gauge pressure of 300 psi (2000 kPa)
3. Yellow — breathing air hose from a gauge pressure of 301 psi to 3000 psi (2001 kPa to 20,000 kPa)
4. Red — breathing air hose over a gauge pressure of 3000 psi (20,000 kPa)

25.13.5* Low-pressure breathing air hose shall be a minimum 1/4 in. (13 mm) ID with a maximum hose length of not more than 300 ft (90 m).

25.13.6 Utility air hose shall be of a flexible type, with a scuff abrasion-resistant outer covering.

25.13.7 The hose shall be oil resistant and shall be compatible with oil, alkalis, kerosene, paraffin, grease, and salt solutions.

25.13.8 The hose connections for utility air hose shall not be the same as for low-pressure breathing air hose or high-pressure air hose.

25.12* Low-Pressure Utility Air Supply. Where the non-emergency use air outlets are supplied by the chassis air brake system, the air supply shall be from an auxiliary air circuit that is equipped with a pressure protection valve (PPV) and auxiliary air tanks.


25.13.1 A breathing air system shall be designed to supply breathing air for a minimum of two personnel at the specified location.

25.13.2 The system shall include storage for at least 400 ft³ (11 m³) of breathing air and shall meet the requirements of Section 25.5.

25.13.3 All components of the piping system shall meet the requirements of Section 25.2.

25.13.3.1 The piping system shall be arranged with an air regulator that shall limit the air pressure in the piping to the desired operating pressure.

25.13.3.2 A pressure relief valve set to relieve the pressure at 10 percent above the desired operating pressure shall be installed on the downstream side of the regulator.

25.13.4 All valves, pressure regulators, and gauges shall be protected from accidental damage.

25.13.5 The piping or hose system between the air cylinder(s) and point of use shall be installed to prevent damage due to abrasion, bending, or pinching.

25.13.6 A holder or box shall be provided for the storage of the breathing air equipment when it is not in use.

25.13.7 A low air warning system shall be provided that monitors the air volume and provides an audible warning when the air volume is at or below 20 percent.

25.14* Testing.

25.14.1 The complete air system shall be tested by the final system installer after its installation on the fire apparatus is complete, using the testing procedure prescribed by the system manufacturer.

25.14.2 The following items shall be tested or verified on all air systems:

1. Pressure test the storage system to its maximum operational pressure and check all connections made as a part of the installation for leaks with a leak detection device, which could include bubble fluid or electronic means.
2. Visually verify the relief valve set points and working pressure of the air storage vessel.
3. Verify the accuracy of all pressure gauges.
4. Fully test the operational capabilities of the fill station as established by the manufacturer of the fill station.
5. Seal all fill adapter connections to eliminate the introduction of contaminants prior to shipment.

25.14.3 If the system’s air supply includes a compressor/purification system, the following additional items shall be tested or verified:

1. Confirm that the fluid levels are at the manufacturer’s recommended levels including the lubricant and coolant, if liquid cooled.
2. Verify the expiration date of the purification filters and cartridges and that they have been installed as required by the manufacturer of the system.
3. Operate the air compressor for a minimum of two hours or the period required to completely fill the on-board air storage cylinders or vessels, whichever is longer.
4. Confirm that all compressor interstage pressures are within guidelines as established by the compressor manufacturer.
5. Confirm the operation of the compressor shutdown switch at the pressure requested by the purchaser.
6. Confirm the set point of the final pressure safety relief valve and pressure maintaining valve.
7. Confirm the factory set limits of all electrical shutdown devices including low oil pressure, automatic condensate drain system, high air temperature, excessive processed air moisture, high carbon monoxide, and motor amperage draw.
8. Perform a cooling airflow test in the compartment where the compressor is installed and assure the flow meets the compressor manufacturer’s requirements.

25.14.4 Air Quality.

25.14.4.1 Prior to delivery of the apparatus to the end user, the final system installer shall draw an air sample from the system and submit the sample to be tested in accordance with NFPA 1989, Standard on Breathing Air Quality for Fire and Emergency Services Respiratory Protection.

25.14.4.2 The breathing air shall meet the air quality standards defined in NFPA 1989.

25.14.5 If the system has a compressor/purification system, the person performing the tests for the final system installer shall have been trained by the compressor/purification system manufacturer and shall be able to provide proof of such training.

25.14.6 The results of all testing including the air quality analysis shall be documented and shall be included in the documentation that is given to the purchaser upon acceptance of the fire apparatus.

25.15 Initial Delivery. The contractor shall deliver the apparatus with all air cylinders, piping, hose, reels, and other fixed equipment charged with breathing air to a gauge pressure of at least 100 psi (700 kPa).
Chapter 26 Winches

26.1 General. If a chassis-mounted winch is installed on the apparatus, it shall meet the requirements of this chapter.

26.1.1* The winch shall be designed for the intended use and shall be installed in accordance with winch manufacturer’s recommendations.

26.1.2 All winches shall be equipped with rollers, guides, or both to prevent damage to the winch wire or synthetic rope or the apparatus.

26.1.3 All rollers and guides shall be designed to match the winch capacity and rope size.

26.2* Winch Wire or Synthetic Rope.

26.2.1 The winch shall have a minimum wire rope or synthetic rope length of 75 ft (22.9 m).

26.2.2 The wire rope shall be of a type and size recommended by the winch manufacturer.

26.2.3 The wire rope assembly, including all hardware such as clevises, hooks, and snatch blocks provided for attachment to the winch, shall have a design load rating greater than the line pull capacity of the winch.

26.3 Electric Powered Winches.

26.3.1 Controls.

26.3.1.1* Operation of the electric motor shall be by means of a hand-held control with forward, neutral, and reverse positions.

26.3.1.2 The control shall be located at the end of an electrical cord that is a minimum 25 ft (7.6 m) long and that plugs into a receptacle near the winch location or shall be integrated into a hand-held transmitter operating on a Federal Communications Commission-approved radio frequency for the winch control device.

26.3.1.3 A free-spooling clutch shall be provided in addition to the remote control device if the winch is not visible to the operator.

26.3.2 Power Supply.

26.3.2.1 Dedicated power and ground circuits shall be utilized.

26.3.2.2 Wiring shall be sized in accordance with the winch manufacturer’s installation instructions and shall comply with Chapter 11 of this standard.

26.3.2.3 The power supply line shall be equipped with a resettable circuit protection device and properly sized for the winch’s power requirements.

26.3.3 Removable Electric Winches.

26.3.3.1 Electric winches that are temporarily attached to the apparatus (at sides, rear, or front) shall meet the same requirements as permanently mounted winches.

26.3.3.2 The attachment to the apparatus shall be with quick-release devices.

26.3.3.3 The attachment system on the apparatus shall meet the requirements of Section 15.11

26.3.4 Electric Power for Removable Winches.

26.3.4.1 The electrical power supply(ies) from the apparatus to the removable winch shall terminate at a quick disconnect receptacle with a connector plug.

26.3.4.2 The receptacle shall have a label indicating its use.

26.3.4.3 The power cord from the receptacle to the winch shall be sized for the power requirements of the winch.

26.3.4.4 The power cord shall be highly flexible and shall be protected from mechanical damage.

26.4 Hydraulic Winches.

26.4.1 Hydraulic Hose.

26.4.1.1 All hydraulic hose shall be designed for hydraulic pressures encountered for the specified hydraulic components.

26.4.1.2 Hose shall be a wire braided–type with a female swivel on one end.

26.4.2 The forward-neutral-reverse hydraulic control for the winch shall be electrically operated to permit remote control of the hydraulic winch operations.

26.4.2.1 Operation of the hydraulic winch shall be by means of a hand-held control with forward, neutral, and reverse positions.

26.4.2.2 The control shall be located at the end of an electrical cord that is a minimum 25 ft (7.6 m) long and that plugs into a receptacle near the winch location or shall be integrated into a hand-held transmitter operating on a Federal Communications Commission-approved radio frequency for the winch control device.

26.4.3 Hydraulic Tanks.

26.4.3.1 The hydraulic fluid tank shall be sized to prevent overheating of the fluid or cavitation of the hydraulic pump at its maximum output level.

26.4.3.2 The tank shall permit visual checking of the fluid level and easy refilling.

26.4.3.3 The fill point shall have a label permanently attached near the fill point stating the hydraulic oil quantity and type.

26.4.3.4 A drain plug shall be installed to permit complete draining of the tank.

26.4.3.5 A tank return line diffuser shall be installed in the tank.

26.4.3.6 A tank swash partition shall be installed in the tank between the suction and return lines.

26.4.3.7 A vent shall be supplied and shall be designed to prevent dirt and moisture from entering the tank.

26.4.4 The system shall be equipped with necessary filters and strainers to keep the hydraulic fluid within the cleanliness requirements necessary for operation of the hydraulic system.

26.4.5* The winch shall be equipped with clutch assembly to permit free-spooling and quick removal of wire or synthetic rope.

26.4.5.1 This control shall be accessible without reaching under the apparatus.

26.4.5.2 If the winch is installed under the apparatus, it shall be remotely controlled.

26.4.6 The hydraulic winch engagement controls shall be located in the driving compartment.

26.4.6.1* A “Hydraulic Winch Engaged” indicator shall be provided in the driving compartment to indicate that the hydraulic pump engagement has been successfully completed.

26.4.6.2 An “OK to Operate Winch” indicator shall be provided in the driving compartment to indicate that the winch is engaged, transmission is in the proper gear (automatic transmissions only), and the parking brake is engaged.

26.4.6.3 An interlock system shall be provided to prevent advancement of the engine speed in the driving compartment or at any operator’s panel unless the transmission is in neutral and the parking brake is engaged, or the apparatus is in the “OK to Operate Winch” mode.

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 The term “new” as applied in this standard is intended to refer to the original construction of a fire apparatus using all new materials and parts.

A.1.3.1 The requirements of this standard apply to fire apparatus that has a GVWR of 10,000 lb (4500 kg) or greater. While the standard was not written specifically to cover vehicles below that size, fire departments should consider using those portions of this standard that address safety issues with smaller emergency vehicles. This would apply particularly to the restraint of equipment in the driving and crew areas and to providing adequate optical warning devices and reflective striping to increase the visibility of the vehicle.

A.1.4 It is not intended that this standard be applied retroactively to existing apparatus. However, if major renovations are made to an existing piece of apparatus, it is suggested that the apparatus be brought into line with this standard as closely as possible. NFPA 1912, Standard for Fire Apparatus Refurbishing, covers the requirements for refurbishing a fire apparatus.

A.1.6 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 where more precision is desired. Table A.1.6(a), Table A.1.6(b), and Table A.1.6(c) provide conversions factors as an aid to the user where more precision is desired.
Table A.1.6(a) Conversion Factors (inch-pound to metric units)

<table>
<thead>
<tr>
<th>Unit</th>
<th>Conversion Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 gallon per minute (gpm)</td>
<td>3.785 liters per minute (L/min)</td>
</tr>
<tr>
<td>1 imperial gallon per minute (gpm)</td>
<td>4.542 liters per minute (L/min)</td>
</tr>
<tr>
<td>1 pound per square inch (psi)</td>
<td>6,895 kilopascals (kPa)</td>
</tr>
<tr>
<td>1 inch of mercury (in. Hg) at 32°F (0°C)</td>
<td>3,368 kilopascals (kPa)</td>
</tr>
<tr>
<td>1 inch (in.)</td>
<td>25.40 millimeters (mm)</td>
</tr>
<tr>
<td>1 foot (ft)</td>
<td>0.305 meter (m)</td>
</tr>
<tr>
<td>1 cubic foot (ft³)</td>
<td>0.0283 cubic meter (m³)</td>
</tr>
<tr>
<td>1 square inch (in.²)</td>
<td>645.2 square millimeters (mm²)</td>
</tr>
<tr>
<td>1 mile per hour (mph)</td>
<td>1.609 kilometer per hour (km/h)</td>
</tr>
<tr>
<td>1 pound (lb)</td>
<td>0.454 kilogram (kg)</td>
</tr>
<tr>
<td>1 horsepower (hp)</td>
<td>0.746 kilowatt (kW)</td>
</tr>
<tr>
<td>1 candle power</td>
<td>12.566 lumens</td>
</tr>
<tr>
<td>1 pound per cubic foot (lb/ft³)</td>
<td>16 kilograms per cubic meter (kg/m³)</td>
</tr>
<tr>
<td>1 footcandle (fc)</td>
<td>10.764 lux (lx)</td>
</tr>
</tbody>
</table>

Table A.1.6(b) Conversion Factors (metric to inch-pound units)

<table>
<thead>
<tr>
<th>Unit</th>
<th>Conversion Factor</th>
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</thead>
<tbody>
<tr>
<td>1 liters per minute (L/min)</td>
<td>0.264 gallon per minute (gpm)</td>
</tr>
<tr>
<td>1 liters per minute (L/min)</td>
<td>0.22 imperial gallon per minute (gpm)</td>
</tr>
<tr>
<td>1 kilopascal (kPa)</td>
<td>0.145 pound per square inch (psi)</td>
</tr>
<tr>
<td>1 kilopascal (kPa)</td>
<td>0.2933 inch of mercury (in. Hg) at 32°F (0°C)</td>
</tr>
<tr>
<td>1 millimeters (mm)</td>
<td>0.0394 inch (in.)</td>
</tr>
<tr>
<td>1 meter (m)</td>
<td>3.279 feet (ft)</td>
</tr>
<tr>
<td>1 cubic meter (m³)</td>
<td>35.34 cubic feet (ft³)</td>
</tr>
<tr>
<td>1 square millimeters (mm²)</td>
<td>0.00155 square inch (in.²)</td>
</tr>
<tr>
<td>1 kilometer per hour (km/h)</td>
<td>0.622 mile per hour (mph)</td>
</tr>
<tr>
<td>1 kilogram (kg)</td>
<td>2.2 pound (lb)</td>
</tr>
<tr>
<td>1 kilowatt (kw)</td>
<td>1.34 horsepower (hp)</td>
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<tr>
<td>1 lumens</td>
<td>0.08 candle power</td>
</tr>
<tr>
<td>1 kilogram per cubic meter (kg/m³)</td>
<td>0.062 pounds per cubic foot (lb/ft³)</td>
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<tr>
<td>1 lux (lx)</td>
<td>0.092 footcandles (fc)</td>
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</table>

Table A.1.6(c) Useful Conversion Factors

<table>
<thead>
<tr>
<th>Unit</th>
<th>Conversion Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 gallon per minute (gpm)</td>
<td>0.833 imperial gallons per minute (gpm)</td>
</tr>
<tr>
<td>1 imperial gallon per minute (gpm)</td>
<td>1.2 gallon per minute (gpm)</td>
</tr>
<tr>
<td>1 foot (ft) of water</td>
<td>0.433 pound per square inch (psi)</td>
</tr>
<tr>
<td>1 pound per square inch (psi)</td>
<td>2.31 feet (ft) of water</td>
</tr>
<tr>
<td>1 metric ton (t)</td>
<td>2,204.6 pounds (lb)</td>
</tr>
<tr>
<td>1 kilopascal (kPa)</td>
<td>100 kilogram (kg)</td>
</tr>
<tr>
<td>1 bar</td>
<td>100 kilopascals (kPa)</td>
</tr>
</tbody>
</table>

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.

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.3.2.4 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A.3.3.42 Compound Gauge. On most gauges, zero equals atmospheric pressure. Gauges typically measure pressure above atmospheric pressure in pounds per square inch (psi) (kPa) and below atmospheric pressure in inches of mercury (Hg) (kPa).

A.3.3.43 A CAFS consists of a compressed air source, pressurized source of foam solution, and discharge hardware.

A.3.3.46 Contractor. The contractor might not necessarily manufacture the fire apparatus or any portion of the fire apparatus but is responsible for the completion, delivery, and acceptance of the entire unit.

A.3.3.56 Eductor. The pressure at the throat of a venturi is below atmospheric pressure, allowing foam concentrate or other fire fighting agent at atmospheric pressure in storage to flow into the water stream.

A.3.3.57 Electric Siren (Electromechanical). Only one type of warning sound can be produced by electric sirens, but the level or pitch can be varied by the speed of the motor.

A.3.3.60 Electronic Siren. Varied types of warning sounds can be produced by electronic sirens, such as a wail, yelp, or simulated air horn.

A.3.3.79 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.

A.3.3.80 GCWR (Gross Combination Weight Rating). A combination vehicle is a tractor trailer-type vehicle having three or more axle systems (a multiaxle installation is one system). When the trailer is detachable, the GCWR limits the axle system(s) maximum load for any replacement trailer.

A.3.3.81 Grade. A 45-degree slope is equal to a 100 percent grade.

A.3.3.85 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.3.3.105 Maximum Pump Close-Off Pressure. Multistage series/parallel pumps are measured with the pump in the pressure (series) setting.

A.3.3.107 Miscellaneous Equipment Allowance. Miscellaneous equipment allowance does not include the weight of fixed generators, hose reels, cord reels, breathing air systems, or other major equipment or components specified by the purchaser to be permanently mounted as received from the apparatus manufacturer, nor does it include the weight of suction hose, fire hose, ground ladders, or personnel required by this standard.

A.3.3.113 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...

Table A.1.6(c) Useful Conversion Factors

<table>
<thead>
<tr>
<th>Unit</th>
<th>Conversion Factor</th>
</tr>
</thead>
<tbody>
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<td>1 gallon per minute (gpm)</td>
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<td>100 kilogram (kg)</td>
</tr>
<tr>
<td>1 bar</td>
<td>100 kilopascals (kPa)</td>
</tr>
</tbody>
</table>
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).

A.3.3.120 Optical Source. An optical source can consist of a single optical element or a fixed array of any number of optical elements whose geometric positioning relative to each other is fixed by the manufacturer of the optical source and is not intended to be modified.

A.3.3.126 Portable Generator. The device has an integral distribution panel with overcurrent protection and receptacle outlets.

A.3.3.130 Preconnected Hose Line. A preconnected hose line is commonly called a bucket line, cross lay, or mattadle.

A.3.3.141 Quint. The primary purpose of this type of 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.

A.3.3.152 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.

A.3.3.157 Standard Cubic Feet per Minute (SCFM). Standard temperature and pressure are 60°F (15°C) and 14.696 psi (760 mm Hg or 29.92 in. Hg).

A.3.3.165 Turning Clearance Radius. An aerial fire apparatus might have a larger overall clearance diameter if measured at a forward-most point of the aerial device.

A.3.3.166 Turntable. Some turntables contain an operator’s control station.

A.3.3.168 Type 4 Rating. Equipment rated NEMA Type 4 will be undamaged by the formation of ice on the equipment.

A.4.1.4.3 It is the responsibility of the purchaser to provide the contractor with sufficient information to enable the preparer to prepare a bid and a complete description of the apparatus the contractor proposes to supply. Completion of the Purchasing Specification Form in Annex B should provide the information required in the various sections of this document.

A.4.9.1 The engine compartment and the underside of the vehicle are not considered areas of normal non-maintenance operation.

A.4.10.2 All required signs, plates, and labels should be highly visible and placed on the vehicle where they are not subject to wear and tear damage.

A.4.11.1 The attachment of electric, air, hydraulic, and other control lines and hoses should be with removable mechanically attached fastening devices. The attachment of such equipment with adhesive or glue on clamps or clips has been found to be inadequate for long-term performance on fire apparatus. The use of plastic ties to bundle wire harness and hoses are permissible but should not be used to attach such items to a cab, body, frame, or other major structure.

A.4.12.2.1 The distribution of the weight between the front and rear wheels should be a major consideration, as improper design will seriously affect the handling characteristics of the fire apparatus. Too much weight on the front wheels can cause a front-end skid and, over bumpy roads, could cause the front of the fire apparatus to veer from side to side. At the very least, it will be difficult to keep the fire apparatus 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.

A.4.12.2.3.1 It is critical that the purchaser provide the manufacturer the equipment inventory and mounting locations for equipment on the apparatus. This should include existing equipment and estimated future equipment to be carried. The arrangements of total equipment payload and mounting locations are essential for proper engineering of a new fire apparatus. It is the responsibility of the purchaser to properly load the fire apparatus and place equipment to comply with GVWR, front to rear weight distribution, and right to left load balance of this standard.

A.4.12.2.3.3 The projections of total equipment payload and mounting locations are essential for proper engineering of a new fire apparatus.

A.4.13.1 The power generated by internal combustion engines can decrease with an increase in altitude. The loss varies with the type of engine, the fuel it uses, and the amount of air inlet supercharging. If the apparatus is going to be regularly used at elevations above 2000 ft (600 m), the manufacturer needs to know the operating elevation to provide an engine that will deliver proper performance. (See Section 4.3.)

A.4.13.2 Although the purchaser needs to specify grades in excess of 6 percent (see Section 4.3), the fire department should evaluate where the apparatus will be expected to operate in a stationary position on such grades. The occasional exposure to excessive grades while moving over roadways is different than prolonged stationary operations. Apparatus might require special lubrication systems for engines and other modifications to ensure the apparatus will not be damaged by operation on the increased grades.

A.4.13.3 The temperature conditions, either hot or cold, where the fire apparatus will be used or stored should be considered in the design of the fire apparatus. If the fire apparatus will be used in conditions that exceed 110°F (43°C), additional cooling of the engine, pump, and other components might be necessary. Likewise, if the unit is to be used or stored in subfreezing conditions, special system design, engine heaters, or other special components might be required to prevent damage or to allow continued use.

A.4.14(2) Although this standard recognizes the need for the fire apparatus to be able to accelerate to a high speed while traveling on public roads, caution should be taken as to how fast the fire apparatus will travel. Consideration should be given to limiting the maximum speed the fire apparatus can obtain for safety.

Where fire apparatus has to operate off paved roads, all-wheel drive, a two-speed rear axle, an auxiliary transmission, or an automatic transmission, or any combination of these, might enhance the fire apparatus’s off-road capability.

A.4.14(3) The purchaser should specify the performance required on grades in excess of 6 percent. The occasional exposure to excessive grades is different than if it is an everyday occurrence. A combination of steep grades and narrow, winding roads might require consultation with manufacturers specializing in modifying the apparatus for the special conditions and specifications and then the determination of special road tests. If apparatus will be subjected to a class of service not normally encountered, a manufacturer cannot be expected to anticipate the need without sufficient specification details.

A.4.15.1 Purchasers might want to specify that all routine lubricant and fluid level checks be performed from ground level to reduce the risks of injury from falling from apparatus.

A.4.17.1 Where the point of delivery is over 2000 ft (600 m) of elevation and a fire pump is provided, the pumping engine overload test described in 16.13.3 should be performed to ensure that the engine will develop adequate power at point of delivery. This test should be performed with the pump supplied from draft per Table 16.2.4.1(a), with the net pressure maintained at 165 psi (1100 kPa).

A.4.18 It is important for the purchaser and contractor to agree on the format of the documentation to be delivered in. It is also important that the purchaser consider the long-term ramifications of the changing media technology if electronic format is used for delivery of the documentation. Software and hardware will need to be maintained over the years to utilize electronic documentation.

A.4.19.2.4 Suppliers of components and equipment installed or supplied by the contractor often supply operations and maintenance documents with those components or equipment. This standard requires that the contractor pass along these documents to the purchaser. The purchaser should specify if multiple copies of these documents are required.

A.5.4 Fire departments should carefully evaluate their water supply needs and the available water delivery systems when considering water tank size. Three hundred gallons (1100 liters) is a minimum tank size and might not meet the needs of the department. Fire departments servicing areas with wide hydrant spacing or areas with no hydrants should strongly consider increasing the water tank size. The department should choose a water tank size that will best support efficient and effective fireground operations.

A.5.5 Additional compartmentation might be required to accommodate the size, shape, and weight of special equipment. Any special equipment to be carried on the apparatus should be identified in the specifications so the apparatus manufacturer can ensure the equipment will be properly accommodated within the design of the apparatus.

A.5.6 Hose storage areas are not required to be contiguous. The purchaser should consider arrangements for hose storage that will best support their operational procedures. The purchaser should also consider specifying some type of cover for the hose compartment(s). Hinged or removable covers might be advantageous.

A.5.7 The recommended minimum equipment listed in this standard (i.e., nozzles, hose, ladders, etc.), might not maximize a community’s grading by the insurance rating authority. Individual fire departments should check with the insurance rating authority for their state or jurisdiction for information on what tools and equipment should be carried to maximize their community’s grading.

A.5.7.1.2 Where there are no ladder trucks in service, pumpers should normally be equipped with a 35-ft (10.7-m) extension ladder. It might be advantageous to standardize on the 35-ft (10.7-m) extension ladder, regardless of available ladder truck service. The purchaser should consider specifying an extension ladder length that will allow the ladder tip to extend
A.5.7.2.3 The size of the suction hose specified in Table 16.2.4.1(a) relates to pump certification only. Other sizes of suction hose, compatible with local needs, could be used and should be specified if they are desired.

A.5.8 See A.5.7.

A.5.8.2 Many departments now find it useful to use large diameter supply hose [4 in. (100 mm) or 5 in. (125 mm)] to effectively move water from its source to the fire scene. Fire departments serving areas with wide hydrant spacing or areas with no hydrants often find it desirable to carry additional hose.

It is recommended that the department carry at least 200 ft (60 m) of 21/2-in. (65-mm) hose for handline operation. If the operations of the department are geared to using multiple large handlines from single apparatus, the department should consider carrying more 21/2-in. (65-mm) hose and additional nozzles. Likewise, the amount and size of hose used to supply large stream devices should be considered in planning the amount and size of hose to be carried.

The department should evaluate its needs and choose the size and amount of hose that will best support its operation and then discuss those hose storage needs with the contractor to ensure the fire apparatus hose storage space will be properly laid out and of sufficient size to accommodate the department's needs.

A.5.8.3 The requirements of service in different communities will necessitate additions to the equipment required. The operational objective is to arrive at the scene of the emergency with the necessary equipment for immediate life safety operations and emergency control.

The mandatory equipment required to be carried on the pumper fire apparatus weighs approximately 600 lb (270 kg). This leaves a remaining capacity of approximately 1400 lb (635 kg) to 1900 lb (860 kg) depending on the volume of cabinetry for storage of optional equipment. The purchaser should advise the contractor if equipment in excess of the allowance in Table 12.1 is to be carried so that the contractor can provide a chassis of sufficient size. (See Sections 4.5 and 12.1.)

The following list of additional equipment is recommended to be carried on pumper fire apparatus. The equipment list provided does not detail each item sufficiently for purchasing purposes. The purchaser should clarify the detailed specifications for these items.

(1) One fire service claw tool.
(2) One smoke ejector, 5000 ft³/min (142 m³/min) minimum capacity. If electrically driven, a suitable adapter cord should be supplied to fit standard house “U” ground outlets and extension cords and outlets on generators used in fire departments.
(3) One crowbar [36 in. (1 m) minimum] with brackets.
(4) One pair of insulated bolt cutters with 1/4-in. (11-mm) minimum cut.
(5) One Halligan-type tool with brackets.
(6) One 21/2-in. (65-mm) hydrant valve (screw-type gate).
(7) One double-gated reducing leader wye, sized to fit hose used in department.
(8) Two shovels (one pointed and one scoop).
(9) Four hose straps.
(10) One 125-ft (38-m) length of utility rope having a breaking strength of at least 5000 lb (2268 kg).
(11) One 3000-W (minimum) portable generator.
(12) Two 500-W portable lights.
(13) Two cord reels with minimum 200-ft (60-m) cord on each with connectors that are compatible with lights, generator, and smoke ejector.
(14) One portable pump.
(15) Toolbox with hammers, wrenches, screwdrivers, and other assorted tools.
(16) Master stream appliance, 1000 gpm (4000 L/min) minimum.
(17) Foam delivery equipment compatible with onboard foam system.
(18) One hose clamp.

A.6.4.6 Additional compartmentation might be required to accommodate the size, shape, and weight of special equipment. Any special equipment to be carried on the apparatus should be identified in the specifications, so the apparatus manufacturer can ensure the equipment will be properly accommodated within the design of the apparatus.

A.6.5 It should be recognized that apparatus of 500 gpm (2000 L/min) rated pump capacity or more normally require more than 300 ft (90 m) of 21/2-in. (65-mm) hose to utilize their pumping capacity and their 21/2-in. (65-mm) or larger discharge connections. For example, the 300-ft (90-m) load provides only 150-ft (45-m) lines from the two outlets of a 500-gpm (2000-L/min) apparatus. Experience has shown that, with large capacity pumps, 600 ft to 1000 ft (180 to 300 m) of hose might be desirable to utilize the available pumping capacity. Additional hose capacity might also be desirable for pumps rated at less than 500 gpm (2000 L/min).

Hose storage areas are not required to be contiguous. The purchaser should consider arrangements for hose storage that will best support their operational procedures. The purchaser should also consider specifying some type of cover for the hose compartment(s). Hinged or removable covers might be advantageous.

A.6.6 The recommended minimum equipment listed in this standard (i.e., nozzles, hose, ladders, etc.) might not maximize a community’s grading by the insurance rating authority. Individual fire departments should check with the insurance rating authority for their state or jurisdiction for information on what tools and equipment should be carried to maximize their community’s grading.

A.6.6.2.3 The size of the suction hose specified in Table 16.2.4.1(a) relates to pump certification only. Other sizes of suction hose, compatible with local operations, could be used and should be specified if they are desired.

A.6.7 See A.6.6.

A.6.7.3 The requirements of service in different communities will necessitate additions to the equipment required. The operational objective is to arrive at the scene of the emergency with the necessary equipment for immediate life safety operations and emergency control.

The mandatory equipment required to be carried on the initial attack fire apparatus weighs approximately 350 lb (159 kg). This leaves a remaining capacity of approximately 550 lb (249 kg) for storage of optional equipment. The purchaser should advise the contractor if equipment in excess of the allowance in Table 12.1 is to be carried so that the contractor can provide a chassis of sufficient size. (See Sections 4.3 and 12.1.)

The following list of additional equipment is recommended to be carried on initial attack fire apparatus. The equipment list provided does not detail each item sufficiently for purchasing purposes. The purchaser should clarify the detailed specifications for these items.

(1) One 6-lb (2.7-kg) flathead axe.
(2) One fire service claw tool.
(3) One 8-ft (2.4-m) or longer pike pole.
(4) One smoke ejector; 5000 ft³/min (142 m³/min) minimum capacity. If electrically driven, a suitable adapter cord should be supplied to fit standard house “U” ground outlets and extension cords and outlets on generators used in fire departments.
(5) One 10-ft (3-m) attic ladder and mounting brackets. The ladder should meet the requirements of NFPA 1931, Standard on Design of and Design Verification Tests for Fire Department Ground Ladders.
(6) One crowbar [36 in. (1 m) minimum] with brackets.
(7) One pair insulated bolt cutters with 1/4-in. (11-mm) minimum cut.
(8) One Halligan-type tool with brackets.
(9) One 21/2-in. (65-mm) hydrant valve (screw-type gate).
(10) Two shovels (one pointed and one scoop).
(11) Two hose straps.
(12) One 125-ft (38-m) length of utility rope having a breaking strength of at least 5000 lb (2268 kg).
(13) One 3000-W (minimum) portable generator.
(14) Two 500-W portable lights.
(15) Two cord reels with minimum 200-ft (60-m) cord on each with connectors that are compatible with lights, generator, and smoke ejector.
(16) Toolbox with hammers, wrenches, screwdrivers, and other assorted tools.
(17) Foam delivery equipment compatible with onboard foam system.
(18) One hose clamp.

A.7.4 Additional compartmentation might be required to accommodate the size, shape, and weight of special equipment. Any special equipment to be carried on the apparatus should be identified in the specifications so that the apparatus manufacturer can ensure the equipment will be properly accommodated within the design of the apparatus.

A.7.5.1.5 The purchaser might want to specify the location and the arrangement of the hose storage area to allow carrying the hose preconnected to the tank inlet.

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The purchaser should consider specifying some type of cover for the hose compartment. Hinged or removable covers might be desirable.

A.7.6 The recommended minimum equipment listed in this standard (i.e., nozzles, hose, ladders, etc.) might not maximize a community’s grading by the insurance rating authority. Individual fire departments should check with the insurance rating authority for their state or jurisdiction for information on what tools and equipment should be carried to maximize their community’s grading.

A.7.6.3 The size of the suction hose specified in Table 16.2.4.1(a) relates to pump certification only. Other sizes of suction hose, compatible with local operations, could be used and should be specified if they are desired.

A.7.7 See A.7.6

A.7.7.2 The purpose of a mobile water supply apparatus does not include attack fire fighting. However, if a pump is provided, the provisions of handlines will allow limited fire-fighting capability, particularly in protecting the apparatus if this becomes necessary.

A.7.7.3.1 The requirements of service in different communities will necessitate additions to the equipment required. The operational objective is to arrive at the scene of the emergency with the necessary equipment for immediate life safety operations and emergency control.

The mandatory equipment required to be carried on the mobile water supply fire apparatus weighs approximately 700 lb (318 kg). This leaves a remaining capacity of approximately 300 lb (136 kg) for storage of optional equipment while staying within the allowance of 1000 lb (454 kg). The purchaser should advise the contractor if equipment in excess of 1000 lb (454 kg) is to be carried so that the contractor can provide a chassis of sufficient size. (See Sections 4.3 and 12.1.)

The following list of additional equipment is recommended to be carried on mobile water supply apparatus. The equipment list provided does not detail each item sufficiently for purchasing purpose. The purchaser should clarify the detailed specifications for these items.

(1) One fire service claw tool
(2) One crowbar [36 in. (1 m) minimum] with brackets
(3) One pair of insulated bolt cutters with 15/32-in. (11-mm) minimum cut
(4) One Halligan-type tool with brackets
(5) One 2/3-in. (65-mm) hydrant valve (screw-type gate)
(6) Two shovels (pointed, long handle)
(7) Four hose straps
(8) One 125-ft (38-m) length of utility rope having a breaking strength of at least 5000 lb (2268 kg)
(9) One portable pump
(10) One low-level strainer for use with portable tanks
(11) Toolbox with hammers, wrenches, screwdrivers, and other assorted tools
(12) One water transfer device to be used between portable tanks
(13) One 1500-gal (6000-L) (minimum) collapsible, portable tank

A.8.3 The purchaser should consider the department’s need for hard or soft suction hose if a fire pump is installed and should specify the appropriate hose to meet this need.

