Second Revision No. 7-NFPA 414-2018 [Global Comment]

Througout the document, replace all occurances of "extendable" with the words "boom-mounted" when referencing turrets.

Submitter Information Verification

Committee: AIR-AAA

Submittal Date: Wed Aug 29 11:50:36 EDT 2018

Committee Statement

Committee Statement: Language regarding "extendable turret" changed to align with 4.19.6 and 4.19.7.

Response Message: SR-7-NFPA 414-2018

Second Revision No. 6-NFPA 414-2018 [Section No. 3.3.24]

~~**3.3.24** Extendable Turret.~~

~~See 3.3.63.1 .~~

Submitter Information Verification

Committee: AIR-AAA

Submittal Date: Wed Aug 29 11:48:57 EDT 2018

Committee Statement

Committee Statement: Definition deleted as it only cross-references to another definition.

Response Message: SR-6-NFPA 414-2018

Second Revision No. 1-NFPA 414-2018 [Section No. 3.3.39]

~~**3.3.39** Lightweight.~~

~~Materials or advanced engineering or both practices, resulting in a weight saving without sacrifice of strength or efficiency.~~

Submitter Information Verification

Committee: AIR-AAA

Submittal Date: Tue Aug 28 10:53:55 EDT 2018

Committee Statement

Committee Statement: The term "lightweight" was removed from the document, making the definition extraneous.

Response Message: SR-1-NFPA 414-2018

Public Comment No. 1-NFPA 414-2018 [Section No. 3.3.39]

Second Revision No. 4-NFPA 414-2018 [Section No. 3.3.63]

3.3.61 Turret.

3.3.61.1 ~~Extendable~~ Boom-Mounted Turret.

~~A~~ An elevated device permanently mounted on the top of the vehicle. A boom-mounted turret might be extendable and mounted either on a rotational or non-rotational base with a power-operated boom or booms~~, designed to supply a large-capacity, mobile, elevatable water stream or other fire-extinguishing agents, or both~~ .

~~**A.3.3.63.1** Extendable Turret.~~

~~The operator, while at the scene of the fire, has the ability to reposition the primary turret and attachments to a location that enhances the visibility of and access to hard-to-reach areas, thus providing the opportunity to utilize fire-fighting agents most effectively.~~

3.3.61.2* Primary Turret.

The largest capacity foam turret used to apply primary extinguishing agent.

A.3.3.61.2 Primary Turret.

Extinguishing agents are discharged from ARFF vehicles in several ways depending on the fire-fighting scenarios. In order to establish common terminology in the field, the following information is provided.

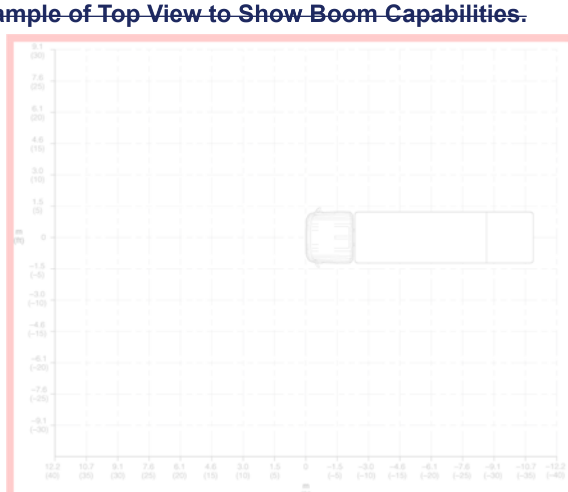
A turret is a pivoted and revolvable device that holds the nozzle. Turrets are either primary or auxiliary depending on discharge rate and method of attack. Bumper turrets are mounted on the front bumper and are remotely operated from the cab of the vehicle. ~~Boom turrets are mounted on articulating~~ Primary turrets might be mounted on booms and located on the front end or top deck of the vehicle. Roof turrets are mounted on a vehicle roof and are manually or remotely operated.

A nozzle is the final piece of hardware in the extinguishing agent delivery system that disperses the extinguishing agent in a manner that effectively extinguishes the fire or serves another purpose, such as ~~provides~~ providing cooling to protect a piece of equipment. A "primary turret nozzle" is one that is mounted on a turret and complies with the primary turret nozzle discharge requirements of Table 4.1.1.2(c) and Table 4.1.1.2(d). A "single agent nozzle" is one that only discharges one type of extinguishing agent such as foam or dry chemical. "Parallel multiple agent nozzles" are nozzles that are joined in parallel and discharge more than one type of extinguishing agent either together or separately. An "entrained multiple agent nozzle" is a nozzle that is designed to discharge multiple entrained fire extinguishing agents.

~~There are several types of booms. The "single axis boom" is remotely operated on a single axis. A "single axis extendable boom" is remotely operated and is capable of being moved on a single axis that can also be extended. A "multiple axis extendable boom" is capable of being extended and operated on both a horizontal and a vertical axis.~~ Manufacturers of vehicles with booms should provide a diagram to the purchaser depicting the capabilities of the boom showing the side and top views of the vehicle. ~~Figure A.3.3.63.2(a) and Figure A.3.3.63.2(b) are examples of the format that could be used.~~

~~**Figure A.3.3.63.2(a) Sample of Side View to Show Boom Capabilities.**~~

~~**Figure A.3.3.63.2(b) Sample of Top View to Show Boom Capabilities.**~~



Supplemental Information

File Name	Description	Approved
414_SR4_3.3.63_for_staff_only.docx	Word docx showing formatting, insertions, deletions, etc. For staff use only.	

Submitter Information Verification

Committee: AIR-AAA

Submittal Date: Wed Aug 29 11:00:17 EDT 2018

Committee Statement

Committee Statement: The changes made in 4.19.6 and 4.19.7 required clarification in the definitions which were provided by this change.

Response Message: SR-4-NFPA 414-2018

Second Revision No. 2-NFPA 414-2018 [Section No. 4.19.6]

4.19.6

If the ~~primary~~ boom-mounted turret is ~~of the extendable type~~ on a rotational base , it shall meet the following design and functional requirements:

(1) The ~~primary~~ boom-mounted turret shall meet the requirements of 4.3.1.3 and 4.3.1.5 while in the stowed position.

(2) The vehicle shall achieve a 20 percent side slope, with the ~~extendable turret~~ boom fully elevated and the nozzle rotated uphill at maximum horizontal rotation while discharging at maximum flow rate.

(3) The vehicle shall be provided with an interlock or warning system and placards in full view of the driver/operator to provide the operational limitations during all phases of operation.

(4) Flow rates shall be in accordance with Table 4.1.1.2(c) and Table 4.1.1.2(d) for major vehicles.

(5) ~~The~~ If the boom-mounted turret is intended to be the primary turret it shall meet the primary water-foam agent turret discharge requirements of Table 4.1.1.2(c) and Table 4.1.1.2(d) for the applicable vehicle class while in the bedded position.

(6) The ~~primary~~ boom-mounted turret shall meet the foam-quality standard of NFPA 412 for the applicable foam applicator and foam type.

(7) The ~~primary~~ boom-mounted turret shall function during ARFF operations without the need for outriggers or other ground contact stabilizers that would render the vehicle immobile or hinder its maneuverability.

(8) The ~~primary~~ boom-mounted turret shall have a deployment time from the bedded position to the maximum height and start the application of agent within 30 seconds.

(9) The high rise, telescoping, and/or articulating movement of the boom/tower shall be accomplished with not more than two adjacent lever controls and be permitted to be manual or automated for preselected positioning of the elevation and reach.

(10) If automated, these functions shall be provided with a manual override positioning capability.

(11) The ~~primary~~ boom-mounted turret shall be capable of applying agent to any interior area of the most current wide-body jet, so as not to impede evacuation and for safety considerations of the vehicle operator.

(12) The device shall be capable of positioning the nozzle within 0.6 m (2 ft) of ground level in front of the vehicle and be capable of applying agent to the interior of the aircraft through cargo bay door openings, passenger doorways, and emergency exits on the type of aircraft being protected while the aircraft is in either the gear-up or gear-down landing position.

(13) The ~~primary~~ boom-mounted turret shall have a range of motion so as to permit positioning of the nozzle to direct a fire-fighting agent stream at least 90 degrees to the longitudinal axis of the fuselage for interior fire extinguishment.

(14) The turret/boom mechanism shall be capable of providing for horizontal movement along the aircraft of at least 30 degrees left and right of the vehicle centerline so as not to require repositioning or movement of the ARFF vehicle.

(15) This horizontal rotation shall be accomplished without the deployment of stabilizers or outriggers that might cause a delay in positioning or emergency movement of the rescue vehicle.

(16) The primary turret shall have backup systems to allow for override of the single-lever boom control and hydraulic system (or other power source) if the primary system becomes disabled.

(17) The driver/operator shall be able to see the boom, as it is rising to its maximum height, from a seated position by means of a camera or direct line of sight.

(18) A means of visually identifying the boom extension available shall be provided either by an external marking on the boom or a display in the cab visible to the vehicle operator.

~~A.4.19.6~~

~~The need for a primary turret extendable to replace conventional turrets as the principal fire extinguishing agent applicator on ARFF vehicles has been recognized for over two decades. Equipment intended to provide this capability for ARFF vehicles has been developed and is operationally practical in the ARFF service environment.~~

~~The intent of the requirements of 4.19.6 is to provide minimum performance criteria so that there is no degradation in basic turret performance, while allowing individual flexibility for specific user needs. These needs can be affected by the type of aircraft being protected, the ability to access the aircraft interior, and the ability to access shielded fires.~~

~~The extendable turret can be used for primary agent application as part of a first-arriving vehicle. As such, the vehicle should be capable of applying agent quickly without the need to deploy supporting outriggers. In the future, other design features or functions might be incorporated. For example, some devices for use in accessing the interior cabin after fire knockdown might be incorporated. These devices might or might not require stabilizing devices; depending on the function of the vehicle, the time to deploy such devices might be permitted. In any event, there should be a maximum time for total deployment of the boom/tower device. A maximum of 30 seconds is recommended. The requirements do not prohibit the development of an advanced device or a unit with a different function, recognizing that the primary turret performance should not be compromised.~~

~~It is not recommended that agent be applied from a vertically extended position before knockdown of the exterior exposure fire, unless the fire cannot otherwise be accessed. Data from demonstrations of extendable turrets, plus data from earlier turret testing, suggest that AFFF discharged at a low level is the most effective technique. The extendable turret should be designed to extend below the primary level of the cab to take advantage of low-level AFFF application. Extension of the extendable turret below the cab level also should provide advantages in accessing shielded/obstructed areas, such as in wheel-well incidents and “gear down” scenarios.~~

~~To improve operator efficiency, the movement of the boom/tower should be accomplished with a single lever located within the cab. Elevation/azimuth indicators are not needed if the turret is in the line of sight of the operator.~~

~~Where specified, the extendable turret should be fitted with the appropriate tools/devices needed for a driver/operator to perform interior aircraft and tail-mounted engine fire-fighting functions remotely. These could include a skin penetrator/agent applicator for penetration of the fuselage to access interior fires from outside the aircraft. Where a penetrator/agent applicator is used, a minimum flow equal to two handlines (as specified in 4.17.4.3) is recommended. Airports planning to use the device for indirect attack with a skin penetrator should preplan appropriate access locations on aircraft served and the conditions under which the device is to be used.~~

4.19.6.1

If specified by the purchaser as the primary water-foam and dry chemical turret — that is, to function as a dual agent turret system — the device shall also be capable of meeting the agent discharge performance of Table 4.1.1.2(c) and Table 4.1.1.2(d) while in the bedded position.

