NFPA No.

414

AIRCRAFT RESCUE AND FIRE FIGHTING VEHICLES 1975

NATIONAL FIRE PROTECTION ASSOCIATION
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Standard for

Aircraft Rescue and Fire Fighting Vehicles

NFPA No. 414 — 1975

1975 Edition of NFPA No. 414

This 1975 Edition of the Standard for Aircraft Rescue and Fire Fighting Vehicles has been developed by the Sectional Committee on Aircraft Rescue and Fire Fighting which reports to the Association through the Correlating Committee on Aviation. It was adopted by the Association at its 1975 Fall Meeting held in Pittsburgh, Pa., on Nov. 18-20, 1975. It supersedes the last previous (1970) edition which was also approved as an American National Standard by the American National Standards Institute (ANSI) and designated B128.1–1970. This edition is being submitted to ANSI for similar approval and when and if so approved, same will be indicated on the cover of the pamphlet editions of this Standard.

This 1975 edition differs from the previous 1970 edition by the deletion of former Part D which covered Tank Vehicles for this service. In addition substantive revisions were made to the following Paragraphs as numbered in this 1975 Edition: 124, 126, 1261, 1263, 127, 134 (including new subparagraphs), 212, 2212, 2221, 2222 (Note), 2224 (part of old 2223), 2311, 2312, 2313, 244, 251, 254, 255, 256, 2631, 2633, 2711, 2714, 2715, 2717, 2721, 281, 2911, 2912, 292, 303, 3112, 3131, 3132, 3134, 3141, 3211, 3223, 3231, 330, 3311, 3312, 3317, 3351, 3352, 3355, 3361, 3362, 3363, 3371, 4911, 5011, 614, 654, 656, 7221 (footnote deleted from old 9221), 7223, 7224, 7312, 7332, 7411, 7511, 7541, 7711, and 7751. Some definitions have been revised or deleted. Under further study are Sections 264, 462, and 862 dealing with vehicle mobility, tires and rims. Some other changes have been made which are editorial in nature or are reference changes because of the deletion of old Part D. Vertical marginal rules indicate where substantive changes occur.

Origin and Development of No. 414

In 1960 a tentative edition of present Parts A and B of this standard was adopted by the Association. In 1961, the Committee recommended official adoption of a revised edition of Parts A and B and submitted a Tentative text for Part C to the Annual Meeting, but their recommendation was rejected and the report returned to the sponsoring Committee for further study. During the latter half of 1961 and early 1962, Parts A, B and C were further processed, present Parts F and G added and at the 1962 Annual Meeting, the revised draft was approved by the Association. In 1963 revisions and additions were made to Parts A, B and C; in 1964, old Part D was added; in 1965 and 1967 a number of revisions were made to the text to keep it current; in 1968, the text was re-edited without change in technical content, and in 1969 Part E was added with a number of changes throughout the text. In 1970 a new class of vehicle was added to Part B and a large number of substantive changes were made. This 1975 Edition supersedes all earlier issues.

Attention is called to the companion publications of the Association dealing with Aircraft Rescue and Fire Fighting Services particularly NFPA Nos. 402, 403, 406M, 412, and 422M. Write to the Association for a free List of Publications.

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This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred.

Interpretation Procedure of the Sectional Committee on Aircraft Rescue and Fire Fighting

Those desiring an interpretation shall supply the Chairman with five identical copies of a statement in which shall appear specific reference to a single problem, paragraph, or section. Such a statement shall be on the business stationery of the inquirer and shall be duly signed.

When applications involve actual field situations they shall so state and all parties involved shall be named.

The Interpretations Committee will reserve the prerogative to refuse consideration of any application that refers specifically to proprietary items of equipment or devices. Generally inquiries should be confined to interpretation of the literal text or the intent thereof.

Requests for interpretations should be addressed to the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210.

Subcommittee Responsible for No. 414

To carry on the work on this Standard the following Subcommittee has been in charge of the activities leading up to this 1975 Edition:

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Standard on Aircraft Rescue and Fire Fighting Vehicles

NFPA No. 414—1975

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Standard for

Aircraft Rescue and Fire Fighting Vehicles

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PART A — SCOPE AND PURPOSE

11. Scope.

111. This standard applies to aircraft rescue and fire fighting vehicles intended to carry rescue and fire fighting equipment for rescuing occupants and combating aircraft fires in disabled or burning aircraft on, or in the vicinity of, an airport. For the purpose of simplification, these vehicles will hereinafter be referred to simply as "vehicles." The basic NFPA recommendations on the use and provision of this equipment are contained in "Standard Operating Procedures, Aircraft Rescue and Fire Fighting" (NFPA No. 402), and "Recommended Practice for Aircraft Rescue and Fire Fighting Services at Airports and Heliports" (NFPA No. 403). Field testing procedures for aircraft rescue and fire fighting vehicles utilizing foam are given in the NFPA Standard for Evaluating Foam Fire Fighting Equipment on Aircraft Rescue and Fire Fighting Vehicles (NFPA No. 412). The Aircraft Fire Investigators Manual (NFPA No. 422M) is designed, in part, to provide technical data useful on evaluating the effectiveness of these vehicles.

NOTE 1: It is essential that additional features such as structural fire fighting components not be permitted to interfere with the basic capability of the vehicle to perform its primary aircraft rescue and fire fighting function. It is considered preferable to have separate vehicles for structural fire fighting equipped with the needed complement of hose and tools since the amount of such equipment which may be appropriately carried on an aircraft rescue and fire fighting vehicle must be limited to conserve weight and space.

NOTE: Vehicles which are not wheeled, such as track, amphibious, or air cushion types, are not covered by this Standard. Where climatic or geographic conditions exist which considerably reduce the effectiveness of wheeled vehicles, it is often necessary to carry extinguishing agents in such specialized units, but at least 75 per cent of the agents required by NFPA No. 403 shall be carried on vehicles which are covered by these Standards unless exceptional circumstances dictate otherwise.

12. Purpose.

121. This standard is prepared as a guide to airport operators intending to purchase aircraft rescue and fire fighting equipment.

122. Part B of this standard is intended to outline features and components which, when assembled, will produce an efficient

and capable major fire fighting vehicle for both on-and-off-pavement performance. The features outlined therein affecting the vehicular capabilities of these vehicles are considered advisable for their proper operation on and off paved surfaces with particular emphasis on their off-pavement capability. This latter feature is particularly important to assure timely and effective response of these vehicles to aircraft accident sites across terrain which might halt or delay standard highway equipment. The features outlined regarding the fire fighting capabilities are considered advisable for the proper performance of these vehicles for the purpose for which they were designed. The omission of any of the features in Part B should be done only with the complete knowledge of how it or they will affect the vehicles' performance.

123. Part C of this standard is intended to outline features and components of rescue vehicles in aircraft rescue service. The features outlined are considered advisable for the proper performance of these vehicles for the purpose for which they are designed. The omission of any of the features in Part C should be done only with the complete knowledge of how it or they will affect performance.

124. Part D of this Standard is intended to outline features and components of combined agent vehicles designed to serve as: (1) a primary fire fighting vehicle at airports and heliports when extinguishing agent capacity and discharge rates meet the requirements outlined in NFPA No. 403 Tables 1B, 1C and 2; or (2) as an alternate to the rescue vehicle described in Part C of this Standard. The features outlined are considered advisable for the proper performance of these vehicles for the purpose for which they are designed. The omission of any of the features in Part D should be done only with the complete knowledge of how it or they will affect performance.

125. The essential elements for the vehicles are included herein. Drafting of complete specifications for bidding purposes is the responsibility of the user exercising care against inclusion of provisions which may conflict with these recommendations.

126. Three basic categories of vehicles are described herein in accordance with NFPA No. 403, Aircraft Rescue and Fire Fighting Services at Airports and Heliports, namely:

1261. MAJOR FIRE FIGHTING VEHICLES (PART B) with a gross weight of eight (8) tons or more and using liquid agents as their primary fire suppression means. Because of the broad range covered by the category, major fire fighting vehicles (Part B), this category is divided into classes according to gross vehicle weight (see Paragraph 212).

1262. LIGHT RESCUE VEHICLES (PART C) with a gross weight of under four (4) tons, having dry chemical, low-pressure carbon dioxide, liquid agents or a limited supply of a combination of these agents as their fire suppression means, coupled with superior acceleration characteristics for rapid response to an aircraft emergency, and

1263. COMBINED AGENT VEHICLES (PART D) with a gross weight of between four (4) and eight (8) tons, designed for superior acceleration, equipped for rescue, and using liquid and dry chemical agents, either singly or in combination, as their fire suppression means.

127. Part G of this Standard gives Definitions and Part F is a Questionnaire designed to secure information on design features of vehicles for aircraft rescue and fire fighting service.

13. Responsibility of Contractors (Suppliers).

131. The emergency nature of aircraft rescue and fire fighting services requires that a high level of competence, reliability, and experience be demanded of contractors building equipment for such service. Materials used in fabrication must be of superior character.

132. The contractor must assume complete responsibility for all component parts of the complete vehicle, even though major portions may be sub-contracted. This responsibility shall include design, construction, inspection, performance test, and servicing. The purchaser should ascertain that the contractor is capable of furnishing parts and technical assistance to the purchaser for the normal life of the vehicle (10 years).

NOTE: Responsibility for servicing shall not include those components supplied to the contractor by the customer, unless so specified in the contract.

133. The contractor shall also be responsible for assuring that the vehicular performance of the vehicle meets this standard and thus qualifies as a well-designed aircraft rescue and fire fighting vehicle. All major components shall have the manufacturer's rating for this type service and these ratings shall not be exceeded by actual imposed loads. A one-year warranty shall be supplied by the contractor. Bidders should be required to furnish with the bids a detailed description of the vehicles offered, and drawings showing general arrangement, weights, and dimensions. Data similar to that provided for in the Questionnaire contained in Part F should also be required.

134. Manuals. The manufacturer shall supply at time of delivery at least two (2) complete copies of the following manuals:

a. Operator's Manual

b. Service Manual

c. Parts Manual.

These manuals will cover the complete vehicle and shall be in accordance with the following:

1341. OPERATOR'S MANUAL. Operating instructions shall include all information required for operation of the vehicle and main equipment, special attachments, and auxiliary equipment under the climatic conditions they may encounter. Location and function of all controls and instruments shall be covered by illustrations and descriptions. These instructions, as a minimum, shall also include the following:

a. Complete description of the vehicle and special equipment.

b. Preparation for use of the vehicle upon receipt.

c. Operator daily maintenance and mission readiness checks.

d. Periodic operator inspection.

1342. SERVICE MANUAL. The repair and overhaul instructions shall be factual, specific, concise and clearly worded so as to be readily understood by a qualified mechanic with no previous experience on the equipment being purchased. The instructions shall cover such typical maintenance and repair operations as trouble shooting, adjustment procedures, minor and major repairs and overhaul, removal and replacement of units, assemblies and subassemblies, and complete instructions for disassembly and re-assembly of components. The instructions shall also include data listing tolerances, specifications and capacities. Illustrations, wiring diagrams and exploded views shall be used to clarify texts and should appear as close to the related text as possible. Special tools required for the repair and overhaul of the equipment shall be listed and illustrated. The service manual shall contain a suitable index.

1343. PARTS MANUAL. The parts list shall include illustrations and exploded views, necessary for the proper identification of all parts, assemblies, subassemblies and special equipment. Assemblies or components shall be shown in illustrations and be identified by reference numbers which correspond to the reference numbers in the parts list. The size, thread dimensions and special

characteristics shall be given on all non-standard nuts, bolts, washers, grease fittings and similar items. The parts identification manual shall show the description and quantity of each item used per vehicle. The parts identification manual shall contain a numerical index.

135. Special operating instructions for agents such as dry chemical, liquid agent, or low pressure carbon dioxide, shall be mounted on the vehicle in a suitable location.

14. Vehicular Design Principles.

141. The vehicle design shall provide for rapid acceleration and high speed; maximum mobility on and off pavements in all seasons and under all weather conditions; ease of operation; safety; reliability; and accessibility for repairs and maintenance.

142. All-wheel drive for off-pavement operation is essential and shall be achieved without sacrificing any of the attributes of high performance, high speed vehicles. Weight shall be distributed substantially equal over all wheels with maximum tire loads limited to provide the highest practicable level of performance on soft, slippery or rough terrain.

143. Special design consideration shall be given to the saving of weight wherever possible, insofar as it can be accomplished while retaining a large factor of safety on wearing and stressed members. This can be accomplished through the use of light-weight construction wherever possible.

144. Performance requirements outlined in this standard shall be met with the vehicle in an in-service condition.

PART B — MAJOR FIRE FIGHTING VEHICLES

21. General.

211. The category of major vehicles encompasses a gross vehicle weight range commencing at 16,000 lbs. and extending to over 80,000 lbs. Because the same performance cannot be expected of all vehicles within this range, it is necessary to classify vehicles into weight ranges within which an equal level of performance is practicable.

212. Accordingly, the following vehicle capacity in gallons has been established in classes for the purpose of this standard. Weight shall not exceed that specified for each class.

Class	Water Capacity (Gallons)	Vehicle Weight Range (Pounds)
1	500	16 000 — 24 999
2	1 000	25 000 — 31 999
3	1 500	32 000 — 46 999
4	2 000	39 000 — 57 999
5	2 500	52 000 — 64 999
6	3 000	58 000 — 74 999
7	3 000 Plus	75 000 and over

213. The weight of a vehicle for purposes of this classification is its gross weight, with all fire fighting and rescue equipment, full load of extinguishing agents, full load of fuel, and complete personnel complement, ready for service.

214. Because definite differences in performance exist between classes, it is essential that specifications for purposes of bidding be drawn to limit the maximum gross weight.

NOTE: Variations in gross weight should be permitted because of differences in design and construction, provided the original performance recommendations as contracted for have been met.

22. Weights and Dimensions.

221. Weights.

2211. The gross vehicle weight rating of the chassis as furnished shall equal or exceed the actual gross weight of the fully loaded and equipped vehicle.

2212. Weight should be distributed as equally as practical over the axles and tires under all conditions of loading for vehicles in Classes 1 through 6; for vehicles in Class 7, the weight should be distributed as equally as practical over the axles and tires under the condition of maximum loading. Under the conditions mentioned above, the variation in weight between any two tires or any one axle shall not exceed 5 per cent right and left, or 10 per cent between any two axles.

NOTE: Weight on individual tire shall be determined by weight scale measurement at the ground.

Weight variations between axles shall be based on the average loading of the axles and, between tires, shall be the average loading of the two tires of a given axle.

These recommendations favor the use of single tires and a drive to all wheels. The tires are also required to be of uniform size. Therefore, best performance and traction are possible only by equalizing the weight on individual tires.

Maintaining equalization of weight over the tires under conditions of light load is also essential for best performance, particularly since the load may be lightened so that the vehicle can traverse extremely soft ground. With Class 7 vehicles, extinguishing agent load is a greater percentage of gross weight, making weight distribution under condition of empty load relatively less significant than in the case of Classes 1 through 6.

Maintaining equalization of weight over the tires under conditions of light load is also essential for best performance, particularly since the load may be lightened so that the vehicle can traverse extremely soft ground.

The conditions of loading considered are those due to addition or discharge of the fire extinguishing medium such as water or chemicals.

2213. Center of gravity of the vehicle shall be kept as low as possible under all conditions of loading. The vehicle shall be capable of operations on a 20 per cent side slope in both directions and shall be capable of ascending and descending a 50 per cent grade in forward gear.

222. Dimensions.

2221. Under-clearances of the chassis shall be sufficient to permit the maximum mobility in soft ground and rough terrain which tire size, weight, and power make the vehicle potentially capable of traversing. The following are the minimum acceptable clearance dimensions and angles:

Angle of Approach	30 degrees
Angle of Departure	30 degrees
Interaxle Clearance Angle	12 degrees
Under-Chassis Clearance	18 inches
Under-Axle Clearance	12 inches

Under-chassis-clearance dimensions shall apply to all portions of the chassis except for tires, axles and wheel-mounted brake drums.

2222. Over-all height, length, and width of the vehicle shall be held to a minimum so as to provide greater maneuverability due to compactness and to facilitate movement on public highways.