A.8.5 Additional compartmentation might be required to accommodate the size, shape, and weight of special equipment. Any special equipment to be carried on the apparatus should be identified in the specifications so that the apparatus manufacturer can properly accommodate the equipment within the design of the apparatus.

A.8.6.1 If the aerial fire apparatus is to carry hose, the purchaser needs to specify the amount and size of hose to be carried and any special requirements for the location in which it is to be carried.

A.8.7 The recommended minimum equipment listed in this standard (i.e., nozzles, hose, ladders, etc.) might not maximize a community’s grading by the insurance rating authority. Individual fire departments should check with the insurance rating authority for their state or jurisdiction for information on what tool and equipment should be carried to maximize their community’s grading.

A.8.7.1 The fire department should study its needs for ground ladders, evaluating which ladders will be arriving at a fire scene with pumpers as well as aerial fire apparatus. Many communities have multiple three- and four-story buildings around which a power-operated aerial device cannot be positioned and that require longer or additional extension ladders to support fire-fighting operations. However, it should be recognized that as requirements for additional ground ladders are added, space for other equipment can become limited.

A.8.7.2 The following list could be used as a ground ladder complement:
(1) One attic ladder a minimum of 10 ft (3 m) in length
(2) Two roof ladders (with folding roof hooks) a minimum of 16 ft (4.9 m) in length
(3) One combination ladder a minimum of 14 ft (4.3 m) in length
(4) One extension ladder a minimum of 24 ft (7.3 m) in length
(5) One extension ladder a minimum of 35 ft (10.7 m) in length

A.8.8 See A.8.7.

A.8.8.2 Axes and long-handled ventilation, salvage, and overhaul poles are now available with wood, fiberglass, or plastic handles. The fire department should specify which material should be used for making the handle.

The requirements of service in different communities will necessitate additions to the equipment required. The operational objective is to arrive at the scene of the emergency with the necessary equipment for immediate life safety operations and emergency control.

The mandatory equipment required to be carried on the aerial fire apparatus weighs approximately 1000 lb (454 kg). This leaves a remaining capacity of approximately 1500 lb (681 kg) for storage of optional equipment while staying within the allowance of 2500 lb (1135 kg). The purchaser should advise the contractor if equipment in excess of 2500 lb (1135 kg) is to be carried so that the contractor can provide a chassis of sufficient size. (See Sections 4.3 and 12.1.)

The following list of additional equipment is recommended to be carried on aerial fire apparatus. The equipment list provided does not detail each item sufficiently for purchasing purpose. The purchaser should clarify the detailed specifications for these items.

(1) Three portable floodlights (500 W).
(2) Two shovels (round point).
(3) Two electric cord reels with 200 ft (60 m) of 12-gauge, 3-wire cord with connectors that are compatible with lights, smoke ejectors, and onboard generators.
(4) Three 2-wire to 3-wire adapters.
(5) One smoke ejector, 5000 ft/min (142 m/min) minimum capacity. If electrically driven, suitable adapter cord should be supplied to fit standard house “U” ground outlets and extension cords and outlets on generators used in fire departments.
(6) Two 10-ton (9000 kg) hydraulic jacks.
(7) Two 20-ton (18,000 kg) hydraulic jacks.
(8) One pair of insulated wire cutters capable of cutting No. 6 gauge wire.
(9) Four additional salvage covers, at least 12 ft × 18 ft (3.6 m × 5.5 m).
(10) Two floor runners, at least 3 ft × 18 ft (1 m × 5.5 m).
(11) Four mops.
(12) Four brooms.
(13) Four squeegees with handles.
(14) Two mop wringers with buckets.
(15) One roll 15-lb (6.8-kg) tar paper or plastic sheeting at least 8 mil thick.
(16) Twelve standard sprinkler heads (assorted temperatures and types).
(17) Two claw hammers, each with assorted nails.
(18) One heavy-duty stapler.
(19) Six sprinkler stops or wedges.
(20) One set of sprinkler head wrenches for the type of heads carried.
(21) Two pairs of safety goggles.
(22) One power saw (chain or heavy-duty rotary type).
(23) Four assorted handsaws.
(24) One portable thermal cutting unit designed for cutting metal.
(25) One rescue-type tool with extension rams and assorted lengths of chain.
(26) One set of air bags.
(27) One deodorizer unit, power operated.
(28) One water pickup vacuum.
(29) Assorted rolls of tape (duct tape, electrical tape, cellophane tape, etc.).
(30) One pneumatic rescue cushion.
(31) One Stokes basket.
(32) One gas shutoff wrench.
(33) One submersible-type pump.
(34) Two pairs of lineman’s gloves with leather glove protectors.
(35) Four bale/mattress hooks.
(36) Two four-tine forks.
(37) Two blankets.
(38) One block and tackle.
(39) One life gun with ammunition.
(40) One water shutoff wrench.

A.9.2.2 Paragraphs 20.6.1 or 20.12.1 require a flow of 1000 gpm (4000 L/min) with a nozzle gauge pressure of 100 psi (700 kPa) and a pressure loss not exceeding 100 psi (700 kPa).

A.9.5 Additional compartmentation might be required to accommodate the size, shape, and weight of special equipment. Any special equipment to be carried on the apparatus should be identified in the specifications so that the apparatus manufacturer can ensure the equipment will be properly accommodated within the design of the apparatus.

A.9.6 Many departments now find it useful to use large diameter supply hose [4 in. or 5 in. (100 mm or 125 mm)] to effectively move water from its source to the fire scene. Fire departments serving areas with wide hydrant spacing or areas with no hydrants often find it advantageous to carry additional hose. The hose storage area provided for in this standard is a minimum to accommodate the smallest size of the amount of hose required to be carried. The department should evaluate its needs and choose the size and amount of hose that will best support its operation and then discuss those hose storage needs with the contractor to ensure the fire apparatus hose storage space will be properly laid out and of sufficient size to accommodate the department’s needs.

Hose storage areas are not required to be contiguous. The purchaser should consider arrangements for hose storage that will best support their operational procedures. The purchaser should also consider specifying some type of cover for the hose compartment(s). Hinged or removable covers might be desirable.

A.9.7 The recommended minimum equipment listed in this standard (i.e., nozzles, hose, ladders, etc.) might not maximize a community’s grading by the insurance rating authority. Individual fire departments should check with the insurance rating authority for their state or jurisdiction for information on what tools and equipment should be carried to maximize their community’s grading.

A.9.7.2.3 The size of the suction hose specified in Table 16.2.4.1(a) relates to pump certification only. Other sizes of suction hose, compatible with local operations, could be used and should be specified if they are desired.

A.9.8 See A.9.7.

A.9.8.2 It is recommended that the department carry at least 200 ft (60 m) of 2 1/2-in. (65-mm) hose for handline operation. If the operations of the department are geared to using multiple large handlines from single apparatus, the department should consider carrying more 2 1/2-in. (65-mm) hose and additional nozzles. Likewise, the amount and size of hose used to supply large stream devices should be considered in planning the amount and size of hose to be carried.

A.9.8.3 The requirements of service in different communities will necessitate additions to the equipment required. The operational objective is to arrive at the scene of the emergency with the necessary equipment for immediate life safety operations and emergency control.

The mandatory equipment required to be carried on the quint fire apparatus weighs approximately 700 lb (318 kg). This leaves a remaining capacity of approximately 1800 lb (817 kg) for storage of optional equipment while staying within the allowance of 2500 lb (1135 kg). The list of equipment required to be carried on a quint contains all the equipment required on a pumper as well as the life safety rope and additional wheel chocks. It is recommended that the purchaser review the list of equipment required to be carried on an aerial fire apparatus (see 8.8.2) as well as the lists in A.5.8.3 and A.8.8.2 for other tools and equipment needed to meet the functional objectives for which the quint is being purchased. The purchaser should advise the contractor if equipment in excess of 2500 lb (1135 kg) is to be carried so that the contractor can provide a chassis of sufficient size. (See Sections 4.3 and 12.1.)

A.10.3 Additional compartmentation might be required to accommodate the size, shape, and weight of special equipment. Any special equipment to be carried on the apparatus should be identified in the specifications so that the apparatus manufacturer can ensure the equipment will be properly accommodated within the design of the apparatus.

A.10.4 The recommended minimum equipment listed in this standard (i.e., nozzles, hose, ladders, etc.) might not maximize a community’s grading by the insurance rating authority. Individual fire departments should check with the insurance rating authority for their state or jurisdiction for information on what tools and equipment should be carried to maximize their community’s grading.

A.10.4.2.3 The size of the suction hose specified in Table 16.2.4.1(a) relates to pump certification only. Other sizes of suction hose, compatible with local operations, could be used and should be specified if they are desired.

A.10.5 See A.10.4.

A.10.5.2 The mandatory equipment required to be carried on a special service fire apparatus weighs approximately 200 lb (91 kg). This leaves a remaining capacity of approximately 1800 lb (817 kg) for storage of optional equipment while staying within the allowance of 2000 lb (908 kg) for the smallest GVWR chassis. The purchaser should advise the contractor if equipment in excess of the allowance in Table 12.1 is to be carried so that the contractor can provide a chassis of sufficient size. (See Sections 4.3 and 12.1.)

Special service fire apparatus can be designed to provide a wide variety of support functions (rescue, command, hazardous material containment, air services, electrical generation and floodlighting, and transportation of support equipment and personnel). Because of this variety, the required list of equipment is minimal and the purchaser needs to develop an appropriate equipment list based on a review of the functions and operations that the apparatus will be expected to support.

The following two lists of equipment are provided for consideration where a fire apparatus is to support rescue operations and hazardous materials containment operations. The equipment lists provided do not detail each item sufficiently for purchasing or use. Purchaser should clarify the detailed specifications for these items.

The equipment on the following list should be considered when deciding what to carry on a rescue apparatus:

(1) 500 ft (150 m) of plastic “emergency scene” or equivalent crowd control tape.
(2) Forty-eight 30-minute road flares.
(3) Twelve road hazard traffic control devices.
(4) One 6-lb (2.7-kg) flathead axe.
(5) One 6-lb (2.7-kg) pickhead axe.
(6) One 6-ft (2-m) pipe pole or plaster hook.
(7) One 8-ft (2.4-m) or longer nonconductive pipe pole.
(8) One crowbar [36 in. (1 m) minimum] with brackets.
(9) One pair of insulated bolt cutters with 7/8-in. (11-mm) minimum cut.
(10) One Halligan-type tool with bracket.
(11) Two shovels (one pointed and one scoop).
(12) Two 12-lb (5.4-kg) sledgehammers.

(13) Two Class I life safety harnesses meeting the requirements of NFPA 1983, Standard on Fire Service Life Safety Rope and System Components.
(14) 150 ft (45 m) of general-use life safety rope meeting the requirements of NFPA 1983.
(15) 150 ft (45 m) of light-use life safety rope meeting the requirements of NFPA 1983.
(16) One 150-ft (45-m) length of utility rope having a breaking strength of at least 5000 lb (2268 kg).
(17) One box of tools to include the following:
   (a) One hacksaw with three blades
   (b) One keyhole saw
   (c) One 18-in. (457-mm) pipe wrench
<table>
<thead>
<tr>
<th>Item Number</th>
<th>Equipment Description</th>
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<tbody>
<tr>
<td>(2)</td>
<td>One copy of U.S. Coast Guard Chemical Hazard Response Information System (CHRS), manual or equivalent reference guide</td>
</tr>
<tr>
<td>(3)</td>
<td>One copy of American Association of Railroads Emergency Action Guide, or equivalent reference guide</td>
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<tr>
<td>(5)</td>
<td>Two pairs of binoculars</td>
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<td>(6)</td>
<td>One gas detection instrument per OSHA standards</td>
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<td>(7)</td>
<td>One radiation-monitoring instrument</td>
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<td>(8)</td>
<td>One pH test kit</td>
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<td>(9)</td>
<td>One colorimetric chemical detector tube kit with 20-chemical minimum detection capability</td>
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<tr>
<td>(10)</td>
<td>Six vapor-protective suits meeting the requirements of NFPA 1991, Standard on Vapor-Protective Ensembles for Hazardous Materials Emergencies</td>
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<tr>
<td>(11)</td>
<td>Twelve liquid splash-protective suits meeting the requirements of NFPA 1992, Standard on Liquid Splash-Protective Ensembles and Clothing for Hazardous Materials Emergencies</td>
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<td>(12)</td>
<td>Twenty-four pairs of disposable boot covers</td>
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<tr>
<td>(13)</td>
<td>Twenty-four pairs of disposable glove liners or inner gloves</td>
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<td>(14)</td>
<td>Forty-eight pairs of disposable chemical protective gloves — gloves should be of three different materials as a minimum</td>
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<tr>
<td>(15)</td>
<td>Six additional SCBA complying with NFPA 1981, Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire and Emergency Services</td>
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<td>(16)</td>
<td>One spare SCBA cylinder for each SCBA</td>
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<td>(17)</td>
<td>Ten traffic cones, 18 in. (0.5 m) minimum height</td>
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<td>(18)</td>
<td>Four rolls 1000-ft × 3-in. (300-m × 76-mm) banner tape</td>
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<tr>
<td>(19)</td>
<td>Two rolls 6 mil (0.152 mm) minimum 10-ft ×100-ft (3-m × 30-m) plastic sheeting</td>
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<tr>
<td>(20)</td>
<td>Two rolls 2 in. (51 mm) wide duct tape</td>
</tr>
<tr>
<td>(21)</td>
<td>Two decontamination containment pools</td>
</tr>
<tr>
<td>(22)</td>
<td>One decontamination shower</td>
</tr>
<tr>
<td>(23)</td>
<td>Two 50-ft (15-m) lengths of heavy-duty garden hose with adapters for connection to a fire pump</td>
</tr>
<tr>
<td>(24)</td>
<td>Two spray nozzles with garden hose thread</td>
</tr>
<tr>
<td>(25)</td>
<td>Four 30-gal (100-L) open-top containers with sealed covers</td>
</tr>
<tr>
<td>(26)</td>
<td>Four long-handle scrub brushes</td>
</tr>
<tr>
<td>(27)</td>
<td>Twenty 50-gal (190-L) capacity heavy-duty garbage bags</td>
</tr>
<tr>
<td>(28)</td>
<td>One assortment decontamination solution</td>
</tr>
<tr>
<td>(29)</td>
<td>Four round point shovels</td>
</tr>
<tr>
<td>(30)</td>
<td>Four portable explosionproof hand lights with mounting brackets</td>
</tr>
<tr>
<td>(31)</td>
<td>Four nonspark, plastic, square point shovels</td>
</tr>
<tr>
<td>(32)</td>
<td>One 6-lb (2.7-kg) flathead axe or forcible entry tool</td>
</tr>
<tr>
<td>(33)</td>
<td>Two street brooms</td>
</tr>
<tr>
<td>(34)</td>
<td>Two floor squeegees with handles</td>
</tr>
<tr>
<td>(35)</td>
<td>One 6-lb (2.7-kg) sledgehammer</td>
</tr>
<tr>
<td>(36)</td>
<td>Two nonspark bung wrenches</td>
</tr>
<tr>
<td>(37)</td>
<td>One gas shutoff wrench</td>
</tr>
<tr>
<td>(38)</td>
<td>One pair 24-in. (0.6 m) bolt cutters</td>
</tr>
<tr>
<td>(39)</td>
<td>One drum upender</td>
</tr>
<tr>
<td>(40)</td>
<td>One nonspark 28-in. (0.7 m) crowbar</td>
</tr>
<tr>
<td>(41)</td>
<td>One plug and patch kit</td>
</tr>
<tr>
<td>(42)</td>
<td>One tool box (wrenches, sockets, screwdrivers, minimum 100 units)</td>
</tr>
<tr>
<td>(43)</td>
<td>Six MC #306/DOT #406 dome clamps</td>
</tr>
<tr>
<td>(44)</td>
<td>400 pads 18 in. × 18 in. × 1/2 in. (450 mm × 450 mm × 9.5 mm) hydrophobic polypropylene-type absorbents</td>
</tr>
<tr>
<td>(45)</td>
<td>150 lb (68 kg) of dry granular or loose absorbent in ruptureproof 5-gal (19-L) containers that can be disposed of by approved methods</td>
</tr>
<tr>
<td>(46)</td>
<td>Four 10-ft (3-m) sorbent booms</td>
</tr>
<tr>
<td>(47)</td>
<td>50 lb (22.7 kg) dry “lime” in ruptureproof 5-gal (19-L) containers</td>
</tr>
<tr>
<td>(48)</td>
<td>One manually operated product transfer pump with minimum 15 gpm (57 L/min) capacity and appropriate hose</td>
</tr>
<tr>
<td>(49)</td>
<td>One 55-gal (208-L) drum (UN-1A2)</td>
</tr>
<tr>
<td>(50)</td>
<td>One 85-gal (322-L) drum (UN-1A2)</td>
</tr>
</tbody>
</table>

Paragraphs 20.6.1 or 20.12.1 require a flow of 1000 gpm (4000 L/min) with a nozzle gauge pressure of 100 psi (700 kPa) and a pressure loss not exceeding 100 psi (700 kPa).
A.11.6 Additional compartmentation might be required to accommodate the size, shape, and weight of special equipment. Any special equipment to be carried on the apparatus should be identified in the specifications so that the apparatus manufacturer can ensure the equipment will be properly accommodated within the design of the apparatus.

A.11.7 Many departments now find it useful to use large diameter supply hose [4 in. or 5 in. (100 mm or 125 mm)] to effectively move water from its source to the fire scene. Fire departments serving areas with wide hydrant spacing and large apparatus without fire hydrants often find it desirable to carry additional hose. The hose storage area provided for in this standard is a minimum to accommodate the smallest size of the amount of hose required to be carried. The department should evaluate its needs and choose the size and amount of hose that will best support its operation and then discuss those hose storage needs with the contractor to ensure that the fire apparatus hose storage space will be properly laid out and of sufficient size to accommodate the department’s needs.

Hose storage areas are not required to be contiguous. The purchaser should consider arrangements for hose storage that will best support their operational procedures. The purchaser should also consider specifying some type of cover for the hose compartment(s). Hinged or removable covers might be advantageous.

A.11.8 The recommended minimum equipment listed in this standard (i.e., nozzles, hose, ladders, etc.) might not maximize a community’s grading by the insurance rating authority. Individual fire departments should check with the insurance rating authority for their state or jurisdiction for information on what types and equipment should be carried to maximize their community’s grading.

A.11.8.1.3 The size of the suction hose specified in Table 16.2.4.1(a) relates to pump certification only. Other sizes of suction hose, compatible with local operations, could be used and should be specified if they are desired.

A.11.9 See A.11.8.

A.11.9.2 It is recommended that the department carry at least 200 ft (60 m) of 2 1/2-,- in. (65-mm) hose for hose line operation. If the operations of the department are geared to using multiple large handlines from single apparatus, the department should consider carrying more 2 1/2-,- in. hose and additional nozzles. Likewise, the amount and size of hose used to support large stream devices should be considered in planning the amount and size of hose to be carried.

A.11.9.3 The requirements of service in different communities will necessitate additions to the equipment required. The operational objective is to arrive at the scene of the emergency with the necessary equipment for immediate life safety operations and emergency control.

The mandatory equipment required to be carried on the mobile foam fire apparatus weighs approximately 700 lb (318 kg). This leaves a remaining capacity of approximately 1300 lb (590 kg) for storage of optional equipment while staying within the allowance of 2000 lb (908 kg). The purchaser should advise the contractor if equipment in excess of 2000 lb (908 kg) is to be carried so that the contractor can provide a chassis of sufficient size. (See Section 4.3, 11.2.)

A.12.1 The carrying capacity of a vehicle is one of the least understood features of design and one of the most important. All vehicles are designed for a maximum GVWR or maximum total weight, which should not be exceeded by the apparatus manufacturer or by the purchaser after the vehicle has been placed in service. For tractor-drawn vehicles, the in-service weight of the apparatus should not exceed the GCWR. There are many factors that make up the rated GVWR, including the design of the springs or suspension system, the rated axle capacity, the rated tire and wheel loading, and the distribution of the weight between the front and rear wheels.

Water Tank. One of the most critical factors is the size of the water tank. Water weights approximately 8.3 lb/gal (1 kg/L). A value of 10 lb/gal (1.2 kg/L) can be used in determining the weight of the tank and its water, making a 500-gal (2000-L) tank and its water about 2.5 tons (2400 kg).

Miscellaneous Equipment. If the finished 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 12.1. (See Section 4.3.3)

Large Compartment Capacity. The manufacturer is only obligated by the standard to provide a miscellaneous equipment allowance in compliance with the minimum allowance listed in Table 12.1. Purchasers who specify vehicles with large compartment capacity should work closely with the vehicle manufacturer to ensure that the GVWR is sufficient to carry the intended equipment. A vehicle with average compartment loading will have a miscellaneous equipment weight of about 8 lb/ft² (125 kg/m²) of compartment space available for miscellaneous equipment. A very lightly loaded vehicle could have as little as 4 lb/ft² (65 kg/m²). A heavily loaded vehicle can reach 12 lb/ft² (200 kg/m²). This volume does not include space occupied by generators, reels, air systems, ladders, hose, and so forth that are not in the miscellaneous equipment allowance. Total equipment weight varies significantly depending on the density of the equipment and how tightly the fire department chooses to pack it.

Overloading. Overloading of the vehicle by the manufacturer through design or by the purchaser adding a great deal of equipment after the vehicle is in service will materially reduce the life of the vehicle and will undoubtedly result in increased maintenance costs, particularly with respect to the transmission, brakes, and shock absorbers. Overloading can also seriously affect handling characteristics, making steering particularly difficult.

Under Loading. Brake equipment on heavy vehicles can be sensitive to the weight distribution of the vehicle. Specifying a GVWR significantly greater than the intended in-service weight can lead to poor brake performance, chatter, and squeal. Purchasers who specify configurations with limited compartment volume on a high capacity chassis should consult the manufacturer to ensure that a vehicle with an under-loaded condition will not result.

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

A.12.1.2 A weight of 250 lb (114 kg) for a fully equipped fire fighter is used elsewhere in NFPA standards. The 200 lb (91 kg) per person used here does not include the weight of SCBA and tools carried by a fire fighter, as the weight of this equipment is accounted for elsewhere.

A.12.2.1 The standard does not contain any minimum for size of engine because the size of the engine needs to be chosen to correspond with the conditions of design and service.

Many fire departments have favored high-torque low-speed engines for fire department service because such engines have good performance characteristics both when powering the apparatus through city traffic and when driving the pump. However, high-speed engines are frequently employed for fire apparatus, particularly in the case of commercial vehicle chassis. Where high-speed gasoline engines are selected for use in fire apparatus that might have to operate off paved highways, it is recommended that either a two-speed rear axle with high numerical ratio in low range or an auxiliary transmission be specified.

A.12.2.1.1 The maximum governed speed is established by the engine manufacturer as a safe limit of engine speed. The governor or electronic fuel control system should prevent the engine from exceeding the safe speed. Most engine manufacturers allow a plus tolerance of 2 percent for maximum governed speed.

A.12.2.1.3 A shut-down beyond the control of the pump operator during firefighting operations can result in loss of water flow from the pump that could severely endanger personnel. Automatic fuel line safety shutoff as required by DOT regulations is not considered an automatic engine shutdown.

A.12.2.1.4.1 An increase in engine speed provides increased alternator output, increased engine cooling, increased air conditioner output, and increased output or performance from other devices which derive their power from the chassis engine.

A.12.2.1.4.2 The intent of the interlock is to ensure that the chassis engine speed cannot be advanced without disengaging the driving wheels of the apparatus either at the transmission (having it in park or neutral) or by having a split shaft PTO fully engaged in the correct position to drive the component.

A.12.2.2.1 Where a regular production model commercial chassis is used, it is recommended that the heavy-duty radiator option be included whenever such is available. Radiators with bolted top and bottom tanks and removable screens, if available, are preferable. Optional features that might be desirable include a coolant conditioner, radiator sight gauges, and automatic radiator shutters, any of which if used should be of a type approved by the engine manufacturer.

Where local environmental extremes exist — that is, high humidity and temperatures or extreme low temperatures — the purchaser should specify a chassis that is expected to operate.

A.12.2.3.1 Full flow oil filters are mandatory with some diesel engines.

A.12.2.4.1 A manual emergency engine shutdown might be provided in addition to the normal engine shutoff switch. It could be of the type that will close off either the air supply or the exhaust gas flow of the engine. The activation mechanism should be provided with a guard and marked with a sign that reads “Emergency Shutdown.” Provisions to prevent restarting of the engine without a special reset procedure should be included.

A.12.2.4.1.1 Caution needs to be used as air intake filters might affect the engine manufacturer’s air restriction requirements.
A.12.2.4.1.1.3 The extent to which air inlet protection is required could depend on specific fire department operations.

A.12.2.4.1.2 To prevent engine shutdown due to fuel contamination, dual filters in parallel, with proper valving so that each filter can be used separately, might be preferable. The purchaser should specify if dual filters are desired. Installation of two or more pumps should be designed so that failure of one pump will not nullify the performance of the others. It should be remembered that commercial vehicles are designed for over-the-road operation, and the fuel system and battery are at least partially cooled by the flow of air resulting from the motion.

A.12.2.4.1.3 With the use of diesel engines, the concern for vapor lock common with gasoline engines does not exist, and electric fuel pumps are not usually compatible for connection in series with a diesel engine fuel system. As a result, when an electric fuel pump is specified with a diesel engine, it is arranged as a fuel priming pump only. When not properly marked and with a label on the control panel which states that the auxiliary priming system can cause the diesel engine to lose its prime. In addition, operation of a priming pump during diesel engine operation can boost fuel inlet pressure to the engine’s fuel system. This could cause erratic engine behavior and loss of engine speed control. Control systems for priming pumps should allow only momentary operation and prevent the operation of the pump while the engine is operating.

A.12.2.5.1 Emissions from exhaust discharge pipes should be directed away from any fire-fighting tools since such emissions contain an oily substance that could make the tools difficult to handle and possibly dangerous to use.

A.12.3.1.5 Adequate braking capacity is essential for the safe operation of fire apparatus. While this subject is normally covered in state highway regulations, it should be noted that fire apparatus might have a special problem as compared with normal vehicles of the same gross vehicle weight. Fire apparatus could be required to make successive brake applications in a short period of time when attempting to respond to alarms with minimum loss of time. Thus, the rate of brake “drag” and braking capability could be critical unless the brakes provided take into account the service requirements. Air actuated brakes are recommended for fire service vehicles of over 25,000 lb (11,000 kg) GVWR.

Where air brakes are provided, it is important that they be of a quick buildup type with dual tanks and a pressure regulating valve. The rated compressor capacity should not be less than 12 ft³/min (0.34 m³/min) for this class of service. Air brakes require attention to guard against condensation in the air lines, such as might occur in areas subject to changes in climate affecting the moisture content of the air. Automatic moisture ejection of nonfreezing type is recommended. Air pressure drops should be limited to normal air losses. The presence of the following conditions indicates the need for immediate service:

1. Air brake pressure drop of more than 2 psi (14 kPa) in 1 minute for single vehicles or more than 3 psi (21 kPa) in 1 minute for vehicle combinations, with the engine stopped and the service brakes released

2. Air pressure drop of more than 3 psi (21 kPa) in 1 minute for single vehicles or more than 4 psi (28 kPa) in 1 minute for vehicle combinations, with the engine stopped and the service brakes fully applied

A.12.3.1.6 There have been occurrences of the driver becoming disabled while driving a fire apparatus. The purchasers might want to specify the placement of the pressure brake control to a location where it can be reached from the officer’s seat or require a second control so the officer could stop the vehicle if the driver became disabled.

A.12.3.1.8 Purchasers of apparatus should consider equipping the apparatus with an auxiliary braking system. Fire apparatus commonly make repeated stops from high speeds that cause rapid brake lining wear and brake fade sometimes leading to accidents.

Auxiliary braking systems are recommended on apparatus that are exposed regularly to steep or long grades, are operating in congested areas where repeated stops are normal, or are responding to a high number of emergencies.

Examples of auxiliary braking systems include engine retarders, transmission retarders, exhaust retarders, and driveline retarders. These devices have various levels of effectiveness on braking. In addition, the systems can be activated by various means and settings, both automatic and manual in operation. The purchaser should carefully evaluate all auxiliary braking systems based on truck weight, terrain, duty cycle, and many other factors.

Some auxiliary braking devices should be disconnected when the apparatus is operated on slippery surfaces. Follow the auxiliary braking device manufacturer’s recommendations for proper instructions.

A.12.3.2.1 Fire departments with vehicles that could be subject to continuous long mileage driving need to specify tire rating for continuous operation in place of intermittent operation.

A.12.3.2.2 The angle of approach or departure affects the road clearance of the vehicle going over short steep grades such as would be found in a drive-in entrance, crossing a high crowned road at a right angle, or in off-road service. Too low an angle of approach or departure will result in the apparatus scraping the ground. Figure A.12.3.2.3 shows the method of determining the angle of approach (in this case) of departure. The angle of approach (front of vehicle) is measured in the same fashion.

In the illustration, the line AT represents the circumstance when the tailboard is the determining lowest point. The line BT represents a circumstance where the tail board is not the lowest point: in this case it is a fuel tank. The angle of departure is shown as XA or XB. To determine the angle of departure, a thin steel strip is placed up against the rear of the tires or a string can be stretched tight from one rear tire to the other. By eyeing and determining the lowest point (the tailboard, fuel tank, or other equipment or component) that would make the smallest angle of departure, use a plumb bob hung from this location to determine the location of this point on the ground. Mark this point on the ground (point of the plumb bob). Measure the vertical distance from the ground to where the plumb bob was hung (distance V). Measure the horizontal distance from the plumb bob point to front of the steel strip or to the string running from rear tire to rear tire (distance H). The ratio of V/H is the tangent of the angle of departure. Knowing this ratio, the angle of departure can be determined from a table of trigonometric functions of angles or from a math calculator. Since the standard requires a minimum angle of departure of 8 degrees and the tangent of 8 degrees is 0.1405, if the ratio of V divided by H is 0.1405 or larger, the angle of departure is 8 degrees or greater.

A.12.3.3 Where automatic transmissions are used, the power takeoff applications could present problems, especially when dual PTO drives are required. In some instances, the PTO drive can only be engaged in torque converter range with resultant chances of overheating with prolonged use. If high engine rpm occurs, there is the possibility, if the vehicle is accidentally left in gear, of the output torque overcoming the parking brake and moving the vehicle. Proper operational instructions are essential with automatic transmissions.

A.12.3.4.1 Where a large capacity fuel tank is desired, as in the case of apparatus designed for rural service, the capacity should be specified by the purchaser.

A.12.3.5 If the purchaser wants the hooks or rings to be accessible without having to open compartment doors, the specifications should state that fact.

A.13.1 This chapter defines the requirements for alternators, batteries, load management, and instrumentation to detect incipient electrical system failure. The intent is to require an electrical system that will operate the apparatus using power supplied by the alternator, shed nonessential electrical driveaway accessories where necessary, and provide early warning of electrical failure in time to permit corrective action.

A.13.2.1 The 125 percent requirement for wiring and circuits is intended to provide end users a minimum amount of extra electrical circuit capacity. It is not the intent to have the final stage manufacturer replace the standard OEM chassis manufacturer’s wiring to meet the 125 percent requirement. It is also not the intent of this requirement to have electrical accessories purchased by the apparatus manufacturer required to meet the 125 percent requirement. Electrical device manufacturer-supplied wiring can be used to the point where it connects to apparatus manufacturer’s installed wiring.

A.13.2.6 It is the intent of 13.2.6 to provide a unique means of identifying a wire or circuit to prevent confusing it with another wire or circuit if electrical system repairs become necessary. If a color coding scheme is used instead of some other unique identification, that color should not be reused for a wire in any unrelated circuits within the same harness. However, 13.2.6 covers low-voltage wiring only and does not apply to shielded cables commonly used for communication purposes or wiring used in line voltage circuits.
A.13.3.2 The minimum alternator size is developed using the loads required to meet the minimum continuous electrical load. Most apparatus will actually have loads exceeding the minimum standard. The purchaser should review the maximum current output of the alternator versus the load study supplied for the apparatus from the manufacturer for on-scene and responding modes.

A.13.3.3(7) The purchaser should analyze the electrical loads that need to be maintained to fulfill the mission of the apparatus and define those loads for the manufacturer 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’s engine and this standard requires that the apparatus be capable of maintaining the minimum continuous electrical load under the conditions defined in 13.3.2. When that load is exceeded and larger alternators are not available, the purchaser and the manufacturer need to work together to determine how to reduce the minimum continuous electrical load to that which can be sustained under the conditions defined in 13.3.2.

A.13.3.4 The unexpected shutdown of a fire apparatus at a fire can place fire fighters in mortal danger and seriously impact the fire attack. With computer-controlled engines and transmissions as well as electric valves and other controls, an electrical system failure could result in an immediate and total shutdown of the apparatus. The low-voltage monitoring system is intended to provide an early warning of an impending electrical failure and provide enough time to permit operator intervention.

A.13.3.6.1 Reduced crew sizes have forced the apparatus operator to assume many new firefighting tasks in addition to that of operating apparatus. Even if the operator is at the apparatus, he or she 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’s electrical systems, they are shed in an order least likely to affect emergency operations. Optical warning devices in excess of the minimum required in this standard can and should be load managed.