4.19.6.2

An adjustable or dual flow rate nozzle shall be provided that will allow flow rates and patterns for interior aircraft fire fighting *[see Table 4.1.1.2(c) and Table 4.1.1.2(d)]*.

Global SR-7

4.19.6.3

Where specified, the ~~extendable~~boom-mounted turret shall be fitted with controls, accessories, and devices needed for a driver or another operator to remotely perform the interior aircraft and highest engine fire-fighting functions.

4.19.6.4

Where auxiliary agent lines are specified, they shall have the following characteristics:

(1) Be capable of discharging either dry chemical, halocarbon agent, or approved equivalent through the nozzle while the device is extended out and up to its maximum operational reach

(2) Meet the minimum auxiliary agent flow rate and pattern requirements of Table 4.1.1.2(c) and Table 4.1.1.2(d)

4.19.6.5

Where remote color optics are specified the following shall apply:

(1) They shall be capable of permitting overall fire scene surveillance when fully extended and provide the driver/operator with the detail needed for placement of the piercing device on the aircraft hull for penetration.

(2) The camera and associated lighting shall be designed and installed for exterior environmental operating conditions encountered by ARFF vehicles.

(3) A monitor 178 mm (7 in.) or larger shall be cab-mounted and viewable from the driver/operator position.

4.19.6.6

Where a piercing nozzle/agent applicator is specified, it shall be movable in conjunction with the water-foam nozzle to allow placement of the nozzle control and be capable of the minimum water-foam flow rate and pattern requirements of Table 4.1.1.2(c) and Table 4.1.1.2(d).

4.19.6.7*

The piercing nozzle shall be capable of a minimum flow rate of 946 L/min (250 gpm).

4.19.6.8

The nozzle system shall be constructed to direct or spray agent and water on both sides of the aircraft at the same time after the penetration is made.

4.19.6.9

Concept of delivery shall be multiple holes causing a spray that covers an area of at least 7.6 m (25 ft) along the length of the fuselage left and right of the penetration point.

4.19.6.10

The point of penetration shall be visible to the driver/operator either by direct line of sight or by remote optics for any piercing position on the aircraft as defined by the manufacturer.

4.19.6.11

The piercing nozzle shall be capable of piercing the aircraft fuselage over the wing area at angles up to 30 degrees left or right of the vehicle centerline in the event that the interior fire is located in this area.

Global SR-7

4.19.6.12

The ~~extendable~~boom-mounted turret with piercing nozzle shall have the ability to perform a multi-axis, multifunction boom operation with penetration and agent flowing at the penetration point (above the windows and below the overhead stowage bins) of a single passenger deck aircraft in less than 45 seconds.

4.19.6.13

For devices designed to reach the second level of a multilevel passenger aircraft, the same function at the second level shall be achieved in less than 60 seconds.

Submitter Information Verification

Committee: AIR-AAA

Submittal Date: Wed Aug 29 10:36:12 EDT 2018

Committee Statement

Committee Statement: This change better describes the differences between the two boom styles outlined in 4.19.6 and 4.19.7.

Response Message: SR-2-NFPA 414-2018

Public Comment No. 2-NFPA 414-2018 [Section No. 4.19.7]

Second Revision No. 3-NFPA 414-2018 [Section No. 4.19.7]

4.19.7

~~Lightweight boom-mounted turrets shall be permitted as primary turrets. These turrets shall meet~~ <u>If the boom-mounted turret is on a non-rotational base, it shall meet</u> the following design and functional requirements:

(1) ~~They shall meet~~ <u>Meet</u> the requirements of 4.3.1.3 and 4.3.1.5 while in the stowed position.

(2) ~~They shall achieve~~ <u>Achieve</u> a 20 percent side slope with the boom ~~turret~~ fully elevated and the nozzle fully rotated uphill at maximum horizontal rotation while discharging at maximum flow rate.

(3) ~~Flow~~ <u>If the non-rotational boom-mounted turret is the primary turret, its flow</u> rates shall be in accordance with Table 4.1.1.2(c) and Table 4.1.1.2(d) for major vehicles.

(4) ~~They shall~~ <u>If the non-rotational boom-mounted turret is the primary turret, it shall</u> meet the primary water-foam agent turret discharge requirements of Table 4.1.1.2(c) and Table 4.1.1.2(d) for the applicable vehicle class while in the bedded condition.

(5) ~~They shall meet~~ <u>Meet</u> the foam quality standard of NFPA 412, Chapter 5.

(6) ~~They shall function~~ <u>Function</u> during ARFF operations without the need for outriggers or other ground contact stabilizers that could render the vehicle immobile or hinder its maneuverability.

(7) The ~~primary turret~~ <u>boom</u> shall have a deployment time from the bedded position to maximum height and start the application of agent within 30 seconds.

(8) ~~They shall be~~ <u>Be</u> capable of applying agent through passenger doorways, to interior areas of the type of aircraft being protected.

(9) The device shall permit the operator to position the nozzle assembly so as to be able to discharge the agent in front of the vehicle at a level that permits the operator to see over the turret discharge.

(10) ~~They shall have~~ <u>Have</u> a range of motion so as to permit positioning of the nozzle to direct a fire-fighting agent stream along the longitudinal axis of the fuselage or up to 90 degrees to the longitudinal axis for interior fire ~~extinguishments~~ <u>extinguishing</u> .

~~**A.4.19.7**~~

~~A lightweight boom-mounted turret is a primary turret mounted on a lightweight boom that is capable of being elevated and depressed to apply agent to aircraft engines, doorways, and emergency exits. Lightweight boom-mounted turrets differ from extendable turrets in that they do not need turntables. Responsive vehicle suspension, steering systems, and drive systems are used to locate the turret more directly and more rapidly.~~

Submitter Information Verification

Committee: AIR-AAA

Submittal Date: Wed Aug 29 10:50:54 EDT 2018

Committee Statement

Committee Statement: This change better describes the differences between the two boom styles outlined in 4.19.6 and 4.19.7.

Response Message: SR-3-NFPA 414-2018

<u>Public Comment No. 3-NFPA 414-2018 [Section No. A.4.19.7]</u>

Second Revision No. 8-NFPA 414-2018 [Section No. 6.3]

Global SR-7

6.3 Prototype Vehicle Tests.

Where the vehicle is fitted with ~~an extendable~~ a boom-mounted turret, the test shall be conducted with the ~~extendable~~ boom-mounted turret in the stowed position.

6.3.1

~~Changes to a vehicle design that qualify the vehicle for prototype testing shall include the following:~~ When a new model or vehicle type is designed, each variant of the vehicle shall be tested to all prototype and operational tests as specified in Sections 6.3 and 6.4 .

~~Changes in engine horsepower~~

~~Changes in drive train~~

~~Chassis/suspension~~

~~Water pump~~

~~Primary fire-fighting system~~

6.3.2

~~Where the vehicle is fitted with an extendable turret, the test shall be conducted with the extendable turret in the stowed position.~~ If sub-system changes are made to a current vehicle model, the vehicle shall be tested to the applicable prototype and operational tests related to that area of the vehicle as specified in 6.3.2.1 through 6.3.2.5 .

6.3.2.1

Changes in engine horsepower of 3 percent or greater shall require the following tests:

(1) Pump and roll on 40 percent grade

(2) Gradeability

(3) Acceleration

(4) Top speed

(5) Agent discharge pumping

(6) Dual pumping discharge

(7) Pump and maneuver

(8) Primary turret flow

6.3.2.2

Changes in drive train components, including transmission, transfer case, water pump drive, axles, or brake system components, shall require the following tests:

(1) Pump and roll on 40 percent grade

(2) Gradeability

(3) Service/emergency brake

(4) Service/parking brake holding

(5) Side slope

(6) Weight/weight distribution

(7) Acceleration

(8) Top speed

(9) Brake operational

(10) Agent discharge pumping

(11) Pump and maneuver

(12) Primary turret flow

6.3.2.3

Changes in chassis/suspension components, including cab, steering system, suspension supplier, suspension rating, or suspension type, shall require the following tests:

(1) Cornering stability

(2) Vehicle dimensions

(3) Driver vision

(4) Electrical charging system

(5) Radio suppression

(6) Body and chassis flexibility

(7) Steering control

(8) Vehicle clearance circle

(9) Warning siren

(10) Cab interior noise

(11) Side slope

(12) Weight/weight distribution

(13) Brake operational

(14) Air system/air compressor

6.3.2.4

Changes to the water pump shall require the following tests:

(1) Pump and roll on 40 percent grade

(2) Agent pump(s)/tank vent discharge

(3) Primary turret flow rate

(4) Handline nozzle flow rate

(5) Ground sweep/bumper turret flow rate

(6) Undertruck nozzle

(7) Dry chemical turret flow rate and range

(8) Agent discharge pumping

(9) Dual pumping system

(10) Foam concentration

(11) Primary turret flow

6.3.2.5

Changes in primary fire-fighting systems, including water tank design, piping layout, pressure relief system, foam mixing system, discharge(s), control systems, or secondary agent systems shall require the following tests:

(1) Rated water and foam tank capacity

(2) Agent pump(s)/tank vent discharge

(3) Water tank fill and overflow

(4) Flushing system

(5) Primary turret flow rate

(6) Primary turret pattern

(7) Primary turret control force measurement

(8) Primary turret articulation

(9) Handline nozzle flow rate

(10) Handline nozzle pattern

(11) Ground sweep/bumper turret flow rate

(12) Ground sweep/bumper turret pattern

(13) Undertruck nozzle

(14) Foam concentration/foam quality

(15) Propellant gas

(16) Pressure regulation

(17) AFFF premix piping and valves

(18) Pressurized agent purging and venting

(19) Complementary agent handline flow rate and range

(20) Dry chemical turret flow rate and range

(21) Side slope

(22) Weight/weight distribution

(23) Acceleration

(24) Agent discharge pumping

(25) Dual pumping system

(26) Foam concentration

(27) Primary turret flow

(28) Piercing/penetrating nozzle

6.3.3

Adding a boom-mounted turret to a vehicle shall deem it as a new model and require all prototype tests.