NOTE: Over-all width should be checked with local jurisdiction. Class 5 through 7 vehicles should be restricted to the immediate environs of the airport.

2223. Chassis shall be so constructed and body and equipment so mounted that a seated driver having an eye height of 31¾ inches shall be able to see the ground 20 feet ahead and shall have a minimum range of vision of 15 degrees above horizontal without leaving or rising in his seat. His vision in the horizontal plane shall be at least 180 degrees. He shall be able to see the ground immediately adjacent to the driver's side of the vehicle. For these conditions, the driver's seat shall be in the vertical and horizontal adjustment midpositions.

NOTE: Eye height is defined as the vertical distance from the depressed seat surface to the inner corner of the eye.

2224. Rear view mirrors with a glass area of not less than 60 square inches shall be provided, one on each side of the vehicle. Each shall be provided with a 3-inch (minimum) wide angle (convex) mirror.

NOTE: Best design dictates either a cab forward or cab-over-engine arrangement to insure that the driver is placed sufficiently far forward so that he can see the ground a short distance ahead of the vehicle.

23. Engine.

231. General Performance Recommendations and Arrangements:

2311. The vehicle engine shall be a diesel having horsepower, torque, and speed characteristics to satisfactorily meet all specified vehicular performance characteristics. The engine manufacturer shall certify that the installed engine is approved for this application.

NOTE: Gasoline powered engines may be used in lieu of diesel engines for Class 1 Vehicles up to 24,999 pounds, provided they meet all required vehicular performance characteristics. The use of modified or special fueled engine shall be prohibited.

2312. The vehicle shall be consistently able, when fully loaded, of accelerating from 0 to 50 miles per hour on dry level concrete pavement within the maximum times shown in the following tabulated material. The acceleration time requirement governs even though the power-to-weight ratio may not apply.

Class	Water Capacity (Gallons)	Gross Vehicle Weight Range (Pounds)	Acceleration (Time 0-50) MPH (Seconds)	Est. Max. Gross Horsepower Per 1,000 Lbs. GVW
1	500	16 000 — 24 999	30	11 — 13
2	1 000	25 000 — 31 999	35	10 — 10.5
3	1 500	32 000 — 46 999	40	9 — 11
4	2 000	39 000 — 57 999	45	10
5	2 500	52 000 — 64 999	45	10
6	3 000	58 000 — 74 999	50	9
7	3 000 Plus	Over 75 000	50	9

NOTE: Horsepower for determining power-to-weight ratios shall be Maximum Gross Horsepower as defined in SAE Standard J816b corrected to Standard Ambient Conditions (SAE Standards are published by Society of Automotive Engineers, Inc., 2 Pennsylvania Plaza, New York, New York 10001).

The above acceleration times shall be achieved in ambient temperatures varying from 0 degrees F to 100 degrees F and at elevations up to 2,000 feet above sea level unless a higher elevation is specified.

NOTE: The above acceleration requirements at elevations up to 2,000 feet above sea level are intended to ensure acceptable performance at the great majority of airports.

Airports above 2,000 feet should state the elevation at which the vehicle will operate in order to ensure the required performance.

2313. Where the engine(s) is (are) used to power both the chassis and the fire fighting pumps, provision shall be made to

ensure that the operation of the pump will not, under any circumstances, cause either:

a. the engine(s) to stall, or

b. more than a slight, and momentary reduction in engine speed and consequent drop in pump pressure.

The vehicle shall also be capable of ascending, stopping, starting and continued ascent of a 40 per cent grade on dry pavement at a speed up to at least 1 mile per hour with extinguishing agents being discharged at maximum rated capacity from the turret(s).

2314. The engine shall be equipped with a governor which shall be set at not more than the maximum permissible revolutions-per-minute recommended by the engine manufacturer under no-load condition.

NOTE: Engine governed speed may have to be set below engine manufacturer's recommendation if torque converter manufacturer or transmission manufacturer has set lower limitations on maximum allowable input speed.

2315. The provisions appearing in Sections 232, 233 and 234 contain recommendations for the engine and its accessories and systems which have proven desirable in vehicles for this type service.

232. Engine Cooling Systems.

2321. LIQUID COOLED ENGINES.

a. The cooling system should be of the closed, forced-feed type using a circulating pump. The radiator, cylinder block, cylinder head, fan and water pump shall be of ample capacity to permit continuous flow with full load operation of the engine at both stationary and maximum vehicle speed without boiling the coolant under ambient temperature conditions up to 110 degrees F. The cooling system shall be provided with an automatic thermostat for prompt engine warming.

b. Radiator shutters, when furnished for cold climates, shall be of the automatic type, and be designed to open automatically upon failure.

2322. AIR-COOLED ENGINES.

a. Air-cooled engines shall be so designed and installed as to permit the vehicle to stand still and pump for indefinite periods without overheating.

b. Air-cooled engine design and installation shall provide for sufficient rate of flow and distribution of air to hold cylinder head and oil temperatures within manufacturer's prescribed limits under all operating conditions. This shall include full power operation for prolonged periods with ambient temperatures up to 110 degrees F, at both stationary and maximum vehicle speed.

c. Cylinder head and oil temperature gages that clearly indicate maximum permissible operating temperature shall be mounted in the cab and elsewhere, as required, to be plainly visible to the driver.

233. Fuel System.

2331. For gasoline engines, a complete fuel system should include a mechanically driven fuel pump, auxiliary electric fuel pump, fuel strainer and necessary piping, including a flexible fuel line from the fuel pump to the tank line. All fuel lines shall be protected from damage, exhaust heat, and exposure to ground fire.

2332. An accessible strainer shall be provided for each fuel line and a drain shall be provided at the bottom of the fuel tank.

2333. Fuel tanks shall not be installed in such a manner as to permit gravity feed to the carburetor.

2334. Fuel tanks shall be provided with an Underwriters' Laboratories, Inc., Underwriters' Laboratories of Canada, or Factory Mutual Engineering Corporation approved flame arrester relief fitting on the filler opening.

2335. Fuel tank capacity shall be sufficient to provide for two (2) hours pumping at rated capacity.

234. Exhaust System.

2341. The exhaust system shall be of such size as to avoid undue back pressure and shall be located and constructed in such a manner that entrance of exhaust gases into the cab will be minimized under all conditions of operation. Exhaust system shall be of high-grade, rust-resistant materials.

2342. The tailpipe and muffler shall be protected from damage due to traversing rough terrain. Tailpipe shall be designed to discharge upward or to the rear and shall not be directed toward the ground.

24. Vehicle Electrical System.

241. Each engine shall be equipped with a complete and separate starting system.

242. The vehicle shall be provided with a complete electrical system of either the 12 or 24 volt type.

243. An alternator and rectifier, capable of delivering a minimum of 100 amperes, 12 volts or 50 amperes, 24 volts, shall be provided.

244. A dual capacity battery system shall be provided. For 12 volt systems, there shall be two (2) 12 volt batteries connected in parallel, 200 ampere hour capacity each at 20 hour rate. For 24 volt systems, there shall be two (2) 24 volt batteries, connected in parallel, 100 ampere hour capacity each, or four (4) 12 volt batteries connected in series parallel, 100 ampere hour capacity each at 20 hour rate.

245. Provisions shall be provided to permit plugging into local electric power supplies to maintain battery charging.

246. An engine coolant preheating device shall be provided as an aid to rapid starting and high initial engine performance.

247. The electrical system shall be insulated, waterproofed and protected against exposure from ground fires.

248. Radio suppression of the electrical system, sufficient to assure positive operation of radio equipment without interference, shall be furnished.

25. Vehicle Drive.

251. The drive shall provide for the transmission of power from the engine flywheel to the wheels of the vehicle with such multiplication of torque that the vehicle is capable of traveling at all speeds necessary for effective aircraft rescue and fire fighting service. With respect to Classes 2 through 7, the drive shall provide for the continuous transmission of power from the engine through a torque converter or fluid coupling and transmission. The transmission shall have the ability to shift from any selected ratio to another in sequence, either forward or reverse, without interruption of power transmission.

NOTE: See Note under Paragraph 2311.

252. The entire drive train shall be designed with sufficient torque capacity to slip the wheels of the fully loaded and balanced vehicle on pavement having a coefficient of friction of 0.6. The following drive line components shall be certified by the

component manufacturer to be suitable for use in the drive line of the complete vehicle considered as a complete vehicle: clutch and/or torque converter, transmission, transfer case, propeller shaft, differentials and axles.

253. The transmission shall have sufficient range of gears to provide a minimum top speed in highest gear of 50 mph and enough reduction in lowest gear to produce the tractive effort needed to ascend a 50 per cent grade. Spacing of intermediate gears shall provide an adequate number of speeds for all operating conditions without excessive overlap.

254. Positive drive to each wheel is required to negotiate soft ground, unimproved surfaces, snow or ice. Positive wheel drive may be achieved by use of torque proportioning differentials, automatic devices, or by means of a driver selectable differential lock (provided the requirements of Paragraph 256 are met) which will ensure that each wheel of the vehicle is driven independently of the other wheels.

255. The transfer case may be either separate or integral with the transmission. It shall incorporate a drive to the front and rear axles which is engaged at all times during the intended airport service and which will not allow the vehicle to stall as long as the tires of any axle have traction. Class 7 vehicles with a dual engine arrangement having one engine driving the front axle(s) and another engine driving the rear axle(s) may omit a transfer case provided the transmissions are synchronized and each engine delivers uninterrupted power to their respective driving wheels whenever it is desired to move the vehicle forward or backward.

256. Front and rear axles shall have adequate capacity to carry the maximum imposed load under all intended operating conditions. The variations in axle tread shall not exceed 20 per cent of the tire sectional width at rated load. Front and rear axles shall meet the requirements of Paragraph 254. When inter-axle differentials are furnished with bogie axles, they shall also meet the requirements of Paragraph 254. When a driver selectable differential lock is used, the lock control shall be placed in the "engaged" position during intended emergency service.

257. It is recommended that front axles be equipped with steering drive ends of the constant velocity type or other provision be made to eliminate objectionable cyclical fluctuations in angular velocity of the wheels when they are cramped in the steering position.

26. Other Chassis Components.

261. Clutch. When a clutch is used, the actuation pedal pressure to obtain release shall not exceed 50 pounds with adequate displacement for wear prior to normal adjustment.

262. Transmission. Where a fire fighting pump is driven from the chassis engine, provision shall be made in design of the power take-off to allow uninterrupted transmission of power to the pump even though the transmission gears are being shifted, clutch is released, or the transmission is placed in any of its speed ranges.

263. Suspension.

2631. The suspension system shall be designed to allow the vehicles, loaded or unloaded, to travel at high speeds over improved road surfaces, and at moderate speeds over rough, unimproved terrain. Special consideration shall be given to the need for cushioning road shocks, providing adequate wheel motion, and reducing unsprung weight. Suspension is not required for 4 by 4 articulated vehicles in Class 7.

2632. Design of the axles and suspension system shall be such that the total unsprung weight of the vehicle will not be greater than 20 per cent of the gross weight of the vehicle when fully loaded.

NOTE: Unsprung weight is that portion of the vehicle weight not carried by the chassis springs.

2633. Design of axles and suspension system shall also provide for a diagonally opposite wheel motion aboveground of not less than 14 inches for vehicles in Classes 1 through 7 without raising any other wheel off the ground.

2634. Suspension design shall be such that at least two inches of deflection remain before bottoming of suspension on the axle stops or bumpers when the vehicle is fully loaded and on level ground.

2635. Double acting hydraulic shock absorbers shall be furnished on front axles, except bogie axles. Front and rear axles shall be furnished with stops for bottoming to prevent damage to axles, propeller shafts, engine oil pan, or any other portions of the chassis which may be damaged by wheel motion beyond allowable amounts.

264. Wheels, Tires and Rims.

2641. Wheels shall be single rim type with tires of identical size and same tread design.

2642. Tires and inflation pressures shall be selected to provide effective performance on the terrain encountered in the intended airport service. For normal terrain conditions, a maximum inflation pressure of 45 pounds per square inch is recommended. For more extreme terrain conditions, lower inflation pressure down to 30 pounds per square inch may be desirable for greater off-pavement mobility. The following Table sets forth recommended maximum loads per tire for standard tire sizes at inflation pressures of 30 pounds per square inch and 45 pounds per square inch.

2643. Actual inflation pressures of the tires with the vehicles in an in-service condition shall be as specified in the Table.

2644. If the vehicle is required to operate on the highway five or more miles beyond the immediate vicinity of the airport at sustained speeds above 30 miles per hour, inflation pressure should be increased to those levels recommended for highway service.

2645. An aggressive tire tread is recommended for general service. Tire manufacturers should be consulted for tread designs to meet special terrain conditions.

2646. Rim contours and sizes shall also be based on current practices of the Tire and Rim Association, Inc.

TIRE LOAD RATINGS

Tire Size	Recommended Load at 30 lb. Inflation	Recommended Load at 45 lb. Inflation
9.00–16	1,950	2,475
8.25–20	2,390	3,030
9.00–20	2,840	3,590
10.00–20	3,200	4,050
11.00–20	3,540	4,480
12.00–20	4,020	5,080
12.00–24	4,520	5,720
14.00–20	5,620	7,100
14.00–24	6,270	7,920
16.00–25	8,200	10,400
18.00–25	10,670	13,520
18.00–33	12,640	16,000
21.00–25	13,640	17,280
21.00–29	14,820	18,770
24.00–25	16,860	21,340
17.5–25	7,620	9,680
20.5–25	9,590	12,170
23.5–25	12,440	15,760
26.5–25	15,530	19,700
26.5–29	17,090	21,650
29.5–25	19,160	24,210
29.5–29	20,650	26,200
29.5–35	23,100	29,290
33.5–33	28,750	36,470
33.5–39	31,800	40,300
37.5–33	35,020	44,400
37.5–39	38,350	48,460
37.5–51	44,950	56,800

NOTE: Adequate ply rating must be selected as determined by load and inflation to be used (refer T & R A Year Book). T & R A refers to the Tire and Rim Association.

NOTE: For tire sizes not shown, current load ratings may be obtained from the Tire and Rim Association, Inc. (Command Building, 34 N. Hawkins Ave., Akron, Ohio 44313) or from the tire manufacturer. The above maximum loads are based on those ratings as shown in the current Tire and Rim Association, Inc. Year Book. Actual inflation pressures of the tires with the vehicles in an in-service condition shall be as specified above.

27. Controlling Mechanisms.

271. Brakes.

2711. Service brakes shall be of the all-wheel type. On vehicles in Class 1, service brakes may be of the hydraulic type with power booster or the air-mechanical type. On vehicles in Classes 2 through 7, service brakes shall be of the air-over-hydraulic or air-mechanical type.

2712. If air-mechanical brakes are furnished, a brake chamber shall be provided for each wheel and shall be mounted so that no part of the brake chamber projects below the axle.

2713. Air brake systems shall include a compressor, release valve, brake control valve, treadle-type actuating pedal, air pressure gage, enclosed-type brake adjusters, low pressure warning, and all necessary connections.

2714. When the vehicle is supplied with air brakes, the air compressor shall meet the following criteria: It shall be engine-driven, having a capacity sufficient to increase air pressure in the supply and service reservoirs from 85 to 100 pounds-per-square inch (psi) when the engine is operating at the vehicle manufacturer's maximum recommended revolutions per minute (rpm) in a minimum of 25 seconds. If reservoir volume is greater than minimum required, proportionately longer buildup time is allowed using the following formula:

$$\frac{\text{Actual reservoir capacity x 25}}{\text{required reservoir capacity}}$$

The total of service reservoir volume must be at least 12 times total combined brake chamber volume at full stroke. Reservoirs shall be equipped with drain and safety valves. Provision for quick buildup of pressure shall be furnished, with quick buildup tank having a minimum capacity of 800 cubic inches. Quick buildup of tank pressure from 5 psi to the pressure regulating valve setting shall be accomplished within 12 seconds.

2715. The service brakes shall be capable of holding the fully loaded vehicle on a 50 per cent grade, and capable of bringing the fully loaded vehicle to five (5) complete successive stops within 30 feet from a speed of 20 mph on dry, hard, approximately level road, free from loose material. For vehicles in Class 7, the stopping distance shall be within 40 feet from a speed of 20 mph.