A.13.4 Batteries on fire apparatus should be larger than those used on commercial vehicles because in addition to starting the vehicle, they need to provide the supplemental energy to power high-amperage, intermittent operation devices such as mechanical sirens and electric rewind hose reels.

Batteries usually have two ratings: “cold cranking amperes,” which determine the size engine that can be started, and “reserve capacity,” which provides a measure of the total power that can be provided at a much lower constant rate of discharge. Fire apparatus batteries should be sized to have enough cold cranking amperage and reserve capacity to restart the engine after being substantially discharged.

A.13.4.4 Overheating of a battery will cause rapid deterioration and early failure; evaporation of the water in the battery electrolyte can also be expected. Batteries in commercial chassis are often installed to take advantage of the cooling effect of the flow of air from motion in over-the-road operation and could be subject to overheating when the apparatus is operated in a stationary position, such as during pumping operations.

A.13.4.5 The power cord from the on-board charger or battery conditioner should only be plugged into a receptacle protected by a ground-fault circuit interrupter (GFCI) at the shoreline origination point.

A.13.4.6 The purchaser might want to consider a second “battery on” pilot light on the outside of the apparatus to warn that the batteries are on when the operator is at the apparatus, he or she is too busy with higher priority tasks to pay much attention to monitoring the condition of the electrical system.

A.13.4.7 Sequential switching devices are sometimes used to minimize the load placed on the electrical system during apparatus start-up for an emergency response.

A.13.7 SAE J551/2, Test Limits and Methods of Measurement of Radio Disturbance Characteristics of Vehicles, Motorboats, and Spark-Ignited Engine-Driven Devices, provides test procedures and recommended levels to assist engineers in the control of broad-band electromagnetic emissions, and in the control of radio interference resulting from equipment installed on the apparatus. Adherence to the recommended levels will minimize the degradation effects of potential interference sources on fireground communication equipment or other devices susceptible to electromagnetic interference.

Procedures are included to measure the radiation from a single device or the entire apparatus. Compliance could be determined through actual tests on the completed apparatus or predictions based on tests previously conducted on similarly equipped apparatus. If compliance certification is required, it should be so indicated in the apparatus specifications.

A.13.8.1 The upper-level optical warning devices provide warning at a distance from the apparatus and the lower-level optical warning devices provide warning in close proximity to the apparatus. (See Figure A.13.8.1.)

Figure A.13.8.1 Upper and Lower Level Optical Warning Zones.

[A13.8.1 Upper and Lower Level Optical Warning Zones. [Existing Figure A-11-8.1, 1999 edition of NFPA 1901, no change]]

A.13.8.3 Under typical conditions, the specified optical warning system provides effective, balanced warning. In some situations, however, the safety of the fire apparatus can be increased by turning off some warning devices. For example, if other vehicles need to pass within close proximity to the parked apparatus, the possibility of distracting other drivers can be reduced if the headlight and lower-level warning lights are turned off. When responding in snow or fog, it could be desirable to turn off forward-facing strobes or oscillating lights to reduce visual disorientation of the apparatus driver.

The intent of the warning light system is to provide full coverage signals through the operation of a single master switch when either responding or blocking the right-of-way. There is no intent to prevent the use of lower levels of warning when the apparatus driver believes such reductions are appropriate, given the vehicle’s mission, the weather, or other operational factors. Additional switches downstream of the master switch can be specified by the purchaser to control individual devices or groups of devices.

Purchasers might want to specify traffic flow-type lighting such as amber directional indicators for use in alerting approaching motorists of blocked or partially blocked highways.

A.13.8.11 When a component such as a flasher or power supply is used to operate more than one optical source, the optical sources should be connected so that the failure of this component does not create a measurement point without a warning signal at any point in any zone on either the upper or lower level. Although a single optical source can be used to provide warning signals into more than one zone, the possibility of a total signal failure at a measurement point is increased when the same flasher or power supply is used to operate multiple optical sources, each providing signals into more than one zone.

A.13.8.12 Flashing headlights are used in many areas as warning lights and provide an inexpensive way to obtain additional warning to the front of the apparatus. Daylight flashing of the high beam filaments is very effective and is generally considered safe. Nighttime flashing could affect the vision of oncoming drivers as well as make driving the apparatus more difficult.

In some jurisdictions, headlight flashing is prohibited or limited to certain types of emergency vehicles. If flashing headlights are employed on fire apparatus, they are to be turned off when the apparatus headlights are on. They should also be turned off along with all other white warning lights when the apparatus is in the blocking mode.

Steady burning headlights are not considered warning lights and can be eliminated in the blocking mode to light the area in front of the apparatus. Consideration should be given, however, to avoid shining lights in the eyes of oncoming drivers.

A.13.8.13 The minimum optical warning system should require no more than an average of 40 amps for the operation of the upper-level and lower-level devices in the blocking mode. On apparatus whose length requires midship lights, no more than 5 amps of additional current should be required for the operation of each set of midship lights. Optical warning systems drawing more than 40 amps might necessitate modification of the electrical system specified in Section 13.3 in order to supply the additional power required.

See Figure A.13.8.13(a) and Figure A.13.8.13(b) for sample illustrations of an optical warning system on a large fire apparatus.

Figure A.13.8.13(a) Sample Illustration Showing the Front and Left Sides of an Apparatus Using an Optical Warning System.

[Existing Figure A-11-8.12.3(a), 1999 edition of NFPA 1901, no change]

Figure A.13.8.13(b) Sample Illustration Showing the Rear and Right Sides of an Apparatus Using an Optical Warning System.

[Existing Figure A-11-8.12.3(b), 1999 edition of NFPA 1901, no change]

A.13.8.13.5 The zone totals reflect the combined performance of the individual optical warning devices oriented as intended on the apparatus when viewed along the perimeter of a circle of 100 ft (30.5 m) radius from the geometric center of the apparatus.
The zone total is the sum of the optical power of all optical sources projecting signals of permissible color into the zone as measured at 5-degree increments along the horizontal plane passing through the optical center. 

The calculation of zone totals assumes that all optical sources are mounted at the geometric center of the apparatus. With the optical center of each optical source located as stated in the engineering combination of the individual test reports for any number of optical warning devices of different color, flash rate, optical source, and manufacturer. 

- The engineering basis of this section permits both the design and certification of an optical warning system by mathematical combination of the actual value of the optical power contributed by every optical source at a given point is taken from the test report and added together to determine the total optical power at that point. The zone total is the sum of the optical power at the 19 measurement points in the zone. The upper- and lower-level optical sources are calculated independently. 

Using the test reports provided by the device manufacturer, the contribution of optical energy from each optical source is determined for every data point. The total candela-seconds/minute of optical energy is determined at each point and then the zone totals are calculated and compared to Table 13.8.13.5. 

A.13.8.14 The minimum optical warning system should require no more than an average of 35 amps for the operation of the devices in the blocking mode. 

A.13.8.16 In a few cases, a manufacturer might wish to type certify by actual measurement of the optical warning system on an apparatus. 

Certification of the actual measurement of the performance of the optical warning system is made with each optical source either mounted on the apparatus or on a frame duplicating the mounting of the device on the apparatus. The performance of the system can be directly measured along the perimeter of a circle with a 100-ft (30.5-m) radius about the geometric center of the apparatus. Each optical warning device used should be certified by its manufacturer as conforming to all of the requirements of this standard pertaining to mechanical and environmental testing. Photometric testing of the system should be performed by qualified personnel in a laboratory for such optical measurements. 

The test voltages and other details should be as called for in this standard for the photometric testing of individual optical warning devices. The elevation of the photometer, however, could be set at the elevation that maximizes the performance of the upper-level devices and at a second different elevation that maximizes the performance of the lower-level devices. 

With the optical center of each device oriented as installed, the sum of the actual value of the optical power contributed by every optical source is then determined at each measurement point. The zone total is the sum of the optical power at the 19 measurement points in the zone. 

Measurements are made to determine all of the optical requirements of this standard including the optical power at each of the required measurement points, the zone totals at the horizontal plane passing through the optical center, and the zone totals at 5 degrees above the horizontal plane passing through the optical center. Any upper-level warning devices mounted above the maximum height specified by the manufacturer(s) should be tested to demonstrate that at 4 ft (1.2 m) above level ground and 100 ft (30.5 m) from the mounted device, the optical energy exceeds 50 percent of the minimum required at the horizontal plane passing through the optical center. 

A.13.9.1.2 If the purchaser wishes to have the siren controls within convenient reach of persons riding in both the right and left front seat positions, they should specify that. In some apparatus, multiple control switches might be necessary to achieve convenient reach from the two positions. If other signal devices, such as an additional siren, bell, air horn(s), or buzzer are desired, the type of device and its control location should also be specified. 

A.13.11.2 Manually operated floodlights on telescoping poles are not required to be tied into the hazard light in the driving compartment. If the purchaser wishes that these devices be tied into the hazard light or otherwise equipped with an indicator to warn the operator the floodlights are in the up position, they should specify that in their purchase specification. 

A.13.14.1 The purchaser might desire to have the entire low-voltage electrical system and warning device system certified by an independent third-party certification organization. 

A.14.1.3 The purchaser will need to define how many seating positions are required to carry personnel and might wish to specify the arrangement of the seating positions. Canopy cab extensions with patio door-type closures or separate telephone booth-type personnel enclosures are acceptable means for providing fully enclosed seating positions. 

A.14.1.7.1 Suspension-style seats have been developed for long-haul truck operations where the operator is driving for many hours at a time. Acceleration and braking is controlled, with an eye to fuel economy. The suspension-style seat in this duty profile provides a smoother ride and reduces fatigue from long hours in the seats. In contrast, the operator of a fire apparatus is typically making short runs with fast acceleration, quick maneuvers, and sudden braking. The bouncing motion of the suspension seat could hinder the driver’s ability to maintain precise control of the throttle, brake, steering wheel, and other driving controls. 

Selection of seating options should be made with consideration to the frequency of time that the driver will spend in the vehicle each day, and whether the department SOP requires or encourages the occupant of the seat to be equipped with head gear during travel. The use of headgear reduces headroom and increases the chance of injury should the vehicle encounter unexpected road undulation or speed bumps. The effect of such road conditions, steering high-speed, and potential for injury might be intensified by the action of a seat suspension. Potential for injury is greatly increased by failure to use or properly adjust the seat belt. 

Proper seat adjustment is another issue that should be addressed by the fire department SOPs if apparatus are equipped with suspension seats. Too much pressure in a suspension seat air bag will reduce static headroom and will negate the potential for injury from a seat suspension. The seat will cause the seat to bounce excessively. The proper amount of pressure is dependent on the weight of the occupant. Departments where multiple drivers share an apparatus must consider that adjustments should be made between each shift. Seat adjustment should not be postponed until the driver is exiting the station on the way to a call. 

The H-point is the mechanically hinged hip point of the torso and thigh on the devices used in defining and measuring vehicle seating accommodation in SAE J826, Devices for Use in Defining and Measuring Vehicle Seating Accommodation. It is an imaginary point located in two-dimensional space above the seat cushion. The H-point is measured using a tool that simulates a human hips and torso of a given size, shape and weight. The H-point will vary with the size, shape, and material of the seat back, seat frame, and seat cushion. If H-point data is not available, it can be approximated by measuring 5 in. (130 mm) ahead of the seat back and 3 in. (75 mm) up from the non-depressed seat cushion surface. 

A.14.1.9.1 SCBA units and other equipment stored in the crew compartment can cause injuries to occupants of the compartment if they fly around the compartment as the result of an accident or other impact. 

A.14.1.3.1 If the purchaser does not specify seating for personnel in an enclosed body area, a secondary means of escape is not required. If the purchaser “might” install such seating in the future, then it is recommended that the secondary escape provisions be provided when apparatus is purchased. 

A.14.3 The purchaser should consider specifying remote controls on the mirrors to facilitate correct mirror adjustment. Where necessary, heated mirrors should also be considered. 

A.14.3.1 With the requirements for fully enclosed driving and crew compartments, the potential for heat buildup in these areas is greater. The purchaser should be aware of this condition and might wish to specify ventilation fans or air conditioning to keep the ambient temperature in the driving and crew compartment(s) lower. 

A.14.3.3 The purchaser should realize that local conditions or operating procedures could cause the passenger to project into the sight pattern of the driver and therefore cause driving obstructions. Seats should be arranged so that SCBA and any passengers wearing protective clothing do not cause vision obstructions. Movement of the passenger should be considered when installing radios, computers, and other equipment so that forward movement or shifting is reduced to a minimum and does not block the driver’s vision. 

A.14.4.3 In many areas, the overall height of the vehicle needs to be restricted in order to clear bridges, station doors, and so forth. The tiller operator’s compartment roof is normally the highest point on the vehicle. Careful consideration should be given to the packaging of the tiller body in deciding ground ladder and body compartmentation design to achieve the required seat head height. 

A.15.1.1 Compartmentation that is sized to meet the size, shape, and weight requirements of special equipment might be required. Any special equipment to be carried on the apparatus should be identified in the specifications so that the apparatus manufacturer can ensure the equipment will be properly accommodated within the design of the apparatus. 

A.15.2 The purchaser needs to provide the apparatus manufacturer with the details of and any special needs for communication equipment such as radio size, power consumption, and location(s) for communication equipment. 

A.15.3.1 Fire fighter injuries resulting from climbing on apparatus to remove, store, and operate equipment can be minimized if specifications require that equipment be accessible from ground level. Examples of ways to reduce the need to climb on the apparatus include, but are not limited to, using powered equipment racks, using remote control deck guns, lowering of target areas for preconnected attack lines and using pull-out trays, using slide-out or pull-down storage trays, and providing for the changing of fluid levels from ground level.
A.15.3.2 Where equipment other than that originally mounted on the apparatus is to be carried, the user of the vehicle should ensure that the equipment is securely attached to the vehicle with appropriate holders.

A.15.5 SCBA units are typically stored in crew seats, behind bench seats, and on walls, doors, or shelves of storage compartments. The area where the complete SCBA unit is to be mounted should be arranged to prevent damage to hose, straps, belts, facemask, regulator, and other attachments. The shell should include provision of wear and tear on the delicate facemask due to vehicle movement. The facemask should be stored in a nylon or plastic bag to prevent such abrasion.

Storage of spare hose assemblies, facemasks, regulators, and other SCBA pack accessories should be in a clean and dry area, away from heat-producing devices or mechanical damage. Preferably, the equipment should be stored individually in plastic or noncorrosive bins with dustfree covers. The contents of each bin should be marked with a label on the exterior.

A.15.5.5 SCBA cylinders should always be stored with valve assemblies atop the cylinder.

A.15.5.6 SCBA cylinders should be stored with valve assemblies exposed to the compartment opening or storage area to permit inspection of valves or gauges.

A.15.6.5 The purchaser should consider specifying additional doors or removable panels for service, maintenance, or replacement of components in the fire pump installation.

A.16.6.1 Intakes at the front or rear of the apparatus, or otherwise specially situated, if any of the intakes are to be equipped with valves. The purchaser should specify if larger intakes are to be provided and the size of any intake. It is strongly suggested that chassis and apparatus manufacturers be consulted concerning available alternatives in order to make driving and crew compartment access as ergonomically convenient and as safe as possible.

A.16.6.5.2 The purchaser should consider specifying additional doors or removable panels for service, maintenance, or replacement of components in the fire pump installation.

A.16.6.6.5 Pumping engine accessories should be in a clean and dry area, away from heat-producing devices or mechanical damage. Preferably, the equipment should be stored individually in plastic or noncorrosive bins with dustfree covers. The contents of each bin should be marked with a label on the exterior.

A.16.7.1A Apparatus are constructed with surface areas that are not intended to be used as stepping, standing, and walking areas. These include cosmetic and protective coverings on horizontal surfaces. During the design stage of the vehicle, purchasers should designate which areas are stepping, standing, or walking areas. It is important that proper materials are selected for the application and local conditions.

When selecting stepping, standing, and walking surfaces, the purchaser should take into consideration the long-term use of the vehicle. The slip resistance of certain surfaces might deteriorate over time. It is also important for the user to properly maintain or replace slip-resistant materials as they deteriorate over time.

A.16.8.4 Handrails should be mounted in a way to minimize the chances of damage or removal from brushing by objects such as trees.

A.16.9.2 Corrosion protection, commonly known as undercoating, might be advantageous in areas where climatic conditions or road treatment will corrode vehicle components. The material, its application method, and the areas to be protected should be carefully specified so the corrosion protection will adequately protect the vehicle’s cab and body sheet metal components subject to corrosive conditions that could be encountered in the user’s area.

A.16.9.2.3 The purchaser should give consideration to the choice of paint color(s) as it relates to the total vehicle conspicuousness.

A.16.10 Apparatus provided with booster hose and reel assemblies should have power rewind capability. However, if a manual rewind is provided, attention should be paid to the location of the hand crank. It should be placed in a location that allows the operator to rewind the hose onto the reel without having to climb onto the apparatus.

If the apparatus is to be used or stored in subfreezing conditions, the reel should be equipped with an air chuck mechanism to allow connection of an external source of compressed air to facilitate removal of water within the booster hose assembly. This mechanism should be located on the discharge side of the booster reel valve.

A.16.10.1 The purchaser should specify whether a single or split hose bed is desired, and any special arrangements desired for preconnected hose lines.

A.16.10.3 It is also recommended that the purchaser consider specifying some type of cover for the hose compartment. Hinged or removable covers might be advantageous.

A.16.11 Trailer hitch type receivers are commonly used as anchor points for both removable winches and rope operations. Removable winches are intended for equipment recovery operations only. Rope operations could involve personnel rescue that require the receiver and its anchorage to be designed using higher safety factors.

A.15.12.2 If the unit is going to be moved on and off a chassis periodically, the purchaser might wish to specify lifting eyes or forklift slots to facilitate its movement.

A.16.2.3.2.4 Parallel operation can be referred to as “volume,” and series operation can be referred to as “pressure.”

A.16.2.4.1 At an altitude of 2000 ft (600 m), the actual (uncorrected) atmospheric pressure equivalent to the sea level reading of 29.9 in. Hg (101 kPa) is 27.8 in. Hg (94.1 kPa).

The values given in Table 16.2.4.1(b) and Table 16.2.4.1(c) are representative values of pressure losses due to flow entrance, velocity, and friction sources through 20 ft (6 m) of suction hose (including strainer) of the diameter indicated.

The basis of the tables on friction loss is tabular data from 1953 testing and other accumulated data and testing. In 1976, this data was reviewed and incorporated in Table 16.2.4.1(b). The data does include a velocity head component and the values do account for bending as the actual values were derived from suction hose bent from the suction intake into the test pit.

A.16.2.4.2 Where the community to which the apparatus is to be delivered is at a considerably higher altitude than the factory or other test location, sufficient excess power should be provided to compensate for the fact that the power of a naturally aspirated internal combustion engine decreases with elevation above sea level. The performance of a fire pump can be adversely affected by the design of the suction piping or the addition of valves to the suction side of the pump. Losses due to additional piping or valves that are added to the fire pump suction can be calculated and used to determine pump performance.

A.16.3.4 A separate pumping engine could use the vehicle chassis battery system, or it could have a separate set of dedicated batteries. Battery charging and electrical supply should be designed to meet this standard, whichever system is used.

A.16.4.3 Each component in the driveline has a continuous duty torque rating. At this level of usage, each component also has a design life expressed as hours of use at rated torque. The design life of some components can be substantially less than the remaining drive system components. An hour-meter activated by the pumping system and marked with a label should be provided to log the number of hours of drive system usage.

A.16.5.1 Pumps and piping frequently required to pump salt water, water with additives, or other corrosive waters should be made of bronze or other corrosion-resistant materials. For occasional pumping of such water, pumps made of other materials are satisfactory if properly flushed out with fresh water after such use. Where corrosive water is being pumped and the pump and piping are not made of corrosion-resistant materials, the placement of anodes in the pump might minimize the corrosive effects.

The term “all bronze” indicates that the pump’s main casing, impeller, intake and discharge manifolds, and other principal components that are exposed to the water to be pumped, with the exception of the shaft bearings and seals, are made of a high-copper alloy material. It is preferable to use similar materials for the pump and piping.

Corrosion effects are proportional to the mass relationship of bronze to iron. It is, therefore, preferable to use similar materials for the pump and piping. Where both iron and bronze are used, it is preferable to keep the mass of the iron larger than that of the bronze.

A.16.6.1 Intakes can be larger than the size of the suction hose specified in Table 16.2.4.1(a). It is also advantageous to have valves on one or more of the intakes. The purchaser should specify if larger intakes are to be provided and if any of the intakes are to be equipped with valves.

Intakes at the front or rear of the apparatus, or otherwise specially situated, might not allow drafting rated pressure. The pumped capacity at rated pressure, if any, should be specified by the manufacturer to certify the actual flow rates from auxiliary intakes.

A.16.6.1.3 Pressurizing a valued suction inlet could create a dynamic water hammer that might cause a hose or fitting failure resulting in injury or death to anyone in the immediate vicinity. Valves should be opened and closed slowly.

A.16.6.2.2 Sizing of the openings of the strainer(s) is intended for debris of generally uniform dimensions. It is recognized that debris of nonuniform dimensions — that is, long in relation to cross section — might be able to pass through the strainer(s) while not being able to pass through the pump.

A.16.6.5 The bleedler valve should be used prior to the removal of a hose or a cap or other closure connected to an intake. The bleedler valve should also
be used while filling a hose connected to an intake with water. Failure to use the bleed valve in these situations might result in serious injury or death.

A.16.7.1 The flows listed for each outlet size are minimum and are for rating purposes only. If piping and valving are sufficient, much higher flows for a given outlet size might be achievable.

A.16.7.2.2 In order to provide standardization, National Hose threads are required. Adapters can then be used to adapt to locally used hose connections.

A.16.7.3 If flows greater than 200 gpm (750 L/min) through preconnected lines are needed, piping from the pump to preconnected hose lines should be larger than 2 in. (52 mm) in order to keep the friction loss to a reasonable level. If additional preconnected lines are wanted, the location and hose size should be specified.

A.16.7.5.2 Control of discharges on apparatus are now available in pull-type actuators, trunnion or swing valves, cable control, gear-operated hand wheel control, and hydraulic, air, and electric operators. These are available with either quick-operating and slow-operating valve mechanisms. The nozzle and hose reaction and “operational effort” for high-flow or high-pressure discharges are critically important to many fire departments. Due to the variations in type of individuals or characteristics of operators involved with pump operations, a purchaser should carefully evaluate control valves. Slow-closing gear operated and other power-operated valves should be considered for valves 3-in. (75-mm) and larger.

A.16.7.9 Where possible, discharge outlets should be positioned in an area away from the pump operator’s position.

A.16.9.1 Ideally, having no intake or discharge connections at the operator’s position would simplify and improve safety for the operator. If complete removal of these connections is impractical, the reduction and careful placement of these connections, with operator safety in mind, would improve the situation considerably.

Many fire departments have found it useful to color code the labels used to identify the various discharge and intake controls. While this process can simplify pump operations, it can also create confusion if a pattern is not followed on all apparatus in the department. For standardization, the color coding scheme in Table A.16.9.1 is recommended for all new apparatus labels, as applicable.

**Table A.16.9.1 Color Scheme for Labels on Discharge and Intake Controls**

| Preconnect #1 or front bumper jump line | Orange* |
| Preconnect #2 | Red* |
| Preconnect #3 or discharge #1 | Yellow* |
| Preconnect #4 or discharge #2 | White* |
| Discharge #3 | Blue |
| Discharge #4 | Black |
| Discharge #5 | Green |
| Deluge/deck gun | Silver |
| Water tower | Purple |
| Large-diameter hose | Yellow with white border |
| Foam line(s) | Red with white border |
| Booster reel(s) | Gray |
| Inlets | Burgundy |

* Since the vast majority of fires are extinguished using preconnected lines, a fire department should give consideration to matching the hose jacket color to the color of these labels. Fire departments using this system have reported that an improvement in fireground operations was achieved.

A.16.10 The indicator lights and interlocks specified in this section are minimum. Some manufacturers or users might choose to add additional indicator lights or interlocks.

A.16.10.1.2 Pumps are operated from the side, top, front, or rear of the vehicle, and stationary pumping requires that there is no power applied to the wheels while pumping. Therefore, it is essential that any controls that could apply power to the wheels while pumping be equipped with a means to prevent dislocation of the control from its set position in the pumping mode.

A.16.10.2.1 Completion of the pump shift might require that the chassis transmission be shifted into pump gear.

A.16.10.3.1 Completion of the pump shift might require that the chassis transmission be shifted into pump gear.

A.16.10.13 The purpose of a pressure control system is to control the discharge pressures in order to protect fire fighters who are operating hose streams as well as to prevent discharge hose from damage in the event attack hose streams are shut off or other valves are closed, reducing flow rates. The system could consist of a discharge relief valve, a pressure regulator that controls the speed of the pump, an intake relief valve, or any combination of these devices. Pressure control systems will relieve excess pressure when valves are closed in a normal manner, but some water hammer conditions could occur due to valves being closed so quickly that the system cannot respond fast enough to eliminate damage to equipment. Proper fireground procedures are still required.

A.16.10.13.1 Pressure control systems can be supplied in the following forms:

1. Integral with the pump and supplied by the pump manufacturer
2. As an external system of components supplied by the apparatus manufacturer
3. As an external control system provided by a pressure control manufacturer

Pressure governors control the engine speed, which relates directly to the net pump pressure; if the speed is raised, the pressure goes up; if the speed is lowered, the pressure goes down.

Discharge relief valves control pressure by passing water from the discharge side of the pump back into the intake side of the pump. This type of system works in a pressure differential of approximately 70 psi to 90 psi (50 kPa to 60 kPa) between the intake and discharge sides of the pump. If the pressure differential relief valve is not present, the discharge relief valve might not control a pressure rise completely.

In the case where an intake relief valve is selected, it must be of sufficient size and response time to handle the pump performance range. It must also be easily controlled by the pump operator so that this incoming pressure can be adjusted for each incident. For best results, the operator should set the intake relief valve to operate at 90 psi (60 kPa) below the desired discharge operating pressure.

The pressure control system should be certified by the appropriate manufacturer or an independent third-party certification organization. Due to the importance of these systems, the purchaser might wish to have performance tests conducted on the installed system.

A.16.10.14 Departments that need to attain a draft while conducting operations off tank water will find that adding a primer selector valve or second priming control valve to allow attaining a draft on the outboard side of the gated pump suction valve will eliminate the danger of cavitation while supplying attack lines. A vacuum line is run to the outboard side of the valve and connected through a selector valve to the primer. Side, front, and rear selector settings can be arranged to allow priming off any side of the unit with one primer.

A.16.11.1 The electronic throttle control systems that are currently available will provide greater flexibility for the operator because they can be set like a traditional throttle or a pressure governor.

A.16.12.1.1 A pumping engine fuel level indicator or red warning light indicating when the fuel level falls below 1/4 of the capacity of the tank(s) should be provided on the pump operator’s panel.

A.16.12.2.2 The rated operating pressure of large-diameter supply hose is substantially less than that of attack fire hose. Therefore, an individual pressure gauge is required to allow the operator to control the discharge pressure even where a flowmeter is provided.

A.16.13.2.3 The purchaser might wish to have an independent third-party certification organization certify the test results, particularly where the pump is required to meet extended continuous duty pumping applications.

A.16.13.2.1.2 Where tests are performed inside a structure or elsewhere that has limited air circulation, carbon monoxide monitoring equipment should be used. Such equipment should be checked and calibrated regularly and should include a suitable warning device.

A.16.13.2.6 If a counter speed shaft is not provided, the engine speed can be read with a photo-tach or strobe light off a rotating element.

A.16.13.3.1 Annex A of NFPA 1911, Standard for Service Tests of Fire Pump Systems on Fire Apparatus, shows a test data form for recording the test readings and other necessary data.
A.16.13.8 If the tests of some components of the apparatus are being certified by an independent third-party certification organization, the purchaser might wish to specify that these tests also be certified by the independent third-party certification organization.

A.17.1 Auxiliary pumps come in a variety of different styles; gear, piston, and centrifugal designs are available. Where centrifugal designs are specified, the purchaser also has to select if it is to be a single stage, series only multistage, or series/parallel multistage-type pump. The purchaser should indicate the type of operation and performance required from the auxiliary pump. Auxiliary pumps are usually for fighting grass fires or other small blazes. Low capacity with high pressure through 3/4-in. (19-mm) or 1-in. (25-mm) booster hose is commonly used for these fires. Pump and roll is often required.

A.17.2 Various types of pump drive systems are available. These pumps are often driven by power takeoff units attached to SAE PTO openings on the chassis transmission. There are also front of engine PTO systems, flywheel PTO systems, split driveline PTO systems, and separate engine drive systems.

A.17.2.1.3 Where the community to which the apparatus is to be delivered

A.17.3 The volume and pressure that can be obtained safely depends on the torque capacity of the apparatus’s transmission or transfer case, power takeoff, and pump driveline. In most cases, the torque rating of the PTO will determine the maximum pump performance. Power takeoff manufacturers assign a torque rating to their products. This torque rating is based on intermittent service, as in operating the PTO at the full torque limit for a period of 5 minutes or less. For continuous duty, the intermittent torque rating is devalued 30 percent.

A.17.3.2 Sustained operations at either high volume, high pressure, or both high volume and high pressure could cause excessive heating of the transmission lubricant. In order to maintain lubricant temperatures below the component manufacturer’s published limits, it might be necessary to employ oil-to-oil or oil-to-water heat exchangers. The latter should be of a type that will not trap water, causing serious damage if the water is subsequently frozen.

A.17.5.1 The purchaser should indicate the number, size, and location of the pump intake connections or combination of connections desired. The types of pump intake connections are as follows:

1. External intake
2. Direct supply line from the water tank
3. Supply line from the discharge side of the fire pump

A.17.6 The purchaser should indicate the size, number, and location of the pump discharge connections desired. The types of pump discharge connections are as follows:

1. Discharge line(s) for nonpreconnected hose lines
2. Discharge line(s) to preconnected hose lines
3. Discharge line(s) to booster reel(s) (if provided)

A.17.6.3 In order to provide standardization, National Hose threads are required. Adapters can then be used to adapt to locally used hose connections.

A.17.9.4 A separate pumping engine could use the vehicle chassis battery system, or it could have a separate set of dedicated batteries. Battery charging and electrical supply should be designed to meet this standard, whichever system is used.

A.18.2.3 This pump and its ratings are designed for high-flow applications, primarily from hydrants, required for large industrial or refinery fires. These pumps are not designed for all the applications that a fire pump is designed to meet. These pumps might not be ideally suited for low flow, on and off operations, or prolonged standby periods.

A.18.2.4.1 At an altitude of 2000 ft (600 m), the actual (uncorrected) atmospheric pressure equivalent to the sea level reading of 29.9 in. Hg (101 kPa) is 27.8 in. Hg (941 kPa).

A.18.2.4.2 Where the community to which the apparatus is to be delivered is at a considerably higher altitude than the manufacturer’s facility or other test location, sufficient excess power should be provided to compensate for the fact that the power of a naturally aspirated internal combustion engine decreases with elevation above sea level. The performance of a fire pump can be adversely affected by the design of the suction piping or the addition of valves to the suction side of the pump. Losses due to additional piping or valves that are added to the fire pump suction can be calculated and used to determine pump performance.

A.18.3.3 A separate pumping engine could use the vehicle chassis battery system, or it could have a separate set of dedicated batteries. Battery charging and electrical supply should be designed to meet this standard, whichever system is used.

A.18.4.3 Each component in the driveline has a continuous duty torque rating. At this level of usage, each component also has a design life expressed as hours of use at rated torque. The design life of some components can be substantially less than the remaining drive system components. An hourmeter activated by the pumping system and marked with a label should be provided to log the number of hours of drive system usage.

A.18.5.1 Pumps and piping frequently required to pump salt water, water with additives, or other corrosive waters should be made of bronze or other corrosion-resistant materials. For occasional pumping of such water, pumps made of other materials are satisfactory if properly flushed out with fresh water after such use. Where corrosive water is being pumped and the pump and piping are not made of corrosion-resistant materials, the placement of anodes in the pump might minimize the corrosive effects. The term “all bronze” indicates that the pump’s main casing, impeller, intake and discharge manifolds, and other principal components that are exposed to the water to be pumped, with the exception of the shaft bearings and seals, are made of a high-copper alloy material. It is preferable to use similar materials for the pump and piping.

Corrosion effects are proportional to the mass relationship of bronze to iron. It is, therefore, preferable to use similar materials for the pump and piping. Where both iron and bronze are used, it is preferable to keep the mass of the iron larger than that of the bronze.
A.18.6.1 Intakes can be larger than the size of the suction hose specified in Table 18.2.4.1(a). It is also advantageous to have valves on one or more of the intakes. The purchaser should specify if larger intakes are to be provided and if any of the intakes are to be equipped with valves.

Intakes at the front or rear of the apparatus, or otherwise specially situated, might not allow drafting rated capacity at rated pressure. The purchaser should specify the flow rates required from auxiliary intakes, especially front and rear intakes or other intakes located 10 ft (3 m) or more away from the pump. When provided, the purchaser should also consider requiring the manufacturer to certify the actual flow rates from auxiliary intakes.

A.18.6.1.3 Pressurizing a valved suction inlet could create a dynamic water hammer that might cause a hose or fitting failure resulting in injury or death to anyone in the immediate vicinity. Valves should be opened and closed slowly.

A.18.6.2 Sizing of the openings of the strainer(s) is intended for debris of generally uniform dimensions. It is recognized that debris of nonuniform dimensions is long in relation to cross section — might be able to pass through the strainer(s) while not being able to pass through the pump.

A.18.6.5 The bleeder valve should be used prior to the removal of a hose or a cap or other closure connected to an intake. The bleeder valve should also be used while filling a hose connected to an intake with water. Failure to use the bleeder valve in these situations might result in serious injury or death.