6.3.4

Unless otherwise stated for testing, if the vehicle is fitted with a boom-mounted turret, the test shall be conducted with the boom-mounted turret in the stowed position.

6.3.5*

The prototype vehicle tests shall be completed in the vehicle's largest capacity configuration.

A.6.3.5

The maximum capacity configuration includes all agent tanks full of agent, and all compartments loaded with the maximum allowable weight.

6.3.6* Rated Water and Foam Tank Capacity Test.

6.3.6.1

Test equipment shall consist of the following:

(1) Calibrated sight gauge

(2) Liquid volume measuring device accurate to within ±1.0 percent

(3) Alternative: A stopwatch and a scale capable of measuring the total vehicle weight accurate to within ±1.0 percent

6.3.6.2

The rated water and foam tank capacity shall be determined as follows:

(1) Park the vehicle on level ground.

(2) If necessary, attach a calibrated site gauge to both the water tank and the foam tank.

(3) Fill the water piping up to a level even with the bottom of the tank. Do not record the water quantity used.

(4) While filling both tanks with a liquid volume measuring device, correlate and record the amount of water added to each tank with the site gauge calibrations. When the tanks are filled to the top, record the total liquid capacity for each tank.

(5) Alternative: After completion of (3), record the weight of the vehicle. Fill the water tank and foam tank and record the weight of the vehicle.

(6) Add dye to the foam tank.

(7) Set the agent system to discharge at the specified foam solution rate, and adjust the system discharge pressure to the recommended pressure.

(8) Starting with tanks that are completely full, discharge at maximum rate through the primary turret(s) until the agent pump(s) shows a drop in discharge pressure, and then stop immediately. Verify that dye is apparent in the discharge stream throughout the test. Record the discharge time if using the weight measurement method.

(9) Alternative: Record the weight of the vehicle after discharging. Calculate the pump-out capacity of the water tank using the weight of the water plus the foam discharged, the foam proportioning rate, and the discharge time, as previously verified.

(10) Measure the amount of liquid remaining in both tanks and convert to liters (gallons) using the conversion established in 6.3.6.2(5). Subtract the amount remaining from the total capacity to determine the amount pumped out. Record the total amount of liquid pumped out of the tanks.

(11) Refill the water tank only (not the foam tank). Discharge the water tank as in 6.3.6.2(8). Verify that dye is apparent throughout the test. Measure and record the additional amount of liquid discharged from the foam tank. Fill the water tank and discharge as many times as necessary to eliminate all usable liquid from the foam tank.

(12) Total and record the amount of liquid discharged from the foam tank from the time of initial fill.

(13) Refill both tanks and repeat 6.3.6.2(6) through 6.3.6.2(11) with the vehicle parked in the following attitudes:

  (a) 20 percent side slope, left side up

  (b) 20 percent side slope, right side up

  (c) 30 percent slope, ascending

  (d) 30 percent slope, descending

(14) After pumping on a slope, with the vehicle in each of the four slope conditions, return the vehicle to level ground to measure the water volume discharged.

(15) Divide the volume of liquid discharged from each tank on the four slope conditions by 0.85 and record.

6.3.6.3

The rated or usable water tank capacity shall be the lesser of the volumes calculated in 6.3.6.2(10) or 6.3.6.2(14).

6.3.6.4

The rated or usable foam tank capacity shall be the lesser of the volumes calculated in 6.3.6.2(12) and 6.3.6.2(14).

6.3.7* Cornering Stability.

6.3.7.1

A calibrated speedometer and a means of indicating steering wheel angle shall be required.

6.3.7.2

The vehicle shall be tested in its fully loaded condition.

6.3.7.3

A speed as outlined in Table 4.1.1.2(a) and Table 4.1.1.2(b) shall be obtained and maintained for one full revolution of the circle in accordance with SAE J2181, as follows:

(1) Slowly drive the vehicle around the 30.5 m (100 ft) radius circle while keeping the centerline of the front of the vehicle directly over the marked line.

(2) Establish a reference position on the steering wheel position indicator at a slow speed.

(3) Gradually increase the speed until the maximum speed is reached.

(4) Record the maximum speed and the corresponding position of the steering wheel.

(5) Repeat 6.3.7.3(1) through 6.3.7.3(4) while driving the vehicle in the opposite direction.

6.3.7.4

The speed achieved shall be in accordance with Table 4.1.1.2(a) and Table 4.1.1.2(b).

6.3.7.5

A double lane change test shall be conducted as follows:

(1) The vehicle shall be driven through the cones at a 40 kph (25 mph) speed in two directions.

(2) This test shall be accomplished for all prototype first article vehicles only.

(3) The vehicle shall be fully loaded and equipped for this test.

6.3.7.5.1 Test Conditions.

Wind speed shall be ≤3 m/s (≤6.7 mph).

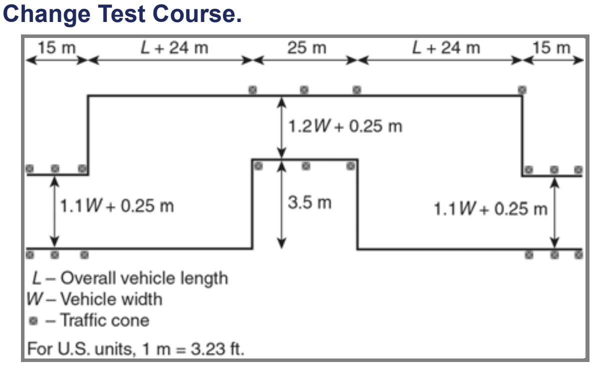
6.3.7.5.2 Test Surface.

The test surface shall be a large uniform paved surface that is hard and level with a slope of ≤2 percent in all directions with a coefficient of friction of ≥0.7 and shall be dry, clean of debris, and large enough to ensure test area safety.

6.3.7.5.3 Test Track Dimensions.

The double lane change track dimensions shall be as shown in Figure 6.3.7.5.3, and traffic cones shall mark the corners as shown in Figure 6.3.7.5.3.

Figure 6.3.7.5.3 Lane Change Test Course.



6.3.7.5.4 Test Procedure.

The test procedure shall be as follows:

(1) The operator shall drive through the first section, keeping the speed as steady as possible while driving the entire test track.

(2) The operator shall repeat the test at various speed increments until one of the following occurs:

   (a) The maximum speed for the test as specified in Table 4.1.1.2(a) and Table 4.1.1.2(b) is completed.

   (b) The limit of the vehicle's stability is attained.

   (c) It becomes impossible to cross the test track without knocking the traffic cones down.

(3) The parameters and the vehicle's behavior during the test shall be recorded.

(4) The test shall be repeated in the opposite direction.

(5) The entire test shall be repeated by a different driver.

6.3.7.5.5 Data Documentation.

The following data from the test shall be documented:

(1) Characteristics of the test surface and the test dimensions

(2) Test number

(3) Direction of test

(4) Speed of test

(5) Vehicle behavior

(6) Number and position of the cones knocked down

6.3.7.6

The vehicle shall demonstrate the ability to traverse the "J" turn test in both directions on smooth, level pavement without the brakes being applied.

6.3.8* Vehicle Dimensions.

6.3.8.1

Test equipment shall consist of a tape measure and a protractor.

6.3.8.2

The vehicle shall be tested in its fully loaded condition with tires inflated to their recommended operating pressure.

6.3.8.3

The following vehicle dimensions shall be measured in accordance with their definitions, with the vehicle positioned on the flat pad:

(1) Angle of approach

(2) Angle of departure

(3) Interaxle clearance angle

(4) Underbody clearance

(5) Underaxle clearance

6.3.8.4

Linear dimensions shall be rounded down to the nearest 12.7 mm (½ in.), and angular dimensions shall be rounded down to the nearest ½ degree.

6.3.9* Driver Vision Measurement.

6.3.9.1

Test equipment shall consist of a plumb bob, a tape measure, and a protractor or an inclinometer.

6.3.9.2

The vehicle shall be tested in its fully loaded condition, with tires inflated to their recommended operating pressure.

6.3.9.3

The driver's range of visibility shall be determined as follows:

(1) Adjust the driver's seat to its mid position with respect to height, weight, and fore and aft adjustments.

(2) Place a structure on the seat cushion for locating an eye height of 806.5 mm (31¾ in.) and a position 304.8 mm (12 in.) forward from the seat back. Place the seat back in a vertical position.

(3) Establish the features that limit the upward and downward line of vision that are located directly in front of the driver’s seat.

(4) Measure and record the angle above the horizon at which upward vision is obstructed from the eye height point established in 6.3.9.3(2).

(5) Establish the lowest possible line of vision below the horizon directly in front of the eye height point and project this line forward of the cab until it intersects with the ground. Project this line of vision by using a light beam, or, if the windshield is removed, use a string line. Measure and record the distance from this intersection with the ground and the front face of the bumper at the front of the truck.

(6) Stretch a line from the eye height point laterally across the cab in order to establish and record the 90 degree line of vision to the left and right of the straight ahead position. Note obstructions within these angles.

6.3.9.4

The recorded values for the distance at which the line of vision meets the ground in front of the truck and the angle of vision above the horizon shall equal or exceed the vehicle's specification.

6.3.9.5

Obstacles within the 90 degree horizontal line of vision to the right or left shall not create an obstruction of more than 7 degrees per obstruction.

6.3.10* Pump and Roll on a 40 Percent Grade.

6.3.10.1

Test equipment shall consist of the following:

(1) Calibrated speedometer

(2) Vehicle-equipped pump pressure gauge

(3) Load cell accurate to within ±227 kg (±500 lb) (applicable only to the alternate drawbar method)

(4) Variable load dynamometer sled (applicable only to the alternate drawbar method)

6.3.10.2

The vehicle shall have had its primary turret(s) discharge rate and pressure verified, with vehicle in its fully loaded condition with tires inflated to their recommended operating pressure, prior to beginning this test to ensure that the turret(s) discharges at or above the minimum rate specified.