2716. The parking or emergency brake system shall be an entirely independent mechanical system or may be connected to the same brake shoes as the service brakes but through entirely separate mechanical means.

2717. The parking brakes shall be capable of holding the fully loaded vehicle on a 20 per cent grade and of stopping the vehicle within 120 feet from a speed of 20 mph on dry, hard, approximately level road, free from loose material. For vehicles in Classes 5 through 7, the stopping distance shall be within 160 feet from a speed of 20 mph. The parking brakes shall be either hand lever operated or spring set type. Spring set type parking brakes shall be integrally mounted with the service air brake chambers of the rear axle(s) and shall be automatically applied should the vehicle air pressure fall below 30 psi. Provision shall be made for release of the spring brakes in an emergency when the air system is inoperative.

272. Steering.

2721. Chassis in Classes 1 through 6 shall be equipped with power-assisted steering. The steering mechanism shall be so designed to permit manual steering sufficient to bring the vehicle to a safe stop in the event of failure of power assist. Chassis in Class 7 may be provided with a full hydraulic power steering system, provided the system permits control of the vehicle even though the power source becomes inoperative.

2722. The power steering shall have sufficient capacity so that no more than 15 lbs. pull is required on the steering wheel in order to turn the steering wheel from lock to lock with the engine running.

28. Turning Diameter.

281. The wall-to-wall turning diameter of the fully loaded vehicle shall be held to a minimum. The minimum acceptable cramp angle shall be 28°.

29. Cab.

291. Arrangement.

2911. The cab shall be mounted on the forward part of the vehicle, and may consist of a unit on the left side of the vehicle, a unit running across the width of the vehicle, or in the case of Classes 5 through 7, two units, one on each side of the vehicle. When the cab consists of two units, the driver shall sit in the left unit, and an internal communication system shall be provided between the two units.

2912. The cab shall meet the visibility requirements of Paragraph 2223. It shall have seats for all assigned crew members, including individually adjustable driver's seat and adequate space for the instruments, controls and equipment specified herein without hindering the crew. Wide opening doors shall be provided on each side of the cab with necessary steps and handgrabs to permit rapid and safe entrance and exit from the cab. When the cab consists of two units, there shall be a walkway with steps and grab handles as necessary to permit crew movement between the two units. The windshield and side windows shall be constructed of shatterproof plate glass. The cab shall be provided with wide gutters to prevent foam and water from dripping on the windshield and side windows. There shall be a quick-opening hatch in the roof providing access to the turret(s).

292. CONSTRUCTION. The cab shall be constructed in Classes 2 through 7 Vehicles (see Paragraph 212), of metal alloy or fiberglass-reinforced plastic, of adequate strength to ensure the safety of the crew. The cab shall be rainproof and dripproof, and shall be fully insulated with a fire resistant insulating material at least one-half inch thick. The cab may be of the unitized rigid body and frame structure type or it may be a separate unit flexibly mounted on the main vehicle frame.

293. INSTRUMENT AND WARNING LIGHTS. The minimum number of instruments and warning lights consistent with the safe, efficient operation of the vehicle and equipment shall be provided. Warning lights shall be used where practicable instead of instruments, and provisions shall be made to readily test the condition of the bulbs. All instruments and warning lights shall be displayed in a panel or panels in such a way that they will be most useful, convenient, and visible to the driver. In a two unit cab arrangement, appropriate duplicate instruments and lights shall be provided in the right hand unit. The panel or panels shall either be easily removable as units or hinged for back access by the employment of quick disconnect fittings

for all electrical, air, and hydraulic circuits. All instruments shall be illuminated by back-lighting. The following instruments and/or warning lights shall be provided:

Speedometer/Odometer
Engine tachometer(s)
Fuel level
Air pressure
Engine(s) coolant temperature
Engine(s) oil pressure
Engine(s) generator indicator
Transmission(s) oil pressure*
Transmission(s) oil temperature*
Pump pressure
Water tank level
Foam liquid tank(s) level
Low air pressure warning
Headlight beam indicator
Pump output indicators (applicable only when two pumps in parallel are furnished)

*Applicable only when torque converters are furnished.

294. CONTROLS. The cab shall have all the necessary controls within easy reach of the driver for the full operation of the vehicle and the pumping system. In a two unit cab arrangement, appropriate duplicate controls shall be provided in the right hand unit. The following cab controls shall be provided:

Accelerator pedal
Brake pedal
Clutch pedal**
Parking brake lever
Steering wheel, with self-cancelling directional signal control and horn
Transmission range selector
Pump control or selector
Foam liquid tank(s) valve control
Siren switch(es)
Ignition switch(es)
Groundsweep valve control
Undertruck valve control
Remote turret controls*
Starter switch(es)
Light switches
Windshield wiper and washer controls
Heater-defroster controls
Master electrical disconnect switch

*Applicable only when remote turret is furnished.
**Applicable to Classes one (1) and two (2) vehicles ONLY.

295. EQUIPMENT. The following equipment shall be provided in or on the cab, as may be applicable:

Heater-defroster, with 200 BTU output per cubic foot of cab space, with blower capacity per minute equal to cab volume, with fresh air intake, and with defroster ducts to windshield
Driver's seat 3-way adjustable, bucket type, with seat belt
Crew seats with individual seat belts
Siren
Horns
2 or more windshield washers*
2 or more windshield wipers*
2 or more sun visors
2 outside rear view mirrors
2 door lights
Cab dome light

*Appropriate for removing foam.

30. Body.

301. CONSTRUCTION. The body shall be constructed of metal alloy or fiber glass-reinforced plastic to provide the lightest weight consistent with the strength necessary for off-pavement operation over rough terrain. The body may be of the unitized with chassis rigid structure type or it may be flexibly mounted on the vehicle chassis. It shall also include front and rear fenders. Body panels are to be removable where necessary to provide access to the interior of the vehicle.

302. ACCESS DOORS. Access doors shall be provided for those areas of the interior of the vehicle which must be frequently inspected. In particular, access doors of sufficient size and number shall be provided for access to:

Both sides of each engine
The pump(s) and pump drive
Foam liquid metering device
Battery storage

Other areas requiring access for inspection or maintenance shall either be open, or have removable panels as specified in Paragraph 301.

303. COMPARTMENTS. Suitable, lighted compartments shall be provided for convenient storage of the equipment and tools furnished with the vehicle. Compartment doors shall be hinged and provided with handles operable with hands covered with bulky gloves. Compartments are to be weather-tight.

304. WORKING DECK. The working deck of the vehicle shall be adequately reinforced to permit the crew to perform their duties in the turret area, cab hatch area, water tank emergency fill area, foam liquid emergency fill area, and in other areas where access to auxiliary or installed equipment is necessary.

305. HAND RAILS. Hand rails or bulwarks are to be provided on the working deck and elsewhere as may be necessary for the safety and convenience of the crew. Rails and stanchions shall be constructed of chrome plated metal or anodized aluminum and shall be strongly braced. Hand rails on the upper deck should be at least 24 inches high when conditions permit or in accordance with local safety requirements.

306. STEPS AND WALKWAY. Steps or ladders shall be provided on each side or at the rear for access to the working deck. The rear step may extend below the angle of departure if it is hinged to swing up. All steps shall be rigidly constructed and shall have a non-skid surface. Walkways on the upper deck shall also have a non-skid surface. The lowermost rear step shall be no more than 28 inches above the ground. Adequate lighting shall be provided to illuminate steps and walkways.

31. Pump(s) and Pump Drive.

311. Water Pump(s).

3111. The water pump(s) shall be constructed of corrosion resistant metal and shall be single or multiple stage centrifugal type, designed for dependable emergency service. It shall be carefully designed and built in accordance with good modern practice. The pump shall be gravity primed from the vehicle tank.

3112. When operating from the water tank, it shall be capable of discharging at a rate equal to or exceeding the amount established in Tables 1B, 1C or 2 of NFPA No. 403, but not less than the total gpm requirements of all foam outlets discharging simultaneously at designed pressures.

312. Foam Generating Pump.

3121. A foam generating pump system may be used for primary foam generation providing that a suitable water pump is also installed to supply water and/or foam solution for handlines. The foam generating pump system when used shall be constructed of corrosion resistant materials and shall be designed to produce foam at a rate sufficient to supply the turret nozzles.

313. Pump(s) Drive.

3131. The pump(s) may be driven by any of the following methods: (a) Separate engine(s) drive; (b) Power take-off drive; or (c) Power divider.

3132. SEPARATE ENGINE(S) DRIVE. An independent pump engine(s) shall be provided having sufficient power to meet the pump performance requirements as listed in Tables 1B, 1C or 2 of NFPA No. 403, at not more than the engine manufacturer's recommended governed speed.

The engine(s) shall have the same voltage ignition system as the chassis engine and shall be equipped with an air cleaner, replaceable element oil filter, a full pressure lubricating system, and an overspeed governing device, the last mentioned designed to prevent damage to the engine if under power when the water supply is exhausted. The engine(s) shall also be provided with a radiator of adequate capacity to cool it when operated continuously under full load up to a 110° F ambient temperature.

The pump may be either mounted directly to the engine bell housing, or it may be mounted separately and drive through a friction clutch and propeller shaft. If mounted separately, the clutch shall be of the single or multiple disc friction type having a capacity equal to the engine torque.

3133. POWER TAKE-OFF DRIVE. If the pump(s) is powered by the same engine(s) which is used to propel the vehicle, it shall be driven by a power take-off which is not affected by changes in transmission ratios or the actuation of clutches in the vehicle drive, except insofar as these changes or actuations may affect engine speed. The overall design shall be such that the requirement of uninterrupted transmission of power set forth in Paragraph 262 is met.

Provision shall be made in the design of the drive system and/or controls to prevent damage to the drive or lurching of the vehicle when the transmission is shifted from neutral to either forward or reverse speed ranges while simultaneously pumping. The take-off drive(s) shall incorporate a friction clutch(es), controlled from the cab, with a torque capacity at least equal to the maximum torque which may be absorbed by the pump(s), and designed to withstand engagement of the pump(s) at all engine speeds and under all operating conditions when a fire fighting capability is required.

When a power take-off pump drive is used, there shall be sufficient engine power both to operate the pump(s) at the rate of discharge required by Paragraph 3112, and to propel the vehicle under all operating conditions when a fire fighting capability is required. The over-all design shall be such that the requirements of Paragraph 2313 shall also be met.

3134. POWER DIVIDER. If the pump(s) is driven by the truck engine through a power divider, it shall permit operation of the pump(s) and simultaneous operation of the vehicle. It shall be designed in such a manner to allow the pumps to be engaged and operated at any speed and any gear. The power divider shall be mounted in such a manner to split the engine drive into separate drives [the main drive to the vehicle transmission and the drive to the pump(s) and clutch(es)].

314. Manifolds and Connections.

3141. SUCTION. The suction system shall be designed for efficient flow at the pumping rates required by Paragraph 3112. The pump suction line(s) shall be of large diameter and shortest length consistent with the most suitable pump(s) location. There shall be a drain at the lowest point with a valve for draining all of the liquid from the pumping system when desired. Suction lines and valves shall be constructed of corrosion-resistant materials.

When two pumps are used, they shall be arranged in parallel with manifolding so that either or both may supply any discharge outlet at the required operating pressure. During single pump operation, total capacity may be reduced.

3142. DISCHARGE. The pump discharge system shall be provided with a minimum of two discharge gates with 2½-inch National Standard Thread* adapters and caps.

When two pumps are used in parallel, a discharge manifold shall be provided incorporating a pressure relief device and a check valve for each pump. The check valve shall function automatically and shall be sized and designed for minimum flow restrictions.

3143. PIPING, COUPLINGS AND VALVES. All piping, couplings and valves shall be sized for required flow with minimum restriction and pressure loss. Material for all piping, couplings and valves shall be selected to avoid corrosive and/or galvanic action.

*See NFPA No. 194, Standard for Fire Hose Connections.

Piping shall be securely mounted and provided with flexible couplings to minimize stress. Union or victaulic type couplings shall be provided where required to facilitate removal of piping.

All valves shall be ¼ turn ball type as selected for ease of operating and freedom from leakage.

All water system piping shall be tested on the suction side of the pump to detect possible leakage. All water and solution discharge piping shall be tested at 50 per cent above system operating pressure.

3144. CHURN LINE. A closed system churn line shall be provided from the pump discharge to a heat exchanger at the tank bottom, to prevent overheating of water in the pump while standing and pumping. The churn line valve shall be automatic or shall have a cab control.

3145. PRESSURE REGULATOR. The automatic pressure regulator shall maintain the desired working pressure at all rates of flow.

32. Water Tank.

321. Capacity.

3211. A water tank shall have a capacity in agreement with Tables 1B, 1C or 2, NFPA No. 403. The tank shall be constructed of glassfiber, reinforced plastic or of metal, coated or lined with a suitable rubber, plastic or ceramic. The tank shall have longitudinal and transverse baffles to prevent undue water surge.

322. Construction.

3221. The construction and connections shall be made to prevent the possibility of galvanic corrosion of dissimilar metals.

3222. When dissimilar metals are used for pipe connections (piping) from the tanks, they should be electrically insulated by the use of non-conductive plastic pipe or hose.

3223. The tank shall be equipped with easily removable manhole covers over the sump and a removable top or panels to permit access within each baffled compartment of the tank. It shall have an anti-swirl baffle and a deep sump with drain valves, and two filler openings with caps. Filler openings shall be not less than 5 inches in diameter. The tank vent and overflow provided shall be of sufficient capacity to permit the tank to receive filling at the maximum desired rate of supply to maintain continuity of operations, assuming an available supplementary water

supply. The water tank outlet and suction piping shall be sized to permit a water flow-off capacity as specified in Tables 1B, 1C or 2 of NFPA No. 403.

3224. The tank shall be flexibly mounted unless attached to or supported by a rigid structure.

323. Tank Fill Connection.

3231. Tank fill connection(s) shall be provided in a position where they can easily be reached from the ground. Either one (1) rear mounted connection, or one (1) connection mounted on each side shall be provided. The connections shall have check valves or be so constructed that water will not be lost from the tank when connection or disconnection is made. The tank fills shall have National Standard Thread* swivel female hose connections and shall be sized to permit refilling on either side of the vehicle at a rate at least equal to the minimum discharge rate required in Paragraph 3112. All water fill openings shall be provided with strainers of ¼-inch mesh.

33. Foam System.

330. General. The quality of foam produced by foam-liquid concentrates is influenced by the devices which proportion the liquid concentrates into water and by the devices which discharge the foam and their conditions of operation. It is recommended that the foam-liquid concentrate used in aircraft fire and rescue vehicles be that supplied and/or recommended by the manufacturer of the foam discharge devices and proportioning equipment. The foam-liquid concentrate used may be a protein foam, or an aqueous-film-forming foam (AFFF). All components of the foam system including the foam-liquid tank, piping, fill troughs, screens, etc., should be made of materials resistant to corrosion by the foam-liquid concentrate and water.

NOTE: If a change in type of concentrate is to be made, see NFPA No. 403, Article 200.

331. Foam Liquid Concentrate Tank(s).

3311. The foam liquid tank(s) should be sized in conformance with Tables 1B, 1C or 2 of NFPA No. 403. Lightweight materials of adequate strength should be used where practical.

3312. Foam-liquid concentrate tanks may be of either rigid or flexible type.

*See NFPA No. 194, Standard for Fire Hose Connections.

a. Flexible type tanks shall be nylon reinforced EPT (ethylene propylene terpolymer), nylon reinforced neoprene, or nylon reinforced Buna N. These elastomers should be compounded for liquid use.

b. Rigid tanks shall be either metal or fiberglass reinforced (FRP).

(1) Metal tanks shall be fabricated from carbon steel with an interior baked phenolic coating of 5–7 mils thickness, or from 304 or 316 stainless steel.

(2) FRP tanks shall be fabricated using isophthalic type polyester resins. An interior gel coat with a minimum thickness of 15–20 mils of isophthalic type polyester resins shall be applied. If the concentrate tank is a part of the water tank, and is exposed to the water, a gel coat of 15–20 mils minimum thickness of isphthalic type polyester shall also be applied to the water side of the tank.