A.18.7.1 The flows listed for each outlet size are minimum and are for rating purposes only. If piping and valving are sufficient, much higher flows for a given outlet size might be achievable.

A.18.7.2 In order to provide standardization, National Hose threads are required. Adapters can then be used to adapt to locally used hose connections.

A.18.7.3 If flows greater than 200 gpm (750 L/min) through preconnected lines are needed, piping from the pump to preconnected hose lines should be larger than 2 in. (52 mm) in order to keep the friction loss to a reasonable level. If additional preconnected lines are wanted, the location and hose size should be specified.

A.18.7.5.2 Control of discharges on apparatus are now available in pull-type actuators, trunnion or swing valves, cable control, gear-operated hand wheel control, and hydraulic, air, and electric operators. These are available with either quick-operating and slow-operating valve mechanisms. The nozzle and hose reaction and "operational effort" for high-flow or high-pressure discharges are critically important to many fire departments. Due to the variations in type of individuals or characteristics of operators involved with pump operations, a purchaser should carefully evaluate valve controls. Slow-closing gear operated and other power-operated valves should be considered for valves 3-in. (75-mm) and larger.

A.18.7.9 Where possible, discharge outlets should be positioned in an area away from the pump operator's position.

A.18.9.1 Ideally, having no intake or discharge connections at the operator's position would simplify and improve safety for the operator. If complete removal of these connections is impractical, the reduction and careful placement of these connections, with operator safety in mind, would improve the situation considerably.

Many fire departments have found it useful to color code the labels used to identify the various discharge and intake controls. While this process can simplify pump operations, it can also create confusion if a pattern is not followed on all apparatus in the department. For standardization, the color coding scheme in Table A.18.9.1 is recommended for all new apparatus labels, as applicable.

A.18.10 The indicator lights and interlocks specified in this section are minimum. Some manufacturers or users might choose to add additional indicator lights or interlocks.

A.18.10.1.2 Pumps are operated from the side, top, front, or rear of the vehicle, and stationary pumping requires that there is no power applied to the wheels while pumping. Therefore, it is essential that any controls that could apply power to the wheels while pumping be equipped with a means to prevent dislocation of the control from its set position in the pumping mode.

A.18.10.2.1 Completion of the pump shift might require that the chassis transmission be shifted into pump gear.

A.18.10.3.1 Completion of the pump shift might require that the chassis transmission be shifted into pump gear.
A.18.12.2.6 If a counter speed shaft is not provided, the engine speed can be read with a photo-tach or strobe light off a rotating element.

A.18.13.2.3.1 Annex A of NFPA 1191, Standard for Service Tests of Fire Pump Systems on Fire Apparatus, shows a test data form for recording the test readings and other necessary data.

A.18.13.2.3.2 Where an engine is operating at or near full power while stationary, the heat generated could raise the temperature of certain chassis or pumping system components above the level that, when touched, can cause extreme discomfort or injury; however, as long as the apparatus can be operated and used satisfactorily for the required duration of the test under such conditions, it should be considered acceptable.

The suction lift can be determined by either measuring the negative pressure (vacuum) in the pump intake manifold by means of a manometer, or other suitable test gauge that measures vacuum accurately, or by adding the vertical lift and the value of friction and entrance loss from Table 18.2.4.1(b) or Table 18.2.4.1(c). To be accurate, gauge readings should be corrected for the difference between the height of the gauge and the centerline of the pump intake, but usually this is not a significant amount and could be ignored. Thus, the net pump pressure can be calculated by using the following formula:

\[
\begin{align*}
\text{Inch-pound units} & : & P = D + (H \times 0.5) \\
\text{or} & : & P = D + 0.43 (L + F) \\
\text{Metric units} & : & P = D_{m} + H_{m} \\
\text{or} & : & P = D_{m} + F_{m} + 9.8 L_{m}
\end{align*}
\]

Where:

\[
\begin{align*}
P & = \text{net pump pressure (psi or kPa)} \\
D & = \text{discharge pressure (psi gauge or kPa)} \\
H & = \text{manometer reading (in. Hg)} \\
L & = \text{vertical lift (ft)} \\
F & = \text{friction and entrance loss (ft or kPa)}
\end{align*}
\]

A.18.13.7 If the tests of some components of the apparatus are being certified by an independent third-party certification organization, the purchaser may wish to specify that these tests also be certified by the independent third-party certification organization.

A.19.2.2 Water tanks should have provisions that would allow for complete inside cleaning for flushing. The purchaser should indicate in the specifications if access to the interior of the tank is required.

A.19.2.3 Water tanks can appear in several different configurations such as round, elliptical, rectangular, or T-shaped. Handling characteristics of the apparatus can be greatly affected by its vertical and horizontal center of gravity. The purchaser should indicate the filling and dumping rates required if these rates exceed the requirements of this standard and any other local needs and let the apparatus manufacturer design the tank shape to best meet the axle loading and center of gravity requirements.

When the tanks are made as one unit with the body and compartments, the material used is important. It should be corrosionproof and a material that does not easily sweat.

A.19.2.5 The design of a water tank can be a very critical factor in the handling characteristics of fire apparatus. If water is free to travel either longitudinally or laterally in a tank, as would be the case if the tank were half full, a tremendous amount of inertia can be built up that will tend to force the fire apparatus in the direction the water has been traveling. When the water reaches the end of the tank, this sudden application of force can throw the fire apparatus out of control and has been known to cause fire apparatus to turn over or skid when going around a curve or coming to a sudden stop. The only methods for preventing such an accident are to restrict or disrupt the movement of the water so that the inertia will not build up in one direction. This is done with the installation of swash partitions in a manner to either contain the water in smaller spaces within the tank (containment method) or disrupt its momentum by changing its direction of motion (gyroscopic method). The partitions in a dynamic system are often staggered in an arrangement designed to change the direction of the water and turn it into a turbulent motion that absorbs much of its own energy.

A.19.3.3 A check valve installed in the tank to pump line is the most common method used to prevent water from backflowing into the tank at an excessive rate if the pump is being supplied from a hydrant or relay pump and the tank to pump line valve has been inadvertently left in the open position.

A hole up to \( \frac{1}{8} \) in. (6 mm) is sometimes provided in the check valve to release steam or other pressure buildup.

A.19.4.1 Where rapid filling of the water tank from an external use is desired, the purchaser should consider an inlet directly into the tank that is capable of allowing the tank to be filled at a rate of 1000 gpm (4000 L/min). Where such a fill connection is provided, it should conform to the requirements of 19.4.4.

A.19.4.1.4 An excessive flow rate when filling a tank could result in a pressure buildup in the tank that could cause permanent damage or failure.

A.19.4.2.2 A vent/overflow outlet is necessary so that overpressurization does not occur within the tank while it is being filled. However, water is likely to spill out of the vent/overflow outlets while the fire apparatus is moving (e.g., accelerating, decelerating, or cornering). The fill tower and vent/overflow outlet should be arranged so that water spillage is minimized and is directed behind the rear tires.

A.19.4.3 Consideration should be given to providing an additional pump cooling/recirculation line that is automatic in operation, as pumps on fire apparatus are often left unattended and a line that is automatic in operation will ensure the pump does not overheat.

A.19.4.3.1 If a larger fill line is desired, the buyer should consult with the manufacturer on construction of the tank inlet location and any required reinforcement or alternation of the tank baffles. It is necessary to design the tank with venting and overflow capability for the maximum fill rate.

A.19.4.3.2 See A.19.4.3.1.

A.19.4.3.3 A locking-type ball valve, globe valve, needle valve, or other type capable of regulating flows should be used. A gate valve is not recommended.

A.19.5.1.1 Where large filling rates are used, fill connections should be equipped with a diffuser inside the tank to minimize potential structural damage. It is important that the purchaser evaluate how the apparatus will be used and define the location and type of fittings desired on this tank fill.

Where rapid filling of the water tank on another type of apparatus from an external use is desired, the purchaser should consider an inlet directly into the tank that is capable of allowing the tank to be filled at a rate of 1000 gpm (4000 L/min). Where such a fill connection is provided, it should conform to the requirements of 19.5.1.

A.19.5.2 It is important that the purchaser evaluate how the apparatus will be used and define the location(s) and types of fittings for these outlets.

Where rapid dumping of the contents of the water tank to an external use is desired on other types of apparatus, the purchaser should consider an outlet directly into the tank that is capable of allowing water to be transferred from the tank at an average rate of at least 1000 gpm (4000 L/min).

A.19.5.2.2 Additional methods might be desired to improve the off-loading rate of gravity dumps. These methods include a jet assist or a pneumatic pump. Control should be from the pump operator’s position. Two types of jet assists can be used, one directed into the throat of the gravity dump and the other a peripheral jet system. Figure A.19.5.2.2(a) shows how the traditional jet is installed. A smooth-tipped “jet” nozzle is supplied by a pump that is capable of delivering at least 250 gpm (1000 L/min) at a gauge pressure of...
150 psi (1000 kPa). Nozzle jets range in size from \( \frac{1}{4} \) in. to \( \frac{1}{2} \) in. (19 mm to 33 mm). The diameter of the tip will be determined by the capacity of the pump being used and the diameter of the discharge piping and dump valve.

The peripheral application of jet assist nozzles has proven highly effective. This approach utilizes two or more jets installed in the sides of the discharge piping just outside the quick dump valve. In addition to the reported discharge advantages of peripheral discharge streams, the externally fed system is easier to-plumb and has fewer maintenance problems. The jets, installed 25 degrees to 30 degrees from the piping wall, contact more surface area of the discharging water, thereby increasing water discharge efficiency. Because the water is drawn through the dump valve, less turbulence is created and the eddy effect often present with traditional in-line jets is overcome. Nozzles made by welding reducer pipe fittings work very effectively as jets. Flow rates of 2000 gpm (8000 L/min) have been obtained using a 300-gpm (1100-L/min) pump to supply two 3/4-in. (19-mm) nozzles in a 6-in. (150-mm) dump valve configuration. Figure A.19.5.2.2(b) shows a diagram of a peripheral jet assist arrangement.

A pneumatic system can be used to pressurize a tank and assist in expelling water. The vacuum pumps can also be used for filling the tank.

Figure A.19.5.2.2(a) Traditional Internal Jet Dump. [Existing Figure A-17-5(a), 1999 edition of NFPA 1901, no change]

Figure A.19.5.2.2(b) Peripheral Jet Assist Arrangement (top view). [Existing Figure A-17-5(b), 1999 edition of NFPA 1901, no change]

A.19.6.1 If the tests of some components of the apparatus are being certified by an independent third-party certification organization, the purchaser might wish to specify that the water tank capacity also be certified by the independent third-party certification organization.

A.20.1 If the purchaser intends to suspend personnel or equipment from the aerial ladder, the purchaser should inform the manufacturer of the intended use in order to determine proper mounting devices and locations as well as associated capacities. Equipment users have the potential to overload the aerial device components if improper methods are used.

A.20.2.13 If the fire department expects to engage in operations where they will need to supply remote breathing air from the system on the aerial ladder to fire fighters working away from the end of an aerial ladder, such as during a rescue operation in a fuel or chemical tank, coal bin, or silo storage tower, it will be necessary to be able to supply breathing air for at least two persons.

A.20.3.4 Ladder capacity ratings are established in many different operating positions other than full extension and zero degrees elevation. Ladders are often rated at higher tip capacities as elevation angles increase or when the ladder is not fully extended. Most manufacturers provide distributed load capacities (several persons) depending on the ladder’s extension and elevation. Combination ratings that include capacity at the tip while discharging water are normally provided. These can vary with elevation and extension and are examples of multiple configurations. It is important that the manufacturer clearly define for the user the ladder’s rated capacity in various positions and operation modes.

A.20.4.3.1 A two-way communication system at two positions on the apparatus is considered a minimum. Depending on the configuration of the apparatus, the purchaser might want to consider communication systems at additional positions, such as at a pump panel or at the monitor operating position on the ladder.

A.20.5.2.1 Turntable bearing bolts are required to be checked and retorqued at regular intervals. The apparatus body should be constructed so as to make this task relatively simple by unbolting access panels, ladder slides, and other obstructions. Space should be provided for checking and torquing of the bearing bolts above and below the turntable using the appropriate tools.

A.20.5.4 The controls located at the tip of an aerial ladder are primarily intended to perform the final positioning of the aerial ladder in rescue or other fire-fighting operations. These controls are not intended to replace the lower control position as the primary operating position for the aerial ladder. Where the tip control is used, the operator(s) needs to use caution due to the following potential problems:

(1) Tip control operators need to be aware of personnel who are on the ladder sections behind them.

(2) Lower control operators need to remain in position and deactivate the tip controls when anyone is moving on the ladder.

(3) Tip control operators need to take care to place their feet on the steps at the tip to avoid injury to their feet from the moving ladder sections below.

(4) Tip control operators need to be belted in position to protect against abrupt or unexpected ladder movements.

A.20.6.1 The arrangement of the waterway could be a telescoping pipe to a fly section or a nontelecesopic pipe to the tip of the base section.

A.20.6.1.3 The tip of an aerial ladder should be capable of being positioned up to a window or other location to allow fire fighters and civilians to climb onto the aerial ladder easily. It might be preferable to keep the monitor behind the last rung of the fly section to protect it in the road position.

A.20.6.1.5 The arrangement of the external inlet should be specified by the purchaser based on the intended local operation in supplying water to the waterway.

If the normal operations are to supply the waterway through the external inlet, a valve should be provided where large diameter hose is to be used. A valve three- or four-inlet siamese should be provided when 2 1/2- in. or 3-in. (65-mm or 75-mm) supply lines are used. Attention should be given to the inlet arrangement to limit friction loss. Also, if the apparatus is equipped with a fire pump and the purchaser wants to use the auxiliary inlet as a discharge, a slow-operating valve needs to be installed in the riser to the swivel.

A.20.6.1.8 Where freezing conditions are expected, an automatic drain valve should be specified in order to drain the waterway when water is not flowing.

A.20.6.2 If the purchaser wants extra length on the hose, a two- or three-inlet siamese, or a shutoff at the base of the ladder, these should be specified. The purchaser might also wish to specify a 500-gpm (2000-L/min) minimum spray nozzle.

The size of hose used to supply the ladder pipe has been considered by the aerial ladder manufacturer in the design of the ladder. Use of larger hose could overload the ladder with excessive weight and should be avoided without consulting the aerial ladder manufacturer first.

The hose should be fastened in a straight line up the middle of the aerial ladder. Hose straps not only secure the hose in place but take the strain off couplings and fittings that might otherwise fail and cause injury.

Where the purchaser wants pulleys and cables for vertical control of the stream from the turntable, the purchaser should specify these.

A.20.9.2.1 A two-way communication system at two positions on the apparatus is considered a minimum. Depending on the configuration of the apparatus, the purchaser might want to consider communication systems at additional positions such as the pump panel.

A.20.10.1 Position lights on the outer corners of the platform can be helpful in providing increased visibility of the platform’s location from the ground operator’s position.

A.20.10.3.1 See A.20.5.2.1.

A.20.12.3.4 Because the water system can be closed at both the top and bottom of the waterway, the purchaser might want to require a vacuum relief valve.

A.20.12.5 The arrangement of the external inlet should be specified by the purchaser based on the intended local operation in supplying water to the waterway. If the normal operations are to supply the waterway through the external inlet, a valve should be provided where large diameter hose is to be used. A valve three- or four-inlet siamese should be provided when 2 1/2- in. or 3-in. (65-mm or 75-mm) supply lines are used. Attention should be given to the inlet arrangement to limit friction loss. Also, if the apparatus is equipped with a fire pump and the purchaser wants to use the auxiliary inlet as a discharge, a slow-operating valve needs to be installed in the riser to the swivel.

A.20.12.9.1 Where freezing conditions are expected, an automatic drain valve should be specified in order to drain the waterway when water is not flowing.

A.20.15.3.1 See A.20.5.2.1.

A.20.16.5 The arrangement of the external inlet should be specified by the purchaser based on the intended local operation in supplying water to the waterway. If the normal operations are to supply the waterway through the external inlet, a valve should be provided where large diameter hose is to be used. A valve three- or four-inlet siamese should be provided when 2 1/2- in. or 3-in. (65-mm or 75-mm) supply lines are used. Attention should be given to the inlet arrangement to limit friction loss. Also, if the apparatus is equipped with a fire pump and the purchaser wants to use the auxiliary inlet as a discharge, a slow-operating valve needs to be installed in the riser to the swivel.

A.20.17.5 It might be desirable to provide an override system to deactivate the interlocks when it is necessary to operate the device with reduced payload or reach. Where an override system is specified, it should require
the action of a person in addition to the operator to deactivate the interlock
system. Where an override system is provided, it is also advisable to provide an
indicator at all aerial device operating positions to warn the operator that
the override controls have been activated.

A.20.18.1 If the operator’s position is located on the turntable, the
operator should have at least 5 ft (0.46 m) of standing and working space
exclusive of other space required. The purchaser should specify any special
requirements for the operator’s position or for other space required on the
turntable for personnel to stand or work.

A.20.18.2 Aerial ladder operational controls should be located such that
the operator can see the tip of the aerial ladder in all operating positions. The
operator’s position is often located on the turntable.

A.20.19.7 While this standard requires the hydraulic system to have
adequate cooling for continuous operation for 2/3 hours, prolonged
operations under adverse environmental conditions could cause the hydraulic
oil to rise in temperature beyond its recommended temperature range. The
purchaser might wish to specify an indicator and alarm that warns the
operator if the fluid temperature begins to overheat.

A.20.20.1 Structural safety factors are widely recognized terms in good
engineering practice but can be unfamiliar to those using this standard.

The following combination of loads should be evaluated to determine
compliance with this standard. To clarify, the terms are defined as follows:

\[ DL = \text{Dead Load Stress} \]

Stress produced by the aerial device structure and all materials, components,
machinery, mechanisms, or equipment permanently fastened thereto. If this equipment is installed by the manufacturer before delivery, it
is included in the dead load. Equipment added to the aerial device by the fire
department that exceeds the manufacturer’s recommendations needs to be
subtracted from the rated capacity.

\[ RL = \text{Rated Capacity Stress} \]

Stress produced by the rated capacity of the aerial device applied at the tip of the fly section for an aerial ladder
[minumum 250 lb (114 kg) at an elevation of zero degrees and full extension]
or on the platform of an elevating platform apparatus [minimum 750 lb (340
kg) at an elevation of zero degrees and full extension].

\[ WL = \text{Water Reaction Stress} \]

Stress produced by nozzle reaction force and the weight of the water in the water delivery system.

\[ FY = \text{Material Yield Strength} \]

The stress at which a material exhibits a specified permanent distortion or set.

\[ 2 \times DL + 2 \times RL < FY \]

(1) With no water in the system, the aerial device positioned at full
extension, zero-degree elevation, and loaded at the rated capacity, the
criterion for structural safety is as follows: the stress produced by two times
the dead load stress (DL) plus the stress produced by two times the rated
capacity stress (RL) should not exceed the material yield stress (FY). (See
formula that follows.) This is a 2:1 safety factor.

\[ 2 \times DL + 2 \times RL + WL < FY \]

(2) With water flowing in the system and the aerial device in the position
that creates the highest stress, the criterion for structural safety is as follows:
the stress produced by two times the dead load stress (DL) plus the stress
produced by two times the rated capacity stress (RL) plus the stress produced
by the water reaction stress (WL) should not exceed the material yield
strength (FY). (See formula that follows.)

A device used in a discharge or intake line to force foam
solution and air into the water stream. The end product of a discharge of foam solution and air.

**Aerated Foam.** The end product of a discharge of foam solution and air.

**Aspirate.** To draw in air; nozzle aspirating systems draw air into the nozzle
to mix with the agent solution.

**Aspirated Foam.** The end product of a mechanically induced air stream that is
drawn into the foam solution at atmospheric pressure to create foam. The
aeration is generated by the energy of the foam solution stream.

**Automatic Regulating Proportioning System.** A proportioning system that
automatically adjusts the flow of foam concentrate into the water stream to
maintain the desired proportioning ratio. These automatic adjustments are
made based on changes in water flow or conductivity.

**Batch Mix.** The manual addition of foam concentrate to a water storage
container or tank to make foam solution.

**Foam Blanket.** A body of foam used for fuel protection that forms an
insulating and reflective layer from heat.

**Injector.** A device used in a discharge or intake line to force foam
concentrate into the water stream.

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

**Proportioning Ratio.** The ratio of foam concentrate to water, usually
expressed as a percentage.

**Surface Tension.** The elastic-like force in the surface of a liquid that tends
to bring droplets together to form a surface.

**Wetting Agent.** A chemical that reduces the surface tension of water and
causes it to spread and penetrate more effectively than plain water, but does
not foam.

A.21.2 Foam proportioning systems can be designed with the following
features:

1. The ability to proportion different types of foam concentrate including
   Class A and Class B foam concentrates

2. The ability to proportion foam concentrate at fixed or variable
   proportioning ratios

3. The ability to proportion foam concentrate into single or multiple
discharge outlets

4. The ability to supply foam solution and water simultaneously from
   multiple discharge outlets

5. Manual or automatic foam proportioning system operation

A.21.2.1 In-line eductor foam proportioning systems are installed in the
water pump discharge as a permanently installed device or as a portable
device. Water is forced through the eductor venturi by water pump discharge
pressure and creating a vacuum that causes foam concentrate to be pushed by
atmospheric pressure into the eductor (into the water stream) at the design
rate of the device [see Figure A.21.2.1(a)]. By design, a nonrecoverable
pressure drop of 30 percent or greater is required for eductor operation.

The maximum recovered pressure, including friction loss and static head
pressure, is nominally 65 percent of the inlet pressure to the eductor. The
in-line eductor is a manually regulated proportioning system.

A variable flow bypass eductor system is a modification of the in-line
eductor foam proportioning system. An eductor is placed in a bypass line
around the mainline water flow control valve so that when the valve is
adjusted to produce water flow through the bypass eductor, foam concentrate
is drawn into the eductor (into the water stream) [see Figure A.21.2.1(b)].
The foam solution in the bypass line is then joined with the mainline water
flow downstream of the water flow control valve. The variable flow bypass
eductor is a manually regulated proportioning system.

A variable pressure eductor is another modification of the in-line
ductor foam proportioning system. This type of eductor is designed to automatically
adjust the area of the eductor venturi to compensate for changes in water
pressure at the inlet of the device. The variable pressure eductor is a
manually regulated proportioning system.

**Figure A.21.2.1(a)** In-Line Eductor Foam Proportioning System
[Existing Figure A-19-2.1(a), 1999 edition of NFPA 1901, no change]

**Figure A.21.2.1(b)** Variable Flow Bypass Eductor System
[Existing Figure A-19-2.1(b), 1999 edition of NFPA 1901, no change]
A.21.2.2 Self-educating master stream nozzles are mounted on the discharge side of the pump. These devices comprise a complete foam proportioning system consisting of a foam proportioning and application device (nozzle). Self-educating master stream nozzles have the following operating characteristics:

1. Operator-adjustable foam solution rates of 3 percent or 6 percent
2. Minimal pressure drop, approximately 1 percent to 2/3 percent of inlet pressure

A.21.2.3 An intake-side foam proportioning system is a manually regulated system. An in-line device, installed in the water pump intake line, provides a connection through a foam concentrate metering valve to the foam concentrate tank. The vacuum created by the water pump allows atmospheric pressure to push foam concentrate directly into the pump intake. Hydrant or relay operation is not possible with this type of foam proportioning system.

A.21.2.4 Around-the-pump proportioning systems operate with an eductor installed between the water pump discharge and the intake. A small flow of water from the water pump discharge passes through the eductor, which creates a vacuum that causes foam concentrate to be pushed into the eductor and discharged into the pump intake. Around-the-pump foam proportioning systems require a pressure differential of 30 percent to 50 percent of inlet pressure for efficient operation.

A manual around-the-pump proportioning system utilizes a manually adjustable foam concentrate metering valve to control the proportioning ratio. [See Figure A.21.2.4(a).]

A flowmeter sensing around-the-pump proportioning system utilizes a flowmeter sensing system to monitor total solution flow and foam concentrate flow. The flow data is transmitted to an electronic control that controls the proportioning ratio through a foam concentrate metering valve. [See Figure A.21.2.4(b).]

A conductivity sensing automatic variable metering around-the-pump proportioning system utilizes electrical conductivity meters to sense the foam solution percentage and provide feedback from the control sample module. Data from the electrical conductivity meters is transmitted to an electronic control that controls the proportioning ratio through a foam concentrate metering valve. [See Figure A.21.2.4(c).]

A.21.2.5 Balanced pressure foam proportioning systems are installed on the discharge side of the water pump. Two orifices discharge water and foam concentrate into a common ratio controller (proportioner) located in the water pump discharge. By adjusting the area of the orifices to a particular ratio, the percent of injection can be controlled if the intake pressures are equal. The method of controlling or balancing the foam concentrate pressure with the water pressure varies with different balanced pressure system designs. The two basic types of balanced pressure systems are systems without a foam concentrate pump and systems with a concentrate pump. Balanced pressure foam proportioning systems are generally automatic regulating proportioning systems.

Balanced pressure systems without a foam concentrate pump are referred to as “pressure proportioning systems” [See Figure A.21.2.5(a)]. These systems utilize a pressure vessel with an internal bladder to contain the foam concentrate. When in operation, water pump pressure is allowed to enter the pressure vessel between the shell and the internal bladder to exert pressure on the internal bladder. The foam concentrate is forced out of the bladder to the foam proportioner at a pressure equal to the water pump pressure.

There are two basic types of balanced pressure foam proportioning systems that utilize a foam concentrate pump, a bypass system, and a demand system. Foam proportioning system operation is not affected by water pump intake pressure or interrupted while refilling the foam concentrate tank in these types of foam proportioning systems.

The bypass system utilizes a valve in the foam concentrate pump recirculating line that balances the foam concentrate and water pressure by bypassing excess foam concentrate. [See Figure A.21.2.5(b).]

The demand system is designed to control the speed of the foam concentrate pump resulting in control of the pump discharge pressure to achieve a balance of foam concentrate and water pressure within the system. [See Figure A.21.2.5(c).]

A.21.2.6 Direct injection foam proportioning systems utilize a foam concentrate pump to inject foam concentrate directly into the water pump discharge. Foam proportioning system operation is not affected by water pump intake pressure or interrupted while refilling the foam concentrate tank. Direct injection foam proportioning systems are generally automatic regulating proportioning systems.

Automatic flow sensing direct injection foam proportioning systems utilize an in-line flowmeter(s) to monitor the system operating conditions. System operating data is transmitted to an electronic control, which controls the proportioning ratio. The following two different flow sensing systems are available.

1. An electronic control receives electronic signals corresponding to the proportioning ratio from the control panel and water flow data from the flowmeter. The electronic control then commands the foam concentrate pump module to deliver foam concentrate at the proportional rate. [See Figure A.21.2.6(a).]

2. An electronic control receives electronic signals corresponding to the foam concentrate flow from a foam concentrate flowmeter, the proportioning ratio from the control panel, and water flow data from the water flowmeter. The electronic control controls the proportioning ratio through a foam concentrate metering valve. [See Figure A.21.2.6(b).]

A conductivity sensing direct injection foam proportioning system utilizes an electrical conductivity meter(s) to sense the proportioning ratio at the water pump discharge(s) and transmits this information to an electronic control that controls the proportioning ratio through a metering valve. A second electrical conductivity meter provides feedback from the control sample module to the electronic control. Foam pump pressure is maintained at a pressure higher than water pump pressure to ensure injection of the concentrate. [See Figure A.21.2.6(c).]

A.21.2.7 In a water motor foam proportioning system, a water motor drives a positive displacement foam concentrate pump. The water motor can be of either a positive displacement type or a turbine type. Water motor foam proportioning systems are automatic regulating proportioning systems. Where a positive displacement water motor drives the foam concentrate pump, the ratio of the water motor displacement to the displacement of the foam concentrate pump is the ratio of the desired foam solution. A positive displacement water motor proportioning system requires no external power. [See Figure A.21.2.7(a).]

A water turbine-driven foam proportioning system uses a water turbine to power a positive displacement foam concentrate pump. Flowmeters sense the foam concentrate pump output and the water flow, sending signals to an electronic control that controls the proportioning ratio by adjusting the water turbine speed. [See Figure A.21.2.7(b).]

A.21.2.7(a) Water Motor Foam Proportioning System. [Existing Figure A-19-2.7(a), 1999 edition of NFPA 1901, no change]

A.21.2.7(b) Water Turbine-Driven Flow Sensing Direct Injection Foam Proportioning System. [Existing Figure A-19-2.7(b), 1999 edition of NFPA 1901, no change]
A.21.1.3.1 Foam proportioning systems that inject foam concentrate into the water pumping system at a higher pressure than the water pressure have the potential to force foam concentrate or foam solution into an external water source. This condition will occur when there is no water flowing and the foam proportioning system is activated in the automatic mode. Backflow prevention devices, or any device that creates additional friction loss in the system, should be installed only with the approval and specific instructions of the foam proportioning system manufacturer.

A.21.3.4 Most foam concentrate manufacturers differentiate in the materials they recommend between those foam proportioning system components that are designed to be flushed with water after operation and those components that are intended to be continuously wetted with foam concentrate.

A.21.4.1 It is desirable to have a visual indicator on the operator’s panel that shows that the foam proportioning system is in the “operating” or the “off” position. A visual means of indicating positive foam concentrate flow at the operator’s panel is also helpful.

A.21.6.3.2 Suitable means to attach the cover to the fill tower could include use of a threaded cap or a hinged cover with a mechanical latching device.

A.21.6.6 On apparatus where a single foam storage tank is used, provisions should be made to flush the tank and all foam concentrate plumbing to avoid contamination of dissimilar foam concentrates when switching types or brands.

A.21.6.8 The foam concentrate tank(s) can be an integral part of the water tank.

A.21.6.10.2 Different types and brands of concentrates can be incompatible with each other and should not be mixed in storage. Concentrate viscosity varies with different types of products and temperatures.

A.21.7.1 The foam concentrate pump is a very critical component of both balanced pressure and direct injection foam proportioning systems.

A.21.7.2 Corrosion-resistant materials are materials such as brass, copper, monel, stainless steel, or equivalent materials.

A.21.7.5 A suitable suction device is required to operate from an external source such as 5-gal (19-L) pails, 55-gal (208-L) drums, and portable tanks or containers.

A.21.9.3 It is desirable for in-line eductor systems to have a label that indicates the system flow rate, the maximum usable hose length, the hose size required, the nozzle type, and allowable elevation changes.

A.21.9.3.2 It is necessary for the operator to familiarize himself or herself with the specific type of foam concentrate that the system manufacturer has designed the system to operate with and proportion accurately. The foam proportioning system might require modification or recalibration if a foam concentrate is introduced into the system that was not intended for use in the system by the manufacturer.

A.21.10 If the tests of some components of the apparatus are being certified by an independent third-party certification organization, the purchaser might wish to specify that these tests also be certified by the independent third-party certification organization.

A.21.10.2 There are four methods for testing a foam proportioning system for calibration accuracy.

Test Method 1. Water Is Substituted for Foam Concentrate. The foam system is operated at the water flow rates at which the system is to be tested. Water is used as a substitute for foam concentrate. The substitute water for the foam concentrate is drawn from a calibrated tank instead of foam concentrate from the foam concentrate tank. The volume of water drawn from the calibrated tank divided by the volume of water pumped over the same time period times 100 represents the percentage of foam the foam proportioner is producing.

Test Method 2. Foam Percent Is Determined by Use of a Refractometer. With the foam system in operation at a given flow, a solution sample is collected from each outlet. The foam concentration solution is measured using a refractometer to determine the refractive index of the collected foam solution sample. This method might not be accurate for AFFF or alcohol-resistant foam and certain other types of foam that typically exhibit very low refractive index readings. Also, the refractometer method should not be used when testing foam percentages of 1 percent or lower because the accuracy, at best, for determining the percent of foam concentrate in a foam solution when using a refractometer is ±0.1 percent. For this reason, the conductivity method could be a preferable test method where AFFF, alcohol-resistant foam, or foam in 1 percent or less concentration (Class A foams) is to be tested.

Test Method 3. Foam Concentrate Pump Output Is Measured Directly. With some direct injection systems, it is possible to directly measure foam concentrate pump output. With the foam system in operation at a given water flow rate, either using foam concentrate or water as a substitute for foam concentrate, the output of the foam concentrate pump is measured by diverting that output into a calibrated container for direct measurement over a measured period of time. An alternative is to measure the foam concentrate flow or water substitute with a calibrated meter.

A.21.3.4 Most foam concentrate manufacturers differentiate in the materials they recommend between those foam proportioning system components that are designed to be flushed with water after operation and those components that are intended to be continuously wetted with foam concentrate.

To use a refractometer to determine percent of foam solution, a base calibration curve needs to be prepared. The following equipment is required:

1. Four 100-ml or larger plastic bottles with caps
2. One measuring pipette (10 ml) or syringe (10 cc)
3. One 100-ml or larger graduated cylinder
4. Three plastic-coated magnetic stirring bars
5. A refractometer
6. Standard graph paper
7. A ruler or other straight edge

Using the water and foam concentrate from the system to be tested, three known foam solution samples are made up using the 100-ml or larger graduated cylinder. These known foam solution samples should include the following:

1. The nominal intended percentage
2. The nominal intended percentage plus 1 percent
3. The nominal intended percentage minus 1 percent

If the nominal intended percent is one percent or less, the three samples should be as follows:

1. The nominal intended percentage
2. The nominal intended percentage plus 0.3 percent
3. The nominal intended percentage minus 0.3 percent

The water required is placed in the 100-ml or larger graduated cylinder leaving space for the foam concentrate. Using the pipette or syringe, the required foam concentrate samples are carefully added to the water. Each measured foam solution is poured from the 100-ml or larger graduated cylinder into a 100-ml or larger plastic bottle. Each bottle should be marked with a label indicating the percent solution it contains. A plastic-coated magnetic stirring bar is added to the bottle. The bottle is capped and shaken thoroughly to mix the foam solution.

