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

**[6.3.16.3.1]**

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

**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:

**[6.3.16.4.1]**

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

(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:

**[6.3.16.5.1]**

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

(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:

**[6.3.18.3]**

$$R = \frac{(\text{length 1})(\text{length 2})(\text{length 3})}{4\,[S\ (S - \text{length 1})\ (S - \text{length 2})\ (S - \text{length 3})]^{1/2}}$$

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:

**[6.3.35.3]**

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

**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:

Δ **[6.3.37.3a]**

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

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

**[6.3.37.3b]**

$$FR = \frac{\text{weight after first discharge} - \text{weight after second discharge}}{2 \times \text{(elapsed discharge time no. 2)}}$$

(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:

Δ [6.3.38.3]

$$FR = \frac{\text{initial test weight} - \text{weight after discharge}}{\text{elapsed discharge time}}$$

**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.

**6.4* Operational Tests.**

**6.4.1 Vehicle Testing, Side Slope.**

**6.4.1.1** This test shall be accomplished on a vehicle prior to the vehicle being delivered to the end user.

**6.4.1.1.1** It shall be accomplished with all requested equipment placed and installed as ordered by the end user.

**6.4.1.1.2** The tilt-table angle shall be recorded on a metal data plate affixed to the left door of the vehicle.

**6.4.1.1.3** The data plate shall list the following items:

(1) Vehicle empty weight
(2) Maximum gross weight
(3) Special equipment installed prior to test
(4) Front and rear axle weights with weight distribution calculation

**6.4.1.1.4** The actual tilt-table angle achieved in the test shall be recorded on the plate for left and right directions.

**6.4.1.1.4.1** The test shall be conducted on a tilt-table facility meeting the following SAE J2180 requirements:

(1) The tilt table shall contain a suitable surface to resist truck sliding during test sequences.
(2) The vehicle shall be restrained and tilted until the vehicle tilt or side slope angle can be positively determined.

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

**6.4.1.2.1** A ballast that is fastened in each seat shall be used in place of the crew for safety.

**6.4.1.3** Where the vehicle is fitted with 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 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.

**6.4.1.4** The side slope capability of the vehicle shall be determined in accordance with SAE J2180, and as follows:

(1) Tilt the vehicle on a table to the angle specified for the vehicle being tested.
(2) Once the vehicle is positioned at the required angle, check the vehicle restraints to ensure that no tension is applied.

**6.4.1.5** The vehicle shall be considered to meet its side slope requirement if the vehicle can stand by itself on the grade without the use of the safety restraints.

**6.4.1.6** Where multiple vehicles are purchased under the same contract and built to exactly the same specifications, the purchaser shall be permitted to have a single unit or a random sample of units tested and the result(s) applied to the other identical units.

**6.4.2* Weight/Weight Distribution.**

**6.4.2.1** Instrumentation for the weight and weight distribution test shall be limited to in-ground or portable scales.

**6.4.2.1.1** The accuracy of the scales shall be ±1.0 percent of the scale capacity.

**6.4.2.2** The vehicle shall be tested in its fully loaded condition.

**6.4.2.2.1** Ballast shall be used for the crew, agent, and equipment as necessary.

**6.4.2.3** The total weight of the vehicle and weight distribution shall be determined as follows:

(1) Determine the total weight of the vehicle by driving the fully loaded vehicle onto the scale(s).
(2) Determine the individual axle loadings by measuring the weight on each axle at the ground. Since the total vehicle weight is more accurately reflected by the single weight measurement in 6.4.2.3(1), correct the individual axle loads proportionately, as necessary, so that their total equals the total vehicle weight. Subtract the lightest loaded axle weight from the heaviest loaded axle weight, and divide the difference by the weight of the heaviest axle.
(3) Determine individual tire loadings by measuring the weight on each tire at the ground. Make proportionate corrections to the individual tire loads so that their total equals the load on the respective axle. Determine the average tire weight for each axle by adding the right-hand and left-hand tire weights for each axle and dividing by 2. Subtract the lightest loaded tire weight from the heaviest loaded tire weight for each axle, and divide the difference by the average tire load for that axle.

**6.4.2.4** The data shall be evaluated on the following basis:

(1) The total weight of the vehicle shall be less than or equal to the vehicle manufacturer's gross vehicle weight rating.
(2) The difference between the heaviest loaded axle and the lightest loaded axle shall be less than or equal to the maximum difference permitted in the specification.
(3) The difference between the tire weights on any given axle shall be less than or equal to the maximum difference permitted in the specification.