6.3.10.3

The capability of the vehicle to ascend, stop, start, and continue ascent on a 40 percent grade without interruption in the discharge rate shall be demonstrated either on an actual grade or by means of an equivalent drawbar test as follows:

(1) Fill both the water and foam tanks with water and add dye to the foam tank.

(2) Set the agent system to discharge in the foam mode and set the system discharge pressure for optimum performance.

(3) Position the vehicle at the bottom of a 40 percent grade and initiate discharge at full output through the primary turret nozzles. Verify that dye is apparent in the discharge stream throughout the test.

(4) Initiate the vehicle's ascent of the grade and achieve a speed of at least 1.6 kph (1 mph). During the ascent, bring the vehicle to a stop and resume the ascent at a speed of at least 1.6 kph (1 mph) without interruption in the discharge stream. Record the vehicle speed and any variation in discharge pressure.

(5) If an actual 40 percent grade is not available, repeat 6.3.10.3(1) through 6.3.10.3(4) with the vehicle coupled to a 40 percent grade equivalent drawbar load determined as follows:

  (a) A 40 percent grade — 21.8 degree angle

  (b) The loaded vehicle weight × sin 21.8 degrees (0.371), which equals the necessary drawbar pull to simulate ascending a 40 percent grade

  (c) The area of the load cell, which can be determined at the time of the test

  (d) The load cell reading, in kPa (psi), that simulates a 40 percent grade, which can be calculated by the following:

$$\text{load cell reading} = \frac{\sin 21.8 \text{ degrees } \times \text{ vehicle weight}}{\text{area of load cell}} \qquad \textbf{[6.3.10.3]}$$

6.3.10.4

The vehicle shall negotiate the grade or drawbar pull smoothly while maintaining an operating pressure of at least 50 percent of the specified design pressure for the primary turret(s) at speeds of at least 1.6 kph (1 mph).

6.3.11* Electrical Charging System.

6.3.11.1

Test instrumentation shall consist of the following:

(1) A laboratory-quality voltmeter with a scale range compatible with the design voltage of the vehicle's electrical system

(2) The scale on the voltmeter graduated to allow reading voltages with a ±0.1 volt accuracy

(3) A laboratory-quality ammeter with a scale range compatible with the anticipated electrical load present on the vehicle

(4) The ammeter graduated to allow reading current flow within a ±3 percent accuracy

(5) Confirmation that the tachometer is installed in the vehicle.

6.3.11.2

The test vehicle shall be tested with the following:

(1) A fully charged set of batteries

(2) Fully operational electric and charging systems

(3) Testing temperature ranges of 10°C to 32.2°C (50°F to 90°F)

6.3.11.3 Electrical System Performance Tests.

6.3.11.3.1

The fire apparatus low voltage electrical system shall be tested as required by this section, and its subsections. [**1901:**13.14.1]

6.3.11.3.2

Tests shall be performed when the air temperature is between –18°C and 43°C (0°F and 110°F). [**1901:**13.14.2]

6.3.11.3.3 Test Sequence.

6.3.11.3.3.1*

The three tests defined in 6.3.11.3.3.2 through 6.3.11.3.3.4(D) shall be performed in the order in which they appear. [**1901:**13.14.3.1]

(A)

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. [**1901:**13.14.3.1.1]

(B)

Failure of any of these tests shall require a repeat of the sequence. [**1901:**13.14.3.1.2]

6.3.11.3.3.2 Reserve Capacity Test.

(A)

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. [**1901:**13.14.3.2.1]

(B)

The engine shall be shut off, and the minimum continuous electrical load shall be activated for 10 minutes. [**1901:**13.14.3.2.2]

(C)

All electrical loads shall be turned off prior to attempting to restart the engine. [**1901:**13.14.3.2.3]

(D)

The battery system shall then be capable of restarting the engine. [**1901:**13.14.3.2.4]

(E)

Failure to restart the engine shall be considered a test failure of the battery system. [**1901:**13.14.3.2.5]

6.3.11.3.3.3 Alternator Performance Test at Idle.

(A)

The minimum continuous electrical load shall be activated with the engine running at idle speed. [**1901:**13.14.3.3.1]

(B)

The engine temperature shall be stabilized at normal operating temperature. [**1901:**13.14.3.3.2]

(C)

The battery system shall be tested to detect the presence of battery discharge current. [**1901:**13.14.3.3.3]

(D)

The detection of battery discharge current shall be considered a test failure. [**1901:**13.14.3.3.4]

6.3.11.3.3.4 Alternator Performance Test at Full Load.

(A)

The total continuous electrical load shall be activated with the engine running up to the engine manufacturer's governed speed. [**1901:**13.14.3.4.1]

(B)

The test duration shall be a minimum of 2 hours. [**1901:**13.14.3.4.2]

(C)

Activation of the load management system shall be permitted during this test. [**1901:**13.14.3.4.3]

(D)

An alarm sounded by excessive battery discharge, as detected by the warning system required in 13.3.4 [of NFPA 1901], or a system voltage of less than 11.8 V dc for a 12 V nominal system, 23.6 V dc for a 24 V nominal system, or 35.4 V dc for a 42 V nominal system for more than 120 seconds shall be considered a test failure. [**1901:**13.14.3.4.4]

6.3.11.3.4 Low Voltage Alarm Test.

6.3.11.3.4.1

The following test shall be started with the engine off and the battery voltage at or above 12 V for a 12 V nominal system, 24 V for a 24 V nominal system, or 36 V for a 42 V nominal system. [**1901:**13.14.4.1]

6.3.11.3.4.2

With the engine shut off, the total continuous electrical load shall be activated and shall continue to be applied until the excessive battery discharge alarm activates. [**1901:**13.14.4.2]

6.3.11.3.4.3

The battery voltage shall be measured at the battery terminals. [**1901:**13.14.4.3]

6.3.11.3.4.4

The test shall be considered a failure if the alarm does not sound in less than 140 seconds after the voltage drops to 11.70 V for a 12 V nominal system, 23.4 V for a 24 V nominal system, or 35.1 V for a 42 V nominal system. [**1901:**13.14.4.4]

6.3.11.3.4.5

The battery system shall then be able to restart the engine. [**1901:**13.14.4.5]

6.3.11.3.4.6

Failure to restart the engine shall be considered a test failure. [**1901:**13.14.4.6]

6.3.11.3.5 Documentation.

The manufacturer shall deliver the following with the fire apparatus:

(1) Documentation of the electrical system performance tests

(2) A written electrical load analysis, including the following:

    (a) The nameplate rating of the alternator

    (b) The alternator rating under the conditions specified in 13.3.2 [of NFPA 1901]

    (c) Each of the component loads specified in 13.3.3 [of NFPA 1901] that make up the minimum continuous electrical load

    (d) Additional electrical loads that, when added to the minimum continuous electrical load, determine the total continuous electrical load

    (e) Each individual intermittent electrical load

[**1901:**13.15]

6.3.11.4

The electrical system performance shall be compared as follows:

(1) Against the specification at engine idle

(2) Also at 50 percent of engine rpm

6.3.11.5

The measured voltage of the batteries shall remain above 13 volts (for a 12-volt system) and 26 volts (for a 24-volt system) at all times while the alternator is running.

6.3.12* Radio Suppression.

6.3.12.1

Test equipment shall be in accordance with SAE J551/1 or the equivalent standard being used.

6.3.12.2

The vehicle shall be configured with all standard electrical features mounted and operational.

6.3.12.2.1

During the tests, all vehicle engines shall be operated at idle.

6.3.12.2.2

All vehicle-mounted electrical devices functioning at the crash site shall be turned on with the following stipulations:

(1) All vehicle lighting shall be on.

(2) All heating, defrosting, and air-conditioning systems, or as many systems as possible, shall be on with their respective fans adjusted to the maximum speed setting.

(3) Complementary power-generating devices (where applicable) shall be running.

(4) Intermittent warning devices, such as hazard flashers, warning buzzers, and horns, shall be turned off.

6.3.12.3

The vehicle shall be tested in accordance with SAE J551/1 or the equivalent standard being used.

6.3.12.4

The results of the test shall be evaluated in accordance with SAE J551/1 or the equivalent standard being used.

6.3.13* Gradeability Test.

6.3.13.1

Test equipment shall consist of the following:

(1) Load cell accurate to within ±227 kg (±500 lb) (applicable only to the alternate drawbar method)

(2) Variable load dynamometer sled (applicable only to the alternate drawbar method)

6.3.13.2

The vehicle shall be tested in its fully loaded condition with tires inflated to their recommended operating pressure.

6.3.13.3

The capability of the fully loaded vehicle to ascend a 50 percent grade shall be demonstrated either on an actual grade or by means of an equivalent drawbar pull test. If an actual 50 percent grade is not available, then the vehicle shall be coupled to a 50 percent equivalent drawbar load, determined as follows:

(1) A 50 percent grade — 26.57 degree angle

(2) The loaded vehicle weight × sin 26.57 degrees (0.447), which equals the necessary drawbar pull to simulate ascending a 50 percent grade

(3) The area of the load cell, determined at the time of the test

(4) The load cell reading, in kPa (psi), that simulates a 50 percent grade, which can be calculated by the following:

$$\text{load cell reading} = \frac{\sin 26.57 \text{ degrees} \times \text{vehicle weight}}{\text{area of load cell}} \quad [6.3.13.3]$$

6.3.13.4

The vehicle shall negotiate the grade or draw pull smoothly.

6.3.14* Body and Chassis Flexibility Test.

6.3.14.1

Test equipment shall consist of two to four 355.6 mm (14 in.) ramps with flat tops large enough for the tire footprint and graduated on both sides to allow the vehicle to ascend and descend.

6.3.14.2

The vehicle shall be tested in its fully loaded condition with tires inflated to their recommended operating pressure.

6.3.14.3

The vehicle shall be tested as follows:

(1) For a 4 × 4, drive the fully loaded vehicle onto 355.6 mm (14 in.) blocks positioned under the diagonally opposite front and rear wheels. For a 6 × 6, block positions correspond to axle 1 and axle 3. For an 8 × 8, block positions correspond to axle 1 and axle 4.

(2) With the vehicle in the position given in 6.3.14.3(1), take the following steps:

 (a) Inspect the vehicle thoroughly to ensure that there are no sheet metal interferences and that all moving parts are free to function.

 (b) Demonstrate all systems to ensure that they function, including discharge from all orifices.

(3) For vehicles with bogie-type construction, add a block under the second wheel of the bogie axle(s) so that both wheels on one side of the bogie are elevated simultaneously and diagonally opposite front and rear, and then repeat 6.3.14.3(2)(a) and 6.3.14.3(2)(b).