An alternate method for making up three foam solution samples is to use a very accurate scale. When a very accurate scale is used, only small amounts of water and foam concentrate are required. To use the scale method, the density of the foam concentrate needs to be known. Look at the data sheet or the MSDS for the foam product density. For example, to make 100 ml of a 3 percent foam solution using a foam concentrate with a density of 1.04, measure 97 g of water into a beaker and add 3.12 g of foam concentrate to the beaker (1.04 × 3 g = 3.12 g).

After the foam solution samples are thoroughly mixed, a refractive index reading is taken of each percentage foam solution sample. This is done by placing a few drops of the solution on the refractometer prism, closing the cover plate, and observing the scale reading at the dark field intersection. Since the refractometer is temperature compensated, it could take 10 seconds to 20 seconds for the sample to be read properly. It is important to take all refractometer readings at ambient temperatures of 50°F (10°C) or above.

Using standard graph paper, the refractive index readings are plotted on one axis and the percent of concentration on the other. This plotted curve serves as the known baseline for the test series. The solution samples should be set aside in the event the measurements need to be checked.

**Sampling and Analysis.** Foam solution samples are collected from the proportioning system using care to make certain that the samples are taken at an adequate distance downstream from the foam proportioner being tested. Refractive index readings of the samples are taken and compared to the plotted curve to determine the percentage of the collected test samples.
The following equipment is used to perform this method:

(a) Two 100-ml or larger containers
(b) One direct reading foam solution conductivity meter

Procedure. A sample of the water to be used in the test is obtained using one of the 100-ml or larger containers. The conductivity meter head is immersed in the water sample and the meter display is set at zero. If the direct reading foam solution conductivity meter is mounted in a discharge line, the meter should be set at zero with plain water flowing.

If the conductivity meter manufacturer does not indicate that the percentage of foam solution can be read directly for the foam concentrate being used, a calibration curve needs to be developed. The calibration curve might show that the direct meter readings are correct for the foam concentrate being used or it might indicate that the calibration curve needs to be used when that foam concentrate is used.

The foam proportioning system is operated and a sample of the foam solution produced by the system is collected using the other 100-ml or larger container. The conductivity meter head is immersed in the foam solution sample and the percentage of the foam solution is read on the meter display. If the conductivity meter is mounted in a discharge line, the percentage of the foam solution is read on the meter display while foam solution is being discharged.

(2) Conductivity Comparison Method. The following equipment is used to perform this method:

(a) Two 100-ml or larger containers
(b) Conductivity meter reading in microsiemens per centimeter (mscm)

Procedure. A sample of the water to be used in the test is obtained using one of the 100-ml or larger containers. Using the conductivity meter, the conductivity value of the water sample is determined.

The foam proportioning system is operated and a sample of the foam solution produced by the system is obtained using the other 100-ml or larger container. Using the conductivity meter, the conductivity value of the foam solution sample is measured.

The conductivity value of the water sample is subtracted from the conductivity value of the foam solution sample and the result is divided by 500 to obtain the percent of foam concentrate in the foam solution.

Conductivity of foam solution — conductivity of water
500

NOTE: Five hundred is used as the divisor assuming that the conductivity meter units are mscm. Other units of conductivity can be used but the value of the divisor (500) will need to be adjusted.

(3) Conductivity Calibration Curve Method. A hand-held conductivity meter is used to measure the conductivity of foam solutions in microsiemens units.

The following equipment is used to perform this method:

(a) Four 100-ml or larger plastic bottles with caps
(b) One measuring pipette (10 ml) or syringe (10 cc)
(c) One 100-ml or larger graduated cylinder
(d) Three plastic-coated magnetic stirring bars
(e) A portable temperature-compensated conductivity meter
(f) Standard graph paper
(g) A ruler or other straight edge

Procedure. A base calibration curve is prepared using the water and foam concentrate from the system to be tested. Three standard solutions are made using the 100-ml or larger graduated cylinder. These known foam solution samples should include the following:

(1) The nominal intended percentage
(2) The nominal intended percentage plus 1 percent
(3) The nominal intended percentage minus 1 percent

If the nominal intended percent is one percent or less, the three samples should be as follows:

(1) The nominal intended percentage
(2) The nominal intended percentage plus 0.3 percent
(3) The nominal intended percentage minus 0.3 percent

The water required is placed in the 100-ml or larger graduated cylinder leaving space for the foam concentrate. Using the pipette or syringe, the required foam concentrate samples are carefully added to the water. Each measured foam solution is poured from the 100-ml or larger graduated cylinder into a 100-ml or larger plastic bottle. Each bottle should be marked with a label indicating the percent solution it contains. A plastic-coated magnetic stirring bar is added to the bottle. The bottle is capped and shaken thoroughly to mix the foam solution.

An alternate method for making up three foam solution samples is to use a very accurate scale. When a very accurate scale is used, only small amounts of water and foam concentrate are required. To use the scale method, the density of the foam concentrate needs to be known. Look at the data sheet or the MSDS for the foam product density. For example, to make 100 ml of a 3 percent foam solution using a foam concentrate with a density of 1.04, measure 97 g of water into a beaker and add 3.12 g of foam concentrate to the beaker (1.04 3 g = 3.12 g).

After the foam solution samples are thoroughly mixed, the conductivity of each solution is measured. The instructions that come with the conductivity meter should be consulted to determine proper procedures for taking readings. It is necessary to switch the meter to the correct conductivity range setting in order to obtain a proper reading. Most synthetic-based foams used with fresh water result in foam solution conductivity readings of less than 2000 mscm. Protein-based foams generally produce conductivity readings in excess of 2000 mscm when fresh water is used to make the foam solution. Due to the temperature-compensation feature of the conductivity meter it could take a short time to obtain a consistent reading.

Once the solution samples have been measured and recorded, the bottles should be set aside for control sample references. The conductivity readings then should be plotted on the graph paper. It is most convenient to place the foam solution percentage on the horizontal axis and the conductivity readings on the vertical axis.

A ruler or straight edge can be used to draw a line that approximates connecting all three points. While it might not be possible to connect all three points with a straight line, they should be very close. If not, the conductivity measurements should be repeated and, if necessary, new control sample solutions should be made until all three points plot in a nearly straight line. This plot serves as the known base (calibration) curve to be used for the test series.

Sampling and Analysis. Foam solution samples are collected from the proportioning system using care to be sure the sample is taken at an adequate distance downstream from the foam proportioner being tested. Using foam solution samples that have been allowed to drain from expanded foam can produce misleading conductivity readings; therefore, this type of sample should not be used to determine percent of foam solution.

When test samples have been collected, their conductivity is measured and the percent of foam solution is determined from the base curve prepared from the control sample foam solutions.

A.22.1 The following terms are not used in this document but are associated with compressed air foam systems and are included here to aid in understanding.

Chatter. An unacceptable flow condition wherein air is not fully mixed with the foam solution.

High-Energy Foam Generator. A foam generator that uses a large amount of external energy to aerate the foam.

Low-Energy Foam Generator. A foam generator that uses energy of the foam stream to aerate the foam.

Mixing Chamber. A device used to produce fine, uniform bubbles in a short distance as foam solution and air flow through it.

Scrubbing. The process of agitating foam solution and air in a confined space such as a hose, pipe, or mixing chamber to produce tiny, uniform bubbles.

Slug Flow. The discharge of distinct pockets of water and air due to the insufficient mixing of foam concentrate, water, and air in a compressed air foam system.

Surge. The sudden decompression of a discharge line caused by the rapid opening of the discharge appliance.

A.22.2.1 It is preferable that the concentrate proportioning system be automatic, inject into the discharge side of the pump, and proportion at a minimum water flow of 2 gpm (8 L/min).
A.22.2.4 It is recommended that compressed air not be injected into the water/foam discharge piping until the flow of water/foam solution has been established in the discharge piping. The nozzle reaction at the end of a hose can be quite high if just air or air and water with no foam solution is flowing in the discharge line. The nozzle reaction could be a safety issue with an operator that is not expecting or not properly braced to withstand this reaction force. The reaction force is substantially reduced when a foam solution is flowing in the discharge hose.

A.22.2.5 Pressure in the form of compressed air can remain trapped in a CAFS as a result of deactivating the system. It is important for the operator to relieve any pressure in the foam proportioning system and connected hose lines before disconnecting hose lines or performing any operation that opens the system to atmosphere.

A.22.4 If the expansion ratio is to be tested, the following equipment and test procedures are recommended:

(1) Gram scale, 1500 g capacity accurate to 0.1 g
(2) One 1000-ml container that can be struck at 1000 ml (a 1000-ml graduated cylinder cut off at 1000 ml works well)

The empty container is placed on the scale and the scale is set to zero. Using the container, a full sample of foam is collected and the foam is struck at the 1000-ml level. The container is placed on the scale and the mass is read in grams.

\[
\text{Expansion} = \frac{100}{\text{foam mass in grams}}
\]

The foam mass in grams assumes that 1 g of foam solution occupies 1 ml of volume.

A.22.5 Any components of the piping system exposed to pressurized air from the CAFS should be designed for a burst gauge pressure of at least 500 psi (3400 kPa).

A.22.7.6 Some systems provide automatic regulation of the water flow; however, instrumentation is still useful to the operator. Even automatic systems have adjustments and performance limits that warrant instrumentation. Where the system design does not allow for such automatic regulation, or where the operator has the ability to control water flow or airflow, air and water flowmeters are necessary for the operator to monitor the operational performance of the CAFS where the nozzle person cannot be seen. Where pumping long hose lengths or pumping to great heights, the operator needs to know what is flowing in order to be certain the proper product is being delivered.

A.22.9 If the tests of some components of the apparatus are being certified by an independent third-party certification organization, the purchaser might wish to specify that these tests also be certified by the independent third-party certification organization.

A.22.9.1.3.3 Care should be taken to avoid injuries to personnel from the discharging airstream. Only those persons actually conducting the tests should be in the test area, and they should wear protection for their ears, eyes, and face from noise and dust during the airflow test.

A.22.9.2 The person conducting the test should check with the manufacturer of the hose being used to ensure the hose has been approved for use with CAFS.

A.23.1 A typical electrical system might consist of a generator system that is bonded to the chassis frame rail. Conductors making up the power supply assembly include the neutral conductor (N), grounding conductor (G), and line voltage conductors (L1, L2, L3). The power supply assembly also includes a manually resettable, main power source overcurrent protective device. The neutral conductor of the power supply assembly is grounded to the generator frame. This is the only location that the neutral conductor is grounded in the entire system. The power supply assembly terminates at the panelboard for distribution to the rest of the system. Figure A.23.1 shows a typical system on a fire apparatus.

It is the responsibility of the purchaser to provide the contractor with sufficient information to enable the contractor to supply an electrical system that will meet the needs of the fire department.

For each piece of line voltage electrical equipment installed on the apparatus or operated using the apparatus line voltage electrical system, the purchaser should provide the following information:

(1) The type of electrical current required, that is, alternating current (ac), direct current (dc), or either ac or dc, as follows:
(a) If ac is required, the nominal operating voltage, the maximum amperage, and whether it is single-phase or three-phase should be provided. For electronic equipment and some motors, the required quality of the ac power should also be stated, including the upper and lower limits of voltage and the allowable variation of frequency and wave form.
generator system controls, which shift the apparatus out of the road mode of operation to place the generator system into operation, be equipped with a means to prevent dislocation of the control from its set position in the power generation mode.

A.23.5.1 Completion of the generator shift might require that the chassis transmission be shifted into the proper gear (split shaft PTOs only).

A.23.6.3.4.1 Emissions from exhaust discharge pipes should be directed away from any fire-fighting tools since such emissions contain an oily substance that could make the tools difficult to handle and possibly dangerous to use.

A.23.6 Belt-driven generator systems use a voltage regulator and a generator driven off the propulsion engine. The complexity of modern engine drive belt configurations limit power output to about 6000 watts. This system will generally maintain acceptable voltage, but the frequency will vary with engine speed. Motor loads should not be powered by this type of power supply.

An alternative system uses a separately driven alternator to supply electrical energy to an inverter, which in turn produces line voltage electrical power. These systems are separate from, and do not affect, the performance of the low-voltage electrical system. These systems are voltage regulated and provide ample power for scene lighting. Due to the belt-driven configuration, the system is still subject to low voltage at idle conditions, which could damage motors.

A.23.6.5.1 A brief description of several different types of systems follows.

Static Power Inverter. A static power inverter converts alternating current (AC) to direct current (DC) with an inverter transformer. In this case, the amount of line voltage power that can be supplied, at any given time, is typically dependent on the other higher priority demands placed on the low-voltage system.

Dynamic Power Inverter. A dynamic power inverter converts AC to DC power to 120-volt DC (or 120/240 volts AC) power. Power is electronically inverted to AC. Usually the largest system of this type is 2000 watts. Voltage and frequency control are typically very good.

Motor-Driven Generators. A motor-driven generator system converts 12-volt DC power to 120-volt DC (or 120/240 volts AC) power. The 12-volt DC motor drives an AC generator. Typical power ratings are less than 1600 watts. Voltage and frequency control are less precise than some of the other systems available. These types of systems are suited to providing electric power while the apparatus is in motion.

Inverters. Transformer systems convert energy from the alternator that is then rectified to 120-volt DC power. Typical installations provide 1000 watts. Output voltage is directly dependent on input voltage. Input voltage is dependent on engine and alternator speed.

A.23.7 Portable generator systems are generally designed with an integral fuel tank and controls in one modular package. This allows the system to be picked up and transported to a remote location from the apparatus. Generators designed for portable use should be accessible for removal. These generators are generally not suited for “enclosed” compartment operation or should be mounted on a slide out tray for adequate ventilation. Such installations require interlocks or a high temperature alarm to assure generator is operated in “slide out” condition.

The generator performance specifications should be evaluated carefully to ensure the required level of performance can be met. Article 445, “Generators,” of NFPA 70, National Electrical Code, requires that overcurrent protection be provided on portable generators.

A.23.8.2.2 This paragraph differs from the requirements in NFPA 70, National Electrical Code, in that this standard does not permit two sources to be simultaneously connected together.

A.23.12.3 Common connectors and terminations that comply with these requirements include the following:

1. Welded or brazed connectors
2. Crimped connectors
3. Soldered connections that are mechanically secured before soldering
4. Screw-type positive pressure connectors
5. Ring terminals
6. Hooks
7. Upturned spade
8. Crimped-on pins
9. Other methods providing a positive mechanical and electrical connection that are acceptable to the authority having jurisdiction

One Pole (1P) or Single Pole (SP). A switch device that opens, closes, or changes connections in a single conductor of an electrical circuit.
Two Pole (2P) or Double Pole (DP). A switch device that opens, closes, or changes connections in both conductors of the same circuit.

Two Circuit (2 CIR). A switch device that opens, closes, or changes connections in a single conductor of two independent circuits.

Single Throw (ST). A switch that opens, closes, or completes a circuit at only one of the extreme positions of its actuator.

Double Throw (DT). A switch that opens, closes, or completes a circuit at both extreme positions of its actuator.

Normally Open (NO). A switch in which one or more circuits are open when the switch actuator is at its normal or rest position.

Normally Closed (NC). A switch in which one or more circuits are closed when the switch actuator is at its normal or rest position.

Switches are rated for the type of load they are designed to control. Switch ratings include the following:

1. Resistive
2. Inductive
3. Horsepower (i.e., motor loads)
4. Tungsten (i.e., incandescent lamp loads)
5. Alternating current
6. Direct current

The ampere rating of a given switch is dependent on the type of load. In particular, switches used to control dc circuits should have the appropriate dc rating.

A.23.12.4.2 In lieu of a switch-rated circuit breaker, a standard circuit breaker could be used with a separate switching device.

A.23.12.5.1.1 The purchaser should specify the number and location of receptacles that are needed to operate the devices to be powered by the system. The purchaser should specify the NEMA number if applicable, manufacturer, and style of the receptacles desired. For other than NEMA-type receptacles, the purchaser should additionally specify the wiring configuration.

A.23.12.5.1.3 If the off-road fire apparatus is to ford water, the receptacle distance should be increased above 30 in. (750 mm). The purchaser should review the proposed height for any receptacles on the apparatus and specify a higher mounting height if desired.

A.23.12.5.6 While NEMA configurations as defined in NEMA WD-6, Wiring Devices — Dimensional Requirements, are recommended to promote compatibility of equipment during mutual aid operations, other configurations are in use and have been adopted by various fire departments.

Acceptable NEMA-type plug and receptacle configurations for various ac voltage and current ratings are shown in Figure A.23.12.5.6.

Figure A.23.12.5.6 Common NEMA Plug Configurations. [Existing Figure A-21-10.5.5, 1999 edition of NFPA 1901, no change]

The letter "R" following the configuration number indicates a receptacle, and the letter "P" denotes a plug. For example, the nonlocking, 15-ampere, grounding receptacle found in most homes is configuration 5-15R and accepts a three-prong plug in the configuration of 5-15P.

Locking-type plugs and receptacles are designed to prevent accidental disconnection when subjected to moderate pull-apart loads. Neither locking nor nonlocking connectors are designed to withstand the loads that can be created when pulling long cords up buildings and stairs.

A.23.13.4 A suggested minimum capacity of a reel is at least 100 ft (30 m) of cord rated to carry 20 amps at 120 volts ac. When sizing the reel, extra capacity should be provided when multiple receptacles are attached to the cord stored on the reel.

A cord reel to supply a single 120 volt circuit requires three collector rings and three conductors in the cord, for line, neutral, and ground. If the power source has 120/240 volt outputs, as most power sources do, a second equivalent circuit with the same rating only requires one additional conductor as the neutral and ground can be common to both circuits. Thus with approximately 25 percent more reel space and cord cost, the cord reel can supply twice the number of lights or other loads.

A.23.13.5 List Table A.23.13.5 lists the suggested cord size for cord reels based on the desired circuit ampacity and the cord length. The ratings for 5 amps, 7.5 amps, and 10 amps should only be used where an appropriate load is permanently connected. Any cord reel with one or more outlets should be rated at 15 amps or greater.

For heavy loads such as large smoke fans and hydraulic rescue tool power plants, the purchaser should consider 240 volt units instead of 120 volt units. This will allow the use of smaller cords and reels. For example, a 150 ft reel to supply a HRT power plant that draws 15 amps at 240 volts would require 14 gauge wire. The same power unit in a version to run on 120 volts would draw 30 amps and would require 10 gauge wire.

Cord reels for three-phase power or other specialized applications should be designed with the assistance of a qualified electrical engineer.

Table A.23.13.5 Wire Size for Various Electrical Cord Lengths

<table>
<thead>
<tr>
<th>Circuit Ampacity</th>
<th>50 ft (15 m)</th>
<th>100 ft (30 m)</th>
<th>150 ft (45 m)</th>
<th>200 ft (60 m)</th>
<th>250 ft (75 m)</th>
<th>300 ft (90 m)</th>
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</table>

*A wire size as AWG

A.23.13.6 The cord on the reel should be provided with a disconnect means within 18 in. (457 mm) from the reel for cord removal if the cord is 8 AWG or smaller.

A.23.13.7 The purchaser might want to color code the cord or cord reel to identify the voltage.

A.23.13.8.2 It might be advantageous to specify a remote power distribution box that has a provision for hanging the unit from a door or ladder.

A.23.13.8.3 Consideration should be given to the use of GFCI devices mounted in the remote power distribution box to provide additional protection to personnel using equipment powered through the box.

A.23.13.8.5 The lamps used in this application should be rough service type. Scene lighting around the remote power distribution box can be provided with an integral, mechanically protected light fixture.

A.23.13.8.5.1 For increased visibility, reflective tape can be applied to the distribution box.

A.23.15.1 The purchaser should specify the type of rotation, telescopic, pan and tilt operations, and other features that are required.

A.23.15.2 When the light mast is mounted above the apparatus driving and crew compartment or the body, a brush and tree limb guard should be considered to protect the mast and floodlights.

A.23.15.2.3 To reduce the electrocution hazards associated with the operation of masts above the apparatus, the purchaser should consider specifying a slide-out operator’s platform, a wireless remote control, or both.

A.23.15.2.8 The lighting assembly should be supported when it is in a transport mode in order to prevent damage to lighting assembly from vibration.

A.23.16.3 The fire department should check the polarity of the wiring in a building prior to interconnecting the fire apparatus mounted electrical system to the electrical system in a building.

A.23.16.5 For heavy loads such as large smoke fans and hydraulic rescue tool power plants, the purchaser should consider 240 volt units instead of 120 volt units. This will allow the use of smaller cords and reels. For example, a 150 ft reel to supply a HRT power plant that draws 15 amps at 240 volts would require 14 gauge wire. The same power unit in a version to run on 120 volts would draw 30 amps and would require 10 gauge wire.

Cord reels for three-phase power or other specialized applications should be designed with the assistance of a qualified electrical engineer.

A.23.16.5.1 Commercially available smaller or intermittent duty low-cost power sources generally are advertised with power ratings tested under
the most favorable operating conditions. Also, some power sources are advertised at peak output or intermittent duty ratings, rather than continuous duty output.

Where a power source will be subjected to higher than ideal operating temperatures, or the advertised rating is a continuous duty rating, the apparatus manufacturer should de-rate the power source and provide the derated data on the power source specification label. The power source should then be tested at this de-rated condition. It is important that the power source specification label on the apparatus meets the fire department requirements for power source output as it indicates the rating to which the power source is tested.

A.24.2 The command center could be an area of the crew compartment, the apparatus body, or a portion of either of these areas. The environment for the area is subject to wide variations in size, noise levels, facilities, and appointments. Command areas in enclosed body areas could be designed to accommodate several personnel. It is common to separate the crew or equipment areas from command areas. A separate entry and enclosed area might be required by the purchaser.

A.24.2.1 If a separately enclosed area is desired, the purchaser should specify the arrangements desired and whether a locking door is necessary.

A.24.2.2 The exact layout, design, and usage of the command area should be determined by each purchaser for each fire apparatus.

A.24.3 If such equipment is to be thermostatically controlled automatically, the purchaser should so state. Powered or nonpowered ventilation equipment should be provided as required by the purchaser.

A.24.4 Supplemental floor, wall, and ceiling acoustical material should be added where required to reduce noise levels below 80 dBA.

A.24.5 Command areas in the driving or crew compartments should be provided with 120-volt lighting systems to reduce 12-volt loads.

A.24.6.1 Removable Plexiglas or wired safety glass-type surfaces can be added to the top of work surfaces.

A.24.7.1 The seating equipment and arrangement can vary considerably. The equipment could include swing-down seats, stools, permanent chairs, or portable chairs, as required.

A.24.8 The enclosures for cabinets or storage areas could be roll-up-type doors, hinged doors, or sliding doors, with protective latches to hold the doors closed in transit. Synthetic netting could also be used in lieu of cabinet doors.

A.24.9.1 The interior surfaces should be bright and easily cleaned.

A.24.10.1 The purchaser needs to provide the manufacturer of the apparatus with all the details of the equipment that is to be installed in the communications area regardless of who is to install the equipment so that the area can be laid out properly and appropriate cabinets and consoles can be provided to house this equipment.

The purchaser should also specify the number, size, and type of conduits for wiring and antennas from the communications area to the driving compartment, power supply area, exterior surfaces, or secondary operational or control panels that are necessary to support the installation of equipment by persons other than the body manufacturer. These conduits should have a pull wire installed to pull future wiring into place.

A.24.11 Due to the cost of complying with the special power and installation requirements for most computer equipment, the use of office-type computers and peripherals in mobile applications is not cost-effective. Consideration should be given to the use of laptop equipment. This equipment was designed to be transported and used in less than ideal environments. Laptop computers and printers can be powered from the vehicle's 12-volt dc power supply or from a 120-volt ac power supply. Laptops run off an internal battery that is rechargeable by one of these two power resources. The input power purity requirements are not that difficult to meet.

The purchaser should obtain technical assistance from the manufacturer of the computer equipment that is selected. The manufacturer's engineering staff can advise the purchaser and the builder both in the areas of initial installation and actual start up of the installed computer system.

A.25.2 The type of fire department air system and its size is determined by the number of SCBA units that will be used simultaneously, the number of SCBAs available, and the length of the event requiring the use of SCBA.

The number of users wearing SCBAs simultaneously should be considered under both peak demand and continuous demand. Peak demand is the maximum number of simultaneous SCBA users needed under the worst emergency conditions for which the fire department feels preparation is necessary. Continuous demand is the minimum number of simultaneous SCBA users necessary to maintain operations for a long-term duration.

To allow a specified number of SCBA users to be deployed without interruption, as many as three times that number of SCBA units should be available on the scene. That allows for backup personnel to have their equipment in readiness to immediately relieve those personnel who have exhausted their air supply as well as providing extra units in the event of failures or equipment problems.

The resupply rate of SCBA cylinders on the scene could be accomplished by an air compressor alone, air cascade alone, or a combination of each type of system with a booster system. The users should determine the supply rate and duration, then determine what system will meet this requirement.

An analysis of the existing fire department SCBAs and breathing air system should be performed to determine what needs, if any, exist. This analysis should include the following:

1. SCBA units: type, quantity, designed duration
2. Extra SCBA cylinders: type, quantity, designed duration
3. Air storage system capability
4. Air compressor capability

A.25.2.1 Special operating conditions such as high temperatures or cold weather operations might require special equipment modifications or design requirements by component manufacturers and body manufacturers. Fire departments need to be specific in stating their operating temperature range and special requirements. Due to high intake air flow with breathing air compressors, special provisions should be made for moisture separator freeze protection in very cold weather operations.

A.25.2.11.6 The purchaser might wish to require the air compressor assembler and final stage installer of the proposed air system to provide drawing of the air equipment arrangement, operator's panel layout, and air piping to allow pre-purchase evaluation of the operational characteristics of the system proposed.

A.25.2.13.1 If the apparatus is equipped with a breathing air system such as an air cascade system or air booster system, the purchaser might still wish to require the system manufacturer rather than just the contractor to provide on-site training on those systems. Expectations for training should be carefully defined in the purchase specifications.

A.25.2.13.2 Due to the extremely complicated nature of breathing air compressor systems, training is a critical component of the safe use of the system. Expectations for training should be carefully defined in the purchase specifications.

A.25.3 Selection of the type of drive for a compressor is one of the most important decisions that has to be made when choosing an air compressor. The compressor drive determines the cost of the compressor, installation requirements, type of operating controls and procedures, and frequency and cost of routine service and maintenance. The type of compressor drive also affects the cost of the fire apparatus when special generators, hydraulic systems, PTOs, or other provisions have to be made in order to power the compressor. The following compressor drives are available:

1. Electric drive
2. Hydraulic drive
3. Gasoline or diesel drive
4. PTO drive (direct drive)
5. Dual drives

Dual drives, such as electric and hydraulic or electric and diesel, are sometimes advantageous so as to permit mobile operation using one drive and in-station operation using the electric motor. The ability to operate in-station with an electric motor prevents leaving a running vehicle outside in order to refill empty SCBA cylinders and air system storage vessels. If filling is to be accomplished with both a compressor and an air storage system in a simultaneous operation, the amount of SCBA fills in the first 1 to 2 hours would be increased considerably. The number of SCBA fills from the air storage system should be calculated and added to the air compressor fill rate. The total fills per hour would have to be an estimate since the compressor could be refilling the air storage system during SCBA connection and disconnection.

If only an air compressor is to be used for refilling SCBA cylinders, the minimum size of the air compressor system needed can be determined based on the number of SCBA cylinders that need to be refilled per hour to meet incident demand requirements. Table A.25.3(a) or Table A.25.3(b) can assist in determining the compressor size.
A.25.3.2.1 To reduce or prevent contaminated air from entering the compressor, consider the following:

(1) Park the fire apparatus as far from the scene as is practical and attempt to remain upwind from smoke or chemical fumes.

(2) Direct or extend fire apparatus and other engine exhaust outlets away from the point of compressor intake. Locate the intake to the compressor as remotely as possible.

A.25.3.3.2 Special air flow engineering, supplement fans, additional doors, and vents might be required for the release of heated air from the air compressor during long periods of operation.

These could include automatic operating doors in the roof of the apparatus, manually opened roof doors, large electric driven exhaust fans, and so forth. These extra provisions installed by the final stage installer could ensure there is adequate cooling to keep the air compressor within the compressor manufacturer’s operating temperature range.

A.25.3.6.2 A final stage pressure gauge might also be desired at the air control panel, in addition to the gauge near compressor. The hourmeter could be located either at the compressor or the main operator’s panel. Interstage pressure gauges should be mounted at the compressor location. Oil gauge or level indicator should be located at the compressor, with alarms located at the main air operator’s panel.

A.25.3.6.3 The purchaser should consider a shorepower connection to permit external electric power supply to the electric motor. If a shore power connection is provided, it is important to have a transfer switch to allow the user to power the air compressor independently from either the onboard generator or shorepower.

A.25.4.1 The purchaser might require a quality of air other than that used for fire fighting. In those situations, it is important that the purchaser specify the standards that such air quality has to meet.

A.25.4.3.2 The purification system should be located where it is easily accessible for service, preferably on slide-out tracks or in location where purifier cartridges and filter elements can be installed from the top. These units can be remote mounted from the air compressor and operator’s panel.

A.25.5.1 In some states in the United States, the regulations of the Occupational Safety and Health Administration (OSHA) of the Department of Labor have been interpreted to require that DOT cylinders be used for mobile systems to transport air on state highways. If DOT cylinders are not required by state regulations, ASME cylinders should be utilized if the design of the apparatus presents a severe difficulty to the removal of cylinders for testing.

A.25.6 Booster-type high-pressure air compressors, used in conjunction with air tank storage arranged for air cascading, serve the purpose of extracting greater quantities of air from high-pressure air storage systems. By adding a high-pressure air booster/amplifier to the system, the yield can be increased by over 100 percent.

A.25.10 The size of the air supply piping, air compressor output, air hose size, and size of auxiliary storage reservoirs are of critical importance for supplying utility air powered tools, confined space breathing air, and high-pressure air supplies to remote locations. The purchaser needs to specify the following information about the air reels that are to be installed on the apparatus so that the manufacturer can design an appropriate system:
(1) Source of air supply to the air reel

(2) Operating pressure range desired

(3) Type of air desired (low- or high-pressure, utility, or breathing air)

(4) Cubic foot (cubic meter) of air output or cubic foot (cubic meter) of air per minute required by air tools or equipment to be used and whether to be used alone or in combination

(5) Specific air tools, air bags, and other devices to be used from the air system

The use of chassis air brake systems for utility air tools is not recommended. Air brake system-supplied air outlets should be used only for nonemergency applications. Rescue air tools, air bags, or other emergency uses should not be supplied from air brake systems but from a high-pressure cascade tank system or a high-capacity utility air compressor especially designed for air tools usage. SCBA or SCUBA air cylinders are suitable for intermittent air supply with limited airflow requirements. Where used for this purpose, additional SCBA cylinders should be defined and segregated on the fire apparatus for such usage.

A.25.10.1 Generally, reels for use with air tools or air bags will be rated to a gauge pressure of 300 psi (2000 kPa), while reels for use with high-pressure breathing air cascade systems will be rated to a gauge pressure of 6000 psi (40,000 kPa).

To assist in differentiating different air pressures on reels on the same apparatus or on multiple apparatus within the fire department, it is suggested the reels be painted distinctive colors. Suggested colors are as follows:

- Blue — reels for utility air hose up to a gauge pressure of 300 psi (2000 kPa)
- White — reels for breathing air hose up to a gauge pressure of 300 psi (2000 kPa)
- Yellow — reels for breathing air hose from a gauge pressure of 301 psi to 3000 psi (2001 kPa to 20,000 kPa)
- Red — reels for breathing air hose over a gauge pressure of 3000 psi (20,000 kPa)

A.25.10.8.2 Typical mechanic’s air tools consume between 35 ft³/min and 90 ft³/min (1 m³/min and 2.5 m³/min) of air. This rate of consumption is well beyond the capacity of most air compressors used to charge the chassis air brake system. For this reason, tools supplied from the chassis air system deplete the air supply quickly and will not operate for more than a few minutes. Air tools operated from a high-capacity system, such as that used for breathing air, will operate much longer before the source is depleted. Departments with specific tools and estimated operation durations should provide the manufacturer with the air capacity requirements of those tools and the expected duration, including to what extent that is an intermittent operation, so that the manufacturer can provide the appropriate air source to meet those needs.

A.25.10.10 The intent of the low-pressure breathing air reel is to supply breathing air through up to 300 ft (90 m) of breathing air hose at an operating gauge pressure of 75 psi (517 kPa) at the outlet point for connection to specific types of breathing apparatus. These arrangements provide for a longer operating duration in toxic or oxygen-deficient atmospheres.

A.25.11.1 The purchaser should evaluate conditions under which utility air hose, high-pressure air hose, or low-pressure breathing air hose could be used and advise the contractor if special hose is required.

A.25.11.3.1 The discharge end of any breathing air hose could have various fittings, threads, or quick connections installed on the threaded end of the discharge hose. The purchaser needs to specify the particular hose termination, thread size, valve control, quick connection fitting, expected application of hose, and other pertinent information if the manufacturer is to provide appropriate connections.

A.25.11.5 Confined space low-pressure hose supplying multiple users or hose lengths greater than 300 feet (90 m) could require larger hose sizes.

A.25.12 The size of the air supply piping, chassis air compressor cubic feet per minute rating, and auxiliary air reservoir(s) cubic foot capacity are of critical importance in supplying non-emergency application utility air outlets. These air outlets could be used to fill truck tires, pressurized water fire extinguishers, and so forth. Such air brake connections are not intended to be used for rescue air bags, air tools, air reels, and other rescue applicances due to their limited duration, volume, and pressure. Air supply for low-pressure utility applications should be from dedicated air compressors or air cascade storage tanks.