3313. Rigid tanks shall be equipped with a removable manhole or a removable tank top to permit access within each baffled compartment of the tank.

3314. Rigid tank outlets should be located above the bottom of the sump and of adequate size to permit maximum flow. The outlets should be arranged so as to permit the use of the full capacity of the tank with the vehicle level and at least 75 per cent of the tank capacity with the vehicle inclined on a 20 per cent side slope or ascending or descending a 30 per cent grade. A large capacity drain connection should be installed flush with the bottom of the sump.

3315. Rigid foam liquid concentrate tanks shall be flexibly mounted unless attached to a rigid structure. Each tank shall be separate and distinct from the body and easily removable as a unit.

3316. A fill trough should be provided equipped with a stainless steel ¼-inch mesh screen and can openers to permit emptying 5-gallon foam liquid concentrate cans into the storage tank at a rapid rate. The trough should be connected to the foam liquid storage tank with a fill line designed to introduce foam liquid concentrate near the bottom of the tank so as to minimize foaming within the storage tank.

3317. A hose connection should be provided at the rear of the vehicle or one on each side of the vehicle to permit the pumping of foam-liquid concentrate into the storage tank or tanks. Positive check or automatic shutoff valves should be provided

to prevent the loss of foam liquid. Where flexible tanks are used, the supply system shall be designed so that the flexible tanks shall not be subject to excess pressure. The supply system should be capable of delivering foam liquid at a rate at least equal to or greater than the maximum discharge rate of the foam system.

3318. The tank(s) shall be adequately vented to permit rapid and complete filling without the buildup of excessive pressure and to permit emptying the tank at the maximum design flow rate without danger of collapse.

332. Foam Liquid Concentrate Pump.

3321. On those vehicles using a pump discharge side proportioning system the foam liquid pump or pumps should be made of bronze or other materials resistant to corrosion by foam liquid concentrate.

3322. The foam liquid concentrate system should be so arranged that the entire piping system including the foam liquid concentrate pump or pumps can be readily flushed with clear water.

3323. The foam liquid concentrate pump or pumps shall be capable of delivering the required quantity of foam liquid at a pressure in excess of the water pump operating pressure regardless of the water flow rate or variations in engine speed.

3324. Where more than one engine is used to drive a water pump or pumps and these same engines are used to drive a foam liquid concentrate pump or pumps, the drive arrangement should be such that whenever power is available to a water pump, power will also be available to a foam liquid concentrate pump.

333. Foam Liquid Concentrate Piping.

3331. The foam liquid concentrate piping shall be of material resistant to corrosion by foam liquid concentrate. Care should be taken that combinations of dissimilar metals that produce galvanic corrosion are not selected or that such dissimilar metals are electrically insulated. Where plastic piping is used, it shall be fabricated from unplasticized resins unless the stipulated plasticizer has been shown not to adversely affect the performance characteristics of the foam liquid concentrate. The plastic pipe may be reinforced with glass fibers. Polyvinyl chloride, polyvinylidene chloride, epoxies and polyesters are among the acceptable classes of resins.

3332. The foam liquid concentrate piping shall be adequately sized to permit the maximum required flow rate.

334. Foam Liquid Proportioning System.

3341. The foam liquid proportioning system shall provide suitable control of the ratio of foam liquid concentrate to the quantity of water being discharged and will permit selection of foam liquid concentrate percentages recommended by the manufacturer.

3342. A maximum tolerance of plus or minus 5 per cent of the proportioning setting shall be permitted at the maximum flow rate.

For example: A proportioner set for 6 per cent should proportion between 5.7 per cent and 6.3 per cent.

The variation below the desired percentage shall not exceed 5 per cent at any flow rate.

335. Turret Nozzles.

3351. Major fire fighting vehicles in service at airports falling into Indexes 4 through 8, as described in Tables 1B and 1C of NFPA No. 403, shall have one or two turret nozzles. Vehicles serving airports falling into Indexes 1 through 3, as described in Table 1B, and Indexes 1 through 4, as described in Table 1C of NFPA No. 403, and in Heliport Categories H-2 and H-3, as described in Table 2 of NFPA No. 403, shall have one turret nozzle.

3352. The total liquid discharge rate from a turret or pair of turrets should be at least 75 per cent of the total rate of discharge for which the vehicle is capable.

3353. Turrets shall be capable of discharging foam in still air in a continuously variable pattern in accordance with the following table:

TURRET FOAM PATTERN REQUIREMENTS*

Foam Solution Discharge Rate (gpm)	Straight Stream		Fully Dispersed or Spray		
	Far Point at Least (ft.)	Near Point No Closer Than (ft.)	Full Width at Least (ft.)	Full Width Extend Out at Least (ft.)	Maximum Solution Density (gpm/ft.^{2})
250–400	125	60	25	25	0.30
500–800	130	40	35	65	0.33
1000	175	40	35	70	0.60
1500	185	50	35	75	0.60
2500	200	60	35	95	0.65

*Turret elevated to 30° (maximum stream reach position).

3354. Turret nozzles with liquid flow rates of 600 gpm or more should preferably be of the dual discharge type and arranged to permit selection of either 50 per cent or 100 per cent of the turret capacity. If these turrets are operable from within the cab, they should have power assist.

3355. Turrets may be hydraulically or manually powered. Where hydraulic controls are provided in the cab, manual override controls shall also be provided from within the cab. Roof-mounted manual controls may be provided if desired. Where a turret is aimed by other than a direct connected control lever, the control should be of the servo type where the control handle is an indicator of the azimuth and elevation angle of the turret.

3356. Turrets should be capable of being depressed at least 15° and elevated at least 45°. Where a single turret is used on a vehicle it shall be capable of being rotated at least 100° to either side (total traverse at least 200°). Where two turrets are used on a vehicle the turrets shall be capable of being rotated at least 100° from the straight ahead position to the side and at least 60° towards the center of the vehicle (total traverse at least 160°).

Where the two turrets are located remotely at or near each end of the vehicle, the forward turret shall be capable of being rotated at least 150° from the straight ahead position (total traverse at least 300°), and the aft turret shall be capable of being rotated at least 150° from the straight aft position (total traverse at least 300°). Suitable stops shall be provided so that neither turret can be directed at the other turret.

3357. Nozzle aspirating systems utilizing protein and fluoroprotein foam liquid concentrates should have a minimum expansion of 8 and a minimum 25 per cent drainage time of 4 minutes. Foam-pump systems utilizing protein and fluoroprotein foam liquid concentrates should have a minimum expansion of 12 and a minimum 25 per cent drainage time of 20 minutes. Aqueous film forming foam (AFFF) systems should have a minimum expansion of 5 and a minimum 25 per cent drainage time of 4 minutes. Measurements of expansions and drainage times shall be in accordance with the procedures outlined in the NFPA Standard for Evaluating Foam Fire Fighting Equipment on Aircraft Rescue and Fire Fighting Vehicles (No. 412).

NOTE: AFFF drains more rapidly than the protein or fluoroprotein foams. The similarity in numerical limits in drainage times of the agents results from the use of different test procedures as detailed in NFPA No. 412.

336. Handline Reels and Nozzles.

3361. Major fire fighting vehicles shall have at least one hose reel and handline.

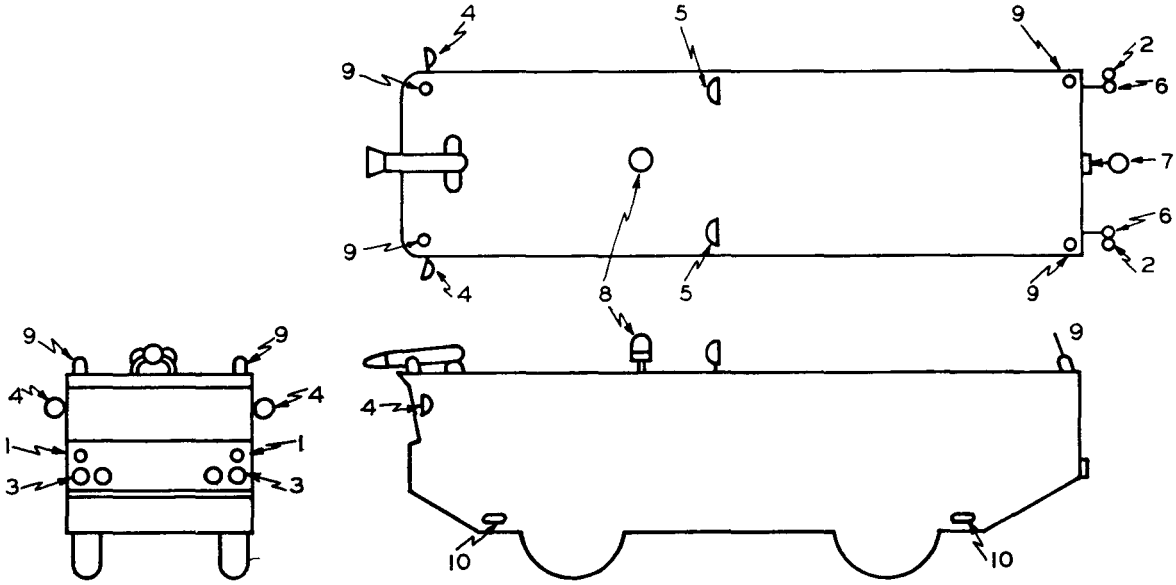
3362. Each reel shall have a capacity for and be equipped with a minimum of 100 feet of 1-inch or 150 feet of 1¼-inch 800 pound test rubber lined hose. Each reel shall be equipped with friction brakes with automatic actuation to prevent hose from unreeling when not desired. Flow to each reel should be controlled by a manually operated quick opening ball-type valve located so that the hose can be charged in the bed position. Each reel shall be designed and positioned to permit hose removal by a single operator from any position in 170° horizontal sector. If a single reel is used, the 170° sector may be centered ahead of the vehicle. The bed position and the top of the reel or reels shall be no more than 5½ feet above the ground. Manual rewind, conveniently located, shall be provided with electric rewind optional.

3363. Each hose shall be equipped with a shutoff type nozzle designed for selection of discharges of foam, water or water fog at a minimum rate of 60 gallons per minute. Each nozzle shall have a foam discharge pattern from a flat 15 ft. width and a 20 ft. range to a solid stream of foam with a minimum 50 ft. range; the resultant foam shall have a minimum expansion and drainage time as specified for turrets in Paragraph 3357, determined with the foam being discharged at the recommended operating pressure.

337. Ground Sweep and Under-Truck Nozzles.

3371. Major fire fighting vehicles provided at airports serving transport type aircraft (see Tables 1B and 1C of NFPA No. 403) should have a ground sweep nozzle or nozzles capable of discharging at least 100 gpm at the recommended operating pressure in a flat pattern 12 ft. wide with a 25 ft. range. The resultant foam shall have a minimum expansion and drainage time as specified for turrets in Paragraph 3358. The ground sweep valve shall be controlled from the cab interior within easy reach of the driver and a crew man and shall also be controlled from a point outside the vehicle.

NOTE: Trucks for airports in Indexes 6 to 8 of Table 1B and Indexes 7 and 8 of Table 1C as described in NFPA No. 403 may be furnished with a movable ground sweep or a bumper nozzle in lieu of a fixed ground sweep nozzle or nozzles. Each movable ground sweep or bumper nozzle should be capable of discharging at least 150 gpm at recommended operating pressure. Each nozzle should be capable of being rotated at least 75 degrees to either side (total traverse at least 150 degrees) and of being depressed at least 15 degrees and elevated at least 30 degrees. It should



The diagram shows the lighting and reflectors recommended in this standard. The numerals have the following meanings: (1) Front direction lights (amber lens); (2) Rear direction lights (red lens); (3) Dual headlights; (4) 6″ Sealed beam spotlight (clear lens); (5) 6″ Sealed beam equipment lights (clear lens); (6) Combination stop and taillights (red lens); (7) Back-up lights (clear lens); (8) Rotating beacon (flashing light); (9) Identification lights (red lens — flashing); (10) Side reflectors (amber).

be capable of discharging foam in a variable pattern from straight stream to dispersed pattern with range and width conforming to 80 per cent of the figures in the Table in Paragraph 3353. Where the flow rate is below that shown in the Table, 80 per cent of the figures for the 250–400 gpm flow rate should be used. The foam produced should have a minimum expansion and drainage time as specified for turrets in Paragraph 3358. The nozzle should have a stowage position which will not limit the angle of approach of the vehicle.

3372. Two or more under-truck nozzles shall be mounted under the truck and controlled from the cab. A sufficient number shall be provided so as to protect the bottom of the vehicle and the inner sides of the wheels and tires with foam solution discharged in a spray pattern.

34. Lighting and Electrical Equipment.

341. Lighting.

3411. Lighting equipment shall include the following:

Two or more sealed-beam headlights with upper and lower driving beams. A foot controlled switch will be provided for beam selection.

Dual taillights and stoplights.

Turn signals, front and rear, conforming to S.A.E. Turn Signal Units, Type 1, Class A, with self-cancelling control, a visual and audible indicator, and a four-way flasher switch.

6-inch minimum chrome plated, sealed-beam spotlight on both left and right sides of the windshield, hand adjustable type, with controls for beam adjustment inside the truck cab.

Reflectors and marker and clearance lights shall be furnished and installed in conformance with the accompanying Figure.

Engine compartment lights, non-glare type, arranged to illuminate both sides of the engine with individual switches located in the engine compartment.

Two swivel mounted lights, 6-inch minimum with clear lens and individual switches, to be mounted on the top deck for equipment lighting.

At least one back-up light installed in the rear of the body.

A flashing red beacon or alternate red and white flashing lights shall be mounted on the top deck and visible 360° in horizontal plane. Mounting of beacon shall also provide good visibility from the air. A control switch shall be provided on the instrument panel in the cab for control of the beacon

342. Siren.

3421. A warning siren shall be provided having a sound output of not less than 95 decibels at 100 feet directly ahead of the siren and not less than 90 decibels at 100 feet measured at 45 degrees on either side. The siren shall be mounted to permit maximum forward sound projection, but shall be protected from foam dripping from the turret, or water splashed up by the tires.

3422. The siren control switches shall be located for use both by the driver, and the officer.

NOTE 1: If desired, the driver's siren control shall be wired for selective control on the steering wheel horn button.

NOTE 2: If a combination public address type siren is desired, an electronic type having the above sound output shall be substituted.

343. Horn.

3431. An electric or air horn shall be provided.

3432. An electric horn shall be mounted at the front part of the vehicle with control by button or ring at steering wheel.

3433. An air operated horn shall be provided when specified with air operated brakes.

344. Radios.

3441. Provision shall be made for mounting two 2-way radios. Operation of the radios shall be from the cab. Radios shall be mounted permitting quick servicing or replacement.

3442. One radio shall be fixed frequency type operating on F.A.A. specified ground control frequency.

3443. One radio shall be two-way local control frequency.

35. Tools.

351. The following equipment shall be provided and properly mounted on the truck or secured in a compartment:

One extension ladder — 2 section folding "A" type, capable of being extended 12 feet. This ladder to be of lightweight alloy, aluminum or magnesium, 24-inch minimum width and mounted in quick release brackets on the apparatus and readily accessible from the ground. This ladder not intended for evacuation use.

Flat step aircraft emergency evacuation stairs, 18 feet in length and 24 inches wide. Upper end to be equipped with door or hatch notches to permit use at varying heights of aircraft doors. The stairs to be provided with a folding guard rail. Stairs to be mounted in quick release brackets on the side of the apparatus applicable to airports in indexes 4 and 5 only.

Two portable electric hand spotlights with a minimum of 25,000 beam candle power rating.

Two axes, 6-pound fire department type, with serrated cutting edges.

One adjustable hydrant wrench.

One set double male and double female connectors to fit fill connections used on the vehicle.

Two spanner wrenches, universal type.

Two spanner wrenches for handline hose couplings.

Two (2) approved dry chemical extinguishers having a minimum UL rating of 80 B:C.

One (1) 36-inch crowbar.

One (1) 36-unit first aid kit.