**6.4.3* Acceleration.**

**6.4.3.1** Ambient temperatures at the test site shall be –17.8°C to 43.3°C (0°F to 110°F), and elevations shall include heights up to 609.6 m (2000 ft) unless otherwise specified by the purchaser.

**6.4.3.2** Instrumentation shall consist of a fifth wheel device, or equivalent, designed to measure and record (at least visibility as a minimum) vehicle speed and time from the time the vehicle begins to move until it reaches a predetermined top speed.

**6.4.3.3** The vehicle shall be tested in its fully loaded condition with the engine and the transmission at their operating temperatures.

**6.4.3.3.1** The tires shall be inflated to the manufacturer's recommended pressure.

**6.4.3.4** The test shall be conducted in the following manner:

(1) Start the test with the vehicle at rest, the engine at idle, and the transmission in gear.
(2) Simultaneously, start the stopwatch and accelerate the vehicle, and continue accelerating to a wide-open throttle condition.
(3) At the moment the vehicle reaches 80.5 kph (50 mph), stop the watch and record the elapsed time.
(4) To compensate for wind conditions and slope, repeat the test in the opposing direction. Record and average a minimum of three readings in each of the two directions.

**6.4.3.5** The average acceleration time to 80.5 kph (50 mph) shall be less than or equal to the requirements specified in Table 4.1.1.2(a) and Table 4.1.1.2(b).

**6.4.4* Top Speed.**

**6.4.4.1** Instrumentation shall consist of the vehicle's speedometer as installed by the manufacturer at the time of delivery.

**6.4.4.2** The vehicle shall be tested in its fully loaded condition with the engine and the transmission at their operating temperatures.

**6.4.4.2.1** The tires shall be inflated to the manufacturer's recommended pressure.

**6.4.4.3** The test shall be conducted in the following manner:

(1) Accelerate the vehicle to the speed specified in Table 4.1.1.2(a) and Table 4.1.1.2(b).
(2) To compensate for wind conditions and slope, repeat the test in the opposing direction.
(3) If the specified speed cannot be achieved in one of the directions, repeat 6.4.4.3(1) and 6.4.4.3(2), accelerating the vehicle to its maximum speed in each direction; record the speeds and average the two numbers.

**6.4.4.4** The test shall be considered successful if the average top speed equals or exceeds 104.6 kph (65 mph).

**6.4.5* Brake Operational Test.**

**6.4.5.1** Instrumentation shall consist of the vehicle's speedometer, as installed by the manufacturer, and a tape measure.

**6.4.5.2** The vehicle shall be tested in its fully loaded condition with the brakes adjusted to the manufacturer's recommended tolerances.

**6.4.5.2.1** The tires shall be inflated to the vehicle manufacturer's recommended inflation pressure.

**6.4.5.2.2** The vehicle's stopping distance shall have been certified by the vehicle manufacturer.

**6.4.5.3** The test shall be conducted in the following manner:

(1) Maintain a constant speed of 32.2 kph (20 mph) while driving down the centerline of the test site.
(2) Apply the brakes as if in a panic stop until the vehicle comes to rest.
(3) Measure and record the distance from the outer edge of the vehicle to the centerline of the lane.
(4) Repeat 6.4.5.3(1) through 6.4.5.3(3) at a constant speed of 64.4 kph (40 mph).

**6.4.5.4** The distance measured shall not exceed one-half the vehicle width plus 0.6 m (2 ft).

**6.4.6 Air System/Air Compressor Test.**

**6.4.6.1** Instrumentation shall consist of the vehicle's air system pressure gauge(s), as installed by the manufacturer, and a stopwatch.

**6.4.6.2** The vehicle's air system shall be fully operational for this test.

**6.4.6.2.1** The manufacturer previously shall have established the ratio of actual to required reservoir capacity and the spring brake release pressure.

**6.4.6.2.2** The test shall be conducted with the transmission in neutral and the parking brakes set.

**6.4.6.3** The test shall be conducted as follows:

(1) Using the brake pedal, bleed off the air reservoir system pressure to a level below 586 kPa (85 psi) as indicated on the cab-mounted air gauge(s).
(2) Accelerate the engine to its wide-open throttle condition.
(3) When the air pressure indicator reaches 586 kPa (85 psi), start the stopwatch. If more than one air pressure indicator is installed on the vehicle, start the stopwatch when the first indicator registers 586 kPa (85 psi).
(4) Continue building air pressure with the engine at wide-open throttle until 689.5 kPa (100 psi) registers on all air pressure indicators, stop the watch, and record the time.
(5) Using the brake pedal, bleed off the air reservoir system pressure to 0 kPa (0 psi), as indicated on the cab-mounted air gauge(s).
(6) Accelerate the engine to a wide-open throttle condition.
(7) When the wide-open throttle condition is reached, simultaneously start the stopwatch.
(8) Continue building air pressure with the engine at wide-open throttle until the previously established spring brake release pressure has been reached in the quick buildup system; stop the watch and record the time.