A.25.14 If the tests of some components of the apparatus are being certified by an independent third-party certification organization, the purchaser might wish to specify that these tests also be certified by the independent third-party certification organization.
APPARATUS PURCHASING SPECIFICATION FORM

Procurement Issues

Date of bid 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.

If an interim inspection trip(s) to the assembly plant is to be provided, indicate the number of trips _______ and the number of participants: ____________________________

How many service and operation manuals are to be provided? ____________________________

Where is the delivery of the apparatus to occur? ____________________________

Where and when is the acceptance to occur? ____________________________

The operation and service training is to be conducted at ____________________________

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 the bid price? ____________________________

Is a performance bond required?  □ Yes  □ No

What percent of the 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? ____________________________

B.1.1 Purchasing Specification Form.
General Requirements — Chapter 4

Special design features required on this apparatus:

What are the maximum allowable dimensions of the apparatus?
Height in inches: _______ (measured at the highest projection)
Overall length in inches: _______ (measured at the front and rearmost projections)
Wheelbase in inches: _______ (measured from the center of the front axle to the center of the rear axle)
Width in inches: _______ (measured at the outside of the mirrors)
Gross vehicle weight in pounds: _______
Maximum weight on the front axle in pounds: _______
Maximum weight on the rear axle in pounds: _______

What is the maximum turning radius allowable? _______ ft measured at □ tires □ body

Maximum elevation at which the apparatus will operate if over 2000 ft:

Maximum grade that apparatus will climb if over 6 degrees:

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

Specify the maximum road speed required:

Specify the minimum and maximum ambient air temperature in which the apparatus is to operate:

Hose Thread Size Information

(TPI x OD or size and type, i.e., 2½-in. NH or 4-in. Storz)

<table>
<thead>
<tr>
<th>Size</th>
<th>1 in. =</th>
<th>1½ in. =</th>
<th>2 in. =</th>
<th>2½ in. =</th>
<th>3 in. =</th>
<th>3½ in. =</th>
<th>4 in. =</th>
<th>4½ in. =</th>
<th>5 in. =</th>
<th>6 in. =</th>
<th>Hydrant =</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 in.</td>
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<td>2 in.</td>
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<td>3 in.</td>
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<td>4 in.</td>
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<td>5 in.</td>
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<tr>
<td>2 in.</td>
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<td>3½ in.</td>
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<tr>
<td>3 in.</td>
<td></td>
<td></td>
<td></td>
<td>4½ in.</td>
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<tr>
<td>4 in.</td>
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<tr>
<td>5 in.</td>
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<td></td>
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<tr>
<td>Hydrant</td>
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</tbody>
</table>

B.1.1 Purchasing Specification Form. (continued)
Testing and Acceptance

If independent certification of tests is required for the pump system, aerial device, or other systems, what independent testing organization is to certify the tests?

Is anyone to witness the manufacturer's predelivery tests?

Where are the road tests to be conducted?

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

Apparatus Type — Chapters 5 through 11

This apparatus is to be used as a:

- Pumper fire apparatus *(see Chapter 5)*
- Initial attack fire apparatus *(see Chapter 6)*
- Mobile water supply apparatus *(see Chapter 7)*
- Aerial fire apparatus *(see Chapter 8)*
- Quint fire apparatus *(see Chapter 9)*
- Special service fire apparatus *(see Chapter 10)*
- Mobile foam fire apparatus *(see Chapter 11)*
- Other ___________________________

What functions or services is this apparatus to perform?

Specify the maximum number of persons to ride on the apparatus:
### Suction Hose

(See 5.7.2, 6.6.2, Section 7.6, 9.7.2, 10.4.2, and 11.8.1)

Is suction hose required?  □ Yes  □ No

- Soft or hard:
- Size and length:
- Connection type and size:
- Mounting arrangement, bracket style, and location:

### Ground Ladders

(See 5.7.1, 6.6.1, Section 8.7, 9.7.1, and 10.4.1)

Specify the ground ladders to be carried on the apparatus:

<table>
<thead>
<tr>
<th>Number</th>
<th>Length</th>
<th>Type</th>
<th>Mounting Location and Bracket Type</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

Indicate whether a specific type or brand of ladder is desired:

---

### Breathing Apparatus

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Make/Model</th>
<th>Mounting Location</th>
</tr>
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<tbody>
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</tr>
</tbody>
</table>

The breathing apparatus is to be supplied by the  □ contractor  □ purchaser.

Special requirements for the breathing apparatus or its mounting:

---

### Equipment Carried on Apparatus

(See Sections 5.8, 6.8, 7.7, 8.8, 9.8, 10.5, and 11.9)

Miscellaneous equipment allowance if it exceeds the standard’s minimum weight:

---

B.1.1 Purchasing Specification Form. (continued)
• 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 and permanent components required on the apparatus stating the item, quantity, weight of each, and dimensions (L × W × H), as well as the location where it is to be carried.

If reserve compartment space is required to accommodate the equipment in the list above, indicate those requirements:

<table>
<thead>
<tr>
<th>Reserved Space Requirements</th>
<th></th>
</tr>
</thead>
</table>

### Chassis and Vehicle Components — Chapter 12

Desired chassis make and model or style: ____________________________

Specify the desired location of the engine: ____________________________

Type of propulsion engine: ____________________________

Is an electric fuel pump or repriming pump required?  □ Yes  □ No

Specify any special lubrication system requirements: ____________________________

Specify any special cooling system requirements: ____________________________

Type of coolant required: ____________________________

Is a manual emergency engine shutdown required?  □ Yes  □ No

Type of fuel filters required: ____________________________

Type of air filters required: ____________________________

Specify the exiting location of the exhaust system: ____________________________

Specify the type of brake system required: ____________________________

Is an auxiliary brake system required?  □ Yes  □ No

Specify the type: ____________________________

Specify the style and type of tires required: ____________________________
<table>
<thead>
<tr>
<th>Requirement</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cast spoke, steel disc, or aluminum wheels are required</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Rear fender liners are required</td>
<td>[ ] Yes [ ] No</td>
<td></td>
</tr>
<tr>
<td>Are tire chains to be used</td>
<td>[ ] Yes [ ] No</td>
<td></td>
</tr>
<tr>
<td>Should the apparatus be designed to operate off paved roads</td>
<td>[ ] Yes [ ] No</td>
<td></td>
</tr>
<tr>
<td>Increased underbody clearance is required</td>
<td>[ ]</td>
<td></td>
</tr>
<tr>
<td>Greater angle of approach is required</td>
<td>[ ]</td>
<td></td>
</tr>
<tr>
<td>Greater angle of departure is required</td>
<td>[ ]</td>
<td></td>
</tr>
<tr>
<td>Steering wheel's required angle turning if it exceeds the standard's minimum</td>
<td>[ ]</td>
<td></td>
</tr>
<tr>
<td>Drive axle traction control or no-spin differential required</td>
<td>[ ]</td>
<td></td>
</tr>
<tr>
<td>Rear wheel steering is required</td>
<td>[ ]</td>
<td></td>
</tr>
<tr>
<td>Special suspension system required</td>
<td>[ ]</td>
<td></td>
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<tr>
<td>Automatic or manual transmission required</td>
<td>[ ]</td>
<td></td>
</tr>
<tr>
<td>Fuel tank capacity required</td>
<td>[ ] gal</td>
<td></td>
</tr>
<tr>
<td>Tow hooks accessible without opening doors</td>
<td>[ ] Yes [ ] No</td>
<td></td>
</tr>
<tr>
<td>Rear license plate bracket and light required</td>
<td>[ ] Yes [ ] No</td>
<td></td>
</tr>
<tr>
<td>Special cab trim features</td>
<td>[ ]</td>
<td></td>
</tr>
<tr>
<td>Low-Voltage Electrical Systems and Warning Devices — Chapter 13</td>
<td></td>
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<tr>
<td>Battery charger, conditioner, or polarized receptacle provided</td>
<td>[ ]</td>
<td></td>
</tr>
<tr>
<td>Required charging rate</td>
<td>[ ]</td>
<td></td>
</tr>
<tr>
<td>Receptacle location for battery charger or conditioner</td>
<td>[ ]</td>
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</tr>
<tr>
<td>Second “battery on” pilot light required</td>
<td>[ ] Yes [ ] No</td>
<td></td>
</tr>
<tr>
<td>Dual battery system required</td>
<td>[ ] Yes [ ] No</td>
<td></td>
</tr>
</tbody>
</table>
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 required, specify the sequence of control (shutdown):

**Warning Light Information**

<table>
<thead>
<tr>
<th>Location</th>
<th>Brand and Model</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front of cab lights</td>
<td></td>
<td></td>
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<tr>
<td>Roof lights</td>
<td></td>
<td></td>
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<tr>
<td>Rear lights — upper</td>
<td></td>
<td></td>
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<tr>
<td>Rear lights — lower</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intersection lights</td>
<td></td>
<td></td>
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<tr>
<td>Mid-body lights</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Specify the brand and model of the siren:

Are air horns required?  □ Yes  □ No  If yes, specify the type of control and its location:

Specify any special emergency lighting or warning features or equipment that is required:

Are cab hand lights or mounted adjustable spotlights required?  □ Yes  □ No

Specify whether additional work lighting is required:

Specify whether additional driving or crew compartment lighting is required:

**Driving and Crew Areas — Chapter 14**

Specify any special seating requirements or arrangements for the driver:

Specify any special seating requirements or arrangements for the crew:

B.1.1 Purchasing Specification Form. (continued)
Is a special hearing protection system required?  ☐ Yes  ☐ No

Make, model, or type: ____________________________________________

Special requirements: __________________________________________

Specify any special arrangements required for carrying tools or equipment within the driving or crew area: ____________________________________________________________

Specify any special step or handrail arrangements required: ____________________________________________________________

If a tiller-steered apparatus is to be provided, specify the type of communication system required between the tiller operator and the apparatus driver: ____________________________________________________________

Is a tilt or telescoping steering column required? ____________________________________________________________

Specify any extra cab instrument panel features required: ____________________________________________________________

Specify the type and style of driving compartment mirrors: ____________________________________________________________

Body, Compartments, and Equipment Mounting — Chapter 15

Body material: ____________________________________________________________

Compartment capacity required: __________ ft³

Specify any special compartment features required: ____________________________________________________________

Specify whether a special compartment floor material or covering is required: ____________________________________________________________

Specify the type and style of compartment doors required: ____________________________________________________________

Specify the style of door latches, locks, or stays required: ____________________________________________________________

B.1.1 Purchasing Specification Form. (continued)
Specify the type of compartment lighting required: ____________________________________________

Radio equipment to be used:
- Make and model: ____________________________________________________________
- Mounting location for radio: _________________________________________________
- Mounting location for control(s) and speaker(s): ________________________________

Type of body tread plate material required: _______________________________________

Type of step and platform material required: _______________________________________

Color of apparatus: ___________________________________________________________

Striping and decoration required: _______________________________________________

Miscellaneous body trim: _______________________________________________________

Is a cab and body rustproofing treatment required? _____________________________

<p>| Hose to Be Carried for Preconnected Lines (See Sections 5.6, 6.5, 7.5, 8.6, 9.6, and 11.7) |</p>
<table>
<thead>
<tr>
<th>Length</th>
<th>Size</th>
<th>Location</th>
<th>Bed or Reel</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

<p>| Hose to Be Carried in Hose Bed or on Reels (See Sections 5.6, 6.5, 7.5, 8.6, 9.6, and 11.7) |</p>
<table>
<thead>
<tr>
<th>Length</th>
<th>Size</th>
<th>Location</th>
<th>Bed or Reel</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

If a hose bed cover(s) is desired, specify type: ______________________________________

Is the fire-fighting system to be a slip-on unit?  ❑ Yes  ❑ No
Specify the lifting arrangement required: 

Specify the anchoring system required: 

Fire Pump — Chapter 16
Industrial Supply Pump — Chapter 18

Is a fire pump required?  □ Yes  □ No
Is an industrial supply pump required?  □ Yes  □ No
Pump rated capacity: ________ gpm
Number of pump stages required: 
Pump type: 
Pump location: 
How is the pump to be driven? 
Type of engine to drive pump if other than the chassis propulsion engine: 
Pump testing authority: 

If pump and roll is required, specify:
  Flow ________ gpm at ________ psi
  Vehicle speed ________ mph
  Type of primer system: 

Special pump performance requirements:
  If altitude over 2000 ft (610 m), specify altitude: 
  If lift over 10 ft (3 m), specify lift: 
  If through more than 20 ft (6 m) of suction hose, specify length: 
Do local water conditions require special materials for pump construction and piping? 

Location of pump operator's panel: 
Pump panel and gauge panel material: 
Type of intake and discharge valve controls desired: 
Specify the size of the master gauges: 
Are individual line pressure gauges required?  □ Yes  □ No
  If yes, are there any special requirements? 

B.1.1 Purchasing Specification Form. (continued)
Are individual line flowmeters required?  ☐ Yes  ☐ No
  If yes, are there any special requirements? ____________________________

Are any special gauges, instruments, or other features required at the pump operator's panel? __________

Are special pump and piping features required to deal with extremely low temperatures? __________

Is the intake relief system to be adjustable at the pump panel?  ☐ Yes  ☐ No
  If no, where: ______________________________________________________

Is a pump pressure governor or a relief valve to be supplied? __________

**Pump Intakes**

Indicate for each pump intake:

<table>
<thead>
<tr>
<th>Size</th>
<th>Type of Connection</th>
<th>Location</th>
<th>Valved (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

Are special adapters required on the pump intakes? __________

**Discharge Outlets**

List the 2½-in. or larger discharge outlets required:

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Size</th>
<th>Type of Connection</th>
<th>Location</th>
<th>Flow Requirement</th>
</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>

B.1.1 Purchasing Specification Form. (continued)
Discharge Outlets for Preconnected Hose Lines

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Size</th>
<th>Type of Connection</th>
<th>Location</th>
<th>Flow Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

If a deck gun is required, indicate:

Type: __________________________

Mounting location: __________________________

Piping size and arrangement: __________________________

Is pump panel color coding required?  ☐ Yes  ☐ No

Is a booster reel required?  ☐ Yes  ☐ No

How many reels? __________________________

Location: __________________________

Hose size and length: __________________________

Reel rewind type: __________________________

Piping to reel: __________________________

Auxiliary Pump — Chapter 17

Is an auxiliary pump required?  ☐ Yes  ☐ No

Type of auxiliary pump operations: __________________________

Auxiliary pump performance: __________________________

Type of auxiliary pump: __________________________

How is the auxiliary pump to be driven? __________________________

Auxiliary pump location: __________________________

Is the auxiliary pump to be connected to the fire pump?  ☐ Yes  ☐ No

Do local water conditions require special materials for pump construction and piping? __________________________

B.1.1 Purchasing Specification Form. (continued)
### Auxiliary Pump Intake Connections

<table>
<thead>
<tr>
<th>Size</th>
<th>Type of Connection</th>
<th>Location</th>
<th>Valved (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

### Auxiliary Pump Discharge Outlets

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Size</th>
<th>Type of Connection</th>
<th>Location</th>
<th>Flow Requirement</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>

Where are the auxiliary pump controls to be located? 

---

Is a booster reel required?  □ Yes  □ No

How many reels? 

Location: 

Hose size and length: 

Reel rewind type: 

Piping to reel: 

---

**Water Tanks — Chapter 19**

Is a water tank required?  □ Yes  □ No

Water tank capacity  *(See Sections 5.4, 6.3, 7.3, 8.4, and 9.4)*:

Tank construction material: 

---

Is an internal coating required?  □ Yes  □ No

Is a removable tank lid required?  □ Yes  □ No

Type of tank level indicator(s): 

Location of additional tank level indicators: 

---

Tank to pump flow rate required: 

Pump to tank fill rate required: 

---

B.1.1 Purchasing Specification Form. (continued)
<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>If yes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is a tank dump valve required?</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>Style of valve:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performance required:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location:</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Type of connector:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>If yes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is a direct tank fill required?</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>Style of valve:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size:</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Performance required:</td>
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<tr>
<td>Location:</td>
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<tr>
<td>Type of connector:</td>
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</tbody>
</table>

### Aerial Devices — Chapter 20

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is an aerial device required?</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

Indicate whether the aerial device is to be an aerial ladder, elevating platform, aerial ladder platform, or water tower: 

### Aerial Ladder

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated vertical height required</td>
<td>ft</td>
</tr>
<tr>
<td>Rated horizontal reach required</td>
<td>ft</td>
</tr>
<tr>
<td>Capacity rating (tip load) required</td>
<td>lb (250-lb minimum)</td>
</tr>
</tbody>
</table>

Location of any secondary speaker/microphone required on the aerial ladder: 

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>If yes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is a prepiped waterway required?</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>What brand and model of monitor is required (must flow at least 1000 gpm at 100 psi)?</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

If the monitor is power operated, are additional sets of controls beyond those required at the ladder operator's position required? 

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>If yes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>What make and model of nozzle is required?</td>
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</tbody>
</table>

Indicate the external inlet arrangement desired, including size, type, and number of inlets, and valving arrangement: 

---

B.1.1 Purchasing Specification Form. (continued)
B.1.1 Purchasing Specification Form. (continued)
Water Tower

Is the water tower to be telescoping, articulating, or both?

Rated vertical height required: ________ ft
Rated horizontal reach required: ________ ft
Indicate waterway capacity required if in excess of 1000 gpm:

What brand and model of monitor is required (must flow at least 1000 gpm at 100 psi)?

What make and model of nozzle is required?

Where are the monitor and nozzle controls to be located?

Indicate the external inlet arrangement desired, including size, type, and number of inlets, and valving arrangement:

Is a three-lever or a single-lever control system required?

List any water tower equipment or features required:

 Foam Proportioning System — Chapter 21

Is a foam proportioning system required?  Yes  No
Type of foam(s) to be used:

Foam concentrate storage capacity:

Discharge Outlets to Be Used with Foam and Their Performance

<table>
<thead>
<tr>
<th>Discharge</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

B.1.1 Purchasing Specification Form. (continued)
Type of foam system required: ________________________________________________

Is an outside foam system inlet or pickup required?  ❑ Yes  ❑ No
Type: ________________________________________________________________

Compressed Air Foam Systems — Chapter 22

Is a CAFS required?  ❑ Yes  ❑ No
What is the total SCFM required? ________________________________________
What type of compressor and driver is 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

<table>
<thead>
<tr>
<th>Discharge</th>
<th>Performance</th>
<th>Hose Size and Length</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

Specify whether automatic water and air pressure tracking is required: ________

Specify whether an airflow meter is required (SCFM): ________________________
Specify the type of wet/dry control required: ______________________________

Line Voltage Electrical System — Chapter 23

Is a line voltage (120/240-volt) electrical system required?  ❑ Yes  ❑ No
Type of generating source (ac or dc, cycles): ______________________________

Capacity of generating source: __________________________________________

Location of generating source: __________________________________________

Mounting of generating source: _________________________________________

B.1.1 Purchasing Specification Form. (continued)
Distribution panel location: ____________________________________________

**Receptacle Information**

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Amps/Volts</th>
<th>Style of Receptacle</th>
<th>Location</th>
</tr>
</thead>
<tbody>
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</table>

**Circuit Remote Control Information**

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<thead>
<tr>
<th>Controlled Circuit</th>
<th>Switch Location</th>
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</tbody>
</table>

**120/240-Volt Lighting Information**

<table>
<thead>
<tr>
<th>Style/Make</th>
<th>Location</th>
<th>Wattage/Bulb</th>
<th>Type Mounting</th>
</tr>
</thead>
<tbody>
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</table>

**Cord Reel Information**

<table>
<thead>
<tr>
<th>Reel #</th>
<th>Reel #</th>
<th>Reel #</th>
<th>Reel #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amperage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Length of cord in feet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receptacle style</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Junction box</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rewind system</td>
<td></td>
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</tbody>
</table>

Is a power-operated light mast required? ☐ Yes ☐ No
If yes, specify the make and model required: ____________________________________________

---

B.1.1 Purchasing Specification Form. (continued)
### Command and Communications — Chapter 24

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is a separate command area required?</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Is the area to be enclosed by walls and doors?</td>
<td></td>
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<tr>
<td>Size of the area _______ length _______ width or _______ ft²</td>
<td></td>
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</tr>
<tr>
<td>Number of persons to be seated and able to work in the area:</td>
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<tr>
<td>Is special lighting required?</td>
<td></td>
<td></td>
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<tr>
<td>What communications equipment is to be operational in the command and communications area?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>List the make, model, and whether the contractor or purchaser is to provide and install the equipment:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What computer equipment is to be operational in the command and communications area?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>List the make, model, and whether the contractor or purchaser is to provide and install the equipment:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What other equipment is to be operational in the command and communications area?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>List the make, model, and whether the contractor or purchaser is to provide and install the equipment:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is external video equipment to be used on the apparatus?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>If yes, where is it to be mounted?</td>
<td></td>
<td></td>
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</tbody>
</table>

### Air Systems — Chapter 25

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is an air system required?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>What is the function of the air system?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐ Refill SCBA cylinders</td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐ Supply remote breathing air</td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐ Supply high-pressure breathing air hose</td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐ Supply utility air</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B.1.1 Purchasing Specification Form. (continued)
Is a cascade system to be supplied?  ☐ Yes  ☐ No

How many SCBA cylinders are to be filled?  

What is the size of the cylinders to be filled?  __________ ft^3
To what pressure are the cylinders to be filled?  __________ psi

Is a compressor required?  ☐ Yes  ☐ No
If yes, what free air delivery (FAD) rating is required?  __________ ft^3 at  __________ psi

Is a SCBA refill station required?  ☐ Yes  ☐ No
If yes, what is the location of the refill station?  

Number of refill lines:  

Is a fragmentation box required?  ☐ Yes  ☐ No

Air Hose Requirements

For each air hose required, specify the following:

(a)  Discharge flow required in ft^3/min  
(b)  Discharge pressure required in psi  
(c)  Whether breathing air or utility air is to be supplied  
(d)  Length of hose in ft  
(e)  Whether hose is to be stored on a reel  
(f)  Mounting location of reel, if applicable  
(g)  Fitting or device at the end of the hose  

Winches — Chapter 26

Is a winch required?  ☐ Yes  ☐ No
What is the single line pull rating required?  
What is the wire rope length required?  
Is the power source for the winch to be electric or hydraulic?  

Specify the winch location:

Type of control required:  

Location of control:  

B.1.1 Purchasing Specification Form. (continued)
B.1.1.2 A major support function of any fire apparatus, no matter the type, is the portable equipment. This is why this document places so much emphasis on finding GVWR, cargo capacity of the completed vehicle, which includes both fixed and portable equipment.

The listings of portable and fixed equipment are so variable, depending on the mission of the vehicle, that the fire department needs to measure and weigh their specific equipment.

The fire department should classify the equipment as follows:
(1) Existing — equipment they currently own that will be carried
(2) Proposed — new equipment that will be carried as the apparatus goes in service
(3) Future — equipment that might 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.1.1.3 After determining the list of present, proposed, and future equipment, the fire department should analyze the “actual” cubic footage (cubic meters) of space necessary for the equipment. The actual usable space in compartments also should be considered, in addition to the individual cubic feet (cubic meters) for each item of equipment to be carried. The following factors might increase the required cubic footage (cubic meters) of storage space required and thus the size of the vehicle body:

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

B.1.1.4 Where local operating conditions necessitate apparatus of 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 occasionally need special attention. For example, a community with many narrow, winding streets should have apparatus capable of readily negotiating switchbacks without delay.

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

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 manufacturers face substantial penalties for infractions of these rules and, therefore, cannot build apparatus to specifications that would require them to perform unlawfully or to delete required items or to include any that are illegal.

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.

B.1.1.6 Many apparatus purchasers find it favorable to provide for an interim inspection at the apparatus assembly plant. The advantages of this inspection include the opportunity to evaluate construction prior to final assembly and painting. The specifications should detail the particulars of such an inspection trip.

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.1.1.7 Training of designated fire department personnel is essential to ensure that the purchaser and user are aware of, and instructed in, the proper operation, care, and maintenance of the apparatus acquired. This training should provide the initial instruction on the new 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 furnishing the training, including where it is to be provided, its duration, and any training aids, such as video tapes or training manuals, are to be furnished.

B.1.1.8 The purchaser should also define in the specifications the warranty desired for the completed apparatus. The warranty is a written guarantee of the integrity of the apparatus 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.1.1.9 The purchaser might want a warranty bond to ensure that any warranty work will be performed, even if the apparatus manufacturer should go out of business. A warranty bond is a third-party secured bond established by the manufacturer before delivery of a vehicle to guarantee workmanship, quality of material, or other stated performance of the vehicle components.

B.1.1.10 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. When the specifications are complete, they should be distributed to apparatus manufacturers and contractors with a request for bids or proposals to furnish the specified apparatus. The request should specify a date, time, and place for formal opening of the bids. This date should allow at least 1 month for the engineering departments of apparatus manufacturers to study the specifications and estimate the cost of the apparatus. More time could be required if engineering drawings of the proposed apparatus are required.

B.1.2.1 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.1.2.2 It is recommended that a pre-bid meeting be held between the purchaser of a piece of fire apparatus and the apparatus manufacturers or their agents prior to the official release of the apparatus specifications. 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 solve misunderstandings or problems prior to their occurrence.

B.1.2.3 With a performance specification, it is usually possible to obtain more favorable bids, since there is genuine competition and the specifications are not overly restrictive. The bid should be accompanied by a detailed description of the apparatus, a list of equipment to be furnished, and other construction and performance details, including, but not limited to, estimated 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.1.2.4 Manufacturers’ proposals might include amendments and exceptions. Frequently, these changes are offered to meet price requirements or because individual manufacturers prefer to build 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.1.2.5 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 proposals, as combinations of specifications bid in a manner that still meet careful analysis. The final arrangement, a delivery date, and the method of delivery should be stipulated and agreed to by the purchasing authority.

B.1.3 Awarding the Contract. 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 manufacturer. Some apparatus manufacturers plant work through a dealer network where the dealer purchases the apparatus from a manufacturer, including taking title, and then resells the apparatus to the purchasing authority. Other manufacturers work through sales agents or representatives who solicit and negotiate a contract between a purchasing authority and a manufacturer but who never take title to the apparatus. This difference can affect where the responsibility lies for the proper fulfillment of the contract.
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.

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.

When the apparatus is ready for delivery and acceptance, the purchaser has a responsibility to check the completed apparatus carefully against the specifications, the contract, and the requirements of this document to ensure all that was required is being delivered. This includes witnessing any required acceptance tests and verifying that the gross vehicle weight and the axle weight distribution are within the chassis and axle ratings. The Delivery Inspection Form shown as Figure B.1.4.1(a) and the As Delivered Weight Analysis Calculation Worksheet shown as Figure B.1.4.1(b) can be useful in the inspection process. The weight analysis of in-service fire apparatus is critical to the safe operation of the apparatus.

The purchaser also should arrange for any training included as part of the delivery and ensure that it is properly delivered.

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

### Table B.1.4.1 Typical Hose Weight Data

<table>
<thead>
<tr>
<th>Nominal Hose Diameter</th>
<th>Weight per Unit Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>in.</td>
<td>lb per foot</td>
</tr>
<tr>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>1/2</td>
<td>38</td>
</tr>
<tr>
<td>1/4</td>
<td>44</td>
</tr>
<tr>
<td>2</td>
<td>50.8</td>
</tr>
<tr>
<td>2 1/4</td>
<td>65</td>
</tr>
<tr>
<td>3</td>
<td>76.2</td>
</tr>
<tr>
<td>3 1/2</td>
<td>90</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>4 1/2</td>
<td>114.3</td>
</tr>
<tr>
<td>5</td>
<td>125</td>
</tr>
<tr>
<td>6</td>
<td>150</td>
</tr>
</tbody>
</table>

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

D.1 History of Specification.

A report of the NFPA Committee on Fire Engines adopted at the 1906 NFPA Annual Meeting included many of the provisions and test procedures since followed in standards for fire department pumping apparatus.

At the convention of the International Association of Fire Engineers in 1911, the Committee of Exhibits conducted some performance tests on automobile pumping engines. The following year, with the assistance of engineers of the National Board of Fire Underwriters, tests were conducted on pumping engines discharging under net pump pressures of 120 psi, 200 psi, and 250 psi. By the 1913 convention of the International Association of Fire Engineers, the committee had developed a standard test procedure of specified duration.

The first national specification on municipal fire apparatus was NFPA 19, [Automobile Fire Apparatus, Suggested Specifications for Combination Pumping Engine and Hose Wagon](http://www.nfpa.org), and was adopted by the National Fire Protection Association in 1914. This was followed in 1916 by specifications adopted by NFPA covering an automobile combination chemical and hose wagon and an automobile service ladder truck. These specifications received the endorsement of the Committee on Fire Department Engineering of the International Association of Fire Engineers and were adopted and published in 1920 by the National Board of Fire Underwriters. The work of the original NFPA Committee on Automobile Apparatus was suspended in 1920.

A new NFPA Committee on Municipal Fire Apparatus was organized in 1938, and NFPA adopted revised editions in 1938, 1939, and 1942. In 1948, the present Committee on Fire Department Equipment was organized. The scope of the committee was broadened to include fire department tools and appliances as well as motorized fire apparatus for both municipal and rural service. There have been numerous revisions of the standard to keep it abreast of current practice; and editions were issued in 1949, 1950, 1951, 1952, 1954, 1955, 1956, 1957, 1958, 1960, 1961, 1963, and 1965.

The work of this committee has been an outstanding example of cooperation among the various fire service organizations concerned with standards for fire department apparatus and equipment. A chief engineer of the former National Board of Fire Underwriters was chairman of the original committee. A very significant contribution of the National Board for over half a century was the listing of thousands of pump and engine combinations that met the specified pumper performance requirements. Recognition is also due the various insurance rating and inspection bureaus, most of which are now part of the Insurance Services Office, whose representatives have witnessed the acceptance tests of apparatus built under these specifications.

The International Association of Fire Chiefs has actively participated in this work since 1912. A fire chief has served as chairman of the committee responsible for these specifications since 1938. In 1952, the Technical Committee of the Fire Apparatus Manufacturers Association was reactivated and has made significant contributions to each subsequent edition of these specifications.

In 1965, the American Insurance Association (AIA), who replaced the National Board of Fire Underwriters, decided to terminate its field testing by Rating Bureaus and record-keeping by the AIA. The Fire Department Equipment Committee in conjunction with Underwriters Laboratories Inc. (UL) and the Technical Committee of the Fire Apparatus Manufacturers Association worked with AIA to transfer the testing program to UL. This program appeared in the standard in the 1966 edition and has been an accepted testing program.

Further revisions were completed and editions issued in 1967, 1968, 1969, 1970, 1971, and 1973. In 1975, the numerical designation of the document was changed to NFPA 1901 in a general renumbering of public fire protection standards, and the name was changed to [Standard on Automotive Fire Apparatus](http://www.nfpa.org). Partial revisions were made and new editions were issued in 1979 and 1985.