One (1) cable cutter AT-501-C (Aircraft Tools, Inc.) or equal

One (1) canvas roll to include the following:

One (1) 24-inch bolt cutter

Two (2) cutting knives, parachute "V" type (Stebco or equal)

One (1) hand axe with serrated face and insulated handle

Two (2) Dzus fastener keys

One (1) lineman's side cutting pliers, 8 inch

One (1) keyhole type metal-cutting saw with assorted metal-cutting blades

Any special tools required for servicing pump or equipment shall be provided, but not normally carried on vehicle.

36. Miscellaneous.

361. Front Bumper. A heavy duty front bumper shall be mounted on the forward end of the vehicle and secured to the frame structure.

362. Towing Connections. Two large tow eyes will be capable of towing the vehicle and shall be mounted at the front of the truck and attached to the frame structure. A pintle tow hook or two tow eyes shall be mounted at the rear of the vehicle and attached to the frame structure.

363. Finish.

3631. For maximum visibility, the apparatus should be painted with non-fading chrome yellow finish. Retro-reflective striping (such as "Scotchlite") shall be applied to the front and rear of the vehicle and may be applied to the top and sides as required for quick night identification for rescue and fire fighting equipment.

3632. The surfaces shall be sanded and thoroughly cleaned to remove all oil, rust and dirt before application of primer and surfacer coats.

3633. All lettering and striping shall be in black, unless otherwise specified.

PART C — LIGHT RESCUE VEHICLES

41. General.

411. The category of "light rescue vehicles" covers a vehicle with a gross weight under four (4) tons as indicated in Paragraph 1272 of Part A of this standard.

412. The weight of a vehicle for purposes of this classification is its gross weight, with all fire fighting and rescue equipment, full load of extinguishing agents, full load of fuel, complete personnel complement, ready for service.

42. Weights and Dimensions.

421. Weights.

4211. The gross vehicle weight rating of the chassis as furnished shall equal or exceed the actual gross weight of the fully loaded and equipped vehicle.

4212. The actual weight of the fully loaded and equipped vehicle should be distributed as equally as possible over the axles and tires. The variation in weight between any two tires of any one axle shall not exceed 10 per cent right and left nor shall any axle carry less than 40 per cent or more than 60 per cent.

NOTE: Weight on individual tire shall be determined by weight scale measurement at the ground.

This specification requires the use of single tires and a drive to all wheels. The tires are also required to be of uniform size. Therefore, best performance and traction are possible only by equalizing the weight on individual tires.

4213. Center of gravity of the vehicle shall be kept as low as possible under all conditions of loading. The vehicle shall be capable of resting on a side slope equivalent to a 30 per cent grade without danger of capsizing.

NOTE: The maximum side slope on which a vehicle can rest without capsizing is an indication of its stability and location of center of gravity.

Because of the combined effects of spring motion, tire deflection, speed and surface conditions, the ability to rest on a 30 per cent side slope should indicate the ability to operate on a side slope, up to 20 per cent at slow speed.

422. Dimensions.

4221. Under clearances of the chassis shall be sufficient to permit the maximum mobility in soft ground and rough terrain which tire sizes, weight, and power make the vehicle potentially capable of traversing. The following are the minimum acceptable clearance dimensions and angles:

Angle of Approach	30 degrees
Angle of Departure	30 degrees
Interaxle Clearance Angle	12 degrees
Minimum Ground Clearance	8 inches

Under-chassis-clearance dimensions shall apply to all portions of the chassis except for tires and brake drums.

4222. Over-all height, length, and width of the vehicle shall be held to an absolute minimum so as to provide maximum maneuverability due to compactness and to facilitate rapid movement on public highways.

4223. Chassis shall be so constructed and body and equipment so mounted that the vehicle driver shall be able to see the ground 20 feet ahead when a driver of average height is in his normal driving position without leaving or rising in his seat. He shall be able to see the ground immediately adjacent to the driver's side of the vehicle. It is recommended that truck-type mirrors, or other provisions, be made for vision to the opposite side of the vehicle.

43. Engine.

431. General Performance Recommendations and Arrangements.

4311. The vehicle shall be powered by means of an internal combustion engine capable of developing sufficient power under operating conditions to achieve the required performance characteristics.

NOTE: Turbine-powered vehicles may be used when experience has been accumulated to permit evaluating the capabilities and limitations of vehicles of these types for this specialized service.

4312. The vehicle shall be consistently able, when fully loaded, of accelerating from 0 to 50 miles per hour on dry level concrete pavement within 25 seconds. The above acceleration time shall be achieved in ambient temperatures varying from 0 degrees F to 100 degrees F and at elevations up to 2,000 feet above sea level, unless a higher elevation is specified.

NOTE: It is recommended that gasoline engines be used for aircraft rescue and fire fighting service due to their higher horsepower-to-weight ratio and greater acceleration capability. See Note under Paragraph 4311.

The requirement that the vehicle be capable of accelerating from 0 to 50 miles per hour within 25 seconds at elevations up to 2,000 feet above sea level is intended to ensure acceptable performance at the great majority of airports. Airports above 2,000 feet should state the elevation at which the vehicle will operate in order to ensure the same performance.

The use of high compression or specially modified engines which require high octane or specially blended fuel, and requiring special maintenance, shall be avoided.

4313. Where the engine is used to power both the chassis and the fire fighting pumps, provision shall be made to ensure that the operation of the pump will not, under any circumstances, cause either:

a. the engine to stall, or

b. more than a slight, and momentary reduction, in engine speed and consequent drop in pump pressure.

4314. The provisions appearing in Sections 432, 433 and 434 contain recommendations for the engine and its accessories and systems which have proven desirable in crash fire fighting vehicles.

432. Engine Cooling Systems.

4321. LIQUID COOLED ENGINES.

a. The cooling system should be of the closed, forced-feed type using a circulating pump. The radiator, cylinder block, cylinder head, fan and water pump shall be of ample capacity to permit continuous full load operation of the engine at both stationary and maximum vehicle speed without boiling the coolant under ambient temperature conditions up to 110 degrees F. The cooling system shall be provided with an automatic thermostat for prompt engine warming.

4322. AIR-COOLED ENGINES.

a. Air-cooled engines shall be so designed and installed as to permit the vehicle to stand still and pump for indefinite periods without overheating.

b. Air-cooled engine design and installation shall provide for sufficient rate of flow and distribution of air to hold cylinder head and oil temperature within manufacturer's prescribed limits under all operating conditions. This shall include full

power operation for prolonged periods with ambient temperatures up to 110 degrees F, at both stationary and maximum vehicle speed.

c. Cylinder head and oil temperature gages or warning lights that clearly indicate maximum permissible operating temperature shall be mounted in the cab and elsewhere, as required, to be plainly visible to the driver.

433. Fuel System.

4331. For gasoline engines, a complete fuel system should include an electric fuel pump located near the fuel tank to prevent vapor-lock, fuel strainer and necessary piping, including a flexible fuel line from the fuel pump to the tank line. All fuel lines shall be protected from damage, exhaust heat, and exposure to ground fire.

4332. A strainer shall be provided for each fuel line and a drain shall be provided at the bottom of the fuel tank.

4333. Fuel tanks shall not be installed in such a manner as to permit gravity feed to the carburetor.

4334. Fuel tanks shall be provided with an Underwriters' Laboratories, Inc., Underwriters' Laboratories of Canada, or Factory Mutual Engineering Corporation approved flame arrester relief fitting on the filler opening.

4335. Fuel tank capacity shall be sufficient for two hours' operation.

434. Exhaust System.

4341. The vehicle shall be furnished with an exhaust system, tailpipe, and muffler of such size as to avoid undue back pressure and shall be located and constructed in such a manner that entrance of exhaust gases into the cab will be minimized under all conditions of operation. Exhaust pipe, muffler and tailpipe shall be of high-grade, rust-resistant materials.

4342. The tailpipe and muffler shall be protected from damage due to traversing rough terrain. Tailpipe shall be designed to discharge to the rear and shall not be directed toward the ground.

44. Vehicle Electrical System.

441. The vehicle shall be provided with battery starting and a complete electrical system of the 12- or 24-volt type.

442. An alternator and rectifier, capable of delivering a minimum of 60 amps at 12 volts or 30 amps at 24 volts, shall be provided.

NOTE: Alternator capacity should be specified by the electrical load experienced at each airport.

443. A 70 ampere-hour, 12 volt battery or an equivalent in 24 volts shall be provided.

444. Provisions shall be provided to permit plugging into local electric power supplies to maintain battery charging.

445. The electrical system shall be insulated, splashproofed and protected against exposure from ground fires.

446. Radio suppression of the electrical system, sufficient to assure positive operation of radio equipment without interference, shall be furnished.

45. Vehicle Drive.

451. The drive shall provide for the transmission of power from the engine flywheel to all wheels of the vehicle with such multiplication of torque that the vehicle is capable of traveling at all speeds necessary for effective aircraft rescue and fire fighting service.

NOTE: See Note following Paragraph 4311.

452. The entire drive train shall be designed with sufficient torque capacity to slip the wheels of the fully loaded and balanced vehicle on pavement having a coefficient of friction of 0.6. The following drive line components shall be certified by the component manufacturer to be suitable for use in the drive line of the complete vehicle considered as a complete vehicle: clutch and/or torque converter, transmission, transfer case, propeller shaft, differentials and axles.

453. The transmission shall have sufficient range of gears to provide a top speed in highest gear of 60 miles per hour and enough reduction in lowest gear to produce the tractive effort needed to ascend a 50 per cent grade. Spacing of intermediate gears shall provide an adequate number of speeds for all operating conditions without excessive overlap.

454. It is recommended that front axles be equipped with steering drive ends of the constant velocity type or other provision be made to eliminate objectionable cyclical fluctuations

in angular velocity of the wheels when they are cramped in the steering position.

455. Rear axles shall be provided with automatic locking or no-spin differentials or other automatic locking devices which will lock out differential action whenever any one tire loses traction. It is recommended that the front axles be similarly equipped.

456. Transfer Case. The transfer case may be either gear or chain operated. If chain is employed, adequate provision shall be made for adjustment of the chain due to wear.

46. Other Chassis Components.

461. Suspension.

4611. The suspension system shall be designed to allow the vehicle, loaded or unloaded, to travel at high speeds over improved road surfaces, and at moderate speeds over rough, unimproved terrain. Special consideration shall be given to the need for cushioning road shocks, providing adequate wheel motion, and reducing unsprung weight.

4612. Design of the axles and suspension system shall be such that the total unsprung weight of the vehicle will not be greater than 15 per cent of the gross weight of the vehicle when fully loaded.

NOTE: Unsprung weight is that portion of the vehicle weight not carried by the chassis springs.

4613. Design of axles and suspension system shall provide for an individual wheel motion above level ground or not less than 8 inches without raising any other wheel off the ground.

4614. Spring design shall be such that at least one inch of spring deflection remains before bottoming of springs on the axle stops when the vehicle is fully loaded and on level ground.

4615. Double acting hydraulic shock absorbers shall be furnished on all axles. Front and rear axles shall be furnished with stops for bottoming to prevent damage to axles, propeller shafts, engine oil pan, or any other portions of the chassis which may be damaged by wheel motion beyond allowable amounts.

462. Wheels, Tires, and Rims.

4621. Wheels shall be single rim type with tires of identical size and same tread design.

4622. Tires and inflation pressures shall be selected to provide effective performance on the terrain encountered in the intended airport service. For normal terrain conditions, a maximum inflation pressure of 45 pounds per square inch is recommended. For more extreme terrain conditions, lower inflation pressure down to 30 pounds per square inch may be desirable for greater off-pavement mobility. The following Table sets forth recommended maximum loads per tire for standard tire sizes at inflation pressures of 30 pounds per square inch and 45 pounds per square inch.

TIRE LOAD RATINGS

Tire Size	Recommended Load at 30 lb. Inflation	Recommended Load at 45 lb. Inflation
7.00–16	1,250	1,580
7.50–16	1,430	1,815
9:00–16	1,950	2,475

NOTE: Adequate ply rating must be selected as determined by load and inflation to be used (refer T & R A Yearbook). T & R A refers to the Tire and Rim Association.

NOTE: For tire sizes not shown, current load ratings may be obtained from the Tire and Rim Association, Inc. (Comand Building, 34 N. Hawkins Ave., Akron, Ohio 44313) or from the tire manufacturer. The above maximum loads are based on those ratings as shown in the current Tire and Rim Association, Inc. Year Book. Actual inflation pressures of the tires with the vehicles in an in-service condition shall be as specified above.

4623. Actual inflation pressures of the tires with the vehicles in an in-service condition shall be as specified in the Table.

4624. If the vehicle is required to operate on the highway five or more miles beyond the immediate vicinity of the airport at sustained speeds above 30 miles per hour, inflation pressure should be increased to those levels recommended for highway service.

4625. An aggressive tire tread is recommended for general service. Tire manufacturers should be consulted for tread designs to meet special terrain conditions.

4626. Rim contours and sizes shall also be based on current practices of the Tire and Rim Association, Inc.

47. Controlling Mechanisms.

471. Brakes.

4711. Service brakes shall be of the all-wheel hydraulic type. Power booster shall be furnished when specified.

4712. The service brakes shall be capable of holding the fully loaded vehicle on a 50 per cent grade, and shall be capable of consistently bringing the fully loaded vehicle to a complete stop within 30 feet from a speed of 20 miles per hour on dry, hard, approximately level road, free from loose material.

4713. The parking or emergency brake system shall be an entirely independent mechanical system or may be connected to the same brake shoes as the service brakes but through entirely separate mechanical means.

4714. The parking brakes shall be hand lever operated and shall be capable of holding the fully loaded vehicle on a 20 per cent grade.

472. Steering.

4721. Power steering, if furnished, shall not prevent normal steering in the event of failure of power assist system.

473. Turning Clearance Diameter.

4731. Wall-to-wall turning clearance diameter of the fully loaded vehicle shall not be greater than 3½ times its over-all length.

48. Cab, Body, and Equipment

481. Cab

4811. The cab shall meet the visibility requirements outlined in Paragraph 4223. It shall provide seating for at least two men and seats shall be adjustable type for driving ease.

4812. The following items of equipment and controls are to be provided:

Heater and defroster, manufacturer's standard fresh air type.
Individual seat belts meeting SAE standards.

One (1) electric siren with flashing light having a sound output of not less than 95 decibels at 100 ft. directly ahead of the siren and not less than 90 decibels at 100 ft. measured at 45 degrees on either side.

One (1) traffic warning electric horn.

Two (2) windshield wipers, electric.

Two (2) windshield washers.

Two (2) sun visors.

Two (2) outside rearview mirrors.

One (1) interior dome light with individual switch.

Standard cab instrument panel with instruments and gauges.

For vehicle equipped with 300 pounds or more of dry chemical, a valve as required by Paragraph 4961 shall be provided and mounted convenient to the driver.

For vehicle equipped with low pressure carbon dioxide, the remote controls for the boom or nozzle required by Paragraph 5042 shall be provided convenient for the driver.

482. Body

4821. The body shall be constructed of metal alloy or fiber glass-reinforced plastic to provide the lightest weight consistent with the strength necessary for off-pavement operation over rough terrain. The body shall provide for mounting the dry chemical unit, or low pressure carbon dioxide unit, with a maximum of accessibility for hand lines and controls. Provision shall be made for easy access to service the dry chemical unit and replacement of the pressurizing cylinder. Fenders or wheel housings shall be provided. Fenders shall be securely attached to the body.

483. Compartments

4831. Suitable lighted compartments shall be provided convenient for the storage of the tools and equipment recommended in Paragraph 521. Compartment doors shall be hinged and provided with chrome plated steel or anodized aluminum handles, operable with heavy gloved hands. Compartments are to be weather-tight.

49. Dry Chemical Components.

491. General.

4911. FLOW RATES. Flow rates of the dry chemical shall be such that they will conform with the requirements of Tables 1B, 1C or 2 of NFPA No. 403.

4912. DRY CHEMICAL CHAMBER. Construction of the dry chemical chamber shall be in accordance with the latest ASME Code for Unfired Pressure Vessels and shall be so stamped.