**6.4.6.4** The results shall be evaluated as follows:

(1) The time needed for a buildup of 586 kPa to 689.5 kPa (85 psi to 100 psi) shall be within 25 seconds of the permitted time, as calculated for larger reservoir capacities.
(2) The quick buildup time shall be within 15 seconds.

**6.4.7* Agent Discharge Pumping Test.**

**6.4.7.1** No test equipment shall be required.

**6.4.7.2** The vehicle's agent system shall be fully operational with all primary handlines deployed for this test.

**6.4.7.3** The simultaneous discharge of all nozzles shall be tested as follows:

(1) Fill both the water tank and the foam (or dyed water) tank completely with water and foam, respectively.
(2) Set the agent system to operate in the foam mode, set the system pressure for optimum performance, and engage the agent pumps. Simultaneously, operate the pumps of vehicles with multiple pumps during this test.
(3) Initiate discharge first through the primary turret and then through the ground sweeps (or optional bumper turret), primary handlines, and undertruck nozzles until all are discharging simultaneously in a straight stream. As each nozzle is turned on, observe the range along with the system pressure.
(4) Continue to discharge until the system pressure has stabilized with all nozzles discharging.

**6.4.7.4** Since measurements of actual flow rates are not accurately obtained in the field, the system shall be considered to have met the agent discharge pumping test requirement in accordance with the procedures of 6.4.7.3, provided the nozzle ranges show no signs of deterioration as additional nozzles are engaged and the agent system pressure does not fluctuate by more than 10 percent where the primary turret flowing by itself is compared with the combined discharge pressure.

**6.4.7.5** Foam (or dyed water) shall be evident in the discharging stream from all nozzles at all times.

**6.4.8* Dual Pumping System Test.**

**6.4.8.1** No special instrumentation shall be required for this test.

**6.4.8.2** The vehicle's agent system shall be fully operational for this test.

**6.4.8.3** The ability of a vehicle equipped with a dual pumping system to provide foam solution to all nozzles when only one system is active shall be tested as follows:

(1) Fill both the water tank and the foam tank completely with water, and add dye or foam concentrate to the foam tank.
(2) Set the agent system to operate in the foam mode, and set the system pressure for optimum performance.
(3) Set the primary turret(s) discharge rate in the half flow rate setting.
(4) Initiate discharge first through the primary turret(s) (at half rate) and then through the ground sweep nozzles (or alternate bumper turret), the primary handline nozzles, and the undertruck nozzles, first with one pump operating, and then the other.

**6.4.8.4** A foam or dye solution discharge stream shall be present at each nozzle tested when either pump is engaged.

**6.4.9* Pump and Maneuver Test.**

**6.4.9.1** No test equipment shall be required.

**6.4.9.2** The vehicle's agent system shall be fully operational for this test.

**6.4.9.3** The positive pump and maneuver capability, along with the smooth engagement of the pump, shall be tested as follows:

(1) Fill both the water tank and the foam tank completely with water, and add dye or foam concentrate to the foam tank.
(2) With the vehicle being driven at 32.2 kph (20 mph), engage and disengage the pump(s) without damage to the pump or pump drive system.
(3) Bring the vehicle to a stop, and prepare the primary turrets and ground sweeps (or optional bumper turret) for discharging.
(4) Place the agent selector in the foam mode, and set the agent system pressure relief to relieve at the recommended pressure for optimum performance.
(5) Initiate discharge through the primary turrets and ground sweeps/bumper turret nozzles, and drive the vehicle in a forward and reverse direction at speeds ranging up to 8 kph (5 mph). Stop and start the vehicle, and change direction from forward to reverse while operating through this speed range without interrupting the discharge flow rate or range. Engage and disengage the pumps during the test.
(6) Repeat 6.4.9.3(5) both on and off the road.

**6.4.9.4** During the test, there shall be no indication of proportioning, pressure, or flow rate instability.

**6.4.9.5** The operation of the pump shall not cause the engine to stall.

**6.4.9.6** Engagement of the pump or vehicle drive shall be accomplished without introducing any vehicle dynamics such as severe lurching.