(4) Switch the blocks to the opposite sides of the truck and repeat 6.3.14.3(1) through 6.3.14.3(3).

6.3.14.4

No moving part shall interfere with another.

6.3.14.4.1

If component contact should occur, it shall in no way damage the component or detract from the vehicle's ability to carry out its mission.

6.3.14.4.2

No clearance shall be permitted between any tire and its supporting surface.

6.3.15* Service/Emergency Brake Test.

6.3.15.1

Instrumentation shall consist of the following:

(1) Calibrated fifth-wheel-type speed measuring device that is accurate to within ±0.8 kph (±0.5 mph) or ±0.5 percent of the actual vehicle speed

(2) Ground speed readout device controlled by the fifth wheel

(3) Trigger device that detects brake pedal movement

(4) Strip chart recording distance traveled, vehicle speed, and the point at which actuation of the brake system occurs

6.3.15.2

The vehicle shall be tested in its fully loaded condition with the brakes adjusted and the tires inflated to the vehicle manufacturer's specifications.

6.3.15.2.1

The brakes shall have been burnished to ensure repeatable results.

6.3.15.3

The service and emergency brake stopping distances shall be determined in the following manner:

(1) While traveling down the center of the lane established by the width of the vehicle plus 1.2 m (4 ft), attain a speed slightly above the desired test speed and release the throttle.

(2) With the strip chart recorder running, at the instant that the vehicle reaches the desired test speed, actuate the brake pedal as if in a panic stop and continue applying the brakes until the vehicle comes to a complete stop. While stopping, modulate the brake pedal as necessary to maintain vehicle control. Record the distance traveled from the time that the brake pedal is applied to the time that the vehicle comes to rest.

(3) Observe whether or not the vehicle leaves the established lane during the brake stop.

(4) Repeat 6.3.15.3(1) through 6.3.15.3(3) for a total of five stops from each test speed.

(5) Repeat 6.3.15.3(1) through 6.3.15.3(4) to obtain results at speeds of 32.2 kph (20 mph) and 64.4 kph (40 mph).

(6) Disable the front service brakes and repeat 6.3.15.3(1) through 6.3.15.3(4) at a test speed of 64.4 kph (40 mph).

(7) Reconnect the front service brakes and disable the rear service brakes and repeat 6.3.15.3(1) through 6.3.15.3(4) at a test speed of 64.4 kph (40 mph).

6.3.15.3.1

Items 6.3.15.3(6) and 6.3.15.3(7) shall not be applicable to commercial chassis.

6.3.15.4

Each of the recorded stops shall be within the specified distance without any part of the vehicle leaving the established test lane.

6.3.16* Service/Parking Brake Grade Holding Test.

6.3.16.1

Test equipment shall consist of the following:

(1) Load cell accurate to within ±227 kg (±500 lb) (applicable only to the alternate drawbar method)

(2) Variable load dynamometer sled (applicable only to the alternate drawbar method)

6.3.16.2

The vehicle shall be tested in its fully loaded condition with the brakes adjusted and the tires inflated to the vehicle manufacturer's specifications.

6.3.16.2.1

The brakes shall have been burnished to ensure repeatable results.

6.3.16.3

The capability of the vehicle's parking brake to hold the vehicle stationary on a 20 percent grade shall be demonstrated either on an actual grade or by means of an equivalent drawbar pull test. If an actual 20 percent grade is available, the tests shall be conducted as follows:

(1) Drive the vehicle in a forward direction onto the 20 percent grade, stop, and set the parking brake.

(2) Shift the transmission to neutral, and release the service brakes and verify that there is no wheel rotation.

(3) Repeat (1) and (2) with the vehicle facing the opposite direction.

6.3.16.3.1

If an actual 20 percent grade is not available, the tests shall be conducted as follows:

(1) Drive the vehicle onto the level test pad. Shift the transmission to neutral.

(2) Couple the vehicle to the horizontal force device so that forward drawbar force can be generated. Release the parking brake.

(3) Pull the vehicle forward at a speed of at least 1.6 kph (1 mph). As the vehicle is being pulled, apply the parking brake until a 20 percent equivalent drawbar is generated. A 20 percent equivalent drawbar load is determined as follows:

(a) A 20 percent grade — 11.31 degree angle

(b) The loaded vehicle weight × sin 11.31 degrees (0.196), which equals the necessary drawbar pull to simulate holding on a 20 percent grade

(c) The area of the load cell, determined at the time of the test

(d) The load cell reading, in kPa (psi), that simulates a 20 percent grade, calculated by the following:

$$\text{load cell reading} = \frac{\sin 11.31 \text{ degrees} \times \text{vehicle weight}}{\text{area of load cell}} \quad \textbf{[6.3.16.3.1]}$$

6.3.16.4

The capability of the vehicle's service brake to hold the vehicle stationary on a 50 percent grade shall be demonstrated either on an actual grade or by means of an equivalent drawbar pull test. If an actual 50 percent grade is available, the tests shall be conducted as follows:

(1) Drive the vehicle in a forward direction onto the 50 percent grade, apply the service brakes, and shift the transmission to neutral.

(2) Verify there is no wheel rotation.

(3) Repeat 6.3.16.4(1) and 6.3.16.4(2) with the vehicle facing the opposite direction.

6.3.16.4.1

If an actual 50 percent grade is not available, the tests shall be conducted as follows:

(1) Drive the vehicle onto the level test pad. Shift the transmission to neutral.

(2) Couple the vehicle to the horizontal force device so that forward drawbar force can be generated. Release the parking brake.

(3) Pull the vehicle forward at a speed of at least 1.6 kph (1 mph). As the vehicle is being pulled, apply the service brakes until a 50 percent equivalent drawbar is generated. A 50 percent equivalent drawbar load is determined as follows:

(a) A 50 percent grade — 26.57 degree angle

(b) The loaded vehicle weight × sin 26.57 degrees (0.447), which equals the necessary drawbar pull to simulate holding on a 50 percent grade

(c) The area of the load cell, determined at the time of the test

(d) The load cell reading, in kPa (psi), that simulates a 50 percent grade, calculated by the following:

$$\text{load cell reading} = \frac{\sin 26.57 \text{ degrees} \times \text{vehicle weight}}{\text{area of load cell}} \quad \textbf{[6.3.16.4.1]}$$

(4) Repeat 6.3.16.4.1(1) through 6.3.16.4.1(3) with a drawbar force applied in the rearward direction.

6.3.16.5

The capability of the vehicle's service brake to hold the vehicle stationary on a 20 percent grade shall be demonstrated either on an actual grade or by means of an equivalent drawbar pull test. If an actual 20 percent grade is available, the tests shall be conducted as follows:

(1) Drive the vehicle in a forward direction onto the 20 percent grade, apply the service brakes, and shift the transmission to neutral.

(2) Verify that there is no wheel rotation.

(3) Repeat 6.3.16.5(1) and 6.3.16.5(2) with the vehicle facing the opposite direction.

6.3.16.5.1

If an actual 20 percent grade is not available, the tests shall be conducted as follows:

(1) Drive the vehicle onto the level test pad. Shift the transmission to neutral.

(2) Couple the vehicle to the horizontal force device so that forward drawbar force can be generated. Release the parking brake.

(3) Pull the vehicle forward at a speed of at least 1.6 kph (1 mph). As the vehicle is being pulled, apply the service brakes until a 20 percent equivalent drawbar is generated. A 20 percent equivalent drawbar load is determined as follows:

    (a) A 20 percent grade — 11.31 degree angle

    (b) The loaded vehicle weight × sin 11.31 degrees (0.196), which equals the necessary drawbar pull to simulate holding on a 20 percent grade

    (c) The area of the load cell, determined at the time of the test

    (d) The load cell reading, in kPa (psi), that simulates a 20 percent grade, calculated by the following:

$$\text{load cell reading} = \frac{\sin 11.31 \text{ degrees} \times \text{vehicle weight}}{\text{area of load cell}} \quad [6.3.16.5.1]$$

(4) Repeat 6.3.16.5.1(1) through 6.3.16.5.1(3) with a drawbar force applied in the rearward direction.

6.3.16.6

The brakes shall lock the wheels and hold the vehicle stationary on both the 20 percent and 50 percent grade (or the brakes shall generate an equivalent drawbar pull), with the vehicle pointed either uphill or downhill.

6.3.17* Steering Control Test.

6.3.17.1

Test equipment shall consist of a steering wheel and a torque meter or a spring scale.

6.3.17.2

The vehicle shall be tested in a fully loaded condition with tires inflated to their operating pressure.

6.3.17.3

The vehicle shall be tested as follows:

(1) Set the road wheels in the straight-ahead position; engage neutral, and release the brakes, ensuring that there is no vehicle movement.

(2) With the engine at idle speed, measure and record the force applied to the steering rim that is necessary to turn the steering linkage from stop to stop.

6.3.17.4

The measured force shall not exceed the manufacturer's design specifications.

6.3.18* Vehicle Clearance Circle Test.

6.3.18.1

A tape measure, markers or a marking device, and a calculator shall be required.

6.3.18.2

The vehicle's steering system shall be fully operational, with the steering linkage stops adjusted within the manufacturer's specified production tolerance limits.

6.3.18.3

The vehicle shall be tested as follows:

(1) Drive the vehicle to the end of steering travel, making a left or right turn as necessary, in at least one complete circle to fully “settle” the wheels into their steady-state condition.

(2) Slowly drive the vehicle in the full cramp turn.

(3) Stop the vehicle in three locations around the turning circle, applying the brake smoothly and gradually.

(4) At each stop, mark the outermost projected point of the vehicle on the ground.

(5) Measure and record the straight line distances between the marks for each of the stop locations (length 1, length 2, and length 3).

(6) Calculate the vehicle clearance circle radius (R) as follows:

$$R = \frac{(\text{length 1})(\text{length 2})(\text{length 3})}{4\left[S\ (S - \text{length 1})\ (S - \text{length 2})\ (S - \text{length 3})\right]^{1/2}} \qquad \textbf{[6.3.18.3]}$$

where:
S = (length 1 + length 2 + length 3)/2

(7) Repeat 6.3.18.3(1) through 6.3.18.3(6) while turning the vehicle in the opposite direction.

6.3.18.4

The vehicle's clearance circle diameter (2R) shall be less than three times the maximum overall length of the vehicle.

6.3.19* Agent Pump(s)/Tank Vent Discharge Test.

6.3.19.1

Test equipment shall consist of a liquid level measuring device accurate to within ±1.0 percent.