NOTE 1: The nominal capacity of the dry chemical containers has generally been based upon the use of sodium bicarbonate based dry chemicals. When dry chemical compounds of different bases are substituted, a difference in the weights of the dry chemicals that can be placed in the same size container can vary considerably.

An example is the replacement of sodium bicarbonate base with potassium bicarbonate base dry chemicals. In such instances the difference in fresh fill capacity weights of the two dry chemicals for the same size container will vary as much as 10 per cent.

NOTE 2: Do NOT substitute one dry chemical formulation for another without the consent and advice of the manufacturer.

4913. PIPING AND VALVES. All piping and fittings shall conform to the appropriate ASME Code and shall be designed to withstand the working pressure of the system. The design of the piping and valving shall be such that it provides the desired flow of gas into the system and the minimum amount of restriction from the chemical chamber to the hose connection. When more than one hose line is provided, piping and fittings shall be so sized and designed that there will be equal flow to each line regardless of the number of lines placed in operation.

4914. PURGING PIPING AND HOSE. Provisions shall be made for the purging of all piping and hose of dry chemical after use without discharging the dry chemical remaining in the dry chemical chamber. Provisions shall also be made for the depressurization of the dry chemical chamber without the loss of the remainder of the dry chemical.

4915. FLUIDIZATION OF AGENT. The system shall be so designed as to insure fluidization of the dry chemical at the time of operation. Where any design includes the movement of the chemical chamber to fluidize the contents, such design shall also include a manual operating feature.

4916. CHECK VALVE. A check valve shall be provided in the gas piping to prevent the extinguishing agent from being forced back into the propellant gas line.

4917. PRESSURE RELIEF. A means of pressure relief conforming to appropriate ASME Codes shall be provided for the dry chemical chamber and piping to prevent overpressurization in the event of a malfunction in the propellant gas regulator system or in the event the container is involved in a severe fire exposure.

4918. FILL OPENING. The fill opening in the dry chemical chamber shall be located so that it will be easily accessible for recharging and require a minimum amount of time and effort to open and close. The filling shall be accomplished without the removal of any of the extinguisher piping or any major component.

492. Propellants. The propelling agent shall be dry nitrogen or dry air.

4921. All propellant gas cylinders and valves shall be in accordance with the regulations of the U. S. Department of Transportation. Cylinders shall bear the DOT marking.

NOTE: This requirement applicable in the U.S.A. This or similar regulations should be followed in other countries.

4922. The method of adequately pressurizing and propelling the dry chemical in the system shall provide a sufficient quantity of gas to expel the agent in its entirety as well as permitting the complete purging of all piping and hose lines after each use.

4923. The design of the propellant source shall be such that it will provide a quick and easy replacement after each use.

4924. A pressure gauge shall be provided which will at all times indicate the pressure on the propellant gas source.

4925. Cylinder valves, gauges, and piping shall be so arranged and/or guarded to preclude accidental mechanical injuries.

493. Pressure Regulation. Pressure regulation shall be so designed that it will automatically reduce the normal cylinder pressure and hold the propellant gas pressure at the designed operating pressure of the dry chemical chamber.

4931. All pressure regulating devices shall be sealed or pinned at the designed operating pressures after final adjustment by the system manufacturer.

4932. Pressure regulating devices shall be equipped with a spring loaded relief valve which will relieve any excess pressure that may develop in the regulator.

4933. The pressure regulator should be of a type without pressure indicating gauges.

494. Hose. Hose shall be installed so that it is easily accessible. The system shall be furnished with one or two hoses.

4941. Provisions shall be made for the adequate storage of hose. It shall be easily removed from its storage position without kinking. Swivel connections may be provided at the nozzle and/or at the base of the hose, but these may be considered as a supplement to other arrangements which will avoid kinking.

4942. All hose shall be of a type and pressure rating adequate for the service intended.

4943. Each hose length shall be a minimum of 50 feet in length and the maximum length shall be compatible with the design of the system.

495. Nozzles.

4951. Hand hose nozzles shall be simple in operation and shall supply adequate dry chemical range and flow. The nozzle shall have a low discharge recoil characteristic. The operation shall be full open to closed position in one simple movement. The construction shall be of nonferrous metal or stainless steel.

496. Operational Design. Simplicity of actuation shall be given prime consideration in the design of any system. A maximum of two operations (exclusive of the nozzle) shall be required to fully charge the system.

4961. A quick acting control for operation by the driver to pressurize the dry chemical system from the cab of the vehicle shall be provided with a similar control at the unit.

4962. Each hose outlet shall be equipped with a shutoff valve on the vehicle for closing the line.

497. Dry Chemical Type. For aircraft rescue and fire fighting purposes, dry chemical shall be of an approved foam compatible type. It is recommended that the equipment manufacturer's dry chemical be used.

498. Maintenance. The manufacturer's operation and maintenance instructions for the dry chemical equipment shall be provided with each vehicle.

50. Low Pressure Carbon Dioxide Components.

501. General.

5011. Low pressure carbon dioxide may be used as a quick knockdown agent on the basis given in Tables 1B, 1C or 2 of NFPA No. 403.

5012. Low pressure storage containers shall be designed to maintain the carbon dioxide supply at a nominal pressure of 300 psi corresponding to a temperature of approximately 0° F.

5013. The combined discharge capacity of hand lines and boom or bumper nozzles when used shall be sufficient to discharge the entire contents of the storage tank in not more than 2 minutes.

5014. A reserve supply of carbon dioxide should be readily available in order to permit immediate recharging of the truck mounted storage container after use.

502. Storage Container.

5021. The pressure container shall be made, tested, approved, equipped and marked in accordance with the current specifications of the American Society of Mechanical Engineers (ASME) Code for Unfired Pressure Vessels.

5022. In addition to the Code requirements, each pressure vessel shall be equipped with a liquid level gauge, a pressure gauge, and a high-low pressure supervisory alarm operated from the truck battery system. A special relief valve (in addition to the Code requirements) should be provided for controlled bleed off at a pressure below the setting of the main safety valve.

5023. The pressure vessel shall be thermally insulated with a suitable material to give an over-all heat transfer coefficient of not more than 0.05 BTU per square foot per degree F. per hour. The insulation shall be protected with a suitable coating or cover to assure fire resistance, prevent water absorption, and protect against mechanical damage.

5024. The insulated pressure vessel shall be securely mounted to the vehicle chassis so as to prevent any possible shifting without transmitting excessive stress to the pressure vessel itself.

5025. A mechanical refrigeration system shall be provided of sufficient capacity to maintain 0° F. in the storage container with not more than 30 per cent running time when the ambient temperature is 70° F. The refrigeration system may be powered by an electric motor where the truck can normally be stationed at a point where electric power is available. The extension cord providing this power should be fitted with an adapter plug that will pull away automatically when the truck is driven away. The refrigeration system shall be automatically controlled to

maintain a pressure differential in the storage tank of approximately 10 psi.

5026. In locations where the vehicle may be exposed to ambient temperatures below about −10° F. for substantial periods of time, a heating system should be provided to maintain the pressure in the storage container at near 300 psi.

503. Piping, Fittings and Valves.

5031. All pipe fittings and valves used to control and convey liquid carbon dioxide shall have a minimum bursting pressure of 1800 psi and shall be suitable for low temperature use.

5032. Pressure relief valves shall be connected to a separate outlet at the top of the storage container and directed so that the discharge cannot become a hazard to operating personnel. Safety relief valves shall also be provided for any pipe section in which liquid carbon dioxide can be trapped between closed valves.

5033. Liquid fill and pressure equalizing lines shall be piped so as to be readily accessible for recharging storage container.

5034. Discharge piping shall be adequately sized to permit the maximum required discharge rate while maintaining a pressure of at least 150 psi at the nozzles. Discharge valves shall be of the quick opening and closing type and may be remote pressure operated using vapor pressure from the storage tank.

5035. Piping and valves shall be arranged so that the minimum amount of piping is under continuous pressure. Piping under continuous pressure should preferably be welded and shall be tested to assure bubble tight connections.

504. Boom Discharge Nozzles.

5041. Where the vehicle mounted storage capacity is substantially more than 1,000 lbs., it may be desirable to use a high capacity discharge nozzle mounted on the front of the vehicle or on an overhead boom.

5042. Vehicle mounted nozzles when used shall be hydraulically controlled so as to permit remote directing of the discharge stream from within the cab. Remote control shall also be provided to conveniently start and stop the discharge as may be required from within the cab.

505. Hand Lines.

5051. Hose lines shall be constructed with wire braid reinforcement and shall have a bursting pressure in excess of 1800 psi. The inner liner shall be of a material that will remain flexible at −65° F. The outer cover over the wire braid shall consist of a cotton braid or protective covering of sufficient porosity to eliminate the formation of bubbles as a result of minor leakage through the inner liner.

5052. The hose shall be stored on a reel permanently connected to supply piping so that the line is ready for immediate use.

5053. The hose line shall be automatically charged when the discharge nozzle assembly is released from its holding device.

5054. The play pipe shall be provided with a quick opening squeeze type manual valve for conveniently starting and stopping the discharge.

5055. The discharge nozzle shall be of the type capable of giving reasonable projection under windy conditions and should have a discharge capacity of at least 300 pounds per minute.

5056. Special nozzles may be provided to permit total flooding of enclosed spaces through small openings.

51. Combined Agent Systems

511. Combined agent systems are normally provided on vehicles constructed in accordance with Part E of this Standard. Such systems may be utilized on light rescue vehicles where the weight factors involved will not overload the vehicle and the gross weight does not exceed 4 tons. For guidance on combined agent systems, see Part D, Paragraph 614 and Sections 72 through 77 hereof.

52. Rescue Vehicle Accessory Equipment. (See Paragraph 422 of NFPA No. 403.)

521. The following rescue equipment is recommended as a minimum to be carried on a light rescue vehicle. In the largest capacity units (1,000 pounds dry chemical) experience has shown that it will not be possible to carry any additional equipment and still keep within the G.V.W. recommended for such vehicles. Any additional equipment should be carried by other vehicles.

One extension ladder — 2 section folding "A" type, capable of being extended 12 feet. This ladder to be of lightweight alloy, aluminum or magnesium, 24-inch minimum width and mounted in quick release brackets on the apparatus and readily accessible from the ground. This ladder not intended for evacuation use.

Flat step aircraft emergency evacuation stairs, 18 feet in length and 24 inches wide. Upper end to be equipped with door or hatch notches to permit use at varying heights of aircraft doors. The stairs to be provided with a folding guard rail. Stairs to be mounted in quick release brackets on the side of the apparatus applicable to airports in indexes 4 and 5 only.

Two portable electric hand spotlights with a minimum of 25,000 beam candle power rating.

Two axes, 6-pound fire department type, with serrated cutting edges.

One adjustable hydrant wrench.

One set double male and double female connectors to fit fill connections used on the vehicle.

Two spanner wrenches, universal type.

Two spanner wrenches for handline hose couplings.

Two (2) approved dry chemical extinguishers having a minimum UL rating of 80 B:C.

One (1) 36-inch crowbar.

One (1) 36-unit first aid kit.

One (1) cable cutter AT-501-C (Aircraft Tools, Inc.) or equal

One (1) canvas roll to include the following:

One (1) 24-inch bolt cutter

Two (2) cutting knives, parachute "V" type (Stebco or equal)

One (1) hand axe with serrated face and insulated handle

Two (2) Dzus fastener keys

One (1) lineman's side cutting pliers, 8 inch

One (1) keyhole type metal-cutting saw with assorted metal-cutting blades

Any special tools required for servicing pump or equipment shall be provided, but not normally carried on vehicle.

53. Miscellaneous.

531. Front Bumper. A heavy duty front bumper shall be mounted on the forward end of the vehicle and secured to the frame structure.

532. Towing Connections. Two large tow eyes will be capable of towing the vehicle and shall be mounted at the front of the truck and attached to the frame structure. A pintle tow hook or two tow eyes shall be mounted at the rear of the vehicle and attached to the frame structure.

533. Finish.

5331. For maximum visibility, the apparatus should be painted with non-fading chrome yellow finish. Retro-reflective striping (such as "Scotchlite") shall be applied to the front and rear of the vehicle and may be applied to the top and sides as required for quick night identification for rescue and fire fighting equipment.

5332. The surfaces shall be sanded and thoroughly cleaned to remove all oil, rust and dirt before application of primer and surfacer coats.

5333. All lettering and striping shall be in black, unless otherwise specified.

PART D — COMBINED AGENT VEHICLES

61. General.

611. The category of "Combined Agent Vehicles" covers a vehicle with a gross weight commencing at 8,000 lbs. and extending to 15,999 lbs. as indicated in Paragraph 1263, Part A of this Standard.

612. The weight of a vehicle for purposes of this classification is its gross weight, with all fire fighting and rescue equipment, full load of extinguishing agents, full load of fuel, complete personnel complement (175 lbs. per operating crew member), ready for service.

NOTE: Refer to Paragraph 480 of NFPA No. 403 for personnel complement.

613. The vehicle described in this Part shall be considered as a suitable alternate for a "Light Rescue Vehicle" as described in Part C of this Standard.

614. The vehicle described in this Part can also be considered as a prime fire fighting vehicle at Index 1 to 3 airports as described in Table 1A of NFPA No. 403 and for Heliport Category H-2 facilities as described in Paragraph 314a. of NFPA No. 403. These vehicles may be provided, in addition to either a foam turret or a twinned-agent turret, with: (a) a dry chemical hand line; (b) a twinned-agent hand line; (c) a foam hand line and a dry chemical hand line; or (d) a dry chemical turret.

NOTE 1: These individual system components are taken up in detail in subsequent paragraphs.

NOTE 2: When the Combined Agent Vehicle is used as a substitute for a Light Rescue Vehicle, the turret is not required providing the water capacity is not applied to the quantities required under Tables 1B or 1C of NFPA No. 403.

62. Weights and Dimensions.

621. Weights.

6211. The gross vehicle weight rating of the chassis as furnished shall equal or exceed the actual gross weight of the fully loaded and equipped vehicle.

6212. Weight should be distributed as equally as possible over the axles and tires under all conditions of loading. The variation in weight between any two tires or any one axle shall not exceed 5 per cent right and left, or 10 per cent between any two axles.

NOTES: Weight on individual tire shall be determined by weight scale measurement at the ground.

Weight variations between axles shall be based on the average loading of the axles and, between tires, shall be the average loading of the two tires of a given axle.

These recommendations favor the use of single tires and a drive to all wheels. The tires are also required to be of uniform size. Therefore, best performance and traction are possible only by equalizing the weight on individual tires.

Maintaining equalization of weight over the tires under conditions of light load is also essential for best performance, particularly since the load may be lightened so that the vehicle can traverse extremely soft ground.

The conditions of loading considered are those due to addition or discharge of the fire extinguishing medium such as water or chemicals.

6213. Center of gravity of the vehicle shall be kept as low as possible under all conditions of loading. The vehicle shall be capable of operations on a 20 per cent side slope in both directions and shall be capable of ascending and descending a 50 per cent grade in forward gear.

622. Dimensions.

6221. Under clearances of the chassis shall be sufficient to permit the maximum mobility in soft ground and rough terrain which tire sizes, weight, and power make the vehicle potentially capable of traversing. The following are the minimum acceptable clearance dimensions and angles:

Angle of Approach	30 degrees
Angle of Departure	30 degrees
Interaxle Clearance Angle	12 degrees
Minimum Ground Clearance	12 inches

Under chassis clearance dimensions shall apply to all portions of the chassis except for tires and brake drums.

6222. Overall height, length and width of the vehicle shall be held to an absolute minimum so as to provide maximum maneuverability due to compactness and to facilitate rapid movement on public highways.

6223. Chassis shall be so constructed and body and equipment so mounted that a seated driver having an eye height of 31¾ inches shall be able to see the ground 20 feet ahead and shall have a minimum range of vision of 15 degrees above horizontal without leaving or rising in his seat. His vision in the horizontal plane shall be at least 180 degrees. He shall be able to see the ground immediately adjacent to the driver's side of the vehicle. For these conditions, the driver's seat shall be in the vertical and horizontal adjustment midpositions.

NOTE: Eye height is defined as the vertical distance from the depressed seat surface to the inner corner of the eye.