In 1991, NFPA 1901 was extensively rewritten and split into four documents. These documents covered pumper fire apparatus (NFPA 1901), initial attack fire apparatus (NFPA 1902), mobile water supply fire apparatus (NFPA 1903), and aerial ladder and elevating platform fire apparatus (NFPA 1904).
<table>
<thead>
<tr>
<th>NFPA 1901 Paragraph</th>
<th>Topic</th>
<th>Description</th>
<th>Yes (Pass)</th>
<th>No (Fail)</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.3.1.1</td>
<td>Brakes</td>
<td>Anti-lock brake system functions.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.3.1.6.2</td>
<td>Brakes</td>
<td>Parking brake grade holding certification provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.3.1.7</td>
<td>Brakes</td>
<td>Stopping distance capability certification provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.3.1.8</td>
<td>Brakes</td>
<td>Auxiliary braking system functions (required above 36,000 lb GVWR).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.3.2.3</td>
<td>Approach angle</td>
<td>Angle of approach at least 8 degrees.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.3.2.3</td>
<td>Departure angle</td>
<td>Angle of departure at least 8 degrees.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.8.16</td>
<td>Warning lights</td>
<td>Manufacturer's certification provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.8.12.1</td>
<td>Warning lights—responding</td>
<td>No yellow lights in Zone A in the “calling for right of way” mode.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.8.12.1</td>
<td>Warning lights—responding</td>
<td>No white lights in Zone C in the “calling for right of way” mode.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.8.12.1</td>
<td>Warning lights—blocking</td>
<td>No white lights in any zone in the “blocking right of way” mode.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.9.1.1</td>
<td>Audible warning</td>
<td>Sirens certified to SAE J1849.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.9.3</td>
<td>Reflective trim</td>
<td>Side of vehicle has stripe at least 4 in. high and 50 percent of vehicle length long.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.9.3</td>
<td>Reflective trim</td>
<td>Front of vehicle has stripe at least 4 in. high and 25 percent of the front width wide.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.9.3</td>
<td>Reflective trim</td>
<td>Rear of vehicle has stripe at least 4 in. high and 50 percent of the vehicle width wide.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.7.1.1</td>
<td>Step height</td>
<td>First step no more than 24 in. and no more than 18 in. between any other step.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.7.1.2</td>
<td>Step size</td>
<td>All steps have minimum area of 35 in².</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.7.1.3</td>
<td>Step size</td>
<td>All steps have 8 in. clearance between leading edge and any obstruction.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.7.1.2</td>
<td>Step size</td>
<td>All steps can have a 5-in. diameter disk placed on them without overlapping the edge.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.7.1.4</td>
<td>Ladder rungs</td>
<td>All ladder rungs have at least 7 in. between them and the body or other obstruction.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.7.2</td>
<td>Step capacity</td>
<td>Steps, platforms and ladders survive a 500-lb load without permanently bending.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.7.3</td>
<td>Step surfaces</td>
<td>Step surface slip-resistance documentation provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.8.1</td>
<td>Handrails</td>
<td>Handrails are provided at each entrance to a driving or crew compartment.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.8.1</td>
<td>Handrails</td>
<td>Handrails are provided at each position where steps or ladders for climbing are provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.8.3</td>
<td>Handrails</td>
<td>All handrails have a diameter greater than 1.00 in. and less than 1.62 in.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.8.3</td>
<td>Handrails</td>
<td>All handrails have 2 in. of clearance to any other surface.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.8.4</td>
<td>Handrails</td>
<td>All handrails are design to reduce the possibility of hand slippage.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.3.3</td>
<td>Pump operator's panel</td>
<td>Platform for pump operator provided — pumper.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure B.1.4.1(a) Delivery Inspection Form
<table>
<thead>
<tr>
<th>NFPA 1901 Paragraph</th>
<th>Topic</th>
<th>Description</th>
<th>Yes (Pass)</th>
<th>No (Fail)</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.3.1</td>
<td>Pump operator's panel</td>
<td>Platform for pump operator provided — aerial.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>9.2.3</td>
<td>Pump operator's panel</td>
<td>Platform for pump operator provided — quint.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>11.3.3</td>
<td>Pump operator's panel</td>
<td>Platform for pump operator provided — mobile foam.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>20.18.2</td>
<td>Aerial operator's station</td>
<td>Platform for aerial device operator provided.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>16.7.9</td>
<td>Pump operator's panel</td>
<td>All discharge connections at pump panel are 2.5 in. or less.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>16.9.2</td>
<td>Pump operator's panel</td>
<td>All gauges, intakes, outlets, and controls are illuminated.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>13.10.3.3</td>
<td>Pump operator's panel</td>
<td>Priming lubricant or reservoir area is illuminated.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>13.10.3.3</td>
<td>Pump operator's panel</td>
<td>Pump compartment is illuminated.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>16.11.2</td>
<td>Pump operator's panel</td>
<td>Engine throttle is between 42 in. and 72 in. above operator platform.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>16.12.1</td>
<td>Pump operator's panel</td>
<td>The instruments listed in 16.12.1 are all located on the pump panel.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>16.12.1.3</td>
<td>Pump operator's panel</td>
<td>Visible and audible warnings are provided for low engine oil pressure and high coolant temperature.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>16.12.2.1</td>
<td>Pump operator's panel</td>
<td>Master intake and pump discharge gauges no more than 8 in. apart edge to edge.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>16.12.2.1.4</td>
<td>Pump operator's panel</td>
<td>Master intake is located to the left of the pump discharge gauge.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>16.12.2.1</td>
<td>Pump operator's panel</td>
<td>Gauges are labeled as “pump intake” and “pump discharge”.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>16.12.3.2</td>
<td>Pump operator's panel</td>
<td>Discharge instrumentation is within 6 in. of the control.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>14.1.3.4</td>
<td>Warning placards</td>
<td>A seat belts required placard is visible from every seating position.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>14.1.2</td>
<td>Warning placards</td>
<td>Cab occupant capacity placard provided and visible to the driver.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>14.3.4.1</td>
<td>Warning placards</td>
<td>Placard indicating the height of the vehicle is visible to the driver.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>5.3.4</td>
<td>Warning placards</td>
<td>Electrocution hazard placard is visible to pump operator — pumper.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>8.3.2</td>
<td>Warning placards</td>
<td>Electrocution hazard placard is visible to pump operator — aerial.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>9.2.4</td>
<td>Warning placards</td>
<td>Electrocution hazard placard is visible to pump operator — quint.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>11.3.4</td>
<td>Warning placards</td>
<td>Electrocution hazard placard is visible to pump operator — mobile foam.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>20.18.3</td>
<td>Warning placards</td>
<td>Electrocution hazard placard is visible to aerial device operator.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>13.7.4</td>
<td>Warning placards</td>
<td>Placard warning that riding is prohibited should be visible at rear platform.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>13.7.4</td>
<td>Warning placards</td>
<td>Placard warning that riding is prohibited should be visible at cross walkway.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>16.6.1.3</td>
<td>Warning placards</td>
<td>If inlet at pump operator's position is valved, a serious injury or death placard is visible.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

Figure B.1.4.1(a) Delivery Inspection Form (continued)
<table>
<thead>
<tr>
<th>NFPA 1901 Paragraph</th>
<th>Topic</th>
<th>Description</th>
<th>Yes (Pass)</th>
<th>No (Fail)</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.11</td>
<td>Hazard light</td>
<td>Red light in driving compartment flashes if the parking brake is released and compartment doors are open.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>13.11</td>
<td>Hazard light</td>
<td>Red light in driving compartment flashes if the parking brake is released and a ladder or equipment rack is down.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>13.11</td>
<td>Hazard light</td>
<td>Red light in driving compartment flashes if the parking brake is released and a powered light tower is raised.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>13.11</td>
<td>Hazard light</td>
<td>Red light in driving compartment flashes if the parking brake is released and outriggers are not stowed.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>13.11</td>
<td>Hazard light</td>
<td>Red light in driving compartment flashes if the parking brake is released and other hazard is deployed.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>13.10.1</td>
<td>Work lighting</td>
<td>Rear of apparatus is illuminated for working.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>13.10.1.1</td>
<td>Work lighting</td>
<td>Hose bed is illuminated for working.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>13.10.2</td>
<td>Ground lighting</td>
<td>Ground lighting is provided at areas where personnel will be stepping or climbing.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>13.10.2.1</td>
<td>Ground lighting</td>
<td>Ground lighting illuminates automatically with the cab doors.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4.10.1</td>
<td>Controls and gauges</td>
<td>All controls, switches, instructions, gauges, and instruments needed for operation are illuminated.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>14.1.1</td>
<td>Cab occupant protection</td>
<td>Driving and crew compartment(s) is fully enclosed.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>14.1.3</td>
<td>Driving and crew compartment occupant protection</td>
<td>Seat belts are provided for each driving and crew compartment occupant.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>14.1.6</td>
<td>Driving and crew compartment occupant protection</td>
<td>Noise level maximum 90 db certification provided.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>14.1.7</td>
<td>Driving and crew compartment occupant protection</td>
<td>Headroom at each seating position meets guideline.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>14.1.9.1</td>
<td>Driving and crew compartment occupant protection</td>
<td>Each SCBA bracket is provided with a retaining device.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>14.1.9.2</td>
<td>Driving and crew compartment occupant protection</td>
<td>SCBA bracket test documentation provided.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>14.1.10.1</td>
<td>Driving and crew compartment occupant protection</td>
<td>All equipment required to be used during a response is contained or fastened.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>14.1.10.2</td>
<td>Driving and crew compartment occupant protection</td>
<td>Equipment mounting documentation provided.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>13.9.2</td>
<td>Driving and crew compartment occupant protection</td>
<td>Audible warning devices and sirens are mounted low and in front of vehicle.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4.9.2</td>
<td>Personnel protection</td>
<td>Isolation or insulation is provided to protect personnel from electrical shock.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4.9.1</td>
<td>Personnel protection</td>
<td>Guards or shields are provided around hot, moving, or rotating parts.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>15.4.2</td>
<td>Powered equipment rack</td>
<td>The rack has a device to lock it in the stowed position.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>15.4.4</td>
<td>Powered equipment rack</td>
<td>Operator can watch the rack from the controls while it is being deployed.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>NFPA 1901 Paragraph</td>
<td>Topic</td>
<td>Description</td>
<td>Yes (Pass)</td>
<td>No (Fail)</td>
<td>N/A</td>
</tr>
<tr>
<td>----------------------</td>
<td>----------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------------</td>
<td>-----------</td>
<td>-----</td>
</tr>
<tr>
<td>15.4.6</td>
<td>Powered equipment rack</td>
<td>The rack is equipped with lights that flash when it is not stowed.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.4.7</td>
<td>Powered equipment rack</td>
<td>The rack has reflective devices to make it more visible when deployed.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.6.2</td>
<td>Pump compartment</td>
<td>Pump compartment access—no dimension less than 18 in.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24.6.2</td>
<td>Work surfaces</td>
<td>Chair level work surfaces are 28 in. to 30 in. above the floor.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24.6.2</td>
<td>Work surfaces</td>
<td>Stand-up work surfaces are 36 in. to 40 in. above the floor.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25.9.5</td>
<td>SCBA fill station</td>
<td>Test documentation or certification is provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25.14.4</td>
<td>Air purification</td>
<td>Test documentation or certification that pure air is being produced is provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.13.8</td>
<td>Tank and piping capacity</td>
<td>Hydrostatic piping test documentation provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.3.2</td>
<td>Tank and piping capacity</td>
<td>Tank-to-pump capacity documentation provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.6</td>
<td>Tank and piping capacity</td>
<td>Tank capacity certification provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.25</td>
<td>Tank and piping capacity</td>
<td>Aerial piping test documentation provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.14.3.2</td>
<td>Electrical 12-volt</td>
<td>Reserve capacity test documentation provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.14.3.3</td>
<td>Electrical 12-volt</td>
<td>Alternator performance test at idle documentation provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.14.3.4</td>
<td>Electrical 12-volt</td>
<td>Alternator performance test at full load documentation provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.14.4</td>
<td>Electrical 12-volt</td>
<td>Low voltage alarm test documentation provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.15</td>
<td>Electrical 12-volt</td>
<td>Load analysis documentation provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23.4.11</td>
<td>Electrical 110-volt</td>
<td>Nominal generator rating chart located at the pump panel.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.3.4.2</td>
<td>Engine and fuel tank</td>
<td>Label is provided at the fuel fill to indicate type of fuel.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.3.4.1</td>
<td>Engine and fuel tank</td>
<td>Certification provided that fuel tank is of sufficient size to meet 12.3.4.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.2.1.5</td>
<td>Engine and fuel tank</td>
<td>Engine manufacturer’s installation approval documentation provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.19.2</td>
<td>Documentation and manuals</td>
<td>Chassis operation and maintenance manual provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.19.2</td>
<td>Documentation and manuals</td>
<td>Pump operation and maintenance manual provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.19.2</td>
<td>Documentation and manuals</td>
<td>Aerial device operation and maintenance manual provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.19.2</td>
<td>Documentation and manuals</td>
<td>Aerial device load chart provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.19.2</td>
<td>Documentation and manuals</td>
<td>Wiring diagram provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.19.2</td>
<td>Documentation and manuals</td>
<td>Lubrication chart provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.19.2</td>
<td>Documentation and manuals</td>
<td>Parts replacement information provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.1.3</td>
<td>Documentation and manuals</td>
<td>Federal Motor Vehicle Safety label.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.19.3</td>
<td>Documentation and manuals</td>
<td>Major component manufacturer’s manuals provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.19.1</td>
<td>Documentation and manuals</td>
<td>Required manufacturer’s data provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure B.1.4.1(a) Delivery Inspection Form (continued)
# As Delivered Weight Analysis Calculation Worksheet

## Axle Rating Reserve Capacity Determination

<table>
<thead>
<tr>
<th></th>
<th>Total Vehicle</th>
<th>Front Axle or tandem</th>
<th>Tiller Axle</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Weight at delivery (with water)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hose Length (m or ft)</th>
<th>Weight per Unit Length (m or ft)</th>
<th>(100%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>Hose allowance Main hose bed</td>
<td>(x)</td>
</tr>
<tr>
<td>c</td>
<td>Hose allowance Main hose bed</td>
<td>(x)</td>
</tr>
<tr>
<td>d</td>
<td>Hose allowance Main hose bed</td>
<td>(x)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>(50%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>e</td>
<td>Hose allowance Cross lay</td>
<td>(x)</td>
</tr>
<tr>
<td>f</td>
<td>Hose allowance Cross lay</td>
<td>(x)</td>
</tr>
<tr>
<td>g</td>
<td>Hose allowance Cross lay</td>
<td>(x)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>(100%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>h</td>
<td>Hose allowance Front bumper</td>
<td>(x)</td>
</tr>
</tbody>
</table>

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>Hose allowance Suction hose</td>
<td>(x)</td>
</tr>
<tr>
<td>j</td>
<td>Hose allowance Other</td>
<td>(x)</td>
</tr>
<tr>
<td>k</td>
<td>Hose allowance Other</td>
<td>(x)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>(100%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>l</td>
<td>Personnel allowance</td>
<td>(x) 200</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>(100%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>m</td>
<td>Miscellaneous equipment allowance (from Table 12.1)</td>
<td></td>
</tr>
</tbody>
</table>

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>Total expected in-service weight (sum of rows a through m)</td>
<td></td>
</tr>
</tbody>
</table>

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>o</td>
<td>Axle weight ratings (from chassis manufacturer's data label)</td>
<td></td>
</tr>
</tbody>
</table>

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>p</td>
<td>Expected reserve capacity</td>
<td></td>
</tr>
</tbody>
</table>

---

**Figure B.1.4.1(b) As Delivered Weight Analysis Calculation Worksheet.**
### Instructions for completing the As Delivered Weight Analysis Calculation Worksheet

(a) Obtain vehicle weights from a certified scale with the following:
   (1) All manufacturing work completed
   (2) Tanks full of water, fuel, and foam
   (3) Ground ladders stored on the vehicle

(b) through (k) Calculate the expected hose load by multiplying the length of hose by the standard values for weight per unit length and enter the product in column 8. Use the values in Table B.1.4.1, Typical Hose Weight Data, or obtain specific values for the brand of hose being used.

(l) Multiply the number of seat-belt equipped seating positions by the NFPA allowance of 200 lb per person and enter the product in column 8.

(m) Enter the miscellaneous equipment allowance from Table 12.1 in column 8. Divide the hose, personnel, and equipment weights in column 8 between the front and rear axles per the indicated percentages (or as appropriate from a detailed weight analysis).

(n) Add the values from rows a through m for each of columns 8 through 11 and enter the sum in row n.

(o) Record the gross vehicle and gross axle weight ratings from the manufacturer’s data label affixed inside the crew compartment.

(p) Subtract values in row n from row o and enter the difference in row p. This is the expected reserve axle capacity of the in-service vehicle. If this number is negative, consult the vehicle manufacturer.

(q) Obtain tire ratings from the tire manufacturer’s catalog, or from the vehicle manufacturer if fire-service ratings apply.

Notes:
   (1) Tire manufacturers often provide special fire service ratings based on the vocational duty cycle differences between fire truck and line haul service profiles.
   (2) Ratings for a specific tire will be different depending on whether the tire is used as a single tire or as a dual tire. Use the rating specific to the application.

(r) Obtain rim ratings from the tire manufacturer’s catalog or engineering specifications.

(s) Obtain axle ratings from the vehicle manufacturer.

Notes:
   (1) Axle manufacturers provide published maximum ratings for their axles. Application-specific ratings can be lower depending on a variety of factors including wheel and tire offsets and the brakes selected.
   (2) Axle ratings higher than the axle manufacturer’s published ratings should be accompanied by a written application approval from the axle manufacturer.

(t) Obtain the nominal suspension rating from the vehicle or suspension manufacturer.

Note: suspensions are designed to provide adequate suspension travel at the rated load. Over-sized suspensions can provide longer suspension life, but the harsher ride quality that results can reduce the life of other vehicle components.

(u) Enter the axle weight rating by selecting the lowest value from each column. This value should match the chassis manufacturer’s certification label affixed inside the cab.

### Table: Axle Weight Rating Verification

<table>
<thead>
<tr>
<th>Axle Weight Rating Verification</th>
<th>Quantity</th>
<th>Rating</th>
<th>GVWR</th>
<th>Front</th>
<th>Rear</th>
<th>Tiller</th>
</tr>
</thead>
<tbody>
<tr>
<td>q Tires</td>
<td></td>
<td>(x)</td>
<td>(=)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Front</td>
<td>(x)</td>
<td>(=)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rear</td>
<td>(x)</td>
<td>(=)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tiller</td>
<td>(x)</td>
<td>(=)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>r Rims</td>
<td></td>
<td>(x)</td>
<td>(=)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Front</td>
<td>(x)</td>
<td>(=)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rear</td>
<td>(x)</td>
<td>(=)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tiller</td>
<td>(x)</td>
<td>(=)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>s Axle</td>
<td></td>
<td>(x)</td>
<td>(=)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Front</td>
<td>(x)</td>
<td>(=)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rear</td>
<td>(x)</td>
<td>(=)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tiller</td>
<td>(x)</td>
<td>(=)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>t Suspension</td>
<td></td>
<td>(x)</td>
<td>(=)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Front</td>
<td>(x)</td>
<td>(=)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rear</td>
<td>(x)</td>
<td>(=)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tiller</td>
<td>(x)</td>
<td>(=)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| u Axle weight rating (lowest rating from each column) | | | | | |

Figure B.1.4.1(b) As Delivered Weight Analysis Calculation Worksheet. (continued)
## WORKSHEET FOR DETERMINING EQUIPMENT WEIGHT ON FIRE APPARATUS

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ground Ladders</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ladder, A-frame Combo, 14 ft</td>
<td>20.5 × 6.25 × 116</td>
<td>33</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ladder, attic</td>
<td>2.5 × 1.5 × 137</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ladder, combo folding (Little Giant type)</td>
<td>20 × 7.75 × 102</td>
<td>28</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ladder, extension, 2 section, 14 ft</td>
<td>21 × 5 × 115</td>
<td>53</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ladder, extension, 2 section, 16 ft</td>
<td>21 × 5 × 129</td>
<td>59</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ladder, extension, 2 section, 20 ft</td>
<td>21 × 5 × 144</td>
<td>66</td>
<td></td>
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</tr>
<tr>
<td>Ladder, extension, 2 section, 24 ft</td>
<td>21 × 5 × 171</td>
<td>75</td>
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</tr>
<tr>
<td>Ladder, extension, 2 section, 28 ft</td>
<td>22 × 5.75 × 199</td>
<td>114</td>
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<td></td>
</tr>
<tr>
<td>Ladder, extension, 3 section, 28 ft</td>
<td>25 × 8.25 × 160</td>
<td>145</td>
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<tr>
<td>Ladder, extension, 3 section, 30 ft</td>
<td>25 × 8.25 × 174</td>
<td>158</td>
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<tr>
<td>Ladder, extension, 3 section, 35 ft</td>
<td>25 × 8.25 × 188</td>
<td>170</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Ladder, folding, 8 ft</td>
<td>22.5 × 5.5 × 96</td>
<td>38</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ladder, folding, 10 ft</td>
<td>30.75 × 5.5 × 120</td>
<td>47</td>
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<tr>
<td>Ladder, Fresno, 10 ft</td>
<td>13.5 × 5 × 87</td>
<td>41</td>
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</tr>
<tr>
<td>Ladder, Fresno, 12 ft</td>
<td>13.5 × 5 × 101</td>
<td>46</td>
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<tr>
<td>Ladder, Fresno, 14 ft</td>
<td>13.5 × 5 × 115</td>
<td>51</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ladder, roof, 12 ft, with hooks</td>
<td>19.25 × 2.75 × 144</td>
<td>36</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Ladder, roof, 14 ft, with hooks</td>
<td>19.25 × 2.75 × 168</td>
<td>42</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ladder, roof, 16 ft, with hooks</td>
<td>19.25 × 2.75 × 192</td>
<td>48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pike Poles</strong></td>
<td></td>
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</tr>
<tr>
<td>Hook, dry wall, 6 ft</td>
<td>Head 7.25 × 5.5 × 5</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hook, dry wall, 8 ft</td>
<td>Head 7.25 × 5.5 × 5</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pike pole, 6 ft</td>
<td>1.5 × 72</td>
<td>6</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Pike pole, 8 ft</td>
<td>1.5 × 96</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pike pole, 10 ft</td>
<td>1.5 × 120</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pike pole, 12 ft</td>
<td>1.5 × 144</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pike pole, closet hook, 3 ft</td>
<td>1.5 × 36</td>
<td>5</td>
<td></td>
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</tr>
<tr>
<td><strong>Hose</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hose, booster, ¾ in. × 100 ft</td>
<td>0.75 × 1200</td>
<td>59</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hose, booster, ¾ in. × 50 ft</td>
<td>0.75 × 600</td>
<td>30</td>
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<tr>
<td>Hose, booster, 1 in. × 100 ft</td>
<td>1 × 1200</td>
<td>79</td>
<td></td>
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</tr>
<tr>
<td>Hose, booster, 1 in. × 50 ft</td>
<td>1 × 600</td>
<td>41</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hose, DJ, 1.5 in. × 50 ft (roll)</td>
<td>3 × 18.5</td>
<td>18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hose, DJ, 1.75 in. × 50 ft, w/1.5-in. couplings (roll)</td>
<td>3.25 × 18.5</td>
<td>19</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Hose, DJ, 2.5 in. × 50 ft (roll)</td>
<td>4.5 × 20</td>
<td>32</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

Figure C.1 Worksheet for Determining Equipment Weight on Fire Apparatus. (continued)
### Weight (lb)

#### Dimensions (in.)

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Weight (lb)</th>
<th>Total Weight (lb)</th>
<th>Compartmen Location</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Portable or Folding Tank</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tank, portable, 1000 gal</td>
<td>99 x 7 x 30</td>
<td>125</td>
<td></td>
</tr>
<tr>
<td>Tank, portable, 2000 gal</td>
<td>135 x 7 x 30</td>
<td>165</td>
<td></td>
</tr>
<tr>
<td>Tank, portable, 3000 gal</td>
<td>159 x 7 x 30</td>
<td>185</td>
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</tr>
<tr>
<td><strong>Nozzles</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deck gun, mounted, 2.5 in., manual type</td>
<td>15.5 x 17 x 18.5</td>
<td>22.5</td>
<td></td>
</tr>
<tr>
<td>Deck gun, portable, 2.5 in., manual type</td>
<td>22.25 x 25 x 21</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>Nozzle, booster, 1 in. aluminum</td>
<td>2.5 ID x 9.6</td>
<td>4.3</td>
<td></td>
</tr>
<tr>
<td>Nozzle, booster, 1 in. brass</td>
<td>2.5 ID x 9.6</td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td>Nozzle, cellar, 1.5 in., brass</td>
<td>5 ID x 5</td>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td>Nozzle, cellar, 2.5 in., brass</td>
<td>7 ID x 5</td>
<td>9.5</td>
<td></td>
</tr>
<tr>
<td>Nozzle, chimney, w/ accessory bag</td>
<td>20 x 12 x 6.5</td>
<td>15</td>
<td></td>
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<tr>
<td>Nozzle, foam attachment, 1.5 in.</td>
<td>6 ID (bottom) x 3 ID (tip) x 15.9</td>
<td>4.8</td>
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</tr>
<tr>
<td>Nozzle, foam, 2.5 in., w/ pickup tube</td>
<td>4.5 ID x 40.5</td>
<td>4.5</td>
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<tr>
<td>Nozzle, foam, deck gun, w/ pickup hose</td>
<td>Pick up 7.1 Nozzle 6 x 7</td>
<td>19</td>
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<tr>
<td>Nozzle, fog, deck gun</td>
<td>6 ID x 10</td>
<td>11.9</td>
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<tr>
<td>Nozzle, forestry, 1 in.</td>
<td>2 ID x 6.8</td>
<td>1</td>
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<tr>
<td>Nozzle, handline, 1.5 in. aluminum</td>
<td>2.5 ID x 9.9</td>
<td>4.4</td>
<td></td>
</tr>
<tr>
<td>Nozzle, handline, 1.5 in. brass</td>
<td>2.5 ID x 9.9</td>
<td>6.5</td>
<td></td>
</tr>
<tr>
<td>Nozzle, handline, 2.5 in. aluminum</td>
<td>3 ID x 12</td>
<td>6.4</td>
<td></td>
</tr>
<tr>
<td>Nozzle, handline, 2.5 in. brass</td>
<td>3 ID x 12</td>
<td>8</td>
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<tr>
<td>Nozzle, piercing, 1.5 in.</td>
<td>51.5 x 1.5 x 6.5</td>
<td>11</td>
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<tr>
<td>Nozzle, play pipe, w/ shaper, 2.5 in.</td>
<td>3 ID x 11.25</td>
<td>8</td>
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</tr>
<tr>
<td>Nozzle, play pipe, w/ shaper, deck gun, 2.5 in. aluminum</td>
<td>3.5 ID x 3</td>
<td>1.5</td>
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</tr>
<tr>
<td>Nozzle, play pipe, w/ shaper, deck gun, 2.5 in. brass</td>
<td>3.5 ID x 3</td>
<td>3.5</td>
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</tr>
<tr>
<td>Nozzle, playpipe, 2.5 in. aluminum</td>
<td>10 x 1.5 x 7 (Coupling 3.5 x 2)</td>
<td>5.8</td>
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</tr>
<tr>
<td>Nozzle, playpipe, 2.5 in. brass</td>
<td>10 x 1.5 x 7 (Coupling 3.5 x 2)</td>
<td>11.1</td>
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</tr>
<tr>
<td>Nozzle, stacked tips, aluminum, 2.5 in.</td>
<td>3 ID x 9</td>
<td>4</td>
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</tr>
<tr>
<td>Nozzle, stacked tips, brass, 2.5 in.</td>
<td>3 ID x 9</td>
<td>8</td>
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</tr>
<tr>
<td>Nozzle, stacked tips, deck gun, aluminum, 2.5 in.</td>
<td>3.5 ID x 16.75</td>
<td>4</td>
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</tr>
<tr>
<td>Nozzle, straight tip, 1.5 in. aluminum, w/ shut-off</td>
<td>Shut off 2.5 x 4.9 Tip 1.5 x 4.5</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>Nozzle, straight tip, 1.5 in. brass, w/ shut-off</td>
<td>Shut off 2.5 x 4.9 Tip 1.5 x 4.5</td>
<td>5.8</td>
<td></td>
</tr>
<tr>
<td>Nozzle, water curtain, 2.5 in.</td>
<td>10 x 3 x 10</td>
<td>13</td>
<td></td>
</tr>
</tbody>
</table>

**Figure C.1 Worksheet for Determining Equipment Weight on Fire Apparatus. (continued)**
<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adapter, 4 in. F × 4 in. STZ, aluminum</td>
<td>3.75 × 6 ID</td>
<td>2.5</td>
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<td></td>
<td></td>
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<tr>
<td>Adapter, 4 in. F × 5 in. STZ, aluminum</td>
<td>3.5 × 7.75 ID</td>
<td>2.5</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Adapter, 4 in. STZ × 5 in. STZ, aluminum</td>
<td>3.75 × 7.75 ID</td>
<td>2.5</td>
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</tr>
<tr>
<td>Adapter, 4.5 in. F × 4 in. STZ, aluminum</td>
<td>3.75 × 6.5 ID</td>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adapter, 4.5 in. F × 5 in. STZ, aluminum</td>
<td>3.5 × 7.75 ID</td>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adapter, 5 in. F × 4 in. STZ, aluminum</td>
<td>3.5 × 6 ID</td>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adapter, 5 in. F × 5 in. STZ, aluminum</td>
<td>4 × 7.75 ID</td>
<td>2.5</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Adapter, 6 in. F × 4 in. STZ, aluminum</td>
<td>3.5 × 8.75 ID</td>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adapter, 6 in. F × 5 in. STZ, aluminum</td>
<td>4 × 8.75 ID</td>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adapter, 6 in. F × 6 in. STZ, aluminum</td>
<td>4 × 8.75 ID</td>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Adapter, double female, 1.5 in., aluminum</td>
<td>3 × 2.5 ID</td>
<td>1</td>
<td></td>
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<td></td>
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<tr>
<td>Adapter, double female, 1.5 in., brass</td>
<td>3 × 2.5 ID</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adapter, double female, 2.5 in., aluminum</td>
<td>3.25 × 4 ID</td>
<td>1</td>
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<tr>
<td>Adapter, double female, 2.5 in., brass</td>
<td>3.25 × 4 ID</td>
<td>4</td>
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<tr>
<td>Adapter, double male, 1.5 in., aluminum</td>
<td>2.5 × 2 ID</td>
<td>0.5</td>
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<td></td>
</tr>
<tr>
<td>Adapter, double male, 1.5 in., brass</td>
<td>2.5 × 2 ID</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adapter, double male, 2.5 in., aluminum</td>
<td>3 × 4 ID</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adapter, double male, 2.5 in., brass</td>
<td>3 × 4 ID</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adapter, reducer, 1.5 in. F × 1 in. M, aluminum</td>
<td>1.5 × 3 ID</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adapter, reducer, 1.5 in. F × 1 in. M, brass</td>
<td>1.5 × 3 ID</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adapter, reducer, 2.5 in. F × 1.5 in. M, aluminum</td>
<td>2 × 4 ID</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adapter, reducer, 2.5 in. F × 1.5 in. M, brass</td>
<td>2 × 4 ID</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elbow, 2.5 in. F × 2.5 in. M, 30 degree, brass</td>
<td>6.5 × 4.5 ID</td>
<td>4.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elbow, 2.5 in. F × 4 in. STZ, 30 degree, aluminum</td>
<td>7.5 × 6 ID</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elbow, 2.5 in. F × 5 in. STZ, 30 degree, aluminum</td>
<td>7.5 × 7.5 ID</td>
<td>6.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure C.1 Worksheet for Determining Equipment Weight on Fire Apparatus. (continued)
<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elbow, 3 in. F × 4 in. STZ, 30 degree, aluminum</td>
<td>7.5 × 6 ID</td>
<td>6.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elbow, 3 in. F × 5 in. STZ, 30 degree, aluminum</td>
<td>7.5 × 7.5 ID</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elbow, 4 in. F × 4 in. STZ, 30 degree, aluminum</td>
<td>8 × 6 ID</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elbow, 4 in. F × 5 in. STZ, 30 degree, aluminum</td>
<td>8 × 7.5 ID</td>
<td>8.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Intake valves</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake valve, external, 5 in. F × 4 in. STZ, w/ relief valve, aluminum</td>
<td>11 × 8.5 ID, 8 × 6.75 ID, 6 × 3 × 2.75</td>
<td>22.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake valve, external, 5 in. F × 4 in. STZ, w/ relief valve, brass</td>
<td>11 × 8.5 ID, 8 × 6.75 ID, 6 × 3 × 2.75</td>
<td>63.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake valve, external, 5 in. F × 5 in. M, w/ relief valve, aluminum</td>
<td>11 × 8.5 ID, 8 × 7.75 ID, 6 × 3 × 2.75</td>
<td>22.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake valve, external, 5 in. F × 5 in. M, w/ relief valve, brass</td>
<td>11 × 8.5 ID, 8 × 7.75 ID, 6 × 3 × 2.75</td>
<td>63.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake valve, external, 6 in. F × 4 in. STZ, w/ relief valve, aluminum</td>
<td>11 × 9.5 ID, 8 × 6.75 ID, 6 × 3 × 2.75</td>
<td>22.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake valve, external, 6 in. F × 4 in. STZ, w/ relief valve, brass</td>
<td>11 × 9.5 ID, 8 × 6.75 ID, 6 × 3 × 2.75</td>
<td>63.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake valve, external, 6 in. F × 5 in. STZ, w/ relief valve, aluminum</td>
<td>11 × 9.5 ID, 8 × 7.75 ID, 6 × 3 × 2.75</td>
<td>22.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake valve, external, 6 in. F × 5 in. STZ, w/ relief valve, brass</td>
<td>11 × 9.5 ID, 8 × 7.75 ID, 6 × 3 × 2.75</td>
<td>63.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake valve, external, 6 in. F × 6 in. M, w/ relief valve, aluminum</td>
<td>11 × 9.5 ID, 8 × 7.75 ID, 6 × 3 × 2.75</td>
<td>22.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hose equipment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake, valve, gated, 4.5 in. F × 2.5 in. M, aluminum</td>
<td>11 ID × 7</td>
<td>11.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siamees, gated, 5 in. F × (3) 2.5 in. F, M</td>
<td>10.5 × 12 × 6</td>
<td>29</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siamees, gated, 6 in. F × (3) 2.5 in. F, M</td>
<td>10.5 × 12 × 7</td>
<td>29</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valve, hydrant, 2.5 in. F × 2.5 in. M, aluminum</td>
<td>10.75 × 4.75 × 7.75</td>
<td>5.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valve, hydrant, 2.5 in. F × 2.5 in. M, brass</td>
<td>10.75 × 4.75 × 7.76</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water thief, gated, 2.5 in. F × 2.5 in. M, aluminum</td>
<td>10.25 × 10 × 6</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water thief, gated, 2.5 in. F × 2.5 in. M, brass</td>
<td>10.25 × 10 × 6</td>
<td>23.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Figure C.1 Worksheet for Determining Equipment Weight on Fire Apparatus. (continued)
<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wye, gated, 1.5 in. F × (2) 1 in. M, aluminum</td>
<td>4.75 × 6 × 3.25</td>
<td>1.75</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wye, gated, 2.5 in. F × (2) 1.5 in. M, aluminum</td>
<td>7.75 × 8.25 × 5</td>
<td>4.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wye, gated, 2.5 in. F × (2) 1.5 in. M, brass</td>
<td>7.75 × 8.25 × 5</td>
<td>8.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wye, gated, 4 in. STZ distribution, w/ relief valve</td>
<td>15 × 8.75 × 11.25</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wye, gated, 4 in. STZ distribution, w/ relief valve</td>
<td>15 × 8.75 × 11.25</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Foam Equipment**

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eductor, foam, 1.5 in. F × 1.5 in. M</td>
<td>2.75 ID × 9.5</td>
<td>9.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eductor, foam, pickup tube</td>
<td>1 ID × 159</td>
<td>7.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foam, Class A, 5-gal pail</td>
<td>14.5 × 11.25 ID</td>
<td>45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foam, Class B, 5-gal pail</td>
<td>14.6 × 11.25 ID</td>
<td>45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foam system, CAFS, wheeled</td>
<td>55.5 × 31 × 35</td>
<td>602</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foam system, CAFS, skid</td>
<td>43 × 27 × 27</td>
<td>577</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Fire Ground Hand Tools**