6.3.19.2

Each discharge nozzle on the vehicle shall have been individually verified as discharging at a flow rate at or above the minimum rate specified when the agent system is operated at the recommended pressure.

6.3.19.3

The test shall be conducted as follows:

(1) Fill the water tank and the foam tank to the top.

(2) Set the foam proportioning system to proportion foams at the concentration specified, and set the agent selector for the foam mode.

(3) Set the agent system pressure relief to the recommended pressure.

(4) Engage the agent pumps, and operate them at maximum pumping speed with all discharge outlets closed.

(5) Simultaneously initiate discharge of the primary turret(s), primary handlines, ground sweeps/bumper turret, and undertruck nozzles. After approximately 75 percent of the contents from the water tank has been discharged, simultaneously stop discharge through all nozzle outlets. Record the time of discharge.

(6) Measure and then add together the total amount of liquid discharged from the water tank and the foam tank. Calculate the average discharge rate using the discharge time from 6.3.19.3(5).

(7) Calculate the quantity of liquid used from the foam tank as a percentage of the total liquid discharged.

6.3.19.4

The measured total discharge rate shall be equal to at least the sum of the minimum specified discharge rates of the nozzles used during the test.

6.3.19.5

The calculated average foam concentration shall be within the tolerance permitted in NFPA 412, Section 5.2.

6.3.20* Water Tank Fill and Overflow Test.

6.3.20.1

Instrumentation shall consist of calibrated mechanical or electronic pressure measuring devices with an accuracy of ±3 percent and a stopwatch.

6.3.20.2

The water tank shall be empty, and the water tank fill and vent system shall be fully operational for this test.

6.3.20.3

The water tank fill and vent system shall be tested as follows to verify that the tank can be filled in 2 minutes or less:

(1) Park the vehicle on level ground.

(2) Attach one pressure measuring device at the inlet to the tank fill piping, and attach the other pressure measuring device to the tank body or an extension of the tank body.

(3) Simultaneously initiate flow to the tank and start the stopwatch. The water supply pressure shall be maintained at 551.6 kPa (80 psi) throughout the test.

(4) At the moment water begins to flow from the overflow piping, stop the watch and record the elapsed time.

(5) While maintaining a 551.6 kPa (80 psi) supply pressure and an overflow condition, record the internal tank pressure. After recording this pressure, shut off the water supply.

6.3.20.4

The results of this test shall be evaluated as follows:

(1) The time to fill the tank to the overflow condition shall be 2 minutes or less.

(2) The internal tank pressure shall not exceed the tank design pressure.

6.3.21* Flushing System Test.

6.3.21.1

No special instrumentation shall be required for this test.

6.3.21.2

The vehicle's agent system and flushing system shall be fully operational for this test.

6.3.21.3

The vehicle's flushing system shall be tested as follows:

(1) Fill the water tank and foam tank with clean water, and add dye to the foam tank.

(2) Discharge agent through each discharge orifice on the vehicle while operating in the foam mode until dye is present in the discharge stream.

(3) Mark the liquid level in the foam tank.

(4) Set the agent system in the flush mode, and discharge through each discharge orifice until clear water is present in the discharge stream.

(5) Shut the agent system down, and drain the piping.

(6) Recheck the foam tank level.

6.3.21.4

Failure to develop a clear water stream through each nozzle shall be considered evidence that the flushing system is not working.

6.3.21.5

There shall be no evidence of feedback of clear water into the foam tank.

6.3.22* Primary Turret Flow Rate Test.

6.3.22.1

Test equipment shall consist of the following:

(1) Calibrated sight gauge

(2) Liquid volume measuring device accurate to within ±1.0 percent

(3) Calibrated pressure gauge, if not already provided on the truck

(4) Alternative: A stopwatch and a scale capable of measuring total vehicle weight accurate to within ±1.0 percent of the scale capacity

6.3.22.2

It shall have been verified that the vehicle's pumping system is capable of operating at full rate.

6.3.22.3

The primary turret discharge rate shall be determined as follows:

(1) Set the primary turret pattern for straight stream operation.

(2) Fill the water tank completely.

(3) Engage the pump, and operate it at design speed.

(4) Open the turret flow control valve.

(5) If necessary, at this stage perform the following procedures:

   (a) If flow meters are used, read and record the flow rate once the discharge pressure stabilizes.

   (b) If a sight gauge is used, read and record the tank volume in gallons while simultaneously starting a stopwatch after the discharge pressure stabilizes. Read and record the tank volume in liters (gallons) when the watch is stopped after allowing flow for at least 1 minute. Determine the flow rate in L/min (gal/min) by dividing the difference in gallons by the time of discharge.

   (c) If a scale is used, record the vehicle weight prior to discharge. Start a stopwatch, and discharge water at stabilized pressure for 1 minute. Record the vehicle weight after discharge and calculate the flow rate.

(6) Reset the primary turret pattern to the dispersed setting and repeat 6.3.22.3(2) through 6.3.22.3(5).

(7) Reset the primary turret to the half flow rate setting (if applicable) and repeat 6.3.22.3(1) through 6.3.22.3(6).

6.3.22.4

The measured turret flow rates shall equal the specified flow rate within a tolerance of +10 percent/–0 percent.

6.3.23 Primary Turret Pattern Test.

The primary turret pattern test shall be conducted in accordance with the requirements of NFPA 412.

6.3.24* Primary Turret Control Force Measurement.

6.3.24.1

Test equipment shall consist of a spring scale that can be attached to the end of the turret control handle or a torque measuring device that can be attached to the rotational axis of the turret.

6.3.24.2

The water tank shall be filled prior to starting the test.

6.3.24.2.1

The water tank shall have been verified that the vehicle pump system is capable of operating at design flow and pressure.

6.3.24.2.2

The test shall be conducted with the primary turret at the full flow rate setting.

6.3.24.2.3

The turret power-assist system, if applicable, shall be fully operational.

6.3.24.3

The test shall be conducted as follows:

(1) Set the turret pattern control for straight stream, and, where applicable, engage the power assist.

(2) Engage the pump, and operate it at design speed.

(3) Open the turret flow control valve.

(4) Using a spring scale attached to the end of the turret aiming handle, rotate the turret to the right and to the left, recording the needed force for each direction. Again, using the spring scale attached to the end of the turret aiming handle, elevate and depress the turret, and record the force needed to elevate and depress.

(5) Repeat 6.3.24.3(2) through 6.3.24.3(4) with the pattern control set at the maximum dispersed position after refilling the water tank as necessary.

6.3.24.4

The forces recorded shall not exceed the forces specified in 4.19.4.

6.3.25* Primary Turret Articulation Test.

6.3.25.1

The test equipment shall consist of a tape measure, a level, and a protractor.

6.3.25.2

The water tank shall be filled prior to the test.

6.3.25.2.1

The turret power-assist system, if applicable, should be fully operational.

6.3.25.3

The test shall be conducted as follows:

(1) With the turret pointed ahead, raise the turret barrel to the maximum elevated position. With a level held horizontal at the vertical rotation axis, measure the angle between the level and the turret barrel with the protractor and record.

(2) Rotate the primary turret barrel to the right and left to the angle needed.

(3) Place a marker 9.1 m (30 ft) in front of the vehicle. Aim the turret straight ahead with the rate control at full flow, with the pattern control in the maximum dispersed position and with the turret in the maximum depressed position. When water discharges, observe whether water strikes the marker or strikes closer to the vehicle.

6.3.25.4

Turret articulation shall be considered as passing if the measurements meet or exceed the specifications.

6.3.26* Handline Nozzle Flow Rate Test.

6.3.26.1

Test equipment shall consist of the following:

(1) Calibrated sight gauge

(2) Liquid volume measuring device accurate to within ±1.0 percent

(3) Calibrated pressure gauge, if not already provided on the truck

(4) Alternative: A stopwatch and a scale capable of measuring total vehicle weight accurate to within ±1.0 percent

6.3.26.2

The vehicle’s pumping system shall be verified to be capable of operating at full rate.

6.3.26.3

The handline nozzle flow rate shall be determined as follows:

(1) Set the handline nozzle pattern for straight stream operation.

(2) Fill the water tank completely.

(3) Engage the pump and operate it at design speed.

(4) Open the handline nozzle flow control valve.

(5) If necessary, at this stage perform the following procedures:

(a) If flow meters are used, read and record the flow rate once the discharge pressure stabilizes.

(b) If a sight gauge is used, read and record the tank volume in gallons while simultaneously starting a stopwatch after the discharge pressure stabilizes. Read and record the tank volume in liters (gallons) when the watch is stopped after allowing flow for at least 5 minutes. Determine the flow rate in L/min by dividing the difference in gallons by the time of discharge.

(c) If an open-top calibrated tank is used, discharge through the nozzle until the pressure stabilizes, and then simultaneously direct the stream into the tank while starting the stopwatch. Stop the stopwatch when the tank is full, and remove or shut off the nozzle. Determine the flow rate by dividing the tank volume in liters (gallons) by the fill time in minutes.

(d) If a scale is used, record the vehicle weight prior to discharge. Start a stopwatch, and discharge water at stabilized pressure for 1 minute. Record the vehicle weight after discharge, and calculate flow rate.

(6) If the nozzle is the non-air-aspirated type, repeat 6.3.26.3(2) through 6.3.26.3(5) with the nozzle pattern setting in the fully dispersed position.

6.3.26.4

The measured handline nozzle flow rates shall equal the specified flow rate within a tolerance of +10 percent/–0 percent.

6.3.27 Handline Nozzle Pattern Test.

The handline nozzle pattern test shall be conducted in accordance with the requirements of NFPA 412.

6.3.28* Ground Sweep/Bumper Turret Flow Rate Test.

6.3.28.1

Test equipment shall consist of the following:

(1) Calibrated sight gauge

(2) Liquid volume measuring device accurate to within ±1.0 percent

(3) Calibrated pressure gauge, if not already provided on the truck

(4) Alternative: A stopwatch and a scale capable of measuring total vehicle weight accurate to within ±1.0 percent

6.3.28.2

The vehicle's pumping system shall be verified to be capable of operating at full rate.

6.3.28.3

The ground sweep/bumper turret discharge rate shall be determined as follows:

(1) Set the ground sweep/bumper turret pattern for straight stream operation.

(2) Fill the water tank completely.

(3) Engage the pump and operate it at design speed.

(4) Open the ground sweep/bumper turret flow control valve.

(5) If necessary, at this stage perform the following procedures:

  (a) If flow meters are used, read and record the flow rate once the discharge pressure stabilizes.