6224. Rearview mirrors with a glass area of not less than 85 square inches shall be provided, one on each side of the vehicle.

63. Engine.

631. General Performance Recommendations and Arrangements.

6311. The vehicle shall be powered by means of an internal combustion (gasoline or diesel) engine capable of developing sufficient power under operating conditions to achieve the required performance characteristics.

NOTE: Turbine-powered vehicles may be used when experience has been accumulated to permit evaluating the capabilities and limitations of vehicles of these types for this specialized service.

6312. The vehicle shall be consistently able, when fully loaded, in accordance with Paragraph 612, of accelerating from 0 to 50 miles per hour on dry level pavement free from loose material within 30 seconds. The above acceleration time shall be achieved in ambient temperatures varying from 0 degrees F to 110 degrees F and at elevations up to 2,000 feet above sea level, unless a higher elevation is specified.

NOTES: The requirement that the vehicle be capable of accelerating from 0 to 50 miles per hour within 30 seconds at elevations up to 2,000 feet above sea level is intended to ensure acceptable performance at the great majority of airports. Airports above 2,000 feet should state the elevation at which the vehicle will operate in order to ensure the same performance.

The use of high compression or specially modified engines which require specially blended fuel, and requiring special maintenance, shall be avoided.

6313. The engine shall be equipped with a governor which shall be set at not more than the maximum permissible revolutions-per-minute recommended by the engine manufacturer under no-load condition or the maximum allowable input speed recommended by the torque converter or transmission manufacturer, whichever is lower.

6314. Where the engine is used to power both the vehicle and a fire fighting pump, provision shall be made to ensure that the operation of the pump will not, under any circumstances, cause either:

a. the engine to stall, or

b. more than a slight, and momentary reduction, in engine speed and consequent drop in pump pressure (see Paragraph 7333).

6315. The vehicle shall also be capable of full rated capacity while conducting a stipulated mud and sand test.

632. Engine Cooling Systems.

6321. Liquid Cooled Engines.

a. The cooling system should be of the closed, forced-feed type using a circulating pump. The radiator, cylinder block, cylinder head, fan and water pump shall be of ample capacity to permit 1 hour full load operation of the engine at both stationary and maximum vehicle speed without boiling the coolant under ambient temperature conditions up to 110 degrees F. The cooling system shall be provided with an automatic thermostat for prompt engine warming.

Note: Where higher ambient temperatures are frequently encountered, greater cooling system capacity will be required and should be so specified.

6322. Air-Cooled Engines.

a. Air-cooled engines shall be so designed and installed as to permit the vehicle to stand still and pump for one hour periods without overheating.

b. Air-cooled engine design and installation shall provide for sufficient rate of flow and distribution of air to hold cylinder head and oil temperature within manufacturer's prescribed limits under all operating conditions. This shall include full

power operation for one hour periods with ambient temperatures up to 110 degrees F, at both stationary and maximum vehicle speed.

c. Cylinder head and oil temperature gages or warning lights that clearly indicate maximum permissible operating temperature shall be mounted in the cab and elsewhere, as required, to be plainly visible to the driver.

633. Fuel System.

6331. For gasoline engines, a complete fuel system should include an electric fuel pump located near the fuel tank to prevent vapor lock, fuel strainer and necessary piping, including a flexible fuel line from the fuel pump to the tank line and from the frame to the engine connection. Fuel lines shall be protected from damage, exhaust heat, and exposure to ground fire and located to prevent vapor lock.

6332. A strainer shall be provided for the fuel line and drain shall be provided at the bottom of the fuel tank.

6333. Fuel tank shall not be installed in such a manner as to permit gravity feed to the carburetor.

6334. Fuel tank shall be provided with an Underwriters' Laboratories, Inc., Underwriters' Laboratories of Canada, or Factory Mutual Engineering Association approved flame arrester relief fitting on the filler opening.

6335. Fuel tanks shall have a minimum capacity of 18 gallons.

634. Exhaust System.

6341. The vehicle shall be furnished with an exhaust system, tailpipe, and muffler of such size as to avoid undue back pressure and shall be located and constructed in such a manner that entrance of exhaust gases into the cab will be minimized under all conditions of operation. Exhaust pipe, muffler and tailpipe shall be of high-grade, rust-resistant materials.

6342. The tailpipe and muffler shall be protected from damage due to traversing rough terrain. Tailpipe shall be designed to discharge to the rear and shall not be directed toward the ground.

64. Vehicle Electrical System.

641. The engine shall be equipped with a complete battery starting system.

642. The vehicle shall be provided with a complete electrical system of either the 12 or 24 volt type.

643. An alternator and rectifier, capable of delivering a minimum of 100 amperes, 12 volts or 50 amperes, 24 volts, shall be provided.

644. A 160 ampere hour, 12 volt battery system or an equivalent 24 volt system shall be provided.

645. A waterproof polarized male plug for a charging connection to the battery shall be provided and mounted on the rear of the vehicle complete with matching female receptacle.

646. An engine coolant preheating device shall be provided as an aid to rapid starting and high initial engine performance.

647. The electrical system shall be insulated, waterproofed and protected against exposure from ground fires.

648. Radio suppression of the electrical system, sufficient to assure radio communications under normal airport operating conditions shall be furnished.

65. Vehicle Drive.

651. The drive shall provide for the transmission of power from the engine flywheel to the wheels of the vehicle with such multiplication of torque that the vehicle is capable of traveling at all speeds necessary for effective aircraft rescue and fire fighting service. The drive shall provide for the continuous transmission of power from the engine through a torque converter or fluid coupling and transmission. The transmission shall have the ability to shift from any selected ratio to another in sequence, either forward or reverse, without interruption of power transmission.

NOTE: See Note under Paragraph 6311.

652. The entire drive train shall be designed with sufficient torque capacity to slip the wheels of the fully loaded and balanced vehicle on pavement having a coefficient of friction of 0.6. The following drive line components shall be certified by the manufacturer to be suitable for use in the drive line of the complete vehicle considered as a complete vehicle: torque converter or fluid coupling transmission, transfer case, propeller shaft, differentials and axles.

653. The transmission shall have sufficient range of gears to provide top speed in highest gear of not less than 60 mph and enough reduction in lowest gear to produce the tractive effort

needed to ascend a 50 per cent grade. Spacing of intermediate gears shall provide an adequate number of speeds for all operating conditions without excessive overlap.

654. Positive drive to each wheel is required to negotiate soft ground, unimproved surfaces, snow or ice. Positive wheel drive may be achieved by use of torque proportioning differentials, automatic devices, or by means of a driver selectable differential lock (provided the requirements of Paragraph 656 are met) which will ensure that each wheel of the vehicle is driven independently of the other wheels.

655. The transfer case may be either separate or integral with the transmission. It shall incorporate a drive to the front and rear axles which is engaged at all times during the intended airport service and which will not allow the vehicle to stall as long as the tires of any axle have traction.

656. Front and rear axles shall have adequate capacity to carry the maximum imposed load under all intended operating conditions. The variations in axle tread shall not exceed 20 per cent of the tire sectional width at rated load. Front and rear axles shall meet the requirements of Paragraph 654. When interaxle differentials are furnished with bogie axles, they shall also meet the requirements of Paragraph 654. When a driver selectable differential lock is used, the lock control shall be placed in the "engaged" position during intended emergency service.

657. It is recommended that front axles be equipped with steering drive ends of the constant velocity type or other provision be made to eliminate objectionable cyclical fluctuations in angular velocity of the wheels when they are cramped in the steering position.

66. Other Chassis Components.

661. Suspension.

6611. The suspension system shall be designed to allow the vehicle, loaded or unloaded, to travel at high speeds over improved road surfaces, and at moderate speeds over rough, unimproved terrain. Special consideration shall be given to the need for cushioning road shocks, providing adequate wheel motion, and reducing unsprung weight.

6612. Design of the axles and suspension system shall be

such that the total unsprung weight of the vehicle will not be greater than 15 per cent of the gross weight of the vehicle when fully loaded.

NOTE: Unsprung weight is that portion of the vehicle weight not carried by the chassis springs.

6613. Design of axles and suspension system shall provide for an individual wheel motion above level ground of not less than 10 inches without raising any other wheel off the ground.

6614. Suspension design shall be such that at least two inches of spring deflection remains before bottoming of suspension on the axle stops or bumpers when the vehicle is fully loaded and on level ground.

6615. Double acting hydraulic shock absorbers shall be furnished on all axles. Front and rear axles shall be furnished with stops for bottoming to prevent damage to axles, propeller shafts, engine oil pan, or any other portions of the chassis which may be damaged by wheel motion beyond allowable amounts.

662. Wheels, Tires and Rims.

6621. Wheels shall be single rim type with tires of identical size and same tread design.

6622. Tires and inflation pressures shall be selected to provide effective performance on the terrain encountered in the intended airport service. For normal terrain conditions, a maximum inflation pressure of 45 pounds per square inch is recommended. For more extreme terrain conditions, lower inflation pressure may be desirable for greater off-pavement mobility. The Table in Paragraph 6626 sets forth recommended maximum loads per tire for standard tire sizes at inflation pressures of 30 psi and 45 psi.

6623. Actual inflation pressures of the tires with the vehicles in an in-service condition shall be as specified in the Table.

6624. If the vehicle is required to operate on the highway five or more miles beyond the immediate vicinity of the airport at sustained speeds above 30 miles per hour, inflation pressure should be increased to those levels recommended for highway service.

6625. An aggressive tire tread is recommended for general service. Tire manufacturers should be consulted for tread designs to meet special terrain conditions.

6626. Rim contours and sizes shall also be based on current practices of the Tire and Rim Association, Inc.

TIRE LOAD RATINGS

Tire Size	Recommended Load at 30 lb. Inflation	Recommended Load at 45 lb. Inflation
9.00–16	1,950	2,475
8.25–20	2,390	3,030
9.00–20	2,840	3,590
10.00–20	3,200	4,050
11.00–20	3,540	4,480
12.00–20	4,020	5,080
12.00–24	4,520	5,720
14.00–20	5,620	7,100
12.–16.5	—	3,000
15.–19.5	—	5,140
15.–22.5	—	5,640
16.5–19.5	—	6,030
16.5–22.5	—	6,590
18.–19.5	—	6,700
18.–22.5	—	7,310

NOTE: Adequate ply rating must be selected as determined by load and inflation to be used (refer T & R A Yearbook). T & R A refers to the Tire and Rim Association.

NOTE: For the tire sizes not shown, current load ratings may be obtained from the Tire & Rim Association, Inc. (Comand Building, 34 N. Hawkins Ave., Akron, Ohio 44313) or from the tire manufacturer.

67. Controlling Mechanisms.

671. Brakes.

6711. Service brakes shall be of the all-wheel type. Service brakes may be of the hydraulic type with power booster or the air-mechanical type.

6712. If air-mechanical brakes are furnished, a brake chamber shall be provided for each wheel and shall be mounted so that no part of the brake chamber projects below the axle.

6713. Air brake systems shall include a compressor, release valve, brake control valve, treadle-type actuating pedal, air pressure gage, enclosed-type brake adjusters, low pressure warning, and all necessary connections.

6714. Compressor for air brakes shall have a minimum capacity of 7 cu. ft. per minute. Air compressor shall be lubricated and cooled by the engine lubrication and cooling system.

6715. Compressed air reservoirs will have a minimum capacity of 2,000 cu. in. and shall be equipped with drain and safety valves. Provision for quick build-up of pressure shall be furnished. Quick build-up of tank pressure from 5 lbs. to the pressure regulating valve setting shall be accomplished within 12 seconds.

6716. The service brakes shall be capable of holding the fully loaded vehicle on a 50 per cent grade, and capable of bringing the fully loaded vehicle to five (5) complete successive stops within 30 feet from a speed of 20 mph on dry, hard, approximately level road, free from loose material.

6717. The parking brake system shall be an entirely independent mechanical system or may be connected to the same brake shoes as the service brakes but through entirely separate mechanical means.

6718. The parking brakes shall be hand lever operated and shall be capable of holding the fully loaded vehicle on a 20 per cent grade.

672. Steering.

6721. All chassis shall be equipped with power-assisted steering. The steering mechanism shall be so designed as to permit manual steering sufficient to bring the vehicle to safe stop in the event of failure of power assist.

6722. The power-assisted steering shall have sufficient capacity so that no more than 15 lbs. pull is required on the steering wheel in order to turn the steering wheel from lock to lock with the engine running.

673. Turning Diameter.

6731. Wall-to-wall turning clearance diameter of the fully loaded vehicle shall not be greater than 3 times its overall length.

68. Cab.

681. Arrangement. The cab shall meet the visibility requirements of Paragraph 6223. It shall have seats for two men, including individually adjustable driver's seat and adequate space for the instruments, controls and equipment specified herein without hindering the crew. Wide opening doors shall be provided on each side of the cab with necessary steps and hand-grabs to permit rapid and safe entrance and exit from the cab. The windshield and side windows shall be con-

structed of shatterproof plate glass. The cab shall be provided with wide gutters to prevent foam and water from dripping on the windshield and side windows where a liquid agent system and turret is specified. There shall be a quick-opening hatch in the roof providing access to the turret (if provided).

682. Construction. The cab shall be constructed of metal or fiber glass-reinforced plastic, of adequate strength to ensure the safety of the crew. The cab shall be rainproof and dripproof, and shall be fully insulated with a fire resistant insulating material at least one-half inch thick. The cab may be of the unitized rigid body and frame structure type or it may be a separate unit flexibly mounted on the main vehicle frame.

683. Instrument and Warning Lights. The minimum number of instruments and warning lights consistent with the safe, efficient operation of the vehicle and equipment shall be provided. Warning lights shall be used where practicable instead of instruments, and provision shall be made to readily test the condition of the bulb. All instruments and warning lights shall be displayed in a panel or panels in such a way that they will be most useful, convenient and visible to the driver. The panel or panels shall either be easily removable as units or hinged for back access by the employment of quick disconnect fittings for all electrical, air and hydraulic circuits. All instruments shall be illuminated by back-lighting. The following instruments and/or warning lights shall be provided as applicable:

Speedometer/odometer
Engine tachometer(s)
Fuel level
Air pressure
Engine(s) coolant temperature
Pump pressure
Water tank level
Foam liquid tank level
Low air pressure warning
Headlight beam indicator
Engine(s) oil pressure
Engine(s) generator indicator
Transmission oil pressure
Transmission oil temperature

684. Controls. The cab shall have all the necessary controls within easy reach of the driver for the full operation of the vehicle and for activating the fire fighting system. The following cab controls shall be provided:

Accelerator pedal
Brake pedal
Parking brake lever
Steering wheel, with self-cancelling directional signal and horn control
Transmission range selector
Pump control or selector
Liquid agent tank valve control
Siren switch(es)
Ignition switch(es)
Dry chemical system control
Remote turret controls*
Starter switch(es)
Light switches
Windshield wiper and washer controls
Heater-defroster controls

*Applicable only when remote turret is furnished.

685. Equipment. The following equipment shall be provided in or on the cab, as may be applicable:

Heater-defroster, with 200 Btu output per cubic foot of cab space, with blower capacity per minute equal to cab volume, with fresh air intake, and with defroster ducts to windshield
Crew seats with individual seat belts
Siren
2 or more windshield washers
2 or more windshield wipers
2 or more sun visors
2 outside rearview mirrors
Cab dome light with manual and door activated switches.

686. Body.

6861. CONSTRUCTION. The body shall be constructed of metal alloy or glass-fiber reinforced plastic to provide the lightest weight consistent with the strength necessary for off-pavement operation over rough terrain. The body may be of the unitized-with-chassis-rigid-structure type or it may be flexibly mounted on the vehicle chassis. It shall also include front and rear fenders and running boards. Body panels are to be removable where necessary to provide access to the interior of the vehicle.

6862. ACCESS DOORS. Access doors shall be provided for those areas of the interior of the vehicle which must be frequently inspected. In particular, access doors of sufficient size and number shall be provided for access to:

Both sides of each engine
The pump and pump drive
Liquid agent metering device
Battery storage

Other areas requiring access for inspection or maintenance shall either be open, or have removable panels as specified in Paragraph 6861.