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axe, flat head, 6 lb.</td>
<td>Head 8.75 × 5.25 × 1.25</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Axe, pick head, 6 lb.</td>
<td>Head 11.5 × 5.25 × 1.25</td>
<td>8.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crow bar, steel, 36 in.</td>
<td>36 × 4 × 0.75</td>
<td>3.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pry bar, steel, 48 in.</td>
<td>48 × 1 × 1</td>
<td>12.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tool, Halligan</td>
<td>Body 29 × 2.5 × 1.75, Point 4.25 × 1 × 1, Flat 3.25 × 1.75 × 0.75</td>
<td>10.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Long Hand Tools**

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shovel, scoop, 48 in. D-handle</td>
<td>11 × 9 × 3, Handle 49 × 1.5 ID</td>
<td>4.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shovel, square end, 48 in. D-handle</td>
<td>9 × 11 × 3, Handle 49 × 1.5 ID</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shovel, round end, 48 in. D-handle</td>
<td>11.5 × 8.5 × 3, Handle 49 × 1.5 ID</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hammer, sledge, 10 lb.</td>
<td>Head 6.75 × 2.75 × 2.75, Handle 1.75 ID × 33</td>
<td>13.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Fire Extinguishers**

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extinguisher, carbon dioxide, 15 lb. (CO₂), Class C</td>
<td>Extinguisher 26 × 6.75 ID, Horn 11 × 4 ID</td>
<td>44.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extinguisher, dry chemical, 10 lb., Class ABC</td>
<td>21.5 × 5.25 ID</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extinguisher, dry chemical, 20 lb., Class ABC</td>
<td>25 × 7.5 ID</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Equipment Description

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extinguisher, foam, pressurized, 2.5 gal, Class B</td>
<td>24.25 × 7 ID</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extinguisher, metal-X, 20 lb., Class D</td>
<td>27.75 × 16 ID</td>
<td>53</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extinguisher, water, pressurized, 2.5 gal, Class A</td>
<td>24.25 × 7 ID</td>
<td>27</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Hose and Coupling Equipment

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hose bridge, steel</td>
<td>23 × 32 × 6</td>
<td></td>
<td>42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hose, clamp, manual</td>
<td>29.5 × 1.75 × 9.75</td>
<td></td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hose, hoist, edge protector</td>
<td>12 × 6 × 6</td>
<td></td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hose, jacket, 2.5 in.</td>
<td>13 × 5.5 ID</td>
<td></td>
<td>16.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hose, jacket, 3 in.</td>
<td>15 × 6 ID</td>
<td></td>
<td>26.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hose, roller, air remover</td>
<td>20 × 5.5 × 3</td>
<td></td>
<td>5.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hose, strap</td>
<td>6.5 x 5 x 0.5</td>
<td></td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mallet, Rubber</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrench, hose, booster, pin lug</td>
<td>11.5 × 3.75 × 0.5</td>
<td></td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrench, hose, spanner</td>
<td>11.5 × 3.75 × 0.5</td>
<td></td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrench, hydrant</td>
<td>Head 6 × 3.75 × 1</td>
<td></td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrench, large diameter hose, LDH</td>
<td>4 × 3.75 × .5</td>
<td></td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrench, spanner, combination</td>
<td>11.5 × 3.75 × 1</td>
<td></td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrench, spanner, folding</td>
<td>5.25 × 2 × .5</td>
<td></td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Smoke Ejectors

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fan, smoke ejector, 16 in., electric</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan, smoke ejector, 20 in., electric</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan, smoke ejector, 24 in., electric</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan, smoke ejector, 30 in., electric</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan, smoke ejector, positive pressure, electric</td>
<td>19 × 18.75 × 12.75</td>
<td></td>
<td>48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan, smoke ejector, positive pressure, gas</td>
<td>18.75 × 24.5 × 24.75</td>
<td></td>
<td>92</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Holder, fan, smoke ejector, door bar</td>
<td>25 × 4.5 × 3</td>
<td></td>
<td>6.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Traffic Control Equipment

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic cones, plastic</td>
<td>8 × 8 × 3.5</td>
<td>10.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic flares, case</td>
<td>16.5 × 6.75 × 7.5</td>
<td>27</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tape, barrier, plastic roll</td>
<td>3.5 × 6.75 ID</td>
<td>3.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vest, reflective</td>
<td>12 × 4.75 × 2</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure C.1 Worksheet for Determining Equipment Weight on Fire Apparatus. (continued)**
<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compart ment Location</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Small Rescue or Entry Equipment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bolt cutter, manual, 30 in.</td>
<td>29.25 × 6.25 × 1.25</td>
<td>29.25</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hose, air, utility, low pressure, w/ couplings</td>
<td>600 × 0.75 ID</td>
<td>600</td>
<td>5.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ram, battering, steel, w/ handles</td>
<td>20 × 6 ID</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saw, cut off</td>
<td>19 × 14 × 15</td>
<td>35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tool, cutter, panel</td>
<td>7 × 1 × 0.5</td>
<td>7</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tool, entry, “K tool”</td>
<td>4 × 3 × 2</td>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tool, entry, rabbit hydraulic</td>
<td>24 × 18 × 8</td>
<td>24</td>
<td>28</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Small Hand Tools</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chisel, coal, 1 in. × 12 in.</td>
<td>12 × 1 ID</td>
<td>12</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chisel, cold, ½ in. × 6 in.</td>
<td>6 × 0.5 ID</td>
<td>6</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chisel, cold, ¼ in. × 6 in.</td>
<td>6 × 0.25 ID</td>
<td>6</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chisel, cold, ¾ in. × 10 in.</td>
<td>10 × 0.75 ID</td>
<td>10</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cutter, glass, Glazier’s swivel cutter</td>
<td>12 × 4 × 6</td>
<td>12</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drill, electric, hammer, battery powered</td>
<td>16.5 × 4.5 × 9</td>
<td>16.5</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>File, metal, 10 in.</td>
<td>10 × 0.75 × 0.25</td>
<td>10</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hammer, ballpean, 12 oz.</td>
<td>Head 3.5 × 1 ID Handle 12 × 1 ID</td>
<td>Head 3.5</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hammer, ballpean, 16 oz.</td>
<td>Head 3.75 × 1 ID Handle 12 × 1</td>
<td>Head 3.75</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hammer, ballpean, 24 oz.</td>
<td>Head 3.75 × 1.25 ID Handle 12 × 1</td>
<td>Head 3.75</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hammer, ballpean, 36 oz.</td>
<td>Head 4 × 1.25 ID Handle 12 × 1</td>
<td>Head 4</td>
<td>2.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hammer, claw</td>
<td>Head 5 × 1.25 ID Handle 13 × 1.25 ID</td>
<td>Head 5</td>
<td>2.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knife, cutter, seat belt</td>
<td>4 × 2 × 0.25</td>
<td>4</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knife, putty, ¼ in.</td>
<td>7.25 × 1.25 × 0.5</td>
<td>7.25</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knife, utility</td>
<td>6 × 1.25 × 0.75</td>
<td>6</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pliers, arc joint, 10 in.</td>
<td>10 × 2.25 × 0.5</td>
<td>10</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pliers, arc joint, 16 in.</td>
<td>16 × 4.5 × 0.5</td>
<td>16</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pliers, diagonal cutting, 8 in.</td>
<td>8 × 2 × 0.5</td>
<td>8</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pliers, lineman’s, 8 in.</td>
<td>8 × 2 × 0.5</td>
<td>8</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pliers, needle nose, 6in.</td>
<td>6 × 2 × 0.5</td>
<td>6</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pliers, slip joint, 8 in.</td>
<td>8 × 1.75 × 0.5</td>
<td>8</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pliers, Vise Grip, 10 in.</td>
<td>10 × 2 × 0.5</td>
<td>10</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Punch, center</td>
<td>4 × 0.25 ID</td>
<td>4</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Punch, window, spring loaded</td>
<td>5 × 0.5 ID</td>
<td>5</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saw, drywall</td>
<td>8.5 × 1 ID</td>
<td>8.5</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure C.1 Worksheet for Determining Equipment Weight on Fire Apparatus. (continued)
<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saw, hand hacksaw, w/ spare blades and wire blades</td>
<td>18.5 x 4 x 1</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saw, hand, crosscut</td>
<td>28 x 6 x 1</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Screwdriver, Phillips, #2 x 6</td>
<td>8 x 1.25 ID</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Screwdriver, Phillips, #3 x 8</td>
<td>10.25 x 1.25 ID</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Screwdriver, slotted, ¼ x 2.5</td>
<td>2.5 x 1 ID</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Screwdriver, slotted, ¼ x 6</td>
<td>8 x 1 ID</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Screwdriver, slotted, ¾ x 12</td>
<td>12 x 1.25 ID</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Screwdriver, slotted, ¾ x 8</td>
<td>10 x 1.25 ID</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shears, metal, snips</td>
<td>9.5 x 2.5 x 0.75</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socket, spark plug</td>
<td>2.75 x 1 ID</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tape, measure, roll</td>
<td>3.25 x 3.25 x 1.25</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tool box, metal, 20 in., hand tools</td>
<td>20 x 8 x 9</td>
<td>10.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tool, axe, hand</td>
<td>Head 5.5 x 3.75 x 0.75</td>
<td>3.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrench, adjustable, 12 in.</td>
<td>12 x 3 x 0.25</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrench, adjustable, 8 in.</td>
<td>8 x 2 x 0.25</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrench, adjustable, 10 in.</td>
<td>10 x 2.5 x 0.25</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrench, combination, metric, open end, 8 mm to 18 mm (11 piece)</td>
<td>13 x 12 x 1</td>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrench, combination, SAE, open end, 5/8 in. to 1 in. (11 piece)</td>
<td>13 x 12 x 1</td>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrench, gas, shut off</td>
<td>8 x 1.5 x 0.5</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrench, hand chain</td>
<td>12 x 2 x 1</td>
<td>1.75</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrench, pipe, adjustable, 18 in.</td>
<td>18 x 3 x 0.5</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrench, ratchet, 5/8 in. drive, metric 8 mm to 18 mm (24 piece)</td>
<td>9.75 x 7.5 x 3</td>
<td>3.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrench, ratchet, 5/8 in. drive, SAE 5/8 in. to 1 in. (24 piece)</td>
<td>9.75 x 7.5 x 2</td>
<td>3.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrench, tire, lug</td>
<td>27.75 x 1 ID</td>
<td>4.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Miscellaneous Equipment**

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gauge, air pressure, tires</td>
<td>6.25 x 1 x 0.5</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sprinkler, wedges, set</td>
<td>3 x 0.75 x 1</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elevator, key</td>
<td>8.25 x 0.25 ID</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hooks, hay bails</td>
<td>Hook 10 x 0.5 ID</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tool, hand, fork, 4-tine</td>
<td>Tines 12 x 8.75 x 0.5</td>
<td>3.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrench, water main, shut off</td>
<td>8 x 1.5 x 0.5</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tool, man hole cover, lifter</td>
<td>44.1 x 10.2 x 6.7</td>
<td>35.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump, portable, water, small gasoline</td>
<td>17.5 x 16 x 19.5</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure C.1 Worksheet for Determining Equipment Weight on Fire Apparatus. (continued)
### Weight (lb)

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saw, chain, gasoline 61 cc, w/ 19-in. bar</td>
<td>Engine 16.75 x 9.5 x 11.25 Bar 19 x 3.75 x 0.25</td>
<td>19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brush, foxtail</td>
<td>8 x 1 ID</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercom, system, w/four headsets</td>
<td>Junction boxes 6.75 x 5.25 x 2.5, 5.25 x 3.6 x 3.1, 7 x 4.3 x 3.1, 8.25 x 5.75 x 4.75 Headset 8.5 x 7.5 x 3</td>
<td>31.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MRE</td>
<td>12 x 7.5 x 2.5</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tent, fire shelter</td>
<td>10 x 6 x 3.5</td>
<td>3.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheel chocks, large</td>
<td>21 x 10.25 x 5.75</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheel chocks, small</td>
<td>10 x 10.25 x 5.75</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

#### Electrical Equipment — Low Voltage

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery, cable puller</td>
<td>4 x 2.5 x 0.5</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Battery, jumper cables</td>
<td>10 x 12 x 2.5</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flashlight, small, w/batteries</td>
<td>10.25 x 2.25 ID</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lantern, head lamp type</td>
<td>3 x 4 x 2</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lanterns, portable, battery powered</td>
<td>11.5 x 4.5 x 6.5</td>
<td>6.5</td>
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</tr>
</tbody>
</table>

#### Personnel Equipment

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belt, safety, ladder type</td>
<td>15 x 5 x 1.75</td>
<td>4.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harness, safety</td>
<td>12 x 4 x 4</td>
<td>2.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light, sticks, Cyalume (box)</td>
<td>6 x 6 x 8</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Masks, dust, box</td>
<td>8 x 5 x 5</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rope, life line, bail out bag</td>
<td>7.5 x 7.5 x 3.5</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water, canteen, 2 qt</td>
<td>7.5 x 3.5 x 8.5</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water, container, 5 gal, w/water</td>
<td>20 x 12.5 ID</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water, container, 5 gal, w/o water</td>
<td>20 x 12.5 ID</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Personnel Gear

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clothing, parkas</td>
<td>20 x 30 x 4</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gear, entry suit, fire</td>
<td>34 x 24 x 23</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gloves, disposable, box</td>
<td>10 x 5 x 3</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gloves, leather, pair</td>
<td>9 x 4.5 x 0.75</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gloves, lineman, rubber</td>
<td>18 x 6 x 1</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gloves, neoprene, 8 in. pair</td>
<td>12 x 5 x 2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gloves, PVC, 8 in. pair</td>
<td>6.5 x 5.5 x 2</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gloves, rubber, Nitrile, 8 in. pair</td>
<td>7.5 x 4.5 x 1.25</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goggles, safety</td>
<td>6 x 3.5 x 2.5</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Helmet, hard hats</td>
<td>12.5 x 8 x 7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Helmet, tool, rescue</td>
<td>10 x 9 x 7</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

Figure C.1 Worksheet for Determining Equipment Weight on Fire Apparatus. (continued)
<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SCBA Equipment and Cylinders</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCBA, alarm, PASS</td>
<td>2 × 3.25 × 1.5</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCBA, cylinder, 4500 psi, spare</td>
<td>22.5 × 7 ID</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCBA, pack, 4500 psi cylinder, w/ PASS and mask</td>
<td>22 × 14 × 7</td>
<td>30.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Instruments</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detector, heat</td>
<td>1 × 1.75 × 6</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitor, carbon monoxide</td>
<td>3.75 × 1.75 × 1</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitor, gas, combustible</td>
<td>5.75 × 6 × 3.25</td>
<td>2.5</td>
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<tr>
<td>Monitor, oxygen</td>
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<td>Electrical, voltage tester</td>
<td>3 × 8 × 1.5</td>
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<td>Detector, gas</td>
<td>8.25 × 3.75 × 3.25</td>
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<td>Radiation, Geiger counter</td>
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<td>Detector, Dosimeter</td>
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<td>Detector, microwave leak</td>
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<td>Kit, sample gathering</td>
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<td><strong>Hydraulic Rescue Tools and Equipment</strong></td>
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<td>HRT, cutter, aircraft type</td>
<td>28.2 × 11 × 7.3</td>
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<td>HRT, hose, spare 16 ft</td>
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<td>HRT, pump, electric, simo</td>
<td>28 × 9.5 × 20.7</td>
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<td>HRT, pump, electric, single</td>
<td>22 × 9.5 × 20.7</td>
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<tr>
<td>HRT, pump, gas</td>
<td>22 × 17.5 × 20.7</td>
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<td>HRT, ram, long</td>
<td>35 × 3.1 × 7</td>
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<td>HRT, ram, medium</td>
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<td>HRT, ram, short</td>
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<td>HRT, reel, and hose, 50 ft</td>
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<td>HRT, spreader, large</td>
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<td>HRT, tool, combination</td>
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<td><strong>Air Rescue Equipment and Bags</strong></td>
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<td>Air bag, controller</td>
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<td>Air bag, high pressure, 6 × 6</td>
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Figure C.1 Worksheet for Determining Equipment Weight on Fire Apparatus. (continued)
<table>
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<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
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<td>Air bag, high pressure, 24 × 24</td>
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<td>Air bag, high pressure, 27 × 27</td>
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<td>Air bag, high pressure, 30 × 30</td>
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<td>Air bag, high pressure, 36 × 36</td>
<td>36 × 36 × 1.2</td>
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<td>Air bag, low pressure</td>
<td>27.5 × 27.5 × 2.3</td>
<td>20</td>
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<td>Air bag, pressure regulator</td>
<td>7 × 6 × 4.5</td>
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<td>Air chisel, set, w/ air cylinder</td>
<td>26 × 11.5 × 11.5</td>
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<td>Air tool, drill</td>
<td>9.5 × 8.5 × 3.5</td>
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<tr>
<td>Air tool, hammer</td>
<td>9.5 × 2.5 ID, 7.75 × 2.25 ID</td>
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<td>Hose, air, low pressure, 50 ft</td>
<td>22 × 11 × 3</td>
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<td>Reel, air, low pressure, with 100-ft hose</td>
<td>20.5 × 18 × 19.5</td>
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<td><strong>Shoring and Cribbing Equipment — Trench Rescue</strong></td>
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<td>Cribbing, wood, 2 × 4 × 18</td>
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<tr>
<td>Cribbing, wood, 4 × 4 × 18</td>
<td>3.25 × 3.25 × 18</td>
<td>3.5</td>
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<td>Cribbing, wood, 2 × 4 × 36</td>
<td>1.5 × 3.25 × 36</td>
<td>3</td>
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<tr>
<td>Wedges, wood, 4 × 4 × 18</td>
<td>3.25 × 3.25 × 18</td>
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<td><strong>Water Rescue Equipment</strong></td>
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<tr>
<td>Harness, rescue, body type</td>
<td>16 × 8 × 8</td>
<td>5</td>
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<tr>
<td>Harness, rescue, chest type</td>
<td>6 × 9 × 2</td>
<td>1.5</td>
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<tr>
<td>Life preserver, personal flotation device</td>
<td>21 × 15 × 3</td>
<td>2.5</td>
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<tr>
<td><strong>Jacks, Come-along, Block and Tackle, Chains</strong></td>
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<tr>
<td>Jack, mechanical, long highlift</td>
<td>48 × 8 × 2</td>
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<td>Jack, hydraulic, bottle type 5 ton</td>
<td>4.5 × 5 × 9</td>
<td>12</td>
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<tr>
<td>Jack, hydraulic, bottle type 12 ton</td>
<td>5.5 × 5.5 × 9.5</td>
<td>18</td>
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<tr>
<td>Jack, hydraulic, bottle type 20 ton</td>
<td>6 × 6.5 × 11</td>
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<td>Plate, outrigger</td>
<td>24 × 24 × 5</td>
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<td>Pulley, swivel side</td>
<td>6 × 4 × 1.5</td>
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<td>Tool, figure 8</td>
<td>7 × 6 × 0.75</td>
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<tr>
<td>Chain, steel, 6 ft with hooks</td>
<td>11 × 7 × 3.5</td>
<td>16.5</td>
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<tr>
<td>Chain, steel, 10 ft with hooks</td>
<td>14 × 7.5 × 4</td>
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<td>Chain, shortener</td>
<td>8.75 × 2.5 × 0.75</td>
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<tr>
<td>Chain, shackle</td>
<td>6 × 4 × 1.5</td>
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<tr>
<td>Chain, steel, 20 ft with hooks</td>
<td>9.5 × 5.75 × 5.25</td>
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<td>Chain, shackle kit</td>
<td>21 × 14 × 5</td>
<td>13.5</td>
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<td>Winch, manual, come along</td>
<td>18.5 × 7 × 5</td>
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<td>Straps, extrication, w/ quick release buckle</td>
<td>7 × 5 × 2</td>
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*Figure C.1 Worksheet for Determining Equipment Weight on Fire Apparatus. (continued)*
<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
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<tbody>
<tr>
<td><strong>Rope Rescue Equipment — High Angle Rescue</strong></td>
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<tr>
<td>Carabiner, locking</td>
<td>4.4 × 4.4 × 0.5</td>
<td>0.5</td>
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<tr>
<td>Harness, body</td>
<td>16 × 8 × 8</td>
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<tr>
<td>Harness, chest</td>
<td>6 × 9 × 2</td>
<td>1.5</td>
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<tr>
<td>Rope, ½ in., Kernmantle, 200 ft, water rescue</td>
<td>11 × 11 ID</td>
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<tr>
<td>Rope, ½ in., nylon, 200 ft</td>
<td>27 × 9 ID</td>
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<tr>
<td>Rope, ¾ in., nylon, 200 ft</td>
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<td>Rope, ¾ in., Kernmantle, 200 ft, water rescue</td>
<td>29 × 12 ID</td>
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<td>Rope, 50 ft, w/ throw bag</td>
<td>15 × 6 ID</td>
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<td>Rope, ascender device</td>
<td>2.5 × 9 × 4.5</td>
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<td>Rope, descender device</td>
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<td>Rope, nylon, ½ in. × 100 ft utility</td>
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<td>Rope, pulley block, double</td>
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<td>Sling, nylon</td>
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<td><strong>Cutting Equipment</strong></td>
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<td>Cutter, Arc Air</td>
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<td>Cutter, pedal</td>
<td>8.5 × 2.75 × 3</td>
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<td>Torch, cutting, acetylene</td>
<td>22.5 × 12.5 × 10</td>
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<td><strong>Hazmat-Related Items</strong></td>
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<td>Absorbent, oil dry</td>
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<td>Absorbent, pads, 100</td>
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<td>Absorbent, Vermiculite</td>
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<td>Broom, Teflon</td>
<td>Broom 36 × 4.25 × 4 Handle 58.5 × 1 ID</td>
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<td>Bucket, plastic, 5 gal</td>
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<td>Caulking, gun</td>
<td>22.5 × 2.5 ID</td>
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<td>Drum, salvage, 8 gal</td>
<td>16.75 × 14 ID</td>
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<td>16.75 × 14.5 ID</td>
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<td>Drum, salvage, 55 gal</td>
<td>25 ID × 37.5</td>
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<td>Drum, salvage, 85 gal</td>
<td>31 ID × 43.25</td>
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<td>Drum, sling</td>
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<td>Drum, tank</td>
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<td>Hazmat, tank kit</td>
<td>33.75 × 23.1 ID</td>
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Figure C.1 Worksheet for Determining Equipment Weight on Fire Apparatus. (continued)
<table>
<thead>
<tr>
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<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
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<tr>
<td>Neutralizer, acid, 1 gal</td>
<td>12.25 ID × 15</td>
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<td>Neutralizer, caustic, 1 gal</td>
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<td>Shovel, non-sparking</td>
<td>Shovel 10 x 11 x 2 Handle 28 × 1 ID</td>
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<td>Shovel, polypropylene</td>
<td>Shovel 10.5 x 14 x 2 Handle 24.5 × 1 ID</td>
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<td>Shower, decontamination</td>
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<td>Squeegees, Teflon</td>
<td>Squeegee 3 x 2.25 x 1 Handle 72 × 1 ID</td>
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<tr>
<td>Suit, Level C hazmat</td>
<td>13 x 6.5 x 1.75</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Towels, bath, terry, 20 x 36</td>
<td>16 x 6 x 3.75</td>
<td>1</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Stretcher and Patient Control Equipment**

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back board, long</td>
<td>71 x 17.75 x 1.5</td>
<td>17.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Back board, short</td>
<td>32 x 16 x 0.75</td>
<td>3</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Body, pouch</td>
<td>17 x 14 x 1</td>
<td>6.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extraction device, KED</td>
<td>34 x 11 x 5</td>
<td>6.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neck brace, C-collar</td>
<td>23 x 10 x 6</td>
<td>3.5</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Stretcher, folding</td>
<td>39.5 x 24.25 x 9.25</td>
<td>60</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Stretcher, scoop</td>
<td>73 x 16.75 x 2</td>
<td>21</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Stretcher, stokes basket</td>
<td>80.5 x 22 x 8</td>
<td>38</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stretcher, stokes, 4-point</td>
<td>4 x 8 x 5</td>
<td>3.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>attachment bridles</td>
<td></td>
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</tr>
</tbody>
</table>

**Medical and EMS equipment**

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blanket, disposable</td>
<td>9.5 x 6 x 0.75</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blanket, fire, w/bag</td>
<td>20 x 19 x 2</td>
<td>5.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blanket, wool</td>
<td>19 x 13 x 2.5</td>
<td>4.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Defibrillator, cardiac, 12 lead monitor</td>
<td>23.5 x 9.5 x 13</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical, air way kit</td>
<td>13.75 x 5 x 4.5</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical, ambulance bag</td>
<td>22 x 13.5 x 8.5</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical, burn kit</td>
<td>13 x 9 x 5</td>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical, drug bag</td>
<td>19.25 x 10.5 x 12</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical, first aid kit, 25 unit</td>
<td>10.5 x 7.5 x 2</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical, OB kit</td>
<td>9.5 x 7.5 x 3.5</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical, rescue breather</td>
<td>4.75 x 4 x 2</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical, snake bite kit</td>
<td>5 x 3 x 1.5</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical, splints</td>
<td>36 x 14 x 5</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical, squeeze bag mask</td>
<td>8.5 x 5.5 x 5.5</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical, suction, portable</td>
<td>15 x 8.25 x 8.75</td>
<td>12</td>
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</tr>
</tbody>
</table>

**Figure C.1 Worksheet for Determining Equipment Weight on Fire Apparatus. (continued)**
<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical, trauma kit</td>
<td>27 x 19 x 10</td>
<td>14.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical, V-vac</td>
<td>13 x 7 x 5</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxygen, cylinders, D</td>
<td>4.25 ID x 19.5</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resuscitation, respirator, oxygen</td>
<td>9 ID x 4.5</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical, V-vac</td>
<td>13 x 7 x 5</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxygen, cylinders, D</td>
<td>4.25 ID x 19.5</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resuscitation, respirator, oxygen</td>
<td>9 ID x 4.5</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Electrical Equipment**

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cord, electric, 50 ft #12/3</td>
<td>17 x 5 x 2.75</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical, “Hot Stick”</td>
<td>20.5 x 1.75 ID</td>
<td>1.25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical, pigtail/adapter</td>
<td>1.5 ID x 8</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generator, portable</td>
<td>25.8 x 18.9 x 19.1</td>
<td>147</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Junction box, electric, distribution</td>
<td>8.5 x 6.25 x 7.5</td>
<td>5.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light, flood, tripod</td>
<td>72 x 4.5 ID</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light, portable, 500 watt</td>
<td>13 x 8.5 x 13</td>
<td>9.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reel, electric, portable with cord</td>
<td>20 x 16 x 9</td>
<td>27</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saw, electric, Sawzall</td>
<td>18 x 6 x 3</td>
<td>8.25</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Gasoline, Engine, Spare Parts (Small Engine and Tools)**

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Container, safety can, 2.5 gal</td>
<td>11.5 x 11.5 ID</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical, tape</td>
<td>0.75 x 3.5 ID</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine, air filter</td>
<td>3.25 x 4.5 ID</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine, fuel filter</td>
<td>2.75 x 1 ID</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine, oil filter</td>
<td>3.25 x 3 ID</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine, oil, 1 quart</td>
<td>8.5 x 4.25 x 2.25</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine, spare O-rings, 10</td>
<td>1.25 x 2.5 ID</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine, spark plug</td>
<td>2.75 x 0.75 ID</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Funnel, plastic</td>
<td>9 x 5 ID</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rags, mechanics</td>
<td>16.75 x 11.5 x 8.25</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saw, blade, extra 10 blades</td>
<td>12.25 x 0.5 x 0.5</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saw, wood, extra chain (gas)</td>
<td>10.5 x 2 x 0.5</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sprayer, Silicone</td>
<td>8.5 x 2.5 ID</td>
<td>41</td>
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<td></td>
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</tr>
</tbody>
</table>

**Non-Sparking Tools**

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tools, non-sparking, drum wrench</td>
<td>15 x 2.5 x 2.25</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tools, non-sparking, hammer</td>
<td>Head 3 x 1 ID</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tools, non-sparking, kit</td>
<td>14.25 x 12. ID</td>
<td>19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tools, non-sparking, knife</td>
<td>6 x 1.25 x 0.75</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tools, non-sparking, pipe wrench</td>
<td>8 x 2.5 x 0.75</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure C.1 Worksheet for Determining Equipment Weight on Fire Apparatus. (continued)
<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Dimensions (in.)</th>
<th>Weight (lb)</th>
<th>Quantity</th>
<th>Total Weight (lb)</th>
<th>Compartment Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tools, non-sparking, pliers</td>
<td>8 × 1 × 0.5</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tools, non-sparking, putty knife</td>
<td>9 × 3 × 1</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tools, non-sparking, screw driver Phillips</td>
<td>7.5 × 1 ID</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tools, non-sparking, screw driver straight</td>
<td>7.5 × 1 ID</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tools, non-sparking, wrench, adjustable</td>
<td>12 × 1.75 × 0.5</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Special Wild-land Equipment</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Axe, brush</td>
<td>Head 9 × 5 × 1</td>
<td>7</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Handle 36 × 1.5 ID</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broom, fire swatter</td>
<td>Swatter 11.5 × 15 × 0.25</td>
<td>5.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Handle 60 × 1.25 ID</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extinguisher, water pump can</td>
<td>17 × 15 × 7</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pick, clay</td>
<td>Head 16.5 × 3 × 0.5</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Handle 1.5 ID × 36</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rake, fire</td>
<td>Rake 12 × 3.5 × 1</td>
<td>4.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Handle 60 × 1.75 ID</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tool, Pulaski</td>
<td>Head 13.25 × 4.75 × 1</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Handle 33.25 × 1.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Salvage Equipment</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broom, household</td>
<td>Broom 11 × 11 × 1.75</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Handle 46 × 1 ID</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broom, push, long handle</td>
<td>Broom 19 × 4 × 3</td>
<td>4.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Handle 50.5 × 1 ID</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bucket, mop, w/ ringer</td>
<td>17.25 × 16 × 21.5</td>
<td>18.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mop, long handle</td>
<td>Mop 21 × 7.75 × 2</td>
<td>5.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Handle 80.25 × 1 ID</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nails, assorted, can</td>
<td>6 × 5 × 5</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plastic, roll, 100 ft × 20 ft</td>
<td>48 × 10 ID</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump, electric, sump</td>
<td>11 × 7 ID</td>
<td>19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Squeegee, long handle</td>
<td>Squeegee 3 × 2.25 × 1</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Handle 72 × 1 ID</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stapler, construction type</td>
<td>8 × 6 × 0.75</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tape, duct</td>
<td>2 × 7 ID</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tarp, floor runner</td>
<td>36 × 12 ID</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tarp, salvage covers</td>
<td>9 ID × 30</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vacuum, water</td>
<td>27 × 15.75 ID</td>
<td>18.5</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Reference and Communication</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Binoculars, eye</td>
<td>4.4 × 4.6 × 1.8</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Book, CHRIS manual</td>
<td>11.5 × 11.25 × 6.5</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Book, DOT reference</td>
<td>7.5 × 5.25 × 0.75</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure C.1 Worksheet for Determining Equipment Weight on Fire Apparatus. (continued)
Significant changes to the 1991 edition included requiring total enclosure of driving and crew areas, limiting the maximum stepping height, requiring access handrails, and requiring additional warning lights and reflective striping. The minimum pump size for a fire pump on a pumper was raised to 750 gpm, and the minimum water tank size was set at 500 gal. The documents also addressed line voltage electrical systems and foam systems for the first time.

The test and delivery data requirements were updated to ensure that more of the performance requirements of the standards were tested as part of the delivery process and that proper documentation was provided to the purchaser. Appendix A was expanded to provide more discussion of the requirements in the standard, and a new appendix was added to provide a form that a purchaser could use to define the information needed by the contractor to properly design, build, and deliver the fire apparatus.

Recognizing that much apparatus is multifunctional and that the process of maintaining separate documents for the traditional types of fire apparatus did not always address the need for nontraditional types or use of fire apparatus, the committee combined the four documents back into a single fire apparatus standard for the 1996 edition and organized the standard to cover not only the traditional types of fire apparatus but also multifunctional and nontraditional use apparatus. New chapters were added to cover compressed air foam systems, air systems, command and communication areas, and winches.

Many requirements were added throughout the document to improve the safety for fire fighters using the apparatus. These requirements included limiting the height of controls to 72 in. (2 m) above the standing position of the operator, requiring equipment in driving and crew areas to be securely fastened or in a compartment, increasing work lighting around the apparatus, and better grouping of pump controls to keep the operator away from the intake and discharge outlets. The low voltage electrical chapter was totally rewritten to require load analysis and load management if the total connected load cannot be supplied by the vehicle’s alternator. The requirements for warning lights were also rewritten to provide for different lighting when “calling for right-of-way” versus “blocking right-of-way.” Requirements for warning lights were increased to provide more visibility of the fire apparatus.

New requirements were added for powered equipment racks, SCBA and cylinder storage, pump and plumbing access, and slip-on fire-fighting modules. The baffling requirements for water tanks were changed to allow for either containment or dynamic baffling to be used. As a fundamental change in the aerial device chapter, water towers were redefined as aerial devices with elevated stream capability only. If water towers have a ladder on them, they are considered aerial ladders. Requirements were also added for secondary controls at the tip of an aerial ladder if such controls are provided.
E.1.2.2 NEMA Publication. National Electrical Manufacturers Association, 1300 North 17th Street, Suite 1847, Rosslyn, VA 22209.


E.1.2.3 SAE Publication. Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.


E.1.2.4 U.S. Coast Guard Publication. U.S. Coast Guard, Department of Transportation, Washington, DC 20241.


E.2 Informational References. (Reserved)

E.3 References for Extracts.