  (b) If a sight gauge is used, read and record the tank volume in gallons while simultaneously starting a stopwatch after the discharge pressure stabilizes. Read and record the tank volume in liters (gallons) when the watch is stopped after allowing flow for at least 1 minute. Determine the flow rate in L/min by dividing the difference in gallons by the time of discharge.

  (c) If a scale is used, record the vehicle weight prior to discharge. Start a stopwatch, and discharge water at stabilized pressure for 1 minute. Record the vehicle weight after discharge, and calculate the flow rate.

(6) If the ground sweep/bumper turret is the non-air-aspirated type, repeat 6.3.28.3(2) through 6.3.28.3(5) with the nozzle pattern setting in the fully dispersed position.

6.3.28.4

The measured flow rates shall equal the specified flow rate within a tolerance of +10 percent/–0 percent.

6.3.29 Ground Sweep/Bumper Turret Pattern Test.

The ground sweep/bumper turret pattern test shall be conducted in accordance with the requirements of NFPA 412.

6.3.30* Undertruck Nozzle Test.

6.3.30.1

Markers shall be available for use in defining the pattern boundaries.

6.3.30.2

The vehicle's pump system shall be verified to be capable of operating at full rate.

6.3.30.2.1

The agent tanks shall be filled with water and foam, respectively.

6.3.30.3

The test shall be conducted as follows:

(1) Set the agent system to operate in the foam mode.

(2) Engage the agent pump and operate it at design speed.

(3) Open the undertruck nozzles to discharge simultaneously, and continue to discharge until a definite pattern outline is apparent.

(4) Close the discharge and mark and record the boundaries of the pattern.

6.3.30.4

The pattern shall be considered acceptable if the foam spray covers the outline created by the vehicle on the ground and wets the inside of all tires.

6.3.31* Foam Concentration/Foam Quality Test.

6.3.31.1

The test equipment described in NFPA 412 shall be used for this test.

6.3.31.2

Each discharge nozzle on the vehicle shall have been individually verified as discharging at a flow rate within the tolerance specified.

6.3.31.2.1

The agent system shall have been verified as capable of operating at full rate.

6.3.31.3

The test shall be conducted as follows:

(1) Fill the water tank and the foam tank to the top, and refill as necessary throughout the test.

(2) Set the foam proportioning system to proportion foams at the concentration specified, and set the agent selector for the foam mode.

(3) Set the agent system pressure relief to the recommended pressure.

(4) Engage the agent pumps, and operate them at maximum pumping speed with all discharge outlets closed.

(5) Test each foam delivery system first for the individual nozzle/flow rate specified in the following list and then for a total combined simultaneous discharge in accordance with NFPA 412:

  (a) Primary turret(s) full rate

  (b) Primary turret(s) half rate

  (c) Ground sweep/bumper turret

  (d) Handline nozzles

  (e) Undertruck nozzles

6.3.31.4

The foam concentrations measured shall fall within the permitted tolerances specified in NFPA 412 for each nozzle and for the combined simultaneous discharge.

6.3.31.4.1

The foam expansion and drainage time measurements shall equal or exceed those specified in NFPA 412 for each nozzle.

6.3.32* Warning Siren Test.

6.3.32.1

Test equipment shall consist of the following:

(1) Sound level meter that meets the requirements of ANSI S1.4 for Type 1 or S1A meters and has been calibrated by a certified testing laboratory within the previous 12 months

(2) Tape measure

6.3.32.2

The capability of the warning siren on the vehicle to project sound forward and to the sides shall be determined as follows:

(1) Set the sound level meter to the A-weighing network, “fast” meter response, and position the meter directly ahead of the vehicle at a distance of 30.5 m (100 ft) from the front bumper, with the microphone at ear level of a 95th percentile male.

(2) Energize the siren and record the meter reading.

(3) Repeat 6.3.32.2(1) and 6.3.32.2(2) with the sound level meter 30.5 m (100 ft) from the vehicle, first at a position 45 degrees to the right and then at 45 degrees to the left of the longitudinal centerline of the vehicle.

6.3.32.3

The recorded noise level shall equal or exceed the specifications.

6.3.33* Propellant Gas.

6.3.33.1

Test equipment shall consist of a calibrated scale or load cell with an accuracy of ±1.0 percent.

6.3.33.2

The vehicle extinguishing agent piping system shall be operational.

6.3.33.2.1

The agent tank(s) shall be empty.

6.3.33.2.2

The propellant gas tank(s) shall be fully charged to the rated pressure.

6.3.33.2.3

A means of lifting the agent tanks for weighing without loss of agent shall be provided.

6.3.33.2.4

As an alternative, the extinguishing agent tank(s) shall be permitted to be tested outside of the vehicle.

6.3.33.2.5

Where the alternative in 6.3.33.2.4 is used, the test shall be conducted with the agent tank(s) and related piping, fittings, valves, hose, and nozzle(s) in the same configurations in which they are installed on the vehicle.

6.3.33.3

The test for each of the extinguishing agents shall be conducted in the following manner:

(1) Weigh the empty tank(s) and record as tare weight.

(2) Using the manufacturer's recommended filling procedure, charge the tank(s) with the manufacturer's recommended extinguishing agent to the upper fill weight/volume tolerance. Reweigh and record this as gross filled weight.

(3) Ensure that all fill caps are tightened, all propellant gas lines are connected, the discharge nozzle(s) is in the closed position, and all fittings and connections are tight.

(4) Pressurize the agent tank(s) using the manufacturer's recommended procedure.

(5) Simultaneously, fully open all discharge nozzles, and keep open until only the pressurizing gas is expelled.

(6) Shut down the propellant gas supply.

(7) Reweigh the agent tank(s) and record this as post-discharge weight.

(8) Calculate and record the total agent discharged as follows: Gross filled weight – post-discharge weight = total agent discharge

6.3.33.4

There shall be a supply of propellant gas to purge all discharge lines as evidenced by the emission from each nozzle of gas only.

6.3.34* Pressure Regulation.

6.3.34.1

Test equipment shall consist of a calibrated pressure gauge or transducer capable of reading the recommended tank top discharge pressure and possessing an accuracy of ±34.5 kPa (±5.0 psi).

6.3.34.2

The vehicle extinguishing agent system shall be piped to all discharge outlets with the tank(s) empty.

6.3.34.2.1

The propellant gas tank(s) shall be fully charged and at pressure.

6.3.34.2.2

A means for mounting a pressure gauge or transducer somewhere between the downstream (low-pressure) side of the regulator and the agent tank top shall be provided.

6.3.34.2.3

As an alternative, the extinguishing agent tank(s) shall be permitted to be tested outside of the vehicle.

6.3.34.2.4

Where the alternative in 6.3.34.2.3 is used, the test shall be conducted with the agent tank(s) and related piping, fittings, valves, hose, and nozzle(s) in the same configuration in which they are installed on the vehicle.

6.3.34.3

The test for each of the extinguishing agents shall be conducted in the following manner:

(1) Using the manufacturer's recommended filling procedure, charge the tank(s) with the manufacturer's recommended extinguishing agent to the upper fill weight/volume tolerance.

(2) Install a pressure gauge or transducer between the downstream (low-pressure) side of the regulator and the agent tank top.

(3) Ensure that all fill caps are tightened, all propellant gas lines are connected, the discharge nozzle(s) is in the closed position, and all fittings are tight.

(4) Pressurize the agent tank(s) using the manufacturer's recommended procedure. Record the agent tank pressure.

(5) Simultaneously, fully open all discharge nozzles, and keep open until only the pressurizing gas is expelled.

(6) During agent discharge, monitor agent tank pressure and record at 5-second or shorter intervals.

(7) Once the gas point has been reached for all discharge nozzles, shut down the gas supply.

6.3.34.4

The pressure regulation system shall be capable of maintaining pressure throughout the discharge.

6.3.34.4.1

At no time shall pressure fall below or exceed the design range specified by the manufacturer.

6.3.35* AFFF Premix Piping and Valves.

6.3.35.1

Test equipment shall consist of the following:

(1) Calibrated scale or load cell with an accuracy of ±1.0 percent

(2) Stopwatch

6.3.35.2

All vehicle foam discharge piping shall be operational, and the premix tank shall be empty.

6.3.35.2.1

The propellant gas tank(s) shall be fully charged and within pressure.

6.3.35.2.2

A means of lifting the agent tank(s) for weighing without loss of agent shall be provided.

6.3.35.2.3

As an alternative, the system shall be permitted to be tested outside of the vehicle.

6.3.35.2.4

Where the alternative in 6.3.35.2.3 is used, the test shall be conducted with the premix tank and related piping, fittings, valves, hose, and nozzle(s) in the same configuration in which they are installed on the vehicle.

6.3.35.3

The test shall be conducted in the following manner:

(1) Weigh the empty premix tank and record as tare weight.

(2) Using the manufacturer's recommended filling procedure, charge the tank with water or premix solution. Reweigh and record as gross filled weight.

(3) Ensure that all fill caps are tightened, all propellant gas lines are connected, the discharge nozzle(s) is in the closed position, and all fittings and connections are tight.

(4) Pull all handline hose from the reel(s) or hose compartment(s).

(5) Pressurize the system using the manufacturer's recommended procedure.

(6) Simultaneously, start the stopwatch and fully open the turret(s), undertruck nozzles, and handline(s).

(7) After discharging for at least 30 seconds, simultaneously stop the stopwatch and close the turret(s), undertruck nozzles, and handline(s). Record the elapsed time on the stopwatch as discharge time.

(8) Following the manufacturer's instructions, shut off the propellant gas supply, and blow down the system.

(9) Reweigh the premix tank and record this as post-discharge weight.

(10) Add the recommended flow rates from each discharge nozzle and record this sum as the designed total flow rate.

(11) Calculate the actual total flow rate (TFR) as follows:

$$\text{TFR} = \frac{\text{gross filled weight} - \text{post-discharge weight}}{(\text{density}) \times \dfrac{(\text{elapsed time in seconds})}{60}} \quad \textbf{[6.3.35.3]}$$

6.3.35.4

The actual TFR shall equal the specified flow rate designed within a tolerance of +10 percent/–0 percent.

6.3.36* Pressurized Agent Purging and Venting.

6.3.36.1

No special test equipment or instrumentation shall be required to conduct the test(s).

6.3.36.2

The vehicle extinguishing agent system(s) shall be fully operational.

6.3.36.2.1

The agent tank(s) shall be fully charged with the manufacturer's recommended agent.

6.3.36.2.2

The propellant gas tank(s) shall be fully charged to the rated pressure.

6.3.36.2.3

As an alternative, the extinguishing agent tank(s) shall be permitted to be tested outside of the vehicle.