6863. COMPARTMENTS. Suitable lighted compartments shall be provided for convenient storage of the equipment and tools furnished with the vehicle. Compartment doors shall be hinged and provided with stainless steel, chrome plated metal, or anodized aluminum handles operable with heavily gloved hands. Compartments are to be weathertight.

6864. WORKING DECK. The working deck of the vehicle shall be adequately reinforced to permit the crew to perform their duties in the turret area, cab hatch area, water tank emergency fill area, liquid agent emergency fill area, and in other areas where access to auxiliary or installed equipment is necessary.

6865. HAND RAILS. Hand rails or bulwarks are to be provided on the working deck and elsewhere as may be necessary for the safety and convenience of the crew. Rails and stanchions shall be constructed of stainless steel, chrome plated metal or

anodized aluminum and shall be strongly braced. Hand rails on the upper deck should be at least 24 inches high when conditions permit or in accordance with local safety requirements.

6866. STEPS AND WALKWAY. Steps or ladders shall be provided on each side or at the rear for access to the working deck. The rear step may extend below the angle of departure if it is hinged to swing up. All steps shall be rigidly constructed and shall have a nonskid surface. Walkways on the upper deck shall also have a nonskid surface. The lowermost rear step shall be no more than 28 inches above the ground. Adequate lighting shall be provided to illuminate steps and walkways.

69. Lighting and Electrical Equipment.

691. Lighting.

6911. Lighting equipment shall include the following:

Two or more sealed-beam headlights with upper and lower driving beams.

A foot controlled switch shall be provided for beam selection.

Dual taillights and stoplights.

Turn signals, front and rear, conforming to S.A.E. Turn Signal Units, Type 1, Class A, with self-cancelling control, a visual and audible indicator, and a four-way flasher switch.

6-inch minimum chrome plated, sealed-beam spotlight on both left and right sides of the windshield, hand adjustable type, with controls for beam adjustment inside the truck cab.

Reflectors and marker and clearance lights shall be furnished and installed in conformance with the Figure on page 414–38.

Engine compartment lights, nonglare type, arranged to illuminate both sides of the engine with individual switches located in the engine compartment.

Two swivel mounted lights, 6-inch minimum with clear lens and individual switches, to be mounted on the top deck for equipment lighting.

At least one back-up light installed in the rear of the body.

A flashing red beacon or alternate red and white flashing lights shall be mounted on the top deck and visible 360 degrees in horizontal plane. Mounting of beacon shall also provide good visibility from the air. A control switch shall be provided on the instrument panel in the cab for control of the beacon.

692. Siren.

6921. A warning siren shall be provided having a sound output of not less than 95 decibels at 100 feet directly ahead of the siren and not less than 90 decibels at 100 feet measured at 45 degrees on either side. The siren shall be mounted to permit maximum forward sound projection, but shall be protected from foam dripping from the turret, or water splashed up by the tires.

6922. The siren control switches shall be located for use both by the driver, and the officer.

NOTE 1: If desired, the driver's siren control shall be wired for selective control on the steering wheel horn button.

NOTE 2: If a combination public address type siren is desired, an electronic type having the above sound output shall be substituted.

693. Horn.

6931. An electric or air horn shall be provided.

6932. An electric horn shall be mounted at the front part of the vehicle with control button or ring at steering wheel.

6933. An air operated horn shall be provided when specified with air operated brakes.

694. Radios.

6941. Provision shall be made for mounting two 2-way radios. Operation of the radios shall be from the cab. Radios shall be mounted permitting quick servicing or replacement.

70. Miscellaneous.

701. Front Bumper. A heavy duty bumper shall be mounted on the forward end of the vehicle and secured to the frame structure.

702. Towing Connections. Two large tow eyes will be capable of towing the vehicle and shall be mounted at the front of the truck and attached to the frame structure. A pintle tow hook or two tow eyes shall be mounted at the rear of the vehicle and attached to the frame.

71. Finish.

7111. For maximum visibility, the apparatus should be painted with nonfading chrome yellow finish. Retro-reflective striping (such as "Scotchlite") shall be applied to the front and rear of the vehicle and may be applied to the top and sides as required for quick night identification for rescue and fire fighting equipment.

7112. The surfaces shall be sanded and thoroughly cleaned to remove all oil, rust and dirt before application of primer and surface coats.

72. Fire Fighting Systems.

721. General.

7211. The fire fighting systems employed on the vehicle may be of several different types. Conventional (protein) foam systems, and aqueous film forming foam (AFFF) systems consist of tanks holding water and the foam concentrate, a proportioner for mixing the two, a pump, and a roof mounted turret nozzle and hand lines for applying the foam. A pressurized foam system utilizes gas pressure reduced down from high pressure cylinders to expel the materials from their respective containers in lieu of pumps. The devices for applying foam to the fire are usually identical for either system. Dry chemical systems and carbon dioxide systems are always applied by pressurized-type equipment.

722. Agents.

7221. As used in combined agent vehicles, the term "foam" applies to conventional (protein) foam liquid concentrates (including fluoroprotein types), and aqueous-film-forming foam (AFFF). The manufacturer of the foam system should be consulted prior to a shift from one type concentrate to another.

7222. Where conventional (protein) foams are used in conjunction with dry chemical agents and compatible materials are required by NFPA No. 403, the foam concentrate as well as the dry chemical shall be of an approved compatible type. In all other applications the conventional (protein) foam shall be of an approved type. AFFF and dry chemicals are compatible.

7223. AFFF concentrate used in the foam system shall be listed as such by a nationally recognized testing laboratory.

7224. Dry chemicals utilized shall be of a type found suitable for use as a fire extinguishing agent by a nationally recognized testing laboratory.

7225. It is recommended that all agents, foam and dry chemical, used in aircraft fire fighting and rescue vehicles be those recommended by the equipment manufacturer.

723. Foam Output.

7231. The foam output from these systems may be evaluated for expansion, drainage time and concentration by procedures described in NFPA No. 412.

7232. Conventional (protein) foams, as discharged by the air aspirating equipment, should have a minimum expansion of 8, a minimum 25 per cent drainage time of 4 min. Conventional (protein) foams generated by a foam pump should have a minimum expansion of 12 and a minimum 25 per cent drainage time of 20 min.

7233. Aqueous Film-Forming Foams (AFFF) should have a minimum expansion of 5 and a minimum 25 per cent drainage time of 4 minutes.

NOTE: AFFF drains more rapidly than protein foams. Similarity in numerical limits for drainage time of the two agents results from the use of different test procedures, as detailed in NFPA No. 412.

73. Conventional (Protein) and AFFF Foam Pumps.

730. All components of the foam system, including the foam liquid tank, piping, fill troughs, screens, etc., should be made of materials resistant to corrosion by foam liquid concentrate and water.

731. Water Pump.

7311. The water pump shall be constructed of corrosion resistant metal and shall be single or multiple stage centrifugal type, designed for dependable emergency service. It shall be carefully designed and built in accordance with good modern practice. The pump shall be gravity primed from the vehicle tank.

7312. When operating from the water tank, it shall be capable of discharging at a rate equal to or exceeding the amount established in Tables 1B, 1C or 2 of NFPA No. 403 as applicable, but not less than the total gpm requirements of all foam outlets discharging simultaneously at designed pressures.

732. Foam Generating Pump.

7321. A foam generating pump system may be used for primary foam generation providing that a suitable water pump is also installed to supply water and/or foam solution for hand lines. The foam generating pump system, when used, shall be

constructed of corrosion resistant materials and shall be designed to produce foam at a rate sufficient to supply the turret nozzle.

733. Pump Drive.

7331. The pump may be driven by either of the following methods: (a) Separate engine drive; (b) Power take-off drive.

7332. SEPARATE ENGINE DRIVE.

a. An independent pump engine shall be provided having sufficient power to meet the pump performance requirements as listed in Tables 1B, 1C or 2 of NFPA No. 403 as applicable, at not more than the engine manufacturer's recommended governed speed.

b. The engine shall have the same voltage ignition and starting system as the chassis engine, air cleaner, replaceable element oil filter, full pressure lubricating system and overspeed governing device to prevent damage to engine if under power when water tank is exhausted. The engine shall be provided with a radiator of adequate capacity to cool the engine when operated continuously under full load up to a 110°F. ambient temperature. An engine speed governor shall be supplied to maintain proper pumping rate.

c. The pump may be either mounted directly to the engine bell housing or it may be mounted separately and drive through a friction clutch and propeller shaft. If mounted separately, the clutch shall be of the single or multiple disc friction type having a capacity equal to the engine torque.

7333. POWER TAKE-OFF DRIVE.

a. If the pump is powered by the same engine which is used to propel the vehicle, it shall be driven by a power take-off which is not affected by changes in transmission ratios or the actuation of clutches in the vehicle drive, except insofar as these changes or actuations may affect engine speed. The overall design shall be such that the requirement of uninterrupted transmission of power set forth in Paragraph 6314 is met.

b. Provision shall be made in the design of the drive system and/or controls to prevent damage to the drive or lurching of the vehicle when the transmission is shifted from neutral to either forward or reverse speed ranges while simultaneously pumping. The take-off drive shall incorporate a friction clutch, controlled from the cab, with a torque capacity at least equal to the maximum torque which may be absorbed by the pump, and designed to withstand engagement of the pump at all engine

speeds and under all operating conditions when a fire fighting capability is required.

c. When a power take-off pump drive is used, there shall be sufficient engine power both to operate the pump at the rate of discharge required, and to propel the vehicle under operating conditions when a fire fighting capability is required. The overall design shall be such that the requirements of Paragraph 6312 shall also be met.

734. Manifolds and Connections.

7341. SUCTION. The suction system shall be designed for efficient flow at the designed pumping rates. The pump suction line shall be of large diameter and shortest length consistent with the most suitable pump location. There shall be a drain at the lowest point with a valve for draining all of the liquid from the pumping system when desired. Suction lines and valves shall be constructed of lightweight, corrosion-resistant materials.

7342. DISCHARGE. The pump discharge system may be provided with discharge gates with 1½-inch National Standard Thread* adapters and caps.

7343. PIPING, COUPLINGS AND VALVES.

a. All piping, couplings and valves shall be sized for required flow with minimum restriction and pressure loss. Material for all piping, couplings and valves shall be selected to avoid corrosive and/or galvanic action.

b. Piping shall be securely mounted and provided with flexible couplings to minimize stress. Union or flexible type couplings shall be provided where required to facilitate removal of piping.

c. All valves should be ¼ turn ball type as selected for ease of operation and freedom from leakage.

d. All water system piping shall be tested for suction side of pump for leakage. All water and solution discharge piping shall be tested at 50 per cent above system operating pressure.

7344. CHURN LINE. A closed system churn line shall be provided from the pump discharge to a heat exchanger at the tank bottom, to prevent overheating of water in the pump while standing and pumping. The churn line valve shall be automatic or shall have a cab control.

*See NFPA No. 194, Standard for Fire Hose Connections.

74. Water Tank.

741. Capacity.

7411. A water tank shall have a capacity in agreement with the applicable portions of Tables 1B, 1C or 2 of NFPA No. 403. The tank should be constructed of glass fiber reinforced plastic or corrosion-resistant metal, or of metal coated or lined with a suitable rubber, plastic or ceramic. The tank shall have longitudinal and transverse baffles to prevent undue water surge.

742. Construction.

7421. The construction and connections shall be made to prevent the possibility of galvanic corrosion of dissimilar metals.

7422. When dissimilar metals are used for pipe connections (piping) from the tanks, they should be electrically insulated by the use of nonconductive plastic pipe or hose.

7423. The tank shall be equipped with easily removable manhole covers over the sump and a removable top or panels to permit access within each baffle compartment of the tank. It shall have an antiswirl baffle and a deep sump. Filler opening shall not be less than 5-inch inside diameter. A tank vent and overflow shall be provided of sufficient capacity to permit the tank to be filled or emptied at not less than the pump discharge rate. Water fill opening shall be provided with a strainer of ¼-inch mesh.

7424. The tank shall be adequately vented to permit rapid and complete filling without the buildup of excessive pressure and to permit emptying the tank at the maximum design flow rate without danger of collapse.

75. Conventional (Protein) and AFFF Foam Systems.

751. Foam Liquid Concentrate Tank(s).

7511. The foam liquid tank should be sized in conformance with the applicable portions of Tables 1B, 1C or 2 of NFPA No. 403. Lightweight materials of adequate strength should be used where practical.

7512. Foam liquid concentrate tanks may be either rigid or flexible type.

Rigid tanks should be made of glass-fiber reinforced plastics. The plastics shall be resistant to attack by the foam liquid concentrate and shall not adversely affect the performance characteristics of the foam liquid concentrate after extended storage

in the tank. Unplasticized reinforced plastics shall be required, such as polyesters, polyvinyl chloride or epoxies.

Flexible types shall be of nylon reinforced neoprene rubber.

7513. Rigid tanks shall be equipped with a removable manhole or a removable tank top to permit access to the tank interior.

7514. Tank outlet shall be of adequate size to permit maximum flow. The outlets should be arranged so as to permit the use of the full capacity of the tank with the vehicle level, and at least 75 per cent of the tank capacity with the vehicle inclined on a 20 per cent side slope, or ascending or descending a 30 per cent grade. A large capacity drain connection should be installed at the low point in the foam piping system.

7515. The tank shall be separate and distinct from the body and easily removable as a unit.

7516. A fill trough should be provided equipped with a stainless steel ¼-inch mesh screen and two can openers to permit emptying 5-gallon foam liquid concentrate cans into the storage tank at a rapid rate. The trough should be connected to the foam liquid storage tank with a fill line designed to introduce foam liquid concentrate near the bottom of the tank so as to minimize foaming within the storage tank.

7517. The tank shall be adequately vented to permit rapid and complete filling without the build-up of excessive pressure and to permit emptying the tank at the maximum design flow rate without danger of collapse. A ¼ turn shutoff valve controllable from the cab shall be provided between the foam tank and foam liquid concentrate proportioner.

752. Foam Liquid Concentrate Piping.

7521. Care should be taken that combinations of dissimilar metals that produce galvanic corrosion are not selected or that such dissimilar metals are electrically insulated. Where plastic piping is used, it shall be fabricated from unplasticized resins unless the stipulated plasticizer has been shown not to adversely affect the performance characteristics of the foam liquid concentrate. The plastic pipe may be reinforced with glass fibers. Polyvinyl chloride, polyvinylidene chloride, epoxies and polyesters are among the acceptable classes of resins. Galvanized pipe shall not be used.

7522. The foam liquid concentrate piping shall be adequately sized to permit the maximum required flow rate.

753. Foam Liquid Proportioning System.

7531. The foam liquid proportioning system shall provide suitable control of the ratio of foam liquid concentrate to the quantity of water being discharged and will permit selection of foam liquid concentrate percentages recommended by the manufacturer.

7532. A maximum tolerance of plus or minus 5 per cent of the proportioning setting shall be permitted at the maximum flow rate.

For example: A proportioner set for 6 per cent should proportion between 5.7 per cent and 6.3 per cent.

The variation below the desired percentage shall not exceed 5 per cent at any flow rate.

754. Foam Turret Nozzles

7541. The total liquid flow rate from any turret equipment (single or dual) dispensing foam only shall be at least 75 per cent of the total minimum rate of discharge specified in Table 1B or 1C of NFPA No. 403.

7542. Turrets shall be capable of discharging foam in still air in a variable pattern in accordance with the following Table:

FOAM TURRET PATTERN REQUIREMENTS*

Foam Solution Discharge Rate (gpm)	Straight Stream		Fully Dispersed or Spray		
	Far Point at Least (ft.)	Near Point No Closer Than (ft.)	Full Width at Least (ft.)	Full Width Extend Out at Least (ft.)	Maximum Solution Density (gpm/ft.²)
150–250	125	60	25	25	0.30

*Turret elevated to 30° (maximum stream reach position).

7543. Manual foam turret controls shall be provided in the cab accessible to both the driver and attendant.

NOTES: Duplicate controls may be provided on the cab roof.

Turret controls may be provided with pneumatic or hydraulic power assist for ease of operation. Where power assist is employed, an override control shall be provided to permit direct manual operation of the turret.

7544. A single turret for foam application may be provided.