6.3.36.2.4

Where the alternative in 6.3.36.2.3 is used, the test shall be conducted with the fully charged agent tank(s) and related piping, fittings, valves, hose, and nozzle(s) in the same configuration in which they are installed on the vehicle.

6.3.36.3

The test for each of the pressurized extinguishing agent systems shall be conducted in the following manner:

(1) Pressurize the agent tank(s) using the manufacturer's recommended procedure.

(2) Pull all hose from the reel(s) or compartment(s).

(3) Fully open all discharge devices.

(4) After approximately 5 seconds to 20 seconds, close all discharge devices.

(5) Purge all discharge lines, and vent the agent tank(s) using the manufacturer's recommended procedure.

6.3.36.4

Any agent beyond the tank outlet shall be purged from the discharge piping and hose as evidenced by the discharge from each nozzle of gas only.

6.3.36.4.1

The depressurization or venting of the agent tank shall allow only minimal quantities of agent to escape.

6.3.37* Complementary Agent Handline Flow Rate and Range.

6.3.37.1

Test equipment shall consist of the following:

(1) Calibrated scale or load cell with an accuracy of ±1.0 percent

(2) Stopwatch

(3) Tape measure or other device for measuring distance

(4) Calibrated anemometer

(5) Pan containing at least 0.09 m^2 (1 ft^2) of motor or aviation gasoline

(6) Agent tank (if equipped with an agent tank) with a liquid level gauge with accuracy of ±1.13 kg (2.5 lb)

6.3.37.2

All vehicle agent piping shall be operational.

6.3.37.2.1

The agent tank shall be empty.

6.3.37.2.2

The propellant gas tank(s) shall be fully charged and within pressure.

6.3.37.2.3

A means of lifting the agent tank(s) for weighing without loss of agent shall be provided.

6.3.37.2.4

As an alternative, the system shall be permitted to be tested outside of the vehicle.

6.3.37.2.5

Where the alternative in 6.3.37.2.4 is used, the test shall be conducted with the agent tank and related piping, fittings, valves, hose, and nozzle(s) in the same configuration in which they are installed on the vehicle.

6.3.37.3

The test shall be conducted in the following manner:

(1) Using the manufacturer's recommended agent and filling procedure, charge the agent tank.

(2) If weight discharged will be based on liquid level gauge readings, record liquid level gauge reading in 9 kg (20 lb) increments, based on weighing of agent supply cylinder, as tank is initially filled.

(3) Ensure that all fill caps are tightened, all propellant gas lines are connected, the discharge nozzle(s) is in the closed position, and all fittings and connections are tight.

(4) Pull all handline hose from the reel(s).

(5) Pressurize the system using the manufacturer's recommended procedure, and open all handline nozzles until agent flow is observed. Close the nozzles.

(6) Activate system and purge handline of air by opening the handline nozzle for approximately 1 second.

(7) Weigh or note weight based on liquid level gauge reading, and record the agent tank as the "initial weight."

(8) Position the handline nozzles at least 6.1 m (20 ft) from the fire pan so that they can be discharged onto a flat grade with no stream obstructions. Ignite the fuel.

(9) Select one of the handline nozzles (nozzle 1). While holding it in a position 0.9 m to 1.2 m (3 ft to 4 ft) above ground level, simultaneously start the stopwatch and fully open the nozzle; then discharge agent onto the fire.

(10) After at least 50 percent of the contents of the tank has been discharged, shut down the nozzle and stop the stopwatch. Record the time as "elapsed discharge time no. 1."

(11) Reweigh the agent tank, and record as "weight after first discharge."

(12) If a second nozzle (nozzle 2) is provided, repeat 6.3.37.3(1) through 6.3.37.3(8).

(13) While holding the two handline nozzles in a fixed horizontal position 0.9 m to 1.2 m (3 ft to 4 ft) above ground level, simultaneously start the stopwatch and fully open both nozzles.

(14) After at least 50 percent of the contents of the tank has been discharged, simultaneously shut down both nozzles, and stop the stopwatch. Record the time as "elapsed discharge time no. 2."

(15) Reweigh the agent tank, and record as "weight after second discharge."

(16) Calculate the flow rate (FR) from nozzle 1 as follows:

$$FR = \frac{\text{initial weight (test 1)} - \text{initial weight (test 2)}}{\text{(elapsed discharge time no. 1)}} \quad [6.3.37.3a]$$

(17) Calculate the flow rate (FR) from nozzle 2 as follows:

$$FR = \frac{\begin{array}{c}\text{weight after}\\ \text{first discharge}\end{array} - \begin{array}{c}\text{weight after}\\ \text{second discharge}\end{array}}{2 \times \text{(elapsed discharge time no. 2)}} \quad [6.3.37.3b]$$

(18) If nozzle 2 is of a different configuration, repeat the fire test for this nozzle.

6.3.37.4

Test results shall be evaluated as follows:

(1) The flow rate from each nozzle shall meet the requirement.

(2) The range from each nozzle shall meet or exceed the requirements as evidenced by extinguishment of the fire(s).

(3) When discharged simultaneously, the flows from nozzle 1 and nozzle 2 shall be within 10 percent of each other.

6.3.38* Dry Chemical Turret Flow Rate and Range.

6.3.38.1

Test equipment should consist of the following:

(1) Calibrated scale or load cell with an accuracy of ±1.0 percent

(2) Stopwatch

(3) Tape measure or other device for measuring distance

(4) Calibrated anemometer

6.3.38.2

All dry chemical discharge piping shall be operational.

6.3.38.2.1

The dry chemical tank shall be empty.

6.3.38.2.2

The propellant gas tank(s) shall be fully charged to the rated pressure.

6.3.38.2.3

A means of lifting the agent tank(s) for weighing without loss of agent shall be provided.

6.3.38.2.4

As an alternative, the system shall be permitted to be tested outside of the vehicle.

6.3.38.2.5

Where the alternative in 6.3.38.2.4 is used, the test shall be conducted with the agent tank and related piping, fittings, valves, hose, and nozzle(s) in the same configuration in which they are installed on the vehicle.

6.3.38.3

The test shall be conducted in the following manner:

(1) Using the manufacturer’s recommended agent and filling procedure, charge the tank.

(2) Ensure that all fill caps are tightened, all propellant gas lines are connected, the discharge nozzle(s) is in the closed position, and all fittings and connections are tight.

(3) Pressurize the system using the manufacturer's recommended procedure, and open the turret discharge valve until agent is observed. Close the valve.

(4) Weigh and record the agent tank as the “initial test weight.”

(5) Position the dry chemical turret so that it can be discharged onto a flat grade with no stream obstructions. Position the turret to obtain maximum straight stream reach.

(6) Simultaneously, start the stopwatch and fully open the turret.

(7) During discharge, place markers at the far point where dry chemical strikes the ground (range marker) and at either side of the widest part of the pattern (width markers), following these procedures:

  (a) The operator(s) placing the markers shall wear safety equipment for this task.

  (b) The agent manufacturer's material safety data sheet shall be consulted.

(8) After discharging at least 75 percent of the contents of the tank, simultaneously stop the stopwatch and shut down the turret. Record the elapsed time in seconds as discharge time.

(9) Measure the distance from the turret to the range marker and record as the far point range.

(10) Measure the distance between the width markers and record as the pattern width.

(11) Reweigh the agent tank and record as the weight after discharge.

(12) Calculate the flow rate (FR) as follows:

$$\text{FR} = \frac{\text{initial test weight} - \text{weight after discharge}}{\text{elapsed discharge time}} \quad \textbf{[6.3.38.3]}$$

6.3.38.4

The stream range and pattern width shall equal or exceed the requirements.

6.3.38.4.1

The discharge flow rate shall equal the requirements in Table 4.1.1.2(a) and Table 4.1.1.2(b).

6.3.39* Cab Interior Noise Test.

6.3.39.1

Test equipment shall consist of a sound level meter that meets the requirements of ANSI S1.4 for Type 1 or S1A meters.

6.3.39.1.1

The sound level meter shall have been calibrated by a certified testing laboratory within the previous 12 months.

6.3.39.2

The vehicle shall be tested in its fully loaded condition with tires inflated to their recommended inflation pressure.

6.3.39.2.1

The cab doors, windows, and hatch openings shall be closed during this test.

6.3.39.2.2

The vehicle shall be driven long enough to bring the drivetrain components up to their operating temperatures prior to starting the test.

6.3.39.2.3

Thermostatically controlled shutters or cooling fans, or both, shall be allowed to function.

6.3.39.2.4

The vehicle agent system(s), the communications system, and the audible warning system and emergency warning system shall be inactive during this test.

6.3.39.3

The interior noise level of the cab shall be determined as follows:

(1) Set the sound level meter to the A-weighing network, “fast” meter response, and position the meter adjacent to the driver’s ear.

(2) Bring the vehicle up to a road speed of 80.5 kph (50 mph) and maintain that speed while recording the noise measurements.

(3) Repeat 6.3.39.3(1) and 6.3.39.3(2) until four readings have been taken, bringing the vehicle to rest between each measurement. If any of the noise measurements differ from the others by more than 2 dBA, they should be replaced by another measurement, since they could be the result of extraneous ambient noises or equipment/measurement error.

(4) Average the four readings.

6.3.39.4

The average of the recorded noise readings shall be less than or equal to the cab interior noise level specification specified in 4.12.3.3.

6.3.39.4.1

Halon 1211 systems shall not be tested.

Submitter Information Verification

Committee: AIR-AAA

Submittal Date: Wed Aug 29 12:00:17 EDT 2018

Committee Statement

Committee The committee has added thresholds and trigger points for the various prototype tests that

Statement:	must be conducted on ARFF vehicles to clarify required tests.
Response Message:	SR-8-NFPA 414-2018

Second Revision No. 5-NFPA 414-2018 [Section No. 6.4.1.3]

6.4.1.3

Where the vehicle is fitted with ~~an extendable~~ a boom-mounted turret, an additional test shall be performed as follows:

(1) Tilt the vehicle on a table or position the vehicle on a 20 percent grade.

(2) Elevate the ~~extendable turret~~ boom to the highest elevation.

(3) Position the turret nozzle uphill at maximum horizontal rotation and discharge the agent at maximum flow rate for the class of vehicle being tested.

Submitter Information Verification

Committee: AIR-AAA

Submittal Date: Wed Aug 29 11:47:05 EDT 2018

Committee Statement

Committee Statement: Language regarding "extendable turret" changed to align with 4.19.6 and 4.19.7.

Response Message: SR-5-NFPA 414-2018